Biology
Higher level
Paper 1

IB Biology HL prediction paper 1

1 hour

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
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- The maximum mark for this examination paper is **[40 marks]**.

21 pages

1. Members of which domain have cell membranes composed of ether-linked lipids and lack peptidoglycan in their cell walls?

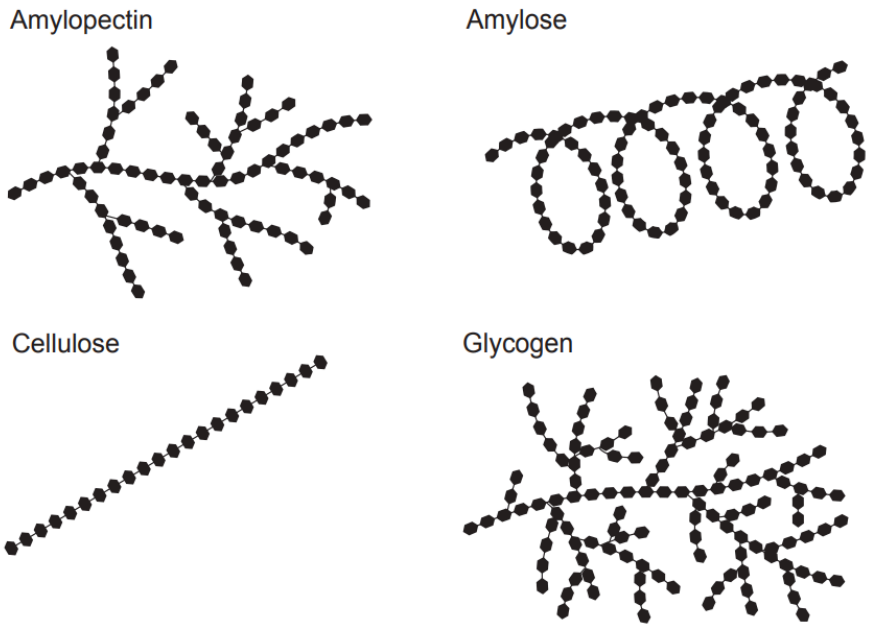
A. Bacteria.

B. Archaea.

C. Eukarya.

D. Viruses.

2. The diagram compares schematic representations of four polysaccharides found in plants and animals.



Which polysaccharide illustrated is optimised for the rapid mobilisation of glucose during intense activity in vertebrate muscle?

A. Amylopectin.

B. Amylose.

C. Cellulose.

D. Glycogen.

3. In pea plants, purple flower colour (P) is dominant to white (p) and tall stem (T) is dominant to dwarf (t). What phenotypic ratio is expected from a test cross between a purple-flowered, tall plant heterozygous for both genes (PpTt) and a white-flowered dwarf plant (pptt)?

A. 9 : 3 : 3 : 1

B. 1 : 1 : 1 : 1

C. 3 : 1

D. 100 % purple tall

4. Which evidence supports the endosymbiotic origin of mitochondria?

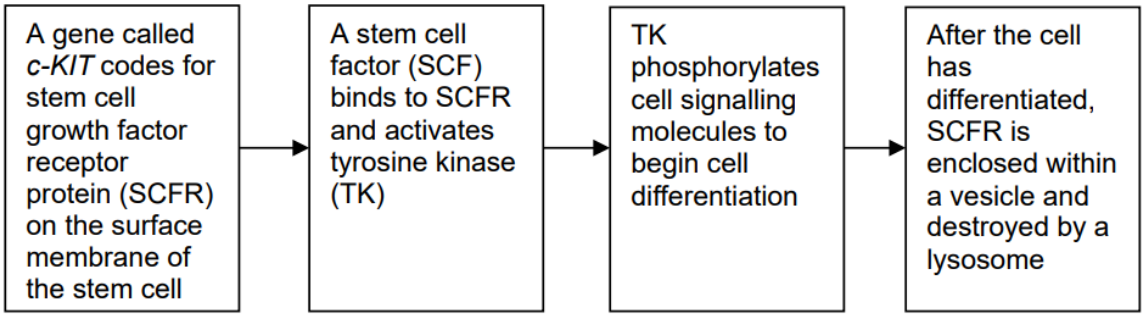
A. Mitochondria possess circular DNA similar to bacterial genomes

B. Mitochondria have many membrane-bound organelles

C. Mitochondria divide only when the host cell divides

D. Mitochondria synthesise cellulose for their cell walls

5. The diagram summarises a signalling pathway that triggers differentiation in bone-marrow stem cells.



Based on the information, SCFR (stem-cell growth factor receptor) is most likely which type of membrane protein?

A. G-protein-coupled receptor (GPCR).

B. Receptor tyrosine kinase (RTK).

C. Ligand-gated ion channel.

D. Intracellular steroid receptor.

6. A temperature-sensitive mutation in *E. coli* produces a DNA polymerase I that loses activity at 42 °C. Which replication process will be directly impaired when the bacteria are shifted to this temperature?

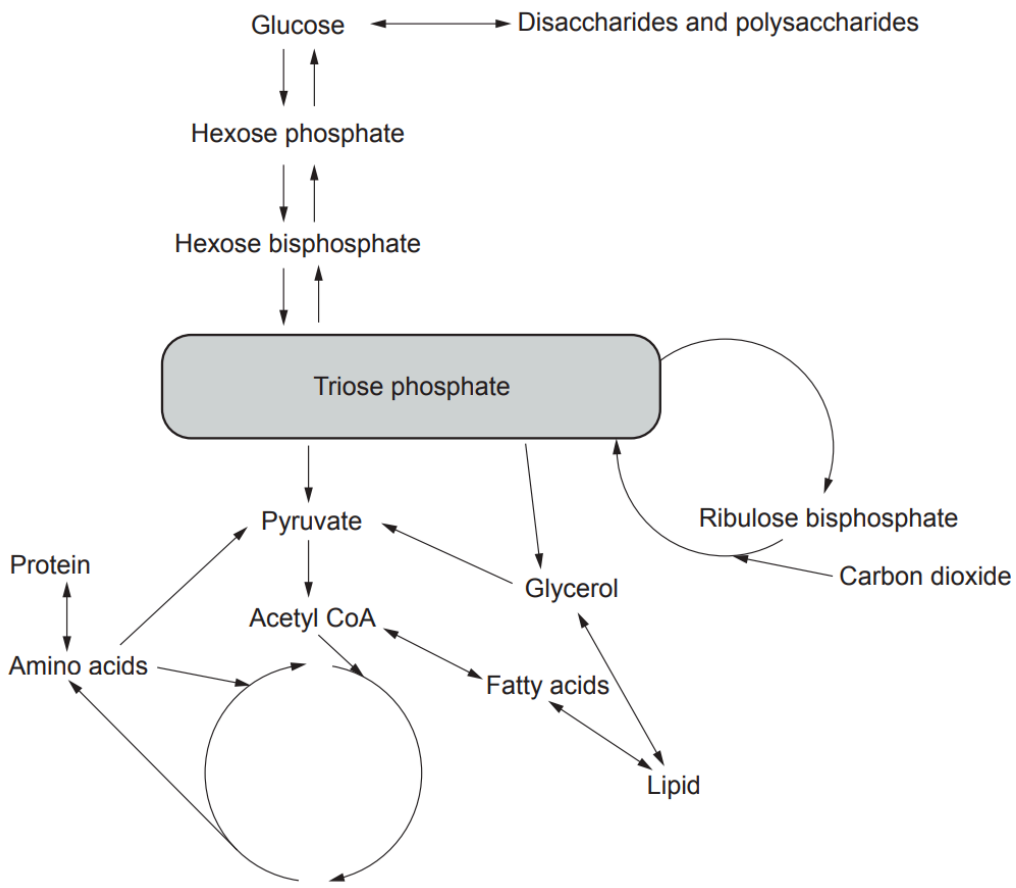
A. Replacement of RNA primers with DNA on the lagging strand.

B. Continuous synthesis of the leading strand.

C. Unwinding of the double helix ahead of the fork.

D. Joining of adjacent Okazaki fragments by phosphodiester bonds.

7. The diagram illustrates the inter-conversions of triose phosphate with other metabolites in a leaf cell.



Which statements about the metabolic pathways shown are correct?

1. Glycolysis is a linear pathway converting hexose phosphate to pyruvate.
2. The Krebs (citric acid) cycle is a cyclic pathway that begins with acetyl-CoA.
3. The Calvin-Benson cycle is a linear pathway converting ribulose bisphosphate to triose phosphate.

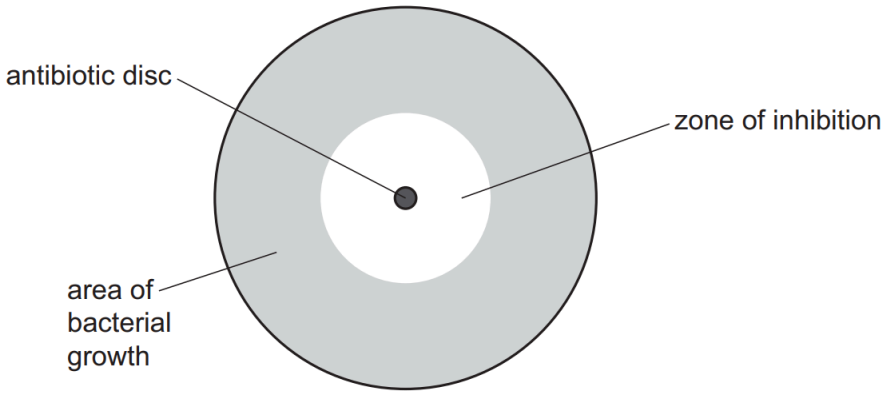
A. 1 only.

B. 1 and 2 only.

C. 2 and 3 only.

D. 1, 2 and 3.

8. The figure shows a Petri dish after incubation with an antibiotic disc.



Which measurement provides the most reliable quantitative indicator of antibiotic effectiveness in this assay?

A. Radius (or diameter) of the clear zone of inhibition in millimetres.

B. Thickness of the agar layer.

C. Mass of the antibiotic disc before incubation.

D. Number of bacterial colonies inside the clear zone.

9. What structural feature of xylem vessels enables the maintenance of a continuous column of water under tension?

A. Thick lignified secondary walls.

B. Presence of sieve plates.

C. High density of plasmodesmata.

D. End walls containing cellulose fibres.

10. Which equation correctly defines net primary productivity (NPP) for an ecosystem?

A. NPP = Gross primary productivity (GPP) − Respiration (R)

B. NPP = Respiration (R) − Gross primary productivity (GPP)

C. NPP = Gross primary productivity (GPP) + Respiration (R)

D. NPP = (Gross primary productivity × Respiration) / area

11. After implantation, which hormone secreted by the developing embryo maintains the corpus luteum during the first trimester of pregnancy?

A. Human chorionic gonadotrophin (hCG).

B. Follicle-stimulating hormone (FSH).

C. Estradiol.

D. Progesterone.

12. Which conservation strategy aims to preserve species within their natural habitats and maintain normal ecological processes?

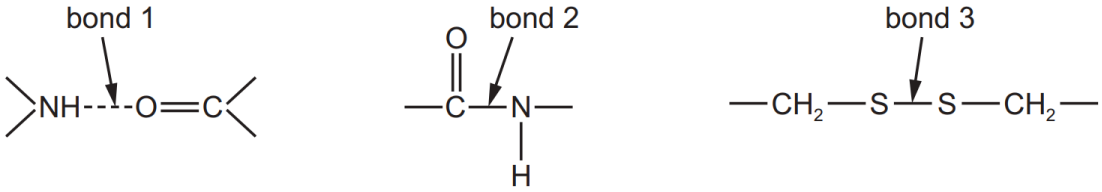
A. Seed banking.

B. Ex situ conservation.

C. Captive breeding programmes.

D. In situ conservation.

13. The diagrams indicate three types of bonds (labelled 1–3) that can form between parts ofa polypeptide chain.



Which bonds stabilise the **tertiary** structure of a protein but are **not** responsible for linking amino acids in its primary structure?

A. Bond 1 only

B. Bonds 1 and 3

C. Bonds 2 and 3

D. Bonds 1, 2 and 3

14. In chloroplasts, where do the light-dependent reactions of photosynthesis occur?

A. Stroma.

B. Thylakoid lumen.

C. Thylakoid membrane.

D. Outer chloroplast membrane.

15. When a bacterial population is repeatedly exposed to an antibiotic, resistant individuals become more common. Which statement best explains this change in the population?

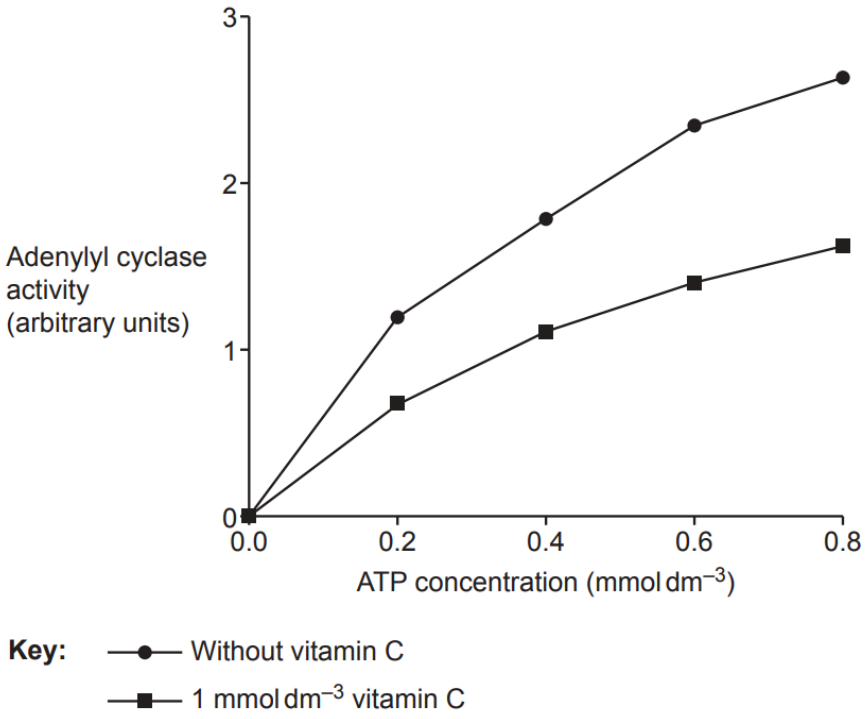
A. Antibiotic exposure induces mutations that create resistance in all bacteria.

B. Resistant bacteria survive and reproduce, passing the resistance allele to offspring.

C. Susceptible bacteria actively learn to degrade the antibiotic over time.

D. All bacteria acquire plasmids carrying resistance genes at equal frequency.

16. The graph shows adenylyl-cyclase activity against ATP concentration with and without vitamin C.



Which conclusion about vitamin C is supported by the data?

A. It is a competitive inhibitor of adenylyl cyclase.

B. It is a non-competitive inhibitor of adenylyl cyclase.

C. It acts as an allosteric activator of adenylyl cyclase.

D. It serves as a substrate for adenylyl cyclase.

17. During skeletal muscle contraction, what event directly exposes the myosin-binding sites on actin filaments?

A. Calcium ions bind to troponin, causing tropomyosin to move.

B. Hydrolysis of ATP by the myosin head pivots the cross-bridge.

C. Release of ADP from the myosin head ends the power stroke.

D. Phosphorylation of tropomyosin alters its conformation.

18. A colour-blind man (X^cY) and a woman who is a carrier for colour blindness (X^cX^N) have children. What proportion of their sons are expected to be colour blind?

A. 0%

B. 25%

C. 50%

D. 100%

19. Which expression represents the relationship between solute potential (Ψs), pressure potential (Ψp) and total water potential (Ψw) in plant cells?

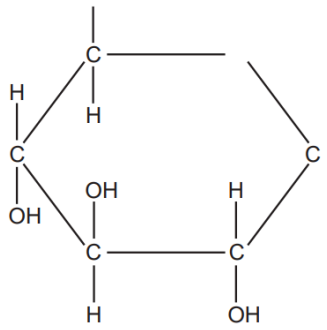
A. $\Psi w = \Psi s + \Psi p$

B. $\Psi w = \Psi s - \Psi p$

C. $\Psi w = \Psi p - \Psi s$

D. $\Psi w = \Psi s \times \Psi p$

20. The diagram shows an incomplete ring-structure of α-glucose in which some side-groups have been omitted.



Which chemical group must be attached to the carbon atom that projects **above** the ring (carbon 6) to complete the structure of α-glucose?

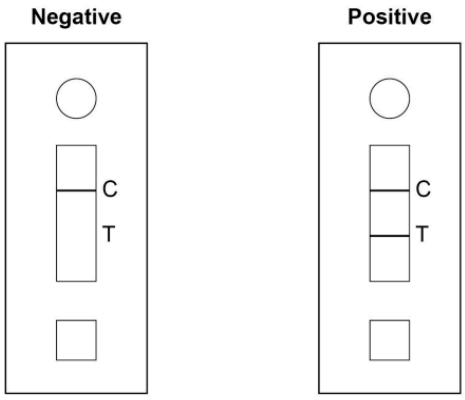
A. –H

B. $–CH_3$

C. $–CH_2OH$

D. –COOH

21. The figure shows a lateral-flow ELISA that detects antibodies to dengue virus. A positive result is illustrated on the right.



The coloured line at the test (T) region appears because the patient's blood contains which molecules, produced by memory B cells?

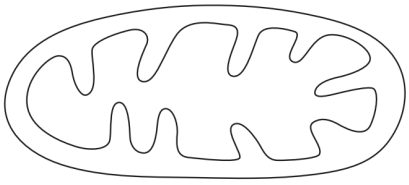
A. –H

B. $–CH_3$

C. $–CH_2OH$

D. –COOH

22. The figure outlines a mitochondrion. During aerobic respiration FAD is reduced to $FADH_2$ before being oxidised again.



In which parts of the organelle do these two events occur respectively?

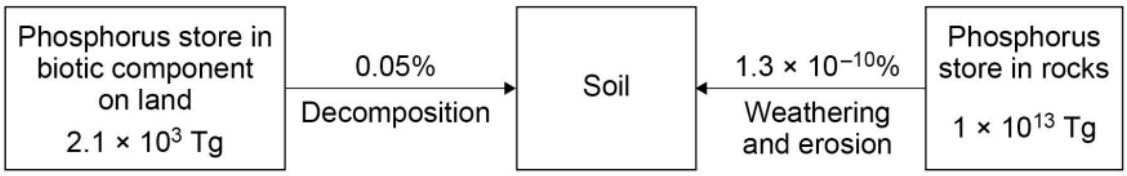
A. Matrix → inner mitochondrial membrane.

B. Matrix → inter-membrane space.

C. Inner mitochondrial membrane → matrix.

D. Inter-membrane space → matrix.

23. The diagram shows the masses of two phosphorus stores and the percentage flux from the biotic store to soil.



One teragram (Tg) is 1×10^{12} grams.

The supply of phosphorus to the soil is shown as a percentage of the total phosphorus mass of each store.

How many times larger is the phosphorus store in rocks than the store in the biotic component on land?

A. 5×10^{6}

B. 5×10^{7}

C. 5×10^{8}

D. 5×10^{9}

24. In eukaryotic cells, which maturation process of pre-mRNA occurs in the nucleus before the transcript is exported for translation?

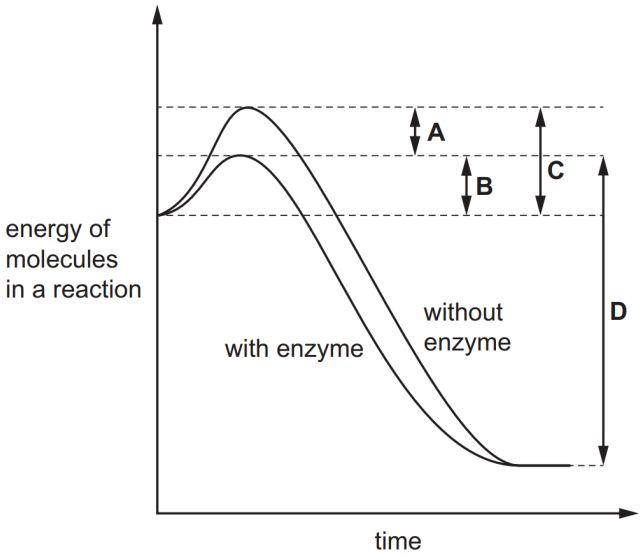
A. Attachment of methionine to tRNA.

B. Removal of introns and joining of exons (splicing).

C. Charging of aminoacyl-tRNA synthetases.

D. Association of mRNA with ribosomal subunits.

25. The graph shows the change in free energy during a reaction carried out with (lower curve) and without (upper curve) an enzyme. Arrows A–D mark particular energy differences.



Which arrow represents the decrease in activation energy produced by the enzyme?

A. A.

B. B.

C. C.

D. D.

26. Which sequence of events occurs in the human body after a carbohydrate-rich meal to restore blood glucose concentration to its set point?

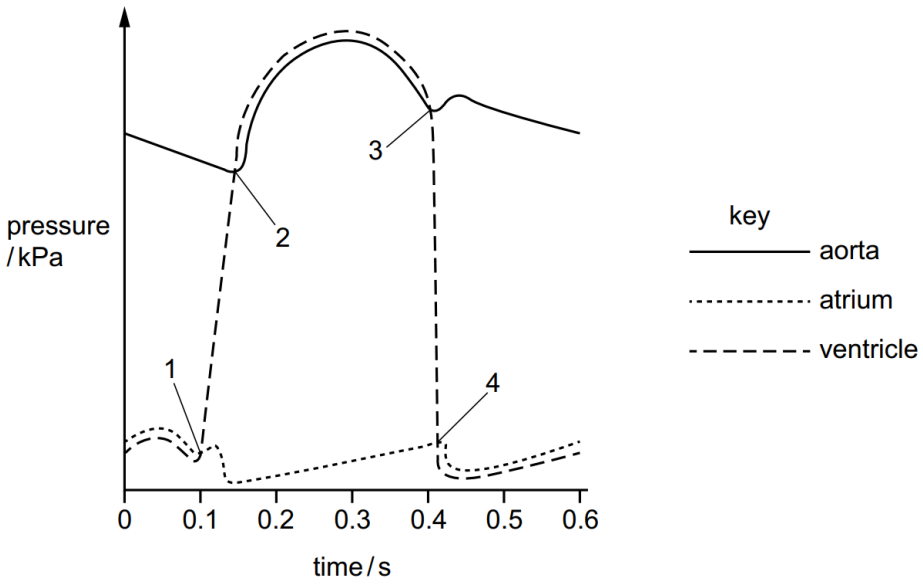
A. Pancreas releases insulin → skeletal muscle breaks down glycogen → blood glucose rises further

B. α-cells release glucagon → liver converts glycogen to glucose → adipose tissue stores excess glucose

C. β-cells release insulin → cells increase glucose uptake → liver converts glucose to glycogen.

D. Adrenal medulla releases adrenaline → glucose converted to fatty acids → blood glucose falls

27. The graph traces pressure changes in the left atrium, left ventricle and aorta during one cardiac cycle.



At ≈ 0.12 s ventricular pressure rises steeply above atrial pressure but is still below aortic pressure. What is the state of the heart valves at this instant?

A. Atrioventricular valve closed; semilunar valve closed.

B. Atrioventricular valve open; semilunar valve open.

C. Atrioventricular valve open; semilunar valve closed.

D. Atrioventricular valve closed; semilunar valve open.

28. Which components form the repeating backbone of a DNA polynucleotide strand?

A. Alternating deoxyribose and phosphate groups.

B. Alternating ribose and phosphate groups.

C. Nitrogenous bases joined by hydrogen bonds.

D. Adenine and thymine joined by peptide bonds.

29. Which greenhouse gas contributes most to anthropogenic global warming because of its high atmospheric concentration and long residence time?

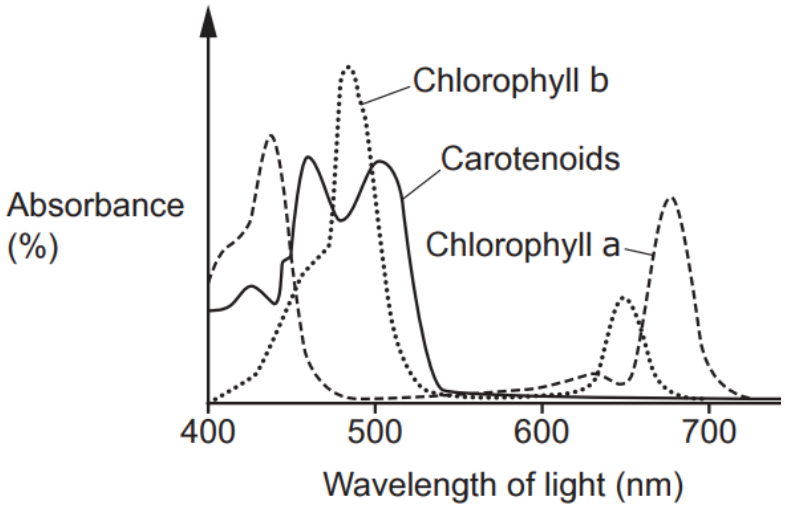
A. Carbon dioxide (CO_2)

B. Methane (CH_4)

C. Nitrous oxide (N_2O)

D. Ozone (O_3)

30. The graph shows the absorbance spectra of chlorophyll a, chlorophyll b and carotenoids across the visible-light range.



A leaf is illuminated only with monochromatic light of wavelength 520 nm. What effect will this have on the light-independent reactions, and why?

A. They continue at the same rate because the Calvin cycle functions independently of light absorption..

B. They slow markedly because insufficient pigment absorption at 520 nm limits ATP and NADPH production in the light-dependent reactions.

C. They increase because carotenoids absorb strongly at 520 nm, enhancing electron transport and ATP synthesis.

D. They stop because low CO_2 concentrations at 520 nm prevent photosystem II from functioning.

31. Which row correctly compares the outcomes of meiosis in human spermatogenesis and oogenesis?

	Spermatogenesis	Oogenesis
A.	Four functional gametes per primary cell	One functional gamete per primary cell
B.	Begins before birth; pauses at prophase I	Continues without arrest after puberty
C.	Unequal cytokinesis produces polar bodies	Equal cytokinesis produces identical gametes
D.	Arrests at prophase I until fertilisation	No meiotic arrest occurs

32. An anticancer drug specifically inhibits telomerase activity. Replication of which human cell type would be most immediately affected?

A. Intestinal bacteria.

B. Differentiated skin fibroblasts.

C. Enucleated red blood cells.

D. Germ-line stem cells in the testes or ovaries.

33. Finish the following statement: The realised niche of a species differs from its fundamental niche because the realised niche…

A. Intestinal bacteria.

B. Differentiated skin fibroblasts.

C. Enucleated red blood cells.

D. Germ-line stem cells in the testes or ovaries.

34. A mother with genotype $I^A i$ for the ABO blood group and a father with genotype $I^B i$ could produce children with which possible blood groups?

A. A and B only.

B. AB only.

C. A, B and AB only.

D. A, B, AB and O.

35. In a population of Arctic foxes, individuals with intermediate fur length have higher fitness than those with very short or very long fur. Which type of natural selection is acting, and how is genetic variation expected to change?

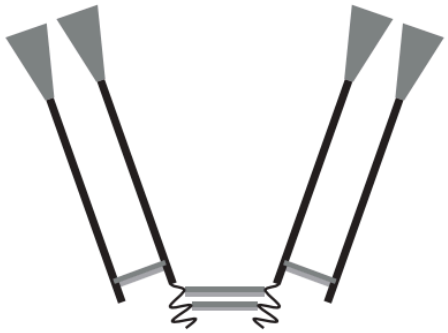
A. Directional selection; variation increases.

B. Stabilising selection; variation decreases.

C. Disruptive selection; variation decreases.

D. Balancing selection; variation is eliminated.

36. The figure shows the structure of a single Fab fragment obtained after enzymatic digestion of an IgG antibody.



Which statement about the fragment's quaternary structure is correct?

A. Each Fab fragment consists of a single continuous polypeptide chain.

B. Each Fab fragment is composed of one heavy and one light chain linked by disulfide bonds.

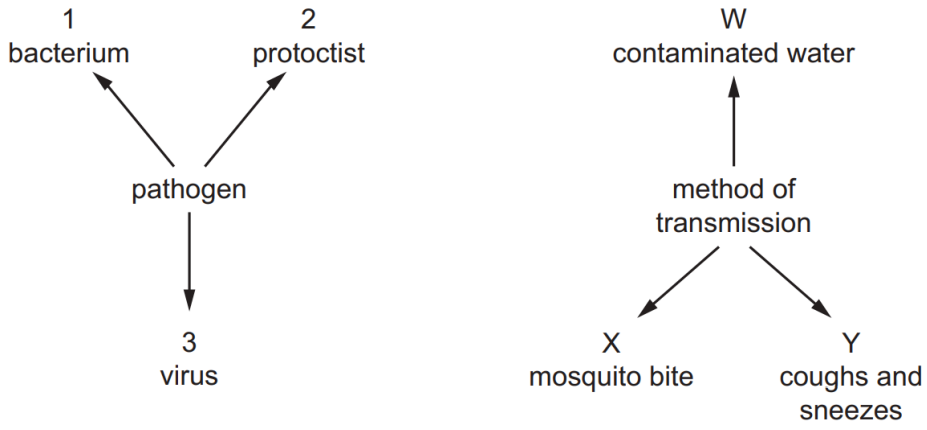
C. The antigen-binding site is located in the constant region of both chains.

D. The Fab fragment retains the Fc region required for complement activation.

37. During prolonged exposure to cold, which physiological responses occur in the skin arterioles and skeletal muscles?

	Skin arterioles	**Skeletal muscles**
A.	Vasoconstriction	Shivering
B.	Vasoconstriction	Sweating
C.	Vasodilation	Shivering
D.	Vasodilation	Sweating

38. The figure categorises three pathogen types (bacterium, protist, virus) and some transmission methods.



Which statement correctly distinguishes viruses from the other pathogens shown?

A. Viruses lack metabolic enzymes and must use a host's machinery for replication.

B. Viruses are unicellular organisms with circular DNA and 70S ribosomes..

C. Viruses possess a peptidoglycan cell wall that protects their nucleic acid.

D. Viruses reproduce by binary fission in the cytoplasm of host cells.

39. In modern cladistics, which type of evidence is most commonly used to establish evolutionary relationships among vertebrate species?

A. Similar ecological niches.

B. Morphological analogies.

C. Comparative DNA or amino-acid sequences.

D. Shared behavioural traits.

40. Which feature is present in mature eukaryotic mRNA but absent in prokaryotic mRNA?

A. 70S ribosomes.

B. 5′ methyl-guanosine cap.

C. Shine-Dalgarno sequence.

D. Poly-cistronic coding regions.

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