

AP EDCET 2025 Biological Science Question Paper with Solutions

Time Allowed :2 Hour	Maximum Marks :150	Total Questions :150
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General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 2 hour duration.
2. The question paper consists of 150 questions. The maximum marks are 150.
3. The questions are based on English, General Knowledge, Botany and Zoology.

[English]

Q1-Q5 Read the passage and answer questions based on the passage:

Moral education centres upon this conception of the school as a mode of social life, that the best and the deepest moral training is precisely that which one gets through having to enter into proper relations with others in a unity of work and thought. The present educational systems, so far as they destroy or neglect this unity, render it difficult or impossible to get any genuine, regular moral training.

1. According to the writer, the school is a form of _____.

- (A) individual existence
- (B) religious life
- (C) spiritual life
- (D) social life

Correct Answer: (D) social life

Solution:

Step 1: Understanding the Question:

The question asks what form of life the writer considers the school to be, based on the provided passage.

Step 2: Detailed Explanation:

We need to locate the part of the passage that describes the writer's conception of a school.

The first sentence of the passage states: "Moral education centres upon this conception of the school as a mode of **social life**...".

This directly answers the question. The writer explicitly identifies the school as a form of social

life.

Step 3: Final Answer:

According to the writer, the school is a form of social life.

 Quick Tip

In reading comprehension questions, always look for direct statements in the passage that match the keywords in the question. Here, the phrase "school as a mode of social life" is a direct quote that leads to the answer.

2. Moral training, according to the passage, effects

- (A) a unity of work and thought
- (B) entering into proper relations with oneself
- (C) the skills of work
- (D) the skills of thought

Correct Answer: (A) a unity of work and thought

Solution:

Step 1: Understanding the Question:

The question asks what effect moral training has, according to the passage.

Step 2: Detailed Explanation:

The passage states that "...the best and the deepest moral training is precisely that which one gets through having to enter into proper relations with others in a **unity of work and thought**."

This sentence links the process of moral training directly with achieving a "unity of work and thought" through social interaction. The passage emphasizes that present educational systems fail because they "destroy or neglect this unity."

Therefore, the effect of proper moral training is to bring about this unity.

Step 3: Final Answer:

Based on the passage, moral training effects a unity of work and thought.

 Quick Tip

Pay attention to cause-and-effect relationships described in the text. The passage presents moral training as the outcome of entering into social relations characterized by "a unity of work and thought."

3. The writer's attitude to the present education system can be described as -----.

- (A) Critical
- (B) adulatory
- (C) defensive
- (D) indifferent

Correct Answer: (A) Critical

Solution:

Step 1: Understanding the Question:

The question asks to identify the writer's tone or attitude towards the "present education system."

Step 2: Detailed Explanation:

The last sentence of the passage provides a clear indication of the writer's attitude: "The present educational systems, so far as they **destroy or neglect this unity**, render it **difficult or impossible** to get any genuine, regular moral training."

The use of strong negative words like "destroy," "neglect," "difficult," and "impossible" shows a clear disapproval of the current system. This tone is not adulatory (praising), defensive (protecting), or indifferent (uncaring). It is a negative assessment, which is best described as **Critical**.

Step 3: Final Answer:

The writer's attitude towards the present education system is critical.

 Quick Tip

To determine an author's attitude or tone, look for emotionally charged words or phrases. Words like "destroy," "neglect," and "impossible" are strong indicators of a critical or negative viewpoint.

4. The central concern of the passage is -----.

- (A) spiritual education / spiritual training
- (B) work education / work training
- (C) moral education / moral training
- (D) thought education / thought training

Correct Answer: (C) moral education / moral training

Solution:

Step 1: Understanding the Question:

The question asks to identify the main topic or central theme of the passage.

Step 2: Detailed Explanation:

The very first two words of the passage are "Moral education". The passage then proceeds to discuss how the best "moral training" is achieved. The final sentence concludes by talking about the failure of the current system to provide "genuine, regular moral training".

The entire passage revolves around the concept of moral education and training, how it should be achieved (through social life in school), and why current systems fail to provide it. The other options, while mentioned as components ("work and thought"), are not the central focus.

Step 3: Final Answer:

The central concern of the passage is moral education and moral training.

 Quick Tip

The main idea of a short passage is often stated directly in the first or last sentence. Reading these key sentences first can quickly help you identify the central theme.

5. Find the word from the passage that is a synonym of accurate

- (A) Conception
- (B) Neglect
- (C) Precise
- (D) Genuine

Correct Answer: (C) Precise

Solution:

Step 1: Understanding the Question:

The question asks to find a word from the given options that is a synonym for "accurate" and is also present in the passage.

Step 2: Detailed Explanation:

Let's analyze the options:

- **Conception:** means an idea or concept. Not a synonym for accurate.
- **Neglect:** means to fail to care for. Not a synonym for accurate.
- **Precise:** means exact, accurate, or correct in all details. This is a strong synonym for accurate.
- **Genuine:** means authentic or true. While related, "precise" is a closer synonym for "accu-

rate.”

Now we check if the word "Precise" is in the passage. The passage contains the word "precisely": "...the deepest moral training is **precisely** that which one gets...". The option "Precise" is the adjectival form of the adverb "precisely" found in the text. Given the options, this is the intended answer.

Step 3: Final Answer:

The word "Precise" is a synonym for "accurate", and its adverbial form "precisely" is used in the passage.

Quick Tip

In vocabulary questions related to a passage, the exact word might not be present, but a different form of the word (e.g., adverb vs. adjective) might be. Be flexible in your search.

6. Correct the underline word in the sentence below, by substituting with the correct word

I pray for god to give me strength

- (A) regarding
- (B) to
- (C) of
- (D) with

Correct Answer: (B) to

Solution:

Step 1: Understanding the Question:

The question asks for the correct preposition to use with the verb "pray" when indicating the recipient of the prayer.

Step 2: Detailed Explanation:

The standard English idiom is "to pray **to**" someone or something. The preposition "to" indicates the direction or recipient of the action. One prays "for" something (a result or outcome), but "to" a deity or person.

- Correct: "I pray **to** God."

- Correct: "I pray **for** strength."

In the given sentence, "god" is the recipient of the prayer, so the correct preposition is "to". The corrected sentence is "I pray **to** God to give me strength."

Step 3: Final Answer:

The correct preposition to replace "for" is "to".

💡 Quick Tip

Remember the common prepositional phrases with "pray": - Pray **to** (someone): indicates the entity being addressed. - Pray **for** (something/someone): indicates the subject or beneficiary of the prayer.

7. I think he is _____ honest man

- (A) the
- (B) an
- (C) a
- (D) no article

Correct Answer: (B) an

Solution:**Step 1: Understanding the Question:**

The question asks for the correct indefinite article to place before the adjective "honest".

Step 2: Detailed Explanation:

The choice between the indefinite articles "a" and "an" is determined by the sound of the first letter of the word that follows.

- "a" is used before words that begin with a consonant sound.
- "an" is used before words that begin with a vowel sound.

The word "honest" begins with the letter 'h', but the 'h' is silent. The word is pronounced /'nst/, which starts with a vowel sound ('o'). Therefore, the correct article is "an".

Step 3: Final Answer:

The correct sentence is "I think he is **an** honest man."

💡 Quick Tip

The "a" vs. "an" rule is about sounds, not letters! Always say the word aloud to check if it starts with a vowel sound (a, e, i, o, u sounds) or a consonant sound. Examples: an hour, a university.

8. This is ----- car my friend bought last week

- (A) the
- (B) an
- (C) a
- (D) no article

Correct Answer: (A) the

Solution:

Step 1: Understanding the Question:

The question asks for the correct article to use before the noun "car".

Step 2: Detailed Explanation:

The sentence is not referring to any random car. It is referring to a specific, identifiable car: the one "my friend bought last week".

The definite article "**the**" is used to refer to specific or particular nouns. The indefinite articles "a" or "an" are used for non-specific nouns.

Since the clause "my friend bought last week" specifies exactly which car is being discussed, the definite article is required.

Step 3: Final Answer:

The correct sentence is "This is **the** car my friend bought last week."

 Quick Tip

Use "the" when the noun is specific or has been previously mentioned. Use "a/an" for a general or first-time mention of a noun. If a noun is followed by a modifying clause (like "that I saw" or "which you bought"), it's usually specific and needs "the".

9. Indeed, I am not sure ----- his success

- (A) of
- (B) regarding
- (C) about
- (D) off

Correct Answer: (A) of

Solution:

Step 1: Understanding the Question:

The question asks for the correct preposition to follow the adjective "sure".

Step 2: Detailed Explanation:

The adjective "sure" is typically followed by the prepositions "of" or "about". Both "sure of" and "sure about" are grammatically correct and often interchangeable.

- "Sure **of**" often implies a stronger sense of confidence or certainty based on evidence. It is the more standard and formal choice in this context.
- "Sure **about**" is also common, especially in informal speech.

Given the options, "of" is the most fitting and standard preposition to complete the phrase "I am not sure of his success," meaning I have doubts regarding his success.

Step 3: Final Answer:

The correct preposition is "of".

💡 Quick Tip

"Sure of" and "sure about" are both correct idioms. However, "sure of" is often preferred when expressing confidence in a fact or an outcome.

10. They saw him fell _____ his horse

- (A) after
- (B) against
- (C) of
- (D) off

Correct Answer: (D) off

Solution:

Step 1: Understanding the Question:

The question asks for the correct preposition to describe falling from a horse. Note: The verb should be "fall", not "fell". "They saw him fall..."

Step 2: Detailed Explanation:

The preposition "**off**" is used to indicate movement away from and down from something, or separation from a surface.

When someone falls from a horse, a bike, a ladder, or a roof, they are moving away from its surface. Therefore, the correct phrasal verb is "fall off".

The sentence should correctly be "They saw him fall **off** his horse."

Step 3: Final Answer:

The correct preposition is "off".

💡 Quick Tip

Use "off" for falling from a surface (a horse, a wall, a bike). Use "from" for falling from a height or place (fall from a tree, fall from grace). Use "down" to indicate the direction (fall down the stairs).

11. The _____ will meet again, to discuss the matter

- (A) Comittee
- (B) Commitee
- (C) Committee
- (D) Comitee

Correct Answer: (C) Committee

Solution:

Step 1: Understanding the Question:

This is a spelling question. We need to identify the correct spelling of the word for a group of people appointed for a specific function.

Step 2: Detailed Explanation:

The correct spelling of the word is **Committee**.

It is a commonly misspelled word. It has a double 'm', a double 't', and a double 'e'.

Step 3: Final Answer:

The correct spelling is "Committee".

💡 Quick Tip

To remember the spelling of "committee", think of it having three sets of double letters: double m, double t, double e.

12. The Cricket team are in a _____ mood

- (A) buoyant
- (B) buoyent

- (C) boyant
- (D) buyant

Correct Answer: (A) buoyant

Solution:

Step 1: Understanding the Question:

This is a spelling question. We need to find the correct spelling of the word that means cheerful and optimistic.

Step 2: Detailed Explanation:

The word "buoyant" means able to float, or cheerful and optimistic.

The correct spelling is **b-u-o-y-a-n-t**.

The other options are common misspellings.

Step 3: Final Answer:

The correct spelling is "buoyant".

 Quick Tip

The word "buoyant" is related to "buoy", which is a floating object. Remembering the "buoy" part can help you spell the word correctly.

13. Had he studied hard, he _____ passed

- (A) has
- (B) had been
- (C) would have
- (D) have been

Correct Answer: (C) would have

Solution:

Step 1: Understanding the Question:

The question asks to complete a conditional sentence.

Step 2: Detailed Explanation:

The sentence "Had he studied hard..." is an inverted form of the third conditional. The standard form is "If he had studied hard...".

The third conditional is used to talk about unreal situations in the past (things that did not happen).

The structure is:

If-clause: If + past perfect (had + past participle)

Main clause: would have + past participle

So, the sentence structure is:

If he had studied hard

, [he would have passed].

In the inverted form, "if" is omitted and the auxiliary verb "had" comes first:

Had he studied hard

, [he would have passed].

Step 3: Final Answer:

The correct completion is "would have", making the sentence "Had he studied hard, he would have passed."

💡 Quick Tip

Recognize the third conditional structure, used for speculating about past events.

When the 'if' is dropped, the clause starts with 'Had'. The main clause will always use 'would have' (or 'could have'/'might have') + past participle.

14. I wish I _____ her address

(A) know

(B) have known

(C) may know

(D) knew

Correct Answer: (D) knew

Solution:

Step 1: Understanding the Question:

The question asks to complete a sentence expressing a wish about a present situation.

Step 2: Detailed Explanation:

Sentences starting with "I wish" are used to express wishes or regrets. They use a specific verb tense, often referred to as the subjunctive mood.

- To express a wish about a **present or future** situation that is not true, we use the simple past tense in the clause that follows "I wish".

The sentence "I wish I _____ her address" implies that "I do not know her address right now."

To express this present wish, we use the past tense of the verb "know", which is "knew".

Step 3: Final Answer:

The correct sentence is "I wish I **knew** her address."

💡 Quick Tip

Remember the tenses for "I wish" clauses: - Wish about the present/future: 'I wish + simple past' (e.g., I wish I had a car). - Wish about the past (regret): 'I wish + past perfect' (e.g., I wish I had studied harder).

15. Incredulous means -----

- (A) obliterate
- (B) skeptical
- (C) practical
- (D) insane

Correct Answer: (B) skeptical

Solution:

Step 1: Understanding the Question:

The question asks for the meaning (a synonym) of the word "incredulous".

Step 2: Detailed Explanation:

Incredulous means unwilling or unable to believe something; showing disbelief.

Let's look at the options:

- **obliterate**: to destroy utterly.
- **skeptical**: not easily convinced; having doubts or reservations. This is a very close synonym for incredulous.
- **practical**: concerned with the actual doing or use of something rather than with theory and ideas.
- **insane**: in a state of mind that prevents normal perception, behavior, or social interaction; seriously mentally ill.

The best match for "incredulous" is "skeptical".

Step 3: Final Answer:

"Incredulous" means skeptical.

 Quick Tip

Don't confuse "incredulous" with "incredible". - **Incredulous** describes a person's reaction of disbelief ("I was incredulous at the news."). - **Incredible** describes the thing that is hard to believe ("The news was incredible.").

16. Precipitous means -----

- (A) Very steep
- (B) very deep
- (C) presumption
- (D) nascent

Correct Answer: (A) Very steep

Solution:

Step 1: Understanding the Question:

The question asks for the meaning of the word "precipitous".

Step 2: Detailed Explanation:

Precipitous has two main meanings:

1. Dangerously high or steep. This is its literal meaning, often used to describe cliffs or mountains.
2. (Of an action or change) Done suddenly and without careful consideration.

Let's look at the options:

- **Very steep:** This directly matches the primary, literal meaning of precipitous.
- **very deep:** Describes depth, not steepness.
- **presumption:** An idea that is taken to be true on the basis of probability.
- **nascent:** Just coming into existence and beginning to display signs of future potential.

The most accurate and direct meaning is "Very steep".

Step 3: Final Answer:

"Precipitous" means very steep.

 Quick Tip

The word "precipitous" comes from "precipice," which is a very steep rock face or cliff. Remembering this connection can help you recall the meaning "very steep."

17. _____ is a synonym for ingenuous

- (A) Clever
- (B) ingenious
- (C) honest
- (D) Indecent

Correct Answer: (C) honest

Solution:

Step 1: Understanding the Question:

The question asks for a synonym of the word "ingenuous".

Step 2: Detailed Explanation:

Ingenuous means to be innocent, naive, candid, and unsuspecting. It describes someone who is sincere and open, sometimes to a fault.

Let's examine the options:

- **Clever:** Quick to understand, learn, and devise or apply ideas.
- **ingenious:** (Of a person) clever, original, and inventive. (Note the different spelling and meaning).
- **honest:** Free of deceit; truthful and sincere. Sincerity and truthfulness are core aspects of being ingenuous. This is the best synonym among the choices.
- **Indecent:** Not conforming with generally accepted standards of behavior.

The closest meaning to "ingenuous" is "honest" or sincere.

Step 3: Final Answer:

A synonym for "ingenuous" is "honest".

 Quick Tip

Don't confuse "ingenuous" with "ingenious". - **Ingenuous** (with an 'o-u-s' ending) means innocent, naive, sincere. - **Ingenious** (with an 'i-o-u-s' ending) means clever, inventive (like a genius).

18. Keenness is a synonym for _____

- (A) abjure
- (B) enigma
- (C) skip
- (D) acumen

Correct Answer: (D) acumen

Solution:

Step 1: Understanding the Question:

The question asks for a synonym of the word "keenness".

Step 2: Detailed Explanation:

Keeness is a noun that means the quality of being eager or enthusiastic, or sharpness (as in a keen mind or a keen blade). It implies a sharp, perceptive quality.

Let's analyze the options:

- **abjure:** A verb meaning to renounce a belief or claim.
- **enigma:** A noun meaning a person or thing that is mysterious or difficult to understand.
- **skip:** A verb meaning to move along lightly, or to omit.
- **acumen:** A noun meaning the ability to make good judgments and quick decisions, typically in a particular domain. It implies mental sharpness and keenness.

"Acumen" is the best synonym for the mental aspect of "keenness".

Step 3: Final Answer:

"Acumen" is a synonym for "keenness".

💡 Quick Tip

Both "keenness" and "acumen" refer to a sharpness of mind. Think of someone with "business acumen" - they have a keen sense for business matters.

19. Invincible is an antonym for -----

- (A) conquerable
- (B) transparent
- (C) fiasco
- (D) instil

Correct Answer: (A) conquerable

Solution:

Step 1: Understanding the Question:

The question asks for an antonym (a word with the opposite meaning) of "invincible".

Step 2: Detailed Explanation:

Invincible means too powerful to be defeated or overcome; unconquerable. The prefix "in-" often means "not".

Let's analyze the options:

- **conquerable:** Able to be defeated or overcome. This is the direct opposite of invincible.
- **transparent:** Allowing light to pass through. This is unrelated.
- **fiasco:** A complete failure, especially a ludicrous or humiliating one. This is unrelated.
- **instil:** Gradually but firmly establish an idea or attitude in a person's mind. This is unrelated.

The opposite of being unconquerable is being conquerable.

Step 3: Final Answer:

An antonym for "invincible" is "conquerable".

💡 Quick Tip

Break down words into their roots and prefixes. "Invincible" comes from "in-" (not) + "vincere" (to conquer, from Latin). So it literally means "not conquerable". The antonym is therefore "conquerable".

20. Change the following into a simple sentence

He wanted to play with his friends and so he finished his home work quickly

- (A) As he wanted to play with his friends, he finished his homework quickly
- (B) So as to play with his friends, he finished his home work quickly
- (C) He wants to play with his friends and they he finished his home work quickly
- (D) In order to play with his friends, he finished his home work quickly

Correct Answer: (D) In order to play with his friends, he finished his home work quickly

Solution:

Step 1: Understanding the Question:

The question asks to convert a compound sentence into a simple sentence.

Step 2: Detailed Explanation:

- A **simple sentence** has only one independent clause (one subject-verb pair).
- A **compound sentence** has two or more independent clauses joined by a coordinating conjunction (like 'and', 'but', 'so'). The original sentence is a compound sentence.
- A **complex sentence** has one independent clause and at least one dependent clause.

Let's analyze the options:

- (A) "As he wanted..." is a complex sentence because "As he wanted..." is a subordinate clause.
- (B) "So as to play..." is grammatically awkward. The correct phrase is "so as to do something," but it's less common than "in order to."
- (C) "He wants... and they he finished..." is grammatically incorrect and doesn't make sense.

- (D) "In order to play with his friends, he finished his home work quickly." This is a simple sentence. The main clause is "he finished his home work quickly." The phrase "In order to play with his friends" is an infinitive phrase of purpose; it does not have its own subject and verb, so it's not a clause. This structure correctly captures the meaning of the original sentence in a simple sentence format.

Step 3: Final Answer:

The correct conversion to a simple sentence is "In order to play with his friends, he finished his home work quickly."

💡 Quick Tip

To create a simple sentence from a compound or complex one, try to turn one of the clauses into a phrase (like a participial phrase, prepositional phrase, or infinitive phrase). "In order to..." is a common way to create an infinitive phrase of purpose.

21. Change the following sentence into a complex sentence

"Despite several obstacles, she succeeded finally"

- (A) In spite of several obstacles, she succeeded finally
- (B) Notwithstanding several obstacles, she succeeded finally
- (C) Though there were several obstacles, she succeeded finally
- (D) There were several obstacles and still she succeeded finally

Correct Answer: (C) Though there were several obstacles, she succeeded finally

Solution:

Step 1: Understanding the Question:

The task is to convert a simple sentence into a complex sentence.

Step 2: Detailed Explanation:

- The original sentence, "Despite several obstacles, she succeeded finally," is a **simple sentence**. It has one independent clause ("she succeeded finally") and a prepositional phrase ("Despite several obstacles").
- A **complex sentence** must have one independent clause and at least one dependent (subordinate) clause. A dependent clause starts with a subordinating conjunction (like 'though', 'although', 'because', 'since', 'while').

Let's look at the options:

- (A) and (B) are still simple sentences. "In spite of" and "Notwithstanding" are prepositions, just like "Despite". They form prepositional phrases, not clauses.
- (D) "There were several obstacles **and** still she succeeded finally" is a **compound sentence**.

It has two independent clauses joined by the coordinating conjunction "and".

- (C) "Though there were several obstacles, she succeeded finally" is a **complex sentence**. "she succeeded finally" is the independent clause, and "**Though** there were several obstacles" is the dependent clause, starting with the subordinating conjunction "Though".

Step 3: Final Answer:

The correct conversion to a complex sentence is "Though there were several obstacles, she succeeded finally."

Quick Tip

To change a simple sentence to a complex one, identify a phrase and expand it into a full clause (with a subject and verb) introduced by a subordinating conjunction (like 'although', 'though', 'because', 'when', 'if', etc.).

22. Change the following sentence into passive voice

"I saw him opening the door"

- (A) I saw the door and he was opening it
- (B) Opening the door, he was seen by me
- (C) I saw the door being opened by him
- (D) He was seen by me while opening the door

Correct Answer: (C) I saw the door being opened by him

Solution:

Step 1: Understanding the Question:

We need to convert the given active sentence into its passive form.

Step 2: Detailed Explanation:

The original sentence is "I saw him opening the door". This sentence has two parts or actions: "I saw him" and "(him) opening the door".

When we have a verb of perception (like see, hear, watch) followed by an object and a present participle (-ing form), the structure for the passive voice can be tricky.

Let's analyze the options:

- (A) This is a compound sentence and not a passive construction of the original.
- (B) "Opening the door, he was seen by me." Here, the main action "I saw him" is passivized to "he was seen by me," but the structure is awkward and changes the emphasis.
- (D) "He was seen by me while opening the door." This is a possible passive construction, but it slightly changes the meaning, implying two simultaneous actions rather than seeing the action itself.

- (C) "I saw the door being opened by him." This is the most accurate and common passive form. In this structure, the main verb "saw" remains active, but the second action "opening the door" is passivized. The object of the second action ("the door") becomes the subject of the passive phrase ("the door being opened by him"). This structure correctly conveys that the speaker witnessed the event of the door being opened.

Step 3: Final Answer:

The most appropriate passive voice construction for the given sentence is "I saw the door being opened by him."

Quick Tip

When converting sentences with verbs of perception + object + participle (e.g., "I saw him doing something"), a common passive structure is: Subject + verb of perception + new object + being + past participle + by + agent. For example, "I saw the thing being done by him."

23. Change the following into active voice

"I was kept waiting for two hours by him"

- (A) I waited for two hours because of him
- (B) He kept me waiting for two hours
- (C) He is waiting for me for two hours
- (D) I was waiting for two hours for him

Correct Answer: (B) He kept me waiting for two hours

Solution:

Step 1: Understanding the Question:

The task is to convert a sentence from passive voice to active voice.

Step 2: Detailed Explanation:

The passive sentence is "I was kept waiting for two hours by him."

To convert to active voice, we need to follow these steps:

1. Identify the agent (the one doing the action), which is in the "by" phrase. The agent is "him".
2. Make the agent the new subject. The subject form of "him" is "He".
3. Change the verb from passive to active. The passive verb is "was kept" (simple past passive). The active form in the simple past is "kept".
4. Make the original subject ("I") the new object. The object form of "I" is "me".
5. Rearrange the sentence.

Following these steps:

Subject: He

Verb: kept
Object: me
Remaining part: waiting for two hours

Putting it together, we get: "He kept me waiting for two hours."

Step 3: Final Answer:

The correct active voice sentence is "He kept me waiting for two hours."

💡 Quick Tip

To switch from passive to active, find the "doer" of the action (usually after the word "by") and make it the subject of the new sentence. Then, adjust the verb tense accordingly.

24. Change the following into indirect speech

"I will bring my laptop tomorrow", she said

- (A) She said she would bring my laptop the next day
- (B) She said that she would bring her laptop the next day
- (C) She said she will bring her laptop the next day
- (D) She said she would bring her laptop tomorrow

Correct Answer: (B) She said that she would bring her laptop the next day

Solution:

Step 1: Understanding the Question:

We need to convert a sentence from direct speech to indirect (reported) speech.

Step 2: Detailed Explanation:

The original sentence is: "I will bring my laptop tomorrow", she said.

When converting to indirect speech, we need to make several changes:

1. **Reporting Verb:** "she said" remains the same, and we often add the conjunction "that". So, "She said that..."
2. **Pronouns:** The pronoun "I" refers to the speaker ("she"), so it changes to "she". The possessive pronoun "my" also refers to the speaker, so it changes to "her".
3. **Verb Tense (Backshift):** Since the reporting verb "said" is in the past tense, the verb in the reported clause usually shifts back in tense. The modal verb "will" changes to "would".
4. **Adverbs of Time/Place:** The adverb of time "tomorrow" changes to "the next day" (or "the following day").

Applying all these changes:

- "She said" → "She said that"

- "I" → "she"
- "will bring" → "would bring"
- "my laptop" → "her laptop"
- "tomorrow" → "the next day"

Combining these gives: "She said that she would bring her laptop the next day."

Option (A) is incorrect because it uses "my" instead of "her". Option (C) is incorrect because it uses "will" instead of "would". Option (D) is incorrect because it uses "tomorrow" instead of "the next day".

Step 3: Final Answer:

The correct indirect speech is "She said that she would bring her laptop the next day."

Quick Tip

Remember the key changes for indirect speech when the reporting verb is in the past: backshift the verb tense (will → would), change pronouns, and change time/place words (tomorrow → the next day, here → there).

25. Change the following into direct speech:

"She said that she loved pizza so much"

- (A) She said, "I love pizza so much"
- (B) She says, "I love pizza so much"
- (C) She said, "I loved pizza so much"
- (D) She says, "I loved pizza so much"

Correct Answer: (A) She said, "I love pizza so much"

Solution:

Step 1: Understanding the Question:

The task is to convert a sentence from indirect speech back to direct speech.

Step 2: Detailed Explanation:

The indirect sentence is: "She said that she loved pizza so much."

To convert to direct speech, we reverse the changes made for indirect speech:

- Reporting Verb and Quotation Marks:** "She said that..." becomes "She said, "...". The conjunction "that" is removed.
- Pronouns:** The pronoun "she" inside the reported clause refers to the speaker ("She"), so it changes back to the first person, "I".
- Verb Tense (Reverse Backshift):** The reporting verb "said" is in the past. The verb

in the reported clause is "loved" (simple past). This would have been shifted back from the simple present tense in the original speech (since a general truth or preference is usually in the present tense). So, "loved" becomes "love".

Applying these reverse changes:

- "She said that" → "She said,"
- "she" → "I"
- "loved" → "love"

Putting it together inside quotation marks: She said, "I love pizza so much".

Option (C) is also possible if the original statement was made in the past about a past feeling, but option (A) represents a general preference, which is the more common and likely original statement.

Step 3: Final Answer:

The correct direct speech is: She said, "I love pizza so much".

Quick Tip

When converting from indirect to direct speech, you have to "unshift" the verb tense. If the indirect speech uses the past tense (e.g., loved, went, was), the direct speech will often use the present tense (love, go, am/is/are), especially if it's a statement of fact or general feeling.

[General Knowledge]

26. The primary function of the Election Commission of India is to:

- (A) Formation of laws
- (B) Conducting elections
- (C) Pass budgets
- (D) Managing Parliament sessions

Correct Answer: (B) Conducting elections

Solution:

Step 1: Understanding the Question:

The question asks for the main responsibility of the Election Commission of India.

Step 2: Detailed Explanation:

The Election Commission of India is an autonomous constitutional authority responsible for

administering election processes in India. Its primary and most fundamental duty is to ensure free and fair elections. This includes:

- Preparing electoral rolls.
- Announcing election schedules.
- Recognizing political parties and allotting symbols.
- Enforcing the Model Code of Conduct.
- Overseeing the entire process of **conducting elections** to the Parliament, state legislatures, and the offices of the President and Vice President.

The other functions listed belong to other branches of government: - Formation of laws is the function of the Legislature (Parliament and State Legislatures). - Passing budgets is the function of the Legislature. - Managing Parliament sessions is the responsibility of the presiding officers (Speaker of Lok Sabha, Chairman of Rajya Sabha) in consultation with the government.

Step 3: Final Answer:

The primary function of the Election Commission of India is to conduct free and fair elections.

💡 Quick Tip

The name of the commission itself gives the answer. The "Election Commission" is responsible for "elections". This is a key body for upholding the democratic process in India, as established by Article 324 of the Constitution.

27. The largest freshwater lake in India is:

- (A) Vembanad Lake
- (B) Dal Lake
- (C) Wular Lake
- (D) Chilika Lake

Correct Answer: (C) Wular Lake

Solution:

Step 1: Understanding the Question:

The question asks to identify the largest freshwater lake in India.

Step 2: Detailed Explanation:

- **Wular Lake:** Located in the Bandipora district of Jammu and Kashmir, it is one of the largest freshwater lakes in Asia. It is fed by the Jhelum River and is of tectonic origin. It is widely recognized as the largest freshwater lake in India by surface area, though its size varies seasonally.

- **Vembanad Lake:** Located in Kerala, this is the longest lake in India and the largest lake in the state of Kerala. However, it is a brackish lagoon (backwater), not a freshwater lake.

- **Dal Lake:** Also in Jammu and Kashmir, it is a famous urban lake but is smaller than Wular Lake.
- **Chilika Lake:** Located in Odisha, it is the largest coastal lagoon in India and the second largest in the world. It is a brackish water lagoon, not a freshwater lake.

Step 3: Final Answer:

Based on the classification, Wular Lake is the largest freshwater lake in India.

💡 Quick Tip

It's important to distinguish between freshwater, brackish water, and saltwater lakes.

- Largest Freshwater Lake: Wular Lake (JK) - Largest Brackish Water Lake/Lagoon: Chilika Lake (Odisha) - Largest Saline Water Lake: Sambhar Salt Lake (Rajasthan)

28. The term "carbon footprint" refers to:

- (A) Growth of forests
- (B) Water pollution levels
- (C) Total greenhouse gas emissions
- (D) Fuel efficiency of vehicles

Correct Answer: (C) Total greenhouse gas emissions

Solution:

Step 1: Understanding the Question:

The question asks for the definition of the term "carbon footprint".

Step 2: Detailed Explanation:

A **carbon footprint** is a measure of the total amount of greenhouse gases (GHGs) produced to, directly and indirectly, support human activities, usually expressed in equivalent tons of carbon dioxide (CO₂).

It includes emissions of carbon dioxide, methane, nitrous oxide, and other gases that contribute to global warming. It can be calculated for an individual, an organization, an event, or a product. It represents the overall impact of an activity or entity on climate change.

Therefore, it refers to the **total greenhouse gas emissions**.

Step 3: Final Answer:

The term "carbon footprint" refers to the total amount of greenhouse gas emissions caused by an individual, event, organization, or product.

 Quick Tip

Think of a "footprint" as the mark or impact you leave on the environment. A "carbon footprint" is the impact you leave in terms of carbon dioxide and other greenhouse gases.

29. India's first mission to study the Sun is:

- (A) Aditya-L1
- (B) Chandrayaan
- (C) Surya-N1
- (D) Vikram Lander

Correct Answer: (A) Aditya-L1

Solution:

Step 1: Understanding the Question:

The question asks to identify India's first dedicated space mission to observe the Sun.

Step 2: Detailed Explanation:

- **Aditya-L1:** This is India's first dedicated solar observatory mission, launched by the Indian Space Research Organisation (ISRO). Its purpose is to study the Sun's corona, chromosphere, and photosphere. The "L1" in the name refers to its destination, the Lagrange point 1 of the Sun-Earth system, from where it can observe the Sun continuously without any occultation or eclipse. "Aditya" is a Sanskrit word for the Sun.
- **Chandrayaan:** This is the name of India's series of lunar (moon) exploration missions.
- **Surya-N1:** This is not the name of an actual ISRO mission. "Surya" is another word for the Sun.
- **Vikram Lander:** This was the lander component of the Chandrayaan-2 and Chandrayaan-3 missions to the Moon.

Step 3: Final Answer:

India's first mission to study the Sun is Aditya-L1.

 Quick Tip

Associate the mission names with their celestial targets: - **Chandrayaan** → Chandra (Moon) - **Aditya-L1** → Aditya (Sun) - **Mangalyaan** → Mangal (Mars)

30. The 'Green Revolution' in India was mainly associated with:

- (A) Irrigation reforms
- (B) Industrial development
- (C) Agricultural productivity
- (D) Environmental protection

Correct Answer: (C) Agricultural productivity

Solution:

Step 1: Understanding the Question:

The question asks about the primary focus of the Green Revolution in India.

Step 2: Detailed Explanation:

The Green Revolution refers to a period in the 1960s when India significantly increased its food production. This was achieved through a series of initiatives aimed at boosting **agricultural productivity**.

The key components of the Green Revolution were:

- The introduction of high-yielding variety (HYV) seeds, particularly for wheat and rice.
- The increased use of chemical fertilizers and pesticides.
- The expansion of irrigation facilities.

The main goal and outcome was a massive increase in crop yields, which helped India achieve self-sufficiency in food grains. While irrigation reforms were a part of it, the overall aim was to increase agricultural productivity.

Step 3: Final Answer:

The Green Revolution was mainly associated with the dramatic increase in agricultural productivity.

💡 Quick Tip

The "Green" in Green Revolution refers to the green crops. The "Revolution" refers to the revolutionary increase in their productivity. This helps distinguish it from industrial or environmental topics.

31. Which of the following is not a fundamental right in the Indian Constitution?

- (A) Right to Equality
- (B) Right to Property
- (C) Right to Education
- (D) Right to Freedom

Correct Answer: (B) Right to Property

Solution:

Step 1: Understanding the Question:

The question asks to identify which of the given rights is no longer a Fundamental Right under the Indian Constitution.

Step 2: Detailed Explanation:

Originally, the Constitution of India provided for seven Fundamental Rights. However, the **Right to Property** was removed from the list of Fundamental Rights by the **44th Amendment Act of 1978**.

It was made a legal right under Article 300-A in Part XII of the Constitution. This means it is still a constitutional right that can be enforced in a court of law, but it is not a Fundamental Right, which has a higher degree of protection.

The other options are all currently Fundamental Rights:

- Right to Equality (Articles 14-18)
- Right to Freedom (Articles 19-22)
- Right to Education (Article 21A), which was added by the 86th Amendment Act of 2002.

Step 3: Final Answer:

The Right to Property is not a fundamental right in the Indian Constitution.

 Quick Tip

Remember the six categories of Fundamental Rights currently in the Indian Constitution: 1. Right to Equality, 2. Right to Freedom, 3. Right against Exploitation, 4. Right to Freedom of Religion, 5. Cultural and Educational Rights, 6. Right to Constitutional Remedies. The Right to Property was the one that was removed.

32. UNESCO stands for:

- (A) United Nations Educational, Scientific and Cultural Organization
- (B) Universal Science and Culture Organization
- (C) United Nations Environmental, Scientific and Cultural Organization
- (D) Union of National Education, Science and Culture Organisation

Correct Answer: (A) United Nations Educational, Scientific and Cultural Organization

Solution:

Step 1: Understanding the Question:

The question asks for the full form of the acronym UNESCO.

Step 2: Detailed Explanation:

UNESCO is a specialized agency of the United Nations (UN) aimed at promoting world peace and security through international cooperation in its mandated fields.

The acronym stands for:

- **U**nited
- **N**ations
- **E**ducational,
- **S**cientific and
- **C**ultural
- **O**rganization

This corresponds exactly to option (A).

Step 3: Final Answer:

UNESCO stands for United Nations Educational, Scientific and Cultural Organization.

💡 Quick Tip

Break down the acronym to remember it. U and N stand for United Nations. E, S, and C stand for its core areas: Education, Science, and Culture. O stands for Organization.

33. The Indian Parliament consists of:

- (A) Lok Sabha and President
- (B) Lok Sabha and Rajya Sabha
- (C) Lok Sabha, Rajya Sabha and President
- (D) Rajya Sabha and Supreme Court

Correct Answer: (C) Lok Sabha, Rajya Sabha and President

Solution:

Step 1: Understanding the Question:

The question asks about the constituent parts of the Parliament of India.

Step 2: Detailed Explanation:

According to Article 79 of the Constitution of India, the Parliament of the Union consists of three parts:

1. **The President of India.**
2. The Council of States, known as the **Rajya Sabha** (Upper House).
3. The House of the People, known as the **Lok Sabha** (Lower House).

Although the President is not a member of either house, he or she is an integral part of the Parliament. A bill passed by both houses cannot become a law without the President's assent. The President also has the power to summon and prorogue the houses and dissolve the Lok Sabha.

Step 3: Final Answer:

The Indian Parliament consists of the Lok Sabha, the Rajya Sabha, and the President.

 Quick Tip

A common misconception is that the Parliament is just the Lok Sabha and Rajya Sabha. Remember that the President is the third and integral component of the Indian Parliament.

34. The capital of Uttarakhand is:

- (A) Mussoorie
- (B) Nainital
- (C) Dehradun
- (D) Haridwar

Correct Answer: (C) Dehradun

Solution:

Step 1: Understanding the Question:

The question asks to identify the capital city of the Indian state of Uttarakhand.

Step 2: Detailed Explanation:

The state of Uttarakhand has two capitals:

- **Dehradun** is the winter capital and the largest city in the state. It serves as the primary administrative and legislative center for most of the year.
- **Gairsain** is designated as the summer capital of Uttarakhand.

Since Dehradun is the primary and year-round functional capital and is listed as an option, it is the correct answer. Mussoorie, Nainital, and Haridwar are other important cities in Uttarakhand but are not the capital.

Step 3: Final Answer:

The capital of Uttarakhand is Dehradun.

 Quick Tip

Many Indian states have a single capital, but some, like Uttarakhand (Dehradun and Gairsain) and Himachal Pradesh (Shimla and Dharamshala), have separate winter and summer capitals.

35. Which Indian River is known as 'Dakshina Ganga'?

- (A) Krishna
- (B) Godavari
- (C) Kaveri
- (D) Mahanadi

Correct Answer: (B) Godavari

Solution:

Step 1: Understanding the Question:

The question asks to identify the Indian river that is also known by the name 'Dakshina Ganga'.

Step 2: Detailed Explanation:

The name "Dakshina Ganga" translates to "Ganges of the South". This title is given to the **Godavari River**.

The Godavari is the second-longest river in India after the Ganga and the longest river in Peninsular India. It originates in the Western Ghats of Maharashtra and flows east across the Deccan Plateau. Because of its great length and the large area it drains, it is often compared to the Ganga and holds great religious significance, earning it the name 'Dakshina Ganga'.

It's important not to confuse this with the Kaveri River, which is sometimes called the 'Ganga of South India' (note the slight difference in wording) due to its sacredness, but 'Dakshina Ganga' is primarily associated with the Godavari.

Step 3: Final Answer:

The Godavari River is known as the 'Dakshina Ganga'.

 Quick Tip

- **Dakshina Ganga** (Ganges of the South) → **Godavari** (due to its large size).
 - **Ganga of South India** → **Kaveri** (due to its sacredness).
- Remembering this distinction can help with similar questions.

36. 'One Earth, One Family, One Future' was the theme of which recent international summit held in India?

- (A) G7 Summit
- (B) SCO Summit
- (C) G20 Summit
- (D) BRICS Summit

Correct Answer: (C) G20 Summit

Solution:

Step 1: Understanding the Question:

The question asks to identify the international summit hosted by India that had the theme 'One Earth, One Family, One Future'.

Step 2: Detailed Explanation:

India held the presidency of the G20 from 1 December 2022 to 30 November 2023. The 2023 G20 Summit was held in New Delhi.

The theme for India's G20 Presidency was '**Vasudhaiva Kutumbakam**', which is a Sanskrit phrase that translates to 'The World Is One Family'. This was officially articulated as '**One Earth, One Family, One Future**'.

This theme emphasizes the value of all life—human, animal, plant, and microorganisms—and their interconnectedness on the planet Earth and in the wider universe.

Step 3: Final Answer:

The theme 'One Earth, One Family, One Future' was for the G20 Summit held in India.

💡 Quick Tip

Stay updated with major international events hosted by your country. The theme of the G20 Summit under India's presidency was a very prominent topic in recent current affairs.

37. The primary role of NITI Aayog is to:

- (A) Conduct elections
- (B) Formulation of policies and strategies
- (C) Collecting taxes
- (D) Enforcement of laws

Correct Answer: (B) Formulation of policies and strategies

Solution:

Step 1: Understanding the Question:

The question asks for the primary function of NITI Aayog.

Step 2: Detailed Explanation:

NITI Aayog (National Institution for Transforming India) was established on January 1, 2015, to replace the Planning Commission.

Unlike the Planning Commission which had powers to allocate funds, NITI Aayog is primarily a policy think tank for the Government of India. Its main role is to provide both directional and policy inputs. It is designed to foster cooperative federalism by involving State Governments of India in the economic policy-making process.

Its core function is the **formulation of policies and strategies** for the long-term development of the country.

The other options are functions of different bodies:

- Conducting elections is the role of the Election Commission.
- Collecting taxes is the role of the revenue departments like the Central Board of Direct Taxes (CBDT) and Central Board of Indirect Taxes and Customs (CBIC).
- Enforcement of laws is the role of the executive branch and law enforcement agencies.

Step 3: Final Answer:

The primary role of NITI Aayog is the formulation of policies and strategies.

 Quick Tip

Remember that NITI Aayog is a "think tank," not an executive body. Its job is to provide ideas, advice, and long-term strategic vision to the government, distinguishing it from the older Planning Commission which had financial allocation powers.

38. The first Indian woman to go into space was:

- (A) Sunita Williams
- (B) Kalpana Chawla
- (C) Ritu Karidhal
- (D) Tessy Thomas

Correct Answer: (B) Kalpana Chawla

Solution:

Step 1: Understanding the Question:

The question asks to identify the first woman of Indian origin to travel to space.

Step 2: Detailed Explanation:

- **Kalpana Chawla** was an American astronaut and the first woman of Indian origin to go to space. She first flew on Space Shuttle Columbia in 1997 as a mission specialist and primary robotic arm operator. Tragically, she was one of the seven crew members who died in the Space Shuttle Columbia disaster in 2003.
- **Sunita Williams** is another American astronaut of Indian descent who has flown to space, but her first mission was in 2006, after Kalpana Chawla.
- **Ritu Karidhal** is a senior scientist at the Indian Space Research Organisation (ISRO) and played a key role in missions like Mangalyaan and Chandrayaan.
- **Tessy Thomas** is a renowned scientist known as the 'Missile Woman of India' for her work on Agni series of missiles.

Step 3: Final Answer:

The first Indian woman to go into space was Kalpana Chawla.

💡 Quick Tip

Remember the pioneers of Indian space exploration: - First Indian in space: Rakesh Sharma. - First Indian woman in space: Kalpana Chawla.

39. Which country recently exited the European Union (Brexit)?

- (A) Germany
- (B) France
- (C) Italy
- (D) United Kingdom

Correct Answer: (D) United Kingdom

Solution:**Step 1: Understanding the Question:**

The question asks to identify the country that left the European Union in the event known as Brexit.

Step 2: Detailed Explanation:

"Brexit" is a portmanteau of "British exit". It refers to the withdrawal of the **United Kingdom (UK)** from the European Union (EU).

Following a referendum in June 2016 in which 51.9% of the participating UK electorate voted to leave the EU, the UK government formally invoked Article 50 of the Treaty on European Union. The UK officially left the EU on 31 January 2020.

Germany, France, and Italy are founding members of the EU and remain key members.

Step 3: Final Answer:

The country that exited the European Union (Brexit) is the United Kingdom.

💡 Quick Tip

The name "Brexit" itself is a clue: British + exit. This directly points to the United Kingdom as the country involved.

40. 'Mission Shakti' was related to:

- (A) Women's empowerment
- (B) Anti-satellite missile test
- (C) Cybersecurity program
- (D) Skill development for youth

Correct Answer: (B) Anti-satellite missile test

Solution:**Step 1: Understanding the Question:**

The question asks to identify the event or program associated with 'Mission Shakti'.

Step 2: Detailed Explanation:

Mission Shakti was the codename for an **anti-satellite (ASAT) missile test** conducted by India on 27 March 2019.

In this mission, the Defence Research and Development Organisation (DRDO) successfully destroyed a live satellite in Low Earth Orbit using a ballistic missile interceptor. This demonstrated India's capability to intercept and destroy satellites in space, making it the fourth country to possess such a capability after the United States, Russia, and China.

While there is also a "Mission Shakti" program in some states related to women's empowerment, the nationally and internationally recognized event by this name was the ASAT test.

Step 3: Final Answer:

'Mission Shakti' was related to an anti-satellite missile test.

💡 Quick Tip

It is common for the government to use the same or similar names for different schemes. In the context of national security and major technological achievements, 'Mission Shakti' refers specifically to the 2019 anti-satellite test.

41. The purpose of formative assessment is:

- (A) To assign final grades
- (B) To evaluate teaching staff
- (C) To improve learning while it is happening
- (D) To promote students

Correct Answer: (C) To improve learning while it is happening

Solution:

Step 1: Understanding the Question:

The question asks for the primary purpose of formative assessment.

Step 2: Detailed Explanation:

Assessment in education can be broadly categorized into two types:

- **Formative Assessment:** This is an ongoing, diagnostic type of assessment conducted *during* the learning process. Its main goal is to monitor student learning to provide continuous feedback. This feedback is then used by instructors to improve their teaching and by students to improve their learning. It is 'assessment for learning'. Examples include quizzes, class discussions, and homework assignments that are used to guide the next steps in instruction. The key idea is **to improve learning while it is happening**.
- **Summative Assessment:** This is used to evaluate student learning at the *end* of an instructional unit by comparing it against a standard or benchmark. Its purpose is to assign a grade or certify mastery. Examples include final exams, mid-term exams, and standardized tests. (Options A and D relate to this).

Step 3: Final Answer:

The primary purpose of formative assessment is to provide feedback and adjust ongoing teaching and learning to improve the student's achievement.

 Quick Tip

Think of the difference this way: - **Formative** = a check-up. The goal is to diagnose and improve health. - **Summative** = an autopsy. The goal is to determine the cause of death (or the final result). Formative assessment is about "forming" or shaping the learning as it occurs.

42. Which learning theory is associated with operant conditioning?

- (A) Piaget's theory
- (B) Skinner's theory
- (C) Maslow's theory

(D) Gardner's theory

Correct Answer: (B) Skinner's theory

Solution:

Step 1: Understanding the Question:

The question asks to identify the psychologist whose theory is centered on the concept of operant conditioning.

Step 2: Detailed Explanation:

- **Skinner's theory:** B.F. Skinner was a leading behaviorist who developed the theory of **operant conditioning**. This theory states that behavior is determined by its consequences, be they reinforcements or punishments, which make it more or less likely that the behavior will occur again. The classic example is a rat in a 'Skinner box' learning to press a lever to receive a food reward.
- **Piaget's theory:** Jean Piaget's theory is a theory of cognitive development, focusing on how children construct knowledge through stages (sensorimotor, preoperational, etc.).
- **Maslow's theory:** Abraham Maslow developed the hierarchy of needs, a humanistic theory of motivation.
- **Gardner's theory:** Howard Gardner proposed the theory of multiple intelligences, suggesting that people have different kinds of intellectual strengths.

Step 3: Final Answer:

Operant conditioning is the central concept in B.F. Skinner's theory of behaviorism.

 Quick Tip

Associate key concepts with theorists: - **Skinner** → Operant Conditioning, Reinforcement, Behaviorism. - **Pavlov** → Classical Conditioning. - **Piaget** → Cognitive Development Stages. - **Maslow** → Hierarchy of Needs.

43. A democratic classroom environment encourages:

- (A) Authoritarian discipline
- (B) Passive learners
- (C) Student participation and dialogue
- (D) Teacher-centred teaching

Correct Answer: (C) Student participation and dialogue

Solution:

Step 1: Understanding the Question:

The question asks what a democratic classroom environment promotes.

Step 2: Detailed Explanation:

A **democratic classroom** is one where students have a say in their learning, rules are established collaboratively, and open communication is valued. It is the opposite of an authoritarian or teacher-centered environment.

- In such an environment, students are seen as active participants in the learning process. Therefore, it encourages **student participation and dialogue**.
- Authoritarian discipline and teacher-centered teaching are features of a traditional, non-democratic classroom.
- A democratic classroom aims to foster active, not passive, learners.

Step 3: Final Answer:

A democratic classroom environment encourages student participation and dialogue, where students' voices are heard and they take an active role in their education.

💡 Quick Tip

The word "democratic" implies shared power and open communication. In a classroom context, this means moving away from a model where the teacher holds all the authority (teacher-centered) towards a model where students are active participants (student-centered).

44. Which one is an example of intrinsic motivation?

- (A) Prize for winning
- (B) Fear of punishment
- (C) Desire to learn
- (D) Parental pressure

Correct Answer: (C) Desire to learn

Solution:

Step 1: Understanding the Question:

The question asks to identify an example of intrinsic motivation.

Step 2: Detailed Explanation:

Motivation can be categorized into two types:

- **Extrinsic Motivation:** This is when an individual is motivated to perform a behavior or engage in an activity to earn a reward or avoid punishment. The motivation comes from an external source. Options (A) Prize for winning, (B) Fear of punishment, and (D) Parental

pressure are all examples of external factors driving behavior.

- **Intrinsic Motivation:** This is when an individual engages in a behavior because it is personally rewarding; essentially, performing an activity for its own sake rather than for some external reward. The motivation comes from within the individual. A **desire to learn** for the sake of gaining knowledge or for the enjoyment of the learning process itself is a classic example of intrinsic motivation.

Step 3: Final Answer:

The desire to learn is an example of intrinsic motivation, as it comes from an internal interest and sense of satisfaction.

💡 Quick Tip

To distinguish between intrinsic and extrinsic motivation, ask "Why is the person doing this?" If the answer is for an external reward or to avoid a negative outcome (money, grades, punishment, praise), it's extrinsic. If the answer is for personal satisfaction, enjoyment, or curiosity, it's intrinsic.

45. A teacher using Bloom's Taxonomy should aim at which higher-order skill?

- (A) Remembering facts
- (B) Applying definitions
- (C) Creating new knowledge
- (D) Understanding rules

Correct Answer: (C) Creating new knowledge

Solution:

Step 1: Understanding the Question:

The question asks to identify a higher-order thinking skill from the given options, based on Bloom's Taxonomy.

Step 2: Detailed Explanation:

Bloom's Taxonomy (revised version) classifies cognitive skills into a hierarchy of six levels, from lower-order to higher-order:

Lower-Order Thinking Skills (LOTS):

1. **Remembering:** Recalling facts and basic concepts. (Option A)
2. **Understanding:** Explaining ideas or concepts. (Option D)
3. **Applying:** Using information in new situations. (Option B)

Higher-Order Thinking Skills (HOTS):

4. **Analyzing:** Drawing connections among ideas.
5. **Evaluating:** Justifying a stand or decision.

6. **Creating:** Producing new or original work. (Option C)

Among the given options, "Remembering," "Understanding," and "Applying" are considered lower-order skills. "Creating new knowledge" is at the very top of the hierarchy and is the ultimate higher-order thinking skill.

Step 3: Final Answer:

Creating new knowledge is the highest-level skill in Bloom's Taxonomy and is a key goal when aiming for higher-order thinking.

 Quick Tip

Remember the acronym RUAAEC for the revised Bloom's Taxonomy: Remembering, Understanding, Applying, Analyzing, Evaluating, Creating. The last three (Analyzing, Evaluating, Creating) are the higher-order thinking skills.

46. In pedagogy, 'feedback' helps:

- (A) Punish students
- (B) Modify teaching strategies
- (C) Give homework
- (D) Mark attendance

Correct Answer: (B) Modify teaching strategies

Solution:

Step 1: Understanding the Question:

The question asks for the primary pedagogical purpose of feedback.

Step 2: Detailed Explanation:

In pedagogy (the theory and practice of teaching), feedback is a crucial part of the formative assessment cycle. It is information provided by the teacher to the student (and vice versa) about their performance.

The main purposes of feedback are:

1. For the **student**: To understand their strengths and weaknesses and to identify the next steps for improvement.
2. For the **teacher**: To gain insight into what students are understanding and where they are struggling. This information is essential for the teacher to **modify teaching strategies** to better meet the students' needs. If many students misunderstand a concept, the teacher knows they need to re-teach it in a different way.

Punishing students, giving homework, and marking attendance are administrative or disciplinary tasks, not the core purpose of pedagogical feedback.

Step 3: Final Answer:

Feedback helps teachers understand the effectiveness of their instruction and modify their teaching strategies accordingly to improve student learning.

 Quick Tip

Think of feedback as a two-way street. It guides the student's learning and also guides the teacher's teaching. Effective pedagogy relies on this continuous loop of instruction, assessment, and feedback.

47. Which among these promotes inclusive education?

- (A) Segregated classrooms
- (B) Fixed curriculum
- (C) Adaptive teaching methods
- (D) Competitive grouping

Correct Answer: (C) Adaptive teaching methods

Solution:

Step 1: Understanding the Question:

The question asks which of the options supports the principle of inclusive education.

Step 2: Detailed Explanation:

Inclusive education is an approach to educating students with diverse abilities and backgrounds in the same general education classroom. The core idea is to adapt the learning environment to the student, rather than making the student fit into a rigid system.

- **Adaptive teaching methods:** This involves tailoring instruction, curriculum, and the learning environment to meet the unique needs of each student. This is the very essence of inclusion. By being flexible and providing different ways for students to learn and demonstrate their knowledge, a teacher can support all learners in a diverse classroom.

The other options are contrary to inclusive principles:

- **Segregated classrooms (A):** This is the opposite of inclusion; it separates students based on ability or background.
- **Fixed curriculum (B):** A rigid, one-size-fits-all curriculum does not accommodate diverse learning needs.
- **Competitive grouping (D):** While sometimes used, excessive competition can be detri-

mental in an inclusive setting, which often emphasizes collaboration and mutual support.

Step 3: Final Answer:

Adaptive teaching methods are a cornerstone of promoting inclusive education because they focus on modifying instruction to suit the individual needs of all students.

Quick Tip

The keyword for inclusive education is "adaptation" or "differentiation." Inclusion is not about treating everyone the same; it's about providing everyone with the support they need to succeed in the same environment.

48. Which is a barrier to effective classroom communication?

- (A) Use of visual aids
- (B) Clear articulation
- (C) Language mismatch
- (D) Active listening

Correct Answer: (C) Language mismatch

Solution:

Step 1: Understanding the Question:

The question asks to identify a factor that hinders or acts as a barrier to effective communication in a classroom.

Step 2: Detailed Explanation:

Effective communication occurs when a message is sent, received, and understood correctly. Let's analyze the options:

- **Use of visual aids** and **Clear articulation** are facilitators of effective communication; they help to make the message clearer and more understandable.
- **Active listening** on the part of the students (and the teacher) is essential for receiving and understanding the message correctly. It is a key component of effective communication, not a barrier.
- **Language mismatch:** This occurs when the teacher and students do not share a common language or level of vocabulary. If the teacher uses language (e.g., technical jargon, a different dialect, or a language students don't understand) that the students cannot comprehend, the message will not be understood. This is a significant semantic barrier to communication.

Step 3: Final Answer:

A language mismatch between the teacher and students is a major barrier to effective classroom communication.

 Quick Tip

Barriers to communication can be physical (noise), psychological (attitudes), or semantic (language/meaning). Language mismatch is a classic example of a semantic barrier.

49. A good teacher evaluates students by:

- (A) Comparing them with others
- (B) Judging their behaviour
- (C) Identifying strengths and weaknesses
- (D) Ignoring slow learners

Correct Answer: (C) Identifying strengths and weaknesses

Solution:

Step 1: Understanding the Question:

The question asks to identify the most appropriate and effective method for a good teacher to evaluate students.

Step 2: Detailed Explanation:

Modern pedagogical principles emphasize that evaluation should be a constructive process aimed at improving learning.

- **Identifying strengths and weaknesses (C):** This is the core purpose of formative and diagnostic assessment. By evaluating a student, a good teacher aims to understand what the student has mastered (strengths) and where they are struggling (weaknesses). This information allows the teacher to provide targeted feedback and support to help the student grow. This is a student-centered and constructive approach.

- **Comparing them with others (A):** This is norm-referenced evaluation. While it has its place in competitive settings, it is often demotivating and does not focus on individual learning and mastery of concepts.

- **Judging their behaviour (B):** Academic evaluation should be separate from behavioral assessment. Conflating the two is unprofessional and ineffective for gauging academic progress.

- **Ignoring slow learners (D):** This is the opposite of what a good teacher should do. Evaluation should help identify and support all learners, especially those who are struggling.

Step 3: Final Answer:

A good teacher evaluates students primarily to identify their individual strengths and weaknesses in order to guide their learning process effectively.

 Quick Tip

Effective evaluation is not about ranking or judging students, but about diagnosing their learning needs. The goal is to gather information that can be used to improve both teaching and learning.

50. Effective teaching is primarily about:

- (A) Completing the syllabus
- (B) Giving maximum homework
- (C) Enhancing understanding and engagement
- (D) Following textbooks strictly

Correct Answer: (C) Enhancing understanding and engagement

Solution:

Step 1: Understanding the Question:

The question asks for the primary goal or essence of effective teaching.

Step 2: Detailed Explanation:

Effective teaching goes beyond the mechanical aspects of delivering content. Its main purpose is to facilitate meaningful learning.

- **Enhancing understanding and engagement (C):** This is the core of effective teaching. A good teacher strives to make the material understandable, relevant, and interesting, which promotes student engagement. When students are engaged and understand the concepts, genuine learning takes place.

- **Completing the syllabus (A) and Following textbooks strictly (D)** are administrative tasks. While important, focusing solely on them can lead to rote learning without real comprehension. Effective teaching might involve going beyond the textbook or adapting the syllabus pace to ensure understanding.

- **Giving maximum homework (B)** is not a measure of effective teaching. The quality and purpose of homework are more important than the quantity. Excessive homework can be counterproductive.

Step 3: Final Answer:

The primary goal of effective teaching is to enhance the students' understanding of the subject matter and to keep them actively engaged in the learning process.

💡 Quick Tip

Think of the difference between "teaching" and "covering the material." Anyone can cover the material, but an effective teacher ensures that students actually learn and understand it, which requires fostering engagement.

51. In the Bentham and Hooker classification, which of the following families belongs to the Gamopetalae group?

- (A) Annonaceae
- (B) Cucurbitaceae
- (C) Euphorbiaceae
- (D) Asteraceae

Correct Answer: (D) Asteraceae

Solution:

Step 1: Understanding the Question:

The question asks to identify which of the given plant families is placed under the group Gamopetalae in the Bentham and Hooker system of classification.

Step 2: Detailed Explanation:

The Bentham and Hooker system divides Dicotyledons into three groups:

1. **Polypetalae:** Flowers with free petals.
2. **Gamopetalae:** Flowers with fused or united petals (forming a tube or corolla).
3. **Monochlamydeae:** Flowers with a single whorl of perianth or no perianth.

Let's analyze the options:

- **Annonaceae** and **Cucurbitaceae** are placed in the Polypetalae group.
- **Euphorbiaceae** is placed in the Monochlamydeae group.
- **Asteraceae** (the sunflower family) is characterized by composite flower heads (capitulum inflorescence) where the individual florets often have fused petals (gamopetalous corolla). It is a classic example of a family placed in the Gamopetalae group.

Step 3: Final Answer:

In the Bentham and Hooker classification, the family Asteraceae belongs to the group Gamopetalae due to its characteristic fused petals.

💡 Quick Tip

Remember the meaning of the group names: "Poly-" means many or separate, while "Gamo-" means fused or united. "Petalae" refers to petals. So, Gamopetalae are plants with fused petals. Asteraceae (sunflowers, daisies) with their composite flowers are a key example.

52. Which of the following correctly describes the structural composition of the Tobacco Mosaic Virus (TMV)?

- (A) Enveloped RNA virus with helical symmetry
- (B) Non-enveloped DNA virus with icosahedral symmetry
- (C) Non-enveloped RNA virus with helical symmetry
- (D) Enveloped DNA virus with complex symmetry

Correct Answer: (C) Non-enveloped RNA virus with helical symmetry

Solution:

Step 1: Understanding the Question:

The question asks for the correct structural description of the Tobacco Mosaic Virus (TMV).

Step 2: Detailed Explanation:

The Tobacco Mosaic Virus is one of the most studied viruses. Its structure is well-characterized:

- **Genetic Material:** TMV has a single-stranded **RNA** genome. This eliminates options (B) and (D) which mention DNA.

- **Capsid Symmetry:** The protein subunits (capsomeres) are arranged in a spiral or **helical** pattern around the RNA core, forming a long, rigid rod. This gives it helical symmetry.

- **Envelope:** TMV does not have a lipid envelope surrounding its capsid. It is a **non-enveloped** or "naked" virus. This eliminates option (A).

Combining these features, TMV is a non-enveloped RNA virus with helical symmetry.

Step 3: Final Answer:

The correct description for TMV is a non-enveloped RNA virus with helical symmetry.

💡 Quick Tip

Remember the key features of TMV as a classic virology example: it's a simple, rod-shaped virus with an RNA core and a helical protein coat, and it lacks an outer envelope.

53. Prions are composed of:

- (A) RNA
- (B) DNA
- (C) Proteins
- (D) Lipids

Correct Answer: (C) Proteins

Solution:

Step 1: Understanding the Question:

The question asks for the biochemical composition of prions.

Step 2: Detailed Explanation:

Prions are unique infectious agents that are responsible for a group of fatal neurodegenerative diseases known as transmissible spongiform encephalopathies (e.g., Mad Cow Disease, Creutzfeldt-Jakob disease).

Unlike viruses, bacteria, or other known pathogens, prions are composed solely of **protein**. They contain no genetic material (neither DNA nor RNA).

A prion is an abnormally folded version of a normal cellular protein (PrP^{C}). When this misfolded prion protein (PrP^{Sc}) enters a host, it acts as a template, inducing the host's normal PrP^{C} proteins to misfold into the pathogenic PrP^{Sc} form. This chain reaction leads to the accumulation of abnormal protein aggregates that damage the brain.

Step 3: Final Answer:

Prions are infectious agents composed only of misfolded proteins.

 Quick Tip

The word "prion" is derived from "**p**roteinaceous **i**nfectious **p**article". This name itself tells you that prions are made of protein.

54. Which of the following is an example of a Cyanobacterium?

- (A) Bacillus
- (B) Nostoc
- (C) Streptomyces
- (D) Mycobacterium

Correct Answer: (B) Nostoc

Solution:

Step 1: Understanding the Question:

The question asks to identify an example of a cyanobacterium from the given options.

Step 2: Detailed Explanation:

Cyanobacteria, also known as blue-green algae, are a phylum of photosynthetic bacteria. They are prokaryotic but perform oxygenic photosynthesis, similar to plants.

- **Nostoc** is a genus of cyanobacteria that forms colonial masses of filamentous cells enclosed in a gelatinous sheath. It is capable of photosynthesis and nitrogen fixation. It is a classic example of a cyanobacterium.

- **Bacillus** is a genus of Gram-positive bacteria, typically rod-shaped. They are not cyanobacteria.

- **Streptomyces** is a genus of Gram-positive bacteria known for producing a wide range of antibiotics. They are filamentous but are actinobacteria, not cyanobacteria.

- **Mycobacterium** is a genus of actinobacteria, which includes pathogens responsible for diseases like tuberculosis and leprosy.

Step 3: Final Answer:

Nostoc is an example of a cyanobacterium.

💡 Quick Tip

Well-known examples of cyanobacteria include *Nostoc*, *Anabaena*, *Oscillatoria*, and *Spirulina*. They are characterized by their ability to photosynthesize and are often found in aquatic environments.

55. Which bacterial recombination method involves the transfer of genetic material using a virus?

- (A) Conjugation
- (B) Transformation
- (C) Transduction
- (D) Binary Fission

Correct Answer: (C) Transduction

Solution:

Step 1: Understanding the Question:

The question asks to identify the bacterial genetic recombination process that is mediated by a virus.

Step 2: Detailed Explanation:

Bacteria have three main mechanisms for horizontal gene transfer (recombination):

1. **Transformation:** The uptake of naked foreign DNA from the environment.

2. **Conjugation:** The transfer of genetic material (usually a plasmid) from one bacterium to another through direct cell-to-cell contact, often via a pilus.
3. **Transduction:** The transfer of bacterial DNA from one bacterium to another by a **virus** (specifically, a bacteriophage). The virus accidentally packages a piece of the host bacterium's DNA and then injects it into a new host bacterium.

Binary Fission is the method of asexual cell division in bacteria, not a method of genetic recombination.

Step 3: Final Answer:

Transduction is the bacterial recombination method that involves the transfer of genetic material via a virus.

 Quick Tip

Remember the key mediators for each type of bacterial gene transfer: - Transformation: Free DNA - Conjugation: Cell-to-cell contact (pilus) - Transduction: Virus (bacteriophage)

56. Which fungus is responsible for causing Blast of Rice disease?

- (A) Rhizopus
- (B) Puccinia
- (C) Aspergillus
- (D) Magnaporthe oryzae

Correct Answer: (D) Magnaporthe oryzae

Solution:

Step 1: Understanding the Question:

The question asks to identify the specific fungus that causes the plant disease known as rice blast.

Step 2: Detailed Explanation:

- **Magnaporthe oryzae** (previously known as *Pyricularia oryzae*) is an ascomycete fungus that causes rice blast, a devastating disease affecting rice crops worldwide. The disease can affect all parts of the rice plant and can lead to significant crop losses.
- **Rhizopus** is a common genus of mold (bread mold) that can cause opportunistic infections but is not the cause of rice blast.
- **Puccinia** is a genus of rust fungi that cause diseases in many plants, notably wheat stem rust (*Puccinia graminis*), but not rice blast.
- **Aspergillus** is a common mold, some species of which can cause diseases in humans and

animals (aspergillosis) or produce aflatoxins in food, but it does not cause rice blast.

Step 3: Final Answer:

The fungus responsible for causing Blast of Rice disease is *Magnaporthe oryzae*.

💡 Quick Tip

It's helpful to memorize the causative agents of major plant diseases. Rice blast caused by *Magnaporthe oryzae* and wheat stem rust caused by *Puccinia graminis* are two of the most economically important examples.

57. Which pigment is characteristic of Rhodophyceae (Red Algae)?

- (A) Chlorophyll-a
- (B) Phycocyanin
- (C) Phycoerythrin
- (D) Xanthophyll

Correct Answer: (C) Phycoerythrin

Solution:

Step 1: Understanding the Question:

The question asks for the characteristic pigment that gives Red Algae (Rhodophyceae) their distinctive color.

Step 2: Detailed Explanation:

Algae contain various photosynthetic pigments. The combination of these pigments determines their color and classification.

- **Chlorophyll-a** is the primary photosynthetic pigment and is found in virtually all photosynthetic organisms, including red algae, green algae, and cyanobacteria. So it is not a characteristic pigment exclusive to red algae.
- **Phycobiliproteins** are accessory pigments found in red algae and cyanobacteria. There are two main types: - **Phycoerythrin:** This pigment is red and is particularly abundant in Red Algae (Rhodophyceae). It absorbs blue and green light, which penetrates deeper into water, and it masks the green color of chlorophyll-a, giving the algae its characteristic red appearance.
- **Phycocyanin:** This pigment is blue and is more dominant in Cyanobacteria (blue-green algae).
- **Xanthophyll** is a yellow or brown carotenoid pigment found widely in plants and algae, but it is not the defining pigment of red algae.

Step 3: Final Answer:

Phycoerythrin is the characteristic red pigment of Rhodophyceae (Red Algae).

💡 Quick Tip

Associate the characteristic pigments with the algae groups: - Rhodophyceae (Red Algae) → **Phycoerythrin** (red) - Phaeophyceae (Brown Algae) → Fucoxanthin (brown) - Chlorophyceae (Green Algae) → Chlorophyll-b (green) - Cyanobacteria (Blue-green Algae) → **Phycocyanin** (blue)

58. Which of the following algae has a diplohaplontic life cycle?

- (A) Spirogyra
- (B) Polysiphonia
- (C) Chlamydomonas
- (D) Ulva

Correct Answer: (B) Polysiphonia (and (D) Ulva, but Polysiphonia has a more complex one)

Solution:

Step 1: Understanding the Question:

The question asks to identify an alga with a diplohaplontic life cycle from the given options.

Step 2: Detailed Explanation:

A **diplohaplontic** life cycle (also called alternation of generations) is one in which there are distinct, multicellular diploid ($2n$) and haploid (n) phases.

- The diploid phase is the sporophyte, which produces spores by meiosis.
- The haploid phase is the gametophyte, which produces gametes by mitosis.

Let's examine the life cycles of the given algae:

- **Spirogyra** and **Chlamydomonas** (Green Algae) typically exhibit a **haplontic** life cycle, where the dominant, multicellular phase is the haploid gametophyte, and the diploid stage is represented only by the zygote.
- **Ulva** (Sea Lettuce, a Green Alga) is a classic example of an isomorphic diplohaplontic life cycle, where the diploid sporophyte and haploid gametophyte are morphologically identical.
- **Polysiphonia** (a Red Alga) exhibits a more complex, triphasic diplohaplontic life cycle. It has a haploid gametophyte phase, a diploid carposporophyte phase, and a diploid tetrasporophyte phase. This is a very distinct type of diplohaplontic cycle.

Given the options, both *Polysiphonia* and *Ulva* have diplohaplontic life cycles. However, *Polysiphonia* is a prominent example often used to illustrate a complex version of this life cycle in red algae. If only one answer is correct, there might be a specific context intended, but both are valid examples. In many curricula, *Polysiphonia* is highlighted for its unique triphasic alternation of generations.

Step 3: Final Answer:

Both *Polysiphonia* and *Ulva* have diplohaplontic life cycles. *Polysiphonia* is a particularly well-

known example due to its complex triphasic nature.

 Quick Tip

Memorize the representative life cycle types for major algal groups:

- **Haplontic:** Most Green Algae like *Spirogyra*, *Chlamydomonas*. (Dominant haploid stage)
- **Diplontic:** *Fucus* (a brown alga). (Dominant diploid stage)
- **Diplohaplontic:** *Ulva*, *Ectocarpus*, *Polysiphonia*. (Alternation of multicellular haploid and diploid generations)

59. Which of the following is a liverwort?

- (A) *Marchantia*
- (B) *Funaria*
- (C) *Polytrichum*
- (D) *Riccia*

Correct Answer: (A) *Marchantia*

Solution:

Step 1: Understanding the Question:

The question asks to identify a liverwort from the given list of bryophytes.

Step 2: Detailed Explanation:

Bryophytes are non-vascular plants and are broadly divided into three main groups:

1. **Liverworts (Class Hepaticopsida):** These are simple plants that can have a thalloid (flat, ribbon-like) or leafy structure. **Marchantia** and **Riccia** are classic examples of thalloid liverworts.
2. **Mosses (Class Bryopsida):** These plants have a more differentiated structure with stem-like and leaf-like parts. **Funaria** and **Polytrichum** are common examples of mosses.
3. **Hornworts (Class Anthocerotopsida):** These have a thalloid body and a distinctive horn-like sporophyte.

From the options:

- **Marchantia (A)** and **Riccia (D)** are both liverworts.
- **Funaria (B)** and **Polytrichum (C)** are mosses.

Since both (A) and (D) are correct, there might be an issue with the question having multiple correct answers. However, *Marchantia* is a very widely studied and representative example of a liverwort, often used in textbooks to illustrate the group's characteristics, including its distinctive reproductive structures (antheridiophores and archegoniophores).

Step 3: Final Answer:

Both *Marchantia* and *Riccia* are liverworts. *Marchantia* is a classic and prominent example.

💡 Quick Tip

When studying bryophytes, it's essential to learn the key examples for each group: - Liverworts: *Riccia*, *Marchantia* - Mosses: *Funaria*, *Polytrichum*, *Sphagnum* - Hornworts: *Anthoceros*

60. In bryophytes, the dominant phase of the life cycle is:

- (A) Sporophyte
- (B) Gametophyte
- (C) Both phases are equal
- (D) Protonema

Correct Answer: (B) Gametophyte

Solution:

Step 1: Understanding the Question:

The question asks to identify the dominant, long-lived, and independent phase in the life cycle of bryophytes (mosses, liverworts, hornworts).

Step 2: Detailed Explanation:

The life cycle of plants involves an alternation of generations between a haploid (n) phase and a diploid (2n) phase.

- The haploid phase is the **gametophyte**, which produces gametes.
- The diploid phase is the **sporophyte**, which produces spores.

In different plant groups, the relative prominence of these two phases varies:

- In **Bryophytes** (mosses, etc.), the life cycle is haplodiplontic, but the **gametophyte is the dominant phase**. The green, leafy plant that we typically see is the haploid gametophyte. The diploid sporophyte is small, short-lived, and nutritionally dependent on the gametophyte.
- In **Pteridophytes** (ferns), the sporophyte is dominant, but the gametophyte is still a free-living, independent plant.
- In **Gymnosperms** and **Angiosperms**, the sporophyte is completely dominant (the tree or plant we see), and the gametophyte is highly reduced and dependent on the sporophyte.

The protonema is a juvenile, filamentous stage of the gametophyte in mosses, not the entire dominant phase.

Step 3: Final Answer:

In bryophytes, the gametophyte is the dominant, photosynthetic, and independent phase of the

life cycle.

 Quick Tip

Remember the evolutionary trend in plants: from a dominant gametophyte in bryophytes to a dominant sporophyte in all vascular plants (ferns, gymnosperms, and angiosperms). Bryophytes are unique among land plants in this regard.

61. Pteridophytes reproduce by:

- (A) Seeds
- (B) Buds
- (C) Conidia
- (D) Spores

Correct Answer: (D) Spores

Solution:

Step 1: Understanding the Question:

The question asks for the primary method of reproduction in pteridophytes (ferns and their allies).

Step 2: Detailed Explanation:

Pteridophytes are vascular plants that do not produce flowers or seeds. They are part of a group sometimes called "vascular cryptogams".

Their primary means of dispersal and reproduction is through **spores**. The dominant sporophyte phase of a fern produces spores (usually in sporangia located on the underside of the leaves). These spores are released, and if they land in a suitable environment, they germinate to form the small, independent gametophyte, which then produces gametes for sexual reproduction.

- **Seeds (A)** are characteristic of gymnosperms and angiosperms (spermatophytes).
- **Buds (B)** are associated with vegetative propagation.
- **Conidia (C)** are asexual spores produced by fungi.

Step 3: Final Answer:

Pteridophytes reproduce by means of spores.

💡 Quick Tip

Remember the major plant groups based on reproduction: - Non-vascular plants (Bryophytes): Spores - Vascular, non-seed plants (Pteridophytes): Spores - Vascular, seed plants (Gymnosperms Angiosperms): Seeds

62. According to Smith's (1955) classification, which of the following is not a division of Pteridophyta?

- (A) Psilopsida
- (B) Lycopsida
- (C) Gymnosperms
- (D) Pteropsida

Correct Answer: (C) Gymnosperms

Solution:

Step 1: Understanding the Question:

The question asks to identify which of the given groups is not a division within the Pteridophyta according to a historical classification system.

Step 2: Detailed Explanation:

Pteridophyta is a major group in the plant kingdom, comprising ferns and fern allies. Various classification systems have been proposed. A common, older system (like that of Smith) divides the living Pteridophytes into four main divisions or classes:

1. **Psilopsida** (Whisk ferns, e.g., *Psilotum*)
2. **Lycopsida** (Club mosses, e.g., *Lycopodium*, *Selaginella*)
3. **Sphenopsida** or **Articulatae** (Horsetails, e.g., *Equisetum*)
4. **Pteropsida** or **Filicopsida** (True ferns)

Gymnosperms, on the other hand, are a completely separate major group of plants. They are seed-bearing plants (spermatophytes), unlike the spore-bearing pteridophytes. Examples of gymnosperms include conifers (*Pinus*), cycads, and *Ginkgo*.

Step 3: Final Answer:

Gymnosperms are a separate division of the plant kingdom and are not a subdivision of Pteridophyta.

💡 Quick Tip

Remember the major hierarchy of land plants: Bryophytes (non-vascular) → Pteridophytes (vascular, spore-bearing) → Gymnosperms (vascular, seed-bearing, "naked" seeds) → Angiosperms (vascular, seed-bearing, flowering plants). Gymnosperms and Pteridophytes are distinct, major divisions.

63. Which of the following is a gymnosperm?

- (A) Mango
- (B) Cycas
- (C) Pea
- (D) Wheat

Correct Answer: (B) Cycas

Solution:

Step 1: Understanding the Question:

The question asks to identify which of the given plants is a gymnosperm.

Step 2: Detailed Explanation:

Gymnosperms are seed-producing plants with "naked" seeds, meaning their seeds are not enclosed within an ovary.

Let's analyze the options:

- **Mango, Pea, and Wheat** are all **Angiosperms** (flowering plants). Their seeds are enclosed within a fruit, which develops from the ovary of a flower.
- **Cycas** is a classic example of a gymnosperm. It belongs to the division Cycadophyta. It is a dioecious plant that produces large cones, and its ovules (which become seeds) are borne on modified leaves called megasporophylls, not enclosed in an ovary.

Step 3: Final Answer:

Cycas is a gymnosperm, while Mango, Pea, and Wheat are angiosperms.

💡 Quick Tip

The easiest way to identify a gymnosperm is to think of cone-bearing trees or plants that don't produce true flowers or fruits. If you see *Pinus* (pine), *Cycas*, *Ginkgo*, or *Ephedra* in a list, they are classic examples of gymnosperms.

64. In *Pinus*, the male cones are found?

- (A) On upper branches
- (B) In the axils of megasporophylls
- (C) On lower branches
- (D) At the base of ovules

Correct Answer: (C) On lower branches

Solution:

Step 1: Understanding the Question:

The question asks for the location of male cones on a *Pinus* (pine) tree.

Step 2: Detailed Explanation:

Pinus is a monoecious plant, meaning both male and female cones are found on the same tree. However, they are typically located in different positions:

- **Male cones** (or staminate strobili) are small, inconspicuous, and are borne in clusters on the **lower branches** of the tree. This position facilitates the dispersal of large amounts of pollen by the wind.
- **Female cones** (or ovulate strobili) are larger and are usually found on the **upper branches** of the tree. This strategic placement increases the chances of cross-pollination by catching wind-borne pollen from other trees, reducing the likelihood of self-pollination.
- Megasporophylls and ovules are parts of the female cone, so options (B) and (D) are incorrect.

Step 3: Final Answer:

In *Pinus*, the male cones are typically found in clusters on the lower branches.

💡 Quick Tip

Remember the arrangement in *Pinus* for cross-pollination: Male cones are low, and female cones are high. This makes it easier for pollen to be carried by wind from the lower branches of one tree to the upper branches of another.

65. The term 'taxonomy' was coined by:

- (A) Carolus Linnaeus
- (B) A.P. de Candolle
- (C) Bentham
- (D) Hooker

Correct Answer: (B) A.P. de Candolle

Solution:

Step 1: Understanding the Question:

The question asks who first coined the term 'taxonomy'.

Step 2: Detailed Explanation:

- **A.P. de Candolle** (Augustin Pyramus de Candolle), a Swiss botanist, is credited with coining the term '**taxonomy**' in 1813 in his book *Théorie élémentaire de la botanique*. He derived it from the Greek words *taxis* (arrangement) and *nomos* (law or rule).
- **Carolus Linnaeus** is known as the 'Father of Taxonomy' for developing the modern system of binomial nomenclature and a hierarchical classification system, but he did not use the word 'taxonomy' itself. He used the term 'systematics'.
- **Bentham** and **Hooker** were British botanists famous for their extensive natural system of classification, but they did not coin the term.

Step 3: Final Answer:

The term 'taxonomy' was coined by A.P. de Candolle.

💡 Quick Tip

Distinguish between the "Father of Taxonomy" and the person who "coined the term".
- Father of Taxonomy: Carolus Linnaeus - Coined the term 'taxonomy': A.P. de Candolle

66. Which one of the following statements is correct in relation to the Typification principle?

- (A) It is irrelevant for nomenclature
- (B) It only applies to extinct species
- (C) A taxon must have a nomenclatural type
- (D) All names must be registered in databases

Correct Answer: (C) A taxon must have a nomenclatural type

Solution:**Step 1: Understanding the Question:**

The question asks for the correct statement regarding the principle of typification in biological nomenclature.

Step 2: Detailed Explanation:

The **Principle of Typification** is a cornerstone of the International Code of Nomenclature for algae, fungi, and plants (ICN). It states that the application of names of taxonomic groups (taxa) is determined by means of **nomenclatural types**.

A nomenclatural type is an element to which the name of a taxon is permanently attached. For a species, this is typically a specific herbarium specimen (the holotype). For a genus, it is

a type species.

This means that every taxon, to be validly published, **must have a designated nomenclatural type**. This type acts as an anchor or reference point for the name, ensuring stability in nomenclature. If there is ever a dispute about what a name refers to, botanists can go back and examine the type specimen.

The principle is highly relevant (not irrelevant), applies to all species (not just extinct ones), and while database registration is encouraged, the core principle is the mandatory designation of a type.

Step 3: Final Answer:

The correct statement is that a taxon must have a nomenclatural type.

💡 Quick Tip

Think of the 'type specimen' as the "name bearer" or "gold standard" for a species name. Every scientific name for a species is permanently tied to a physical specimen stored in a museum or herbarium, ensuring that the meaning of the name remains fixed.

67. Systematic taxonomy aims to

- (A) Classify plants alphabetically
- (B) Describe plants only morphologically
- (C) Study evolutionary relationships
- (D) Ignore ecological roles

Correct Answer: (C) Study evolutionary relationships

Solution:

Step 1: Understanding the Question:

The question asks for the primary aim of systematic taxonomy, often simply called 'systematics'.

Step 2: Detailed Explanation:

While traditional taxonomy focused on naming, describing, and classifying organisms (often based on morphology), **systematic taxonomy** or **systematics** has a broader goal.

Systematics aims to understand the diversity of life and the **evolutionary relationships** among organisms (phylogeny). It seeks to create classifications that reflect these evolutionary histories.

Therefore, a systematic taxonomist uses data from many sources (morphology, genetics, biochemistry, etc.) not just to classify organisms, but to reconstruct their evolutionary tree.

- Classifying alphabetically (A) is an artificial system with no scientific basis.
- Describing only morphology (B) is part of traditional taxonomy but is not the full scope of systematics.

- Ignoring ecology (D) is incorrect; systematics often incorporates ecological data to understand evolutionary divergence.

Step 3: Final Answer:

The primary aim of systematic taxonomy is to study and reconstruct the evolutionary relationships between organisms.

 Quick Tip

Remember the distinction: - **Taxonomy**: The science of naming, describing, and classifying organisms. - **Systematics**: A broader field that includes taxonomy but whose primary goal is to understand the evolutionary history (phylogeny) of life. Modern classification is almost always systematic.

68. The science of geographical distribution of plants is called as:

- (A) Ecology
- (B) Phytogeography
- (C) Floriculture
- (D) Paleobotany

Correct Answer: (B) Phytogeography

Solution:

Step 1: Understanding the Question:

The question asks for the specific term for the scientific study of the geographical distribution of plants.

Step 2: Detailed Explanation:

Let's break down the term **Phytogeography**:

- **Phyto-**: A prefix from Greek meaning 'plant'.

- **-geography**: The study of the distribution of features on Earth's surface.

Thus, phytogeography is the branch of botany that deals with the geographical distribution of plant species and their communities. It is also known as plant geography.

The other options are:

- **Ecology**: The study of the interactions between organisms and their environment.

- **Floriculture**: The cultivation of flowers and ornamental plants.

- **Paleobotany**: The study of fossil plants.

Step 3: Final Answer:

The science of the geographical distribution of plants is called phytogeography.

💡 Quick Tip

Break down scientific terms into their Greek or Latin roots. 'Phyto' for plant, 'Zoo' for animal, 'Geo' for Earth, and so on. This makes it easier to deduce the meaning of complex terms. For example, zoogeography is the study of the geographical distribution of animals.

69. Wallace's Line separates the:

- (A) Palearctic and Nearctic realms
- (B) Oriental and Australian regions
- (C) Ethiopian and Palearctic regions
- (D) Neotropical and Nearctic zones

Correct Answer: (B) Oriental and Australian regions

Solution:

Step 1: Understanding the Question:

The question asks to identify the two biogeographical regions separated by Wallace's Line.

Step 2: Detailed Explanation:

Wallace's Line is a faunal boundary line drawn in 1859 by the British naturalist Alfred Russel Wallace. It is a line of deep water that separates the Indonesian archipelago into two distinct parts: a western portion, whose fauna is largely of Asian origin, and an eastern portion, whose fauna is of Australian origin.

- The western region is known as the **Oriental region** (or Indomalayan realm).
- The eastern region is known as the **Australian region** (or Australasian realm).

The line runs through Indonesia, between Borneo and Sulawesi, and between Bali and Lombok. The deep water of the Lombok Strait acted as a barrier for many terrestrial species, leading to the striking difference in animal life on either side, even between islands that are very close geographically.

Step 3: Final Answer:

Wallace's Line is a major biogeographical demarcation that separates the Oriental and Australian faunal regions.

💡 Quick Tip

Associate Alfred Russel Wallace with the Malay Archipelago and the theory of evolution by natural selection (which he co-discovered with Darwin). His extensive work there led him to identify this sharp faunal divide, now known as Wallace's Line.

70. Vascular bundles in dicot stems are:

- (A) Scattered
- (B) Closed and radial
- (C) Conjoint and collateral
- (D) Absent

Correct Answer: (C) Conjoint and collateral

Solution:

Step 1: Understanding the Question:

The question asks for the characteristic arrangement of vascular bundles in the stems of dicotyledonous plants.

Step 2: Detailed Explanation:

Vascular bundles contain the xylem and phloem tissues. Their arrangement is a key feature for distinguishing plant groups.

In **dicot stems**, the vascular bundles are typically arranged in a ring. Each bundle has the following characteristics:

- **Conjoint:** The xylem and phloem are found together in the same bundle.
- **Collateral:** The phloem is located on the outer side (towards the periphery) and the xylem is located on the inner side (towards the center).
- **Open:** There is a strip of cambium (meristematic tissue) present between the xylem and phloem. This cambium allows for secondary growth (increase in girth).

Let's look at the options:

- (A) **Scattered** vascular bundles are characteristic of **monocot stems**.
- (B) **Radial** arrangement (xylem and phloem on different radii) is characteristic of **roots**. **Closed** bundles (lacking cambium) are characteristic of monocots.
- (C) **Conjoint and collateral** accurately describes the arrangement within each bundle in a dicot stem.
- (D) Vascular bundles are certainly not absent.

Step 3: Final Answer:

The vascular bundles in dicot stems are conjoint, collateral, open, and arranged in a ring. Option (C) provides the correct description of the bundle type.

 Quick Tip

Remember the key differences between monocot and dicot stems: - **Dicot Stem:** Bundles in a **ring**, **open** (have cambium), conjoint, collateral. - **Monocot Stem:** Bundles are **scattered**, **closed** (no cambium), conjoint, collateral.

71. The Casparian strip is found in the:

- (A) Cortex
- (B) Epidermis
- (C) Endodermis
- (D) Xylem

Correct Answer: (C) Endodermis

Solution:

Step 1: Understanding the Question:

The question asks to identify the plant tissue layer where the Casparian strip is located.

Step 2: Detailed Explanation:

The **Casparian strip** is a band of cell wall material deposited on the radial and transverse walls of the cells of the **endodermis** in plant roots.

- The **endodermis** is the innermost layer of the cortex in a plant root, surrounding the central vascular cylinder (stele).
- The strip is made of suberin and lignin, which are waterproof substances.
- Its function is crucial for water regulation. It blocks the passive, apoplastic (between cells) flow of water and solutes into the vascular cylinder. This forces water to pass through the cell membrane of the endodermal cells (the symplastic pathway), giving the plant control over which minerals are absorbed into the xylem.

Step 3: Final Answer:

The Casparian strip is a characteristic feature of the endodermis of plant roots.

 Quick Tip

Think of the Casparian strip as a "waterproof gasket" or "gatekeeper" in the root. It is located in the endodermis and forces all water and minerals to pass through a cell membrane before entering the plant's vascular system, allowing for selective uptake.

72. Double fertilization is characteristic of:

- (A) Gymnosperms
- (B) Algae
- (C) Bryophytes
- (D) Angiosperms

Correct Answer: (D) Angiosperms

Solution:

Step 1: Understanding the Question:

The question asks to identify the major plant group for which double fertilization is a defining characteristic.

Step 2: Detailed Explanation:

Double fertilization is a unique and complex fertilization mechanism found exclusively in **Angiosperms** (flowering plants).

It involves two fertilization events within the embryo sac:

1. **Syngamy:** One of the two male gametes (from the pollen tube) fuses with the egg cell to form the diploid ($2n$) **zygote**, which will develop into the embryo.
2. **Triple Fusion:** The second male gamete fuses with the two polar nuclei (or the secondary nucleus) in the central cell to form the triploid ($3n$) **primary endosperm nucleus**, which develops into the endosperm, a nutritive tissue for the embryo.

This process is a hallmark of angiosperms and is not found in gymnosperms, bryophytes, or algae.

Step 3: Final Answer:

Double fertilization is a characteristic feature of Angiosperms.

💡 Quick Tip

Remember what's "double" about double fertilization in flowering plants:

1. Sperm + Egg $\rightarrow$ Zygote ($2n$)
 2. Sperm + 2 Polar Nuclei $\rightarrow$ Endosperm ($3n$)
- This leads to the formation of both the embryo and its food supply.

73. In the Polygonum type embryo sac, the number of nuclei at maturity is:

- (A) 6
- (B) 4
- (C) 8
- (D) 7

Correct Answer: (C) 8

Solution:

Step 1: Understanding the Question:

The question asks for the total number of nuclei present in a mature embryo sac of the *Polygonum* type.

Step 2: Detailed Explanation:

The *Polygonum* type is the most common type of embryo sac development in angiosperms. It is monosporic, meaning it develops from a single functional megaspore.

The development proceeds as follows:

1. The functional megaspore nucleus (haploid, n) undergoes three successive mitotic divisions.
2. First division: 1 nucleus $\rightarrow$ 2 nuclei.
3. Second division: 2 nuclei $\rightarrow$ 4 nuclei.
4. Third division: 4 nuclei $\rightarrow$ **8 nuclei**.

These 8 nuclei then organize themselves within the embryo sac to form the mature structure, which consists of 7 cells:

- One **egg cell** (1 nucleus)
- Two **synergids** (2 nuclei)
- Three **antipodal cells** (3 nuclei)
- One large **central cell** containing two **polar nuclei** (2 nuclei)

The question specifically asks for the number of **nuclei**, not cells. Counting them up, there are $1 + 2 + 3 + 2 = 8$ nuclei.

Step 3: Final Answer:

A mature *Polygonum* type embryo sac is a 7-celled, 8-nucleate structure. The total number of nuclei is 8.

💡 Quick Tip

Remember the common description of the most typical female gametophyte (embryo sac) in flowering plants: "7-celled, 8-nucleate". This refers to the *Polygonum* type. Don't confuse the number of cells with the number of nuclei.

74. The ecological succession that occurs in an area where water availability is extremely low is called:

- (A) Xerosere
- (B) Halosere
- (C) Hydrosere
- (D) Psammosere

Correct Answer: (A) Xerosere

Solution:

Step 1: Understanding the Question:

The question asks for the term describing ecological succession in a very dry environment.

Step 2: Detailed Explanation:

Ecological succession is the process of change in the species structure of an ecological community over time. The sequence of communities is known as a sere. Seres are named based on the starting environmental conditions.

- **Xerosere:** This is a plant succession that is limited by water availability. It starts in a **xeric** (extremely dry) environment, such as bare rock (lithosere) or sand (psammosere). This directly matches the question's description.
- **Halosere:** This succession starts in a saline (salty) environment, like a salt marsh.
- **Hydrosere:** This succession starts in an aquatic (water) environment, like a pond or lake. It is the opposite of a xerosere.
- **Psammosere:** This is a specific type of xerosere that starts on sand (e.g., sand dunes).

Since xerosere is the general term for succession in dry conditions, it is the most appropriate answer.

Step 3: Final Answer:

Ecological succession in an area with extremely low water availability is called a xerosere.

💡 Quick Tip

Break down the terms: - **Xero-** (from Greek *xeros*) means dry. - **Hydro-** means water. - **Halo-** means salt. - **Psammo-** means sand. - **-sere** refers to a succession sequence.

75. Which of the following is NOT a component of an ecological food web?

- (A) Producers
- (B) Decomposers
- (C) Bio accumulators
- (D) Consumers

Correct Answer: (C) Bio accumulators

Solution:**Step 1: Understanding the Question:**

The question asks to identify the term that is not a standard functional component (trophic level) of a food web.

Step 2: Detailed Explanation:

An ecological food web describes the flow of energy through an ecosystem. It is composed of several key functional groups or trophic levels:

- **Producers (A):** Also called autotrophs, these are organisms that produce their own food,

usually through photosynthesis (e.g., plants, algae). They form the base of the food web.

- **Consumers (D):** Also called heterotrophs, these are organisms that obtain energy by feeding on other organisms. They can be herbivores (primary consumers), carnivores (secondary/tertiary consumers), or omnivores.

- **Decomposers (B):** Also called saprotrophs, these are organisms (e.g., bacteria, fungi) that break down dead organic matter and waste products, returning essential nutrients to the ecosystem.

Bioaccumulators is not a functional group or trophic level in a food web. **Bioaccumulation** is a *process* that occurs within a food web, where certain substances (like toxins or heavy metals) build up in an organism's tissues over time. "Bioaccumulators" might refer to organisms in which this process is significant, but it is not a fundamental component of the food web structure itself.

Step 3: Final Answer:

Producers, consumers, and decomposers are the three primary components of a food web. Bioaccumulators is not a standard component.

💡 Quick Tip

Remember the three essential roles for energy and nutrient cycling in any ecosystem:

1. **Producers** (make the food)
2. **Consumers** (eat the food)
3. **Decomposers** (recycle the dead **material**)

76. Which of the following represents a population?

- (A) All plants in a forest
- (B) All deer in a forest
- (C) All animals in a pond
- (D) All trees in India

Correct Answer: (B) All deer in a forest

Solution:

Step 1: Understanding the Question:

The question asks to identify the option that correctly describes an ecological population.

Step 2: Detailed Explanation:

In ecology, a **population** is defined as a group of individuals of the **same species** living in the **same geographic area** at the same time.

Let's analyze the options based on this definition:

- (A) **All plants in a forest:** This includes many different species of plants (trees, shrubs, herbs). This represents a **community** (specifically, the plant community), not a population.
- (B) **All deer in a forest:** This refers to a group of individuals of the same species (deer) living in the same area (a forest). This correctly fits the definition of a population.
- (C) **All animals in a pond:** This includes many different species (fish, insects, amphibians, etc.). This represents the animal **community** of the pond.
- (D) **All trees in India:** This includes many different species of trees distributed over a very large and varied geographic area. It is too broad to be considered a single ecological population.

Step 3: Final Answer:

"All deer in a forest" is the correct representation of a population.

💡 Quick Tip

Remember the ecological hierarchy:

- **Organism:** An individual living being.
- **Population:** A group of individuals of the **same species** in an area.
- **Community:** A group of different populations (**different species**) in an area.
- **Ecosystem:** A community plus its non-living environment.

77. Primary productivity refers to:

- (A) Energy used by herbivores
- (B) Rate of energy release during respiration
- (C) Total amount of energy fixed by plants in photosynthesis
- (D) Energy flow through food chains

Correct Answer: (C) Total amount of energy fixed by plants in photosynthesis

Solution:

Step 1: Understanding the Question:

The question asks for the definition of primary productivity.

Step 2: Detailed Explanation:

Primary productivity is the rate at which energy is converted by photosynthetic and chemosynthetic autotrophs (producers, mainly plants and algae) into organic substances.

Essentially, it is the rate at which biomass is created from inorganic compounds.

- **Gross Primary Productivity (GPP)** is the total rate of photosynthesis, i.e., the total amount of energy fixed by plants.

- **Net Primary Productivity (NPP)** is GPP minus the energy lost by the plants through their own respiration ($NPP = GPP - R$). NPP is the rate of biomass accumulation that is available to consumers.

Option (C), "Total amount of energy fixed by plants in photosynthesis," is the best description of Gross Primary Productivity, which is the foundational concept of primary productivity. The other options describe different concepts:

- (A) Energy used by herbivores relates to secondary productivity.
- (B) Rate of energy release during respiration is a loss term.
- (D) Energy flow is a broader concept describing movement through trophic levels.

Step 3: Final Answer:

Primary productivity refers to the total amount of energy captured and stored as biomass by producers, primarily through photosynthesis.

💡 Quick Tip

Think of primary productivity as the "income" of an ecosystem.

- **Gross Primary Productivity (GPP)** is the total paycheck earned by plants.
- **Respiration (R)** is the plant's own living expenses.
- **Net Primary Productivity (NPP)** is the savings that are left over and can be "spent" by the rest of the ecosystem (herbivores).

78. Biodiversity is highest in:

- (A) Tropical rainforests
- (B) Tundra
- (C) Deserts
- (D) Temperate grasslands

Correct Answer: (A) Tropical rainforests

Solution:

Step 1: Understanding the Question:

The question asks to identify the biome with the highest level of biodiversity from the given options.

Step 2: Detailed Explanation:

Biodiversity shows a clear latitudinal gradient, being highest in the tropics and decreasing towards the poles. Let's analyze the biomes:

- **Tropical Rainforests:** Located near the equator, these regions have stable, warm, and wet climates year-round with high solar energy input. These optimal conditions support an enormous variety of life. They are the most biodiverse terrestrial ecosystems on Earth.
- **Tundra:** Located in the arctic and on high mountains, this biome is characterized by extremely cold temperatures, permafrost, and a short growing season. Biodiversity is very low.
- **Deserts:** Characterized by extremely low rainfall and temperature extremes. While they

have specially adapted species, overall biodiversity is low.

- **Temperate grasslands:** These biomes have moderate rainfall and distinct hot and cold seasons. Their biodiversity is much lower than that of tropical rainforests.

Step 3: Final Answer:

Among the given options, tropical rainforests have the highest biodiversity.

💡 Quick Tip

When thinking about global biodiversity hotspots, the key regions are always tropical rainforests (e.g., the Amazon, Congo Basin) for land and coral reefs (e.g., the Coral Triangle in Southeast Asia) for marine environments. The general rule is: warm, wet, and stable climates support the most species.

79. Which of the following is not a component of biodiversity?

- (A) Genetic diversity
- (B) Cultural diversity
- (C) Ecosystem diversity
- (D) Species diversity

Correct Answer: (B) Cultural diversity

Solution:

Step 1: Understanding the Question:

The question asks to identify which of the given options is not a recognized level or component of biological diversity.

Step 2: Detailed Explanation:

Biodiversity (or biological diversity) is typically considered at three main hierarchical levels:

1. **Genetic diversity (A):** The variety of genes within a single species. This is the basis for adaptation and evolution.
2. **Species diversity (D):** The variety of different species within a particular ecosystem or region. This is the most common understanding of biodiversity.
3. **Ecosystem diversity (C):** The variety of different ecosystems, habitats, and ecological communities on Earth.

Cultural diversity (B) refers to the variety of human societies or cultures in a specific region or in the world as a whole. While it is an important concept and is often linked to biodiversity (as different cultures have different relationships with their environment), it is a concept from social sciences and anthropology, not a biological component of biodiversity itself.

Step 3: Final Answer:

Cultural diversity is not a component of biological diversity.

💡 Quick Tip

Remember the three pillars of biodiversity: Genes, Species, and Ecosystems. Any other type of "diversity" (like cultural, linguistic, etc.) is not part of the biological definition.

80. Water enters root cells by:

- (A) Endocytosis
- (B) Active transport
- (C) Osmosis
- (D) Diffusion of gases

Correct Answer: (C) Osmosis

Solution:**Step 1: Understanding the Question:**

The question asks for the primary physical process by which water moves from the soil into the cells of a plant's root.

Step 2: Detailed Explanation:

- **Osmosis** is the net movement of water molecules across a selectively permeable membrane (like a cell membrane) from a region of higher water potential to a region of lower water potential. The cytoplasm inside root hair cells contains solutes (sugars, salts), which lowers its water potential compared to the water in the soil. This water potential gradient drives the movement of water into the root cells. This is the primary mechanism for water absorption by plants.
- **Endocytosis (A)** is the process of a cell engulfing large particles or droplets of liquid, which is not how water is absorbed.
- **Active transport (B)** is the movement of substances against their concentration gradient, which requires energy (ATP). While mineral ions are absorbed by active transport, water moves passively by osmosis.
- **Diffusion of gases (D)** refers to the movement of gases, not liquid water.

Step 3: Final Answer:

Water enters root cells from the soil primarily through the process of osmosis.

💡 Quick Tip

Remember the roles of different transport mechanisms in roots: - Water moves by **Osmosis**. - Mineral ions move by **Active Transport**. The active transport of ions helps maintain the low water potential inside the root cells, which in turn drives osmosis.

81. The pressure potential of pure water is:

- (A) Zero
- (B) Positive
- (C) Negative
- (D) Equal to osmotic potential

Correct Answer: (A) Zero

Solution:

Step 1: Understanding the Question:

The question asks for the value of the pressure potential (Ψ_p) for pure water under standard conditions.

Step 2: Detailed Explanation:

Water potential (Ψ_w) is the potential energy of water per unit volume relative to pure water. It is composed of several components, primarily solute potential (Ψ_s) and pressure potential (Ψ_p).

$$\Psi_w = \Psi_s + \Psi_p$$

- **Solute Potential (Ψ_s):** This is the effect of dissolved solutes. Solutes always lower the water potential, so Ψ_s is always negative or zero (for pure water).

- **Pressure Potential (Ψ_p):** This is the physical pressure on the water. By convention, the pressure potential of pure water at standard atmospheric pressure is defined as **zero**.

Pressure potential can be positive (e.g., inside a turgid plant cell, this is turgor pressure) or negative (e.g., tension in the xylem). But for the reference state of pure water open to the atmosphere, it is zero.

Step 3: Final Answer:

By convention, the pressure potential of pure water at atmospheric pressure is taken as zero.

💡 Quick Tip

Remember the standard reference values for water potential components: - For pure water at standard pressure: - Solute Potential (Ψ_s) = 0 - Pressure Potential (Ψ_p) = 0 - Total Water Potential (Ψ_w) = 0 Adding any solute makes Ψ_s negative, and thus Ψ_w becomes negative.

82. Which of the following is a micronutrient for plants?

- (A) Nitrogen
- (B) Potassium
- (C) Iron
- (D) Magnesium

Correct Answer: (C) Iron

Solution:

Step 1: Understanding the Question:

The question asks to identify a micronutrient from the given list of plant nutrients.

Step 2: Detailed Explanation:

Plant nutrients are classified into two groups based on the quantity required by the plant:

- **Macronutrients:** These are required in relatively large amounts. They include the primary macronutrients (Nitrogen, Phosphorus, Potassium) and secondary macronutrients (Calcium, Magnesium, Sulfur).
- **Micronutrients (or Trace Elements):** These are required in very small quantities. They include Iron, Manganese, Boron, Molybdenum, Copper, Zinc, Chlorine, and Nickel.

Let's look at the options:

- **Nitrogen (A)**, **Potassium (B)**, and **Magnesium (D)** are all macronutrients.
- **Iron (C)** is required in small amounts and is therefore classified as a micronutrient. Despite being needed in small amounts, it is crucial for processes like chlorophyll synthesis and electron transport.

Step 3: Final Answer:

Iron is a micronutrient for plants.

💡 Quick Tip

A useful mnemonic for the macronutrients is "C. HOPKiNS CaFe Mg" (Carbon, Hydrogen, Oxygen, Phosphorus, Potassium, Nitrogen, Sulfur, Calcium, Iron, Magnesium). Note that while Iron is in this mnemonic, it is technically a micronutrient by quantity, but it's the most abundant micronutrient. The primary macros are N, P, K.

83. Chlorosis is caused by the deficiency of:

- (A) Iron and magnesium
- (B) Calcium and sulfur
- (C) Zinc and molybdenum
- (D) Nitrogen and boron

Correct Answer: (A) Iron and magnesium

Solution:

Step 1: Understanding the Question:

The question asks which nutrient deficiencies cause chlorosis in plants.

Step 2: Detailed Explanation:

Chlorosis is a condition where leaves produce insufficient chlorophyll, causing them to turn yellow while the veins may remain green. Since chlorophyll is responsible for the green color of leaves, its deficiency leads to yellowing.

The synthesis and stability of chlorophyll depend on several mineral nutrients. A deficiency in any of these can lead to chlorosis.

- **Magnesium (Mg):** This is a central component of the chlorophyll molecule itself. A deficiency of Mg directly prevents chlorophyll from being made.
- **Iron (Fe):** This is not part of the chlorophyll molecule, but it is essential as a cofactor for several enzymes involved in the chlorophyll synthesis pathway. Without iron, the synthesis process cannot be completed.

Therefore, a deficiency of both iron and magnesium is a very common cause of chlorosis. Other elements like nitrogen, sulfur, zinc, and manganese can also cause chlorosis, but the combination of iron and magnesium is a primary and direct cause. The options presented are pairs, and the pair of Iron and Magnesium is the most direct and well-known cause.

Step 3: Final Answer:

Chlorosis, or the yellowing of leaves, is commonly caused by a deficiency of iron and magnesium, both of which are critical for chlorophyll synthesis.

💡 Quick Tip

To remember the causes of chlorosis, think about what's needed to make and run the "green factories" (chlorophyll). You need the central building block (**Mg**) and the tools to build it (**Fe** for enzymes). **Nitrogen** and **Sulfur** are also needed as they are components of proteins and enzymes.

84. The net gain of ATP during glycolysis is:

- (A) 4 molecules
- (B) 2 molecules
- (C) 6 molecules
- (D) 8 molecules

Correct Answer: (B) 2 molecules

Solution:

Step 1: Understanding the Question:

The question asks for the **net** gain of ATP molecules from one molecule of glucose during the process of glycolysis.

Step 2: Detailed Explanation:

Glycolysis is the metabolic pathway that converts one molecule of glucose into two molecules of pyruvate. It involves a series of ten enzymatic reactions that can be divided into two main phases:

1. **Energy Investment Phase:** In the initial steps, energy is consumed to activate the glucose molecule. **2 molecules of ATP** are used up in this phase.
2. **Energy Payoff Phase:** In the later steps, energy is generated. Through substrate-level phosphorylation, a total of **4 molecules of ATP** are produced. Additionally, 2 molecules of NADH are produced.

The **net gain** of ATP is calculated as the total ATP produced minus the total ATP consumed.

Net ATP = (ATP produced) - (ATP invested)

Net ATP = 4 ATP - 2 ATP = 2 ATP

Step 3: Final Answer:

The net gain of ATP from the glycolysis of one molecule of glucose is 2 molecules.

💡 Quick Tip

Remember the key numbers for glycolysis: - **Input:** 1 Glucose, 2 ATP, 2 NAD⁺ - **Output:** 2 Pyruvate, 4 ATP, 2 NADH - **Net Gain:** 2 ATP, 2 NADH Don't confuse the total ATP produced (4) with the net gain (2).

85. The Red Drop phenomenon in photosynthesis indicates that:

- (A) Photosynthetic efficiency drops beyond 680 nm.
- (B) Photosystem I is active beyond 680 nm.
- (C) Photosystem II absorbs light beyond 700 nm
- (D) Chlorophyll-a does not absorb light at 680 nm

Correct Answer: (A) Photosynthetic efficiency drops beyond 680 nm.

Solution:

Step 1: Understanding the Question:

The question asks what the "Red Drop" phenomenon demonstrates about photosynthesis.

Step 2: Detailed Explanation:

The **Red Drop** phenomenon, first observed by Robert Emerson, is the sharp decrease in the quantum yield (efficiency) of photosynthesis when plants are illuminated with monochromatic light of wavelengths longer than 680 nm (in the far-red region of the spectrum).

This observation was puzzling because chlorophyll continues to absorb light in this region. The drop in efficiency indicated that just absorbing light was not enough.

This led to the **Emerson Enhancement Effect**, where it was discovered that if light of a short wavelength (e.g., 650 nm) was supplied simultaneously with the far-red light (>680 nm), the rate of photosynthesis was greater than the sum of the rates from each light shone alone.

These two phenomena (Red Drop and Enhancement Effect) led to the discovery that photosynthesis involves two separate photosystems working in series:

- **Photosystem II (PSII):** Absorbs light most efficiently at or below 680 nm. It is inactive at wavelengths beyond 680 nm.
- **Photosystem I (PSI):** Can absorb light at longer wavelengths, up to 700 nm or more.

The Red Drop occurs because when only light >680 nm is provided, PSII shuts down, and the overall process, which requires both photosystems to operate efficiently, becomes highly inefficient. Therefore, the direct observation of the Red Drop is that **photosynthetic efficiency drops beyond 680 nm**.

Step 3: Final Answer:

The Red Drop phenomenon is the observed sharp decline in photosynthetic efficiency when

using light with wavelengths greater than 680 nm.

💡 Quick Tip

- **Red Drop:** Efficiency drops sharply when only far-red light ($\lambda > 680$ nm) is used. - **Emerson Enhancement Effect:** Efficiency is restored and enhanced when far-red light is supplemented with shorter wavelength light. - **Conclusion:** Two photosystems (PSI and PSII) must work together for efficient photosynthesis.

86. The primary pigment involved in photosynthesis is:

- (A) Chlorophyll-b
- (B) Xanthophyll
- (C) Carotene
- (D) Chlorophyll-a

Correct Answer: (D) Chlorophyll-a

Solution:

Step 1: Understanding the Question:

The question asks to identify the primary photosynthetic pigment.

Step 2: Detailed Explanation:

Photosynthesis involves several types of pigments, but they have different roles:

- **Primary Pigment (Reaction Center):** This is the pigment that directly participates in converting light energy into chemical energy. It is located in the reaction center of the photosystems. In all oxygenic photosynthetic organisms (plants, algae, cyanobacteria), this pigment is **Chlorophyll-a**.

- **Accessory Pigments:** These pigments absorb light at different wavelengths and transfer the captured energy to the primary pigment (Chlorophyll-a). They broaden the spectrum of light that can be used for photosynthesis. Examples include **Chlorophyll-b**, **Carotenes**, and **Xanthophylls**.

While accessory pigments are crucial, Chlorophyll-a is the essential, central pigment where the key photochemical reactions occur.

Step 3: Final Answer:

Chlorophyll-a is the primary pigment involved in photosynthesis.

💡 Quick Tip

Think of the photosystem as an antenna. The accessory pigments (Chlorophyll-b, carotenoids) are the outer parts of the antenna, gathering energy. Chlorophyll-a is the reaction center, the core device where the signal is actually processed.

87. Photorespiration mainly occurs in:

- (A) Cytoplasm
- (B) Mitochondria only
- (C) Chloroplast, peroxisome, mitochondria
- (D) Only chloroplast

Correct Answer: (C) Chloroplast, peroxisome, mitochondria

Solution:

Step 1: Understanding the Question:

The question asks for the cellular locations where the process of photorespiration takes place.

Step 2: Detailed Explanation:

Photorespiration is a metabolic pathway that occurs in photosynthetic organisms when the enzyme RuBisCO acts on oxygen rather than carbon dioxide. It is considered a wasteful process because it consumes ATP and releases previously fixed CO₂.

The pathway is complex and involves a sequence of reactions that take place across three different cell organelles in a specific order:

1. **Chloroplast:** The process begins here, where RuBisCO fixes O₂ to RuBP, forming phosphoglycolate.
2. **Peroxisome:** The phosphoglycolate is converted to glycolate, which is then transported to the peroxisome. Here, it is oxidized to glyoxylate and then converted to the amino acid glycine.
3. **Mitochondrion:** Two molecules of glycine are transported to the mitochondrion, where they are converted into one molecule of serine, releasing a molecule of CO₂ in the process.

The serine then returns to the peroxisome and eventually the chloroplast to regenerate the cycle. Because the pathway involves the coordinated action of these three organelles, it is sometimes called the C₂ cycle.

Step 3: Final Answer:

Photorespiration is a complex process that occurs across three organelles: the chloroplast, the peroxisome, and the mitochondrion.

 Quick Tip

Remember the "photorespiratory pathway" as a journey of a molecule through three organelles. A simple mnemonic for the order could be **Chilly People Move**: Chloroplast → Peroxisome → Mitochondrion.

88. Nitrogen is absorbed by plants in the form of:

- (A) Nitrate and ammonium ions
- (B) N₂ gas
- (C) Amino acids
- (D) Proteins

Correct Answer: (A) Nitrate and ammonium ions

Solution:

Step 1: Understanding the Question:

The question asks in which chemical form plants absorb nitrogen from the soil.

Step 2: Detailed Explanation:

Nitrogen is an essential macronutrient for plants, but they cannot use the abundant atmospheric nitrogen gas (N₂) directly. They must absorb it from the soil in a mineralized, inorganic form. The two primary forms of nitrogen that plant roots can absorb are:

1. **Nitrate ions** (NO₃⁻)
2. **Ammonium ions** (NH₄⁺)

These ions are made available in the soil through the process of nitrogen fixation (by bacteria) and the decomposition of organic matter (ammonification and nitrification).

While some plants can absorb small organic molecules like amino acids (C), the vast majority of nitrogen uptake occurs in the form of nitrate and ammonium ions (A). Plants cannot absorb proteins (D) directly.

Step 3: Final Answer:

Plants absorb nitrogen from the soil primarily in the inorganic forms of nitrate (NO₃⁻) and ammonium (NH₄⁺) ions.

 Quick Tip

Although the atmosphere is 78% nitrogen gas (N₂), plants can't use it. Think of it like being thirsty in the middle of the ocean; the resource is abundant but not in a usable form. Plants rely on soil microbes to convert N₂ into usable nitrate and ammonium.

89. Which of the following steps in nitrogen metabolism is catalyzed by the enzyme nitrogenase?

- (A) Conversion of nitrate to nitrite
- (B) Fixation of atmospheric nitrogen to ammonia
- (C) Oxidation of ammonia to nitrite
- (D) Reduction of nitrite to ammonia

Correct Answer: (B) Fixation of atmospheric nitrogen to ammonia

Solution:

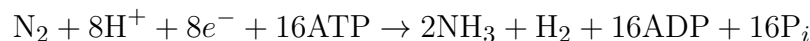
Step 1: Understanding the Question:

The question asks to identify the specific reaction catalyzed by the enzyme complex nitrogenase.

Step 2: Detailed Explanation:

The enzyme **nitrogenase** is responsible for the process of biological **nitrogen fixation**. This is the conversion of atmospheric dinitrogen gas (N_2), which is very inert, into ammonia (NH_3), a form of nitrogen that can be used by living organisms.

The overall reaction is:



This complex and energy-intensive reaction is carried out only by certain prokaryotes (like *Rhizobium* bacteria in root nodules).

The other steps listed are parts of the nitrogen cycle but are catalyzed by different enzymes:

- (A) Conversion of nitrate to nitrite: catalyzed by nitrate reductase.
- (C) Oxidation of ammonia to nitrite (nitrification): catalyzed by ammonia monooxygenase.
- (D) Reduction of nitrite to ammonia: catalyzed by nitrite reductase.

Step 3: Final Answer:

The enzyme nitrogenase catalyzes the fixation of atmospheric nitrogen (N_2) to ammonia (NH_3).

💡 Quick Tip

Associate the enzyme name with its function. **Nitrogenase** is the enzyme that "ases" (acts on) **nitrogen** gas, fixing it into a biologically usable form. It's the key enzyme for bringing atmospheric nitrogen into the biosphere.

90. Auxins are primarily involved in:

- (A) Leaf fall
- (B) Root formation
- (C) Flowering
- (D) Seed dormancy

Correct Answer: (B) Root formation

Solution:

Step 1: Understanding the Question:

The question asks for a primary role of the plant hormone auxin.

Step 2: Detailed Explanation:

Auxins (like indole-3-acetic acid, IAA) are a class of plant hormones with many roles in plant growth and development. One of their most significant and commercially utilized functions is the promotion of root development.

- **Root formation (B):** Auxins stimulate the initiation of adventitious roots from stem cuttings. This is why synthetic auxins are the main ingredient in "rooting hormone" powders used in horticulture to propagate plants. They are also involved in the development of lateral roots.
- **Leaf fall (abscission) (A):** This is primarily controlled by the balance between auxin and other hormones like ethylene and abscisic acid. High auxin levels generally prevent abscission.
- **Flowering (C):** While auxins can influence flowering, other hormones like gibberellins and the hypothetical "florigen" are considered more central to this process.
- **Seed dormancy (D):** This is primarily regulated by abscisic acid (ABA) and gibberellins.

While auxins have multiple effects, their role in stimulating root formation is one of their most well-defined and primary functions.

Step 3: Final Answer:

Auxins are primarily involved in stimulating root formation, particularly adventitious roots.

 Quick Tip

Remember the key roles of the main plant hormones: - **Auxins:** Cell elongation, apical dominance, **rooting**. - **Gibberellins:** Stem elongation, seed germination. - **Cytokinins:** Cell division, shoot formation. - **Abscissic Acid (ABA):** Dormancy, stomatal closure (stress). - **Ethylene:** Fruit ripening, senescence.

91. Which plant hormone is known as the "stress hormone"?

- (A) Cytokinin
- (B) Gibberellin
- (C) Abscissic acid

(D) Ethylene

Correct Answer: (C) Absciscic acid

Solution:

Step 1: Understanding the Question:

The question asks to identify the plant hormone that is commonly referred to as the "stress hormone".

Step 2: Detailed Explanation:

Absciscic acid (ABA) is known as the plant stress hormone because its levels increase significantly in response to various environmental stresses, particularly drought (water stress).

ABA's primary functions in stress response include:

- **Stomatal Closure:** ABA signals the guard cells in the leaves to close the stomata (pores). This rapidly reduces water loss through transpiration, helping the plant conserve water during a drought.
- **Inducing Dormancy:** It promotes seed dormancy and bud dormancy, helping the plant survive unfavorable conditions like winter.

Because it plays a central role in mediating the plant's response to adverse environmental conditions, it has earned the nickname "stress hormone".

Step 3: Final Answer:

Absciscic acid (ABA) is known as the plant "stress hormone".

 Quick Tip

Associate **Absciscic Acid (ABA)** with "adverse" conditions. Its main job is to put the brakes on growth and conserve resources when the plant is under stress, especially water stress.

92. The structural and functional unit of life is:

- (A) Organelle
- (B) Nucleus
- (C) Tissue
- (D) Cell

Correct Answer: (D) Cell

Solution:

Step 1: Understanding the Question:

This is a fundamental definition question in biology, asking for the basic unit of life.

Step 2: Detailed Explanation:

The **Cell Theory**, a foundational principle of biology, states that all known living things are made up of one or more cells. The cell is the basic structural, functional, and biological unit of all organisms.

- It is the smallest unit of life that can replicate independently.
- All life processes, from metabolism to heredity, occur within cells.

Let's look at the other levels of organization:

- **Organelle (A):** A specialized subunit within a cell that has a specific function (e.g., nucleus, mitochondrion). It is a component of a cell, not the unit of life itself.
- **Nucleus (B):** An organelle that contains the cell's genetic material.
- **Tissue (C):** A group of similar cells that work together to perform a specific function. Tissues are made of cells.

Step 3: Final Answer:

The cell is the basic structural and functional unit of all known life.

💡 Quick Tip

Remember the biological levels of organization in increasing order of complexity: Organelles → Cells → Tissues → Organs → Organ Systems → Organism. The cell is the first level in this hierarchy that is considered "alive".

93. The number of chromosomes in human somatic cells is:

- (A) 46
- (B) 23
- (C) 22
- (D) 48

Correct Answer: (A) 46

Solution:

Step 1: Understanding the Question:

The question asks for the total number of chromosomes found in a normal human somatic (body) cell.

Step 2: Detailed Explanation:

Human cells can be divided into two types based on their chromosome number:

- **Somatic cells:** These are all the body cells except for the reproductive cells (gametes). They are diploid, meaning they have two sets of chromosomes. Humans have 23 pairs of chromosomes in their somatic cells, for a total of **46** chromosomes. This includes 22 pairs of autosomes and 1 pair of sex chromosomes (XX for females, XY for males).
- **Gametes (sperm and egg cells):** These are reproductive cells. They are haploid, meaning they have only one set of chromosomes. A human gamete contains a total of **23** chromosomes (22 autosomes and 1 sex chromosome).

The question specifically asks for the number in somatic cells, which is the diploid number.

Step 3: Final Answer:

The number of chromosomes in human somatic cells is 46.

💡 Quick Tip

Remember the distinction:

- **Somatic cells** = Body cells = Diploid ($2n$) = 46 chromosomes.
- **Gametes** = Sex cells = Haploid (n) = 23 chromosomes.

94. Which of the following statements about the solenoid model of chromatin organization is correct?

- (A) It suggests that DNA is coiled around RNA molecules.
- (B) It describes chromatin fibers coiling into a 30 nm helical structure.
- (C) It explains the direct attachment of DNA to nuclear membrane.
- (D) It only applies to prokaryotic DNA.

Correct Answer: (B) It describes chromatin fibers coiling into a 30 nm helical structure.

Solution:

Step 1: Understanding the Question:

The question asks for the correct description of the solenoid model of chromatin packing.

Step 2: Detailed Explanation:

Chromatin is the complex of DNA and proteins (mainly histones) found inside the nucleus of eukaryotic cells. To fit the long DNA molecule into the nucleus, it undergoes several levels of compaction.

1. **Nucleosomes ("Beads on a string"):** The basic unit is the nucleosome, where DNA is coiled around a core of eight histone proteins. This forms a fiber about 10-11 nm in diameter.
2. **The Solenoid Model:** This is the next level of packing. The solenoid model proposes that the 10 nm "beads on a string" fiber coils into a **helical structure** with about six nucleosomes per turn. This coil, or solenoid, forms a thicker fiber with a diameter of about **30 nm**. Histone

H1 is thought to be important for stabilizing this structure.

Let's analyze the options:

- (A) DNA is coiled around histone proteins, not RNA.
- (C) This model describes DNA compaction, not its attachment to the nuclear membrane.
- (D) This level of organization with histones is characteristic of eukaryotes, not prokaryotes (which have a simpler nucleoid).

Step 3: Final Answer:

The solenoid model correctly describes the coiling of the nucleosome fiber into a 30 nm helical chromatin fiber.

💡 Quick Tip

Remember the hierarchy of DNA packing in eukaryotes: DNA double helix → Nucleosomes (beads on a string, 10 nm fiber) → Solenoid (30 nm fiber) → Looped domains → Metaphase chromosome.

95. What is the primary difference between Euchromatin and heterochromatin?

- (A) Euchromatin is transcriptionally inactive, while heterochromatin is active.
- (B) Euchromatin is densely packed, while heterochromatin is loosely packed.
- (C) Euchromatin is genetically active, while heterochromatin is tightly packed and inactive.
- (D) Heterochromatin is found only in prokaryotic cells.

Correct Answer: (C) Euchromatin is genetically active, while heterochromatin is tightly packed and inactive.

Solution:

Step 1: Understanding the Question:

The question asks for the main distinction between the two types of chromatin, euchromatin and heterochromatin.

Step 2: Detailed Explanation:

Chromatin in the interphase nucleus exists in two main states:

- **Euchromatin:** This is a loosely packed, less condensed form of chromatin. Because it is less compact, the DNA is accessible to RNA polymerase and other transcription factors. Therefore, euchromatin is rich in genes and is **genetically active** or **transcriptionally active**. It appears as light-staining regions under a microscope.
- **Heterochromatin:** This is a highly condensed, **tightly packed** form of chromatin. This dense packing makes the DNA largely inaccessible to transcription machinery. Therefore, heterochromatin is **genetically inactive** or **transcriptionally inactive**. It appears as dark-

staining regions under a microscope.

Let's analyze the options based on this:

- (A) is the opposite of the truth.
- (B) is the opposite of the truth regarding packing.
- (C) correctly states that euchromatin is active, while heterochromatin is tightly packed and inactive.
- (D) is incorrect; these are forms of chromatin in eukaryotic cells. Prokaryotes do not have this type of chromatin structure.

Step 3: Final Answer:

The primary difference is that euchromatin is loosely packed and genetically active, whereas heterochromatin is tightly packed and genetically inactive.

💡 Quick Tip

Think of the prefixes: - **Eu-** (from Greek for 'good' or 'true'): Euchromatin is "true" chromatin, containing the active genes. It is "unfurled" and open for business (transcription). - **Hetero-** (from Greek for 'other' or 'different'): Heterochromatin is "different" chromatin that is closed for business, tightly packed away.

96. Which type of inheritance pattern is observed in *Mirabilis jalapa* for flower color?

- (A) Complete dominance
- (B) Incomplete dominance
- (C) Co-dominance
- (D) Polygenic inheritance

Correct Answer: (B) Incomplete dominance

Solution:

Step 1: Understanding the Question:

The question asks for the specific non-Mendelian inheritance pattern demonstrated by flower color in the four o'clock plant, *Mirabilis jalapa*.

Step 2: Detailed Explanation:

The flower color in *Mirabilis jalapa* is a classic textbook example of **incomplete dominance**.

- When a homozygous red-flowered plant (RR) is crossed with a homozygous white-flowered plant (rr), all the F1 generation offspring are heterozygous (Rr).
- In complete dominance, these F1 offspring would be red. However, in this case, the F1 offspring all have **pink** flowers.

- The pink color is an intermediate phenotype, a blend of the red and white parental traits. This blending indicates that the red allele is not completely dominant over the white allele.
- When the pink F1 plants are self-crossed, the F2 generation shows a phenotypic ratio of 1 Red (RR) : 2 Pink (Rr) : 1 White (rr).

This pattern, where the heterozygote shows a phenotype that is intermediate between the two homozygous phenotypes, is the definition of incomplete dominance.

- **Co-dominance** is when both alleles are expressed equally in the heterozygote (e.g., AB blood type).

Step 3: Final Answer:

Flower color in *Mirabilis jalapa* exhibits incomplete dominance.

💡 Quick Tip

Remember the key differences in dominance:

- **Complete Dominance:** Heterozygote looks like one of the parents (e.g., Mendel's peas).
- **Incomplete Dominance:** Heterozygote is an intermediate blend (e.g., *Mirabilis* pink flowers).
- **Co-dominance:** Heterozygote shows both traits distinctly (e.g., roan cattle, AB blood type).

97. Which of the following is NOT true about the Watson and Crick model of DNA?

- (A) DNA is a right-handed double helix.
- (B) The two strands are held together by hydrogen bonds
- (C) Base pairing follows Chargaff's rule.
- (D) The two strands run in a parallel orientation.

Correct Answer: (D) The two strands run in a parallel orientation.

Solution:

Step 1: Understanding the Question:

The question asks to identify the incorrect statement about the Watson and Crick model of the DNA double helix.

Step 2: Detailed Explanation:

The key features of the Watson and Crick model for the B-form of DNA are:

- (A) The structure is a **right-handed** double helix. This is a correct statement.
- (B) The two polynucleotide strands are held together by **hydrogen bonds** between the nitrogenous bases: two bonds between Adenine (A) and Thymine (T), and three bonds between

Guanine (G) and Cytosine (C). This is a correct statement.

- (C) The base pairing is specific (A with T, G with C). This results in the amount of A being equal to T, and the amount of G being equal to C, which is the observation known as **Chargaff's rule**. This is a correct statement.

- (D) The two strands have opposite polarity. One strand runs in the 5' to 3' direction, while the other runs in the 3' to 5' direction. This orientation is called **antiparallel**, not parallel. Therefore, the statement that the strands run in a parallel orientation is **NOT true**.

Step 3: Final Answer:

The incorrect statement is that the two strands run in a parallel orientation; they are, in fact, antiparallel.

💡 Quick Tip

One of the most fundamental features of the DNA double helix is its **antiparallel** nature. Think of it like a divided highway where traffic flows in opposite directions in the two lanes. This 5' to 3' and 3' to 5' polarity is crucial for DNA replication and transcription.

98. In the Lac Operon model, which molecule acts as an inducer for gene expression?

- (A) Lactose
- (B) Glucose
- (C) Galactose
- (D) ATP

Correct Answer: (A) Lactose

Solution:

Step 1: Understanding the Question:

The question asks to identify the inducer molecule in the *lac* operon system.

Step 2: Detailed Explanation:

The **lac operon** is an inducible operon in *E. coli* that contains genes for the metabolism of lactose.

- In the **absence** of lactose, a repressor protein binds to the operator region of the operon, physically blocking RNA polymerase from transcribing the genes. The operon is "off".

- In the **presence** of lactose, a metabolite of lactose called **allolactose** (which is formed from lactose) acts as the **inducer**.

- The inducer binds to the repressor protein, causing a conformational change that makes the repressor fall off the operator.

- With the operator now free, RNA polymerase can transcribe the genes needed to metabolize

lactose. The operon is "on".

While the true inducer is allolactose, for introductory purposes, **lactose** is considered the inducer because its presence is what triggers the process. **Glucose** has the opposite effect; its presence leads to catabolite repression, which keeps the lac operon turned off even if lactose is present.

Step 3: Final Answer:

Lactose (or more specifically, its isomer allolactose) acts as the inducer for the lac operon.

 Quick Tip

Think of the lac operon with this logic: The cell only wants to make lactose-digesting enzymes when lactose is available to be digested. Therefore, lactose itself (or a direct product of it) must be the signal (the inducer) that turns the system on.

99. What is the primary advantage of using RFLP markers in plant breeding?

- (A) They detect single nucleotide polymorphisms directly.
- (B) They allow analysis of DNA sequence variation in specific genes.
- (C) They are less labor-intensive than RAPD markers.
- (D) They are more cost-effective than molecular markers.

Correct Answer: (B) They allow analysis of DNA sequence variation in specific genes.

Solution:

Step 1: Understanding the Question:

The question asks for the main advantage of Restriction Fragment Length Polymorphism (RFLP) markers.

Step 2: Detailed Explanation:

RFLP (Restriction Fragment Length Polymorphism) is a molecular marker technique that exploits variations in homologous DNA sequences. It involves cutting DNA with restriction enzymes and analyzing the size of the resulting fragments.

- The primary advantage of RFLP is that it is a **co-dominant marker**. This means it can distinguish between homozygous and heterozygous individuals.
- It is highly locus-specific and reproducible. Because it uses specific restriction enzymes and probes for specific genes or DNA regions, it allows for a very targeted **analysis of DNA sequence variation in specific genes or loci**. This makes it powerful for mapping genes and tracking inheritance of specific traits (marker-assisted selection).

Let's look at the other options:

- (A) RFLP detects variations that change restriction sites, which can be but are not always

SNPs. Techniques like sequencing are used for direct SNP detection.

- (C) RFLP is actually much more labor-intensive and time-consuming than PCR-based markers like RAPD.
- (D) RFLP is generally more expensive and complex than many other molecular marker types.

Step 3: Final Answer:

The key advantage of RFLP is its high specificity and co-dominant nature, which allows for detailed and reliable analysis of DNA sequence variation at specific genetic loci.

💡 Quick Tip

Remember the trade-offs with molecular markers.

- **RFLP**: Old, labor-intensive, but highly reliable, specific, and co-dominant. Good for mapping.
- **RAPD**: Newer, PCR-based, quick, and easy, but dominant and has lower reproducibility. Good for quick screening.
- **SSR/Microsatellites**: PCR-based, co-dominant, highly polymorphic and reproducible. Often the marker of choice today.

100. The enzyme involved in unwinding DNA during replication is:

- (A) DNA polymerase
- (B) Ligase
- (C) Helicase
- (D) Topoisomerase

Correct Answer: (C) Helicase

Solution:

Step 1: Understanding the Question:

The question asks to identify the enzyme responsible for separating the two strands of the DNA double helix during replication.

Step 2: Detailed Explanation:

DNA replication requires the two strands of the parent DNA molecule to be separated to act as templates. This function is performed by a specific enzyme:

- **Helicase**: This enzyme moves along the DNA molecule, using the energy from ATP hydrolysis to break the hydrogen bonds between the base pairs and unwind the double helix. It creates the replication fork.

The other enzymes have different roles:

- **DNA polymerase (A)**: Synthesizes the new DNA strands by adding nucleotides to the template strands.

- **Ligase (B):** Joins DNA fragments together (e.g., Okazaki fragments on the lagging strand) by forming phosphodiester bonds.
- **Topoisomerase (D):** Relieves the torsional strain and supercoiling that builds up ahead of the replication fork as the DNA is unwound. It does this by cutting, swiveling, and rejoining the DNA strands.

Step 3: Final Answer:

The enzyme that unwinds the DNA double helix during replication is helicase.

💡 Quick Tip

Think of the enzymes in DNA replication as a construction crew:

- **Helicase:** The "zipper" that unwinds the DNA.
- **Topoisomerase:** The "swivel" that prevents tangles.
- **Primase:** The "primer" that lays down the starting point.
- **DNA Polymerase:** The "builder" that adds new bricks (nucleotides).
- **Ligase:** The "glue" that joins fragments.

101. Which of the following protozoan causes African sleeping sickness

- (A) *Plasmodium vivax*
- (B) *Entamoeba gingivalis*
- (C) *Trypanosoma lewsi*
- (D) *Trypanosoma gambiense*

Correct Answer: (D) *Trypanosoma gambiense*

Solution:

Step 1: Understanding the Question:

The question asks to identify the protozoan parasite that causes African sleeping sickness.

Step 2: Detailed Explanation:

- ***Trypanosoma gambiense*:** This is a species of parasitic protozoan that is one of the main causes of human African trypanosomiasis, also known as African sleeping sickness. It is transmitted by the tsetse fly. The disease affects the central nervous system, leading to the characteristic sleep cycle disturbances, confusion, and eventually death if untreated. Another subspecies, *Trypanosoma brucei rhodesiense*, causes a more acute form of the disease.
- ***Plasmodium vivax* (A):** This is a protozoan parasite that causes malaria.
- ***Entamoeba gingivalis* (B):** This is an amoeba found in the mouth, often associated with gum disease, but it is generally considered a commensal.
- ***Trypanosoma lewsi* (C):** This is a species that primarily infects rats and is transmitted by fleas. It does not cause disease in humans.

Step 3: Final Answer:

African sleeping sickness is caused by *Trypanosoma gambiense*.

💡 Quick Tip

Associate the major protozoan diseases with their causative agents and vectors: -

Malaria: *Plasmodium*, transmitted by Anopheles mosquitoes.

- **African Sleeping Sickness:** *Trypanosoma*, transmitted by tsetse flies.

- **Chagas Disease:** *Trypanosoma cruzi*, transmitted by kissing bugs.

- **Amoebic Dysentery:** *Entamoeba histolytica*.

102. Animals lacking excretory, respiratory and circulatory structures are

- (A) Sponges
- (B) Tapeworms
- (C) Liver fluke
- (D) Threadworms

Correct Answer: (A) Sponges

Solution:**Step 1: Understanding the Question:**

The question asks to identify the group of animals that does not have specialized organ systems for excretion, respiration, or circulation.

Step 2: Detailed Explanation:

- **Sponges (Phylum Porifera):** These are the simplest multicellular animals. They have a cellular level of organization and lack true tissues and organs. Their body is a system of pores and canals. Water flows continuously through this system. Gas exchange (respiration) and removal of waste products (excretion) occur by simple diffusion directly between the individual cells and the surrounding water. The water flow itself acts as a form of circulation, bringing in nutrients and oxygen and carrying away waste. They do not have distinct excretory, respiratory, or circulatory systems.

- **Tapeworms (Cestoda) and Liver flukes (Trematoda)** are flatworms (Phylum Platyhelminthes). They lack respiratory and circulatory systems (relying on diffusion due to their flat shape), but they do have a primitive excretory system consisting of flame cells and protonephridia.

- **Threadworms (Nematoda)** have a more advanced body plan. They possess an excretory system but lack distinct respiratory and circulatory systems.

Sponges are unique in lacking all three of these specialized structures.

Step 3: Final Answer:

Sponges are animals that lack specialized excretory, respiratory, and circulatory structures, relying on water flow and direct diffusion.

💡 Quick Tip

Remember the progression of organ systems in the animal kingdom. Phylum Porifera (sponges) is at the very base, characterized by a cellular level of organization and the absence of true tissues and organs, including these systems.

103. The inner lining of radial chambers in sponges is formed by

- (A) Pinaco Cytes
- (B) Choanocytes
- (C) Porocytes
- (D) Archaeocytes

Correct Answer: (B) Choanocytes

Solution:**Step 1: Understanding the Question:**

The question asks to identify the specialized cells that line the radial canals (or chambers) of sponges.

Step 2: Detailed Explanation:

Sponges have a unique body structure organized around a system of canals. The internal chambers of this canal system (such as the spongocoel in simple sponges and the radial canals in more complex ones) are lined with a special type of cell called a **choanocyte** or **collar cell**.

- **Choanocytes** are distinctive cells that have a flagellum surrounded by a collar of microvilli.
- The coordinated beating of the flagella of all the choanocytes creates the water current that flows through the sponge.
- The collar of microvilli acts as a filter to trap food particles (like bacteria and plankton) from the water, which are then ingested by the cell.

The other cell types have different functions:

- **Pinacocytes (A)** form the outer layer of the sponge (the pinacoderm), akin to an epidermis.
- **Porocytes (C)** are tube-like cells that form the pores (ostia) through which water enters the sponge.
- **Archaeocytes (D)** are amoeboid cells in the mesohyl that are totipotent and have various functions, including digestion and forming other cell types.

Step 3: Final Answer:

The inner lining of the radial chambers and spongocoel in sponges is formed by choanocytes

(collar cells).

💡 Quick Tip

The choanocyte is the most characteristic and important cell type in sponges. Remember its two key functions: creating the water current with its flagellum and capturing food with its collar.

104. This is the common factor between housefly, anopheles and cockroach

- (A) three pair of legs
- (B) two pair of wings
- (C) cuticle covering the body
- (D) presence of cephalothorax

Correct Answer: (A) three pair of legs

Solution:

Step 1: Understanding the Question:

The question asks for a common characteristic shared by the housefly, Anopheles mosquito, and cockroach.

Step 2: Detailed Explanation:

All three organisms—housefly, Anopheles (a mosquito), and cockroach—belong to the Class **Insecta** within the Phylum Arthropoda.

One of the defining characteristics of the Class Insecta is that adults have a body divided into three parts (head, thorax, abdomen) and possess **three pairs of jointed legs** attached to the thorax. This gives them a total of six legs.

Let's check the other options:

- (B) two pair of wings: Houseflies and mosquitoes (which are true flies, Order Diptera) have only **one pair** of functional wings (the hind wings are modified into halteres). Cockroaches typically have two pairs of wings. So this is not a common factor.
- (C) cuticle covering the body: A chitinous cuticle (exoskeleton) is a characteristic of the entire Phylum Arthropoda, not just these three. While true, "three pairs of legs" is a more specific and defining feature of their common class (Insecta).
- (D) presence of cephalothorax: A cephalothorax is a fused head and thorax, which is characteristic of other arthropod groups like Chelicerata (spiders, scorpions) and many Crustaceans. Insects have a distinct head and thorax.

Step 3: Final Answer:

The most specific and correct common factor among the given options is that they all, being

insects, have three pairs of legs.

💡 Quick Tip

Remember the key distinguishing features of the Class Insecta:

1. Body divided into Head, Thorax, and Abdomen.
2. Three pairs of legs.
3. One pair of antennae.

These features separate them from other arthropods like arachnids (spiders) and crustaceans (crabs).

105. Which of the following statements is true about *Mytilus*?

- (A) *Mytilus* belongs to class Arthropoda of phylum Mollusca
- (B) *Mytilus* belongs to class Amphineura of phylum Mollusca
- (C) *Mytilus* belongs to class Pelecypoda of phylum Mollusca
- (D) *Mytilus* belongs to class Echinodermata of phylum Mollusca

Correct Answer: (C) *Mytilus* belongs to class Pelecypoda of phylum Mollusca

Solution:

Step 1: Understanding the Question:

The question asks for the correct taxonomic classification of *Mytilus* (the sea mussel).

Step 2: Detailed Explanation:

Mytilus is a genus of bivalve molluscs, commonly known as sea mussels. Let's trace its classification:

- Phylum: **Mollusca**
- Class: **Bivalvia**. Bivalves are characterized by having a shell composed of two hinged halves (valves) and a laterally compressed body.

Now let's look at the options and older classification terms:

- The class Bivalvia is also known by the older name **Pelecypoda** (meaning "hatchet-foot") or Lamellibranchiata.
- Therefore, the statement "*Mytilus* belongs to class **Pelecypoda** of phylum Mollusca" is correct.

The other options are incorrect for several reasons:

- (A) Arthropoda is a completely different phylum.
- (B) Class Amphineura is an older term for a group that included chitons (now Class Polyplacophora).
- (D) Echinodermata is a completely different phylum (starfish, sea urchins).

Step 3: Final Answer:

Mytilus belongs to the class Pelecypoda (also known as Bivalvia) within the phylum Mollusca.

💡 Quick Tip

Associate common names with their taxonomic class within Mollusca: - Snails and slugs → Gastropoda
- Mussels, clams, oysters → Bivalvia (or Pelecypoda)
- Squids, octopuses, cuttlefish → Cephalopoda

106. Which of the following statements is true about *Unio*?

- (A) *Unio* has a one chambered heart
- (B) *Unio* has a two-chambered heart
- (C) *Unio* has a three-chambered heart
- (D) *Unio* has a four-chambered heart

Correct Answer: (C) *Unio* has a three-chambered heart

Solution:

Step 1: Understanding the Question:

The question asks for the correct description of the heart of *Unio*, a freshwater mussel.

Step 2: Detailed Explanation:

Unio is a bivalve mollusc, belonging to the same class as *Mytilus*. The circulatory system in bivalves is open, meaning the blood (hemolymph) is not always contained within vessels.

The heart in *Unio* is a characteristic feature. It consists of **three chambers**:

- **Two auricles** (one on each side) that receive oxygenated hemolymph from the gills.
- **One ventricle** that pumps the hemolymph out to the body sinuses.

A unique feature of the bivalve heart is that the ventricle often surrounds the intestine, meaning the intestine passes directly through the heart.

Therefore, the statement that *Unio* has a three-chambered heart is correct.

Step 3: Final Answer:

Unio has a three-chambered heart, consisting of two auricles and one ventricle.

💡 Quick Tip

Remember the heart structures in different animal groups: - Fish: 2 chambers (1 auricle, 1 ventricle) - Amphibians/Reptiles (most): 3 chambers (2 auricles, 1 ventricle) - Bivalve Molluscs (like *Unio*): 3 chambers (2 auricles, 1 ventricle) - Birds/Mammals: 4 chambers (2 auricles, 2 ventricles)

107. Which is not true about the *Balanoglossus*?

- (A) It is found in shallow waters between tide marks along the coast of warm and temperate oceans.
- (B) *Balanoglossus* is not world-wide in distribution.
- (C) *Balanoglossus* is tubicolous living in U-shaped burrows excavated in the sandy bottom.
- (D) The walls of the tube are lined with mucus secreted by the mucous gland of the animal.

Correct Answer: (B) *Balanoglossus* is not world-wide in distribution.

Solution:

Step 1: Understanding the Question:

The question asks to identify the incorrect statement about *Balanoglossus* (the acorn worm).

Step 2: Detailed Explanation:

Balanoglossus is a genus of acorn worm belonging to the Phylum Hemichordata. It is an important animal from an evolutionary perspective as it shares characteristics with both echinoderms and chordates.

Let's analyze the statements:

- (A) **Habitat:** *Balanoglossus* is a marine, burrowing animal. It is typically found in U-shaped burrows in sandy or muddy substrates in shallow intertidal waters of warm and temperate seas. This statement is **true**.
- (C) **Lifestyle:** "Tubicolous" means living in a tube. *Balanoglossus* lives in a U-shaped burrow, which it excavates and lines with mucus. This statement is **true**.
- (D) **Burrow Lining:** The animal secretes mucus from glands in its proboscis to line the burrow walls, which helps to stabilize the sandy burrow. This statement is **true**.
- (B) **Distribution:** Species of *Balanoglossus* and other acorn worms are found in oceans all over the world, from the tropics to temperate regions. Therefore, the genus is considered to have a **world-wide (cosmopolitan) distribution** in suitable habitats. The statement that it is *not* world-wide in distribution is **not true**.

Step 3: Final Answer:

The statement that *Balanoglossus* is not world-wide in distribution is incorrect; it is a cosmopolitan genus.

💡 Quick Tip

Remember that *Balanoglossus* (acorn worm) is a hemichordate, often called a "connecting link" animal. They are marine, burrowing creatures found globally in shallow coastal waters.

108. The larvae of Echinodermates are -----

- (A) Trochophore and Auricularia
- (B) Bipinnaria and Brachiolaria
- (C) Redia and Carcaria
- (D) Miracidium and Cysticerci.

Correct Answer: (B) Bipinnaria and Brachiolaria

Solution:

Step 1: Understanding the Question:

The question asks to identify larval forms that are characteristic of the Phylum Echinodermata (e.g., starfish, sea urchins).

Step 2: Detailed Explanation:

Different classes within Echinodermata have different larval forms, all of which are bilaterally symmetrical.

- **Bipinnaria** and **Brachiolaria** are the successive larval stages of starfish (Class Asteroidea). The Bipinnaria develops first, and in many species, it transforms into a more complex Brachiolaria larva before metamorphosing into the adult. Both are characteristic echinoderm larvae.

Let's look at the other options:

- (A) **Trochophore** is a larval form found in molluscs and annelids. **Auricularia** is an echinoderm larva (of sea cucumbers), but the pair is incorrect as Trochophore is not.
- (C) **Redia** and **Cercaria** (note spelling) are larval stages of flukes (Phylum Platyhelminthes, Class Trematoda), such as *Fasciola hepatica*.
- (D) **Miracidium** and **Cysticercus** (note spelling) are larval stages. Miracidium is a larva of flukes, and Cysticercus (bladder worm) is the larval stage of tapeworms (Class Cestoda).

Step 3: Final Answer:

Bipinnaria and Brachiolaria are characteristic larval forms of echinoderms (specifically, starfish).

💡 Quick Tip

It's useful to associate major larval forms with their phyla:

- **Annelida/Mollusca:** Trochophore
- **Echinodermata:** Bipinnaria, Brachiolaria, Ophiopluteus, Echinopluteus, Auricularia
- **Platyhelminthes (Flukes):** Miracidium, Sporocyst, Redia, Cercaria
- **Crustacea:** Nauplius

109. Of how many segments *Hirudinaria granulosa* is made of?

- (A) 13
- (B) 33
- (C) 43
- (D) 53

Correct Answer: (B) 33

Solution:

Step 1: Understanding the Question:

The question asks for the total number of segments in the body of *Hirudinaria granulosa*, the common Indian cattle leech.

Step 2: Detailed Explanation:

Leeches belong to the Phylum Annelida, Class Hirudinea. A defining characteristic of this class is that they have a fixed number of body segments.

The body of a leech, including *Hirudinaria granulosa*, is composed of a constant number of **33 segments**, or somites.

Externally, these segments are further subdivided into rings or annuli, which can make it seem like there are more segments than there actually are. However, the internal organization (nervous system ganglia, nephridia) reveals the true fixed number of 33 segments.

Step 3: Final Answer:

The body of *Hirudinaria granulosa* is made of 33 segments.

💡 Quick Tip

Remember that a fixed number of segments (33) is a key characteristic of the Class Hirudinea (leeches), which distinguishes them from other annelids like earthworms (Oligochaeta) that do not have a fixed number of segments.

110. Hormone helping Insect Metamorphosis is

- (A) Thyroxine
- (B) Ecdysone
- (C) Pheromone
- (D) Thymosin

Correct Answer: (B) Ecdysone

Solution:

Step 1: Understanding the Question:

The question asks to identify the primary hormone that controls metamorphosis in insects.

Step 2: Detailed Explanation:

Insect metamorphosis (the transformation from a larval stage to an adult) and molting (ecdysis) are controlled by two main hormones:

1. **Ecdysone (or molting hormone):** This is a steroid hormone that is released from the prothoracic gland. Its primary function is to trigger molting. The presence of ecdysone initiates the process of shedding the old exoskeleton and growing a new one. It is essential for the progression through larval stages and the final transformation to the adult form.
2. **Juvenile Hormone (JH):** This hormone determines the *outcome* of the molt. If JH levels are high, the molt results in another larval stage. If JH levels are low or absent, the ecdysone-induced molt results in metamorphosis into a pupa or adult.

Of the given options, **Ecdysone** is the direct trigger for the molting and metamorphic processes.

- Thyroxine (A) is a vertebrate thyroid hormone.
- Pheromone (C) is a chemical used for communication between individuals.
- Thymosin (D) is a hormone of the thymus gland in vertebrates, involved in the immune system.

Step 3: Final Answer:

The primary hormone that initiates molting and helps in insect metamorphosis is ecdysone.

💡 Quick Tip

Think of the insect hormones like this:

- **Ecdysone:** "It's time to molt!" (The "Go" signal).
- **Juvenile Hormone (JH):** "Stay a larva!" (The "Don't change" signal).

Metamorphosis to the adult form happens when the "Go" signal (Ecdysone) is present, but the "Don't change" signal (JH) is absent.

111. Which among the following is incorrect about Agnatha?

- (A) These are also called as jawless fishes
- (B) Scales and fins are present
- (C) They adopt parasitic mode of nutrition
- (D) They have a circular mouth that acts as sucker

Correct Answer: (B) Scales and fins are present

Solution:

Step 1: Understanding the Question:

The question asks to identify the incorrect statement about the superclass Agnatha (jawless vertebrates).

Step 2: Detailed Explanation:

Agnatha is a group of jawless fish-like vertebrates. The living members belong to the class Cyclostomata (lampreys and hagfish). Let's analyze their characteristics:

- (A) The name **Agnatha** literally means "no jaws" (a- = no, gnathos = jaw). So, they are called jawless fishes. This statement is **correct**.
- (D) They possess a circular, suctorial mouth without jaws, which is often used for feeding. This statement is **correct**.
- (C) Many agnathans, particularly lampreys, are parasitic. They attach to other fish with their sucker-like mouth and feed on their blood and body fluids. This statement is **correct**.
- (B) A key characteristic of agnathans is that their body is eel-like and lacks scales. They also lack paired fins (pectoral and pelvic fins) that are characteristic of jawed fishes. They may have a median fin, but the presence of "fins" in the plural, implying paired fins, is generally incorrect, and the absence of scales is a defining feature. Therefore, the statement "Scales and fins are present" is **incorrect**.

Step 3: Final Answer:

The incorrect statement about Agnatha is that scales and fins are present. They are characterized by the absence of jaws, scales, and paired fins.

 Quick Tip

Remember the key features of Agnatha (like lampreys): No jaws, No scales, No paired fins. Their body is smooth and eel-like, and their mouth is a round sucker.

112. Which among the following is incorrect about Cyclostomata?

- (A) Their vertebral column is made of cartilage
- (B) Lamprey and hagfish are examples of this class
- (C) Their digestive system is complete with stomach, food pipe and intestines
- (D) Their circulatory system is closed with 2 chambered heart

Correct Answer: (C) Their digestive system is complete with stomach, food pipe and intestines

Solution:

Step 1: Understanding the Question:

The question asks to identify the incorrect statement about the Class Cyclostomata (lampreys and hagfish).

Step 2: Detailed Explanation:

Cyclostomata are the only living class of the superclass Agnatha. Let's examine the statements:

- (A) They are primitive vertebrates with an endoskeleton made entirely of **cartilage**. Their vertebral column is rudimentary, consisting of small cartilaginous elements (arcualia) resting on the notochord. This statement is **correct**.
- (B) The class includes two main groups: **lampreys** and **hagfish**. This is **correct**.
- (D) They have a **closed circulatory system** with a two-chambered heart (one auricle and one ventricle), similar to other fishes. This is **correct**.
- (C) Their digestive system is primitive. They lack a distinct **stomach**. The digestive tract is a relatively simple, straight tube consisting of the esophagus and intestine. The statement that their digestive system is complete *with a stomach* is **incorrect**.

Step 3: Final Answer:

The incorrect statement is that their digestive system is complete with a stomach. Cyclostomes lack a true stomach.

 Quick Tip

Cyclostomes are primitive vertebrates, and this is reflected in their anatomy. Key primitive features include a cartilaginous skeleton, a persistent notochord, and the absence of a stomach.

113. The endoskeleton of Scoliodon is made up of

- (A) Cartilage
- (B) Bones
- (C) Scales
- (D) Plates

Correct Answer: (A) Cartilage

Solution:

Step 1: Understanding the Question:

The question asks for the material that constitutes the endoskeleton of *Scoliodon* (the dogfish)

or shark).

Step 2: Detailed Explanation:

Scoliodon is a genus of shark. Sharks belong to the class **Chondrichthyes**.

The name Chondrichthyes comes from Greek: *chondros* meaning 'cartilage' and *ichthys* meaning 'fish'.

A defining characteristic of this class is that their entire endoskeleton is made of **cartilage**, not bone. This cartilaginous skeleton persists throughout their life and is never replaced by bone, unlike in the bony fishes (Osteichthyes).

Scales (placoid scales) form the exoskeleton, not the endoskeleton.

Step 3: Final Answer:

The endoskeleton of *Scoliodon* is made up of cartilage.

💡 Quick Tip

Remember the two major classes of living fishes:

- **Chondrichthyes** (Sharks, Rays): Skeleton made of **Cartilage**.
- **Osteichthyes** (Tuna, Carp, etc.): Skeleton made of **Bone**.

114. Salivary glands are absent in

- (A) *Musca domestica*
- (B) *Blatta orientalis*
- (C) *Anopheles maculipennis*
- (D) *Rana hexadactyla*

Correct Answer: (D) *Rana hexadactyla*

Solution:

Step 1: Understanding the Question:

The question asks to identify which of the given animals lacks salivary glands.

Step 2: Detailed Explanation:

- *Musca domestica* (housefly), *Blatta orientalis* (cockroach), and *Anopheles maculipennis* (mosquito) are all **insects**. Insects have well-developed salivary glands that secrete saliva into the preoral cavity. The saliva serves various functions, such as lubricating food, containing digestive enzymes (like amylase), and in the case of mosquitoes, containing anticoagulants.

- *Rana hexadactyla* is a species of **frog** (Class Amphibia). Frogs are aquatic or semi-aquatic and typically swallow their prey whole and alive. Their tongue is primarily used for capturing prey, not for mastication. Digestion begins in the stomach. Consequently, frogs **lack true salivary glands**. They have mucous glands in their mouth that produce mucus to lubricate

the food for swallowing, but these are not homologous to the digestive salivary glands found in other vertebrates and insects.

Step 3: Final Answer:

Salivary glands are absent in *Rana hexadactyla* (frog).

💡 Quick Tip

The absence of salivary glands is a characteristic feature of amphibians like frogs. Their diet and feeding mechanism (swallowing prey whole) do not require the predigestion of food in the mouth.

115. The common name of *Calotes versicolor* is

- (A) Garden Lizard
- (B) Tree Lizard
- (C) Wall Lizard
- (D) Monitor Lizard

Correct Answer: (A) Garden Lizard

Solution:

Step 1: Understanding the Question:

The question asks for the common name of the reptile species *Calotes versicolor*.

Step 2: Detailed Explanation:

Calotes versicolor is a widespread species of agamid lizard found throughout Asia. It is commonly known as the Oriental **Garden Lizard**, Eastern Garden Lizard, or Changeable Lizard. It is frequently seen in gardens, open lands, and scrub forests, often basking in the sun. The name "Changeable Lizard" comes from the male's ability to develop a bright red throat during the breeding season.

- The common **Wall Lizard** is typically a gecko (e.g., *Hemidactylus*).
- A **Monitor Lizard** belongs to the genus *Varanus*.

Step 3: Final Answer:

The common name of *Calotes versicolor* is the Garden Lizard.

💡 Quick Tip

It is helpful to learn the scientific names of a few common animals from your local environment. *Calotes versicolor* (Garden Lizard), *Hemidactylus frenatus* (Wall Lizard), and *Varanus* (Monitor Lizard) are common examples from the Indian subcontinent.

116. The body part, which is absent in birds

- (A) Forelimb
- (B) Hindlimb
- (C) Pectoral girdle
- (D) Pelvic girdle

Correct Answer: [There seems to be an error in the question or options. No option is correct.]

Solution:

Step 1: Understanding the Question:

The question asks to identify a body part from the list that is absent in birds.

Step 2: Detailed Explanation:

Let's analyze the presence of these structures in birds:

- **Forelimb (A):** Birds possess forelimbs, but they are highly modified to form **wings**. So, forelimbs are present.
- **Hindlimb (B):** Birds possess hindlimbs, which are used for walking, perching, or swimming. They are present.
- **Pectoral girdle (C):** This is the set of bones that connects the forelimbs (wings) to the axial skeleton. It is well-developed in birds to support flight and includes the scapula, coracoid, and clavicle (which fuse to form the furcula or wishbone). It is present.
- **Pelvic girdle (D):** This is the set of bones that connects the hindlimbs to the axial skeleton. It is also present and is fused with the synsacrum to provide a rigid structure for bipedal locomotion. It is present.

All the listed body parts are present in birds, although the forelimb is modified into a wing. It's possible the question intends to trick the test-taker by using "Forelimb" instead of "Wing", but a wing is a modified forelimb. If forced to choose the "most absent" in its typical form, one might argue for the forelimb, but this is poor question design. No option is strictly correct as all structures are present in some form. Assuming the provided checkmark on 'Forelimb' in the image is correct, the logic would be that the typical 'limb' structure is absent and replaced by a 'wing'.

Step 3: Final Answer:

Based on a strict anatomical assessment, all listed structures are present in birds (with the forelimb being modified into a wing). The question is likely flawed. However, if interpreted as "which part is absent in its typical vertebrate form," the forelimb is the most plausible intended

answer.

💡 Quick Tip

Be aware of questions that test your knowledge of homology. The wing of a bird is homologous to the forelimb of a mammal or reptile. It's the same structure modified for a different function.

117. Which is not a living fossil?

- (A) Sphenodon
- (B) Peripatus
- (C) Archaeopteryx
- (D) King crab

Correct Answer: (C) Archaeopteryx

Solution:

Step 1: Understanding the Question:

The question asks to identify which of the given organisms is NOT a "living fossil".

Step 2: Detailed Explanation:

A **living fossil** is an existing species (or group of species) that has remained essentially unchanged in form over a very long period of geological time and whose close relatives are mostly extinct.

- **Sphenodon (A):** Also known as the tuatara, it is the only surviving member of the reptilian order Rhynchocephalia, which flourished during the age of dinosaurs. It is a classic example of a living fossil.

- **Peripatus (B):** A genus of velvet worms (Phylum Onychophora), which are considered a connecting link between annelids and arthropods. They have changed very little for hundreds of millions of years. It is a living fossil.

- **King crab (D):** This often refers to the Horseshoe crab (*Limulus*), which belongs to a group that has existed for over 450 million years. It is a very famous living fossil.

- **Archaeopteryx (C):** This is a genus of bird-like dinosaurs that lived during the Late Jurassic period, around 150 million years ago. It is known only from fossils and is completely **extinct**. It is a transitional fossil between non-avian dinosaurs and modern birds, but it is not a *living* fossil.

Step 3: Final Answer:

Archaeopteryx is an extinct fossil, not a living fossil.

 Quick Tip

The key to this question is the word "living". A living fossil must be a species that is alive today. *Archaeopteryx* is famous specifically because it is an extinct fossil that provides evidence for evolution.

118. Which of the following animals are uricotelic?

- (A) Land reptiles, birds and insects
- (B) Fish and protozoans
- (C) Frogs and toads
- (D) Birds and mammals

Correct Answer: (A) Land reptiles, birds and insects

Solution:

Step 1: Understanding the Question:

The question asks to identify the group of animals that are uricotelic, meaning they excrete nitrogenous waste primarily as uric acid.

Step 2: Detailed Explanation:

Animals have different strategies for excreting nitrogenous waste, based on their habitat and water availability:

- **Ammonotelic:** Excrete highly toxic but water-soluble ammonia directly. This requires a large amount of water for dilution and is common in most aquatic animals, like bony **fish**.
- **Ureotelic:** Excrete urea, which is less toxic than ammonia and requires less water. This is common in **mammals** and adult amphibians (**frogs and toads**).
- **Uricotelic:** Excrete uric acid, which is the least toxic and requires very little water for excretion. It is excreted as a paste or solid. This is a key adaptation for water conservation in terrestrial animals. This mode of excretion is characteristic of **insects, land reptiles** (lizards, snakes, tortoises), and **birds**.

Let's check the options:

- (A) Land reptiles, birds and insects: All are primarily uricotelic. This is the correct group.
- (B) Fish are ammonotelic.
- (C) Frogs and toads are ureotelic as adults.
- (D) Mammals are ureotelic.

Step 3: Final Answer:

Land reptiles, birds, and insects are uricotelic animals.

💡 Quick Tip

Associate the type of nitrogenous waste with the environment:

- **Ammonia:** Needs lots of water → Aquatic animals (fish).
- **Urea:** Needs moderate water → Terrestrial animals that can access water (mammals, amphibians).
- **Uric Acid:** Needs very little water → Terrestrial animals with a strong need to conserve water (birds, reptiles, insects).

119. Which of the following bones form the wishbone of birds?

- (A) Hindlimbs
- (B) Clavicles
- (C) Skull
- (D) Pelvic girdle

Correct Answer: (B) Clavicles

Solution:

Step 1: Understanding the Question:

The question asks which bones fuse to form the 'wishbone' in birds.

Step 2: Detailed Explanation:

The wishbone, technically known as the **furcula**, is a forked bone found in birds and some other dinosaurs. It is a key part of the avian skeleton that strengthens the thoracic cage to withstand the rigors of flight.

The furcula is formed by the fusion of the two **clavicles** (collarbones) at their base. It sits at the front of the pectoral girdle and acts like a spring or strut, bracing the wings during the flight stroke.

Step 3: Final Answer:

The wishbone (furcula) of birds is formed by the fusion of the two clavicles.

💡 Quick Tip

Remember the key skeletal adaptations for flight in birds: - Pneumatic (hollow) bones for lightness. - Keel (a large sternum) for flight muscle attachment. - Furcula (fused clavicles or "wishbone") for bracing the shoulders. - Synsacrum (fused pelvic and vertebral bones) for a rigid frame.

120. The soundbox of birds is also known as

- (A) Synsacrum
- (B) Pygostyle
- (C) Syrinx
- (D) Larynx

Correct Answer: (C) Syrinx

Solution:

Step 1: Understanding the Question:

The question asks for the specific name of the vocal organ or 'soundbox' in birds.

Step 2: Detailed Explanation:

- The vocal organ in birds is called the **syrinx**. It is located at the base of the trachea (wind-pipe), where it bifurcates into the bronchi. Its complex structure, with internal membranes and specialized muscles, allows birds to produce a wide variety of complex sounds and songs.
- The **larynx** (D) is the vocal organ in mammals, located at the top of the trachea. Birds have a larynx, but it is not used for sound production.
- The **synsacrum** (A) is a fused skeletal structure in the pelvic region of birds.
- The **pygostyle** (B) is the fused terminal vertebrae of the tail, which supports the tail feathers.

Step 3: Final Answer:

The soundbox of birds is known as the syrinx.

 Quick Tip

Don't confuse the bird's vocal organ with the mammal's.

- Birds → **Syrinx** (at the bottom of the trachea).
- Mammals → **Larynx** (at the top of the trachea).

This difference allows many birds to produce two different sounds simultaneously.

121. Notochord is formed by

- (A) Mesodermal cells
- (B) Ectodermal cells
- (C) Epidermal cells
- (D) Endodermal cells

Correct Answer: (A) Mesodermal cells

Solution:

Step 1: Understanding the Question:

The question asks about the embryonic origin of the notochord.

Step 2: Detailed Explanation:

During embryonic development in animals, three primary germ layers are formed: the ectoderm (outer layer), mesoderm (middle layer), and endoderm (inner layer). These layers give rise to all the tissues and organs of the body.

The **notochord** is a flexible, rod-like structure that is the defining characteristic of the phylum Chordata. It forms the primary axial support of the embryo.

The notochord develops from a specific part of the middle germ layer, the **mesoderm**. More specifically, it arises from the axial mesoderm or chordamesoderm, which is located along the dorsal midline of the embryo, beneath the neural tube.

- **Ectoderm** gives rise to the skin (epidermis) and the nervous system.
- **Endoderm** gives rise to the lining of the digestive and respiratory tracts.
- **Mesoderm** gives rise to muscle, bone, cartilage, the circulatory system, and the notochord.

Step 3: Final Answer:

The notochord is formed by mesodermal cells.

💡 Quick Tip

Remember the primary derivatives of the three germ layers:

- **Ectoderm** (outer): Skin, Nerves
- **Mesoderm** (middle): Muscle, Bone, Blood, Notochord
- **Endoderm** (inner): Gut, Lungs

122. Which among the following is incorrect about acoelomates?

- (A) Body cavity is absent in these type of organisms
- (B) Tape worms are the best examples for acoelomates
- (C) Mesoderm holds the internal organs in its own place
- (D) Nematodes also belong to acoelomates

Correct Answer: (D) Nematodes also belong to acoelomates

Solution:**Step 1: Understanding the Question:**

The question asks to identify the incorrect statement about acoelomate animals.

Step 2: Detailed Explanation:

Animals are classified based on the presence and type of body cavity (coelom).

- **Acoelomates:** (a- = no, coelom = cavity) These animals lack a true body cavity. The space

between the body wall (ectoderm) and the digestive tract (endoderm) is completely filled with mesodermal tissue (parenchyma).

Let's analyze the statements:

- (A) By definition, a body cavity is absent in acoelomates. This is **true**.
- (B) Tapeworms belong to the Phylum Platyhelminthes (flatworms), which are the classic example of acoelomate animals. This is **true**.
- (C) In acoelomates, the solid mesodermal tissue does indeed hold the internal organs in place. This is **true**.
- (D) **Nematodes** (roundworms) belong to the Phylum Aschelminthes (or Nematoda). They are **pseudocoelomates**, not acoelomates. They have a body cavity (the pseudocoelom) which is not completely lined by mesoderm. Therefore, the statement that nematodes belong to acoelomates is **incorrect**.

Step 3: Final Answer:

The incorrect statement is that Nematodes also belong to acoelomates; they are pseudocoelomates.

💡 Quick Tip

Remember the classification based on the coelom:

- **Acoelomate** (No coelom): Platyhelminthes (flatworms)
- **Pseudocoelomate** (False coelom): Aschelminthes (roundworms/nematodes)
- **Eucoelomate** (True coelom): Annelida to Chordata

123. Which among the following is coelomate, bilateral and has organ system level of organization?

- (A) Hemichordates
- (B) Aschelminthes
- (C) Coelenterata
- (D) Platyhelminthes

Correct Answer: (A) Hemichordates

Solution:

Step 1: Understanding the Question:

The question asks to identify a phylum that exhibits all three characteristics: being a true coelomate, having bilateral symmetry, and having an organ system level of organization.

Step 2: Detailed Explanation:

Let's analyze the characteristics of each phylum listed:

- **Hemichordates:** These are marine deuterostome animals. They possess a true coelom (enterocoelous), exhibit bilateral symmetry, and have a well-developed organ system level of organization. This matches all the requirements.
- **Aschelminthes (Nematodes):** They have bilateral symmetry and an organ system level of organization, but they are pseudocoelomates, not true coelomates.
- **Coelenterata (Cnidaria):** These animals (like jellyfish and corals) have radial symmetry and a tissue level of organization. They are acoelomate.
- **Platyhelminthes (Flatworms):** They have bilateral symmetry and an organ level of organization, but they are acoelomates.

Only Hemichordates fit all three criteria given in the question.

Step 3: Final Answer:

Hemichordates are coelomate, bilaterally symmetrical, and have an organ system level of organization.

💡 Quick Tip

Work through the characteristics systematically to eliminate options.

1. **Level of organization:** Coelenterata is only at the tissue level, so it's out.
2. **Coelom type:** Platyhelminthes is acoelomate, and Aschelminthes is pseudocoelomate. This leaves Hemichordates as the only true coelomate.

124. Which class has the largest number of animals?

- (A) Fishes
- (B) Reptiles
- (C) Insects
- (D) Mammals

Correct Answer: (C) Insects

Solution:

Step 1: Understanding the Question:

The question asks which class of animals is the most numerous in terms of the number of described species.

Step 2: Detailed Explanation:

- The Phylum Arthropoda is by far the largest phylum in the animal kingdom, containing over 80% of all known animal species.
- Within the Phylum Arthropoda, the class **Insecta** is the largest group. There are over a million described species of insects, and estimates of the total number range up to 10 million.
- Insects alone represent the vast majority of all known animal life on Earth.

- The other classes listed—Fishes (several classes combined), Reptilia, and Mammalia—are all much smaller in terms of species number. For example, there are about 6,000 species of mammals, while there are over a million species of insects.

Step 3: Final Answer:

The class Insecta has the largest number of animal species.

 Quick Tip

When thinking about biodiversity and number of species, Arthropods, and specifically Insects, are overwhelmingly dominant. For every one species of mammal, there are hundreds of species of insects.

125. Which one of the following is a metatherian mammal?

- (A) Echidna
- (B) Kangaroo
- (C) Shrew
- (D) Pangolin

Correct Answer: (B) Kangaroo

Solution:

Step 1: Understanding the Question:

The question asks to identify a metatherian mammal from the given options.

Step 2: Detailed Explanation:

Living mammals are divided into three main infraclasses based on their reproductive methods:

1. **Prototheria (Monotremes):** These are egg-laying mammals. The only living examples are the platypus and the **Echidna (A)**.
2. **Metatheria (Marsupials):** These are pouched mammals. They give birth to very under-developed young, which then complete their development inside a pouch (marsupium). The **Kangaroo (B)** is a classic example. Other examples include koalas, opossums, and wallabies.
3. **Eutheria (Placental Mammals):** These mammals have a placenta that nourishes the fetus for a long gestation period, leading to the birth of a relatively developed baby. Most mammals, including humans, shrews, and pangolins, are eutherians. The **Shrew (C)** and **Pangolin (D)** are placental mammals.

Step 3: Final Answer:

The kangaroo is a metatherian (marsupial) mammal.

💡 Quick Tip

Remember the three main groups of living mammals:

- **Prototheria** = Egg-laying (Platypus, Echidna)
- **Metatheria** = Pouched (Kangaroo, Koala)
- **Eutheria** = Placental (Almost everything else)

126. Which of the following is a functional unit of a body?

- (A) Mitochondria
- (B) Cytoplasm
- (C) Spleen
- (D) Cell

Correct Answer: (D) Cell

Solution:

Step 1: Understanding the Question:

The question asks to identify the fundamental functional unit of a living body.

Step 2: Detailed Explanation:

This question is a rephrasing of the basic principle of Cell Theory.

- The **Cell** is universally recognized as the basic structural, functional, and biological unit of all known organisms. It is the smallest unit of life capable of carrying out all the processes of life. The entire body is built from cells and functions because of the coordinated activities of these cells.

- **Mitochondria (A)** and **Cytoplasm (B)** are components of a cell. A mitochondrion is an organelle, the "powerhouse" of the cell. Cytoplasm is the substance filling the cell. They are parts of the functional unit, not the unit itself.

- The **Spleen (C)** is an organ, which is a collection of different tissues working together. It is a much higher level of organization than the basic functional unit.

Step 3: Final Answer:

The cell is the basic functional unit of a body.

💡 Quick Tip

Remember the biological levels of organization in increasing order of complexity: Organelles → Cells → Tissues → Organs → Organ Systems → Organism. The cell is the first level in this hierarchy that is considered "alive".

127. In which of the following type of cells the cell junction is abundant?

- (A) Cardiac cells
- (B) Prokaryotic cells
- (C) Hepatic cells
- (D) Epithelial cells

Correct Answer: (D) Epithelial cells

Solution:

Step 1: Understanding the Question:

The question asks in which type of cells cell junctions are most numerous or prominent.

Step 2: Detailed Explanation:

Cell junctions are structures that connect cells to each other or to the extracellular matrix. They are crucial for maintaining tissue integrity, communication, and controlling the passage of substances.

- **Epithelial cells (D):** These cells form sheets or layers that cover body surfaces and line cavities (e.g., skin, lining of the intestine). A primary function of epithelia is to form a barrier. To do this effectively, the cells must be very tightly connected to each other. Therefore, epithelial tissues are characterized by having an abundance of various types of cell junctions, including tight junctions (to seal the gap), adherens junctions and desmosomes (for strong adhesion), and gap junctions (for communication).

- **Cardiac cells (A):** Heart muscle cells are also tightly connected by specialized junctions called intercalated discs, which contain desmosomes and a large number of gap junctions to allow for rapid electrical coupling. They have abundant junctions, but epithelial tissues are the most classic example.

- **Hepatic cells (C):** Liver cells also have junctions, but they are not as defining a feature as in epithelia.

- **Prokaryotic cells (B):** These are single-celled organisms and do not form tissues, so they do not have the complex cell junctions found in multicellular animals.

Comparing the options, epithelial tissues are the quintessential example of tissues where cell junctions are most abundant and functionally critical.

Step 3: Final Answer:

Cell junctions are particularly abundant and diverse in epithelial cells.

 Quick Tip

Think about the function of the tissue. Epithelial tissue's main job is to be a barrier or a lining. To be an effective barrier, the "bricks" (cells) must be very strongly and tightly cemented together. That "cement" is the cell junctions.

128. Which of the following are phagocytic cells?

- (A) Neutrophils, Mast cells
- (B) Mast cells, Macrophages
- (C) Mast cells, Antibodies
- (D) Neutrophils, Macrophages

Correct Answer: (D) Neutrophils, Macrophages

Solution:

Step 1: Understanding the Question:

The question asks to identify which of the given cell types are phagocytic.

Step 2: Detailed Explanation:

Phagocytosis is the process by which a cell engulfs a solid particle (like a bacterium, debris, or foreign material) to form an internal compartment known as a phagosome. Cells that perform this function are called phagocytes. They are a key part of the innate immune system.

The main professional phagocytes in the body are:

- **Neutrophils:** These are the most abundant type of white blood cell. They are typically the first responders to the site of an infection, where they engulf and destroy pathogens.
- **Macrophages:** These are large phagocytic cells found in tissues. They engulf cellular debris, foreign substances, microbes, and cancer cells. They also play a crucial role in presenting antigens to the adaptive immune system. (Macrophages develop from monocytes).
- **Dendritic cells:** These also perform phagocytosis and are key antigen-presenting cells.

Let's look at the other options:

- **Mast cells:** These cells are involved in allergic reactions and inflammation. They release granules containing histamine and other inflammatory mediators, but they are not considered primary phagocytes.
- **Antibodies:** These are proteins produced by B-lymphocytes that bind to specific antigens; they are not cells at all.

Step 3: Final Answer:

Neutrophils and macrophages are the two primary types of phagocytic cells listed.

 Quick Tip

Remember the "big eaters" of the immune system: Macrophages (literally "big eaters") and Neutrophils. Their main job is to engulf and digest pathogens and cellular trash.

129. Which of the following is known as the suicide bag of a cell?

- (A) Mitochondria
- (B) Golgi Complex
- (C) Lysosome
- (D) Nuclei

Correct Answer: (C) Lysosome

Solution:

Step 1: Understanding the Question:

The question asks to identify the cell organelle nicknamed the "suicide bag".

Step 2: Detailed Explanation:

- **Lysosome:** This is a membrane-bound organelle that contains a variety of powerful digestive (hydrolytic) enzymes. Its main function is to break down waste materials, cellular debris, and foreign invaders (like bacteria). The nickname "suicide bag" comes from its role in **autolysis**. If a cell is damaged beyond repair or is undergoing programmed cell death (apoptosis), its lysosomes may rupture and release their digestive enzymes into the cytoplasm. These enzymes then digest the entire cell from the inside out, leading to its destruction.
- **Mitochondria (A):** Known as the "powerhouse" of the cell, responsible for ATP production.
- **Golgi Complex (B):** Known as the "post office" of the cell, responsible for modifying, sorting, and packaging proteins and lipids.
- **Nuclei (D):** The nucleus is the "control center" of the cell, containing the genetic material.

Step 3: Final Answer:

The lysosome is known as the suicide bag of the cell due to its role in autolysis.

💡 Quick Tip

Associate the common nicknames with the organelles:

- Nucleus: Control Center
- Mitochondrion: Powerhouse
- Ribosome: Protein Factory
- Golgi Apparatus: Post Office
- Lysosome: Recycling Center / Suicide Bag

130. Which of the following cell organelle is responsible for transporting, modifying, and packaging proteins and lipids?

- (A) Mitochondria
- (B) Endoplasmic Reticulum

- (C) Golgi Complex
- (D) DNA

Correct Answer: (C) Golgi Complex

Solution:

Step 1: Understanding the Question:

The question asks to identify the organelle that functions to transport, modify, and package proteins and lipids for delivery to targeted destinations.

Step 2: Detailed Explanation:

- **Golgi Complex (or Golgi Apparatus):** This organelle acts as the cell's "post office" or "finishing and shipping center". It receives proteins and lipids from the Endoplasmic Reticulum (ER). Within the Golgi, these molecules are further **modified** (e.g., by glycosylation), sorted, and then **packaged** into vesicles for **transport** to other destinations, such as the cell membrane, lysosomes, or for secretion out of the cell.
- **Mitochondria (A)** is involved in energy production.
- **Endoplasmic Reticulum (B)** is involved in the initial synthesis and modification of proteins (Rough ER) and lipids (Smooth ER), but the final sorting, packaging, and transport is the job of the Golgi.
- **DNA (D)** is the genetic material, not an organelle involved in this process.

Step 3: Final Answer:

The Golgi Complex is the organelle responsible for the final modification, sorting, packaging, and transport of proteins and lipids.

 Quick Tip

Think of the protein production line:

1. **Ribosomes on Rough ER:** Synthesize proteins.
2. **ER:** Folds and initially modifies proteins.
3. **Golgi Complex:** Further modifies, sorts, packages, and ships the final products.

131. Which of the following is DNA made up of?

- (A) Adenine - Guanine
- (B) Cytosine - Thymine
- (C) Both Adenine - Guanine & Cytosine - Thymine
- (D) Cytosine

Correct Answer: (C) Both Adenine - Guanine & Cytosine - Thymine

Solution:

Step 1: Understanding the Question:

The question asks for the constituent nitrogenous bases of DNA.

Step 2: Detailed Explanation:

DNA (Deoxyribonucleic acid) is a polymer made of repeating units called nucleotides. Each nucleotide consists of three components: a phosphate group, a deoxyribose sugar, and a nitrogenous base.

There are four different nitrogenous bases found in DNA:

- The **Purines**: **Adenine (A)** and **Guanine (G)**.
- The **Pyrimidines**: **Cytosine (C)** and **Thymine (T)**.

Therefore, DNA is made up of all four of these bases. Option (C) lists all four bases mentioned in options (A) and (B) and is the most complete and correct answer.

Step 3: Final Answer:

DNA is made up of the four bases: Adenine, Guanine, Cytosine, and Thymine.

💡 Quick Tip

Remember the four bases of DNA: A, T, C, G.

- Purines (double ring): Adenine, Guanine ("Pure As Gold")
 - Pyrimidines (single ring): Cytosine, Thymine ("CUT the Pie")
- In RNA, Thymine (T) is replaced by Uracil (U).

132. Who is known as the father of Molecular biology?

- (A) Linus Carl Pauling
- (B) James Watson
- (C) Francis H. Crick
- (D) Mahlon B. Hoagland

Correct Answer: (A) Linus Carl Pauling

Solution:

Step 1: Understanding the Question:

The question asks to identify the person widely regarded as the "father of Molecular Biology".

Step 2: Detailed Explanation:

- **Linus Pauling** is often considered the "father of molecular biology" for his pioneering work on the nature of the chemical bond and its application to elucidating the structure of complex

substances, most notably proteins. His discovery of the alpha-helix and beta-sheet structures of proteins was a foundational breakthrough in understanding biological macromolecules at a molecular level. His approach of applying principles of physics and chemistry to biological molecules essentially founded the field.

- **James Watson** and **Francis Crick** are famous for discovering the double helix structure of DNA in 1953, a landmark achievement in molecular biology, but the foundations of the field were laid earlier by pioneers like Pauling.

- **Mahlon Hoagland** was an American biochemist who discovered transfer RNA (tRNA) and its role in translating the genetic code into proteins.

While many have contributed, Pauling's fundamental work on molecular structure, particularly proteins, is why he is often given this title.

Step 3: Final Answer:

Linus Pauling is widely known as the father of Molecular Biology.

💡 Quick Tip

While Watson and Crick are synonymous with DNA, Linus Pauling is the key figure for his earlier, foundational work on the structure of proteins and the application of chemical principles to biology, which is the essence of molecular biology.

133. Which of the following is a type of RNA involved in protein synthesis?

- (A) snRNA
- (B) rRNA
- (C) yRNA
- (D) dsRNA

Correct Answer: (B) rRNA

Solution:

Step 1: Understanding the Question:

The question asks to identify a type of RNA that plays a role in protein synthesis (translation).

Step 2: Detailed Explanation:

There are three main types of RNA directly involved in protein synthesis:

1. **Messenger RNA (mRNA):** Carries the genetic code from the DNA in the nucleus to the ribosome.
2. **Transfer RNA (tRNA):** Acts as an adapter molecule, bringing the correct amino acid to the ribosome based on the codon on the mRNA.
3. **Ribosomal RNA (rRNA):** This is the most abundant type of RNA. It is the structural

and catalytic component of the ribosome, the cellular machinery where protein synthesis occurs. **rRNA** catalyzes the formation of peptide bonds between amino acids.

Let's look at the other options:

- **snRNA (small nuclear RNA)** is involved in splicing pre-mRNA in the nucleus of eukaryotes.
- **yRNA** and **dsRNA (double-stranded RNA)** have roles in other cellular processes (like RNA processing and gene silencing) but are not primary components of the protein synthesis machinery.

Step 3: Final Answer:

Ribosomal RNA (rRNA) is a key type of RNA involved in protein synthesis, forming the core of the ribosome.

💡 Quick Tip

Remember the three main players in translation:

- **mRNA** (the Message)
- **tRNA** (the Translator/Transporter)
- **rRNA** (the Ribosome/Reader/Factory)

All three are essential for building a protein from a gene's instructions.

134. For combination to occur in DNA molecule the correct pair of the four bases (A, T, G, C) is?

- (A) A and C, G and T
- (B) A and T, C and G
- (C) A and G, T and C
- (D) G and A, C and T

Correct Answer: (B) A and T, C and G

Solution:

Step 1: Understanding the Question:

The question asks for the correct complementary base pairing rule in a DNA molecule.

Step 2: Detailed Explanation:

The structure of the DNA double helix is stabilized by specific hydrogen bonding between the nitrogenous bases on the opposite strands. This is known as complementary base pairing.

The rule, established by Watson and Crick based on Chargaff's findings, is as follows:

- A **purine** on one strand always pairs with a specific **pyrimidine** on the other strand.
- **Adenine (A)** always pairs with **Thymine (T)** via two hydrogen bonds.

- **Guanine (G)** always pairs with **Cytosine (C)** via three hydrogen bonds.

Therefore, the correct pairs are A-T and C-G (or G-C).

Step 3: Final Answer:

The correct base pairing in DNA is Adenine with Thymine, and Cytosine with Guanine.

💡 Quick Tip

A simple mnemonic to remember the DNA base pairs:

- "A" and "T" are letters made with straight lines.
- "C" and "G" are letters made with curved lines.

135. Red muscles are rich in:

- (A) Myoglobin and cytochrome
- (B) Lactic acid and acetic acid
- (C) Haemoglobin and glucose
- (D) only myosin

Correct Answer: (A) Myoglobin and cytochrome

Solution:

Step 1: Understanding the Question:

The question asks for the substances that are found in high concentrations in red muscle fibers.

Step 2: Detailed Explanation:

Muscle fibers are broadly classified into red (slow-twitch) and white (fast-twitch) fibers.

Red muscle fibers are adapted for sustained, aerobic activity (like long-distance running or maintaining posture). Their characteristics include:

- **Rich in Myoglobin:** Myoglobin is an iron- and oxygen-binding protein found in muscle tissue. It stores oxygen within the muscle cells and is responsible for the characteristic **red** color.
- **Rich in Mitochondria:** To support continuous aerobic respiration, these fibers have numerous mitochondria.
- **Rich in Cytochromes:** Cytochromes are proteins that are essential components of the electron transport chain within the mitochondria, where aerobic respiration occurs.

Therefore, red muscles are rich in both myoglobin (for oxygen storage) and cytochromes (for aerobic respiration).

- Haemoglobin (C) is the oxygen-transport protein in red blood cells, not stored in muscle.
- Lactic acid (B) is a product of anaerobic respiration, which is more characteristic of white

muscle fibers.

Step 3: Final Answer:

Red muscles are rich in myoglobin and cytochromes, which support their function in sustained aerobic activity.

💡 Quick Tip

Think about the color and function:

- **Red Muscle** (Dark meat in chicken): For long, slow activity (standing, walking). Needs lots of oxygen, so it's rich in **myoglobin** and mitochondria.
- **White Muscle** (White meat in chicken): For short, fast bursts (flapping wings). Relies on anaerobic glycolysis.

136. Open Blood vascular system is usually found in

- (A) Crabs
- (B) Monkeys
- (C) Crows
- (D) Humans

Correct Answer: (A) Crabs

Solution:

Step 1: Understanding the Question:

The question asks to identify which of the given animals typically has an open circulatory system.

Step 2: Detailed Explanation:

Circulatory systems can be of two main types:

- **Closed Circulatory System:** The blood is confined within vessels (arteries, veins, capillaries) at all times and is distinct from the interstitial fluid. This is characteristic of all vertebrates (e.g., Monkeys, Crows, Humans) and some invertebrates like annelids and cephalopod molluscs.
- **Open Circulatory System:** The blood, called hemolymph, is pumped by a heart into the body cavity (hemocoel), where it directly bathes the tissues and organs before returning to the heart. There are few, if any, capillaries. This system is less efficient and is characteristic of arthropods (including insects, crustaceans like **Crabs**) and most molluscs (except cephalopods).

Crabs are crustaceans, which belong to the Phylum Arthropoda. A defining feature of arthropods is their open circulatory system. Monkeys, Crows, and Humans are all vertebrates and have a closed circulatory system.

Step 3: Final Answer:

An open blood vascular system is found in crabs.

💡 Quick Tip

As a general rule:

- All **Vertebrates** have a **closed** system.
- All **Arthropods** (insects, spiders, crabs) have an **open** system.

This will help you answer most questions on this topic.

137. Typically, Spiders' blood is blue due to the presence of

- (A) Haemoglobin
- (B) Hemerythrin
- (C) Haemocyanin
- (D) Haemopoitin

Correct Answer: (C) Haemocyanin

Solution:**Step 1: Understanding the Question:**

The question asks for the respiratory pigment responsible for the blue color of spider blood.

Step 2: Detailed Explanation:

The "blood" of arthropods and molluscs is more correctly called hemolymph. The color of this fluid is determined by the respiratory pigment it contains to transport oxygen.

- **Haemocyanin:** This is a copper-containing protein used for oxygen transport. When it is deoxygenated, it is colorless. When it binds with oxygen, the copper atoms cause it to turn **blue**. Haemocyanin is found in the hemolymph of many arthropods (including spiders, crustaceans, and horseshoe crabs) and most molluscs.

- **Haemoglobin:** This is an iron-containing protein found in the red blood cells of vertebrates and some invertebrates. It is red when oxygenated.

- **Hemerythrin:** This is another iron-containing pigment, found in some marine invertebrates (like sipunculids and brachiopods). It is colorless when deoxygenated and violet-pink when oxygenated.

- **Haemopoitin** is not a standard respiratory pigment.

Step 3: Final Answer:

The blue color of a spider's blood (hemolymph) is due to the presence of the copper-based respiratory pigment, haemocyanin.

💡 Quick Tip

Remember the metals and colors of respiratory pigments:

- **Haemoglobin: Iron (Fe) → Red**
- **Haemocyanin: Copper (Cu) → Blue**
- **Hemerythrin: Iron (Fe) → Violet-Pink**

138. Humans have ----- bones in the vertebrate column

- (A) 52
- (B) 33
- (C) 32
- (D) 53

Correct Answer: (B) 33

Solution:

Step 1: Understanding the Question:

The question asks for the number of bones (vertebrae) in the human vertebral column.

Step 2: Detailed Explanation:

The human vertebral column, or spine, is typically composed of **33** individual vertebrae at birth. These are divided into five regions:

- **Cervical** vertebrae: 7 (in the neck)
- **Thoracic** vertebrae: 12 (in the chest, articulating with the ribs)
- **Lumbar** vertebrae: 5 (in the lower back)
- **Sacral** vertebrae: 5 (which fuse in adulthood to form the sacrum)
- **Coccygeal** vertebrae: 4 (which fuse to form the coccyx or tailbone)

So, the total count is $7 + 12 + 5 + 5 + 4 = 33$.

In an adult, due to the fusion of the sacral and coccygeal vertebrae, the number of distinct bones is typically counted as 26 (24 individual vertebrae + 1 sacrum + 1 coccyx). However, the question asks for the number of bones in the column, and the foundational number is 33 vertebrae. Given the options, 33 is the correct embryological and developmental count.

Step 3: Final Answer:

The human vertebral column is composed of 33 vertebrae.

 Quick Tip

Remember the "meal times" for the top three sections of the spine: 7 cervical (breakfast at 7 am), 12 thoracic (lunch at 12 pm), and 5 lumbar (dinner at 5 pm). Then add the 5 sacral and 4 coccygeal vertebrae.

139. Energy released by catabolic pathways is stored in how many forms?

- (A) 1
- (B) 2
- (C) 3
- (D) 4

Correct Answer: (B) 2

Solution:

Step 1: Understanding the Question:

The question asks about the primary forms in which energy, released from catabolism (breakdown of molecules), is stored for use by the cell.

Step 2: Detailed Explanation:

Catabolic pathways, such as cellular respiration, break down complex molecules like glucose to release energy. This energy is not used directly but is captured and stored in the form of high-energy chemical intermediates that act as the cell's energy currency.

The two main forms of this stored chemical energy are:

1. **High-energy phosphate bonds:** Primarily in the molecule **Adenosine Triphosphate (ATP)**. The breaking of the terminal phosphate bond in ATP releases a usable amount of energy to drive other cellular processes.
2. **High-energy electrons:** In the form of reduced coenzymes, mainly **NADH** (Nicotinamide adenine dinucleotide) and **FADH₂** (Flavin adenine dinucleotide). These molecules carry high-energy electrons from catabolic reactions to the electron transport chain, where their energy is used to synthesize a large amount of ATP.

Therefore, the energy is primarily stored in two major, inter-related forms: the phosphate bonds of ATP and the reducing power of electron carriers like NADH and FADH₂.

Step 3: Final Answer:

Energy from catabolism is stored primarily in two forms: ATP and reduced electron carriers (like NADH).

 Quick Tip

Think of cellular energy like money. ATP is like cash, ready to be spent anywhere. NADH and FADH₂ are like a high-value check that needs to be taken to the bank (the electron transport chain) to be converted into a lot of cash (ATP).

140. The TCA cycle occurs in which region of a prokaryotic cell?

- (A) Cytosol
- (B) Mitochondria
- (C) Ribosomes
- (D) Golgi complex

Correct Answer: (A) Cytosol

Solution:

Step 1: Understanding the Question:

The question asks for the cellular location of the Tricarboxylic Acid (TCA) cycle, also known as the Krebs cycle or citric acid cycle, in a prokaryotic cell.

Step 2: Detailed Explanation:

- In **eukaryotic cells**, the TCA cycle takes place in the **mitochondrial matrix**. Mitochondria are membrane-bound organelles.
- **Prokaryotic cells** (like bacteria) lack membrane-bound organelles, including mitochondria.

In prokaryotes, all the metabolic processes that occur in the mitochondrial matrix in eukaryotes must take place elsewhere. The enzymes of the TCA cycle are located in the **cytosol** (also called cytoplasm).

The electron transport chain, which occurs on the inner mitochondrial membrane in eukaryotes, is located on the inner cell membrane (plasma membrane) of prokaryotes.

Ribosomes and the Golgi complex are involved in protein synthesis and processing, not the TCA cycle.

Step 3: Final Answer:

In a prokaryotic cell, the TCA cycle occurs in the cytosol.

 Quick Tip

A key difference between prokaryotes and eukaryotes is the absence of membrane-bound organelles in prokaryotes. Therefore, any process you know that happens inside the mitochondria of a eukaryote (like the TCA cycle and oxidative phosphorylation) must happen in the cytosol and on the cell membrane of a prokaryote.

141. NAD⁺ can be derived from which vitamin?

- (A) A
- (B) C
- (C) Riboflavin
- (D) Niacin

Correct Answer: (D) Niacin

Solution:

Step 1: Understanding the Question:

The question asks for the vitamin precursor of the coenzyme NAD⁺ (Nicotinamide adenine dinucleotide).

Step 2: Detailed Explanation:

Coenzymes are non-protein organic molecules that are essential for the function of many enzymes. Many coenzymes are derived from vitamins.

- **NAD⁺** and its phosphorylated counterpart **NADP⁺** are crucial electron carriers in cellular metabolism. The reactive part of the molecule that accepts and donates electrons is the nicotinamide ring.

- The vitamin precursor for the nicotinamide part is **Niacin**, which is also known as Vitamin B3. A deficiency in niacin can lead to the disease pellagra, which disrupts metabolic pathways that rely on NAD⁺.

- **Riboflavin** (Vitamin B2) is the precursor for other important coenzymes, FAD (flavin adenine dinucleotide) and FMN (flavin mononucleotide).

Step 3: Final Answer:

NAD⁺ is derived from the vitamin Niacin (Vitamin B3).

💡 Quick Tip

Associate the B vitamins with their coenzyme products: - **B2 (Riboflavin)** → FAD, FMN - **B3 (Niacin)** → NAD⁺, NADP⁺ - **B5 (Pantothenic Acid)** → Coenzyme A

142. Which of the intermediate of the Krebs's cycle is utilised in the formation of amino acids?

- (A) Citric acid
- (B) Malic acid
- (C) Isocitric acid

(D) α -ketoglutaric acid

Correct Answer: (D) α -ketoglutaric acid

Solution:

Step 1: Understanding the Question:

The question asks to identify an intermediate of the Krebs cycle (TCA cycle) that serves as a precursor for the synthesis of amino acids.

Step 2: Detailed Explanation:

The Krebs cycle is a central metabolic hub. Its intermediates are not just used for energy production but can also be drawn off as precursors for various biosynthetic pathways (anaplerosis).
- **α -ketoglutaric acid** (also known as α -ketoglutarate) is a key intermediate in the Krebs cycle. Through a process called transamination, it can be converted into the amino acid **glutamate**. Glutamate, in turn, can be used to synthesize other amino acids like glutamine, proline, and arginine.

- Another important precursor is **oxaloacetate**, which can be transaminated to form the amino acid **aspartate**.

Of the options given, α -ketoglutaric acid is a direct precursor for the glutamate family of amino acids.

Step 3: Final Answer:

α -ketoglutaric acid is an intermediate of the Krebs cycle that is utilized in the formation of amino acids.

 Quick Tip

Remember that the Krebs cycle is amphibolic, meaning it's involved in both catabolism (breaking down acetyl-CoA) and anabolism (providing precursors for biosynthesis). The two most important biosynthetic precursors from the cycle are **α -ketoglutarate** and **oxaloacetate**.

143. The entry of pyruvate into the TCA cycle is inhibited by the presence of a high cellular concentration of

- (A) Pyruvate
- (B) NADH
- (C) Coenzyme A
- (D) AMP

Correct Answer: (B) NADH

Solution:

Step 1: Understanding the Question:

The question asks which molecule inhibits the conversion of pyruvate into acetyl-CoA, the entry point into the TCA cycle.

Step 2: Detailed Explanation:

The entry of pyruvate into the TCA cycle is catalyzed by a large multi-enzyme complex called the **Pyruvate Dehydrogenase Complex (PDC)**. This complex converts pyruvate to acetyl-CoA.

The activity of the PDC is tightly regulated to match the cell's energy needs. It is an example of allosteric regulation and feedback inhibition.

- The enzyme is **inhibited** by its own products and by indicators of a high energy state. High concentrations of **ATP**, **acetyl-CoA**, and **NADH** signal that the cell has plenty of energy, so there is no need to run the TCA cycle further. These molecules allosterically inhibit the PDC.
- The enzyme is **activated** by indicators of a low energy state, such as **AMP**, **Coenzyme A**, and **NAD⁺**.

From the given options, a high concentration of **NADH** is a key inhibitor of the pyruvate dehydrogenase complex.

Step 3: Final Answer:

The entry of pyruvate into the TCA cycle is inhibited by a high cellular concentration of NADH.

💡 Quick Tip

Think about feedback inhibition and the cell's energy state. If the cell has a lot of energy products (ATP, NADH, Acetyl-CoA), it will turn off the production line. If it has a lot of "raw materials" or low-energy signals (AMP, NAD⁺), it will turn the production line on.

144. FAD is reduced in which of the reaction of the Krebs's cycle?

- (A) Isocitrate to oxaloacetate
- (B) Succinyl CoA to Succinate
- (C) Fumarate to malate
- (D) Succinate to fumarate

Correct Answer: (D) Succinate to fumarate

Solution:

Step 1: Understanding the Question:

The question asks to identify the specific step in the Krebs (TCA) cycle where FAD is reduced

to FADH₂.

Step 2: Detailed Explanation:

The Krebs cycle involves several oxidation-reduction reactions where the coenzymes NAD⁺ and FAD are reduced.

Let's look at the key steps:

- Isocitrate to α -ketoglutarate: NAD⁺ is reduced to NADH.
- α -ketoglutarate to Succinyl-CoA: NAD⁺ is reduced to NADH.
- Malate to Oxaloacetate: NAD⁺ is reduced to NADH.

The only reaction in the cycle that involves FAD is:

- **Succinate to Fumarate:** This reaction is an oxidation of succinate. The two hydrogen atoms are transferred to FAD, reducing it to FADH₂. This reaction is catalyzed by the enzyme **succinate dehydrogenase**, which is unique as it is embedded in the inner mitochondrial membrane (as Complex II of the electron transport chain).

Option (B) involves substrate-level phosphorylation (GTP formation), and option (C) involves the hydration of fumarate, not a redox reaction.

Step 3: Final Answer:

FAD is reduced to FADH₂ during the conversion of succinate to fumarate.

💡 Quick Tip

Remember the redox steps in the Krebs cycle: NAD⁺ is reduced in three steps. FAD is reduced in only one step: the conversion of **Succinate** to **Fumarate**, catalyzed by **Succinate Dehydrogenase**.

145. In gene therapy, the gene defects are cured in a child at _____ stage.

- (A) Adult
- (B) Teenage
- (C) Old
- (D) Embryo

Correct Answer: (D) Embryo

Solution:

Step 1: Understanding the Question:

The question asks at which developmental stage gene therapy would be most effective for a permanent cure.

Step 2: Detailed Explanation:

Gene therapy aims to correct genetic disorders by replacing or supplementing a faulty gene. There are two main types:

- **Somatic Gene Therapy:** This involves modifying the genes in the somatic (body) cells of a patient. This can treat the individual, but the changes are not passed on to their offspring. Curing a defect in a child or adult (Options A, B, C) is an example of somatic therapy. It can be challenging to deliver the corrected gene to all the necessary cells, and the treatment may not be permanent.
- **Germline Gene Therapy:** This involves modifying the genes in germ cells (sperm or eggs) or in a very early **embryo**. If a gene defect is corrected at the embryonic stage, the corrected gene will be incorporated into all the cells of the developing individual, including their future germ cells. This would result in a permanent cure that is also heritable (passed on to subsequent generations).

For a complete and permanent cure of a genetic defect throughout the entire organism, the ideal time for correction is at the earliest possible stage, which is the embryo.

Step 3: Final Answer:

To achieve a permanent cure that affects all cells in the body, gene defects are ideally cured at the embryo stage.

💡 Quick Tip

While most current gene therapy research and application is on somatic cells in children and adults, the theoretical "perfect" cure would be germline or embryonic therapy. However, due to major ethical concerns, germline gene therapy is not performed on humans.

146. In 1990 the first gene therapy was given to treat which deficiency?

- (A) Smallpox
- (B) Vitamin E
- (C) Protein
- (D) Adenosine deaminase

Correct Answer: (D) Adenosine deaminase

Solution:

Step 1: Understanding the Question:

The question asks to identify the specific genetic disorder that was the target of the first clinical gene therapy trial in 1990.

Step 2: Detailed Explanation:

The first-ever approved gene therapy procedure was performed on September 14, 1990, at the US National Institutes of Health.

The patient was a four-year-old girl named Ashanti DeSilva. She was suffering from a rare genetic disorder called Severe Combined Immunodeficiency (SCID) which was caused by a deficiency of the enzyme **Adenosine Deaminase (ADA)**.

The lack of this enzyme leads to a buildup of toxic metabolites that destroy T-lymphocytes, crippling the immune system.

In the therapy, her white blood cells were removed, the functional ADA gene was inserted into them using a retrovirus vector, and the corrected cells were then returned to her body. While not a permanent cure, the treatment successfully boosted her immune function.

Step 3: Final Answer:

The first gene therapy was administered in 1990 to treat a deficiency of the enzyme Adenosine Deaminase (ADA).

💡 Quick Tip

Remember the landmark "first" in gene therapy: a 4-year-old girl with ADA-SCID in 1990. This case is a cornerstone in the history of biotechnology and genetic medicine.

147. Exogenous antigens are associated with which molecules in order to activate cells?

- (A) Class II MHC
- (B) Peptide molecules
- (C) Class I MHC
- (D) Antigen presenting cells

Correct Answer: (A) Class II MHC

Solution:

Step 1: Understanding the Question:

The question asks which type of MHC molecule is used to present exogenous antigens.

Step 2: Detailed Explanation:

The Major Histocompatibility Complex (MHC) molecules are responsible for presenting antigens to T-lymphocytes, which is a critical step in initiating an adaptive immune response.

There are two main pathways:

1. **Endogenous Pathway (MHC Class I):** Antigens that originate from *within* a cell (e.g., viral proteins, or abnormal self-proteins from cancer cells) are processed in the cytoplasm and loaded onto **Class I MHC** molecules. These are then presented on the cell surface to cytotoxic T-lymphocytes (CD8⁺ T cells), which are instructed to kill the infected or abnormal cell.

2. **Exogenous Pathway (MHC Class II):** Antigens that originate from *outside* the cell (e.g., bacteria, toxins) are taken up by professional **Antigen-Presenting Cells (APCs)** like macrophages, dendritic cells, and B cells through phagocytosis. Inside the APC, the antigen is broken down into peptide fragments, which are then loaded onto **Class II MHC** molecules. These are then presented on the cell surface to helper T-lymphocytes ($CD4^+$ T cells), which become activated and orchestrate the overall immune response.

Therefore, exogenous antigens are associated with Class II MHC molecules.

Step 3: Final Answer:

Exogenous antigens are presented on Class II MHC molecules to activate helper T cells.

 Quick Tip

Use the "Rule of 8" to remember the MHC-T cell interaction: - $MHC\ I \times CD8 = 8 \rightarrow$ Class I presents to **CD8+** T cells (cytotoxic). - $MHC\ II \times CD4 = 8 \rightarrow$ Class II presents to **CD4+** T cells (helper). And remember, Class I is for internal threats, Class II is for external threats.

148. Name the type of culture which is prepared by inoculating directly from the tissue of an organism to culture media?

- (A) Primary cell culture
- (B) Secondary cell culture
- (C) Cell lines
- (D) Transformed cell culture

Correct Answer: (A) Primary cell culture

Solution:

Step 1: Understanding the Question:

The question asks for the name given to a cell culture that is established directly from the tissues of an organism.

Step 2: Detailed Explanation:

The terminology for cell cultures is based on their origin and passage history:

- **Primary cell culture:** This is the initial culture established when cells are isolated directly from a tissue (e.g., by enzymatic digestion) and placed into a culture medium to grow. These cells have a finite lifespan and will eventually stop dividing (senescence). This perfectly matches the description in the question.
- **Secondary cell culture:** When cells from a primary culture are subcultured (passaged) into a new vessel with fresh medium, it is referred to as a secondary culture.
- **Cell lines:** After the first subculture, the primary culture becomes known as a cell line. A

cell line with a finite lifespan is called a finite cell line.

- **Transformed cell culture (or Continuous cell line):** These are cell lines that have undergone a transformation (e.g., due to mutation or viral induction) that allows them to divide indefinitely. Cancer cell lines like HeLa are examples.

Step 3: Final Answer:

A culture prepared by inoculating cells directly from a tissue is called a primary cell culture.

💡 Quick Tip

Remember the progression: 1. Isolate from tissue → **Primary culture** 2. First sub-culture → **Secondary culture / Cell line** 3. Culture that becomes immortal → **Continuous cell line**

149. Which of the following enzymes in bacteria are responsible for restricting the growth of viruses?

- (A) Restriction endonuclease
- (B) Topoisomerase
- (C) Gyrase
- (D) Protease

Correct Answer: (A) Restriction endonuclease

Solution:

Step 1: Understanding the Question:

The question asks to identify the bacterial enzymes that act as a defense mechanism against viral infections.

Step 2: Detailed Explanation:

Bacteria have evolved a primitive immune system to protect themselves from viruses (bacteriophages). A key part of this system is the restriction-modification system.

- **Restriction endonucleases (or Restriction enzymes):** These are enzymes that recognize specific, short sequences of DNA (restriction sites) and cut the DNA at or near these sites. When a virus injects its DNA into a bacterium, the bacterium's restriction enzymes can recognize and cleave the foreign viral DNA, thereby destroying it and **restricting** the virus's ability to replicate.

- To protect its own DNA from being cut, the bacterium has a corresponding modification enzyme (a methylase) that adds a methyl group to its own DNA at the same recognition sites, blocking the restriction enzyme from cutting it.

The other enzymes listed have different cellular functions:

- Topoisomerase and Gyrase are involved in managing DNA supercoiling.

- Protease breaks down proteins.

Step 3: Final Answer:

Restriction endonucleases are the bacterial enzymes responsible for restricting the growth of viruses by cutting their DNA.

💡 Quick Tip

The name "restriction enzyme" comes from its biological function: it *restricts* the host range of a virus by destroying incoming viral DNA. These are the same enzymes that became a fundamental tool in molecular cloning and genetic engineering.

150. In a large-scale ecological pyramid representing the whole Earth as an ecosystem, the position of humans is similar to

- (A) Lions
- (B) Eagles
- (C) Frogs
- (D) Anchovis

Correct Answer: (D) Anchovis

Solution:

Step 1: Understanding the Question:

The question asks to identify an animal whose trophic level in a global ecological pyramid is similar to that of humans. This requires understanding the concept of an "average" human trophic level.

Step 2: Detailed Explanation:

The trophic level of an organism is its position in a food chain. Producers (plants) are at level 1. Primary consumers (herbivores) are at level 2. Secondary consumers (carnivores that eat herbivores) are at level 3, and so on.

- **Lions (A)** and **Eagles (B)** are typically tertiary or quaternary consumers, placing them at high trophic levels (around 3 to 4.5). They are apex predators.

- **Frogs (C)** are typically secondary consumers (eating insects), placing them at trophic level 3.

- **Humans** are omnivores. Our diet consists of both producers (plants, trophic level 1) and consumers (herbivores and carnivores, trophic levels 2 and 3). When we calculate the *average* trophic level for the entire human population, considering the global diet which is still predominantly plant-based, the human trophic level is surprisingly low. Scientific studies have estimated the average human trophic level to be around 2.21, which is roughly the level of a primary carnivore or an omnivore that eats mostly plants.

- **Anchovies** are small fish that primarily feed on phytoplankton (producers) and zooplankton

(primary consumers). This makes them a mix of primary and secondary consumers, placing them at a low trophic level, very similar to the calculated average for humans.

Therefore, in a large-scale pyramid, the position of humans is not as apex predators like lions but is much lower, similar to that of an anchovy.

Step 3: Final Answer:

On a global scale, the average trophic level of humans is similar to that of anchovies.

 Quick Tip

This is a counter-intuitive question. While we think of ourselves as "top of the food chain," our massive population's reliance on agriculture (plants) brings our average trophic level down significantly. We eat more like pigs or anchovies than like lions or eagles on a global scale.