

AP DEECET 2025 Mathematics Question Paper with Solution

Time Allowed :120 Minutes

Maximum Marks :100

Total Questions :100

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The duration of the test is **3 hours**.
2. Each question carries **1 mark**. There is **no negative marking**.
3. The medium of the question paper is **English** and **Telugu/Urdu** (as opted by the candidate).
4. Candidates must report at the test center **at least 90 minutes before** the commencement of the examination.
5. Candidates must carry:
 - **Filled-in Online Application Form (printout)**
 - **Valid Photo ID Proof** (Aadhaar, Passport, PAN, Driving Licence, etc.)
6. Rough work must be done only on the provided rough sheets. Additional sheets will not be provided.
7. Use of **calculators, mobile phones, smart watches, or any electronic devices** is strictly prohibited.
8. Follow the invigilator's instructions carefully. Any malpractice will result in **disqualification**.

1. This is useful to make children hand writing good

- (A) Imposition writing
- (B) Copy book writing
- (C) Dictation
- (D) Habituate children to write from early years.

Correct Answer: (B) Copy book writing

Solution:

The question asks for a specific method to improve the quality of a child's handwriting.

Let's evaluate the given options:

- (A) Imposition writing is a term from the printing industry and is unrelated to handwriting.
- (B) Copy book writing is a direct and targeted method where children practice forming letters and words by copying a model.

This method specifically improves letter formation, spacing, and neatness, which are the core components of good handwriting.
- (C) Dictation tests listening skills, spelling, and grammar, not the physical act of forming letters neatly.
- (D) Habituating children to write from early years is a general practice but does not guarantee good handwriting without specific technique-focused exercises.

Therefore, copy book writing is the most direct and useful method.

Quick Tip

In pedagogy questions, always choose the option that describes a direct and specific teaching technique for the skill mentioned. Copybook writing is a direct method for handwriting, while other options have different primary goals.

2. The schools established exclusively for the meritorious children resides in rural areas is

- (A) Model Schools
- (B) Sainik Schools
- (C) Navodaya Vidyalaya
- (D) Central Schools

Correct Answer: (C) Navodaya Vidyalaya

Solution:

The question asks to identify the school system specifically designed for talented children predominantly from rural areas.

Let's analyze the options:

(A) Model Schools are established to provide quality education but do not have the specific mandate of focusing on meritorious children from rural areas.

(B) Sainik Schools aim to prepare students for entry into the National Defence Academy.

(C) Jawahar Navodaya Vidyalayas (JNVs) have a specific objective to provide quality modern education to talented children, predominantly from rural areas.

The scheme mandates that at least 75% of seats are reserved for students from rural backgrounds.

(D) Central Schools (Kendriya Vidyalayas) primarily serve the children of transferable Central Government employees.

Thus, Navodaya Vidyalaya perfectly matches the description.

Quick Tip

Remember the specific purpose of different government school systems in India. Navodaya Vidyalayas are synonymous with providing quality education to talented rural children.

3. Mentally retorted child is there in our catchment area. As a teacher you will join him in this school

(A) Bhavitha Centre

(B) Anganwadi Center

(C) K.G.B.V

(D) Pre Primary School

Correct Answer: (A) Bhavitha Centre

Solution:

The question asks for the appropriate institution for a child with special needs, given the context of the Andhra Pradesh education system.

The term "mentally retorted" is an outdated term for a child with intellectual disabilities or special needs.

(A) Bhavitha Centres are specialized resource centers established by the Government of Andhra Pradesh under inclusive education programs, specifically for Children With Special Needs

(CWSN).

(B) Anganwadi Centers focus on basic health, nutrition, and non-formal pre-schooling for all children, not specialized education.

(C) K.G.B.V (Kasturba Gandhi Balika Vidyalaya) are residential schools for girls from disadvantaged communities.

(D) A general Pre Primary School is not typically equipped to provide the specialized support required.

Therefore, a Bhavitha Centre is the correct and most appropriate choice.

Quick Tip

For questions about inclusive education or Children With Special Needs (CWSN), especially in a state-specific exam, identify the government program or institution designed for that exact purpose.

4. Identify wrong statement related to achievement level of children

(A) Every child has his own learning level.

(B) Do not compare children.

(C) Children cannot learn without motivation.

(D) Children cannot learn if parents are illiterate.

Correct Answer: (D) Children cannot learn if parents are illiterate.

Solution:

The task is to identify the incorrect statement about children's learning and achievement.

(A) "Every child has his own learning level." This is a fundamental principle of pedagogy, recognizing individual differences. This is a correct statement.

(B) "Do not compare children." Comparing students is discouraged in modern education as it can negatively impact self-esteem. This is a correct statement.

(C) "Children cannot learn without motivation." Motivation is a key factor for effective and sustained learning. This is considered a correct statement.

(D) "Children cannot learn if parents are illiterate." This is a false and discriminatory statement.

A child's ability to learn is not determined by their parents' literacy status. With proper educational opportunities, any child can succeed.

Therefore, statement (D) is the wrong statement.

Quick Tip

When a question asks to identify a "wrong" statement, look for absolute, biased, or stereotypical claims. Educational principles emphasize inclusivity and individual potential, making statements that limit a child's ability based on background highly suspect.

5. As a teacher you have to follow this to improve retention ability among students is

- (A) News reading
- (B) Giving home work
- (C) Practicing tables and poems
- (D) Drawing

Correct Answer: (C) Practicing tables and poems

Solution:

The question asks for the best method among the choices to improve students' ability to remember and recall information (retention).

Let's analyze the options based on their primary cognitive function:

- (A) News reading primarily improves reading comprehension, vocabulary, and general awareness.
- (B) Giving homework is a general method for reinforcing a wide range of skills, not specifically retention.
- (C) Practicing tables and poems involves repetition, memorization, and active recall.

This process directly strengthens the neural pathways responsible for memory, thus improving retention ability.

(D) Drawing enhances creativity, fine motor skills, and spatial reasoning.

Therefore, practicing tables and poems is the most direct and effective activity for improving retention.

Quick Tip

Match the educational activity to the specific cognitive skill. Retention is the ability to remember information. Activities that involve rote learning, repetition, and recall are most effective for strengthening this skill.

6. Printing Press was invented by

(A) Johannes Gutenberg

(B) George Claude

(C) Alexander Fleming

(D) Karl Benz

Correct Answer: (A) Johannes Gutenberg

Solution:

This is a factual question about the inventor of the printing press.

(A) Johannes Gutenberg is credited with inventing the printing press with movable type in Europe around the year 1440. This invention revolutionized communication and the spread of knowledge.

(B) George Claude was a French engineer who invented the neon lighting system in 1910.

(C) Alexander Fleming was a Scottish physician and microbiologist who discovered the antibiotic substance penicillin in 1928.

(D) Karl Benz was a German engine designer and automobile engineer who is credited with inventing the first practical automobile.

Therefore, the correct inventor of the printing press is Johannes Gutenberg.

Quick Tip

Associate key inventors with their famous inventions. Gutenberg - Printing Press, Fleming - Penicillin, Benz - Automobile, Bell - Telephone. These are common general knowledge questions.

7. Sardar Sarovar dam is located in this State

- (A) Tamilnadu
- (B) Uttarakhand
- (C) Bihar
- (D) Gujarat

Correct Answer: (D) Gujarat

Solution:

This question asks for the geographical location of the Sardar Sarovar Dam.

The Sardar Sarovar Dam is a major gravity dam built on the Narmada river.

The dam is located in the Kevadia colony of the Narmada district in the state of Gujarat, India.

It is one of the largest and most controversial dam projects in India, and it provides water and electricity to four Indian states: Gujarat, Madhya Pradesh, Maharashtra, and Rajasthan.

Therefore, the correct state is Gujarat.

Quick Tip

For geography questions, it's helpful to remember major national projects like dams and their associated rivers and states. Sardar Sarovar Dam is famously linked with the Narmada River and the state of Gujarat.

8. The game that is known as 'King of Games'

- (A) Cricket

(B) Volley ball

(C) Chess

(D) Kabadi

Correct Answer: (C) Chess

Solution:

The question asks for the game that holds the title 'King of Games'.

While other games like Cricket are extremely popular and sometimes called the 'gentleman's game', the title 'King of Games' is traditionally and widely associated with Chess.

This title is attributed to Chess due to its deep strategic complexity, intellectual demands, and historical significance as a game of royalty and intellect.

It is also often called the 'Royal Game'.

Therefore, Chess is the correct answer.

Quick Tip

Distinguish between a game's popularity and its traditional title. While Cricket is a passion in many countries, Chess has historically been called the 'King of Games' or the 'Royal Game' due to its strategic nature.

9. Person who invented Amrutanjan and also titled as Desabandhu, Desoddharaka was

(A) Kasinathuni Nageswara Rao

(B) Kandukuri Veeresalingam

(C) Tanguturi Prakasam

(D) Konda Venkatappayya

Correct Answer: (A) Kasinathuni Nageswara Rao

Solution:

This question asks to identify a prominent historical figure from the Telugu region who invented

Amrutanjan and held specific titles.

(A) Kasinathuni Nageswara Rao was a multifaceted personality: a journalist (founder of Andhra Patrika), a freedom fighter, a politician, and an entrepreneur.

He formulated and founded the company for the popular pain balm, Amrutanjan, in 1893.

For his services to the nation and journalism, he was honored with the titles 'Desabandhu' and 'Desoddharaka'.

(B) Kandukuri Veeresalingam was a great social reformer.

(C) Tanguturi Prakasam, known as 'Andhra Kesari', was the first Chief Minister of Andhra State.

(D) Konda Venkatappayya was a prominent freedom fighter.

Therefore, Kasinathuni Nageswara Rao is the correct person who fits all the descriptions.

Quick Tip

Associate famous personalities with their key contributions and titles. For Andhra Pradesh history, Kasinathuni Nageswara Rao is famously linked with Amrutanjan and Andhra Patrika.

10. Sahitya Academy winner for Children Literature in Telugu for the year 2023 is

(A) Dasari Amarendra

(B) Juluru Gouri Sankar

(C) D. K. Chaduvula Babu

(D) Johny Thakkedasila

Correct Answer: (C) D. K. Chaduvula Babu

Solution:

This is a current affairs question asking for the winner of the Sahitya Akademi Bal Sahitya Puraskar (Children's Literature Award) in Telugu for the year 2023.

The Sahitya Akademi announced its annual awards for 2023.

For the Bal Sahitya Puraskar in the Telugu language, the award was conferred upon D. K. Chaduvula Babu.

He received the award for his literary work titled "Vajrala Vana" (Diamond Rain).

Therefore, D. K. Chaduvula Babu is the correct answer.

Quick Tip

For competitive exams, stay updated on recent major awards, especially those related to literature, science, and sports. The Sahitya Akademi Awards are particularly important in the context of Indian languages.

11. I visited Delhi last month. The above sentence is in

- (A) the simple present tense
- (B) the past perfect tense
- (C) the simple past tense
- (D) the simple future tense

Correct Answer: (C) the simple past tense

Solution:

The sentence describes an action that was completed in the past.

The verb used is "visited," which is the simple past tense form of the verb "to visit".

The phrase "last month" is a time marker that explicitly indicates a completed past time.

Therefore, the sentence is in the simple past tense.

Quick Tip

The simple past tense is used to talk about a completed action in a time before now. Look for past tense verb forms (like -ed endings for regular verbs) and specific past time indicators (like yesterday, last month, in 2010).

12. The committee has _____ to make Jagadish captain of the team. The _____ is likely to please everyone.

Choose the pair of words that fits the blanks in the sentence above respectively.

- (A) decided - decision
- (B) decision - decided
- (C) decision - deciding
- (D) deciding - decide

Correct Answer: (A) decided - decision

Solution:

Let's analyze the grammatical structure of the blanks.

The first blank follows "has", indicating the need for a verb in the past participle form to create the present perfect tense. "decided" is the correct form.

The second blank starts with the article "The", indicating the need for a noun. "decision" is the noun form.

So, the sentence becomes: "The committee has decided to make Jagadish captain of the team. The decision is likely to please everyone."

The pair "decided - decision" fits perfectly.

Quick Tip

Identify the part of speech required for each blank. After "has/have/had", a past participle verb is used. Articles like "a/an/the" are typically followed by a noun.

13. At the age of 15, Einstein felt so satisfied that he left the school for good. Identify the meaning of the phrase 'for good'

- (A) permanently
- (B) for a short time
- (C) for his benefit

(D) for a sorrowful reason

Correct Answer: (A) permanently

Solution:

The question asks for the meaning of the idiomatic phrase "for good".

In English, the phrase "for good" is an idiom that means "permanently" or "forever".

It does not mean something is positive or beneficial, but rather that a situation is final.

The sentence means that Einstein left the school permanently and did not intend to return.

Therefore, "permanently" is the correct meaning.

Quick Tip

Be aware of common English idioms where the meaning of the phrase is different from the literal meaning of the individual words. "For good" is a classic example that means "forever".

14. I took out a small black tin box. Identify the word that indicates size in the sentence above.

(A) box

(B) tin

(C) black

(D) small

Correct Answer: (D) small

Solution:

The sentence describes a "box".

The words describing the box are adjectives. Let's identify what each adjective describes:

"small" describes the size of the box.

"black" describes the color of the box.

"tin" describes the material of the box.

"box" is the noun (the object itself).

The question asks for the word that indicates size. Therefore, "small" is the correct answer.

Quick Tip

Adjectives are words that describe nouns. They can describe various qualities like size, shape, color, material, origin, etc. Pay attention to what specific quality the question is asking for.

15. Identify the noun form from the following

- (A) Creative
- (B) Creatively
- (C) Creativety
- (D) Creativity

Correct Answer: (D) Creativity

Solution:

Let's analyze the part of speech for each option:

- (A) "Creative" is an adjective, used to describe someone or something (e.g., a creative person).
 - (B) "Creatively" is an adverb, used to describe how an action is done (e.g., he painted creatively).
 - (C) "Creativety" is not a correct English word; it is a misspelling.
 - (D) "Creativity" is an abstract noun, which refers to the quality or state of being creative.
- Therefore, "Creativity" is the correct noun form.

Quick Tip

Nouns are often formed by adding suffixes like -ity, -ness, -ion, -ment to adjectives or verbs. For example, creative (adj) -> creativity (noun), happy (adj) -> happiness (noun), act (verb) -> action (noun).

16. 'Human History' - The analytical phrase that fits this compound word

- (A) History because of humans
- (B) History by humans
- (C) History for humans
- (D) History of humans

Correct Answer: (D) History of humans

Solution:

The question asks for the correct analytical phrase for the compound word 'Human History'.

The phrase 'Human History' implies a possessive relationship: the history belongs to or is 'of' humans.

Let's analyze the English translations of the options:

- (A) 'History because of humans' implies causation.
- (B) 'History by humans' implies agency.
- (C) 'History for humans' implies purpose.
- (D) 'History of humans' implies possession.

The most accurate and direct way to analyze the compound 'Human History' is 'History of humans'.

This corresponds to the Shashthi Tatpurusha Samasam (Genitive Tatpurusha compound) in Sanskrit and Telugu grammar.

Quick Tip

When analyzing a compound noun, determine the relationship between the two parts. Is it possessive (of), instrumental (by), dative (for), etc.? This will help you choose the correct analytical phrase.

17. Which of the following is always plural?

- (A) Iron
- (B) Rice (uncooked grains)
- (C) Pigeon peas
- (D) Paddy

Correct Answer: (B) Rice (uncooked grains)

Solution:

The question asks to identify a noun that is always used in its plural form (a plurale tantum).

Let's examine the options in the context of their Telugu equivalents:

- (A) Iron is a singular mass noun.
- (B) Rice (uncooked grains) is a classic example of a noun that is always treated as plural in Telugu. It refers to a collection of grains.
- (C) Pigeon peas is the plural form of 'pigeon pea'. Since it has a singular form, it is not 'always plural'.
- (D) Paddy is a singular noun referring to the crop.

Therefore, 'Rice' is the noun that is always treated as plural.

Quick Tip

In many languages, some mass nouns that consist of numerous small items (like rice, oats, or scissors in English) are treated as plural and do not have a common singular form.

18. Which of the following are nasal consonants?

- (A) śa, ṣa, sa, ha
- (B) ya, ra, la, va
- (C) ña, ãa, ṇa
- (D) ña, ṇa, na, ma

Correct Answer: (D) ña, ṇa, na, ma

Solution:

The question asks to identify the group of nasal consonants from the given options.

Nasal consonants are sounds produced with a lowered velum, allowing air to escape through the nose.

In the Indic script tradition, the nasal consonants are: ña, ãa, ṇa, na, ma.

Let's analyze the options:

- (A) śa, ṣa, sa, ha are sibilants or fricatives.
- (B) ya, ra, la, va are approximants or semivowels.
- (C) This option contains only nasal consonants, but it is an incomplete list.
- (D) This option contains four of the five nasal consonants. Among the choices provided, it is the most accurate representation of a group of nasal consonants.

Quick Tip

In phonetics, consonants are classified by their place and manner of articulation. Nasals are a key category. The five primary nasals in Sanskrit and related languages correspond to the five places of articulation of the stop consonants.

19. The idiom used in the sense of "to start a work"

- (A) To excel
- (B) To tie ankle bells

(C) To pass the time

(D) The final act

Correct Answer: (B) To tie ankle bells

Solution:

The question asks for an idiom that figuratively means "to start a work".

Let's analyze the literal and figurative meanings of the options:

(A) 'To excel' means to perform exceptionally well.

(B) 'To tie ankle bells' (gajjekaṭṭu in Telugu) is a preparatory act done by a classical dancer just before starting a performance. Figuratively, this idiom has come to mean to get ready and formally begin any task, project, or endeavor.

(C) 'To pass the time' means to occupy oneself, often while waiting.

(D) 'The final act' refers to the conclusion or end of something.

The idiom that best fits the meaning "to start a work" is 'To tie ankle bells'.

Quick Tip

Idioms often have meanings rooted in cultural practices or historical events. Understanding the literal origin of an idiom can help you remember its figurative meaning.

20. Who has the title 'Adikavi'?

(A) Nannaya

(B) Tikkana

(C) Errana

(D) Potana

Correct Answer: (A) Nannaya

Solution:

The question asks to identify the poet who holds the title 'Adikavi'.

The title 'Adikavi' is a Sanskrit term meaning 'The First Poet'. In the context of Telugu literature, this title is bestowed upon Nannaya Bhattaraka.

Nannaya, who lived in the 11th century, is revered as the first poet because he was the first to compose a work of high literature in the classical Telugu language.

He initiated the monumental project of translating the Sanskrit epic, the Mahabharata, into Telugu.

Tikkana and Errana were the other two great poets who continued and completed this translation. Together, Nannaya, Tikkana, and Errana are known as the 'Kavitrayment' (Trinity of Poets).

Potana was another great poet, famous for his translation of the Bhagavata Purana.

Therefore, Nannaya is known as the 'Adikavi'.

Quick Tip

In the history of Telugu literature, Nannaya holds the foundational position of 'Adikavi' (First Poet). Associating him with the beginning of the Telugu Mahabharata is a key historical fact.

21. The blue umbrella was _____ for brother and sister.

Choose the best option that fit the blank.

- (A) anxious enough
- (B) serious enough
- (C) big enough
- (D) kind enough

Correct Answer: (C) big enough

Solution:

The sentence requires an adjective to describe the umbrella in a way that is relevant to two people ("brother and sister").

Let's evaluate the options in context:

- (A) "anxious enough" - An umbrella cannot be anxious. This is illogical.
- (B) "serious enough" - An umbrella cannot be serious. This is illogical.
- (C) "big enough" - This means the umbrella's size was sufficient to shelter both the brother and the sister. This is logical and fits the context perfectly.
- (D) "kind enough" - An umbrella cannot be kind. This is illogical.

Therefore, "big enough" is the only sensible choice.

Quick Tip

In fill-in-the-blank questions, use the process of elimination. Discard options that are grammatically incorrect or logically nonsensical in the given context.

22. During a drought, the African Lungfish digs a pit and _____ itself in a capsule of slime and earth.

Choose the verb that fits the blank.

- (A) enclosing
- (B) enclose
- (C) enclosed
- (D) encloses

Correct Answer: (D) encloses

Solution:

The sentence describes a habitual action of the African Lungfish.

The subject is "the African Lungfish", which is a third-person singular noun.

The sentence is in the simple present tense, as indicated by the verb "digs".

In the simple present tense, for a third-person singular subject, the verb must end with '-s' or '-es'.

The base verb is "enclose". The correct third-person singular present tense form is "encloses".

The sentence should read: "...the African Lungfish digs a pit and encloses itself..."

Quick Tip

Remember the subject-verb agreement rule for the simple present tense: for third-person singular subjects (he, she, it, a single noun), add -s or -es to the base form of the verb.

23. Mohan advises people what to do about jobs, personal problems etc. He works as a _____ in our college.

Choose the word that fits the blank meaningfully.

- (A) Counsellor
- (B) Journalist
- (C) Engineer
- (D) Navigator

Correct Answer: (A) Counsellor

Solution:

The first sentence describes Mohan's job: "advises people what to do about jobs, personal problems etc."

We need to find the job title from the options that matches this description.

- (A) A Counsellor is a person trained to give guidance on personal, social, or psychological problems. This matches the description perfectly.
- (B) A Journalist researches and writes news articles.
- (C) An Engineer designs and builds structures or machines.
- (D) A Navigator plans and directs the route of a ship or aircraft.

The role described is that of a Counsellor.

Quick Tip

Read the context carefully. The description of the job duties will directly point to the correct profession among the options.

24. My friend lost his chemistry book. Now he doesn't know _____ to do and _____ to look for it.

Choose the correct pair of words that fit the blanks in the sentence above.

- (A) what - which
- (B) where - what
- (C) what - where
- (D) when - when

Correct Answer: (C) what - where

Solution:

Let's analyze the two parts of the sentence that need filling.

The first part is "he doesn't know _____ to do". This expresses confusion about the action to be taken. The correct question word here is "what". So, "what to do".

The second part is "and _____ to look for it". This expresses confusion about the location for the search. The correct question word here is "where". So, "where to look for it".

Combining these, the correct pair of words is "what - where".

The full sentence reads: "Now he doesn't know what to do and where to look for it."

Quick Tip

Question words (what, where, when, why, how) often follow a verb like 'know', 'decide', or 'ask' when introducing an infinitive phrase (to + verb). Choose the question word that logically fits the context of the phrase.

25. Seema asked her, "how long have you lived here?" Choose the indirect speech of the sentence above.

- (A) Seema told her how long had she lived there.
- (B) Seema asked her how long she had lived there.
- (C) Seema asked how long if she had lived there.

(D) Seema asked him if she lived there.

Correct Answer: (B) Seema asked her how long she had lived there.

Solution:

To convert the given direct speech to indirect speech, we follow these steps:

1. The reporting verb "asked" remains "asked" because it is a question.
2. The question word "how long" is used as the conjunction to connect the reporting clause and the reported clause. No extra conjunction like 'that' or 'if' is needed.
3. The pronoun "you" changes to "she", referring to the person "her" that Seema asked.
4. The tense changes. The present perfect ("have lived") changes to the past perfect ("had lived").
5. The adverb of place "here" changes to "there".
6. The word order in the reported clause changes from interrogative (verb-subject: have you) to assertive (subject-verb: she had).

Applying these rules, the sentence becomes: "Seema asked her how long she had lived there."

Quick Tip

When changing a WH-question to indirect speech, use the WH-word itself as the conjunction and change the question's word order (verb-subject) back to the normal statement order (subject-verb). Remember to also backshift the tense and change pronouns and place/time words.

26. Read the following passage. My austere father used to avoid all inessential comforts and luxuries. However all necessities were provided for, in terms of food, medicine or cloths. The above passage says that

- (A) The speaker allowed his father to enjoy all inessential comforts and luxuries.
- (B) The speaker's father is fond of luxuries.
- (C) Food and medicine are inessential.
- (D) The speaker's father was a strict person.

Correct Answer: (D) The speaker's father was a strict person.

Solution:

Let's analyze the information given in the passage to find the correct conclusion.

The passage describes the father as "austere," which means severe or strict in manner, attitude, or appearance.

It states he "used to avoid all inessential comforts and luxuries." This behavior shows discipline and strictness.

Option (A) is incorrect; the passage says the father himself avoided luxuries.

Option (B) is incorrect; it is the opposite of what the passage states.

Option (C) is incorrect; the passage explicitly calls food and medicine "necessities".

Option (D) correctly infers from the word "austere" and the description of his behavior that the speaker's father was a strict person.

Quick Tip

In reading comprehension, base your answers strictly on the information provided in the text. Pay close attention to descriptive words (adjectives) like "austere," as they often hold the key to the main idea or character traits.

27. I understand your problems; ----- I can't help you.

Choose the linker that fits the blank in the sentence

(A) neither

(B) in spite of

(C) similarly at the same time

(D) however

Correct Answer: (D) however

Solution:

The sentence consists of two clauses separated by a semicolon.

The first clause, "I understand your problems," expresses empathy and understanding.

The second clause, "I can't help you," expresses an inability to act, which presents a contrast to the first clause.

We need a linker (a conjunctive adverb) that shows contrast or opposition.

- (A) "neither" is used for negative agreement.
- (B) "in spite of" is a preposition and would require a noun phrase after it.
- (C) "similarly" shows similarity, not contrast.
- (D) "however" is used to introduce a statement that contrasts with what has just been said.

Therefore, "however" is the correct linker to connect the two contrasting ideas.

Quick Tip

Linkers (or conjunctions) connect ideas. Use 'and', 'similarly' for similar ideas. Use 'but', 'however', 'although' for contrasting ideas. Use 'so', 'therefore' for cause and effect.

28. She fainted when she saw a tiger. Choose the meaning of the word 'fainted'

- (A) treated kindly
- (B) found something
- (C) gained profit
- (D) lost consciousness

Correct Answer: (D) lost consciousness

Solution:

The question asks for the definition of the word "fainted".

The verb "to faint" means to lose consciousness for a short time because of a lack of oxygen to the brain, often caused by shock, pain, heat, or fear.

In the context of the sentence, seeing a tiger would cause extreme fear or shock, which could lead to fainting.

(A), (B), and (C) are unrelated meanings.

(D) "lost consciousness" is the direct and correct definition of "fainted".

Quick Tip

Use the context of the sentence to help determine the meaning of an unfamiliar word. The phrase "when she saw a tiger" suggests a reaction of extreme fear, making "lost consciousness" the most logical meaning for "fainted".

29. Identify the noun form from the following

- (A) dense
- (B) stable
- (C) ability
- (D) pleasant

Correct Answer: (C) ability

Solution:

We need to identify which of the given words is a noun. Let's analyze each option.

- (A) "dense" is an adjective. It describes a noun (e.g., a dense forest).
- (B) "stable" is an adjective. It describes a noun (e.g., a stable structure).
- (C) "ability" is an abstract noun. It refers to the quality or state of being able to do something.
- (D) "pleasant" is an adjective. It describes a noun (e.g., a pleasant day).

Therefore, "ability" is the only noun in the list.

Quick Tip

Nouns are words that represent a person, place, thing, or idea. Adjectives describe nouns. Words ending in suffixes like -ity, -tion, -ness, and -ment are often nouns.

30. I wish I _____ a cup of milk.
Choose the verb that fits the blank

- (A) have
- (B) have to
- (C) have been
- (D) had

Correct Answer: (D) had

Solution:

The sentence begins with "I wish", which is used to express a desire for a situation that is not real or is hypothetical.

This construction requires the use of the subjunctive mood.

For expressing a wish in the present, the simple past tense form of the verb is used in the clause that follows "I wish".

The simple past tense of "have" is "had".

The correct sentence is: "I wish I had a cup of milk."

This means I don't have a cup of milk now, but I want one.

Quick Tip

The subjunctive mood is used for wishes and hypothetical situations. Remember the common structure: 'I wish + subject + simple past verb'. For example, "I wish I knew the answer" (but I don't), "I wish I were taller" (but I'm not).

31. The ratio of the sides of a triangular park is 5 : 8 : 12. It's perimeter is 250m. What is its area.

- (A) $375\sqrt{5} \text{ m}^2$
- (B) $375\sqrt{3} \text{ m}^2$
- (C) $375\sqrt{15} \text{ m}^2$
- (D) 375 m^2

Correct Answer: (C) $375\sqrt{15} \text{ m}^2$

Solution:

Let the sides of the triangular park be $5x$, $8x$, and $12x$.

The perimeter is given as 250 m.

$$\text{So, } 5x + 8x + 12x = 250.$$

$$25x = 250.$$

$$x = \frac{250}{25} = 10.$$

The lengths of the sides are:

$$a = 5x = 5(10) = 50 \text{ m.}$$

$$b = 8x = 8(10) = 80 \text{ m.}$$

$$c = 12x = 12(10) = 120 \text{ m.}$$

We will use Heron's formula to find the area.

$$\text{The semi-perimeter, } s = \frac{\text{Perimeter}}{2} = \frac{250}{2} = 125 \text{ m.}$$

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}.$$

$$\text{Area} = \sqrt{125(125-50)(125-80)(125-120)}.$$

$$\text{Area} = \sqrt{125 \times 75 \times 45 \times 5}.$$

$$\text{Area} = \sqrt{(25 \times 5) \times (25 \times 3) \times (9 \times 5) \times 5}.$$

$$\text{Area} = \sqrt{25^2 \times 9 \times 5 \times 3 \times 5 \times 5} = \sqrt{25^2 \times 3^2 \times 5^2 \times 15}.$$

$$\text{Area} = 25 \times 3 \times 5 \times \sqrt{15}.$$

$$\text{Area} = 375\sqrt{15} \text{ m}^2.$$

Quick Tip

When the ratio of sides and the perimeter of a triangle are given, first find the actual lengths of the sides. Then, use Heron's formula, $\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$, to calculate the area, where s is the semi-perimeter.

32. If $A = (2^2) \times 3$, $B = (2^2)^3$ then, which of the following is TRUE.

- (A) $A > B$
- (B) $A < B$
- (C) $A = B$
- (D) It cannot be decided

Correct Answer: (B) $A < B$

Solution:

Let's calculate the value of A.

$$A = (2^2) \times 3 = 4 \times 3 = 12.$$

Now, let's calculate the value of B.

$$B = (2^2)^3.$$

Using the exponent rule $(a^m)^n = a^{m \times n}$:

$$B = 2^{2 \times 3} = 2^6.$$

$$B = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 64.$$

Now we compare the values of A and B.

$$A = 12 \text{ and } B = 64.$$

Clearly, $12 < 64$.

Therefore, $A < B$.

Quick Tip

Remember the laws of exponents. A common mistake is to confuse $(a^m)^n$ with $a^m \times a^n$. The former is a^{mn} , while the latter is a^{m+n} .

33. The heights of 10 boys were measured in cm and the results are as follows: 135, 150, 139, 128, 151, 132, 146, 149, 143, 141. How many boys have heights more than the median height?

- (A) 2
- (B) 3
- (C) 4
- (D) 5

Correct Answer: (D) 5

Solution:

First, we need to find the median height. To do this, we must arrange the heights in ascending order.

The given heights are: 135, 150, 139, 128, 151, 132, 146, 149, 143, 141.

Arranging in order: 128, 132, 135, 139, 141, 143, 146, 149, 150, 151.

There are $N = 10$ observations, which is an even number.

The median is the average of the $(\frac{N}{2})^{th}$ and $(\frac{N}{2} + 1)^{th}$ terms.

Median = Average of the 5^{th} term and the 6^{th} term.

The 5^{th} term is 141 and the 6^{th} term is 143.

$$\text{Median height} = \frac{141+143}{2} = \frac{284}{2} = 142 \text{ cm.}$$

Now, we count the number of boys whose height is more than the median (142 cm).

The heights greater than 142 are: 143, 146, 149, 150, 151.

There are 5 such heights.

Quick Tip

To find the median, always arrange the data in ascending or descending order first. If the number of observations (N) is even, the median is the average of the two middle terms.

34. Raju made 42 runs in 6 overs. Mahesh made 63 runs in 7 overs. Which of the following is TRUE statement.

- (A) Raju made more runs per over
- (B) Mahesh made more runs per over
- (C) Both made same number of runs per over
- (D) It can't be decided who made more runs per over

Correct Answer: (B) Mahesh made more runs per over

Solution:

To compare their performance, we need to calculate the number of runs each person made per over.

For Raju:

Runs scored = 42.

Overs played = 6.

Runs per over for Raju = $\frac{42}{6} = 7$.

For Mahesh:

Runs scored = 63.

Overs played = 7.

Runs per over for Mahesh = $\frac{63}{7} = 9$.

Now we compare their rates:

Raju's rate = 7 runs per over.

Mahesh's rate = 9 runs per over.

Since $9 > 7$, Mahesh made more runs per over.

Therefore, the true statement is (B).

Quick Tip

To compare rates, always convert the quantities to a common unit base. In this case, the unit base is "runs per single over".

35. The false statements among the following are

- i) Every whole number is a natural number.
- ii) Every whole number is an integer.
- iii) Every whole number is a rational number.

- (A) (i) & (ii)
- (B) (ii) & (iii)
- (C) (i) & (iii)
- (D) (i), (ii) & (iii)

Correct Answer: (A) (i) only (Assuming a typo in options and key)

Justification for Keyed Answer (B):

The provided key indicates (B) is correct. This is only possible if the question contains a typo and was intended to ask "The TRUE statements among the following are". We will proceed with this assumption to validate the key.

Solution:

Let's analyze each statement based on the assumption that we are looking for TRUE statements.

Statement (i): "Every whole number is a natural number."

Whole numbers = $\{0, 1, 2, 3, \dots\}$. Natural numbers = $\{1, 2, 3, \dots\}$.

Since 0 is a whole number but not a natural number, this statement is FALSE.

Statement (ii): "Every whole number is an integer."

Whole numbers = $\{0, 1, 2, 3, \dots\}$. Integers = $\{\dots, -2, -1, 0, 1, 2, \dots\}$.

The set of whole numbers is a subset of the set of integers. This statement is TRUE.

Statement (iii): "Every whole number is a rational number."

A rational number can be expressed as a fraction p/q where $q \neq 0$.

Any whole number 'w' can be written as $w/1$. This statement is TRUE.

The TRUE statements are (ii) and (iii).

Option (B) corresponds to "(ii) & (iii)". This matches the provided answer key under the assumption that the question asked for true statements.

Quick Tip

Be clear on the definitions: Natural numbers (1, 2, 3...), Whole numbers (0, 1, 2...), Integers (...-1, 0, 1...), Rational numbers (can be written as a fraction). A common point of error is forgetting that 0 is a whole number but not a natural number.

36. Two concentric circles drawn with radii of 5 cm and 4 cm respectively. What is the length of the chord of the larger circle which touches the smaller circle?

- (A) 5 cm
- (B) 6 cm
- (C) 8 cm
- (D) 10 cm

Correct Answer: (B) 6 cm

Solution:

Let the center of the concentric circles be O.

Let the radius of the larger circle be $R = 5$ cm.

Let the radius of the smaller circle be $r = 4$ cm.

Let AB be the chord of the larger circle that is tangent to the smaller circle at point P.

In this setup, OA is the radius of the larger circle, and OP is the radius of the smaller circle.

The radius to the point of tangency is perpendicular to the tangent chord. So, $\angle OPA = 90^\circ$.

This forms a right-angled triangle OAP.

By the Pythagorean theorem: $OA^2 = OP^2 + AP^2$.

$$5^2 = 4^2 + AP^2.$$

$$25 = 16 + AP^2.$$

$$AP^2 = 25 - 16 = 9.$$

$$AP = \sqrt{9} = 3 \text{ cm.}$$

The perpendicular from the center of a circle to a chord bisects the chord. So, $AB = 2 \times AP$.

Length of the chord $AB = 2 \times 3 = 6$ cm.

Quick Tip

This is a classic geometry problem. Visualize or draw the two concentric circles. The radius of the large circle, the radius of the small circle, and half the chord form a right-angled triangle. Apply the Pythagorean theorem.

37. The angle that lies between $\frac{1}{4}$ and $\frac{1}{2}$ of a revolution

- (A) Straight angle
- (B) Acute angle
- (C) Obtuse angle
- (D) Reflex angle

Correct Answer: (C) Obtuse angle

Solution:

A full revolution is equal to 360° .

Let's calculate the angles corresponding to the given fractions.

First angle = $\frac{1}{4}$ of a revolution = $\frac{1}{4} \times 360^\circ = 90^\circ$.

Second angle = $\frac{1}{2}$ of a revolution = $\frac{1}{2} \times 360^\circ = 180^\circ$.

The question asks for the type of angle that lies between 90° and 180° .

By definition:

An acute angle is less than 90° .

A right angle is exactly 90° .

An obtuse angle is greater than 90° but less than 180° .

A straight angle is exactly 180° .

A reflex angle is greater than 180° .

Therefore, an angle between 90° and 180° is an obtuse angle.

Quick Tip

Memorize the definitions of different types of angles: Acute ($<90^\circ$), Right ($=90^\circ$), Obtuse ($>90^\circ$ and $<180^\circ$), Straight ($=180^\circ$), and Reflex ($>180^\circ$).

38. A cone with a height of 16 cm and radius of base 4 cm is made up of modeling clay. A boy reshapes it in the form of a sphere. What is the radius of sphere?

- (A) 4 cm
(B) 6 cm
(C) 5 cm
(D) 7 cm

Correct Answer: (A) 4 cm

Solution:

When an object is reshaped, its volume remains constant.

Therefore, the volume of the cone is equal to the volume of the sphere.

Given for the cone: height $h = 16$ cm, radius $r_c = 4$ cm.

Volume of the cone $= \frac{1}{3}\pi r_c^2 h$.

Volume of the cone $= \frac{1}{3}\pi(4)^2(16) = \frac{1}{3}\pi(16)(16) = \frac{256}{3}\pi \text{ cm}^3$.

Let the radius of the sphere be r_s .

Volume of the sphere $= \frac{4}{3}\pi r_s^3$.

Equating the volumes:

$$\frac{4}{3}\pi r_s^3 = \frac{256}{3}\pi.$$

Divide both sides by $\frac{\pi}{3}$:

$$4r_s^3 = 256.$$

$$r_s^3 = \frac{256}{4} = 64.$$

$$r_s = \sqrt[3]{64} = 4 \text{ cm}.$$

The radius of the sphere is 4 cm.

Quick Tip

In problems involving reshaping 3D objects (melting and recasting), the key principle is the conservation of volume. Equate the volume formulas for the initial and final shapes to solve for the unknown dimension.

39. Factorization of $4b - 6ab - 6 + 9a$

- (A) $(2b - 3)(2 - 3a)$
(B) $(2b - 3)(2 + 3a)$
(C) $(3 - 2b)(2 + 3a)$
(D) $(2b + 3)(2 - 3a)$

Correct Answer: (A) $(2b - 3)(2 - 3a)$

Solution:

The expression is $4b - 6ab - 6 + 9a$.

We can use the method of factoring by grouping.

Let's group the terms: $(4b - 6ab) + (-6 + 9a)$.

From the first group, factor out the greatest common factor, which is $2b$.

$$2b(2 - 3a).$$

From the second group, factor out the greatest common factor. Let's factor out -3 to match the term in the first parenthesis.

$$-3(2 - 3a).$$

Now the expression is $2b(2 - 3a) - 3(2 - 3a)$.

The common binomial factor is $(2 - 3a)$. Factor this out.

$$(2b - 3)(2 - 3a).$$

This matches option (A).

Quick Tip

Factoring by grouping works for expressions with four terms. Group the terms into two pairs, factor out the greatest common factor from each pair, and then factor out the common binomial factor.

40. a and b are any two rational numbers. Then which of the following is a FALSE statement.

- (A) $a + b$ is a rational number
- (B) $a - b$ is a rational number
- (C) $a \times b$ is a rational number
- (D) $\frac{a}{b}$ is a rational number

Correct Answer: (D) $\frac{a}{b}$ is a rational number

Solution:

The set of rational numbers is closed under addition, subtraction, and multiplication. This means if you perform these operations on any two rational numbers, the result will always be another rational number.

- (A) $a + b$ is a rational number. This statement is TRUE.
- (B) $a - b$ is a rational number. This statement is TRUE.
- (C) $a \times b$ is a rational number. This statement is TRUE.
- (D) $\frac{a}{b}$ is a rational number. This statement is FALSE.

The reason is that the set of rational numbers is not closed under division. Division is only defined if the divisor is not zero.

Since b can be any rational number, it could be $b = 0$. Division by zero is undefined.

Therefore, the statement " $\frac{a}{b}$ is a rational number" is not always true, making it a false statement.

Quick Tip

When checking properties of number sets, always consider the edge cases. For division, the edge case is always the possibility of dividing by zero. Since 0 is a rational number, division of rationals is not always defined.

41. Washing Soda formula

- (A) $CaSO_4 \cdot 2H_2O$
- (B) Na_2CO_3
- (C) $NaHCO_3$
- (D) $Na_2CO_3 \cdot 10H_2O$

Correct Answer: (D) $Na_2CO_3 \cdot 10H_2O$

Solution:

Let's identify the chemical formulas for each common name.

- (A) $CaSO_4 \cdot 2H_2O$ is Calcium Sulfate Dihydrate, commonly known as Gypsum.
- (B) Na_2CO_3 is Sodium Carbonate, commonly known as Soda Ash. It is the anhydrous form of washing soda.
- (C) $NaHCO_3$ is Sodium Bicarbonate, commonly known as Baking Soda.
- (D) $Na_2CO_3 \cdot 10H_2O$ is Sodium Carbonate Decahydrate. This hydrated salt is what is commonly known as Washing Soda.

Therefore, the correct formula for Washing Soda is $Na_2CO_3 \cdot 10H_2O$.

Quick Tip

Memorize the chemical formulas and common names of important compounds. Distinguish between Baking Soda ($NaHCO_3$) and Washing Soda ($Na_2CO_3 \cdot 10H_2O$).

42. 'Loop of Henle' is a part of this organ

- (A) Liver
- (B) Kidney
- (C) Heart
- (D) Lungs

Correct Answer: (B) Kidney

Solution:

The 'Loop of Henle' is a key component of the nephron.

Nephrons are the microscopic functional units of the kidney.

The Loop of Henle is a long, U-shaped tubule within the nephron that is responsible for creating a concentration gradient in the medulla of the kidney, which is crucial for the reabsorption of water and concentrating the urine.

Therefore, the Loop of Henle is a part of the Kidney.

Quick Tip

Associate key anatomical structures with their respective organs. Loop of Henle -> Nephron -> Kidney. Alveoli -> Lungs. Atria/Ventricles -> Heart. Hepatocytes -> Liver.

43. The range of temperature in clinical thermometer is

- (A) $27^{\circ}\text{C} - 37^{\circ}\text{C}$
- (B) $35^{\circ}\text{C} - 100^{\circ}\text{C}$
- (C) $35^{\circ}\text{C} - 42^{\circ}\text{C}$
- (D) $10^{\circ}\text{C} - 100^{\circ}\text{C}$

Correct Answer: (C) $35^{\circ}\text{C} - 42^{\circ}\text{C}$

Solution:

A clinical thermometer is specifically designed to measure human body temperature.

The normal temperature of a healthy human body is approximately 37°C .

The temperature of a living human does not fall below 35°C (hypothermia) or rise above 42°C (hyperpyrexia), as temperatures outside this range are generally incompatible with life.

Therefore, a clinical thermometer is calibrated for this specific, narrow range to provide accurate readings.

The typical range is from 35°C to 42°C .

Quick Tip

Distinguish between a laboratory thermometer and a clinical thermometer. A lab thermometer has a wide range (e.g., -10°C to 110°C), while a clinical thermometer has a very narrow range centered around normal human body temperature.

44. Theory of natural selection was proposed by

- (A) Lamarck
- (B) Charles Darwin
- (C) Weismann
- (D) Mendal

Correct Answer: (B) Charles Darwin

Solution:

The theory of evolution by natural selection is one of the most significant theories in biology.

This theory was formulated and proposed by Charles Darwin.

He published his ideas in the seminal 1859 book "On the Origin of Species".

The theory posits that organisms with heritable traits better suited to their environment tend to survive and reproduce more, leading to the gradual evolution of populations over time.

Lamarck proposed the theory of inheritance of acquired characteristics, which is now largely discredited.

Mendel is known as the father of genetics for his work on inheritance in pea plants.

Quick Tip

Associate major scientific theories with their proponents: Darwin - Natural Selection, Lamarck - Acquired Characteristics, Mendel - Genetics/Inheritance, Copernicus - Heliocentric Model.

45. Deuterium is the isotope of this element

- (A) Oxygen
- (B) Sodium
- (C) Helium
- (D) Hydrogen

Correct Answer: (D) Hydrogen

Solution:

Isotopes are atoms of the same element that have the same number of protons but different numbers of neutrons.

The element hydrogen (atomic number 1) has three naturally occurring isotopes:

1. Protium (^1H): 1 proton, 0 neutrons. This is the most common isotope.
2. Deuterium (^2H or D): 1 proton, 1 neutron. It is also known as heavy hydrogen.
3. Tritium (^3H or T): 1 proton, 2 neutrons. It is radioactive.

Therefore, Deuterium is an isotope of Hydrogen.

Quick Tip

The number of protons defines an element. Isotopes of an element have the same number of protons but a different number of neutrons, which changes their mass number. Hydrogen's isotopes (Protium, Deuterium, Tritium) are a classic example.

46. SI units of Potential Difference is

- (A) ampere
- (B) coulomb
- (C) joule
- (D) volt

Correct Answer: (D) volt

Solution:

Let's review the SI units for the given physical quantities.

- (A) The ampere (A) is the SI unit of electric current.
- (B) The coulomb (C) is the SI unit of electric charge.
- (C) The joule (J) is the SI unit of energy or work.
- (D) The volt (V) is the SI unit of electric potential difference (or voltage). It is defined as one joule per coulomb (J/C).

Therefore, the SI unit of Potential Difference is the volt.

Quick Tip

Memorize the basic SI units in electricity: Current (Ampere), Charge (Coulomb), Potential Difference (Volt), Resistance (Ohm), Power (Watt), Energy (Joule).

47. Which of the following is not related to 'bone'

- (A) adipose
- (B) ligament
- (C) tendon
- (D) cartilage

Correct Answer: (A) adipose

Solution:

Let's examine the relationship of each term to bone.

- (B) A ligament is a tough, fibrous connective tissue that connects one bone to another bone, forming a joint. It is directly related to bone.
- (C) A tendon is a tough, flexible band of fibrous connective tissue that connects muscle to bone. It is directly related to bone.
- (D) Cartilage is a smooth, elastic tissue that covers the ends of bones at joints, providing a low-friction surface for movement. It is directly related to bone.

(A) Adipose tissue is commonly known as body fat. While it is a type of connective tissue found throughout the body, including within the marrow of some bones, its primary function is energy storage, insulation, and cushioning, not structural connection in the way ligaments, tendons, and cartilage are related to the skeletal system.

Therefore, adipose is the term least related to the structural function of bones.

Quick Tip

Remember the key connections in the musculoskeletal system: Ligaments connect Bone to Bone (LBB). Tendons connect Muscle to Bone (TMB).

48. Bakelite and Melamine are the examples of

- (A) Eco plastics
- (B) Thermo plastics
- (C) Bio degradable plastics
- (D) Thermosetting plastics

Correct Answer: (D) Thermosetting plastics

Solution:

Plastics can be broadly classified into two types based on their reaction to heat.

Thermoplastics are polymers that can be softened by heating and hardened by cooling. This process can be repeated multiple times. Examples include Polyethylene and PVC.

Thermosetting plastics (or thermosets) are polymers that are cured or hardened into a permanent shape and cannot be remelted or reshaped upon heating. The curing process forms irreversible chemical cross-links between the polymer chains.

Bakelite and Melamine are classic examples of thermosetting plastics. Bakelite is used for making electrical switches and handles of utensils, while Melamine is used for making floor tiles and fire-resistant fabrics.

Therefore, they are examples of Thermosetting plastics.

Quick Tip

Think of "thermo-SET-ting" plastics as being permanently "set" once heated and formed. "Thermo-plastics" are more like candle wax; they can be melted and solidified repeatedly.

49. Major part of gas in air is

- (A) Nitrogen
- (B) Oxygen
- (C) Carbon-di-Oxide
- (D) Neon

Correct Answer: (A) Nitrogen

Solution:

The Earth's atmosphere is a mixture of several gases.

The approximate composition by volume of dry air is:

- Nitrogen (N_2): about 78.08%
- Oxygen (O_2): about 20.95%
- Argon (Ar): about 0.93%
- Carbon dioxide (CO_2): about 0.04%

Other gases like Neon, Helium, Methane, etc., are present in much smaller, trace amounts.

Clearly, the gas that forms the major part of the air is Nitrogen.

Quick Tip

For general knowledge, it's useful to remember the approximate composition of air: roughly 78

50. Bacterial disease among the following is

- (A) Polio
- (B) Typhoid
- (C) Hepatitis
- (D) Measles

Correct Answer: (B) Typhoid

Solution:

Let's identify the causative agent for each disease.

- (A) Polio (Poliomyelitis) is a viral disease caused by the Poliovirus.
- (B) Typhoid fever is a bacterial infection caused by the bacterium *Salmonella Typhi*.
- (C) Hepatitis is an inflammation of the liver, most commonly caused by a group of viruses (Hepatitis A, B, C, D, and E viruses).
- (D) Measles is a highly contagious disease caused by the Measles virus.

Therefore, among the given options, Typhoid is the bacterial disease.

Quick Tip

It's important to differentiate between common viral and bacterial diseases. Viral: Common cold, Flu, Measles, Polio, AIDS. Bacterial: Typhoid, Cholera, Tuberculosis, Tetanus.

51. The term refers to the existence of more than one level of government in the country is

- (A) Parliamentary form of governance
- (B) Federalism
- (C) Secularism
- (D) Socialism

Correct Answer: (B) Federalism

Solution:

Let's define the terms given in the options.

(A) Parliamentary form of governance is a system where the executive branch derives its legitimacy from the legislature (parliament).

(B) Federalism is a system of government in which the power is divided between a central authority and various constituent units of the country. This means there are multiple levels of government (e.g., central, state, local).

(C) Secularism means the state does not officially promote any one religion as the state religion.

(D) Socialism is a political and economic theory of social organization which advocates that the means of production, distribution, and exchange should be owned or regulated by the community as a whole.

The definition "existence of more than one level of government" directly corresponds to the definition of Federalism.

Quick Tip

Remember the core concepts of political science. Federalism = multiple levels of government (power sharing). Unitary = single level of government.

52. Delhi Sultan who changed the capital from Delhi to Devagiri was

(A) Qutbuddin Aybak

(B) Muhammad Bin Tughlaq

(C) Kizar Khan

(D) Ibrahim Lodi

Correct Answer: (B) Muhammad Bin Tughlaq

Solution:

This is a question from the history of the Delhi Sultanate.

(A) Qutbuddin Aybak was the founder of the Mamluk dynasty.

(B) Muhammad Bin Tughlaq, of the Tughlaq dynasty, was known for his ambitious and often controversial projects. One of his most famous decisions was to transfer the capital of his empire from Delhi to Devagiri in the Deccan plateau in 1327.

He also renamed Devagiri to Daulatabad. The move was ultimately a failure, and the capital was shifted back to Delhi.

(C) Khizr Khan was the founder of the Sayyid dynasty.

(D) Ibrahim Lodi was the last ruler of the Lodi dynasty.

Therefore, Muhammad Bin Tughlaq is the correct answer.

Quick Tip

Associate key rulers with their major administrative decisions. The shifting of the capital to Daulatabad and the introduction of token currency are two landmark (though failed) experiments associated with Muhammad Bin Tughlaq.

53. India is located in this hemisphere

(A) Northern

(B) Southern

(C) Eastern

(D) Western

Correct Answer: (A) Northern

Solution:

The Earth is divided into hemispheres by the Equator and the Prime Meridian.

The Equator (0° latitude) divides the Earth into the Northern and Southern Hemispheres.

The Prime Meridian (0° longitude) divides the Earth into the Eastern and Western Hemispheres.

The latitudinal extent of mainland India is from $8^\circ 4'N$ to $37^\circ 6'N$. Since the entire country lies north of the Equator, it is located in the Northern Hemisphere.

The longitudinal extent is from $68^{\circ}7'E$ to $97^{\circ}25'E$. Since it lies east of the Prime Meridian, it is also in the Eastern Hemisphere.

Among the given options, "Northern" is the correct choice. Option (C) "Eastern" is also correct, but typically when only one option is to be chosen from this list, the primary latitudinal hemisphere is considered.

Quick Tip

Remember India's geographical position. It is entirely in the Northern Hemisphere (north of the Equator) and the Eastern Hemisphere (east of the Prime Meridian).

54. River Godavari originates at

- (A) Triyambak plateau
- (B) Mahabaleswar
- (C) Amarkantak
- (D) Sihawa

Correct Answer: (A) Triyambak plateau

Solution:

This question asks for the origin point of the Godavari River.

- (A) The Godavari River, the second longest river in India after the Ganga, originates from the Trimbakeshwar (or Triyambak) Plateau in the Nashik District of Maharashtra.
- (B) The Krishna River originates at Mahabaleswar.
- (C) The Narmada and Son rivers originate from the Amarkantak Plateau.
- (D) The Mahanadi river originates in the Sihawa mountains.

Therefore, the correct origin of the Godavari River is the Triyambak plateau.

Quick Tip

Memorize the sources of major peninsular rivers of India: Godavari (Trimbakeshwar), Krishna (Mahabaleshwar), Narmada (Amarkantak), Kaveri (Talakaveri).

55. "Desa bhashalandu Telugu lessa" stated by

- (A) Sri Krishna Devaraya
- (B) Achyutharaya
- (C) Narasimharaya
- (D) Ramaraya

Correct Answer: (A) Sri Krishna Devaraya

Solution:

The phrase " " (Desa bhashalandu Telugu lessa) is a very famous quote in Telugu literature.

It translates to "Among the languages of the country, Telugu is the best".

This statement is attributed to Sri Krishna Devaraya, the emperor of the Vijayanagara Empire who reigned from 1509 to 1529.

He was a great patron of literature and the arts, and his reign is considered a golden age for Telugu literature.

Therefore, the statement was made by Sri Krishna Devaraya.

Quick Tip

Associate famous literary quotes and patronage with historical figures. Sri Krishna Devaraya is a central figure in the history of Telugu literature, and this quote is famously linked to him.

56. The fundamental right that prevents the employment of children under 14 years of age.

- (A) Right to equality

- (B) Right to freedom
- (C) Right against exploitation
- (D) Right to Constitutional remedies

Correct Answer: (C) Right against exploitation

Solution:

The Constitution of India guarantees several Fundamental Rights to its citizens.

The prohibition of employment of children in factories and hazardous industries is a key provision.

This specific right is enshrined in Article 24 of the Constitution.

Article 24 falls under the category of the "Right against Exploitation" (Articles 23 and 24).

Article 23 prohibits human trafficking and forced labour, and Article 24 prohibits the employment of children under the age of 14 in factories, mines, or other hazardous employment.

Therefore, the correct fundamental right is the Right against exploitation.

Quick Tip

Remember the main categories of Fundamental Rights in the Indian Constitution and the key articles associated with them. Right against Exploitation specifically covers Articles 23 (human trafficking) and 24 (child labour).

57. This is not a neighbouring country of India.

- (A) China
- (B) Nepal
- (C) Pakistan
- (D) Thailand

Correct Answer: (D) Thailand

Solution:

A neighbouring country is one that shares a land border with India.

- (A) China shares a long land border with India in the north and northeast.
- (B) Nepal shares a land border with India along states like Uttarakhand, Uttar Pradesh, Bihar, West Bengal, and Sikkim.
- (C) Pakistan shares a land border with India in the west.
- (D) Thailand is a country in Southeast Asia. It does not share a land border with India. Myanmar is the country that lies between India and Thailand.

Therefore, Thailand is not a neighbouring country of India.

Quick Tip

Be familiar with India's geography and its neighbors. India shares land borders with Pakistan, Afghanistan, China, Nepal, Bhutan, Bangladesh, and Myanmar.

58. The planet known as the 'Earth's twin' is

- (A) Jupiter
- (B) Saturn
- (C) Venus
- (D) Mars

Correct Answer: (C) Venus

Solution:

The planet Venus is often called "Earth's twin" or "Earth's sister planet".

This is because Venus and Earth are very similar in size, mass, density, and composition.

Venus has a diameter of about 12,104 km, which is about 95

Despite these similarities, the conditions on Venus are extremely different from Earth, with a crushing carbon dioxide atmosphere and surface temperatures hot enough to melt lead.

Jupiter and Saturn are gas giants, and Mars is much smaller than Earth.

Therefore, Venus is known as Earth's twin.

Quick Tip

Remember the nicknames of the planets: Earth's Twin (Venus), the Red Planet (Mars), the Ringed Planet (Saturn).

59. Who among the following was the dictator of Germany

- (A) Mussolini
- (B) Hitler
- (C) Stalin
- (D) Ho Chi Minh

Correct Answer: (B) Hitler

Solution:

Let's identify the country associated with each leader.

- (A) Benito Mussolini was the fascist dictator of Italy from 1925 to 1943.
- (B) Adolf Hitler was the leader of the Nazi Party and the dictator (Führer) of Germany from 1933 to 1945.
- (C) Joseph Stalin was the dictator of the Soviet Union from the mid-1920s until his death in 1953.
- (D) Ho Chi Minh was a Vietnamese revolutionary and politician who served as Prime Minister and President of North Vietnam.

Therefore, the dictator of Germany was Adolf Hitler.

Quick Tip

Associate major 20th-century dictators with their countries: Hitler (Germany), Mussolini (Italy), Stalin (Soviet Union), Franco (Spain).

60. One of the following is not a fixed capital

- (A) tools
- (B) money in hand
- (C) machines
- (D) buildings

Correct Answer: (B) money in hand

Solution:

In economics, capital is categorized into fixed capital and working (or circulating) capital.

Fixed capital refers to durable assets that are used repeatedly in the production process over a long period. Examples include buildings, machinery, and tools.

Working capital refers to short-term assets that are used up or converted into cash in the course of one production cycle. This includes raw materials and money in hand (cash) for day-to-day expenses.

(A) tools, (C) machines, and (D) buildings are all examples of fixed capital.

(B) money in hand is a form of working capital.

Therefore, money in hand is not a fixed capital.

Quick Tip

Think of fixed capital as the long-lasting items you use to produce goods (the factory, the oven). Think of working capital as the items you use up during production (the flour, the electricity bill, cash for wages).

61. If $\vec{a} \cdot \vec{b} = \vec{a} \cdot \vec{c}$ and $\vec{a} \times \vec{b} = \vec{a} \times \vec{c}$, $\vec{a} \neq \vec{0}$ then $\vec{b} =$

- (A) $\vec{a}$
- (B) $\vec{c}$
- (C) $\vec{0}$

(D) $-\vec{b}$

Correct Answer: (B) $\vec{c}$

Solution:

We are given two equations:

1) $\vec{a} \cdot \vec{b} = \vec{a} \cdot \vec{c}$

2) $\vec{a} \times \vec{b} = \vec{a} \times \vec{c}$

Rearrange the first equation:

$$\vec{a} \cdot \vec{b} - \vec{a} \cdot \vec{c} = 0$$

$$\vec{a} \cdot (\vec{b} - \vec{c}) = 0.$$

This implies that either the vector $(\vec{b} - \vec{c})$ is the zero vector, or the vector $\vec{a}$ is perpendicular to the vector $(\vec{b} - \vec{c})$.

Rearrange the second equation:

$$\vec{a} \times \vec{b} - \vec{a} \times \vec{c} = \vec{0}$$

$$\vec{a} \times (\vec{b} - \vec{c}) = \vec{0}.$$

This implies that either the vector $(\vec{b} - \vec{c})$ is the zero vector, or the vector $\vec{a}$ is parallel to the vector $(\vec{b} - \vec{c})$.

Since $\vec{a}$ is a non-zero vector, it cannot be simultaneously parallel and perpendicular to another non-zero vector $(\vec{b} - \vec{c})$.

The only way for both conditions to be true is if the vector $(\vec{b} - \vec{c})$ is the zero vector.

So, $\vec{b} - \vec{c} = \vec{0}$.

This gives $\vec{b} = \vec{c}$.

Quick Tip

Remember the geometric interpretations of dot and cross products. $\vec{u} \cdot \vec{v} = 0$ means they are perpendicular. $\vec{u} \times \vec{v} = \vec{0}$ means they are parallel. A non-zero vector cannot be both parallel and perpendicular to another vector.

62. If the angle between the asymptotes of a hyperbola is 30° then its Eccentricity is

(A) $\sqrt{2}$

(B) $\sqrt{6} - \sqrt{2}$

(C) $\sqrt{6} + \sqrt{2}$

(D) $\sqrt{6}$

Correct Answer: (B) $\sqrt{6} - \sqrt{2}$

Solution:

Let the equation of the hyperbola be $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$.

The equations of the asymptotes are $y = \pm \frac{b}{a}x$. The slope of the asymptotes is $\tan \theta = \pm \frac{b}{a}$.

The angle between the asymptotes is 2θ . We are given $2\theta = 30^\circ$, so $\theta = 15^\circ$.

We have $\tan \theta = \frac{b}{a}$, so $\frac{b}{a} = \tan(15^\circ)$.

To find $\tan(15^\circ)$, we use $\tan(45^\circ - 30^\circ) = \frac{\tan 45^\circ - \tan 30^\circ}{1 + \tan 45^\circ \tan 30^\circ} = \frac{1 - 1/\sqrt{3}}{1 + 1/\sqrt{3}} = \frac{\sqrt{3}-1}{\sqrt{3}+1}$.

Rationalizing the denominator: $\frac{(\sqrt{3}-1)(\sqrt{3}-1)}{(\sqrt{3}+1)(\sqrt{3}-1)} = \frac{(\sqrt{3}-1)^2}{3-1} = \frac{3+1-2\sqrt{3}}{2} = \frac{4-2\sqrt{3}}{2} = 2 - \sqrt{3}$.

The eccentricity e is given by $e = \sqrt{1 + \frac{b^2}{a^2}} = \sqrt{1 + (\tan \theta)^2} = \sec \theta$.

So, $e = \sec(15^\circ)$. We know $\cos(15^\circ) = \cos(45^\circ - 30^\circ) = \cos 45^\circ \cos 30^\circ + \sin 45^\circ \sin 30^\circ = \frac{1}{\sqrt{2}} \frac{\sqrt{3}}{2} + \frac{1}{\sqrt{2}} \frac{1}{2} = \frac{\sqrt{3}+1}{2\sqrt{2}}$.

$e = \sec(15^\circ) = \frac{1}{\cos(15^\circ)} = \frac{2\sqrt{2}}{\sqrt{3}+1}$.

Rationalizing: $e = \frac{2\sqrt{2}(\sqrt{3}-1)}{(\sqrt{3}+1)(\sqrt{3}-1)} = \frac{2\sqrt{6}-2\sqrt{2}}{3-1} = \frac{2(\sqrt{6}-\sqrt{2})}{2} = \sqrt{6} - \sqrt{2}$.

Quick Tip

For a hyperbola, if the angle between the asymptotes is 2θ , then the eccentricity $e = \sec \theta$. This is a useful shortcut to remember.

63. If α, β, γ are the roots of $4x^3 - 6x^2 + 7x + 3 = 0$. Then the value of $\alpha\beta + \beta\gamma + \gamma\alpha$

(A) $\frac{3}{2}$

(B) $\frac{3}{4}$

(C) $\frac{7}{4}$

(D) 0

Correct Answer: (C) $\frac{7}{4}$

Solution:

For a general cubic equation $ax^3 + bx^2 + cx + d = 0$ with roots α, β, γ , Vieta's formulas give the relationships between the coefficients and the roots.

Sum of the roots: $\alpha + \beta + \gamma = -\frac{b}{a}$

Sum of the products of the roots taken two at a time: $\alpha\beta + \beta\gamma + \gamma\alpha = \frac{c}{a}$

Product of the roots: $\alpha\beta\gamma = -\frac{d}{a}$

The given equation is $4x^3 - 6x^2 + 7x + 3 = 0$.

Here, $a = 4$, $b = -6$, $c = 7$, and $d = 3$.

We need to find the value of $\alpha\beta + \beta\gamma + \gamma\alpha$.

Using the formula, $\alpha\beta + \beta\gamma + \gamma\alpha = \frac{c}{a} = \frac{7}{4}$.

Quick Tip

Memorize Vieta's formulas for polynomial equations. For a cubic equation $ax^3 + bx^2 + cx + d = 0$, the sum of roots pairwise is c/a . Notice the alternating signs in the formulas: $-b/a, c/a, -d/a$.

64. The variance of 20 observations is 5. If each of the observation is multiplied by 2, then the variance of resulting observations is

(A) 20

(B) 10

(C) 100

(D) 50

Correct Answer: (A) 20

Solution:

Let the original observations be $x_1, x_2, \dots, x_{20}$.

The variance of these observations is given as $\text{Var}(X) = 5$.

Now, each observation is multiplied by 2. The new observations are $y_i = 2x_i$.

We need to find the variance of the new set of observations, $\text{Var}(Y)$.

There is a property of variance that states: If $Y = kX$, where k is a constant, then $\text{Var}(Y) = k^2\text{Var}(X)$.

In this problem, $k = 2$ and $\text{Var}(X) = 5$.

So, the new variance is $\text{Var}(Y) = 2^2 \times \text{Var}(X)$.

New variance $= 4 \times 5 = 20$.

Quick Tip

Remember the effect of scaling and shifting on variance. If you multiply each data point by a constant 'k', the variance is multiplied by k^2 . If you add a constant 'c' to each data point, the variance does not change.

65. If ω is complex cube root (not real) of 1. Then the value of $\begin{vmatrix} 1 & \omega & \omega^2 \\ \omega & \omega^2 & 1 \\ \omega^2 & 1 & \omega \end{vmatrix}$

(A) 0

(B) 1

(C) -1

(D) 3

Correct Answer: (A) 0

Solution:

Let the given determinant be Δ .

$$\Delta = \begin{vmatrix} 1 & \omega & \omega^2 \\ \omega & \omega^2 & 1 \\ \omega^2 & 1 & \omega \end{vmatrix}$$

We know the properties of the complex cube roots of unity:

1) $1 + \omega + \omega^2 = 0$

2) $\omega^3 = 1$

Let's apply the column operation $C_1 \rightarrow C_1 + C_2 + C_3$.

$$\Delta = \begin{vmatrix} 1 + \omega + \omega^2 & \omega & \omega^2 \\ \omega + \omega^2 + 1 & \omega^2 & 1 \\ \omega^2 + 1 + \omega & 1 & \omega \end{vmatrix}$$

Using the property $1 + \omega + \omega^2 = 0$, the first column becomes all zeros.

$$\Delta = \begin{vmatrix} 0 & \omega & \omega^2 \\ 0 & \omega^2 & 1 \\ 0 & 1 & \omega \end{vmatrix}$$

Since all the elements in the first column are zero, the value of the determinant is 0.

Quick Tip

When dealing with determinants involving cube roots of unity, always look for an opportunity to apply the property $1 + \omega + \omega^2 = 0$ by adding rows or columns. This often simplifies the determinant to zero.

66. If $f(x) = \log(\sec x + \tan x)$ then the value of $f'(x)$

(Note: Assuming the question intended to ask for $f'(x)$ instead of $f^{-1}(x)$ to match the options and keyed answer.)

(A) $\sec x$

(B) $\tan x$

(C) $\sec x + \tan x$

(D) $\sec x - \tan x$

Correct Answer: (A) $\sec x$

Solution:

We are given the function $f(x) = \log(\sec x + \tan x)$. We need to find its derivative, $f'(x)$.

Using the chain rule for differentiation, $\frac{d}{dx}(\log u) = \frac{1}{u} \cdot \frac{du}{dx}$.

Here, $u = \sec x + \tan x$.

First, let's find the derivative of u .

$$\frac{du}{dx} = \frac{d}{dx}(\sec x + \tan x) = \sec x \tan x + \sec^2 x.$$

Now, apply the chain rule:

$$f'(x) = \frac{1}{\sec x + \tan x} \cdot (\sec x \tan x + \sec^2 x).$$

Factor out $\sec x$ from the second term in the numerator.

$$f'(x) = \frac{1}{\sec x + \tan x} \cdot \sec x(\tan x + \sec x).$$

Cancel the common term $(\sec x + \tan x)$ from the numerator and denominator.

$$f'(x) = \sec x.$$

Quick Tip

The integral of $\sec x$ is $\log(\sec x + \tan x)$. Therefore, the derivative of $\log(\sec x + \tan x)$ is $\sec x$. This is a standard result worth memorizing.

67. If A and B are independent events with $P(A) = 0.2$, $P(B) = 0.5$ Then $P(A \cap B)$ = ___

(A) 0.2

(B) 0.1

(C) 0.5

(D) 0.6

Correct Answer: (B) 0.1

Solution:

The question asks for the probability of the intersection of two independent events, A and B.

The definition of independent events is that the occurrence of one event does not affect the probability of the other event occurring.

For two independent events A and B, the probability that both occur is given by the formula:

$$P(A \cap B) = P(A) \times P(B).$$

We are given:

$$P(A) = 0.2$$

$$P(B) = 0.5$$

Substituting these values into the formula:

$$P(A \cap B) = 0.2 \times 0.5 = 0.10.$$

Therefore, the value of $P(A \cap B)$ is 0.1.

Quick Tip

For independent events, $P(A \cap B) = P(A) \times P(B)$. For mutually exclusive events, $P(A \cap B) = 0$. Do not confuse these two concepts.

68. If $\tan\left(\frac{C-A}{2}\right) = K \cot\left(\frac{B}{2}\right)$ Then K =

(A) $\frac{c+a}{c-a}$

(B) $\frac{c-a}{c+a}$

(C) $\frac{a+c}{a-c}$

(D) 1

Correct Answer: (B) $\frac{c-a}{c+a}$

Solution:

This question relates to the properties of triangles, specifically Napier's Analogy, also known as the Law of Tangents.

Napier's Analogy states that for any triangle with angles A, B, C and opposite sides a, b, c:

$$\tan\left(\frac{A-B}{2}\right) = \frac{a-b}{a+b} \cot\left(\frac{C}{2}\right)$$

$$\tan\left(\frac{B-C}{2}\right) = \frac{b-c}{b+c} \cot\left(\frac{A}{2}\right)$$

$$\tan\left(\frac{C-A}{2}\right) = \frac{c-a}{c+a} \cot\left(\frac{B}{2}\right)$$

The question gives the equation: $\tan\left(\frac{C-A}{2}\right) = K \cot\left(\frac{B}{2}\right)$.

By directly comparing the given equation with the third form of Napier's Analogy, we can see that:

$$K = \frac{c-a}{c+a}.$$

Quick Tip

Napier's Analogy (Law of Tangents) is a useful formula relating the sides and angles of a triangle. The pattern is easy to remember: tan of half the difference of two angles relates to the difference and sum of the corresponding opposite sides, and the cot of half the third angle.

69. The ratio in which the X - axis divide the line segment $\overline{AB}$ joining A(2, -3) and B(3, -6)

(A) 2 : 1

(B) -1 : 2

(C) -3 : 2

(D) 2 : 3

Correct Answer: (B) -1 : 2

Solution:

Let the X-axis divide the line segment joining points $A(x_1, y_1) = (2, -3)$ and $B(x_2, y_2) = (3, -6)$ in the ratio $m : n$.

Any point on the X-axis has its y-coordinate equal to 0.

Using the section formula for the y-coordinate:

$$y = \frac{my_2 + ny_1}{m+n}.$$

We set $y = 0$:

$$0 = \frac{m(-6) + n(-3)}{m+n}.$$

$$0 = -6m - 3n.$$

$$6m = -3n.$$

$$\frac{m}{n} = \frac{-3}{6} = -\frac{1}{2}.$$

So, the ratio $m : n$ is $-1 : 2$.

The negative sign indicates that the division is external.

Quick Tip

A useful shortcut: The ratio in which the X-axis divides the line segment joining (x_1, y_1) and (x_2, y_2) is given by $-y_1 : y_2$. Here, it would be $-(-3) : (-6) = 3 : -6 = 1 : -2$ or $-1 : 2$.

70. The General Solution of $\frac{dy}{dx} = \frac{2y}{x}$

(A) $x^2 = cy$

(B) $x = cy^2$

(C) $y = cx^2$

(D) $x = cy$

Correct Answer: (C) $y = cx^2$

Solution:

The given differential equation is $\frac{dy}{dx} = \frac{2y}{x}$.

This is a variable separable differential equation. We can separate the variables by getting all y terms on one side and all x terms on the other.

$$\frac{dy}{y} = \frac{2}{x}dx.$$

Now, we integrate both sides of the equation.

$$\int \frac{1}{y}dy = \int \frac{2}{x}dx.$$

$\ln |y| = 2 \ln |x| + C$, where C is the constant of integration.

Using the property of logarithms, $n \ln m = \ln m^n$.

$$\ln |y| = \ln |x^2| + C.$$

Let's write the constant C as $\ln |c|$ for convenience, where c is another constant.

$$\ln |y| = \ln |x^2| + \ln |c|.$$

Using the property $\ln m + \ln n = \ln(mn)$.

$$\ln |y| = \ln |cx^2|.$$

Taking the antilogarithm (exponentiating) on both sides:

$$y = cx^2.$$

Quick Tip

For first-order differential equations, always check if you can use the 'separation of variables' method. It's one of the simplest techniques, involving moving all y and dy terms to one side and all x and dx terms to the other, then integrating.

71. The slope of tangent to the curve $y = 5x^2$ at $(-1, 5)$

(A) 0

(B) 1

(C) -10

(D) 10

Correct Answer: (C) -10

Solution:

The slope of the tangent to a curve at any point is given by the value of its derivative at that point.

The given curve is $y = 5x^2$.

First, we find the derivative of y with respect to x .

$$\frac{dy}{dx} = \frac{d}{dx}(5x^2) = 5 \times 2x = 10x.$$

Now, we need to find the slope at the point $(-1, 5)$. This means we evaluate the derivative at $x = -1$.

$$\text{Slope at } x = -1 \text{ is } \left. \frac{dy}{dx} \right|_{x=-1} = 10(-1) = -10.$$

Therefore, the slope of the tangent at $(-1, 5)$ is -10.

Quick Tip

To find the slope of a tangent line to a function $y = f(x)$ at a specific point (x_0, y_0) , you must first find the derivative function $f'(x)$ and then evaluate it at $x = x_0$.

72. Equation of the director circle of the Ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is

- (A) $x^2 + y^2 = a^2$
- (B) $x^2 + y^2 = b^2$
- (C) $x^2 + y^2 = a^2 + b^2$
- (D) $x^2 + y^2 = 1$

Correct Answer: (C) $x^2 + y^2 = a^2 + b^2$

Solution:

The director circle of an ellipse is defined as the locus of the point of intersection of perpendicular tangents to the ellipse.

For the standard ellipse given by the equation $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, the equation of its director circle is a standard result.

The equation of the director circle is $x^2 + y^2 = a^2 + b^2$.

This is a circle centered at the origin with a radius of $\sqrt{a^2 + b^2}$.

Therefore, option (C) is the correct formula.

Quick Tip

Memorize the standard equations for director circles: For an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, it is $x^2 + y^2 = a^2 + b^2$. For a hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$, it is $x^2 + y^2 = a^2 - b^2$. For a circle $x^2 + y^2 = r^2$, it is $x^2 + y^2 = 2r^2$.

73. $\int \frac{\sin^4 x}{\cos^6 x} dx$ on $\mathbb{R}$

- (A) $\tan^5 x + c$

(B) $\sec^5 x + c$

(C) $\frac{1}{5} \tan^5 x + c$

(D) $\frac{1}{5} \sin^5 x + c$

Correct Answer: (C) $\frac{1}{5} \tan^5 x + c$

Solution:

Let the given integral be I .

$$I = \int \frac{\sin^4 x}{\cos^6 x} dx.$$

We can rewrite the integrand as:

$$I = \int \frac{\sin^4 x}{\cos^4 x} \cdot \frac{1}{\cos^2 x} dx.$$

Since $\frac{\sin x}{\cos x} = \tan x$ and $\frac{1}{\cos x} = \sec x$, we have:

$$I = \int \tan^4 x \sec^2 x dx.$$

Now, we can use the method of substitution.

Let $u = \tan x$.

Then, the derivative is $du = \sec^2 x dx$.

Substituting u and du into the integral:

$$I = \int u^4 du.$$

Using the power rule for integration, $\int u^n du = \frac{u^{n+1}}{n+1} + c$.

$$I = \frac{u^{4+1}}{4+1} + c = \frac{u^5}{5} + c.$$

Now, substitute back $u = \tan x$.

$$I = \frac{1}{5} \tan^5 x + c.$$

Quick Tip

When integrating expressions with powers of sine and cosine, look for ways to convert them into tangent and secant. The form $\int \tan^n x \sec^2 x dx$ is ideal for a u-substitution with $u = \tan x$.

74. The domain of real valued function $f(x) = \sqrt{9 - x^2}$ is

(A) $[-3, 3]$

(B) $[0, 3]$

(C) $[-3, 0]$

(D) $[3, 0]$

Correct Answer: (A) $[-3, 3]$

Solution:

The given function is $f(x) = \sqrt{9 - x^2}$.

For a function with a square root to be real-valued, the expression inside the square root must be non-negative (greater than or equal to zero).

So, we must have $9 - x^2 \geq 0$.

$9 \geq x^2$, which is the same as $x^2 \leq 9$.

To solve this inequality, we take the square root of both sides.

$$\sqrt{x^2} \leq \sqrt{9}.$$

$$|x| \leq 3.$$

The inequality $|x| \leq a$ is equivalent to $-a \leq x \leq a$.

Therefore, $-3 \leq x \leq 3$.

In interval notation, the domain is $[-3, 3]$.

Quick Tip

The domain of a function $f(x) = \sqrt{g(x)}$ is the set of all x values for which $g(x) \geq 0$. Solving this inequality will give you the domain.

75. The centroid of the tetrahedron whose vertices are $(2, 3, -4)$, $(-3, 3, -2)$, $(-1, 4, 2)$, $(3, 5, 1)$ is

(A) $(-1, 15, 3)$

(B) $(-\frac{1}{4}, \frac{15}{4}, \frac{3}{4})$

(C) $(\frac{1}{4}, \frac{15}{4}, -\frac{3}{4})$

(D) $(1, 15, 3)$

Correct Answer: (C) $(\frac{1}{4}, \frac{15}{4}, -\frac{3}{4})$

Solution:

The coordinates of the centroid of a tetrahedron with vertices (x_1, y_1, z_1) , (x_2, y_2, z_2) , (x_3, y_3, z_3) , and (x_4, y_4, z_4) are given by the formula:

$$\text{Centroid} = \left(\frac{x_1+x_2+x_3+x_4}{4}, \frac{y_1+y_2+y_3+y_4}{4}, \frac{z_1+z_2+z_3+z_4}{4} \right).$$

The given vertices are $(2, 3, -4)$, $(-3, 3, -2)$, $(-1, 4, 2)$, and $(3, 5, 1)$.

The x-coordinate of the centroid is:

$$x = \frac{2+(-3)+(-1)+3}{4} = \frac{2-3-1+3}{4} = \frac{1}{4}.$$

The y-coordinate of the centroid is:

$$y = \frac{3+3+4+5}{4} = \frac{15}{4}.$$

The z-coordinate of the centroid is:

$$z = \frac{-4+(-2)+2+1}{4} = \frac{-4-2+2+1}{4} = \frac{-3}{4}.$$

So, the centroid is $(\frac{1}{4}, \frac{15}{4}, -\frac{3}{4})$.

Quick Tip

The centroid of a geometric shape (triangle, tetrahedron, etc.) is simply the average of the coordinates of its vertices. For a tetrahedron (4 vertices), you sum the coordinates and divide by 4.

76. If a line makes angles α, β, γ with the positive directions of X, Y, Z - axes, then the value of $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma$ is

(A) 1

(B) 0

(C) 2

(D) -1

Correct Answer: (C) 2

Solution:

If a line makes angles α, β, γ with the positive X, Y, and Z axes respectively, then its direction cosines are $l = \cos \alpha$, $m = \cos \beta$, and $n = \cos \gamma$.

A fundamental identity for direction cosines is:

$$l^2 + m^2 + n^2 = 1.$$

$$\text{So, } \cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma = 1.$$

We need to find the value of $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma$.

Using the trigonometric identity $\sin^2 \theta + \cos^2 \theta = 1$, we can write $\sin^2 \theta = 1 - \cos^2 \theta$.

So, the expression becomes:

$$(1 - \cos^2 \alpha) + (1 - \cos^2 \beta) + (1 - \cos^2 \gamma).$$

Rearranging the terms:

$$3 - (\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma).$$

Substitute the value of the identity for direction cosines:

$$3 - 1 = 2.$$

Therefore, $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma = 2$.

Quick Tip

Remember the two key identities for direction angles: $\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma = 1$ and $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma = 2$. You can derive one from the other using $\sin^2 \theta + \cos^2 \theta = 1$.

77. The largest binomial co-efficient in the expansion of $(1 + x)^{24}$

(A) ${}^{24}C_{11}$

(B) ${}^{24}C_{12}$

(C) ${}^{24}C_{13}$

(D) ${}^{24}C_{10}$

Correct Answer: (B) ${}^{24}C_{12}$

Solution:

For the binomial expansion of $(a + b)^n$, the coefficients are given by nC_r , where r ranges from 0 to n .

The binomial coefficients increase up to the middle term(s) and then decrease symmetrically.

When the power n is an even number, the largest binomial coefficient occurs at the middle term, which is when $r = n/2$.

In this case, the expansion is for $(1 + x)^{24}$, so $n = 24$.

Since $n = 24$ is even, the largest coefficient is at $r = 24/2 = 12$.

The largest binomial coefficient is therefore ${}^{24}C_{12}$.

Quick Tip

To find the largest coefficient in $(1 + x)^n$: - If n is even, the largest coefficient is ${}^nC_{n/2}$.
- If n is odd, there are two largest coefficients which are equal: ${}^nC_{(n-1)/2}$ and ${}^nC_{(n+1)/2}$.

78. If the line $2y = 5x + K$ is a tangent to the parabola $y^2 = 6x$. Then the value of $K =$

(A) $\frac{1}{2}$

(B) $\frac{3}{5}$

(C) $\frac{5}{6}$

(D) $\frac{6}{5}$

Correct Answer: (D) $\frac{6}{5}$

Solution:

The equation of the parabola is $y^2 = 6x$.

Comparing this with the standard form $y^2 = 4ax$, we get $4a = 6$, so $a = \frac{6}{4} = \frac{3}{2}$.

The equation of the line is $2y = 5x + K$.

Let's write this line in the slope-intercept form, $y = mx + c$.

$$y = \frac{5}{2}x + \frac{K}{2}.$$

From this, the slope is $m = \frac{5}{2}$ and the y-intercept is $c = \frac{K}{2}$.

The condition for a line $y = mx + c$ to be tangent to the parabola $y^2 = 4ax$ is $c = \frac{a}{m}$.

Now, we substitute the values of a , m , and c .

$$\frac{K}{2} = \frac{3/2}{5/2}.$$

$$\frac{K}{2} = \frac{3}{2} \times \frac{2}{5} = \frac{3}{5}.$$

$$K = 2 \times \frac{3}{5} = \frac{6}{5}.$$

Quick Tip

Memorize the condition of tangency for standard conic sections. For a parabola $y^2 = 4ax$, the line $y = mx + c$ is a tangent if $c = a/m$. This is a very common problem type.

79. The equation $ax^2 + 2hxy + by^2 = 0$ represent a pair of straight lines. If θ is angle between the lines then $\cos \theta =$

(A) $\frac{|a-b|}{\sqrt{(a-b)^2 + 4h^2}}$

(B) $\frac{|a+b|}{\sqrt{(a-b)^2 + 4h^2}}$

(C) $\frac{2\sqrt{h^2 - ab}}{|a+b|}$

(D) $\frac{|a+b|}{\sqrt{(a+b)^2 + 4h^2}}$

Correct Answer: (B) $\frac{|a+b|}{\sqrt{(a-b)^2 + 4h^2}}$

Solution:

This is a standard formula derivation from coordinate geometry.

The standard formula for the angle θ between the pair of lines represented by $ax^2 + 2hxy + by^2 = 0$ is given in terms of tangent:

$$\tan \theta = \frac{|2\sqrt{h^2 - ab}|}{|a+b|}.$$

We can derive the formula for $\cos \theta$ from this using a right-angled triangle.

Let the opposite side be $P = |2\sqrt{h^2 - ab}|$ and the adjacent side be $B = |a + b|$.

The hypotenuse H is given by $H = \sqrt{P^2 + B^2}$.

$$H = \sqrt{(2\sqrt{h^2 - ab})^2 + (a + b)^2} = \sqrt{4(h^2 - ab) + a^2 + 2ab + b^2}.$$

$$H = \sqrt{4h^2 - 4ab + a^2 + 2ab + b^2} = \sqrt{a^2 - 2ab + b^2 + 4h^2} = \sqrt{(a - b)^2 + 4h^2}.$$

$$\text{Now, } \cos \theta = \frac{\text{Adjacent}}{\text{Hypotenuse}} = \frac{B}{H}.$$

$$\cos \theta = \frac{|a+b|}{\sqrt{(a-b)^2 + 4h^2}}.$$

This matches option (B).

Quick Tip

While it's most common to remember the formula for $\tan \theta$, knowing how to quickly derive the formulas for $\sin \theta$ and $\cos \theta$ using a right triangle is a valuable skill. $\tan \theta = \frac{2\sqrt{h^2 - ab}}{a+b}$ is the key formula.

80. Principal solutions of $\tan^2 \theta = 3$

(A) $\pm\pi/3$

(B) $\pm\pi/4$

(C) $\pm\pi/6$

(D) $\pm\pi/2$

Correct Answer: (A) $\pm\pi/3$

Solution:

The given equation is $\tan^2 \theta = 3$.

Taking the square root of both sides, we get:

$$\tan \theta = \pm\sqrt{3}.$$

This gives two separate cases for finding the principal solutions. Principal solutions are usually taken in the interval $(-\pi, \pi]$ or $[0, 2\pi)$. The options suggest an interval symmetric around 0.

Case 1: $\tan \theta = \sqrt{3}$.

The principal value for which $\tan \theta$ is $\sqrt{3}$ is $\theta = \frac{\pi}{3}$.

Case 2: $\tan \theta = -\sqrt{3}$.

The principal value for which $\tan \theta$ is $-\sqrt{3}$ is $\theta = -\frac{\pi}{3}$.

Combining the solutions from both cases, the principal solutions are $\theta = \pm \frac{\pi}{3}$.

Quick Tip

When solving equations like $\tan^2 \theta = k$, remember to consider both the positive and negative square roots, i.e., $\tan \theta = \pm \sqrt{k}$. This will give you solutions in multiple quadrants.

81. The normal form of the plane $x + 2y - 3z - 6 = 0$

(A) $\frac{x}{6} + \frac{y}{3} - \frac{z}{2} = 1$

(B) $\frac{x}{\sqrt{14}} + \frac{2y}{\sqrt{14}} - \frac{3z}{\sqrt{14}} = 1$

(C) $\frac{x}{\sqrt{14}} + \frac{2y}{\sqrt{14}} + \frac{3z}{\sqrt{14}} = \frac{6}{\sqrt{14}}$

(D) $\frac{x}{\sqrt{14}} + \frac{2y}{\sqrt{14}} - \frac{3z}{\sqrt{14}} = \frac{6}{\sqrt{14}}$

Correct Answer: (D) $\frac{x}{\sqrt{14}} + \frac{2y}{\sqrt{14}} - \frac{3z}{\sqrt{14}} = \frac{6}{\sqrt{14}}$

Solution:

The given equation of the plane is $x + 2y - 3z - 6 = 0$, which can be written as $x + 2y - 3z = 6$.

The normal form of a plane is $lx + my + nz = p$, where (l, m, n) are the direction cosines of the normal to the plane and p is the perpendicular distance from the origin to the plane (p must be positive).

The direction ratios of the normal are $(1, 2, -3)$.

To find the direction cosines, we need to divide by the magnitude of this vector.

$$\text{Magnitude} = \sqrt{1^2 + 2^2 + (-3)^2} = \sqrt{1 + 4 + 9} = \sqrt{14}.$$

We divide the entire equation of the plane by $\sqrt{14}$.

$$\frac{1}{\sqrt{14}}x + \frac{2}{\sqrt{14}}y - \frac{3}{\sqrt{14}}z = \frac{6}{\sqrt{14}}.$$

Since the constant term on the right side, $p = \frac{6}{\sqrt{14}}$, is positive, this is the correct normal form.

This matches option (D). (Option A is the intercept form).

Quick Tip

To convert the plane equation $ax + by + cz = d$ to normal form, divide the entire equation by $\sqrt{a^2 + b^2 + c^2}$. Ensure the constant term on the right side (p) is positive.

82. If $A = \begin{pmatrix} -1 & 2 & 3 \\ 2 & 5 & 6 \\ 3 & x & 7 \end{pmatrix}$ is a symmetric matrix, Then the value of x is

(A) 2

(B) 7

(C) -1

(D) 6

Correct Answer: (D) 6

Solution:

A matrix A is symmetric if it is equal to its transpose, i.e., $A = A^T$.

This means that the element in the i -th row and j -th column must be equal to the element in the j -th row and i -th column for all i and j . That is, $a_{ij} = a_{ji}$.

The given matrix is $A = \begin{pmatrix} -1 & 2 & 3 \\ 2 & 5 & 6 \\ 3 & x & 7 \end{pmatrix}$.

Let's check the elements that must be equal.

$a_{12} = 2$ and $a_{21} = 2$. (Matches)

$a_{13} = 3$ and $a_{31} = 3$. (Matches)

For symmetry, we must also have $a_{23} = a_{32}$.

From the matrix, a_{23} (2nd row, 3rd column) is 6.

And a_{32} (3rd row, 2nd column) is x .

Therefore, for the matrix to be symmetric, we must have $x = 6$.

Quick Tip

For a matrix to be symmetric, the elements must be mirrored across the main diagonal (from top-left to bottom-right). Simply check that the element at position (i, j) is the same as the element at (j, i) .

83. For any $x \in R$, $\tan^{-1} x + \cot^{-1} x$

(A) 0

(B) $\pi/2$

(C) $\pi/3$

(D) $\pi/4$

Correct Answer: (B) $\pi/2$

Solution:

This question asks for the value of a standard inverse trigonometric identity.

For any real number x , the sum of the inverse tangent and inverse cotangent is a constant value.

The identity is:

$$\tan^{-1} x + \cot^{-1} x = \frac{\pi}{2} \text{ for all } x \in R.$$

Similarly, there are other identities:

$$\sin^{-1} x + \cos^{-1} x = \frac{\pi}{2} \text{ for } x \in [-1, 1].$$

$$\sec^{-1} x + \csc^{-1} x = \frac{\pi}{2} \text{ for } |x| \geq 1.$$

Therefore, the value of the given expression is $\frac{\pi}{2}$.

Quick Tip

Memorize the three co-function identities for inverse trigonometric functions. The sum of an inverse function and its inverse co-function is always $\pi/2$ within their common domains.

84. The complex conjugate of $(3 + 4i)(2 - 3i)$

(A) $18 + i$

(B) $18 - i$

(C) $-18 + i$

(D) $-18 - i$

Correct Answer: (A) $18 + i$

Solution:

First, we need to simplify the product of the two complex numbers.

Let $z = (3 + 4i)(2 - 3i)$.

$$z = 3(2) + 3(-3i) + 4i(2) + 4i(-3i).$$

$$z = 6 - 9i + 8i - 12i^2.$$

Since $i^2 = -1$:

$$z = 6 - i - 12(-1) = 6 - i + 12.$$

$$z = 18 - i.$$

Now, we need to find the complex conjugate of z .

The complex conjugate of a number $a + bi$ is $a - bi$.

So, the conjugate of $z = 18 - i$ is $\bar{z} = 18 + i$.

Quick Tip

To find the complex conjugate of a product or quotient, you can either simplify first and then find the conjugate, or find the conjugates first and then perform the operation.

$$(\overline{z_1 z_2}) = \overline{z_1} \cdot \overline{z_2}.$$

85. $\int \frac{dx}{x^2 - 81}$ on $\mathbf{R}$

(A) $\log \left| \frac{x-9}{x+9} \right| + c$

(B) $\log \left| \frac{x+9}{x-9} \right| + c$

(C) $\log |x^2 - 81| + c$

(D) $\frac{1}{18} \log \left| \frac{x-9}{x+9} \right| + c$

Correct Answer: (D) $\frac{1}{18} \log \left| \frac{x-9}{x+9} \right| + c$

Solution:

The given integral is $\int \frac{dx}{x^2-81}$.

This can be written as $\int \frac{dx}{x^2-9^2}$.

This is a standard integral form: $\int \frac{dx}{x^2-a^2} = \frac{1}{2a} \ln \left| \frac{x-a}{x+a} \right| + c$.

In this problem, $a = 9$.

Substituting $a = 9$ into the formula:

$$\int \frac{dx}{x^2-9^2} = \frac{1}{2(9)} \ln \left| \frac{x-9}{x+9} \right| + c.$$

$$= \frac{1}{18} \ln \left| \frac{x-9}{x+9} \right| + c.$$

The problem uses "Log" which is equivalent to "ln" in this context.

So the answer is $\frac{1}{18} \log \left| \frac{x-9}{x+9} \right| + c$.

Quick Tip

Memorize the standard integration formulas for rational functions, especially: $\int \frac{dx}{x^2-a^2} = \frac{1}{2a} \ln \left| \frac{x-a}{x+a} \right| + c$ $\int \frac{dx}{a^2-x^2} = \frac{1}{2a} \ln \left| \frac{a+x}{a-x} \right| + c$ $\int \frac{dx}{x^2+a^2} = \frac{1}{a} \tan^{-1} \left(\frac{x}{a} \right) + c$

86. Value of $\sec(2100^\circ)$

(A) 0

(B) 2

(C) 1

(D) $\frac{1}{2}$

Correct Answer: (B) 2

Solution:

We need to find the value of $\sec(2100^\circ)$.

First, we find the coterminal angle within the range $[0^\circ, 360^\circ)$. We can do this by dividing 2100 by 360.

$$2100 \div 360 = 5 \text{ with a remainder of } 2100 - (360 \times 5) = 2100 - 1800 = 300.$$

$$\text{So, } \sec(2100^\circ) = \sec(300^\circ).$$

The angle 300° is in the fourth quadrant. In the fourth quadrant, the secant function is positive.

We can write 300° as a reference angle: $300^\circ = 360^\circ - 60^\circ$.

$$\sec(300^\circ) = \sec(360^\circ - 60^\circ) = \sec(60^\circ).$$

$$\text{We know that } \cos(60^\circ) = \frac{1}{2}.$$

Since $\sec \theta = \frac{1}{\cos \theta}$, we have:

$$\sec(60^\circ) = \frac{1}{1/2} = 2.$$

Quick Tip

To find the value of a trigonometric function for a large angle, first find its coterminal angle by finding the remainder when the angle is divided by 360° . Then, use the quadrant and reference angle to find the value.

87. The angle between the circles $x^2 + y^2 - 12x - 6y + 41 = 0$ and $x^2 + y^2 + 4x + 6y - 59 = 0$ is

(A) 90°

(B) 45°

(C) 60°

(D) 30°

Correct Answer: (B) 45°

Solution:

Let the two circles be S_1 and S_2 .

For $S_1 : x^2 + y^2 - 12x - 6y + 41 = 0$.

Comparing with $x^2 + y^2 + 2gx + 2fy + c = 0$, we get $g_1 = -6, f_1 = -3, c_1 = 41$.

Center $C_1 = (-g_1, -f_1) = (6, 3)$.

Radius $r_1 = \sqrt{g_1^2 + f_1^2 - c_1} = \sqrt{(-6)^2 + (-3)^2 - 41} = \sqrt{36 + 9 - 41} = \sqrt{4} = 2$.

For $S_2 : x^2 + y^2 + 4x + 6y - 59 = 0$.

We get $g_2 = 2, f_2 = 3, c_2 = -59$.

Center $C_2 = (-g_2, -f_2) = (-2, -3)$.

Radius $r_2 = \sqrt{g_2^2 + f_2^2 - c_2} = \sqrt{2^2 + 3^2 - (-59)} = \sqrt{4 + 9 + 59} = \sqrt{72} = 6\sqrt{2}$.

Let d be the distance between the centers C_1 and C_2 .

$d = \sqrt{(6 - (-2))^2 + (3 - (-3))^2} = \sqrt{8^2 + 6^2} = \sqrt{64 + 36} = \sqrt{100} = 10$.

The angle of intersection θ is given by the formula:

$$\cos \theta = \frac{r_1^2 + r_2^2 - d^2}{2r_1r_2}.$$

$$\cos \theta = \frac{2^2 + (6\sqrt{2})^2 - 10^2}{2(2)(6\sqrt{2})} = \frac{4 + 72 - 100}{24\sqrt{2}} = \frac{-24}{24\sqrt{2}} = -\frac{1}{\sqrt{2}}.$$

The question asks for the angle between circles, which is conventionally the acute angle. If $\cos \theta = -1/\sqrt{2}$, $\theta = 135^\circ$. The other angle is $180^\circ - 135^\circ = 45^\circ$. So we take the acute angle. Alternatively, the formula is often given with an absolute value: $\cos \theta = \frac{|r_1^2 + r_2^2 - d^2|}{2r_1r_2}$.

$$\cos \theta = \frac{|-24|}{24\sqrt{2}} = \frac{24}{24\sqrt{2}} = \frac{1}{\sqrt{2}}.$$

Therefore, $\theta = 45^\circ$.

Quick Tip

To find the angle between two circles, find their centers (C_1, C_2) and radii (r_1, r_2). Calculate the distance between centers, d . Then use the cosine rule on the triangle formed by the centers and a point of intersection: $\cos \theta = \frac{|r_1^2 + r_2^2 - d^2|}{2r_1r_2}$. If the circles are orthogonal, $d^2 = r_1^2 + r_2^2$.

88. The equation of locus of a point equidistant from A (2, 0) and the Y - axis

(A) $x^2 - 4x + 4 = 0$

(B) $y^2 - 4x + 4 = 0$

(C) $x^2 + y^2 = 4$

(D) $x^2 - y^2 = 4$

Correct Answer: (B) $y^2 - 4x + 4 = 0$

Solution:

Let the point on the locus be $P(x, y)$.

The given fixed point is $A(2, 0)$.

The given fixed line is the Y-axis, whose equation is $x = 0$.

The distance between the point $P(x, y)$ and the point $A(2, 0)$ is given by the distance formula:

$$PA = \sqrt{(x-2)^2 + (y-0)^2} = \sqrt{(x-2)^2 + y^2}.$$

The perpendicular distance from the point $P(x, y)$ to the line $x = 0$ (Y-axis) is $|x|$.

According to the problem, the point P is equidistant from point A and the Y-axis.

So, $PA = |x|$.

$$\sqrt{(x-2)^2 + y^2} = |x|.$$

Squaring both sides to remove the square root:

$$(x-2)^2 + y^2 = x^2.$$

$$x^2 - 4x + 4 + y^2 = x^2.$$

Cancelling x^2 from both sides:

$$-4x + 4 + y^2 = 0.$$

Rearranging the terms, we get the equation of the locus:

$$y^2 - 4x + 4 = 0.$$

This is the equation of a parabola.

Quick Tip

A locus problem involves finding an equation that satisfies a given geometric condition. Translate the condition (e.g., "equidistant") into algebraic expressions using distance formulas, and then simplify the resulting equation.

89. $\lim_{x \rightarrow 3} \frac{e^x - e^3}{x - 3}$

(A) 1

(B) 0

(C) e^3

(D) e^x

Correct Answer: (C) e^3

Solution:

This limit is of the form $\frac{0}{0}$ as $x \rightarrow 3$. We can solve this using two methods.

Method 1: Using L'Hopital's Rule.

Since the limit is in the indeterminate form $\frac{0}{0}$, we can differentiate the numerator and the denominator with respect to x .

$$\lim_{x \rightarrow 3} \frac{\frac{d}{dx}(e^x - e^3)}{\frac{d}{dx}(x - 3)}.$$

$$= \lim_{x \rightarrow 3} \frac{e^x - 0}{1 - 0} = \lim_{x \rightarrow 3} e^x.$$

Substituting $x = 3$, we get e^3 .

Method 2: Using the definition of the derivative.

The definition of the derivative of a function $f(x)$ at a point a is:

$$f'(a) = \lim_{x \rightarrow a} \frac{f(x) - f(a)}{x - a}.$$

By comparing the given limit with this definition, we can see that:

$$f(x) = e^x \text{ and } a = 3.$$

The limit is therefore equal to the derivative of $f(x) = e^x$ evaluated at $x = 3$.

$$f'(x) = \frac{d}{dx}(e^x) = e^x.$$

$$f'(3) = e^3.$$

Quick Tip

Recognize when a limit problem matches the first principle definition of a derivative, $f'(a) = \lim_{h \rightarrow 0} \frac{f(a+h) - f(a)}{h}$ or $\lim_{x \rightarrow a} \frac{f(x) - f(a)}{x - a}$. This can often be much faster than using L'Hopital's Rule.

90. If $\frac{5x+1}{(x+2)(x-1)} = \frac{A}{x+2} + \frac{2}{x-1}$, then the value of A is

(A) 3

(B) 0

(C) -3

(D) 1

Correct Answer: (A) 3

Solution:

Start with $\frac{5x+1}{(x+2)(x-1)} = \frac{A}{x+2} + \frac{2}{x-1}$.

Combine the right side over the common denominator $(x+2)(x-1)$.

$$\frac{A}{x+2} + \frac{2}{x-1} = \frac{A(x-1) + 2(x+2)}{(x+2)(x-1)}.$$

Since denominators are equal, equate numerators: $5x+1 = A(x-1) + 2(x+2)$.

Use the cover-up (evaluation) method for A by substituting $x = -2$.

$$5(-2) + 1 = A(-2-1) + 2(-2+2).$$

$$-10 + 1 = -3A + 0.$$

$$-9 = -3A \implies A = 3.$$

Thus, the required value of A is 3.

Quick Tip

The "cover-up" method for partial fractions is very efficient. To find the constant 'A' above a linear factor $(x-p)$, cover up that factor in the original fraction and substitute $x=p$ into the rest of the expression.

91. A poisson variable satisfies $P(X=1) = P(X=2)$ then $P(X=5) =$

(A) $\frac{e^{-2}2^4}{2!}$

(B) $\frac{e^{-2}2^3}{3!}$

(C) $\frac{e^{-2}2^5}{5!}$

(D) $\frac{e^22^5}{5!}$

Correct Answer: (C) $\frac{e^{-2}2^5}{5!}$

Solution:

The probability mass function for a Poisson distribution is given by:

$$P(X=k) = \frac{e^{-\lambda}\lambda^k}{k!}, \text{ where } \lambda \text{ is the mean of the distribution.}$$

We are given that $P(X=1) = P(X=2)$.

Using the formula, we can write:

$$\frac{e^{-\lambda}\lambda^1}{1!} = \frac{e^{-\lambda}\lambda^2}{2!}.$$

Since λ cannot be 0 (for a non-trivial distribution), we can divide both sides by $e^{-\lambda}$ and λ .

$$\frac{1}{1} = \frac{\lambda}{2}.$$

$$1 = \frac{\lambda}{2}.$$

So, $\lambda = 2$.

Now we need to find $P(X = 5)$ using $\lambda = 2$.

$$P(X = 5) = \frac{e^{-2}2^5}{5!}.$$

This matches option (C).

Quick Tip

For Poisson distribution problems, start with the probability mass function $P(X = k) = \frac{e^{-\lambda}\lambda^k}{k!}$. Use the given information (like $P(X = a) = P(X = b)$) to solve for the mean, λ , first.

92. If $1, \omega, \omega^2$ are the cube root of unity then the value of $(1 - \omega + \omega^2)^3$

(A) 0

(B) 1

(C) -8

(D) 8

Correct Answer: (C) -8

Solution:

We are given that $1, \omega, \omega^2$ are the cube roots of unity.

We use the fundamental property of these roots: $1 + \omega + \omega^2 = 0$.

From this property, we can express $1 + \omega^2$ as $-\omega$.

Now let's look at the expression inside the parenthesis: $(1 - \omega + \omega^2)$.

We can rearrange this as $(1 + \omega^2) - \omega$.

Substitute $1 + \omega^2 = -\omega$:
 $(-\omega) - \omega = -2\omega$.

Now we need to calculate the value of $(-2\omega)^3$.
 $(-2\omega)^3 = (-2)^3 \cdot (\omega)^3$.

We know that $(-2)^3 = -8$.

We also know another fundamental property of cube roots of unity: $\omega^3 = 1$.

So, the expression becomes $-8 \cdot 1 = -8$.

Quick Tip

When working with expressions involving cube roots of unity (ω), always try to use the identity $1 + \omega + \omega^2 = 0$ to simplify terms inside parentheses before applying powers. Also remember $\omega^3 = 1$.

93. The equation of circle with Centre $(-1, 2)$ and radius 5 is

(A) $(x - 1)^2 + (y - 2)^2 = 5^2$

(B) $(x + 1)^2 + (y + 2)^2 = 5^2$

(C) $(x + 1)^2 + (y - 2)^2 = 5^2$

(D) $(x - 1)^2 + (y + 2)^2 = 5^2$

Correct Answer: (C) $(x + 1)^2 + (y - 2)^2 = 5^2$

Solution:

The standard equation of a circle with center (h, k) and radius r is:
 $(x - h)^2 + (y - k)^2 = r^2$.

We are given the center of the circle as $(h, k) = (-1, 2)$.

We are given the radius of the circle as $r = 5$.

Now we substitute these values into the standard equation.

$$(x - (-1))^2 + (y - 2)^2 = 5^2.$$

Simplifying the expression inside the first parenthesis:

$$(x + 1)^2 + (y - 2)^2 = 5^2.$$

This matches option (C).

Quick Tip

Be very careful with the signs when using the standard circle equation $(x-h)^2 + (y-k)^2 = r^2$. The coordinates of the center (h, k) appear with opposite signs inside the brackets.

94. The area under the curve $f(x) = \cos x$ in $[0, 2\pi]$ is

(A) 1

(B) $\frac{1}{2}$

(C) 2

(D) 4

Correct Answer: (D) 4

Solution:

The phrase "area under the curve" implies the total area between the curve and the x-axis, which means we must consider the absolute value of the function.

$$\text{Area } A = \int_0^{2\pi} |\cos x| dx.$$

We need to split the integral based on where $\cos x$ is positive or negative in the interval $[0, 2\pi]$.

$$\cos x \geq 0 \text{ for } x \in [0, \pi/2] \cup [3\pi/2, 2\pi].$$

$$\cos x < 0 \text{ for } x \in (\pi/2, 3\pi/2).$$

So, the integral becomes:

$$A = \int_0^{\pi/2} \cos x dx + \int_{\pi/2}^{3\pi/2} (-\cos x) dx + \int_{3\pi/2}^{2\pi} \cos x dx.$$

The integral of $\cos x$ is $\sin x$.

$$A = [\sin x]_0^{\pi/2} - [\sin x]_{\pi/2}^{3\pi/2} + [\sin x]_{3\pi/2}^{2\pi}.$$

$$A = (\sin(\pi/2) - \sin(0)) - (\sin(3\pi/2) - \sin(\pi/2)) + (\sin(2\pi) - \sin(3\pi/2)).$$

$$A = (1 - 0) - (-1 - 1) + (0 - (-1)).$$

$$A = 1 - (-2) + 1.$$

$$A = 1 + 2 + 1 = 4.$$

Quick Tip

When calculating the geometric area under a curve, you must integrate the absolute value of the function. This often requires splitting the integral into parts where the function is positive and where it is negative. A simple definite integral $\int_a^b f(x)dx$ gives the net area, which can be zero if positive and negative areas cancel out.

95. The number of diagonal of polygon with 12 sides

(A) 36

(B) 40

(C) 54

(D) 24

Correct Answer: (C) 54

Solution:

The formula for the number of diagonals in a polygon with n sides is given by:

$$\text{Number of diagonals} = \frac{n(n-3)}{2}.$$

In this problem, the polygon has 12 sides, so $n = 12$.

Substitute $n = 12$ into the formula:

$$\text{Number of diagonals} = \frac{12(12-3)}{2}.$$

$$\text{Number of diagonals} = \frac{12 \times 9}{2}.$$

$$\text{Number of diagonals} = 6 \times 9 = 54.$$

Alternatively, from n vertices, we can choose any 2 vertices to form a line segment. This is nC_2 . These segments are either sides or diagonals. Since there are n sides, the number of diagonals is ${}^nC_2 - n$. For $n = 12$: ${}^{12}C_2 - 12 = \frac{12 \times 11}{2} - 12 = 66 - 12 = 54$.

Quick Tip

Memorize the formula for the number of diagonals in an n -sided polygon: $D = \frac{n(n-3)}{2}$. It's derived from the fact that from each vertex, you can draw a diagonal to every other vertex except itself and its two neighbors.

96. If $x^2 - 6x + 5 = 0$ and $x^2 - 12x + P = 0$ have a common root then $P =$

(A) 11 or 35

(B) 2 or 3

(C) 10 or 2

(D) 3 or 5

Correct Answer: (A) 11 or 35

Solution:

First, let's find the roots of the first quadratic equation, $x^2 - 6x + 5 = 0$.

We can factor this equation:

$$(x - 1)(x - 5) = 0.$$

So, the roots of the first equation are $x = 1$ and $x = 5$.

The problem states that the two equations have a common root. This means one of these two roots must also be a root of the second equation.

Case 1: The common root is $x = 1$.

If $x = 1$ is a root of the second equation, it must satisfy it. Substitute $x = 1$ into $x^2 - 12x + P = 0$.

$$(1)^2 - 12(1) + P = 0.$$

$$1 - 12 + P = 0.$$

$$-11 + P = 0 \implies P = 11.$$

Case 2: The common root is $x = 5$.

If $x = 5$ is a root of the second equation, substitute $x = 5$ into $x^2 - 12x + P = 0$.

$$(5)^2 - 12(5) + P = 0.$$

$$25 - 60 + P = 0.$$

$$-35 + P = 0 \implies P = 35.$$

So, the possible values for P are 11 or 35.

Quick Tip

When two equations are given to have a common root, first find the roots of the equation that is fully specified. Then, substitute each of those roots into the second equation to find the possible values of the unknown parameter.

97. If $\vec{a} = 2\vec{i} + 5\vec{j} + \vec{k}$ and $\vec{b} = 4\vec{i} + m\vec{j} + n\vec{k}$ are collinear vectors, then the value of 'm'

(A) 2

(B) 6

(C) 10

(D) 5

Correct Answer: (C) 10

Solution:

Two vectors are collinear if one is a scalar multiple of the other.

That is, $\vec{b} = \lambda\vec{a}$ for some scalar constant λ .

So, $4\vec{i} + m\vec{j} + n\vec{k} = \lambda(2\vec{i} + 5\vec{j} + \vec{k})$.

$$4\vec{i} + m\vec{j} + n\vec{k} = 2\lambda\vec{i} + 5\lambda\vec{j} + \lambda\vec{k}.$$

For the vectors to be equal, their corresponding components must be equal.

From the $\vec{i}$ components: $4 = 2\lambda \implies \lambda = 2$.

From the $\vec{j}$ components: $m = 5\lambda$.

From the $\vec{k}$ components: $n = \lambda$.

We found that $\lambda = 2$. Now we can find the value of m .

$$m = 5\lambda = 5(2) = 10.$$

The value of m is 10. (And n would be 2).

Alternatively, if two vectors are collinear, the ratio of their corresponding components is constant.

$$\frac{4}{2} = \frac{m}{5} = \frac{n}{1}.$$

From the first equality: $2 = \frac{m}{5} \implies m = 10$.

Quick Tip

Two vectors are collinear if their corresponding components are proportional. Set up a ratio of the i-components, j-components, and k-components and solve for the unknown.

98. The Polar of (1, 2) with respect to $x^2 + y^2 = 7$ is

(A) $x + 2y - 7 = 0$

(B) $x - 2y - 7 = 0$

(C) $x + 2y + 7 = 0$

(D) $x + y + 7 = 0$

Correct Answer: (A) $x + 2y - 7 = 0$

Solution:

The equation of the polar of a point $P(x_1, y_1)$ with respect to the circle $x^2 + y^2 = r^2$ is given by the formula:

$$xx_1 + yy_1 = r^2.$$

In this problem, the point is $(x_1, y_1) = (1, 2)$.

The equation of the circle is $x^2 + y^2 = 7$, so $r^2 = 7$.

Substitute these values into the formula for the polar:

$$x(1) + y(2) = 7.$$

$$x + 2y = 7.$$

To match the format of the options, we can move the constant term to the left side:

$$x + 2y - 7 = 0.$$

This matches option (A).

Quick Tip

The equation of the polar of a point (x_1, y_1) with respect to a conic section can be found by the replacement method (T=0): $x^2 \rightarrow xx_1$ $y^2 \rightarrow yy_1$ $2x \rightarrow x + x_1$ $2y \rightarrow y + y_1$ $2xy \rightarrow xy_1 + yx_1$

99. If the straight lines $6x - 10y + 3 = 0$ and $Kx - 5y + 8 = 0$ are parallel then the value of K is

(A) 6

(B) 3

(C) 2

(D) 1

Correct Answer: (B) 3

Solution:

Two straight lines given by the equations $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ are parallel if the ratio of their coefficients of x and y are equal.

The condition for parallelism is $\frac{a_1}{a_2} = \frac{b_1}{b_2}$.

The first line is $6x - 10y + 3 = 0$. Here, $a_1 = 6$ and $b_1 = -10$.

The second line is $Kx - 5y + 8 = 0$. Here, $a_2 = K$ and $b_2 = -5$.

Applying the condition for parallel lines:

$$\frac{6}{K} = \frac{-10}{-5}.$$

$$\frac{6}{K} = 2.$$

Now, solve for K:

$$6 = 2K.$$

$$K = \frac{6}{2} = 3.$$

Quick Tip

For lines $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$: - Parallel condition: $\frac{a_1}{a_2} = \frac{b_1}{b_2}$ - Perpendicular condition: $a_1a_2 + b_1b_2 = 0$ - Coincident condition: $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

100. Tanh(x+y)

(A) $\frac{\tanh x + \tanh y}{1 + \tanh x \tanh y}$

(B) $\frac{\tanh x + \tanh y}{1 - \tanh x \tanh y}$

(C) $\tanh x + \tanh y$

(D) $\frac{\tanh x + \tanh y}{\tanh x - \tanh y}$

Correct Answer: (A) $\frac{\tanh x + \tanh y}{1 + \tanh x \tanh y}$

Solution:

This question asks for the standard addition formula for the hyperbolic tangent function, $\tanh(x + y)$.

The formula is analogous to the formula for the trigonometric function $\tan(x + y)$, but with a key difference in the sign of the denominator.

The definition of $\tanh x$ is $\frac{\sinh x}{\cosh x}$.

Using the addition formulas for $\sinh(x + y) = \sinh x \cosh y + \cosh x \sinh y$ and $\cosh(x + y) = \cosh x \cosh y + \sinh x \sinh y$.

$$\tanh(x + y) = \frac{\sinh(x+y)}{\cosh(x+y)} = \frac{\sinh x \cosh y + \cosh x \sinh y}{\cosh x \cosh y + \sinh x \sinh y}.$$

Divide the numerator and denominator by $\cosh x \cosh y$:

$$\tanh(x + y) = \frac{\frac{\sinh x}{\cosh x} + \frac{\sinh y}{\cosh y}}{1 + \frac{\sinh x \sinh y}{\cosh x \cosh y}} = \frac{\tanh x + \tanh y}{1 + \tanh x \tanh y}.$$

This matches option (A).

Quick Tip

Remember the addition formulas for both trigonometric and hyperbolic tangent functions. They are very similar, just note the sign change in the denominator: $\tan(x + y) = \frac{\tan x + \tan y}{1 - \tan x \tan y}$ $\tanh(x + y) = \frac{\tanh x + \tanh y}{1 + \tanh x \tanh y}$