



General Instructions

- (i) The test is of 3 hours and 15 minutes duration.
- (ii) This test paper consists of 180 questions. The maximum marks are 720.
- (iii) Physics and Chemistry contains 45 questions each and Biology (Botany and Zoology) contains 90 questions.
- (iv) Each question carries +4 marks for correct answer and –1 mark for wrong answer.

136. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : In recombinant DNA technology, lysozyme is used for disrupting bacterial cells while cellulase is for plant cells.

Reason R : Isolation of genetic material needs disruption of cells.

In the light of the above statements, choose the *most appropriate* answer from the options given below :

- (A) A is not correct but R is correct
- (B) Both A and R are correct and R is the correct explanation of A
- (C) Both A and R are correct but R is not the correct explanation of A
- (D) A is correct but R is not correct

Correct Answer: (B) Both A and R are correct and R is the correct explanation of A

Solution:

Step 1: Understanding the Question:

We need to evaluate an assertion about the specific enzymes used for cell lysis in biotechnology and a reason describing the necessity of cell disruption.

Step 2: Detailed Explanation:

Assertion A: In recombinant DNA technology, the first step is extracting DNA. To extract the DNA, the cell wall must be broken. Bacteria have cell walls made of peptidoglycan, which is degraded by the enzyme **lysozyme**. Plant cells have cell walls made of cellulose, which is degraded by **cellulase** (and pectinase). Thus, the assertion is factually correct.

Reason R: The fundamental reason why these specific degrading enzymes (lysozyme and cellulase) are utilized is precisely because the **isolation of genetic material requires the disruption and breakdown of the cell envelope**. The Reason is true, and it directly justifies why the actions described in the Assertion are being performed.

Therefore, both statements are correct, and the Reason provides a valid, logical rationale for the actions taken in the Assertion.

Step 3: Final Answer:

Both A and R are correct and R is the correct explanation of A.

Quick Tip: Also remember the enzyme for fungal cell disruption: chitinase (since fungal cell walls are made of chitin).

137. The method of directly injecting a sperm into ovum in assisted reproductive technology is called :

- (A) Embryo transfer (ET)
- (B) Gamete intra fallopian transfer (GIFT)
- (C) Zygote intra fallopian transfer (ZIFT)
- (D) Intra cytoplasmic sperm injection (ICSI)

Correct Answer: (D) Intra cytoplasmic sperm injection (ICSI)

Solution:

Step 1: Understanding the Question:

Identify the specific Assisted Reproductive Technology (ART) procedure where a single sperm is manually injected directly into the cytoplasm of an egg.

Step 2: Detailed Explanation:

Let's define the provided acronyms:

- **ET (Embryo Transfer):** Involves transferring an already formed embryo into the uterus or fallopian tube.
- **GIFT (Gamete Intra Fallopian Transfer):** Involves transferring collected sperm and unfertilized eggs directly into the fallopian tube to allow natural fertilization.
- **ZIFT (Zygote Intra Fallopian Transfer):** Involves fertilizing eggs *in vitro* and transferring the zygote (up to 8 blastomeres) into the fallopian tube.
- **ICSI (Intra Cytoplasmic Sperm Injection):** A highly specialized *in vitro* fertilization procedure where a single healthy sperm is isolated and injected directly into the center (cytoplasm) of an ovum using a micropipette. This is specifically used to overcome severe male infertility issues.

Step 3: Final Answer:

The procedure is Intra cytoplasmic sperm injection (ICSI).

Quick Tip: The name itself holds the answer: Intra (Inside) Cytoplasmic (Cytoplasm) Sperm Injection. It literally describes the mechanical act of injecting the sperm into the egg cell.

138. Adaptive radiation in placental mammals and Australian Marsupials leading to similarity between distant species is an example of _____

- (A) genetic drift
- (B) divergent evolution

- (C) convergent evolution
(D) founder effect

Correct Answer: (C) convergent evolution

Solution:

Step 1: Understanding the Question:

Identify the evolutionary phenomenon where two separate, geographically isolated lineages of mammals undergo adaptive radiation and end up developing strikingly similar phenotypic traits to fill identical ecological niches.

Step 2: Detailed Explanation:

- Adaptive radiation within a single lineage (e.g., Darwin's finches starting from one ancestor and diversifying) is an example of **divergent evolution**.
- However, when more than one adaptive radiation occurs in isolated geographical areas (one lineage of placental mammals in the Americas/Eurasia, and one lineage of marsupial mammals in Australia), and different groups evolve remarkably similar morphologies to adapt to similar habitats (e.g., the placental wolf and the marsupial Tasmanian wolf), this parallel adaptation is a classic example of **convergent evolution**.

Step 3: Final Answer:

The phenomenon is an example of convergent evolution.

Quick Tip: Divergent evolution = 1 ancestor → Many different forms. Convergent evolution = Different ancestors → Similar forms adapted to similar environments.

139. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : In an experiment, Mendel observed that the F₁ progeny plants are all tall and none are dwarf.

Reason R : Stem height is a contrasting trait, with tall being dominant and dwarf being recessive.

In the light of the above statements, choose the *most appropriate* answer from the options given below :

- (A) A is not correct but R is correct
- (B) Both A and R are correct and R is the correct explanation of A
- (C) Both A and R are correct but R is not the correct explanation of A
- (D) A is correct but R is not correct

Correct Answer: (B) Both A and R are correct and R is the correct explanation of A

Solution:

Step 1: Understanding the Question:

Evaluate an assertion concerning Mendel's monohybrid cross results and its underlying genetic reason.

Step 2: Detailed Explanation:

Assertion A: When Gregor Mendel crossed pure-breeding tall pea plants (TT) with pure-breeding dwarf pea plants (tt), he found that 100% of the resulting F1 generation plants were tall (Tt). He observed no dwarf plants in the F1 generation. Thus, the Assertion is historically and genetically accurate.

Reason R: The phenomenon observed in the F1 generation is explained by the Law of Dominance. Stem height in peas has two contrasting traits: Tall and Dwarf. The 'tall' allele (T) is dominant over the 'dwarf' allele (t). Therefore, in the heterozygous F1 hybrids (Tt), only the dominant tall trait is expressed, masking the recessive dwarf trait. Thus, the Reason is correct, and it perfectly explains the observation made in the Assertion.

Step 3: Final Answer:

Both A and R are correct and R is the correct explanation of A.

Quick Tip: The complete masking of one trait by another in an F1 hybrid is the fundamental basis for Mendel's Law of Dominance.

140. Arrange the following in descending order of number of species in the Amazonian rain forest.

- (a) Plants
- (b) Birds
- (c) Fishes
- (d) Invertebrates
- (e) Mammals

Choose the correct answer from the options given below :

- (A) (b) > (a) > (d) > (c) > (e)
- (B) (c) > (b) > (d) > (e) > (a)
- (C) (d) > (a) > (c) > (b) > (e)
- (D) (e) > (b) > (a) > (c) > (d)

Correct Answer: (C) (d) > (a) > (c) > (b) > (e)

Solution:

Step 1: Understanding the Question:

We must arrange various taxa in decreasing order based on their approximate species diversity found within the Amazonian rainforest.

Step 2: Detailed Explanation:

According to ecological data (and standard NCERT biodiversity statistics), the Amazonian rainforest harbors staggering biodiversity. The approximate species counts are:

1. **Invertebrates (d):** More than 1,25,000 species.
2. **Plants (a):** More than 40,000 species.
3. **Fishes (c):** Around 3,000 species.
4. **Birds (b):** Around 1,300 species.
5. **Mammals (e):** Around 427 species.

Arranging these from highest to lowest yields:

Invertebrates > Plants > Fishes > Birds > Mammals

Therefore, the correct sequence is (d) > (a) > (c) > (b) > (e).

Step 3: Final Answer:

The correct order is (d) > (a) > (c) > (b) > (e).

Quick Tip: In almost any terrestrial ecosystem, invertebrates (specifically insects) constitute the vast majority of species diversity, while large mammals are the least diverse.

141. Sponges exchange O_2 with CO_2 by

- (A) gills
- (B) simple diffusion over their entire body surfaces
- (C) moist cuticle
- (D) tracheal tubes

Correct Answer: (B) simple diffusion over their entire body surfaces

Solution:

Step 1: Understanding the Question:

Identify the primary mechanism of respiratory gas exchange utilized by sponges (Phylum Porifera).

Step 2: Detailed Explanation:

Sponges are very simple, multicellular organisms that possess a cellular level of organization. They lack any specialized respiratory, circulatory, or excretory systems.

Because their bodies are highly porous and water flows continuously through their canal systems, nearly all of their cells are in direct contact with the surrounding water.

Consequently, the exchange of gases (absorbing dissolved O_2 and releasing CO_2) occurs exclusively through **simple diffusion** across the cell membranes over their entire body surface.

Other options like gills (fish), moist cuticle (earthworms), and tracheal tubes (insects) are

specialized respiratory organs found in higher, more complex animal phyla.

Step 3: Final Answer:

Sponges exchange gases by simple diffusion over their entire body surfaces.

Quick Tip: Lower invertebrates like Sponges, Coelenterates, and Flatworms rely entirely on simple diffusion through their body surface for gas exchange.

142. For a person with blood group 'O', which of the following is not a possible combination of parents' blood group genotypes ?

- (A) Father : $I^A I^B$ and Mother : $I^A i$
- (B) Father : $I^A i$ and Mother : $I^B i$
- (C) Father : $I^A i$ and Mother : $I^A i$
- (D) Father : $I^B i$ and Mother : $I^B i$

Correct Answer: (A) Father : $I^A I^B$ and Mother : $I^A i$

Solution:

Step 1: Understanding the Question:

We need to determine which set of parental genotypes makes it genetically impossible to produce a child with an 'O' blood type.

Step 2: Detailed Explanation:

The ABO blood group system is controlled by the gene 'I'. The 'O' blood group is a recessive phenotype, meaning a person must possess a homozygous recessive genotype (ii).

To have an 'O' blood type child (ii), the child must inherit one recessive 'i' allele from the father and one recessive 'i' allele from the mother. Thus, **both parents must possess at least one 'i' allele.**

Let's evaluate the options:

- (A) Father is $I^A I^B$. He has no 'i' allele to pass on. He can only pass I^A or I^B . Therefore, this couple can never have a child with blood group 'O'.
- (B) Both parents are heterozygous ($I^A i$ and $I^B i$). Both can pass the 'i' allele. (Possible)
- (C) Both parents are heterozygous ($I^A i$). Both can pass the 'i' allele. (Possible)
- (D) Both parents are heterozygous ($I^B i$). Both can pass the 'i' allele. (Possible)

Step 3: Final Answer:

The impossible combination is Father : $I^A I^B$ and Mother : $I^A i$.

Quick Tip: An AB blood group parent ($I^A I^B$) can NEVER have an O blood group child, and an O blood group parent (ii) can NEVER have an AB blood group child, regardless of the other parent's genotype.

143. Given below are two statements :

Statement I : Modern *Homo sapiens* arose in Australia and moved across continents.

Statement II : *Homo sapiens* arose around 75000 to 10000 years ago.

In the light of the above statements, choose the *most appropriate* answer from the options given below :

- (A) Statement I is incorrect but Statement II is correct
- (B) Both Statement I and Statement II are correct
- (C) Both Statement I and Statement II are incorrect
- (D) Statement I is correct but Statement II is incorrect

Correct Answer: (A) Statement I is incorrect but Statement II is correct

Solution:

Step 1: Understanding the Question:

Evaluate statements regarding the geographical origin and the temporal emergence of modern humans.

Step 2: Detailed Explanation:

Statement I: Anthropological and genetic evidence overwhelmingly demonstrates that anatomically modern *Homo sapiens* arose in **Africa**, not Australia. From Africa, they subsequently migrated outward to populate other continents. Thus, Statement I is factually incorrect.

Statement II: According to established evolutionary timelines, *Homo sapiens* arose during the ice age, specifically between 75,000 to 10,000 years ago. This statement aligns with the accepted evolutionary timeline in standard biology texts. Thus, Statement II is correct.

Step 3: Final Answer:

Statement I is incorrect but Statement II is correct.

Quick Tip: Always remember the "Out of Africa" theory. It is the widely accepted model for the origin and dispersion of modern humans.

144. Which of the following is used as an effective sedative and painkiller for treating post-surgery patients ?

- (A) Anti-retroviral drugs
- (B) Interferon
- (C) Antibiotics
- (D) Morphine

Correct Answer: (D) Morphine

Solution:

Step 1: Understanding the Question:

Identify the pharmacological agent specifically utilized in clinical settings to provide pain relief and sedation following surgical procedures.

Step 2: Detailed Explanation:

Let's review the medical applications of the listed drugs:

- **Anti-retroviral drugs** are used to treat viral infections like HIV.
- **Interferons** are signaling proteins used to stimulate the immune system, particularly against viral infections and certain cancers.
- **Antibiotics** are used to treat bacterial infections.
- **Morphine** is a potent opioid analgesic derived from the latex of the poppy plant (*Papaver somniferum*). It acts directly on the central nervous system to relieve severe pain and induce sleep (sedation). It is highly effective and widely used for managing post-operative pain.

Step 3: Final Answer:

Morphine is used as an effective sedative and painkiller.

Quick Tip: Opioids bind to specific opioid receptors in the CNS and GI tract. Morphine is the classic benchmark against which all other painkillers (analgesics) are measured.

145. Which of the following plant produces non-albuminous seeds ?

- (A) Pea
- (B) Wheat
- (C) Maize
- (D) Barley

Correct Answer: (A) Pea

Solution:

Step 1: Understanding the Question:

Identify the plant species from the options that produces seeds lacking residual endosperm at maturity (non-albuminous/ex-albuminous seeds).

Step 2: Detailed Explanation:

Seeds are broadly classified based on the presence of endosperm at maturity:

1. **Albuminous (Endospermic) seeds:** The endosperm is retained and serves to nourish the embryo during germination. These are typical of **monocots** like Wheat, Maize, Barley, Rice, and Coconut (and a few dicots like Castor).

2. **Non-albuminous (Ex-albuminous) seeds:** The endosperm is completely consumed by the developing embryo before seed maturation. Food is stored in fleshy cotyledons instead. These are typical of **dicots** like **Pea**, Gram, Bean, and Groundnut.

Therefore, the Pea plant produces non-albuminous seeds.

Step 3: Final Answer:

Pea produces non-albuminous seeds.

Quick Tip: General rule of thumb: Monocots = Albuminous (exception: Orchids). Dicots = Non-albuminous (exception: Castor).

146. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : Abingdon tortoise in Galapagos islands became extinct within a decade after goats were introduced.

Reason R : Goats were more efficient at browsing than Abingdon tortoise.

In the light of the above statements, choose the *most appropriate* answer from the options given below :

(A) A is not correct but R is correct

(B) Both A and R are correct and R is the correct explanation of A

(C) Both A and R are correct but R is not the correct explanation of A

(D) A is correct but R is not correct

Correct Answer: (B) Both A and R are correct and R is the correct explanation of A

Solution:

Step 1: Understanding the Question:

We need to evaluate an assertion about an ecological extinction event and assess if the given reason represents the correct ecological mechanism behind it.

Step 2: Detailed Explanation:

Assertion A: Historical ecological records show that the Abingdon tortoise population on the Galapagos Islands suffered a dramatic collapse, leading to extinction shortly after goats were introduced to the islands by humans. The Assertion is factually correct.

Reason R: The rapid extinction was a classic case of **competitive exclusion** between two distinct species sharing the same limited food resource. Goats are highly active, voracious, and efficient browsers capable of rapidly clearing out ground-level vegetation. The slow-moving tortoises simply could not compete with the grazing efficiency of the goats and ultimately starved. The Reason is factually correct and perfectly explains the mechanism of the extinction described in the Assertion.

Step 3: Final Answer:

Both A and R are correct and R is the correct explanation of A.

Quick Tip: This is a standard textbook example of 'Competitive Exclusion' where an introduced alien species outperforms a native species, driving the native species to extinction.

147. The covering of ovum at ovulation is

- (A) chorion
- (B) endometrium
- (C) zona radiata
- (D) zona pellucida

Correct Answer: (D) zona pellucida

Solution:

Step 1: Understanding the Question:

Identify the primary acellular envelope surrounding the human egg cell (secondary oocyte) at the time it is released from the ovary.

Step 2: Detailed Explanation:

During ovulation, a mature Graafian follicle ruptures to release the secondary oocyte. At this stage, the oocyte is immediately surrounded by a thick, transparent, non-cellular glycoprotein layer known as the **zona pellucida**, which is synthesized by the oocyte itself. Outside the zona pellucida is a cellular layer formed by follicle cells, known as the corona radiata (not zona radiata). Chorion and endometrium are structures related to pregnancy and the uterus, not the unfertilized ovum.

Step 3: Final Answer:

The covering of the ovum at ovulation is the zona pellucida.

Quick Tip: The zona pellucida plays a crucial role during fertilization: it binds spermatozoa and initiates the acrosome reaction, and subsequently hardens to prevent polyspermy (entry of multiple sperm).

148. Which of the following is used as a clot buster ?

- (A) Statins
- (B) Streptokinase
- (C) Penicillin
- (D) Cyclosporin A

Correct Answer: (B) Streptokinase

Solution:

Step 1: Understanding the Question:

Identify the biologically derived substance used medically to dissolve blood clots in patients experiencing heart attacks.

Step 2: Detailed Explanation:

Let's review the medical applications of the options: - **Statins:** Produced by the yeast *Monascus purpureus*; used as blood-cholesterol-lowering agents. - **Streptokinase:** An enzyme produced by the bacterium *Streptococcus*. It is modified by genetic engineering and used as a "clot buster" to dissolve blood clots in the blood vessels of patients suffering from myocardial infarction (heart attack). - **Penicillin:** A classic antibiotic derived from fungi, used to kill bacteria. - **Cyclosporin A:** Produced by the fungus *Trichoderma polysporum*; used as an immunosuppressive agent in organ transplant patients.

Step 3: Final Answer:

Streptokinase is used as a clot buster.

Quick Tip: Memorize these three high-yield medical products from microbes: Statins (cholesterol), Streptokinase (clot buster), and Cyclosporin A (immunosuppressant).

149. Which of the following structure is not a part of the male reproductive system ?

- (A) Infundibulum
- (B) Rete testis
- (C) Epididymis
- (D) Vasa efferentia

Correct Answer: (A) Infundibulum

Solution:

Step 1: Understanding the Question:

Identify the anatomical structure that belongs exclusively to the female reproductive system and not the male reproductive system.

Step 2: Detailed Explanation:

The male reproductive accessory ducts include: - **Rete testis**: A network of tubules within the testes. - **Vasa efferentia**: Fine ciliated ductules that exit the rete testis. - **Epididymis**: A highly coiled tube located on the posterior surface of the testis, serving as a site for sperm maturation. - **Vas deferens**: The tube that transports sperm from the epididymis.

The **Infundibulum**, however, is the funnel-shaped terminal portion of the female Fallopian tube (oviduct) that lies close to the ovary and possesses finger-like fimbriae to collect the ovum. It is completely absent in males.

Step 3: Final Answer:

Infundibulum is not a part of the male reproductive system.

Quick Tip: To remember the sequence of male accessory ducts, use the pathway of sperm: Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis → Vas deferens.

150. Given below are two statements :

Statement I : Ovulation is caused by LH surge leading to rupture of Graafian follicles.

Statement II : Graafian follicle remaining after ovulation transform into corpus luteum and secretes large amount of estrogen.

In the light of the above statements, choose the *most appropriate* answer from the options given below :

- (A) Statement I is incorrect but Statement II is correct
- (B) Both Statement I and Statement II are correct
- (C) Both Statement I and Statement II are incorrect
- (D) Statement I is correct but Statement II is incorrect

Correct Answer: (D) Statement I is correct but Statement II is incorrect

Solution:

Step 1: Understanding the Question:

Evaluate statements detailing the hormonal control of ovulation and the subsequent development of ovarian structures.

Step 2: Detailed Explanation:

Statement I: Around the 14th day of a normal menstrual cycle, there is a rapid peak in the secretion of Luteinizing Hormone (LH), known as the LH surge. This surge directly induces the rupture of the mature Graafian follicle, thereby releasing the ovum (ovulation). Thus, Statement I is entirely correct.

Statement II: Following ovulation, the ruptured structural remnants of the Graafian follicle reorganize into a temporary endocrine gland called the **corpus luteum**. The corpus luteum functions primarily to secrete large amounts of **progesterone** (not estrogen), which is essential for maintaining the endometrial lining for potential implantation. Because the statement wrongly identifies the primary hormone as estrogen, Statement II is incorrect.

Step 3: Final Answer:

Statement I is correct but Statement II is incorrect.

Quick Tip: Remember the dominant hormones by cycle phase: Follicular phase = Estrogen (secreted by growing follicles). Luteal phase = Progesterone (secreted by Corpus luteum).

151. The opening between the right atrium and the right ventricle is guarded by

- (A) sino-atrial node
- (B) bicuspid valve
- (C) tricuspid valve
- (D) semilunar valve

Correct Answer: (C) tricuspid valve

Solution:

Step 1: Understanding the Question:

Identify the specific anatomical valve that regulates blood flow between the right upper chamber (atrium) and right lower chamber (ventricle) of the human heart.

Step 2: Detailed Explanation:

The human heart possesses several valves to ensure unidirectional blood flow: 1. **Tricuspid Valve:** Located between the right atrium and the right ventricle. It is formed by three muscular flaps (cusps). 2. **Bicuspid (Mitral) Valve:** Located between the left atrium and the left ventricle. It is formed by two flaps. 3. **Semilunar Valves:** Guard the openings of the right ventricle into the pulmonary artery and the left ventricle into the aorta.

The sino-atrial (SA) node is a patch of tissue generating electrical impulses (pacemaker), not a valve.

Step 3: Final Answer:

The opening is guarded by the tricuspid valve.

Quick Tip: Mnemonic to avoid confusion: "Try to be Right" → **Tricuspid** valve is on the **Right** side.

152. Which of the following is not evidence for evolution ?

- (A) Divergent evolution of anatomical structures such as forelimbs
- (B) Convergent evolution of traits like wings of birds and butterflies
- (C) Paleontological evidence from fossil records
- (D) Embryological support for evolution as proposed by Ernst Haeckel

Correct Answer: (D) Embryological support for evolution as proposed by Ernst Haeckel

Solution:

Step 1: Understanding the Question:

Identify the theory or concept among the options that is historically rejected and no longer accepted by modern science as valid evidence for evolution.

Step 2: Detailed Explanation:

Let's analyze the options based on evolutionary biology standards: - **Divergent and Convergent evolution** (Options A and B) represent comparative anatomical evidence (homology and analogy) firmly establishing evolutionary relationships. - **Paleontological evidence** (Option C) from fossils is the most direct physical evidence of historical evolutionary change. - **Ernst Haeckel's "Embryological support"** (Option D) originally proposed the "Recapitulation Theory" (ontogeny recapitulates phylogeny), suggesting that embryos pass through the exact adult stages of their evolutionary ancestors. However, this proposal was strictly **disapproved and rejected** following careful studies performed by Karl Ernst von Baer, who noted that embryos never pass through the *adult* stages of other animals. Therefore, Haeckel's specific framework is not considered valid evidence today.

Step 3: Final Answer:

Embryological support for evolution as proposed by Ernst Haeckel is not considered evidence.

Quick Tip: While general embryological similarities do support evolution, Haeckel's specific "recapitulation theory" was famously debunked. Always pay attention to the names attached to the theories in evolutionary biology questions.

153. The inactive form of Bt toxin is converted to the active form in the insect gut

- (A) by nucleases
- (B) due to alkaline pH
- (C) due to acidic pH
- (D) by proteases

Correct Answer: (B) due to alkaline pH

Solution:

Step 1: Understanding the Question:

Identify the specific physiological trigger inside the gut of an insect that activates the lethal properties of the Bt toxin.

Step 2: Detailed Explanation:

The bacterium *Bacillus thuringiensis* (Bt) produces insecticidal proteins in an inactive crystal form known as protoxins. When an insect ingests these crystals, they enter the midgut. The **alkaline pH** of the insect's midgut solubilizes the crystals and triggers the conversion of the inactive protoxins into active toxic proteins. These activated toxins then bind to the surface of the midgut epithelial cells, creating pores that cause cell swelling and lysis, ultimately leading to the death of the insect. This requirement for alkaline pH is why the toxin is harmless to mammals, including humans, as our stomachs possess an acidic pH.

Step 3: Final Answer:

It is converted to the active form due to alkaline pH.

Quick Tip: This mechanism is the core reason genetically modified Bt crops are safe for human consumption. We have an acidic stomach, while target insects have an alkaline midgut!

154. Colostrum, secreted by mother during initial days of lactation, is abundant in

- (A) IgD
- (B) IgG
- (C) IgM
- (D) IgA

Correct Answer: (D) IgA

Solution:

Step 1: Understanding the Question:

Identify the specific class of antibody (immunoglobulin) that is highly concentrated in the first breast milk (colostrum) provided to a newborn.

Step 2: Detailed Explanation:

Colostrum is the yellowish fluid produced by the mammary glands during the first few days after childbirth. It is uniquely rich in **Immunoglobulin A (IgA)** antibodies. These IgA antibodies provide crucial passive immunity to the infant, specifically coating the mucosal surfaces of the infant's digestive and respiratory tracts to protect against invasive environmental pathogens during the highly vulnerable early days of life.

Step 3: Final Answer:

Colostrum is abundant in IgA.

Quick Tip: Antibody tricks: **IgA** = Secretions (colostrum, saliva, tears). **IgG** = Gestation (only antibody that crosses the placenta). **IgE** = Eosinophils/Allergies. **IgM** = First responder (largest).

155. Which of the following in female gametophyte of an angiosperm helps in guiding the pollen tube for fertilizing the eggs ?

- (A) Polar nucleus
- (B) Antipodals
- (C) Synergids
- (D) Central cells

Correct Answer: (C) Synergids

Solution:

Step 1: Understanding the Question:

Identify the specific cells within the embryo sac that functionally direct the entry of the pollen tube.

Step 2: Detailed Explanation:

A mature female gametophyte (embryo sac) in angiosperms is a 7-celled, 8-nucleate structure. At the micropylar end, three cells group together to form the egg apparatus: one egg cell and two **synergids**. These synergids possess special cellular thickenings at their micropylar tip known as the **filiform apparatus**. The primary function of the filiform apparatus of the synergids is to release chemical attractants that guide the growing pollen tube precisely into the synergid, facilitating the release of male gametes for fertilization.

Step 3: Final Answer:

Synergids help in guiding the pollen tube.

Quick Tip: Think of the **Synergids** acting like airport ground crew holding light wands (filiform apparatus) guiding an airplane (pollen tube) safely into the terminal.

156. Which of the following disease is not sexually transmitted ?

- (A) Genital warts
- (B) Syphilis
- (C) Tuberculosis
- (D) Gonorrhoea

Correct Answer: (C) Tuberculosis

Solution:

Step 1: Understanding the Question:

Identify the infectious disease among the options that is not categorized as a Sexually Transmitted Infection (STI).

Step 2: Detailed Explanation:

Let's classify the mode of transmission for each disease: - **Genital warts** are caused by the Human Papillomavirus (HPV) and are highly contagious via sexual contact. - **Syphilis** is a bacterial infection caused by *Treponema pallidum* and is transmitted almost exclusively via sexual contact. - **Gonorrhoea** is a bacterial infection caused by *Neisseria gonorrhoeae* and is transmitted via sexual contact. - **Tuberculosis (TB)** is a bacterial infection caused by *Mycobacterium tuberculosis*. It primarily affects the lungs and is transmitted via **airborne respiratory droplets** (coughs and sneezes), not through sexual contact.

Step 3: Final Answer:

Tuberculosis is not sexually transmitted.

Quick Tip: Common STIs to remember for biology exams: Syphilis, Gonorrhea, Chlamydia, Genital herpes, Genital warts, Trichomoniasis, Hepatitis B, and HIV.

157. Which of the following statements about lac-operon is correct ?

- (A) Galactose can act as an inducer of lac operon
- (B) Gene i is constitutively expressed
- (C) Lactose activates repressor to bind to the operator
- (D) Genes i, z, y and a share single common promoter

Correct Answer: (B) Gene i is constitutively expressed

Solution:

Step 1: Understanding the Question:

Evaluate the provided statements regarding the genetic structure and regulation mechanism of the *lac* operon in bacteria.

Step 2: Detailed Explanation:

Let's review the facts regarding the *lac* operon: - **Option A:** The inducer of the *lac* operon

is **lactose** (or its isomer allolactose), not galactose. (Incorrect) - **Option C:** The binding of the inducer (lactose) to the repressor protein actually **inactivates** it, changing its shape so it *cannot* bind to the operator, thereby allowing transcription. It does not activate it. (Incorrect) - **Option D:** While the structural genes (z, y, and a) share a single common promoter, the regulatory gene 'i' is independent and possesses its own distinct promoter. (Incorrect) - **Option B:** The regulatory gene 'i' constantly synthesizes the repressor protein at a low background level regardless of environmental conditions. Genes that are continuously expressed without external regulation are called "constitutive genes". Thus, gene i is constitutively expressed. (Correct)

Step 3: Final Answer:

The correct statement is that Gene i is constitutively expressed.

Quick Tip: The letter 'i' in the *lac* operon stands for "inhibitor", not inducer! It codes for the repressor protein which is always present (constitutive expression) to keep the operon firmly turned off until lactose shows up.

158. Match List-I with List-II.

List-I	List-II
A. Transformation	I. Restriction enzyme
B. Cloning site	II. Transfer DNA to host bacteria
C. Selection	III. Replication
D. Ori	IV. Antibiotic

Choose the correct answer from the options given below:

- (A) A-IV, B-I, C-III, D-II
- (B) A-II, B-I, C-IV, D-III
- (C) A-I, B-II, C-IV, D-III
- (D) A-III, B-IV, C-II, D-I

Correct Answer: (B) A-II, B-I, C-IV, D-III

Solution:

Step 1: Understanding the Question:

The question requires matching terms related to recombinant DNA technology (List-I) with their corresponding biological functions or features (List-II).

Step 2: Detailed Explanation:

Let us match the given terms correctly:

A. **Transformation:** It is a procedure through which a piece of recombinant DNA is introduced into a host bacterium. (A-II)

B. **Cloning site:** In a vector, cloning sites are essentially the recognition sequences for specific restriction enzymes where the foreign DNA is ligated. (B-I)

C. **Selection:** Selectable markers, often antibiotic resistance genes, help in identifying and selecting transformants from non-transformants. (C-IV)

D. **Ori:** Origin of replication is the specific sequence from where replication starts. (D-III)

Therefore, the correct matching sequence is A-II, B-I, C-IV, D-III.

Quick Tip: Remember that vectors require three essential features for cloning: Origin of replication (Ori), a selectable marker (like antibiotic resistance), and cloning sites (for restriction enzymes).

159. A population of diploid organisms is at Hardy-Weinberg equilibrium. If the frequency of allele A is 0.1, the frequency of AA is _____.

- (A) 0.99
- (B) 0.01
- (C) 0.02
- (D) 0.10

Correct Answer: (B) 0.01

Solution:

Step 1: Understanding the Question:

We need to calculate the frequency of a homozygous dominant genotype in a population that is at Hardy-Weinberg equilibrium, given the frequency of the dominant allele.

Step 2: Key Formula or Approach:

According to the Hardy-Weinberg equation:

$$p^2 + 2pq + q^2 = 1$$

where p is the frequency of the dominant allele (A) and p^2 is the frequency of the homozygous dominant genotype (AA).

Step 3: Detailed Explanation:

Given the frequency of allele A (p) = 0.1.

The frequency of the AA genotype is p^2 .

$$p^2 = (0.1)^2 = 0.01.$$

Quick Tip: Always double-check what the question asks for: allele frequency (p or q) or genotype frequency (p^2 , q^2 , or $2pq$).

160. Sperm motility is due to _____.

- (A) muscular movement
- (B) flagellar movement
- (C) ciliary movement
- (D) amoeboid movement

Correct Answer: (B) flagellar movement

Solution:

Step 1: Understanding the Question:

The question asks for the specific type of cellular movement mechanism that allows human spermatozoa to swim.

Step 2: Detailed Explanation:

A mammalian sperm consists of a head, neck, a middle piece, and a tail. The tail is a long flagellum containing a central axoneme (microtubule structure). The vigorous, whip-like lashing movement of the tail facilitates sperm motility essential for it to swim through the female reproductive tract and reach the ovum for fertilization. Therefore, sperm motility is entirely due to flagellar movement.

Quick Tip: Flagellar movement is characteristic of spermatozoa, whereas ciliary movement is seen in the respiratory tract and fallopian tubes, and amoeboid movement is characteristic of macrophages and leukocytes.

161. Consider a population of 10 million cells. Given the per-capita birth rate of 0.002 (per unit time) and the per-capita death rate of 0.002 (per unit time), the expected number of cells after 10 generations is _____.

- (A) 100 million
- (B) 1 million
- (C) 5 million
- (D) 10 million

Correct Answer: (D) 10 million

Solution:

Step 1: Understanding the Question:

We need to determine the future population size given an initial population size along with

the per-capita birth and death rates.

Step 2: Key Formula or Approach:

The intrinsic rate of natural increase (r) determines population growth and is given by:

$$r = b - d$$

where b is the per-capita birth rate and d is the per-capita death rate.

Step 3: Detailed Explanation:

Given values: Birth rate (b) = 0.002 Death rate (d) = 0.002 Calculating the intrinsic rate of natural increase:

$$r = 0.002 - 0.002 = 0$$

Since $r = 0$, the population is experiencing zero growth (births perfectly balance deaths). Consequently, the population size will remain constant over time. Therefore, after 10 generations, the expected number of cells remains unchanged at 10 million.

Quick Tip: Whenever $b = d$, r is zero, and the population is stable (at a plateau). You don't need complex exponential formulas to solve this!

162. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : Forelimbs of human and bats are homologous.

Reason R : Forelimbs of humans and bats have similar anatomical structure.

In the light of the above statements, choose the most appropriate answer from the options given below :

- (A) A is false but R is true
- (B) Both A and R are correct and R is the correct explanation of A
- (C) Both A and R are true, but R is not the correct explanation of A
- (D) A is true but R is false

Correct Answer: (B) Both A and R are correct and R is the correct explanation of A

Solution:

Step 1: Understanding the Question:

The question asks to evaluate an assertion about the relationship between human and bat forelimbs and a reason explaining the basis of this relationship.

Step 2: Detailed Explanation:

Assertion A states that the forelimbs of humans and bats are homologous. This is correct because homologous organs are those that share a common origin and basic structural plan, even if they have evolved to perform different functions (grasping in humans vs. flying in bats).

Reason R states that they have a similar anatomical structure. This is also correct, as both possess a similar arrangement of bones: humerus, radius, ulna, carpals, metacarpals, and phalanges. This fundamental similarity in their anatomical plan is the exact biological evidence and reason for classifying them as homologous organs (indicating divergent evolution from a common ancestor).

Therefore, both A and R are correct, and R provides the correct explanation for A.

Quick Tip: Homology = Same origin/structure, different function (Divergent evolution). Analogy = Different origin/structure, same function (Convergent evolution).

163. Muscle contraction is initiated by a signal sent by the central nervous system by the release of _____

- (A) cyclic adenine monophosphate
- (B) acetyl choline
- (C) acetyl coenzyme A
- (D) cyclic guanine monophosphate

Correct Answer: (B) acetyl choline

Solution:

Step 1: Understanding the Question:

We need to identify the specific neurotransmitter responsible for initiating skeletal muscle contraction at the neuromuscular junction.

Step 2: Detailed Explanation:

Muscle contraction is initiated by a neural signal from the Central Nervous System (CNS) transmitted via a motor neuron. When the neural signal reaches the neuromuscular junction (the junction between a motor neuron and the sarcolemma of the muscle fiber), it causes the synaptic vesicles to release a neurotransmitter called **acetylcholine**. The binding of acetylcholine to receptors on the sarcolemma generates an action potential that ultimately leads to muscle contraction via the release of calcium ions.

Quick Tip: Acetylcholine (ACh) is the primary neurotransmitter of the somatic nervous system stimulating skeletal muscles. Acetyl coenzyme A is an intermediate in cellular respiration, not a neurotransmitter.

164. Which of the following hormone is not secreted by human placenta ?

- (A) LH
- (B) hCG
- (C) Estrogen
- (D) Progesterone

Correct Answer: (A) LH

Solution:

Step 1: Understanding the Question:

Identify the hormone that is not synthesized and secreted by the human placenta during pregnancy.

Step 2: Detailed Explanation:

The human placenta acts as a temporary endocrine tissue and produces several essential hormones to maintain pregnancy. These include: - Human chorionic gonadotropin (hCG) - Human placental lactogen (hPL) - Estrogens - Progestogens (Progesterone) Luteinizing Hormone (LH), however, is a gonadotropin secreted by the anterior pituitary gland of the brain, not by the placenta. (Interestingly, hCG mimics the action of LH to maintain the corpus luteum during early pregnancy).

Quick Tip: hCG, hPL, and Relaxin are hormones produced in a woman only during pregnancy.

165. Which of the following statements is correct about *Plasmodium* ?

- (A) Fertilization takes place in mosquito gut
- (B) Reproduces sexually in liver cells
- (C) Reproduces sexually in RBCs
- (D) Gametocytes develop in mosquito gut

Correct Answer: (A) Fertilization takes place in mosquito gut

Solution:

Step 1: Understanding the Question:

We need to select the true statement regarding the life cycle of the malaria parasite, *Plasmodium*.

Step 2: Detailed Explanation:

Let's review the life cycle of *Plasmodium*: - Gametocytes (sexual stages) are formed inside the red blood cells (RBCs) of the human host. Therefore, option (D) is incorrect. - The human acts as the intermediate host where *Plasmodium* reproduces **asexually** (in liver cells and RBCs). Therefore, options (B) and (C) are incorrect. - When a female *Anopheles* mosquito takes a blood meal, it ingests these gametocytes. Inside the mosquito's stomach/gut, the gametes mature and **fertilization** (syngamy) takes place. Thus, option (A) is correct.

Quick Tip: Asexual reproduction = Human (Liver RBCs). Sexual reproduction (Fertilization) = Mosquito (Gut). Gametocyte formation = Human (RBCs).

166. Which of the following are primary consumers in a food chain ?

- (A) Carnivores
- (B) Parasites
- (C) Predators
- (D) Herbivores

Correct Answer: (D) Herbivores

Solution:

Step 1: Understanding the Question:

Identify the group of organisms that occupy the second trophic level (primary consumers) in a grazing food chain.

Step 2: Detailed Explanation:

In a food chain, the first trophic level consists of producers (plants/autotrophs) that fix solar energy. Organisms that feed directly on these producers are termed primary consumers. Since they exclusively eat plant material, primary consumers are **herbivores** (e.g., insects, deer, cows). Carnivores eat herbivores, making them secondary or tertiary consumers.

Quick Tip: Producers = Trophic level 1. Primary consumers = Herbivores = Trophic level 2. Secondary consumers = Primary Carnivores = Trophic level 3.

167. Which of the following statements about the reabsorption process in Henle's loop are correct?

- (a) The descending limb of Henle's loop is permeable to water but almost impermeable to electrolytes.
- (b) Urine gets concentrated in Henle's loop.
- (c) Reabsorption of Na^+ and water takes place in Henle's loop.
- (d) Active or passive transport of electrolytes occurs in the ascending limb of Henle's loop.

Choose the correct answer from the options given below:

- (A) (a), (b) and (d) only
- (B) (a) and (b) only
- (C) (b), (c) and (d) only
- (D) (a), (b) and (c) only

Correct Answer: (A) (a), (b) and (d) only

Solution:

Step 1: Understanding the Question:

Evaluate multiple statements regarding the physiological properties and functions of the Loop of Henle during urine formation.

Step 2: Detailed Explanation:

Let's analyze the statements: - **Statement (a):** True. The descending limb is highly permeable to water but practically impermeable to electrolytes. - **Statement (b):** True. Because water leaves the descending limb, the filtrate (urine) becomes increasingly concentrated as it moves down toward the hairpin turn. The loop plays a crucial role in maintaining medullary osmolarity, which ultimately concentrates urine. - **Statement (d):** True. The ascending limb is impermeable to water but allows the passage of electrolytes (like NaCl) actively or passively into the medullary fluid. - **Statement (c):** While both Na^+ and water are technically reabsorbed somewhere in the loop, they are not reabsorbed together in the same segment. The statement is broad and often considered misleading in multiple-choice formats compared to the specific accuracy of (a), (b), and (d). Based on the best-fit options provided, (a), (b), and (d) represent the most definitive and precise facts outlined in standard texts.

Quick Tip: Descending limb = Water exits (concentrates filtrate). Ascending limb = Electrolytes exit (dilutes filtrate).

168. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : The logistic growth model of populations is considered more realistic than the exponential growth model.

Reason R : Resources are finite.

In the light of the above statements, choose the most appropriate answer from the options given below :

- (A) A is not correct but R is correct
- (B) Both A and R are correct and R is the correct explanation of A
- (C) Both A and R are correct but R is not the correct explanation of A
- (D) A is correct but R is not correct

Correct Answer: (B) Both A and R are correct and R is the correct explanation of A

Solution:

Step 1: Understanding the Question:

Assess an assertion regarding population growth models and whether the given reason logically supports it.

Step 2: Detailed Explanation:

Assertion A is correct: In ecology, the logistic growth model (which results in an S-shaped or sigmoid curve) is considered highly realistic for natural populations, whereas the exponential model (J-shaped curve) is theoretical and rarely sustained.

Reason R is correct: The primary reason the exponential model fails in nature is that environmental resources (food, space, light) are limited and finite. As a population grows, competition for these finite resources increases, eventually halting growth as it approaches the carrying capacity (K). Therefore, the fact that resources are finite is the exact reason why the logistic model is more realistic.

Both statements are true, and R correctly explains A.

Quick Tip: Exponential growth occurs only under ideal, unlimited resource conditions. Logistic growth occurs under realistic, limited resource conditions characterized by carrying capacity (K).

169. Which of the following is the correct order of arrangement of vertebrate column from the head to toe?

- (A) Cervical vertebra, thoracic vertebra, lumbar vertebra, sacrum
- (B) Cervical vertebra, thoracic vertebra, sacrum, lumbar vertebra
- (C) Sacrum, lumbar vertebra, thoracic vertebra, cervical vertebra
- (D) Cervical vertebra, lumbar vertebra, thoracic vertebra, sacrum

Correct Answer: (A) Cervical vertebra, thoracic vertebra, lumbar vertebra, sacrum

Solution:

Step 1: Understanding the Question:

Identify the correct anatomical sequence of the regions of the human vertebral column starting from the superior end (head) to the inferior end (toe).

Step 2: Detailed Explanation:

The human vertebral column consists of 26 serially arranged vertebrae. From the skull downwards, they are arranged in the following order: 1. **Cervical** vertebrae (7 in number) in the neck region. 2. **Thoracic** vertebrae (12 in number) in the chest region. 3. **Lumbar** vertebrae (5 in number) in the lower back. 4. **Sacral** vertebra (1 fused bone consisting of 5 sacral vertebrae) in the pelvic region. 5. **Coccygeal** vertebra (1 fused bone consisting of 4 coccygeal vertebrae, forming the tailbone). Therefore, the sequence is Cervical → Thoracic → Lumbar → Sacrum.

Quick Tip: Remember the formula: $C_7T_{12}L_5S_{(5)}C_{(4)}$. The order is naturally top to bottom!

170. Match List-I with List-II.

List-I

A. Both species are harmed

B. One species is harmed and the other is benefited

C. Both species are benefited

D. One is benefited while the other has no effect

List-II

I. Predation

II. Mutualism

III. Competition

IV. Commensalism

Choose the correct answer from the options given below:

(A) A-III, B-I, C-II, D-IV

(B) A-III, B-IV, C-II, D-I

(C) A-I, B-II, C-III, D-IV

(D) A-II, B-I, C-IV, D-III

Correct Answer: (A) A-III, B-I, C-II, D-IV

Solution:

Step 1: Understanding the Question:

Match the description of population interactions (+, -, 0) to their corresponding ecological terms.

Step 2: Detailed Explanation:

A. **Both species are harmed (-/-):** This describes **Competition**, where both species expend energy fighting over a limited resource. (A-III)

B. **One species is harmed and the other is benefited (+/-):** This describes **Predation** (or Parasitism), where a predator gains nutrition at the fatal expense of the prey. (B-I)

C. **Both species are benefited (+/+):** This describes **Mutualism**, an obligate or facultative mutually beneficial partnership. (C-II)

D. **One is benefited while the other has no effect (+/0):** This describes **Commensalism**. (D-IV)

The correct match is A-III, B-I, C-II, D-IV.

Quick Tip: Amensalism is the opposite of commensalism: one is harmed, the other is unaffected (-/0).

171. If the diploid chromosome number of typical angiosperm is 36, what would be the chromosome number in its endosperm ?

- (A) 72
- (B) 18
- (C) 36
- (D) 54

Correct Answer: (D) 54

Solution:

Step 1: Understanding the Question:

Calculate the ploidy level and specific chromosome count of the endosperm in an angiosperm, given its somatic (diploid) chromosome number.

Step 2: Key Formula or Approach:

The somatic cells of a plant are diploid ($2n$). The gametes (pollen/egg) are haploid (n). In angiosperms, the endosperm is formed by triple fusion (one haploid male gamete fusing with two haploid polar nuclei), making it triploid ($3n$).

Step 3: Detailed Explanation:

Given diploid number ($2n$) = 36.

Therefore, haploid number (n) = $\frac{36}{2} = 18$.

Chromosome number in the endosperm ($3n$) = $3 \times 18 = 54$.

Quick Tip: Gymnosperm endosperm is haploid (n) because it is formed before fertilization, whereas angiosperm endosperm is triploid ($3n$) as a product of double fertilization.

172. Which of the following enzymes synthesizes precursor mRNA ?

- (A) DNA polymerase
- (B) RNA polymerase I
- (C) RNA polymerase II
- (D) RNA polymerase III

Correct Answer: (C) RNA polymerase II

Solution:

Step 1: Understanding the Question:

Identify the specific eukaryotic RNA polymerase responsible for transcribing the precursor to messenger RNA.

Step 2: Detailed Explanation:

In eukaryotes, there is a clear division of labor among three RNA polymerases: 1. **RNA polymerase I** transcribes ribosomal RNAs (rRNAs: 28S, 18S, and 5.8S). 2. **RNA polymerase II** transcribes the precursor of mRNA, which is known as heterogeneous nuclear RNA (hnRNA). 3. **RNA polymerase III** transcribes transfer RNA (tRNA), 5S rRNA, and small nuclear RNAs (snRNAs). Since precursor mRNA is hnRNA, it is synthesized by RNA polymerase II.

Quick Tip: Mnemonic for RNA Polymerases I, II, III: **r, m, t** (rRNA, mRNA, tRNA) in that exact order (1, 2, 3).

173. Given below are two statements :

Statement I : Plasmids are autonomously replicating DNA.

Statement II : Plasmids are extrachromosomal DNA.

In the light of the above statements, choose the most appropriate answer from the options given below:

- (A) Statement I is incorrect but Statement II is correct
- (B) Both Statement I and Statement II are correct
- (C) Both Statement I and Statement II are incorrect

(D) Statement I is correct but Statement II is incorrect

Correct Answer: (B) Both Statement I and Statement II are correct

Solution:

Step 1: Understanding the Question:

Evaluate the core definitions and features of bacterial plasmids used in biotechnology.

Step 2: Detailed Explanation:

Statement I states that plasmids are autonomously replicating DNA. This is correct. Plasmids possess their own origin of replication (Ori), allowing them to replicate independently of the main bacterial chromosome.

Statement II states that plasmids are extrachromosomal DNA. This is also correct. They are small, typically circular, double-stranded DNA molecules found outside the main nucleoid (chromosomal DNA) of the bacteria.

Both statements accurately describe fundamental properties of plasmids.

Quick Tip: Because plasmids replicate autonomously and reside outside the main genome, they make perfect vectors for carrying foreign DNA into a host cell in recombinant DNA technology.

174. How many theca are present in each lobe of a typical bilobed angiosperm anther ?

- (A) 12
- (B) 2
- (C) 6
- (D) 8

Correct Answer: (B) 2

Solution:

Step 1: Understanding the Question:

Identify the number of chambers (theca) present within a single lobe of a typical plant anther.

Step 2: Detailed Explanation:

A typical angiosperm anther consists of two lobes (bilobed structure). A longitudinal groove runs lengthwise, separating these two lobes. Inside each lobe, there are two distinct compartments or cavities called theca. Because each lobe has two theca, the typical anther is described as **ditheous**. Therefore, the number of theca per lobe is 2.

Quick Tip: 1 anther = 2 lobes. 1 lobe = 2 theca. Therefore, a typical bilobed anther is ditheous and has 4 microsporangia in total (tetrasporangiate).

175. Natural selection can lead to

- (a) stabilisation
- (b) genetic drift
- (c) directional change
- (d) disruption

Choose the correct answer from the options given below :

- (A) (a) and (c) only
- (B) (a) only
- (C) (a), (c) and (d) only
- (D) (a), (b), (c) and (d)

Correct Answer: (C) (a), (c) and (d) only

Solution:

Step 1: Understanding the Question:

Identify the possible evolutionary outcomes that can arise from the operation of natural selection on a population's traits.

Step 2: Detailed Explanation:

Depending on environmental pressures, natural selection acts on phenotypic variations in three primary ways: 1. **Stabilisation (a)**: Individuals with average/mean traits are favored, narrowing the distribution curve. 2. **Directional change (c)**: Individuals at one extreme of the trait distribution are favored, shifting the curve in one direction. 3. **Disruption (d)**: Individuals at both extremes are favored over the mean, leading to a bimodal (two-peaked) curve. **Genetic drift (b)** is an entirely separate mechanism of evolution driven by random chance events (sampling error) in small populations, not by natural selection. Thus, (b) is excluded.

Quick Tip: Genetic drift and Natural Selection are both forces of evolution, but they are entirely independent processes. Drift is random; selection is non-random.

176. Which of the following statements are correct?

- (a) Energy flow from producers to consumers is unidirectional
- (b) Energy pyramid can never be inverted
- (c) Transfer of energy follows the 10% law

Choose the correct answer from the options given below :

- (A) (b) and (c) only
- (B) (a), (b) and (c)
- (C) (a) and (b) only
- (D) (a) and (c) only

Correct Answer: (B) (a), (b) and (c)

Solution:

Step 1: Understanding the Question:

Assess the correctness of fundamental ecological principles relating to energy flow in an ecosystem.

Step 2: Detailed Explanation:

- **Statement (a):** True. Energy flow is strictly unidirectional. Solar energy captured by autotrophs moves through the trophic levels to consumers and is lost as heat. It is never returned to the sun or transferred back from consumers to producers. - **Statement (b):** True. The pyramid of energy is always upright and can never be inverted. This is a direct consequence of the Second Law of Thermodynamics, as energy is progressively lost as heat at each successive trophic step. - **Statement (c):** True. The transfer of energy between trophic levels strictly obeys Lindeman's 10% law, meaning that on average, only about 10% of the energy available at one trophic level is passed onto the next. Since all three statements are biologically correct, option (B) is the right choice.

Quick Tip: While pyramids of numbers and biomass can sometimes be inverted (e.g., insects on a single tree, or phytoplankton in the sea), the energy pyramid is universally upright.

177. Match List-I with List-II.

List-I

List-II

- | | |
|--------------------------|---|
| A. Excess growth hormone | I. Reabsorption of water and electrolytes in kidney |
| B. Luteinizing hormone | II. Contraction of uterus during child birth |
| C. Vasopressin | III. Acromegaly |
| D. Oxytocin | IV. Ovulation |

Choose the correct answer from the options given below:

- (A) A-IV, B-III, C-I, D-II
(B) A-III, B-IV, C-II, D-I
(C) A-III, B-IV, C-I, D-II
(D) A-II, B-IV, C-I, D-III

Correct Answer: (C) A-III, B-IV, C-I, D-II

Solution:

Step 1: Understanding the Question:

Match human hormones and their pathological disorders with their primary physiological

functions.

Step 2: Detailed Explanation:

A. **Excess growth hormone:** Hypersecretion of GH in adults causes abnormal bone growth, particularly in the face and extremities, a condition called **Acromegaly**. (A-III)

B. **Luteinizing hormone (LH):** A mid-cycle surge in LH stimulates the rupture of the Graafian follicle, leading to **Ovulation**. (B-IV)

C. **Vasopressin:** Also known as Antidiuretic Hormone (ADH), it acts on the distal convoluted tubule and collecting duct to stimulate the **reabsorption of water and electrolytes** to prevent diuresis. (C-I)

D. **Oxytocin:** A posterior pituitary hormone that acts heavily on uterine smooth muscles, stimulating vigorous **contraction of the uterus during child birth**. (D-II)

Therefore, the correct sequence is A-III, B-IV, C-I, D-II.

Quick Tip: Excess GH in childhood = Gigantism. Excess GH in adulthood = Acromegaly. Deficiency of GH = Dwarfism.

178. Which of the following are secondary lymphoid organs?

- (a) Bone marrow
- (b) Tonsils
- (c) Spleen
- (d) Thymus

Choose the correct answer from the options given below :

- (A) (a) and (d) only
- (B) (a) and (b) only
- (C) (b) and (c) only
- (D) (b) and (d) only

Correct Answer: (C) (b) and (c) only

Solution:

Step 1: Understanding the Question:

Categorize the listed anatomical structures into primary and secondary lymphoid organs.

Step 2: Detailed Explanation:

The human immune system features two types of lymphoid organs: 1. **Primary lymphoid organs:** The sites where lymphocytes are produced, matured, and acquire antigen-specific receptors. These are exclusively the **Bone marrow** and the **Thymus**. (Thus, (a) and (d) are excluded). 2. **Secondary lymphoid organs:** The sites where mature lymphocytes migrate to interact with antigens and proliferate to become effector cells. These include the **Spleen**, **Tonsils**, lymph nodes, and Peyer's patches of the small intestine. (Thus, (b) and (c) are correct).

Quick Tip: Think of Primary lymphoid organs as the "training academies" for white blood cells and Secondary lymphoid organs as the "battlefields" where they fight infections.

179. During PCR, primers bind to the DNA strands in the _____ step.

- (A) ligation
- (B) denaturation
- (C) extension
- (D) annealing

Correct Answer: (D) annealing

Solution:

Step 1: Understanding the Question:

Identify the specific step in the Polymerase Chain Reaction (PCR) cycle where short RNA/DNA primers attach to the target sequence.

Step 2: Detailed Explanation:

A single cycle of PCR involves three steps:

1. **Denaturation:** The double-stranded DNA template is heated (approx. 94°C) to separate it into two single strands.
 2. **Annealing:** The temperature is lowered (approx. $50 - 60^{\circ}\text{C}$), allowing the short oligonucleotide primers to hydrogen bond (anneal) to the complementary regions at the 3' ends of the single-stranded DNA templates.
 3. **Extension:** The temperature is raised again (approx. 72°C), and Taq polymerase synthesizes the new DNA strand by adding dNTPs to the primers.
- Therefore, primers bind during the annealing step.

Quick Tip: The order of PCR steps dictates the temperature profile: High (Denature) $\rightarrow$ Low (Anneal) $\rightarrow$ Medium (Extend).

180. Given below are two statements :

Statement I : Down's syndrome is caused by the absence of one of the X-chromosomes.

Statement II : Turner's syndrome is caused by the presence of an additional copy of the chromosomes.

In the light of the above statements, choose the correct answer from the options given below :

- (A) Statement I is incorrect but Statement II is correct
- (B) Both Statement I and Statement II are correct
- (C) Both Statement I and Statement II are incorrect
- (D) Statement I is correct but Statement II is incorrect

Correct Answer: (C) Both Statement I and Statement II are incorrect

Solution:

Step 1: Understanding the Question:

Evaluate the cytogenetic causes of two major chromosomal disorders: Down's syndrome and Turner's syndrome.

Step 2: Detailed Explanation:

Let's review the genetic basis of both disorders:

- **Statement I:** Down's syndrome is an autosomal aneuploidy caused by the presence of an **additional copy of chromosome 21** (Trisomy 21). It has nothing to do with the absence of an X-chromosome. Therefore, Statement I is completely false.
- **Statement II:** Turner's syndrome is a sex-chromosomal disorder affecting females, caused by the **absence of one of the X chromosomes** (karyotype 45, X0). It is a monosomy, not a case of an additional chromosome. Therefore, Statement II is also completely false.

Both statements essentially swap the definitions of the disorders. Thus, both statements are incorrect.

Quick Tip: Trisomy 21 = Down's syndrome (47 chromosomes). XXY = Klinefelter's syndrome (47 chromosomes). X0 = Turner's syndrome (45 chromosomes).