NEST Biology Sample Paper – 3

Duration: 45 Minutes **Maximum Marks: 60**

Instructions

- This paper contains **20 Multiple Choice Questions (single correct answer)**, modelled on the Biology section of **NEST 2026**.
- Each correct answer carries **+3 marks**. There is a deduction of -1 **mark** for each incorrect answer; **no marks** are deducted for an unattempted question.
- Every question has exactly **four options**, of which only **one** is correct. Choose carefully.
- Personal calculators, log tables, mobile phones, and other electronic gadgets are strictly prohibited in the examination hall.
- A simple on-screen (virtual) calculator is provided in the computer-based test interface and may be used; blank sheets for rough work are supplied at the exam centre.

Q1. A microbiologist isolates an organism whose cells lack a true membrane-bound nucleus, possess a rigid cell wall made of peptidoglycan, and reproduce mainly by binary fission without a mitotic spindle. The organism is best placed in the kingdom

(A) Protista

(B) Monera

(C) Fungi

(D) Plantae

Q2. An invertebrate is examined and found to possess a segmented body with paired *jointed appendages*, a chitinous exoskeleton, and an open circulatory system with haemocoel. To which phylum does it belong?

(A) Cnidaria

(B) Echinodermata

(C) Arthropoda

(D) Annelida

Q3. In a bisected ovary, the ovules are found attached to a central axis in a multilocular (multi-chambered) ovary, as in *Hibiscus* and tomato. This type of placentation is called

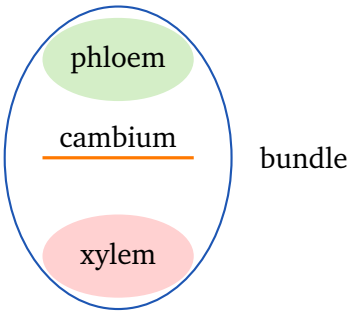
(A) axile

(B) parietal

(C) marginal

(D) free central

Q4. The diagram shows the arrangement of tissues in a vascular bundle from a dicot stem. The xylem lies towards the centre, the phloem towards the periphery, and a strip of cambium lies between them.



This kind of vascular bundle is correctly described as

(A) radial and closed

(B) conjoint, collateral and closed

(C) radial and open

(D) conjoint, collateral and open

Q5. According to the fluid-mosaic model, certain solutes cross the plasma membrane against their concentration gradient with the help of carrier proteins and direct expenditure of ATP. This mode of membrane transport is

(A) simple diffusion through the lipid bilayer

(B) osmosis of water across the membrane

(C) active transport

(D) facilitated diffusion without energy input

Q6. A competitive inhibitor reduces the rate of an enzyme-catalysed reaction. The molecular basis of this inhibition is that the inhibitor

(A) binds permanently to a site away from the active site and denatures the enzyme

(B) closely resembles the substrate and competes for the active site

(C) raises the activation energy of the reaction

(D) removes the metal-ion cofactor from the enzyme

Q7. In a somatic cell with diploid DNA content $2C$ during G_1, the amount of nuclear DNA present at the end of the S phase (just before G_2) is

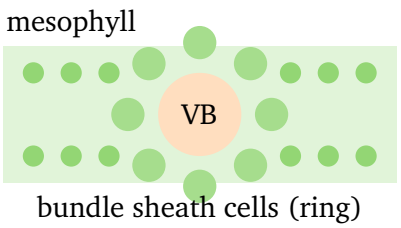
(A) $4C$

(B) $2C$

(C) $1C$

(D) $8C$

Q8. The figure shows a transverse section through the leaf of a C_4 plant such as *Zea mays*, in which a ring of large cells surrounds each vascular bundle.



The ring of large cells around the vascular bundle is the site of the Calvin cycle and characterises

(A) the C_3 pathway in spongy mesophyll

(B) photorespiration in guard cells

(C) the light reactions only

(D) Kranz anatomy with bundle-sheath cells rich in RuBisCO

Q9. During aerobic respiration in a eukaryotic cell, the complete oxidation of one molecule of pyruvate through the link reaction plus one turn of the Krebs cycle directly yields how many molecules of CO_2?

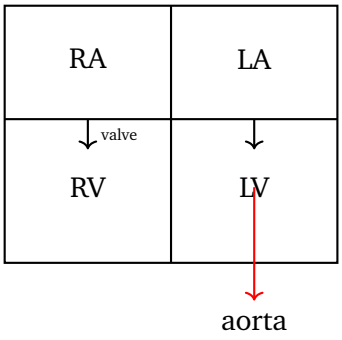
(A) 1

(B) 2

(C) 3

(D) 6

Q10. The schematic shows the four chambers of the human heart and the great vessels.



During ventricular systole, the valves that close to prevent backflow of blood into the atria are the

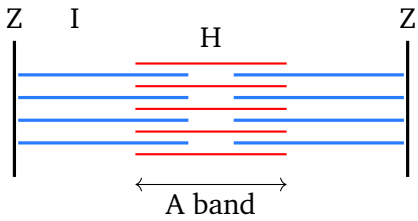
(A) semilunar (aortic and pulmonary) valves

(B) atrioventricular (tricuspid and bicuspid) valves

(C) only the bicuspid valve

(D) venous valves of the vena cava

Q11. The diagram represents one sarcomere of a skeletal muscle fibre, with thick (myosin) and thin (actin) filaments between two Z-lines.



According to the sliding filament theory, during muscle contraction

(A) the thick filaments shorten while the thin filaments lengthen

(B) both thick and thin filaments shorten equally

(C) the A band shortens markedly

(D) the thin filaments slide over the thick filaments, shortening the H zone and I band while the A band stays constant

Q12. In the embryo sac of a flowering plant, one male gamete fuses with the egg cell while the second male gamete fuses with the two polar nuclei. The product of the second fusion (triple fusion) develops into the

(A) triploid (3n) endosperm

(B) diploid zygote

(C) haploid suspensor

(D) diploid seed coat

Q13. After fertilization in the human female, the blastocyst becomes embedded in the uterine endometrium. The functional connection between the developing embryo and the uterine wall, which mediates exchange of nutrients, gases and wastes, is the

(A) corpus luteum

(B) zona pellucida

(C) placenta

(D) Graafian follicle

Q14. In the human ABO blood-group system, the alleles I^A and I^B are both fully expressed in an I^AI^B individual, who therefore has blood group

AB. This pattern of inheritance, in which both alleles are simultaneously expressed in the heterozygote, is an example of

(A) incomplete dominance

(B) codominance

(C) complete dominance of I^A

(D) pleiotropy

Q15. In eukaryotes, the primary transcript (hnRNA) synthesised by RNA polymerase II must be processed before it can be translated. The processing step in which non-coding intron sequences are removed and exons are joined is called

(A) capping at the 5' end

(B) polyadenylation at the 3' end

(C) reverse transcription

(D) splicing

Q16. The forelimbs of a whale, a bat and a human have the same basic skeletal plan but perform different functions, because they were inherited from a common ancestor. Such structures are described as

(A) homologous organs, illustrating divergent evolution

(B) analogous organs, illustrating convergent evolution

(C) vestigial organs with no function

(D) homologous organs, illustrating convergent evolution

Q17. The human immunodeficiency virus (HIV) is a retrovirus. After entering a helper T-lymphocyte, the first molecular event unique to its replication cycle is the

(A) translation of viral RNA directly into capsid proteins

(B) replication of double-stranded viral DNA by host DNA polymerase

(C) synthesis of viral DNA from the RNA genome by reverse transcriptase

(D) budding of mature virions from the host cell

Q18. During the secondary (biological) treatment of municipal sewage, vigorously growing aerobic microbes form flocs and consume most of the organic matter in the effluent. As a direct result of this microbial activity, the effluent shows a

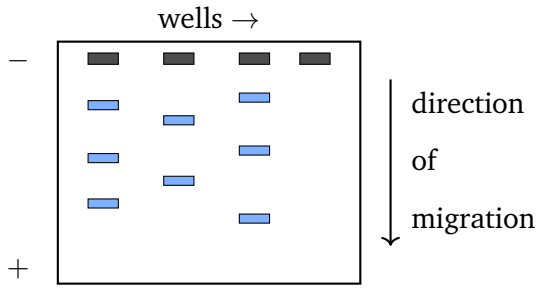
(A) large increase in biochemical oxygen demand (BOD)

(B) rise in suspended large solids removed earlier

(C) conversion into primary sludge

(D) large decrease in biochemical oxygen demand (BOD)

Q19. In recombinant DNA work, DNA fragments cut by restriction enzymes are separated on an agarose gel to which an electric field is applied. The figure shows the gel after the run; the wells are at the top and several bands have appeared.



The smallest DNA fragments are found in the bands that have

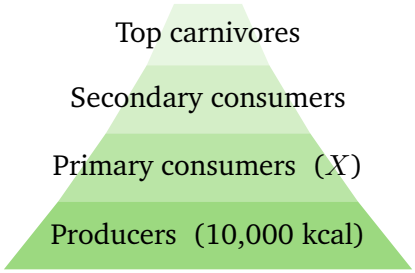
(A) migrated farthest from the wells (towards the anode)

(B) remained closest to the wells (near the cathode)

(C) not moved at all from the wells

(D) migrated towards the negative electrode

Q20. The ecological pyramid shows energy flow through a grassland ecosystem. Following Lindeman's ten per cent law, only about one-tenth of the energy at any trophic level is transferred to the next.



If the producers (autotrophs) trap $10{,}000$ kcal of energy, the energy available to the primary consumers (X) is approximately

(A) $5{,}000$ kcal

(B) $1{,}000$ kcal

(C) 100 kcal

(D) $10{,}000$ kcal

Detailed Solutions

Q1.

Solution

Concept — Kingdom Monera: Monera comprises prokaryotes (bacteria, cyanobacteria). They lack a true nucleus and membrane-bound organelles, have a peptidoglycan (murein) cell wall, and divide by binary fission, not mitosis.

Step 1 — Match the features: No membrane-bound nucleus $\Rightarrow$ prokaryote; peptidoglycan wall and amitotic binary fission are hallmark bacterial traits. All point to Monera.

Why other options are wrong:

- (A) Protista are eukaryotes with a true nucleus.
- (C) Fungi are eukaryotes with a chitinous (not peptidoglycan) wall.
- (D) Plantae are multicellular eukaryotes with cellulose walls.

Final Answer: The organism is a prokaryote belonging to Monera $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Phylum Arthropoda: The largest animal phylum is defined by jointed appendages, a chitinous exoskeleton, a segmented body, and an open circulatory system with a haemocoel.

Step 1 — Match the features: Jointed legs + chitin exoskeleton + open circulation $\Rightarrow$ Arthropoda (e.g. insects, crustaceans).

Why other options are wrong:

- (A) Cnidaria have nematocysts and a radially symmetric, diploblastic body, no jointed legs.
- (B) Echinodermata have a water vascular system and spiny skin, not jointed appendages.
- (D) Annelida are segmented but have a closed circulatory system and no jointed legs.

Final Answer: Jointed-legged, exoskeleton-bearing invertebrate $\Rightarrow$ Arthropoda $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Placentation: The arrangement of ovules within the ovary is the placentation. When the placenta is axial and the ovules are attached to a central column in a multilocular ovary, it is axile placentation.

Step 1 — Identify: Central axis + many chambers (locules), as in *Hibiscus*, tomato, lemon $\Rightarrow$ axile placentation.

Why other options are wrong:

- (B) Parietal: ovules on the inner wall of a one-chambered ovary (becomes two-chambered by a false septum), e.g. mustard.
- (C) Marginal: ovules along the ventral suture in a single locule, e.g. pea.
- (D) Free central: ovules on a central axis but with *no* septa, e.g. *Dianthus*.

Final Answer: Multilocular ovary with central-axis ovules $\Rightarrow$ axile $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Vascular bundles: A bundle with both xylem and phloem is conjoint; with phloem on only one side (outer) it is collateral. The presence of a cambium between xylem and phloem makes it open (capable of secondary growth); its absence makes it closed.

Step 1 — Read the figure: Xylem and phloem are present together (conjoint), phloem is on the outer/peripheral side only (collateral), and a cambium strip lies between them $\Rightarrow$ open.

Step 2 — Conclude: Conjoint, collateral and open — the typical dicot-stem bundle.

Why other options are wrong:

- (A) Radial bundles have xylem and phloem on different radii (roots) and have no cambium here.
- (B) "Closed" is wrong because a cambium is clearly present.

- (C) Radial is wrong; the xylem and phloem lie on the same radius, not alternate radii.

Final Answer: Conjoint, collateral and open vascular bundle $\Rightarrow$ D

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Membrane transport: Movement of a solute *against* its concentration gradient requires energy. Carrier (pump) proteins coupled to ATP hydrolysis carry out active transport.

Step 1 — Match: "Against the gradient" + "carrier protein" + "ATP" $\Rightarrow$ active transport (e.g. the Na^+/K^+ pump).

Why other options are wrong:

- (A) Simple diffusion is passive and moves down the gradient, no protein.
- (B) Osmosis is the passive movement of water, not active solute transport.
- (D) Facilitated diffusion uses carriers but is passive (no ATP) and moves down the gradient.

Final Answer: Carrier-mediated, ATP-driven, uphill transport $\Rightarrow$ active transport $\Rightarrow$ C

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Competitive inhibition: A competitive inhibitor is structurally similar to the substrate and binds reversibly at the active site, blocking substrate entry. Its effect can be overcome by increasing substrate concentration.

Step 1 — Mechanism: Resembling the substrate, the inhibitor competes for the same active site (classic example: malonate competing with succinate for succinate dehydrogenase).

Why other options are wrong:

- (A) Binding away from the active site describes a non-competitive/allosteric inhibitor, not a competitive one.

- (C) Enzymes *lower* activation energy; inhibitors do not raise it as their mechanism of action.
- (D) Removing a cofactor is not the defining mechanism of competitive inhibition.

Final Answer: Substrate-mimic that competes for the active site $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — DNA replication in the cell cycle: DNA is synthesised (replicated) during the S phase. The DNA content therefore doubles from $2C$ (in G_1) to $4C$ (in G_2), although the chromosome *number* stays $2n$ (each chromosome now has two sister chromatids).

Step 1 — Track DNA amount: $G_1 = 2C \xrightarrow{\text{S phase, replication}} 4C$ at the end of S (and throughout G_2).

Why other options are wrong:

- (B) $2C$ is the content *before* S phase (G_1).
- (C) $1C$ is the haploid content (a gamete after meiosis II).
- (D) $8C$ would need two rounds of replication without division.

Final Answer: DNA doubles in S phase $\Rightarrow$ $4C$ at end of S $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — Kranz anatomy of C_4 plants: C_4 plants such as *Zea mays* show Kranz ("wreath") anatomy: vascular bundles are surrounded by a ring of large, thick-walled bundle-sheath cells rich in RuBisCO. Initial CO_2 fixation (to oxaloacetate) occurs in mesophyll; the Calvin cycle runs in the bundle-sheath cells.

Step 1 — Read the figure: A ring of large cells around the vascular bundle is the bundle sheath, the diagnostic feature of Kranz anatomy and the site of the Calvin cycle.

Why other options are wrong:

- (A) Spongy-mesophyll C_3 fixation does not describe the bundle-sheath ring.
- (B) Photorespiration in guard cells is unrelated to this structure.
- (C) Light reactions occur in both cell types; the ring's special role is the Calvin (dark) reactions.

Final Answer: Bundle-sheath ring rich in RuBisCO $\Rightarrow$ Kranz anatomy $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — CO_2 release in aerobic respiration: One pyruvate is decarboxylated once in the link reaction (pyruvate $\rightarrow$ acetyl-CoA, 1 CO_2) and twice in one turn of the Krebs cycle (isocitrate $\rightarrow$ α-ketoglutarate, and α-ketoglutarate $\rightarrow$ succinyl-CoA), giving 2 more CO_2.

Step 1 — Count: 1 (link reaction) $+ 2$ (Krebs cycle) $= 3$ CO_2 per pyruvate.

Why other options are wrong:

- (A) 1 counts only the link reaction.
- (B) 2 counts only the two Krebs decarboxylations.
- (D) 6 is the total for one glucose (two pyruvate molecules), not one pyruvate.

Final Answer: 3 CO_2 per pyruvate fully oxidised $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q9

Q10.

Solution

Concept — Cardiac cycle valves: During ventricular systole the ventricles contract and pressure rises; the atrioventricular (AV) valves — tricuspid on the right and bicuspid (mitral) on the left — snap shut to prevent backflow into the atria, producing the first heart sound ("lub").

Step 1 — Apply to systole: Ventricles contract $\Rightarrow$ AV valves close (blood is pushed out through the now-open semilunar valves into the aorta and pulmonary artery).

Why other options are wrong:

- (A) The semilunar valves *open* (not close) during ventricular systole to let blood out.

- (C) Both AV valves close, not just the bicuspid.
- (D) Venous valves of the vena cava are not part of the cardiac-cycle backflow control here.

Final Answer: Tricuspid and bicuspid (AV) valves close during systole $\Rightarrow$ B

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Sliding filament theory: Muscle shortening occurs because the thin (actin) filaments slide *over* the stationary thick (myosin) filaments toward the centre of the sarcomere. The filaments themselves do not shorten.

Step 1 — Track the bands: As thin filaments slide in, the H zone and the I band shorten and the Z-lines move closer, but the A band (length of the thick filament) remains constant.

Why other options are wrong:

- (A) Filaments slide, they do not change length.
- (B) Neither filament shortens.
- (C) The A band does *not* shorten; only the H zone and I band do.

Final Answer: Thin filaments slide over thick; H zone and I band shorten, A band constant $\Rightarrow$ D

Answer: (D) Go Back to Q11

Q12.

Solution

Concept — Double fertilization: In angiosperms, one male gamete (n) fuses with the egg (n) to form the diploid zygote (syngamy). The second male gamete (n) fuses with the two polar nuclei (n + n) in triple fusion, forming the triploid (3n) primary endosperm nucleus, which develops into nutritive endosperm.

Step 1 — Identify the product of triple fusion: $n + n + n = 3n \Rightarrow$ triploid endosperm.

Why other options are wrong:

- (B) The diploid zygote is the product of syngamy (egg + first male gamete),

not triple fusion.
- (C) The suspensor arises from the developing embryo, not from triple fusion.
- (D) The seed coat develops from the integuments of the ovule, not from fusion of gametes.

Final Answer: Triple fusion forms the $3n$ endosperm $\Rightarrow$ A

Answer: (A) Go Back to Q12

Q13.

Solution

Concept — Placenta: After implantation, finger-like chorionic villi of the embryo interdigitate with the uterine endometrium to form the placenta, the structural and functional connection through which nutrients, O_2 and wastes are exchanged between mother and foetus.

Step 1 — Identify: "Connection between embryo and uterine wall mediating exchange" $\Rightarrow$ placenta.

Why other options are wrong:

- (A) The corpus luteum is an ovarian structure that secretes progesterone; it is not the embryo–uterus connection.
- (B) The zona pellucida is a glycoprotein coat around the ovum, shed before implantation.
- (D) The Graafian follicle is the mature ovarian follicle that releases the ovum.

Final Answer: Embryo–uterus exchange structure $\Rightarrow$ placenta $\Rightarrow$ C

Answer: (C) Go Back to Q13

Q14.

Solution

Concept — Codominance: When both alleles of a heterozygote are fully and independently expressed in the phenotype (neither masks the other and no blending occurs), the relationship is codominance.

Step 1 — Apply to ABO: An $I^A I^B$ person makes *both* A and B surface antigens, giving group AB — both alleles expressed together $\Rightarrow$ codominance.

Why other options are wrong:

- (A) Incomplete dominance gives an intermediate (blended) phenotype, e.g. pink *Mirabilis* flowers — not the case here.
- (C) I^A does not dominate I^B; both are expressed.
- (D) Pleiotropy is one gene affecting many traits, unrelated to this allelic relationship.

Final Answer: Both alleles expressed in $I^A I^B \Rightarrow$ codominance $\Rightarrow$ B

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — RNA processing in eukaryotes: The hnRNA (primary transcript) made by RNA polymerase II undergoes 5' capping, 3' polyadenylation, and splicing. Splicing is the removal of introns and the joining of exons to give the mature mRNA.

Step 1 — Match the description: "Introns removed, exons joined" $\Rightarrow$ splicing (carried out by the spliceosome).

Why other options are wrong:

- (A) Capping adds a methyl-guanosine cap at the 5' end; it does not remove introns.
- (B) Polyadenylation adds a poly-A tail at the 3' end.
- (C) Reverse transcription (RNA $\rightarrow$ DNA) is not a step in normal eukaryotic mRNA processing.

Final Answer: Intron removal and exon joining $\Rightarrow$ splicing $\Rightarrow$ D

Answer: (D) Go Back to Q15

Q16.

Solution

Concept — Homologous organs and divergent evolution: Organs with the same fundamental structure and common ancestral origin but different functions are homologous; they arise by divergent evolution (adaptive radiation from a common plan).

Step 1 — Apply: Whale flipper, bat wing and human arm share the same bone plan (humerus, radius, ulna, carpals...) inherited from a common ancestor but

do different jobs ⇒ homologous, divergent evolution.

Why other options are wrong:

- (B) Analogous organs (e.g. insect wing vs bird wing) have different structure but similar function (convergent evolution) — opposite of the case here.
- (C) These limbs are functional, not vestigial.
- (D) Homology illustrates divergent, not convergent, evolution.

Final Answer: Same plan, different function, common ancestor ⇒ homologous / divergent ⇒ A

Answer: (A) Go Back to Q16

Q17.

Solution

Concept — HIV replication: HIV is a retrovirus carrying a single-stranded RNA genome and the enzyme reverse transcriptase. On entering a helper T-cell, reverse transcriptase first makes a complementary DNA copy from the viral RNA; this DNA then integrates into the host genome (as provirus).

Step 1 — First unique event: RNA → DNA by reverse transcriptase, the step that distinguishes retroviruses.

Why other options are wrong:

- (A) Direct translation of the RNA into capsid proteins is not the *first* unique step; the genome is first reverse-transcribed.
- (B) Host DNA polymerase does not replicate the incoming viral genome as the initial event.
- (D) Budding of virions is a late step, occurring after replication and assembly.

Final Answer: Reverse transcription of viral RNA into DNA ⇒ C

Answer: (C) Go Back to Q17

Q18.

Solution

Concept — Secondary treatment of sewage: In the biological (secondary) stage, aerobic microbes form flocs (activated sludge) and oxidise the dissolved organic matter. Because the organic load is consumed, the biochemical oxygen demand (BOD) of the effluent drops sharply — a falling BOD is the indicator of successful treatment.

Step 1 — Effect on BOD: Microbes eat organic matter $\Rightarrow$ less organic load $\Rightarrow$ large *decrease* in BOD.

Why other options are wrong:

- (A) BOD decreases, it does not increase, during effective secondary treatment.
- (B) Removal of large suspended solids occurs in *primary* (physical) treatment, not the biological stage described.
- (C) Primary sludge is formed in primary settling, not by this aerobic floc activity.

Final Answer: Aerobic microbial action sharply lowers the BOD $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept — Agarose gel electrophoresis: DNA is negatively charged (phosphate backbone), so in an electric field it migrates towards the positive electrode (anode). Smaller fragments move through the gel pores more easily and therefore travel farther from the wells than larger fragments.

Step 1 — Apply to the figure: The bands farthest from the wells (nearest the anode, $+$) contain the smallest fragments.

Why other options are wrong:

- (B) Bands near the wells (cathode side) hold the *largest* fragments, which move slowest.
- (C) DNA does move; only fragments too large or undigested stay in the well.
- (D) DNA is negatively charged and moves towards the positive electrode, not the negative one.

Final Answer: Smallest fragments migrate farthest (towards the anode) $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept — Ten per cent law (Lindeman): Only about 10% of the energy at one trophic level is passed on to the next; the rest is lost as heat (respiration) and in unassimilated matter.

Step 1 — Apply: Producers trap $10{,}000$ kcal; primary consumers receive about 10% of this.

$$X = 0.10 \times 10{,}000 = 1{,}000 \text{ kcal}.$$

Why other options are wrong:

- (A) $5{,}000$ kcal assumes 50% transfer, far above the 10% law.
- (C) 100 kcal is the energy at the *secondary* consumers (10% of $1{,}000$), one level too high.
- (D) $10{,}000$ kcal assumes no loss between levels.

Final Answer: 10% of $10{,}000$ kcal $= 1{,}000$ kcal to primary consumers $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q20

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	A	4	D	5	C
6	B	7	A	8	D	9	C	10	B
11	D	12	A	13	C	14	B	15	D
16	A	17	C	18	D	19	A	20	B