

AIIMS Paramedical Biology

Sample Paper – 9

Duration: 30 Minutes

Maximum Marks: 30

Instructions

- This paper contains **30** Multiple Choice Questions (Single Correct Answer), modelled on the Biology portion of **AIIMS Paramedical** entrance.
- Each correct answer carries **+1 mark**. Each incorrect answer attracts a **penalty of $-\frac{1}{3}$ mark**. Unattempted questions carry **0 marks**.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11 & 12 NCERT Biology**
- Use of mobile phones, calculators, or electronic gadgets is strictly prohibited.

Q1. Which of the following represents the correct sequence of taxonomic categories arranged from the lowest to the highest rank?

- (A) Species → Family → Genus → Order → Class → Phylum → Kingdom
- (B) Species → Genus → Family → Order → Class → Phylum → Kingdom
- (C) Genus → Species → Order → Family → Class → Kingdom → Phylum
- (D) Kingdom → Phylum → Class → Order → Family → Genus → Species

Q2. According to the universal rules of binomial nomenclature, the scientific name of mango is written as *Mangifera indica* Linn. Which statement about this name is correct?

- (A) *indica* is the generic name and *Mangifera* is the specific epithet.
- (B) Both words should begin with a capital letter when printed.



- (C) The first word is the genus and starts with a capital letter, the second is the species and starts with a small letter; both are italicised, and “Linn.” is the author citation.
- (D) In print the name should be underlined and not italicised, even when typesetting is available.

Q3. Which of the following statements about the nutrition and reproduction of bacteria is correct?

- (A) Bacteria show diverse modes of nutrition (photosynthetic, chemosynthetic, saprophytic, parasitic) and reproduce mainly by binary fission.
- (B) All bacteria are obligate photoautotrophs that cannot live without sunlight.
- (C) Bacteria reproduce only by sexual reproduction involving the fusion of gametes.
- (D) Chemosynthetic bacteria obtain energy by trapping light in chlorophyll.

Q4. The phenomenon of producing two kinds of spores — larger megaspores and smaller microspores — as seen in *Selaginella* and *Salvinia*, is called:

- (A) Homospory
- (B) Heterospory
- (C) Apospory
- (D) Polyembryony

Q5. Which set of features is found in all chordates at some stage of their life?

- (A) A solid ventral nerve cord, a non-segmented body and an open circulatory system
- (B) A dorsal heart, a ventral notochord and the absence of a post-anal tail



- (C) A calcareous exoskeleton, jointed appendages and compound eyes
- (D) A notochord, a dorsal hollow nerve cord, paired pharyngeal gill slits and a post-anal tail

Q6. During secondary growth of a typical dicot stem, the vascular cambium is most active and:

- (A) Forms secondary phloem towards the inside and secondary xylem towards the outside.
- (B) Produces cork (phellem) on both its inner and outer faces.
- (C) Cuts off secondary xylem towards the inside and secondary phloem towards the outside, the xylem usually being produced in greater amount.
- (D) Adds no new tissue but only increases the length of the stem.

Q7. Which statement about the organ systems of the frog (*Rana tigrina*) is correct?

- (A) The frog has a single-chambered heart and a single circulation.
- (B) Excretion in the frog is carried out by Malpighian tubules.
- (C) The frog respire only through lungs throughout its life.
- (D) The frog has a three-chambered heart and carries out respiration through skin, buccal cavity and lungs.

Q8. The cell theory, as finally formulated, states that all living organisms are composed of cells and that all cells arise from pre-existing cells. Which of the following is a recognised exception or limitation of the cell theory?

- (A) Viruses are acellular and lie outside the scope of the cell theory, as they are not made of cells.
- (B) Bacteria do not contain cells and so violate the cell theory.
- (C) Plants are not made of cells and therefore are an exception.
- (D) Every cell is now known to arise spontaneously from non-living matter.



- Q9.** Which event of meiosis is chiefly responsible for generating new combinations of genes and hence genetic variation among the offspring?
- (A) The duplication of DNA during the S phase before meiosis begins
 - (B) The separation of sister chromatids during meiosis II only
 - (C) Crossing over between homologous chromosomes and the independent assortment of chromosomes
 - (D) The constant doubling of chromosome number in each daughter cell
- Q10.** Magnesium is an essential mineral element for plants. Its deficiency most directly causes:
- (A) Failure of the cell plate to form during cell division
 - (B) Interveinal chlorosis, because magnesium is a constituent of the chlorophyll molecule
 - (C) Loss of turgor and immediate wilting of all leaves
 - (D) An increase in the rate of photosynthesis above normal
- Q11.** The Emerson enhancement effect demonstrated that:
- (A) Photosynthesis stops completely at wavelengths beyond 680 nm.
 - (B) Only one photosystem is required for the light reaction of photosynthesis.
 - (C) Far-red light alone gives a higher yield than red and far-red light combined.
 - (D) Two photosystems acting together (red light < 680 nm plus far-red light > 680 nm) give a photosynthetic yield greater than the sum of the two used separately.
- Q12.** The promotion of flowering by a period of low-temperature (cold) treatment, as required by certain winter varieties of wheat before they can flower, is called:
- (A) Vernalisation



- (B) Photoperiodism
- (C) Phototropism
- (D) Senescence

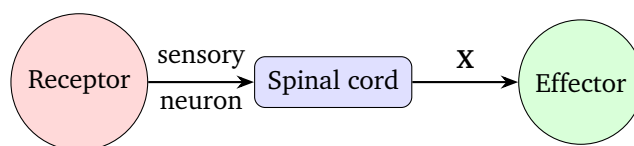
Q13. Which statement about the secretions of the liver and pancreas in human digestion is correct?

- (A) Bile from the liver contains digestive enzymes that break down proteins into amino acids.
- (B) The pancreas secretes bile salts that emulsify fats in the stomach.
- (C) Bile contains no enzymes but its bile salts emulsify fats, while pancreatic juice supplies trypsin, lipase and amylase.
- (D) The liver secretes hydrochloric acid that activates pancreatic enzymes.

Q14. During blood clotting (coagulation), the soluble plasma protein fibrinogen is converted into insoluble fibrin threads. The enzyme that directly catalyses this conversion is:

- (A) Prothrombin
- (B) Thrombin
- (C) Heparin
- (D) Pepsin

Q15. The diagram shows the pathway of a simple spinal reflex arc. The component labelled **X**, which carries the impulse from the spinal cord to the muscle that responds, is the:



- (A) Sensory (afferent) neuron
- (B) Interneuron of the brain



- (C) Receptor organ
- (D) Motor (efferent) neuron

Q16. Pollen–pistil interaction allows the pistil to recognise compatible pollen. After a compatible pollen grain lands on the stigma, the event that immediately follows is:

- (A) Germination of the pollen grain and growth of the pollen tube through the style towards the ovule.
- (B) Immediate rejection of the pollen by the stigma in every case.
- (C) Direct fusion of the pollen grain with the egg without any tube.
- (D) Conversion of the stigma into a seed.

Q17. Which difference between spermatogenesis and oogenesis in humans is correct?

- (A) Spermatogenesis produces one functional sperm from each primary spermatocyte, while oogenesis produces four functional ova.
- (B) Both processes are completed entirely before birth.
- (C) One primary spermatocyte forms four functional sperms, whereas one primary oocyte forms a single functional ovum and polar bodies.
- (D) Oogenesis produces sperms and spermatogenesis produces ova.

Q18. In assisted reproductive technologies, the technique in which an ovum collected from a donor or wife is fertilised by sperm in the laboratory and the resulting early embryo is then transferred into the fallopian tube is called:

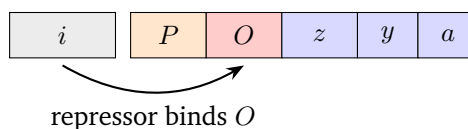
- (A) GIFT (gamete intra-fallopian transfer)
- (B) ZIFT (zygote intra-fallopian transfer)
- (C) AI (artificial insemination)
- (D) Tubectomy



- Q19.** Mendel's law of segregation is best explained by which of the following statements?
- (A) The two alleles of a gene, which were together in the parent, separate from each other during gamete formation so that each gamete receives only one allele.
 - (B) Both alleles of a gene always pass together into the same gamete.
 - (C) Alleles of different genes are always inherited together as a single unit.
 - (D) The dominant allele is permanently lost in the heterozygous condition.
- Q20.** In *Drosophila*, the gene for white eye is recessive and X-linked. When a white-eyed female is crossed with a red-eyed male, the expected phenotypes of the offspring are:
- (A) All offspring red-eyed, regardless of sex.
 - (B) All offspring white-eyed, regardless of sex.
 - (C) All daughters white-eyed and all sons red-eyed.
 - (D) All daughters red-eyed and all sons white-eyed.
- Q21.** DNA, rather than RNA, serves as the genetic material in most organisms mainly because:
- (A) RNA can never store any genetic information in any organism.
 - (B) DNA is chemically more reactive and therefore mutates faster than RNA.
 - (C) DNA is more stable than RNA (the 2'-OH of RNA makes it reactive and labile), and the thymine in DNA confers additional stability, making DNA better suited for long-term storage.
 - (D) DNA is single-stranded while RNA is double-stranded, giving DNA greater stability.



Q22. The diagram shows the components of the *lac* operon of *E. coli*. In the **absence** of lactose, the operon is switched off because:



- (A) The structural genes *z*, *y* and *a* are permanently deleted from the DNA.
- (B) The repressor protein (made by the *i* gene) binds to the operator and blocks RNA polymerase, so transcription of the structural genes does not occur.
- (C) Lactose itself binds the operator and switches the operon off.
- (D) The promoter is destroyed whenever lactose is absent.

Q23. When a few individuals from a large population establish a new isolated colony, the allele frequencies of the new colony may differ markedly from those of the original population purely by chance. This special case of genetic drift is called the:

- (A) Founder effect
- (B) Bottleneck recovery
- (C) Stabilising selection
- (D) Gene flow

Q24. Which of the following correctly describes dengue fever?

- (A) It is a bacterial disease spread through contaminated drinking water.
- (B) It is caused by a protozoan transmitted by the female *Anopheles* mosquito.
- (C) It is a fungal infection spread by direct skin contact.
- (D) It is a viral disease transmitted by the bite of *Aedes* mosquitoes.

Q25. Which harmful effect is most directly associated with the nicotine present in cigarette smoke?



- (A) It binds permanently to haemoglobin and is the sole cause of all lung infections.
- (B) It improves the oxygen-carrying capacity of the blood.
- (C) It stimulates the adrenal glands to release adrenaline and noradrenaline, raising blood pressure and heart rate.
- (D) It has no effect on the cardiovascular system at all.

Q26. The conversion of milk into curd (yoghurt) is brought about by lactic acid bacteria (LAB) such as *Lactobacillus*. The role of these bacteria includes that they:

- (A) Produce lactic acid that coagulates the milk protein and also improve the nutritional quality by increasing vitamin B₁₂.
- (B) Convert the milk sugar into ethanol and carbon dioxide.
- (C) Make the milk strongly alkaline by producing ammonia.
- (D) Digest the milk completely, leaving only water.

Q27. To force a recombinant plasmid into a bacterial cell, the cell is first made “competent”. In the commonly used method, the bacteria are treated with a divalent cation and then briefly placed at 42°C. This treatment uses:

- (A) A gene gun firing DNA-coated gold particles
- (B) Calcium chloride to make the membrane permeable, followed by a brief heat shock that helps the DNA enter the cell
- (C) A disarmed retrovirus as the vector
- (D) Strong ultraviolet radiation to open pores in the wall

Q28. The hepatitis B vaccine in common use today is a recombinant vaccine. This means that it is produced by:

- (A) Injecting live, fully virulent hepatitis B virus into the body.
- (B) Using whole killed bacteria grown from a patient's blood.

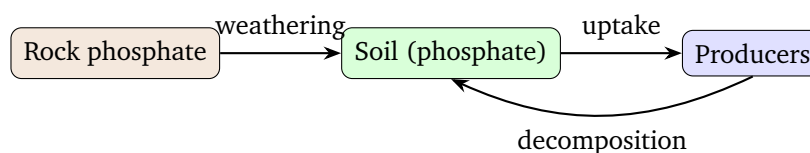


- (C) Extracting the antigen directly from infected human livers.
- (D) Cloning the gene for the surface antigen into yeast, which then produces the harmless antigen protein used as the vaccine.

Q29. The age pyramid of a population shows the relative proportion of pre-reproductive, reproductive and post-reproductive individuals. A pyramid with a very broad base is characteristic of a population that is:

- (A) Expanding, with a large proportion of young (pre-reproductive) individuals
- (B) Declining, with very few young individuals
- (C) Stable, with equal numbers in all age groups and no growth
- (D) Already extinct, with no individuals in any age group

Q30. The diagram outlines the phosphorus cycle. Unlike the carbon and nitrogen cycles, the phosphorus cycle is described as a sedimentary cycle mainly because:



- (A) Phosphorus has a large and important gaseous (atmospheric) reservoir.
- (B) Atmospheric nitrogen is the main source of phosphorus for plants.
- (C) The main reservoir of phosphorus is the rock, and there is no significant gaseous (atmospheric) phase in its cycling.
- (D) Phosphorus is fixed from the air by symbiotic bacteria in root nodules.



Detailed Solutions

Q1.

Solution

Concept — Taxonomic hierarchy: Classification arranges organisms in a series of categories (taxa) from the most specific to the most general.

Step 1 — Lowest unit: Species is the lowest (basic) category. A group of closely related species makes a genus.

Step 2 — Build upward: Related genera form a family, related families an order, related orders a class, related classes a phylum (division in plants), and related phyla a kingdom. So from lowest to highest the order is Species → Genus → Family → Order → Class → Phylum → Kingdom.

Why other options are wrong:

- Option A: Family is placed above genus, not below it.
- Option C: Genus is above species, and phylum is above class.
- Option D: This is the correct descending order (highest to lowest), not the lowest-to-highest order asked for.

Final Answer: Species → Genus → Family → Order → Class → Phylum → Kingdom ⇒ **B**

Answer: (B) [Go Back to Q1](#)

Q2.

Solution

Concept — Binomial nomenclature: Each scientific name has two words, the genus name and the species name (specific epithet), governed by international codes.

Step 1 — Capitalisation: The first word (genus) begins with a capital letter; the second word (species) begins with a small letter.

Step 2 — Style and author: Both words are printed in italics (or underlined separately when handwritten). The author who first described the species may be added after the name in an abbreviated form, e.g. "Linn." for Linnaeus.

Why other options are wrong:

- Option A: *Mangifera* is the genus and *indica* is the specific epithet, not the



reverse.

- Option B: Only the genus begins with a capital letter, not both words.
- Option D: When typeset, the name is italicised; underlining is only for hand-writing.

Final Answer: Capital genus, small species, both italic, “Linn.” is the author ⇒

C

Answer: (C) [Go Back to Q2](#)

Q3.

Solution

Concept — Bacterial nutrition and reproduction: Bacteria are the most abundant micro-organisms and show extreme metabolic diversity.

Step 1 — Nutrition: Bacteria may be autotrophic (photosynthetic or chemosynthetic) or heterotrophic (saprophytic or parasitic). Thus they occupy almost every nutritional mode.

Step 2 — Reproduction: They reproduce mainly asexually by binary fission; under unfavourable conditions some form spores. A primitive sort of DNA transfer (genetic recombination) also occurs but is not the main mode.

Why other options are wrong:

- Option B: Not all bacteria are photoautotrophs; many are heterotrophic or chemosynthetic.
- Option C: Their chief mode is asexual binary fission, not gametic fusion.
- Option D: Chemosynthetic bacteria oxidise inorganic substances for energy; they do not trap light.

Final Answer: Diverse nutrition with reproduction mainly by binary fission ⇒ A

Answer: (A) [Go Back to Q3](#)



Q4.

Solution

Concept — Spore types in pteridophytes: Most pteridophytes are homosporous, producing one kind of spore, but a few are heterosporous.

Step 1 — Heterospory: The production of two morphologically different spores — large megaspores and small microspores — is called heterospory, seen in *Se-laginella* and *Salvinia*.

Step 2 — Significance: The megaspores form female gametophytes and microspores form male gametophytes, which develop while retained on the parent — an important evolutionary forerunner of the seed habit.

Why other options are wrong:

- Option A: Homospory is production of only one kind of spore.
- Option C: Apospory is gametophyte formation without spores.
- Option D: Polyembryony is the formation of more than one embryo, unrelated to spores.

Final Answer: Two kinds of spores (mega- and micro-) = heterospory ⇒ **B**

Answer: (B) [Go Back to Q4](#)

Q5.

Solution

Concept — Chordate features: Phylum Chordata is defined by a set of features present at some stage of the life cycle.

Step 1 — The four hallmarks: A notochord, a dorsal hollow (tubular) nerve cord, paired pharyngeal gill slits, and a post-anal tail are the fundamental chordate characters.

Step 2 — Additional features: Chordates also have a ventral heart and a closed circulatory system, and are bilaterally symmetrical, triploblastic and coelomate.

Why other options are wrong:

- Option A: Chordates have a dorsal hollow nerve cord, not a solid ventral one.
- Option B: The heart is ventral and the notochord dorsal; a post-anal tail is present.
- Option C: An exoskeleton with jointed appendages is a feature of Arthro-



poda.

Final Answer: Notochord, dorsal hollow nerve cord, gill slits, post-anal tail ⇒ D

Answer: (D) [Go Back to Q5](#)

Q6.

Solution

Concept — Secondary growth: In dicot stems, increase in girth occurs by the activity of the vascular cambium and cork cambium.

Step 1 — Direction of cutting: The vascular cambium forms new cells on both sides. It cuts off secondary xylem (wood) towards the inside and secondary phloem (bast) towards the outside.

Step 2 — Relative amounts: Much more secondary xylem is produced than secondary phloem, so the wood accumulates and the stem thickens.

Why other options are wrong:

- Option A: The directions are reversed; xylem is internal and phloem external.
- Option B: Cork (phellem) is formed by the cork cambium (phellogen), not the vascular cambium.
- Option D: Secondary growth increases girth, not length.

Final Answer: Secondary xylem inside, secondary phloem outside, xylem in excess ⇒ C

Answer: (C) [Go Back to Q6](#)

Q7.

Solution

Concept — Organ systems of the frog: The frog is an amphibian with well-developed organ systems adapted to life on land and in water.

Step 1 — Heart: The frog has a three-chambered heart — two atria and one ventricle.

Step 2 — Respiration: It respire through the skin (cutaneous), the buccal cavity and the lungs (pulmonary), depending on its environment.

Why other options are wrong:



- Option A: The heart is three-chambered, not single-chambered.
- Option B: Excretion is by a pair of kidneys; Malpighian tubules are insect structures.
- Option C: The frog also respire through its skin and buccal cavity, not lungs alone.

Final Answer: Three-chambered heart with skin, buccal and lung respiration ⇒

D

Answer: (D) [Go Back to Q7](#)

Q8.

Solution

Concept — Cell theory: Proposed by Schleiden and Schwann and extended by Virchow, it holds that all organisms are made of cells and all cells arise from pre-existing cells.

Step 1 — Exception: Viruses are acellular — they are not made of cells but of a nucleic acid core with a protein coat, and they reproduce only inside a host cell. They therefore fall outside the scope of the cell theory.

Step 2 — Confirmation: All true organisms, including bacteria and plants, are made of cells, so the cell theory holds for them.

Why other options are wrong:

- Option B: Bacteria are unicellular; they fully obey the cell theory.
- Option C: Plants are made of cells and are not an exception.
- Option D: Cells arise from pre-existing cells, not spontaneously from non-living matter.

Final Answer: Acellular viruses lie outside the cell theory ⇒ A

Answer: (A) [Go Back to Q8](#)



Q9.

Solution

Concept — Significance of meiosis: Meiosis halves the chromosome number and, importantly, creates genetic variation among gametes.

Step 1 — Crossing over: During prophase I, homologous chromosomes pair and exchange segments (crossing over), producing recombinant chromosomes with new allele combinations.

Step 2 — Independent assortment: During metaphase/anaphase I, the maternal and paternal chromosomes of each pair assort independently into the gametes, multiplying the number of possible combinations.

Why other options are wrong:

- Option A: DNA duplication merely copies the existing genes; it does not create new combinations.
- Option B: Separation of sister chromatids alone does not mix parental alleles.
- Option D: Meiosis halves, not doubles, the chromosome number.

Final Answer: Crossing over and independent assortment generate variation ⇒

C

Answer: (C) [Go Back to Q9](#)

Q10.

Solution

Concept — Role of magnesium: Each essential element has a specific role, and its deficiency produces a characteristic symptom.

Step 1 — Function of Mg: Magnesium is the central atom of the chlorophyll molecule and also activates several enzymes of respiration and photosynthesis.

Step 2 — Deficiency symptom: Lack of magnesium prevents chlorophyll formation, causing interveinal chlorosis (yellowing between the veins), seen first in older leaves.

Why other options are wrong:

- Option A: Cell-plate formation needs calcium, not magnesium.
- Option C: Immediate wilting is mainly a water/potassium issue, not a magnesium symptom.
- Option D: Deficiency lowers, not raises, photosynthesis.



Final Answer: Mg deficiency causes interveinal chlorosis (Mg is in chlorophyll)
⇒ **B**

Answer: (B) [Go Back to Q10](#)

Q11.

Solution

Concept — Red drop and enhancement effect: Emerson studied the efficiency of photosynthesis at different wavelengths of light.

Step 1 — Red drop: Beyond 680 nm (in the far-red region) the yield of photosynthesis drops sharply even though light is still absorbed — the “red drop”.

Step 2 — Enhancement effect: When red light (< 680 nm) and far-red light (> 680 nm) are given together, the total yield is greater than the sum of the yields obtained when each is given alone. This showed that two photosystems (PS I and PS II) cooperate.

Why other options are wrong:

- Option A: Photosynthesis is reduced but not completely stopped beyond 680 nm.
- Option B: Two photosystems, not one, are required.
- Option C: Far-red light alone gives a lower, not higher, yield.

Final Answer: Combined red and far-red light give a more-than-additive yield (two photosystems) ⇒ **D**

Answer: (D) [Go Back to Q11](#)

Q12.

Solution

Concept — Control of flowering: Flowering can be promoted by day length (photoperiodism) or by cold treatment (vernalisation).

Step 1 — Vernalisation: Vernalisation is the promotion of flowering by exposing the plant (or its seedlings/seeds) to a period of low temperature. Winter wheat needs such cold treatment before it can flower.

Step 2 — Distinguish: Photoperiodism is the response to relative lengths of day and night, a separate mechanism.



Why other options are wrong:

- Option B: Photoperiodism is a response to day length, not to cold.
- Option C: Phototropism is bending of an organ towards light.
- Option D: Senescence is ageing and death of plant parts.

Final Answer: Cold treatment promoting flowering = vernalisation $\Rightarrow$ **A**

Answer: (A) [Go Back to Q12](#)

Q13.

Solution

Concept — Liver and pancreatic secretions: Both the liver and the pancreas pour their secretions into the duodenum to aid digestion.

Step 1 — Bile: Bile, made by the liver, contains no digestive enzymes. Its bile salts emulsify fats, breaking large fat globules into small droplets so that lipases can act.

Step 2 — Pancreatic juice: The pancreas secretes pancreatic juice containing trypsin (proteins), pancreatic lipase (fats) and pancreatic amylase (starch).

Why other options are wrong:

- Option A: Bile has no enzymes; it only emulsifies fats.
- Option B: Bile salts come from the liver, not the pancreas, and act in the duodenum.
- Option D: The liver does not secrete hydrochloric acid; HCl is from the stomach.

Final Answer: Bile (no enzymes) emulsifies fats; pancreatic juice provides trypsin, lipase, amylase $\Rightarrow$ **C**

Answer: (C) [Go Back to Q13](#)



Q14.

Solution

Concept — Blood coagulation: A clot is formed by a cascade of reactions that ends with a mesh of fibrin threads.

Step 1 — Activation of thrombin: Injury releases factors that, with calcium ions, convert inactive prothrombin into the active enzyme thrombin.

Step 2 — Fibrin formation: Thrombin then catalyses the conversion of soluble fibrinogen into insoluble fibrin threads, which trap blood cells to form the clot.

Why other options are wrong:

- Option A: Prothrombin is the inactive precursor; it does not itself act on fibrinogen.
- Option C: Heparin is a natural anticoagulant that prevents clotting.
- Option D: Pepsin is a protein-digesting enzyme of the stomach.

Final Answer: Thrombin converts fibrinogen to fibrin $\Rightarrow$ **B**

Answer: (B) [Go Back to Q14](#)

Q15.

Solution

Concept — Reflex arc: A reflex action is an automatic, involuntary response carried out through a reflex arc that passes through the spinal cord.

Step 1 — Pathway: A receptor detects the stimulus; a sensory (afferent) neuron carries the impulse to the spinal cord; an interneuron relays it; and a motor (efferent) neuron carries the response outward.

Step 2 — Identify X: The labelled component X carries the impulse from the spinal cord to the muscle (effector). This is the motor (efferent) neuron.

Why other options are wrong:

- Option A: The sensory neuron carries impulses towards the cord, not away from it.
- Option B: A simple spinal reflex does not need a brain interneuron.
- Option C: The receptor only detects the stimulus; it does not carry impulses to the muscle.

Final Answer: The impulse from cord to muscle travels along the motor (efferent) neuron $\Rightarrow$ **D**



Answer: (D) [Go Back to Q15](#)

Q16.

Solution

Concept — Pollen–pistil interaction: The pistil can recognise the pollen and accept compatible pollen while rejecting incompatible pollen.

Step 1 — Germination: When a compatible pollen grain lands on the stigma, it germinates and produces a pollen tube.

Step 2 — Tube growth: The pollen tube grows through the tissue of the stigma and style, carrying the male gametes towards the ovule, where fertilisation later occurs.

Why other options are wrong:

- Option B: Rejection happens only with incompatible pollen, not always.
- Option C: The male gametes reach the egg through the pollen tube, not by direct fusion of the grain.
- Option D: The stigma does not turn into a seed.

Final Answer: Compatible pollen germinates and the pollen tube grows towards the ovule $\Rightarrow$ **A**

Answer: (A) [Go Back to Q16](#)

Q17.

Solution

Concept — Gametogenesis: Both spermatogenesis and oogenesis involve meiosis but differ in their products.

Step 1 — Spermatogenesis: One primary spermatocyte undergoes meiosis to give four equal, functional spermatids, each maturing into a sperm.

Step 2 — Oogenesis: One primary oocyte undergoes meiosis with unequal cytoplasmic division to form a single large functional ovum and two or three small polar bodies that degenerate.

Why other options are wrong:

- Option A: Spermatogenesis gives four sperms, not one; oogenesis gives one ovum, not four.



- Option B: Spermatogenesis begins at puberty and continues; it is not completed before birth.
- Option D: Spermatogenesis produces sperms and oogenesis produces ova, not the reverse.

Final Answer: One spermatocyte → four sperms; one oocyte → one ovum + polar bodies ⇒

Answer: (C) [Go Back to Q17](#)

Q18.

Solution

Concept — Assisted reproductive technologies (ART): Several techniques help infertile couples to have children.

Step 1 — ZIFT: In ZIFT (zygote intra-fallopian transfer), the ovum is fertilised by sperm in the laboratory and the resulting zygote or early embryo (up to the 8-cell stage) is transferred into the fallopian tube.

Step 2 — Distinguish from GIFT: In GIFT, an ovum (gamete) collected from a donor is transferred into the fallopian tube of a woman who cannot produce one, so fertilisation occurs inside her body.

Why other options are wrong:

- Option A: GIFT transfers a gamete (unfertilised ovum), not a laboratory-formed embryo.
- Option C: Artificial insemination introduces semen, not a formed embryo.
- Option D: Tubectomy is a sterilisation method, not an ART.

Final Answer: Laboratory-formed early embryo placed in the fallopian tube = ZIFT ⇒

Answer: (B) [Go Back to Q18](#)



Q19.

Solution

Concept — Law of segregation: This is Mendel's first law, also called the law of purity of gametes.

Step 1 — Statement: The two alleles of a gene, present together in a diploid parent, separate (segregate) from each other during the formation of gametes, so that each gamete carries only one allele of the pair.

Step 2 — Purity of gametes: Because a gamete carries only one allele, the gametes are "pure" for that character; the alleles reunite at fertilisation.

Why other options are wrong:

- Option B: The two alleles separate; they do not pass together into one gamete.
- Option C: Inheritance of different genes together describes linkage, not segregation.
- Option D: A recessive (or dominant) allele is not lost; it reappears in later generations.

Final Answer: Paired alleles separate so each gamete gets only one $\Rightarrow$ **A**

Answer: (A) [Go Back to Q19](#)

Q20.

Solution

Concept — X-linked inheritance: The white-eye gene in *Drosophila* is recessive and located on the X chromosome.

Step 1 — Set the cross: White-eyed female is $X^w X^w$; red-eyed male is $X^W Y$ (W = red, dominant).

Step 2 — Work out offspring: Daughters receive X^W from the father and X^w from the mother, so they are $X^W X^w$ (red-eyed carriers). Sons receive X^w from the mother and Y from the father, so they are $X^w Y$ (white-eyed). Hence all daughters are red-eyed and all sons are white-eyed (criss-cross inheritance).

Why other options are wrong:

- Option A: Sons are white-eyed, so not all offspring are red-eyed.
- Option B: Daughters get the father's X^W and are red-eyed.
- Option C: It is the daughters that are red and the sons that are white, not



the reverse.

Final Answer: Daughters red-eyed, sons white-eyed $\Rightarrow$ D

Answer: (D) [Go Back to Q20](#)

Q21.

Solution

Concept — DNA as genetic material: Both DNA and RNA can carry genetic information, but DNA is preferred for long-term storage.

Step 1 — Chemical stability: RNA has a reactive 2'-OH group on its sugar, making it chemically labile and easily degraded. DNA lacks this group and is far more stable.

Step 2 — Role of thymine: In DNA, uracil is replaced by thymine (5-methyl uracil), which adds extra stability and allows repair of mutations, suiting DNA for stable storage of information.

Why other options are wrong:

- Option A: RNA is the genetic material in some viruses, so it can store information.
- Option B: DNA is less reactive and mutates more slowly than RNA, not faster.
- Option D: DNA is double-stranded and RNA is usually single-stranded, not the reverse.

Final Answer: DNA is chemically more stable (no 2'-OH; has thymine) for long-term storage $\Rightarrow$ C

Answer: (C) [Go Back to Q21](#)

Q22.

Solution

Concept — The *lac* operon: The operon has a regulatory gene (*i*), a promoter (*P*), an operator (*O*) and three structural genes (*z*, *y*, *a*).

Step 1 — Repressor in absence of lactose: The *i* gene makes a repressor protein. When lactose is absent, the repressor binds to the operator region.

Step 2 — Block transcription: A repressor bound to the operator blocks the movement of RNA polymerase, so the structural genes (*z*, *y*, *a*) are not transcribed



and the operon stays switched off.

Why other options are wrong:

- Option A: The structural genes are present in the DNA; they are not deleted.
- Option C: Lactose (its inducer) binds the repressor, not the operator, and switches the operon on, not off.
- Option D: The promoter is not destroyed; it remains intact.

Final Answer: The repressor binds the operator and blocks RNA polymerase ⇒

B

Answer: (B) [Go Back to Q22](#)

Q23.

Solution

Concept — Genetic drift: Random change in allele frequencies in a small population is called genetic drift.

Step 1 — Founder effect: When a few individuals leave a large population and start a new colony, their alleles are only a chance sample of the parent population, so the new colony may have very different allele frequencies. This is the founder effect.

Step 2 — Outcome: The drifted population can become so different that it forms a new species over time.

Why other options are wrong:

- Option B: A bottleneck is a drastic reduction in population, not the founding of a new colony.
- Option C: Stabilising selection favours intermediate phenotypes; it is not drift.
- Option D: Gene flow is the movement of alleles between populations, the opposite of isolation.

Final Answer: A few founders giving a new colony with altered allele frequencies = founder effect ⇒ **A**

Answer: (A) [Go Back to Q23](#)



Q24.

Solution

Concept — Dengue: Dengue is a common viral disease in tropical regions.

Step 1 — Causative agent: Dengue is caused by the dengue virus (a flavivirus), not by bacteria, protozoa or fungi.

Step 2 — Mode of spread: It is transmitted to humans through the bite of *Aedes* (especially *Aedes aegypti*) mosquitoes.

Why other options are wrong:

- Option A: Dengue is viral, not a water-borne bacterial disease.
- Option B: A protozoan carried by *Anopheles* describes malaria, not dengue.
- Option C: Dengue is not a fungal infection.

Final Answer: Dengue is a viral disease spread by *Aedes* mosquitoes ⇒ D

Answer: (D) [Go Back to Q24](#)

Q25.

Solution

Concept — Effects of smoking: Cigarette smoke contains nicotine, carbon monoxide and many carcinogens, each with specific harmful effects.

Step 1 — Nicotine action: Nicotine stimulates the adrenal glands to release adrenaline and nor-adrenaline (epinephrine and nor-epinephrine).

Step 2 — Consequence: These hormones raise the heart rate and blood pressure, increasing the risk of cardiovascular disease.

Why other options are wrong:

- Option A: It is carbon monoxide (not nicotine) that binds haemoglobin, and smoking is not the sole cause of all lung infections.
- Option B: Smoking lowers, not improves, the oxygen-carrying capacity of blood.
- Option D: Nicotine strongly affects the cardiovascular system.

Final Answer: Nicotine raises adrenaline/nor-adrenaline, increasing blood pressure and heart rate ⇒ C

Answer: (C) [Go Back to Q25](#)



Q26.

Solution

Concept — Lactic acid bacteria (LAB): LAB such as *Lactobacillus* are used to set curd and have probiotic value.

Step 1 — Curd formation: LAB grow in milk and convert the milk sugar (lactose) into lactic acid. The acid coagulates and partially digests the milk protein, setting the milk into curd.

Step 2 — Nutritional benefit: The bacteria also increase the content of vitamin B₁₂ and, in the stomach, check disease-causing microbes, acting as probiotics.

Why other options are wrong:

- Option B: Ethanol and carbon dioxide are products of yeast fermentation, not of LAB.
- Option C: LAB make the milk acidic, not alkaline.
- Option D: LAB set the milk into curd; they do not digest it down to water.

Final Answer: LAB produce lactic acid to set curd and raise vitamin B₁₂ ⇒ A

Answer: (A) [Go Back to Q26](#)

Q27.

Solution

Concept — Bacterial transformation: To clone a gene, the recombinant plasmid must be taken up by a host bacterium. Bacteria do not readily take up DNA, so they must be made “competent”.

Step 1 — Treat with calcium ions: The bacteria are treated with a specific divalent cation, such as calcium (calcium chloride), which increases the permeability of the cell membrane to DNA.

Step 2 — Heat shock: The cells with DNA are incubated on ice, then given a brief heat shock at about 42°C and put back on ice; this helps the recombinant DNA enter the bacteria.

Why other options are wrong:

- Option A: A gene gun is used for plant cells, not for making bacteria competent.
- Option C: A disabled retrovirus is used to transfer genes into animal cells.
- Option D: Ultraviolet radiation is not used to make bacteria competent.



Final Answer: CaCl_2 to make cells permeable, then a brief 42°C heat shock $\Rightarrow$ **B**

Answer: (B) [Go Back to Q27](#)

Q28.

Solution

Concept — Recombinant vaccines: A recombinant vaccine uses an antigen produced by genetic engineering rather than the whole pathogen.

Step 1 — The hepatitis B vaccine: The gene coding for the hepatitis B surface antigen is isolated and cloned into yeast cells.

Step 2 — Production: The yeast cells then mass-produce the harmless surface antigen protein, which is purified and used as the vaccine; it triggers immunity without any infectious virus.

Why other options are wrong:

- Option A: A recombinant vaccine does not use the live, virulent virus.
- Option B: It does not use whole killed bacteria from a patient.
- Option C: The antigen is made by engineered yeast, not extracted from infected livers.

Final Answer: The surface-antigen gene cloned in yeast yields the antigen used as the vaccine $\Rightarrow$ **D**

Answer: (D) [Go Back to Q28](#)

Q29.

Solution

Concept — Age pyramids: The shape of an age pyramid reveals whether a population is growing, stable or declining.

Step 1 — Broad base: A broad base means there is a large proportion of young, pre-reproductive individuals who will soon enter the reproductive age.

Step 2 — Interpretation: Such a population is expanding (growing), because the many young individuals will reproduce and add to the population.

Why other options are wrong:

- Option B: A declining population has a narrow, not broad, base.



- Option C: A stable population has a roughly bell-shaped pyramid, not a very broad base.
- Option D: An extinct population would have no individuals at all.

Final Answer: A broad-based pyramid indicates an expanding (growing) population $\Rightarrow$

Answer: (A) [Go Back to Q29](#)

Q30.

Solution

Concept — Phosphorus cycle: Nutrient cycles are gaseous (carbon, nitrogen) or sedimentary (phosphorus, sulphur) depending on their main reservoir.

Step 1 — Reservoir: The main reservoir of phosphorus is rock, which contains phosphorus as phosphates. Weathering of rocks releases phosphate into the soil.

Step 2 — No gaseous phase: Plants take up phosphate from the soil, and decomposition returns it to the soil. Unlike carbon and nitrogen, there is almost no gaseous (atmospheric) phase, which is why the phosphorus cycle is called a sedimentary cycle.

Why other options are wrong:

- Option A: Phosphorus has no important gaseous reservoir; that is true of carbon, not phosphorus.
- Option B: Atmospheric nitrogen is the source of nitrogen, not of phosphorus.
- Option D: Nitrogen, not phosphorus, is fixed by root-nodule bacteria.

Final Answer: Rock is the main reservoir and there is no significant gaseous phase $\Rightarrow$

Answer: (C) [Go Back to Q30](#)



Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	A	4	B	5	D
6	C	7	D	8	A	9	C	10	B
11	D	12	A	13	C	14	B	15	D
16	A	17	C	18	B	19	A	20	D
21	C	22	B	23	A	24	D	25	C
26	A	27	B	28	D	29	A	30	C

