Diploma Programme
Programme du diplôme
Programa del Diploma

# Biology
# Higher level
# Paper 1A

28 October 2025

**Zone A** afternoon | **Zone B** afternoon | **Zone C** afternoon

2 hours [Paper 1A and Paper 1B]

## Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Answer all questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- A calculator is required for this paper.
- The maximum mark for paper 1A is **[40 marks]**.
- The maximum mark for paper 1A and paper 1B is **[75 marks]**.

20 pages

8825 – 6019
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**1.** Which of the following describes the molecular structure of DNA?

I. Complementary base pairing occurs within the molecule

II. Contains deoxyribose

III. Contains thymine

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

**2.** It has been hypothesized that asteroids were the primary source of Earth's water. What has caused the retention of water on Earth?

A. The gases of the early atmosphere absorbed water vapour.

B. High atmospheric pressure prevented water vapour from escaping.

C. Temperatures on Earth allowed condensation of water.

D. Water was trapped in the pores of newly formed rocks.

**3.** The table shows some essential and non-essential amino acids.

| **Essential amino acids** | **Non-essential amino acids** |
|---|---|
| valine | alanine |
| lysine | glycine |

What is a valid conclusion for an amino acid in the table?

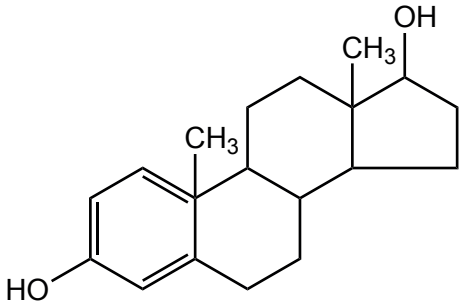
A. Lysine is synthesized by the human body.

B. Alanine can only be obtained from food.

C. Glycine is not used in the human body.

D. Valine must be supplied in the diet.

**4.** Oestradiol is a steroid hormone.




How does oestradiol cross plasma membranes?

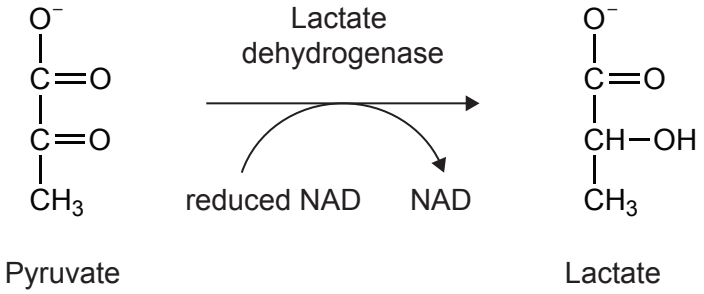
A. It can move between phospholipids because it is non-polar.

B. It can pass either between phospholipids or through channel proteins because it is amphipathic.

C. It can only pass through hydrophilic pores as its polar ends can form H bonds.

D. It must pass through channel proteins due to its large size.

**5.** The diagram shows the chemical reaction that occurs during the last step of anaerobic respiration in human skeletal muscle cells.




What is the purpose of this reaction?

A. To allow the release of energy from glucose breakdown to continue

B. To establish a concentration gradient of hydrogen ions for adenosine triphosphate (ATP) synthesis

C. To provide electrons for the electron transport chain

D. To reduce carbon compounds in the absence of oxygen

**6.** A solution of laundry detergent containing enzymes was used to soak some blood-stained clothes in order to remove the stains. Each item of stained clothing was soaked in a solution of a different temperature. After one hour, the stains remaining on the clothes were measured on a colour intensity scale.

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

lightest colour (lowest intensity) → darkest colour (highest intensity)

| Temperature / °C | Colour intensity of stain |
|---|---|
| 10 | 4 |
| 20 | 3 |
| 30 | 2 |
| 40 | 1 |
| 50 | 5 |

What is a valid explanation for these results?

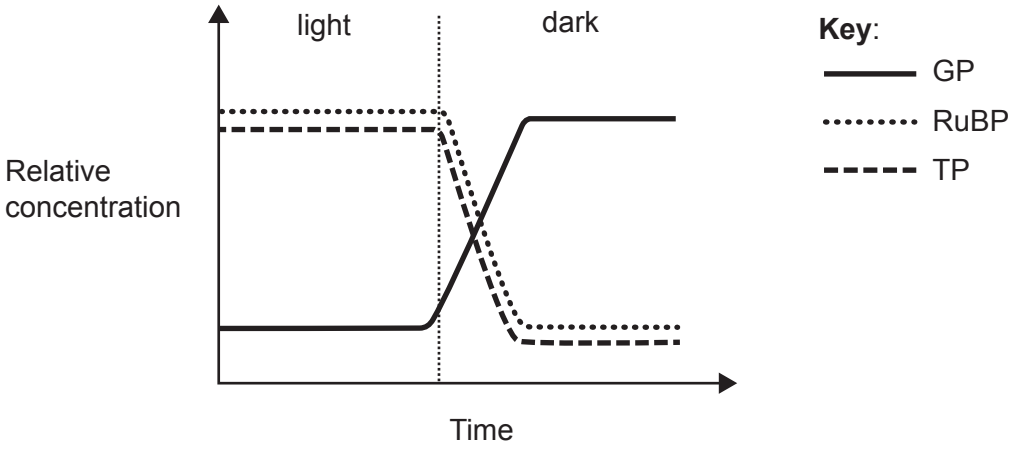
A. At 10 °C the enzymes denature.

B. At 20 °C the shape of some enzyme active sites change.

C. At 30 °C the enzyme and substrate molecules have the greatest kinetic energy.

D. At 50 °C the chance of successful binding between enzyme and substrate is low.

**7.** A photosynthesis experiment was set up in both light and dark conditions to determine the variations in relative concentrations of glycerate-3-phosphate (GP), triose phosphate (TP) and ribulose bisphosphate (RuBP).




What explains the results obtained in the dark conditions?

A. TP and RuBP from the light-dependent reaction are used to synthesize GP.

B. Less ATP and reduced NADP (NADPH) are available to convert GP to TP.

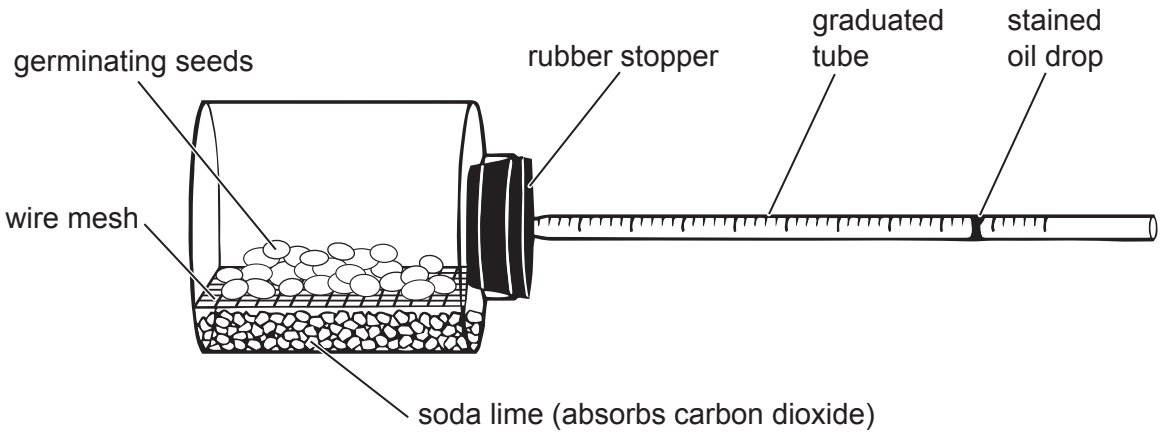
C. There is a low carbon dioxide supply for carbon fixation.

D. The enzyme Rubisco is only active in the presence of light.

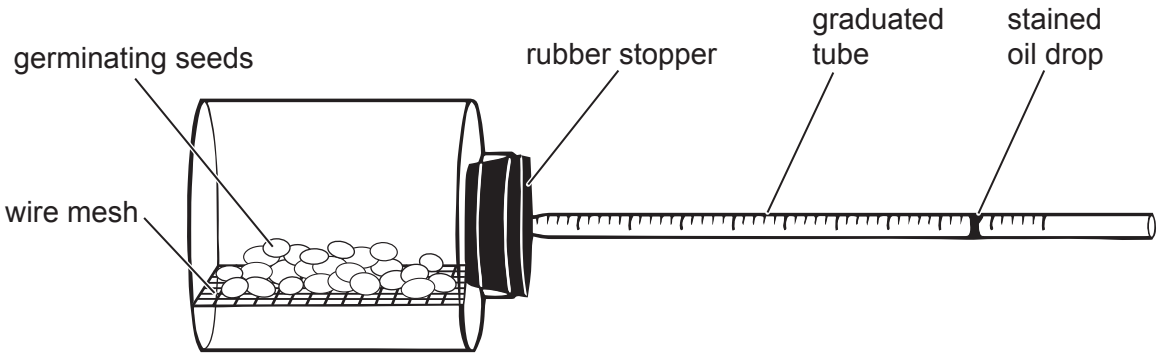
**8.** Students prepared respirometers in order to investigate respiration rates in seeds.

**diagram not to scale**

**Respirometer 1**




**Respirometer 2**




How would the results differ in the respirometers after 30 minutes?

| | Respirometer 1 | Respirometer 2 |
|---|---|---|
| A. | Oil drop does not move | Oil drop moves left |
| B. | Oil drop does not move | Oil drop moves right |
| C. | Oil drop moves left | Oil drop moves right |
| D. | Oil drop moves left | Oil drop does not move |

**9.** Which of the following is a consequence of the degeneracy of the genetic code?

A. Codons affected by mutagens always code for non-functional proteins.

B. There are variations in the amino acid sequences for the same protein.

C. Some base mutations cause no changes in protein structure.

D. A codon may code for more than one amino acid in response to environmental changes.

**10.** DNA fragments can be amplified by the polymerase chain reaction (PCR) to obtain many identical copies that can be used in forensic investigations.

What is a function of primers in PCR?

A. To form hydrogen bonds between complementary bases

B. To proofread the newly synthesized DNA copies

C. To keep double-stranded DNA fragments separated

D. To identify the regions of DNA that need to be replicated

**11.** Knockout organisms are used as models in research. The p53 knockout mouse is named after p53, a gene which codes for a protein that normally suppresses the growth of cancerous tumours.

How could scientists use p53 knockout mice in cancer research?

A. To extract tumour suppressor protein from p53 knockout mice for cancer treatments

B. To obtain functional copies of the p53 gene to use in gene replacement therapy

C. To investigate the effect of new anti-cancer drugs on mouse tumours

D. To study the effect of mutations on the expression of the p53 gene

**12.** What is a reason that both phloem sieve tube elements and human red blood cells are considered atypical?

A. They have no cytoplasm

B. Their DNA is free in the cytoplasm

C. They do not have a nucleus

D. All membrane-bound organelles are missing

**13.** Which feature is common to all viruses?

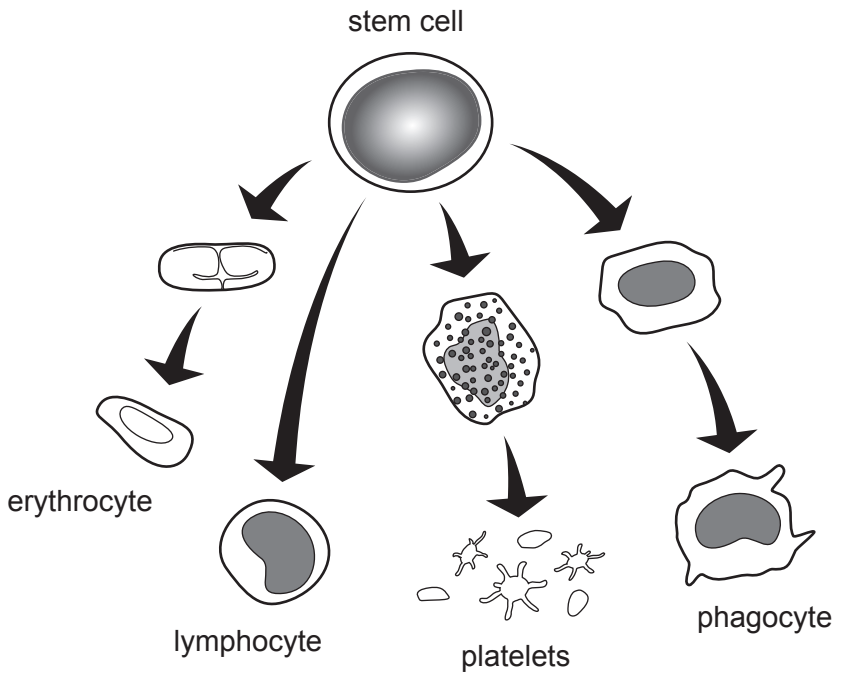
A. Has a capsid

B. Contains RNA

C. Contains cytoplasm

D. Enveloped in host cell membrane

**14.** Stem cells can differentiate to produce a variety of cell types in the adult human body.




Which description corresponds to the stem cell in the diagram?

| | Type | Location |
|---|---|---|
| A. | totipotent | bone marrow |
| B. | multipotent | bone marrow |
| C. | totipotent | blood |
| D. | multipotent | blood |

**15.** Which changes would take place in the plasma membrane composition to maintain fluidity at very low temperatures?

| | Unsaturated fatty acids | Saturated fatty acids | Proteins |
|---|---|---|---|
| A. | increase | increase | decrease |
| B. | no change | increase | decrease |
| C. | increase | decrease | no change |
| D. | decrease | no change | increase |

**16.** What is a benefit of double membranes surrounding the nuclei of eukaryotic cells?

A. They reduce the surface area of the nucleus.

B. They can easily break down into vesicles during mitosis.

C. Hydrophilic phospholipid tails can be kept away from the cytoplasm.

D. Pores are formed to allow movement of DNA from the nucleus to the cytoplasm.

**17.** Mutualistic bacterium *Vibrio fischeri* lives in the light organ of some squid species. As a result of quorum sensing, bioluminescence is produced, which camouflages squid from predators.

How does quorum sensing trigger bioluminescence?

A. At high population density, bacteria secrete ligands that bind to receptors in the squid's light organ.

B. Above a critical *V. fischeri* density, signalling molecules activate bacterial genes involved in bioluminescence.

C. A high concentration of bacterial signalling molecules causes the expression of bioluminescence genes in the squid DNA.

D. When at risk, the squid's light organ sends signals to stimulate production of bioluminescence in bacteria.

**18.** The conduction velocity of electrical impulses was measured in different myelinated nerve fibres.

| Type of nerve fibre | Conduction velocity / m $s^{-1}$ |
|---|---|
| P | 3–10 |
| Q | 30–70 |
| R | 80–110 |

Which hypothesis would explain the higher conduction velocity of nerve fibre R, compared to nerve fibres P and Q?

A. It is the longest.

B. It has the thinnest myelin sheath.

C. It has the largest diameter.

D. It has the greatest number of mitochondria.

**19.** In which order do the following steps occur in a cell that divides by meiosis?

1 Separation of homologous chromosomes

2 DNA replication

3 Crossing over

4 Pairing of homologous chromosomes

A. $2 \rightarrow 4 \rightarrow 3 \rightarrow 1$

B. $2 \rightarrow 3 \rightarrow 4 \rightarrow 1$

C. $4 \rightarrow 3 \rightarrow 2 \rightarrow 1$

D. $4 \rightarrow 2 \rightarrow 3 \rightarrow 1$

**20.** What is a consequence of nucleases binding to mRNA?

A. Transcription stops.

B. mRNA binds to ribosomes.

C. More mRNA is synthesized.

D. mRNA cannot be translated again.

**21.** Domain is a taxonomic level above kingdom that has been used to classify living organisms into three groups.

What has provided the evidence for classification of organisms into domains?

A. Ribosomal RNA (rRNA) base sequences

B. Mitochondrial DNA base sequences

C. Cell wall structure

D. Amino acid sequence of ATP synthase

**22.** What is **always** a consequence of single-nucleotide polymorphisms (SNPs) within a species?

A. Different proteomes

B. Different genomes

C. Deletion mutations

D. Insertion mutations

**23.** A titinopathy is a muscle disorder caused by titin abnormalities. What could be a consequence of abnormal titin in muscles?

A. Muscles would detach from tendons.

B. Muscles would stretch too much during relaxation.

C. Muscles would have less ATP for contraction.

D. Antagonistic muscles would contract at the same time.

**24.** The micrograph shows a transverse section of blood vessels in a human leg muscle.

Which is the main contributor to the movement of blood along vessel X?

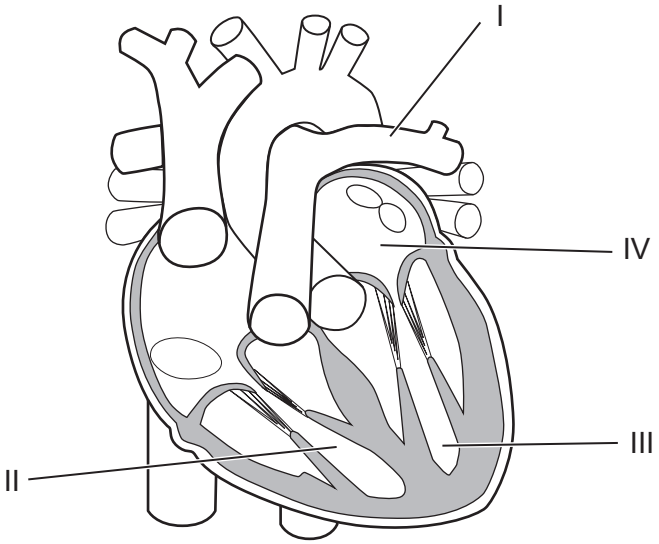
A. The smooth surface of the inner lining

B. Stretching and recoiling of the vessel walls

C. Differences in plasma solute concentration

D. Contraction of muscles adjacent to the vessel

**25.** The diagram shows the human heart.




After oxygen has been released from a red blood cell in the brain, which sequence shows the path taken by this red blood cell through the heart before it reaches the aorta?

A. I → II → III → IV

B. IV → III → II → I

C. II → I → IV → III

D. IV → III → I → II

**26.** Which of the following will cause the production of antibodies during an infection?

A. Conversion of fibrinogen to fibrin by thrombin

B. B-cell activation by helper T-cells and antigens

C. Plasma cell activation by platelets

D. Activation of phagocytes by infected body cells

**27.** What can cause hormone secretion from the pineal gland?

A. The intake of glucose

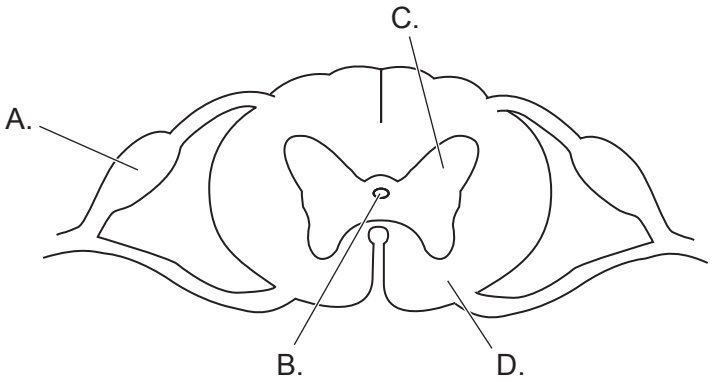
B. The sound of classical music

C. The onset of darkness

D. A decrease in body temperature

**28.** The spinal cord is involved in the coordination of involuntary actions such as the pain reflex.

Where are synapses between sensory neurons and interneurons found?




**29.** Flowering plants can use either self-pollination or cross-pollination when they carry out sexual reproduction. Which plants are most likely to cross-pollinate?

A. Plants that are hermaphrodites

B. Plants whose anthers and stigmas mature at the same time

C. Plants with flowers that have much longer stamens than stigmas

D. Plants that are either male or female

**30.** Gametogenesis produces sex cells for sexual reproduction. What distinguishes oogenesis from spermatogenesis in humans?

A. The first meiotic division starts at puberty.

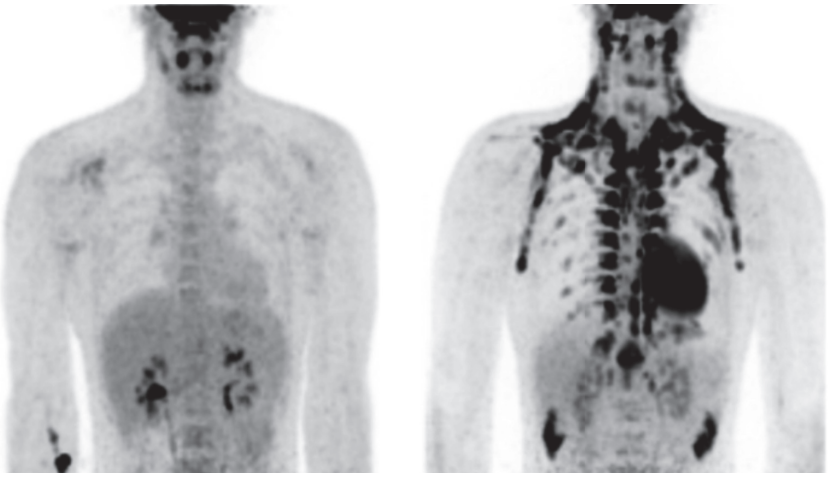
B. Mitosis produces many cells for gametogenesis.

C. Unequal division of cytoplasm occurs at cytokinesis.

D. Haploid gametes are produced at the end of meiosis II.

**31.** The dark areas in the PET/CT scanning images show the activity of brown adipose tissue in an adult human at room temperature (20 °C) and 2 °C.

room temperature 2 °C



How does brown adipose tissue contribute to regulating body temperature at 2 °C?

A. It provides adenosine triphosphate (ATP) for muscle contraction when shivering.

B. It further insulates the body so that internal heat is not lost.

C. It turns into thick layers of white adipose tissue to prevent hypothermia.

D. It breaks down fat to generate heat but not ATP.

**32.** Scientists incubated larvae of the moth *Utetheisa ornatrix* at either 15 °C or 22 °C until they hatched. They found the hatched moths had different wing colour patterns due to phenotypic plasticity.

Moth from larvae incubated at 15 °C

Moth from larvae incubated at 22 °C

Which of the following explains the observed differences in wing colour?

A. Colder temperatures induce mutations in genes for wing colour.

B. The expression of genes for wing colour is affected by temperature.

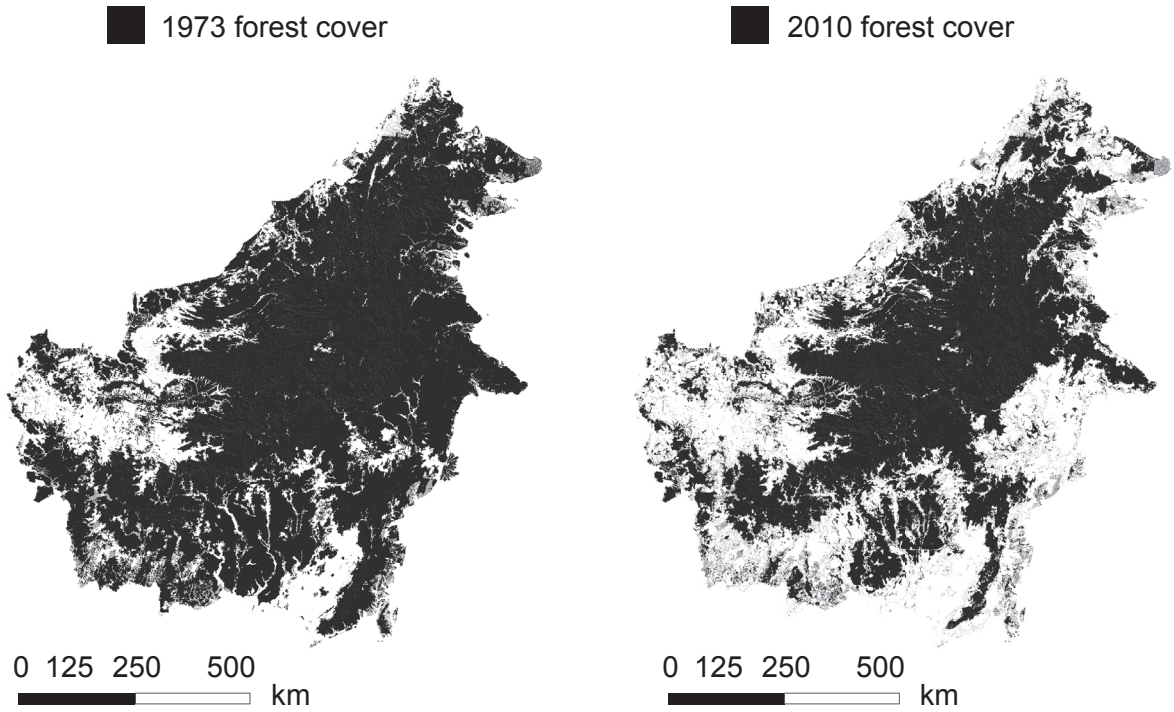
C. A mutation makes moths less visible to predators in cold climates.

D. Wing colour is the result of polygenic inheritance.

**33.** What is the evolutionary origin and function of analogous structures in living organisms?

| | **Evolutionary origin** | **Function** |
|---|---|---|
| A. | different origin | similar function |
| B. | different origin | same or different function |
| C. | same or different origin | same function |
| D. | same origin | different function |

**34.** The satellite images show changes in the area covered by forest, much of which is mixed dipterocarp forest, on the island of Borneo in Southeast Asia.




Which human activities are most likely to have caused the changes shown in the map?

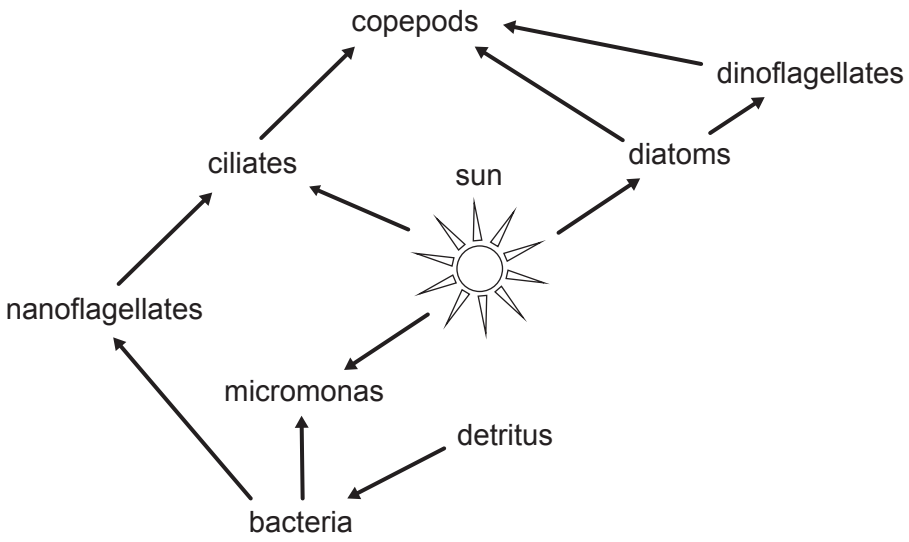
A. Logging and palm oil plantation

B. Logging and rewilding

C. Mining and afforestation

D. Afforestation and palm oil plantation

**35.** The diagram shows the flow of energy between some Arctic species.




Which organism is a mixotroph?

A. Bacteria

B. Nanoflagellates

C. Micromonas

D. Copepods

**36.** What is an example of a population control mechanism within a community?

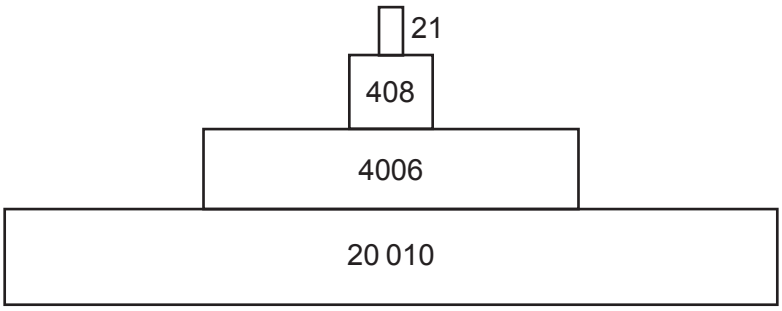
A. Bottom-up control of herbivores by a top predator

B. Top-down control of grasses by consumers

C. Top-down control of a plant species by soil nutrient availability

D. Bottom-up control of dissolved oxygen by corals

**37.** The diagram shows a pyramid of energy. The unit is $kJ\,m^{-2}\,year^{-1}$.




What is a valid conclusion from the data displayed in the pyramid?

A. Producers lose almost 16 000 $kJ\,m^{-2}\,year^{-1}$ as they reflect some sunlight.

B. 4006 $kJ\,m^{-2}\,year^{-1}$ is gained by primary consumers.

C. Tertiary consumers use 408 $kJ\,m^{-2}\,year^{-1}$ in life processes.

D. 21 $kJ\,m^{-2}\,year^{-1}$ is used by detritivores.

**38.** The Hardy–Weinberg equation, used to calculate expected genotype frequencies in a population in genetic equilibrium, is:

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

The length of the mouthparts in an insect population is controlled by a gene with two alleles: long mouthparts (dominant) and short mouthparts (recessive). The frequency of the allele for long mouthparts is 0.72. What is the expected genotype frequency of individuals with short mouthparts?

A. 0.52

B. 0.40

C. 0.28

D. 0.08

**39.** Which of the following could be a subject of phenological research?

A. Timing of budburst in a tree species each year

B. Changes in allele frequencies in a population over time

C. The relationship between changes in ocean acidification and carbon dioxide concentration

D. The emergence of a new species of migratory bird by divergent evolution

**40.** Increased leaching of nitrogen fertilizers disrupts the stability of aquatic ecosystems such as lakes. What change is expected if nitrogen leaches into a lake over time?

A. Wilting of surface plants

B. Increased biochemical oxygen demand (BOD)

C. Weakened mollusc shells

D. Bioaccumulation of pollutants at higher trophic levels

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**References:**

**24.** Calvo, J.L., 2018. *Muscular artery, vein and nerve bundles surrounded by adipose tissue, near a lymph node*. Available at: https://www.shutterstock.com/image-photo/muscular-artery-vein-nerve-bundles-surrounded-785176687?dd_referrer=. Source adapted.

**31.** From *The New England Journal of Medicine* [online], Lichtenbelt, W.D. van M., Vanhommerig, J.W., Smulders, N.M., Drossaerts, J., Kemerink, G.J., Bouvy, N.D., Schrauwen, P. and Teule, G.J.J., Cold-Activated Brown Adipose Tissue in Healthy Men, Vol. 360, No. 15, Figure 1, © 2009 Massachusetts Medical Society. Reprinted with permission from Massachusetts Medical Society. Available at: https://www.nejm.org/doi/full/10.1056/nejmoa0808718 [Accessed 22 October 2024]. Source adapted.

**32.** Sourakov, A., 2015. Temperature-dependent phenotypic plasticity in wing pattern of *Utetheisa ornatrix bella* (*Erebidae*, *Arctiinae*). *Tropical Lepidoptera Research*, June 2015, Vol. 25, No. 1. Available at: https://journals.flvc.org/troplep/article/view/89750 [Accessed 14 November 2025]. Source adapted.

**34.** Gaveau, D.L.A., Sloan, S., Molidena, E., Yaen, H., Sheil, D., Abram, N.K., Ancrenaz, M., Nasi, R., Quinones, M., Wielaard, N. and Meijaard, E., 2014. *Plos One*, [online] Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0101654 [Accessed 17 October 2024]. Reference redacted. Source adapted.

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