AIIMS Paramedical Biology

Sample Paper – 2

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**. A penalty of $-\frac{1}{3}$ **mark** is deducted for each incorrect answer. Unattempted questions carry **0** marks (no negative marking).
- 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. In a herbarium, a plant specimen is dried, pressed and mounted on a sheet. According to the standard convention, on which corner of the herbarium sheet is the label bearing the date, place of collection and the name of the collector usually fixed?

(A) Lower right-hand corner

(B) Upper left-hand corner

(C) Centre of the sheet

(D) Upper right-hand corner

Q2. In the binomial name *Mangifera indica*, the word *indica* represents the:

(A) Generic name

(B) Specific epithet

(C) Family name

(D) Order

Q3. Which of the following protists possesses two flagella, a stiff cellulose cell wall, and is photosynthetic, often appearing yellow, green, brown or blue and being responsible for “red tides”?

(A) Euglenoids

(B) Slime moulds

(C) Dinoflagellates

(D) Chrysophytes (diatoms)

Q4. Which feature is characteristic of bryophytes (such as mosses and liverworts)?

(A) They possess well-developed xylem and phloem for conduction

(B) The sporophyte is the dominant, independent generation

(C) They produce seeds enclosed within fruits

(D) They require water for fertilisation and have a dominant gametophyte

Q5. The presence of cnidoblasts (stinging cells) used for anchorage, defence and capturing prey is a defining feature of which animal phylum?

(A) Coelenterata (Cnidaria)

(B) Porifera

(C) Platyhelminthes

(D) Annelida

Q6. The underground stem of ginger and turmeric, which stores food and helps the plant survive unfavourable conditions, is a stem modification known as a:

(A) Bulb

(B) Rhizome

(C) Tap root

(D) Corm tendril

Q7. Which of the following is a specialised fluid connective tissue in which the cells are suspended in a liquid matrix called plasma?

(A) Areolar tissue

(B) Tendon

(C) Blood

(D) Adipose tissue

Q8. According to the fluid mosaic model of the plasma membrane proposed by Singer and Nicolson, the lipid molecules are arranged as a bilayer in which:

(A) Proteins float within or are embedded in a fluid lipid bilayer, allowing lateral movement

(B) Proteins form a continuous rigid sheet on both surfaces of a fixed lipid layer

(C) Lipids are arranged as a single layer with no proteins

(D) The membrane is completely rigid and immobile

Q9. The bond that links two amino acids together in a protein chain, formed between the carboxyl group of one amino acid and the amino group of the next with the loss of a water molecule, is called a:

(A) Glycosidic bond

(B) Peptide bond

(C) Phosphodiester bond

(D) Hydrogen bond

Q10. The opening of stomata during the day is brought about mainly by:

(A) Loss of water making guard cells flaccid

(B) Decrease in solute concentration of guard cells

(C) Entry of water into guard cells making them turgid as K^+ ions accumulate

(D) Closure of the leaf cuticle

Q11. In the Calvin cycle (C_3 pathway), the primary CO_2 acceptor is a 5-carbon compound. This acceptor molecule is:

(A) Phosphoenolpyruvate (PEP)

(B) Oxaloacetate

(C) 3-Phosphoglyceric acid (PGA)

(D) Ribulose-1,5-bisphosphate (RuBP)

Q12. The Krebs cycle (citric acid cycle) begins when acetyl CoA (2-carbon) combines with oxaloacetate (4-carbon) to form which 6-carbon compound?

(A) Citric acid

(B) Pyruvic acid

(C) Succinic acid

(D) α-Ketoglutaric acid

Q13. During normal inspiration in humans, the diaphragm and external intercostal muscles contract. This leads to:

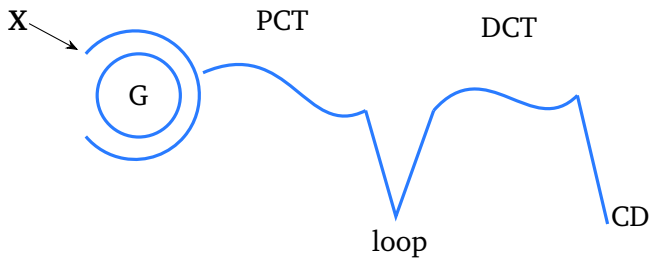
(A) A decrease in thoracic volume and a rise in intra-pulmonary pressure

(B) An increase in thoracic volume, lowering intra-pulmonary pressure so air rushes in

(C) No change in lung volume

(D) Air being forced out of the lungs

Q14. The diagram shows a nephron, the functional unit of the kidney. The cup-shaped structure labelled **X**, which encloses the glomerulus and is the site of ultrafiltration, is the:



(A) Loop of Henle

(B) Distal convoluted tubule

(C) Bowman's capsule

(D) Collecting duct

Q15. Which endocrine gland is often called the "master gland" because the hormones it secretes regulate the secretions of several other endocrine glands?

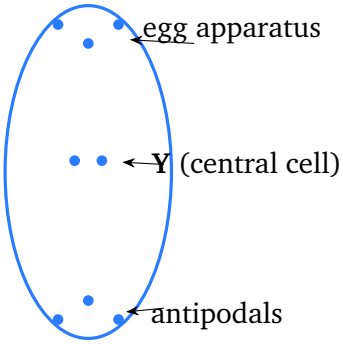
(A) Pituitary gland

(B) Thyroid gland

(C) Adrenal gland

(D) Pancreas

Q16. The figure shows a mature (7-celled, 8-nucleate) embryo sac of a flowering plant. The single large central cell labelled **Y**, which fuses with one male gamete to form the triploid primary endosperm nucleus, contains the:



(A) One synergid nucleus

(B) Two polar nuclei

(C) The egg nucleus only

(D) Three antipodal nuclei

Q17. In the human female reproductive system, fertilisation of the ovum by the sperm normally occurs in the:

(A) Uterus

(B) Cervix

(C) Ampullary region of the fallopian tube

(D) Vagina

Q18. Which of the following is a sexually transmitted disease caused by a bacterium and *not* by a virus?

(A) Syphilis

(B) AIDS

(C) Genital herpes

(D) Hepatitis-B

Q19. In a dihybrid cross between two heterozygous pea plants ($RrYy \times RrYy$), the offspring show a characteristic phenotypic ratio in the F_2 generation, illustrating Mendel's Law of Independent Assortment. The mini-Punnett below recalls the gamete types. This classic F_2 phenotypic ratio is:

	RY	ry
RY	*RRYY*	*RrYy*
ry	*RrYy*	*rryy*

(A) $3:1$

(B) $9:3:3:1$

(C) $1:2:1$

(D) $1:1:1:1$

Q20. In *Mirabilis jalapa* (four o'clock plant), a cross between a red-flowered (RR) and a white-flowered (rr) plant produces pink-flowered (Rr) offspring in the F_1 generation. This pattern of inheritance is an example of:

(A) Complete dominance

(B) Codominance

(C) Incomplete dominance

(D) Multiple allelism

Q21. During transcription in a cell, the enzyme that catalyses the synthesis of an RNA strand using a DNA template is:

(A) DNA ligase

(B) DNA helicase

(C) DNA polymerase

(D) RNA polymerase

Q22. The genetic code is said to be "degenerate". This property means that:

(A) Some amino acids are coded by more than one codon

(B) One codon codes for several different amino acids

(C) The code differs from organism to organism

(D) Codons overlap with one another

Q23. The forelimbs of a human, a whale, a bat and a cheetah have a similar basic skeletal pattern but perform different functions. Such organs are described as:

(A) Analogous organs showing convergent evolution

(B) Homologous organs showing divergent evolution

(C) Vestigial organs

(D) Atavistic organs

Q24. The antibody that is the most abundant in human blood and is the only one able to cross the placenta to provide passive immunity to the foetus is:

(A) IgA

(B) IgM

(C) IgG

(D) IgE

Q25. The spread of cancer cells from their site of origin to distant parts of the body, where they form secondary tumours, is known as:

(A) Metastasis

(B) Apoptosis

(C) Contact inhibition

(D) Differentiation

Q26. The antibiotic penicillin, the first to be discovered (by Alexander Fleming), is obtained from which microorganism?

(A) The bacterium *Streptomyces*

(B) The mould *Penicillium notatum*

(C) The yeast *Saccharomyces cerevisiae*

(D) The bacterium *Lactobacillus*

Q27. In recombinant DNA technology, a plasmid used as a cloning vector must necessarily possess an "ori". This "ori" refers to the:

(A) A site that gives resistance to antibiotics

(B) A recognition site for restriction enzymes

(C) A gene coding for an enzyme

(D) The origin of replication, the sequence from which replication starts

Q28. Human insulin produced by genetic engineering (marketed as humulin) consists of two short polypeptide chains, A and B, linked together by:

(A) Disulphide bridges

(B) Peptide bonds within a single chain

(C) Hydrogen bonds only

(D) Glycosidic linkages

Q29. The interaction between the sea anemone and the clown fish, in which the clown fish gains protection while the anemone is neither benefited nor harmed, is an example of:

(A) Mutualism

(B) Commensalism

(C) Predation

(D) Parasitism

Q30. In most ecosystems, the pyramid of energy is always upright (never inverted). The fundamental reason for this is that:

(A) Producers are always fewer in number than consumers

(B) Energy increases at each successive trophic level

(C) Energy is lost (as heat) at each transfer, so each higher trophic level has less available energy

(D) The number of organisms always decreases up the food chain

Detailed Solutions

Q1.

Solution

Concept — Taxonomic aids (herbarium): A herbarium is a store house of collected, dried, pressed and preserved plant specimens mounted on sheets of standard size. Each sheet carries a label giving identifying information.

Step 1 — Label convention: By international convention, the label is fixed on the **lower right-hand corner** of the herbarium sheet. It records the date and place of collection, the English/local name, the botanical name, the family, and the collector's name.

Step 2 — Why the corner matters: Placing the label in the lower right corner keeps the centre free for the specimen and allows uniform filing and quick reference in the herbarium.

Why other options are wrong:

- (B) and (D) Upper corners are not the standard position for the data label.
- (C) The centre is reserved for mounting the specimen itself, not the label.

Final Answer: The label goes on the lower right-hand corner $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q 1

Q2.

Solution

Concept — Binomial nomenclature: Each scientific name has two components, the generic name (genus) written first and the specific epithet written second. The specific epithet identifies the species within the genus.

Step 1 — Analyse the name: In *Mangifera indica*, the first word *Mangifera* is the generic name (genus), and the second word *indica* is the specific epithet.

Step 2 — Apply the rule: Therefore *indica* represents the specific epithet, the part that names the particular species (the mango) within the genus *Mangifera*.

Why other options are wrong:

- (A) The generic name is *Mangifera*, the first word.
- (C) and (D) Family and order are higher taxonomic categories, not part of the two-word species name.

Final Answer: *indica* is the specific epithet ⇒ B

Answer: (B) Go Back to Q 2

Q3.

Solution

Concept — Kingdom Protista: Protists are single-celled eukaryotes. The group includes chrysophytes, dinoflagellates, euglenoids, slime moulds and protozoans, each with distinguishing features.

Step 1 — Match the clues: The organism described has two flagella, a stiff cellulose wall and is photosynthetic, appearing in varied colours.

Step 2 — Identify the group: These are the features of **dinoflagellates**. When they multiply rapidly they cause red tides, and toxins released by some (e.g. *Gonyaulax*) can kill marine animals.

Why other options are wrong:

- (A) Euglenoids lack a cell wall; they have a protein-rich pellicle instead.
- (B) Slime moulds are saprophytic, not photosynthetic, and form plasmodia.
- (D) Diatoms have a silica cell wall (frustule) and are not described as causing red tides.

Final Answer: The organism is a dinoflagellate ⇒ C

Answer: (C) Go Back to Q 3

Q4.

Solution

Concept — Bryophytes: Bryophytes are "amphibians of the plant kingdom". They live in moist, shady places and lack true vascular tissue.

Step 1 — Key features: In bryophytes the gametophyte (the green, photosynthetic plant body) is the dominant, longer-lived generation. The sporophyte is dependent on the gametophyte for nutrition.

Step 2 — Need for water: The male gametes (antherozoids) are flagellate and require a film of water to swim to the female organ (archegonium) for fertilisation.

Why other options are wrong:

- (A) Bryophytes lack well-developed xylem and phloem; conduction is lim-

ited.

- (B) The gametophyte, not the sporophyte, is the dominant generation.
- (C) Bryophytes do not produce seeds or fruits; they reproduce by spores.

Final Answer: Water-dependent fertilisation with a dominant gametophyte $\Rightarrow$ D

Answer: (D) Go Back to Q 4

Q5.

Solution

Concept — Phylum Coelenterata (Cnidaria): These are aquatic, mostly marine, radially symmetrical, diploblastic animals with a central gastrovascular cavity.

Step 1 — Diagnostic cell: Their defining feature is the presence of **cnidoblasts** (or cnidocytes), specialised stinging cells located on the tentacles and the body.

Step 2 — Function: Cnidoblasts contain nematocysts and are used for anchorage, for defence, and for capturing prey. Examples include *Hydra*, *Adamsia* and *Aurelia* (jellyfish).

Why other options are wrong:

- (B) Poriferans (sponges) have choanocytes (collar cells), not cnidoblasts.
- (C) Platyhelminthes are flatworms with no stinging cells.
- (D) Annelids are segmented worms lacking cnidoblasts.

Final Answer: Cnidoblasts characterise Coelenterata $\Rightarrow$ A

Answer: (A) Go Back to Q 5

Q6.

Solution

Concept — Stem modifications: Stems may be modified underground for storage and perennation. The presence of nodes, internodes, buds and scale leaves marks a structure as a modified stem rather than a root.

Step 1 — Identify the structure: The thick, horizontal underground stem of ginger and turmeric bears nodes, scale leaves and buds. Such a structure is a **rhizome**.

Step 2 — Function: The rhizome stores food and helps the plant survive unfavourable seasons, sprouting new aerial shoots when conditions improve.

Why other options are wrong:

- (A) A bulb (e.g. onion) is a reduced stem with fleshy scale leaves, not the structure in ginger.
- (C) A tap root is a root, not a stem, and lacks nodes and scale leaves.
- (D) Corms are vertical and tendrils are climbing organs; neither describes ginger.

Final Answer: Ginger and turmeric have a rhizome $\Rightarrow$ B

Answer: (B) Go Back to Q 6

Q7.

Solution

Concept — Connective tissues: Connective tissues link and support other tissues. Their cells are embedded in an abundant matrix, which may be jelly-like, fibrous, solid or fluid.

Step 1 — Fluid connective tissue: Blood is a specialised connective tissue in which the cells (erythrocytes, leucocytes, platelets) are suspended in a fluid matrix called plasma.

Step 2 — Role: As a fluid connective tissue, blood transports gases, nutrients, wastes and hormones throughout the body.

Why other options are wrong:

- (A) Areolar tissue is loose connective tissue with a semi-fluid matrix, not a fluid one.
- (B) A tendon is dense regular connective tissue joining muscle to bone.
- (D) Adipose tissue stores fat; its matrix is not a liquid plasma.

Final Answer: Blood is the fluid connective tissue $\Rightarrow$ C

Answer: (C) Go Back to Q 7

Q8.

Solution

Concept — Fluid mosaic model: Proposed by Singer and Nicolson (1972), this model describes the plasma membrane as a fluid lipid bilayer studded with proteins.

Step 1 — Lipid bilayer: Phospholipids form a bilayer with hydrophilic heads facing outward and hydrophobic tails facing inward.

Step 2 — Mobile proteins: Proteins are embedded within (integral) or attached to the surface (peripheral) of this bilayer. Because the bilayer is fluid (quasi-fluid), the lipids and many proteins can move laterally, giving the membrane its mosaic, dynamic character.

Why other options are wrong:

- (B) and (D) The membrane is fluid, not a rigid fixed sheet (this was the older sandwich model).
- (C) The membrane is a bilayer, not a single lipid layer, and it does contain proteins.

Final Answer: Proteins float in a fluid lipid bilayer $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 8

Q9.

Solution

Concept — Proteins and amino acids: Proteins are polymers of amino acids. Adjacent amino acids are joined by a covalent bond formed during a condensation (dehydration) reaction.

Step 1 — Bond formation: The carboxyl group ($-COOH$) of one amino acid reacts with the amino group ($-NH_2$) of the next, releasing a molecule of water.

Step 2 — Name the bond: The resulting $C-N$ linkage is called a **peptide bond**, and the chain so formed is a polypeptide.

Why other options are wrong:

- (A) Glycosidic bonds link monosaccharides in carbohydrates.
- (C) Phosphodiester bonds link nucleotides in nucleic acids.
- (D) Hydrogen bonds stabilise protein folding but do not covalently join amino acids in the chain.

Final Answer: Amino acids are joined by peptide bonds $\Rightarrow$ B

Answer: (B) Go Back to Q 9

Q10.

Solution

Concept — Stomatal mechanism: Stomata are pores bordered by two guard cells. Their opening and closing is governed by changes in the turgidity of the guard cells.

Step 1 — Ion uptake: During the day, K^+ ions are actively pumped into the guard cells. This lowers their water potential.

Step 2 — Turgor change: Water then enters the guard cells by osmosis, making them turgid. The unevenly thickened guard cells bow outward, and the stoma opens. (Loss of water and K^+ reverses this, closing the stoma.)

Why other options are wrong:

- (A) Flaccid guard cells cause closing, not opening.
- (B) A decrease in solute concentration would raise water potential and tend to close the stoma.
- (D) The cuticle is a waxy layer and does not open or close stomata.

Final Answer: Turgid guard cells (from K^+ uptake) open the stoma $\Rightarrow$ C

Answer: (C) Go Back to Q 10

Q11.

Solution

Concept — Calvin cycle (C_3 pathway): The Calvin cycle fixes CO_2 into carbohydrate in the stroma of the chloroplast. It has three phases: carboxylation, reduction and regeneration.

Step 1 — Carboxylation: CO_2 is accepted by a 5-carbon sugar, ribulose-1,5-bisphosphate (RuBP), in a reaction catalysed by the enzyme RuBisCO.

Step 2 — Product: The unstable 6-carbon intermediate splits into two molecules of 3-carbon 3-phosphoglyceric acid (PGA), which is why the pathway is called C_3. Thus the primary CO_2 acceptor is RuBP.

Why other options are wrong:

- (A) PEP is the CO_2 acceptor in the C_4 pathway, not the Calvin cycle.
- (B) Oxaloacetate is the first product in C_4 plants.
- (C) PGA is the first stable product of fixation, not the acceptor.

Final Answer: The primary acceptor is RuBP $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q 11

Q12.

Solution

Concept — Krebs cycle: Also called the citric acid or TCA cycle, it occurs in the mitochondrial matrix and completes the oxidation of acetyl CoA.

Step 1 — The first step: Acetyl CoA (2 carbons) condenses with oxaloacetic acid (4 carbons) in the presence of water.

Step 2 — The product: This forms the 6-carbon **citric acid**, releasing the coenzyme A. Citric acid is then progressively oxidised, regenerating oxaloacetate to continue the cycle.

Why other options are wrong:

- (B) Pyruvic acid is the 3-carbon end product of glycolysis, formed before the cycle.
- (C) Succinic acid is a 4-carbon intermediate formed later in the cycle.
- (D) α-Ketoglutaric acid is a 5-carbon intermediate, also formed later.

Final Answer: The 6-carbon product is citric acid $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q 12

Q13.

Solution

Concept — Mechanism of breathing: Breathing depends on pressure gradients between the atmosphere and the lungs, created by changes in the volume of the thoracic cavity.

Step 1 — Inspiration: Contraction of the diaphragm (which flattens) and of the external intercostal muscles (which raise the ribs and sternum) increases the volume of the thoracic chamber.

Step 2 — Pressure and airflow: The increased thoracic volume lowers the intra-

pulmonary pressure below atmospheric pressure. Air therefore rushes into the lungs from outside to equalise the pressure.

Why other options are wrong:

- (A) and (D) Decreased volume and raised pressure describe expiration, when air is pushed out.
- (C) Lung volume clearly changes during a normal breath.

Final Answer: Increased thoracic volume lowers pressure so air enters $\Rightarrow$ B

Answer: (B) Go Back to Q 13

Q14.

Solution

Concept — Nephron and urine formation: The nephron is the functional unit of the kidney. It begins with a filtering apparatus called the renal corpuscle (Malpighian body), followed by the tubule.

Step 1 — Identify X: The cup-shaped structure that encloses the glomerulus (G) is the **Bowman's capsule**. Together the glomerulus and Bowman's capsule form the Malpighian corpuscle.

Step 2 — Function: Blood pressure in the glomerular capillaries forces water and small solutes out of the blood into the Bowman's capsule. This pressure-driven filtration is called ultrafiltration, the first step of urine formation.

Why other options are wrong:

- (A) The loop of Henle is the U-shaped portion concerned with concentrating urine.
- (B) The DCT performs selective reabsorption and secretion further along the tubule.
- (D) The collecting duct receives urine from many nephrons; it does not enclose the glomerulus.

Final Answer: X is the Bowman's capsule $\Rightarrow$ C

Answer: (C) Go Back to Q 14

Q15.

Solution

Concept — Endocrine system: Endocrine glands are ductless and secrete hormones directly into the blood. One gland coordinates the activity of several others.

Step 1 — The master gland: The **pituitary gland** secretes trophic hormones (such as TSH, ACTH, FSH and LH) that stimulate other endocrine glands like the thyroid, adrenal cortex and gonads.

Step 2 — Why master: Because its hormones regulate the secretions of these other glands, the pituitary is traditionally called the master gland (though it is itself controlled by the hypothalamus).

Why other options are wrong:

- (B) The thyroid is regulated by the pituitary, not the other way round.
- (C) The adrenal cortex is stimulated by pituitary ACTH.
- (D) The pancreas chiefly regulates blood glucose, not other endocrine glands.

Final Answer: The pituitary is the master gland $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q 15

Q16.

Solution

Concept — Embryo sac (female gametophyte): A typical mature embryo sac is 7-celled and 8-nucleate: an egg apparatus of 3 cells (one egg + two synergids) at the micropylar end, three antipodal cells at the chalazal end, and one large central cell.

Step 1 — Identify the central cell: The single large central cell (Y) contains two polar nuclei, which lie near the centre of the embryo sac.

Step 2 — Role in double fertilisation: During double fertilisation, one male gamete fuses with the two polar nuclei (triple fusion) to form the triploid (3n) primary endosperm nucleus, which develops into the nourishing endosperm.

Why other options are wrong:

- (A) Synergid nuclei belong to the egg apparatus, not the central cell.
- (C) The egg nucleus fuses with the other male gamete (syngamy), forming

the zygote.
- (D) The three antipodal nuclei lie at the chalazal end and play no role in this fusion.

Final Answer: The central cell contains two polar nuclei $\Rightarrow$ B

Answer: (B) Go Back to Q 16

Q17.

Solution

Concept — Female reproductive system: The fallopian tube (oviduct) carries the released ovum from the ovary towards the uterus. It has distinct regions: infundibulum, ampulla and isthmus.

Step 1 — Site of fertilisation: The sperm, swimming up through the cervix and uterus, meets the ovum in the **ampullary region** (the wider part) of the fallopian tube. Fertilisation normally occurs here.

Step 2 — After fertilisation: The resulting zygote travels down to the uterus, where implantation in the endometrium takes place.

Why other options are wrong:

- (A) The uterus is the site of implantation, not usually of fertilisation.
- (B) and (D) The cervix and vagina form the passage but are not the site of fertilisation.

Final Answer: Fertilisation occurs in the ampulla of the fallopian tube $\Rightarrow$ C

Answer: (C) Go Back to Q 17

Q18.

Solution

Concept — Sexually transmitted diseases: STDs are infections passed mainly through sexual contact. They are caused by various pathogens: bacteria, viruses and protozoa.

Step 1 — Classify by cause: Syphilis is caused by the bacterium *Treponema pallidum*. It is therefore a bacterial STD.

Step 2 — Compare: AIDS, genital herpes and hepatitis-B are all viral diseases. Hence among the options, only syphilis is bacterial.

Why other options are wrong:

- (B) AIDS is caused by the human immunodeficiency virus (HIV).
- (C) Genital herpes is caused by the herpes simplex virus.
- (D) Hepatitis-B is caused by the hepatitis-B virus.

Final Answer: Syphilis is the bacterial STD $\Rightarrow$ A

Answer: (A) Go Back to Q 18

Q19.

Solution

Concept — Dihybrid cross and independent assortment: A dihybrid cross follows two pairs of contrasting traits. Mendel's Law of Independent Assortment states that the alleles of one gene segregate independently of the alleles of another.

Step 1 — The gametes: Each $RrYy$ parent produces four kinds of gametes: RY, Ry, rY and ry.

Step 2 — The F_2 outcome: Combining these gametes in a 4×4 Punnett square gives 16 combinations. The phenotypes appear in the ratio 9 (round, yellow) : 3 (round, green) : 3 (wrinkled, yellow) : 1 (wrinkled, green), the classic dihybrid ratio.

Why other options are wrong:

- (A) $3:1$ is the F_2 ratio of a monohybrid cross.
- (C) $1:2:1$ is the genotypic ratio of a monohybrid cross.
- (D) $1:1:1:1$ is the ratio of a dihybrid test cross, not the F_2 of $RrYy \times RrYy$.

Final Answer: The F_2 phenotypic ratio is $9:3:3:1 \Rightarrow$ B

Answer: (B) Go Back to Q 19

Q20.

Solution

Concept — Incomplete dominance: In incomplete dominance, the heterozygote shows a phenotype intermediate between the two homozygous parents because neither allele is completely dominant.

Step 1 — Analyse the cross: Red (RR) $\times$ white (rr) gives pink (Rr) in the F_1. The pink colour is intermediate between red and white.

Step 2 — Conclusion: Since the heterozygote (Rr) is neither red nor white but an intermediate pink, this is a clear case of incomplete dominance. (The F_2 phenotypic ratio here is 1 red : 2 pink : 1 white, the same as the genotypic ratio.)

Why other options are wrong:

- (A) In complete dominance the heterozygote would look exactly like the dominant parent.
- (B) In codominance both alleles express fully and separately (e.g. AB blood group), not as a blend.
- (D) Multiple allelism involves more than two alleles of a gene, which is not the situation here.

Final Answer: The intermediate pink shows incomplete dominance $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q 20

Q21.

Solution

Concept — Transcription: Transcription is the copying of genetic information from a DNA template into a complementary RNA molecule. It needs a specific enzyme.

Step 1 — The enzyme: RNA polymerase binds the promoter, unwinds the DNA, and synthesises RNA in the $5' \rightarrow 3'$ direction using the template strand.

Step 2 — Outcome: The enzyme adds ribonucleotides complementary to the template (A pairs with U, not T), producing the mRNA, tRNA or rRNA transcript.

Why other options are wrong:

- (A) DNA ligase seals nicks by joining DNA fragments, used in replication and repair.
- (B) DNA helicase only unwinds the double helix; it does not make RNA.

- (C) DNA polymerase synthesises DNA, not RNA, during replication.

Final Answer: RNA polymerase carries out transcription $\Rightarrow$ D

Answer: (D) Go Back to Q 21

Q22.

Solution

Concept — The genetic code: The genetic code is the set of rules by which triplet codons in mRNA specify amino acids. It has several defining properties.

Step 1 — Degeneracy defined: The code is degenerate because most amino acids are specified by more than one codon. For example, leucine is coded by six different codons.

Step 2 — Significance: This redundancy buffers the effect of some point mutations, since a changed codon may still specify the same amino acid.

Why other options are wrong:

- (B) A single codon never codes for several amino acids; the code is unambiguous.
- (C) The code is nearly universal, the same in most organisms, not different from one to another.
- (D) The code is non-overlapping; codons are read in continuous, non-overlapping triplets.

Final Answer: Degeneracy means one amino acid has more than one codon $\Rightarrow$ A

Answer: (A) Go Back to Q 22

Q23.

Solution

Concept — Homologous vs analogous organs: Homologous organs share a common basic structure and origin but may perform different functions, indicating descent from a common ancestor (divergent evolution).

Step 1 — Examine the example: The forelimbs of human, whale, bat and cheetah have the same fundamental skeletal plan (humerus, radius, ulna, carpals, etc.) but are adapted for grasping, swimming, flying and running respectively.

Step 2 — Classify: Same structure, different functions $\Rightarrow$ homologous organs, the

result of divergent evolution from a common ancestor.

Why other options are wrong:

- (A) Analogous organs have different structure but similar function (e.g. wings of insect and bird); that is convergent evolution.
- (C) Vestigial organs are reduced, non-functional remnants (e.g. the appendix).
- (D) "Atavistic organs" is not the correct term for this set of forelimbs.

Final Answer: These are homologous organs showing divergent evolution $\Rightarrow$ B

Answer: (B) Go Back to Q 23

Q24.

Solution

Concept — Antibodies and immunity: Antibodies (immunoglobulins) are Y-shaped proteins produced by B-lymphocytes. There are five classes: IgG, IgA, IgM, IgE and IgD.

Step 1 — Most abundant antibody: IgG is the most abundant immunoglobulin in human blood serum.

Step 2 — Placental transfer: IgG is the only class small enough and able to cross the placenta. By passing from mother to foetus, it provides natural passive immunity to the developing baby.

Why other options are wrong:

- (A) IgA is found mainly in secretions such as saliva, tears and milk.
- (B) IgM is the first antibody produced in a primary response and is too large to cross the placenta.
- (D) IgE is involved in allergic reactions and defence against parasites.

Final Answer: IgG is most abundant and crosses the placenta $\Rightarrow$ C

Answer: (C) Go Back to Q 24

Q25.

Solution

Concept — Cancer: Cancer arises when cells lose the property of contact inhibition and divide uncontrollably, forming a mass called a tumour. Malignant tumours can invade and spread.

Step 1 — Define the spread: Cells sloughed from a malignant tumour reach distant sites through the blood and lymph, where they start new (secondary) tumours. This spreading is called **metastasis**.

Step 2 — Significance: Metastasis is the most dangerous property of malignant tumours and the main reason cancer becomes difficult to treat.

Why other options are wrong:

- (B) Apoptosis is programmed cell death, the opposite of uncontrolled growth.
- (C) Contact inhibition is the normal property cancer cells lose; it does not describe spreading.
- (D) Differentiation is the development of specialised cell types, not the spread of cancer.

Final Answer: The spread of cancer is called metastasis $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q 25

Q26.

Solution

Concept — Microbes in human welfare: Many useful substances, including antibiotics, are industrial products of microorganisms. Antibiotics are chemicals produced by some microbes that kill or inhibit other microbes.

Step 1 — Origin of penicillin: Penicillin, the first antibiotic discovered by Alexander Fleming, is produced by the blue-green mould *Penicillium notatum* (a fungus).

Step 2 — Use: Penicillin acts against many Gram-positive bacteria and revolutionised the treatment of bacterial infections.

Why other options are wrong:

- (A) *Streptomyces* is a bacterium that produces other antibiotics such as streptomycin, not penicillin.
- (C) *Saccharomyces cerevisiae* (yeast) is used in baking and brewing, not for

penicillin.

- (D) *Lactobacillus* is used in curd formation, not for producing penicillin.

Final Answer: Penicillin comes from *Penicillium notatum* $\Rightarrow$ B

Answer: (B) Go Back to Q 26

Q27.

Solution

Concept — Cloning vectors: A cloning vector is a DNA molecule (often a plasmid) that carries a foreign gene into a host cell. To be useful it must have certain key features.

Step 1 — Meaning of ori: The "ori" is the **origin of replication**, a specific DNA sequence from which replication starts. Any piece of DNA linked to the ori can be made to replicate inside the host.

Step 2 — Importance: Because the ori allows the vector (and the inserted gene) to replicate, large numbers of copies of the foreign DNA can be produced.

Why other options are wrong:

- (A) Antibiotic resistance comes from a separate selectable marker gene, not the ori.
- (B) Restriction sites are recognised by restriction enzymes; they are not the ori.
- (C) A coding gene is the cargo, not the origin of replication.

Final Answer: "ori" is the origin of replication $\Rightarrow$ D

Answer: (D) Go Back to Q 27

Q28.

Solution

Concept — Genetically engineered insulin (humulin): Mature human insulin has two short polypeptide chains, the A chain and the B chain, held together by a particular kind of covalent bond.

Step 1 — Linkage between chains: The A and B chains of insulin are joined by **disulphide bridges** ($-S-S-$) formed between cysteine residues.

Step 2 — Production: In the recombinant approach, the A and B chains were pro-

duced separately in *E. coli*, then extracted and combined; the disulphide bridges link them to form functional human insulin (humulin).

Why other options are wrong:

- (B) Peptide bonds join amino acids within each chain, not the two separate chains to each other.
- (C) Hydrogen bonds help fold the protein but do not covalently link the chains.
- (D) Glycosidic linkages join sugars, not polypeptide chains.

Final Answer: The A and B chains are linked by disulphide bridges $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 28

Q29.

Solution

Concept — Population interactions: Interactions between two species are classified by whether each partner is benefited $(+)$, harmed $(-)$ or unaffected (0).

Step 1 — Analyse the pair: The clown fish living among the stinging tentacles of the sea anemone gains protection from predators $(+)$, while the anemone is neither helped nor harmed (0).

Step 2 — Classify $(+/0)$: An interaction where one species benefits and the other is unaffected is **commensalism**.

Why other options are wrong:

- (A) Mutualism is $+/+$, where both species benefit.
- (C) Predation is $+/-$, where the predator gains and the prey is killed.
- (D) Parasitism is $+/-$, where the parasite benefits at the host's expense.

Final Answer: The clown fish–anemone link is commensalism $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 29

Q30.

Solution

Concept — Ecological pyramids: An ecological pyramid represents the relationship of number, biomass or energy between successive trophic levels of an ecosystem.

Step 1 — Energy flow rule: Energy flow in an ecosystem is one-directional. At each transfer from one trophic level to the next, only about 10% of the energy is passed on; the rest is lost mainly as heat in respiration.

Step 2 — Why always upright: Because the energy available decreases at every higher trophic level, the pyramid of energy is always upright and can never be inverted.

Why other options are wrong:

- (A) and (D) Statements about numbers can have exceptions (a pyramid of numbers can be inverted, e.g. one tree supporting many insects); they are not the fundamental reason.
- (B) Energy decreases, not increases, at each higher level.

Final Answer: Energy lost at each transfer keeps the energy pyramid upright $\Rightarrow$ C

Answer: (C) Go Back to Q 30

Answer Key

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