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# Biology

## Standard level

### Paper 1

13 May 2024

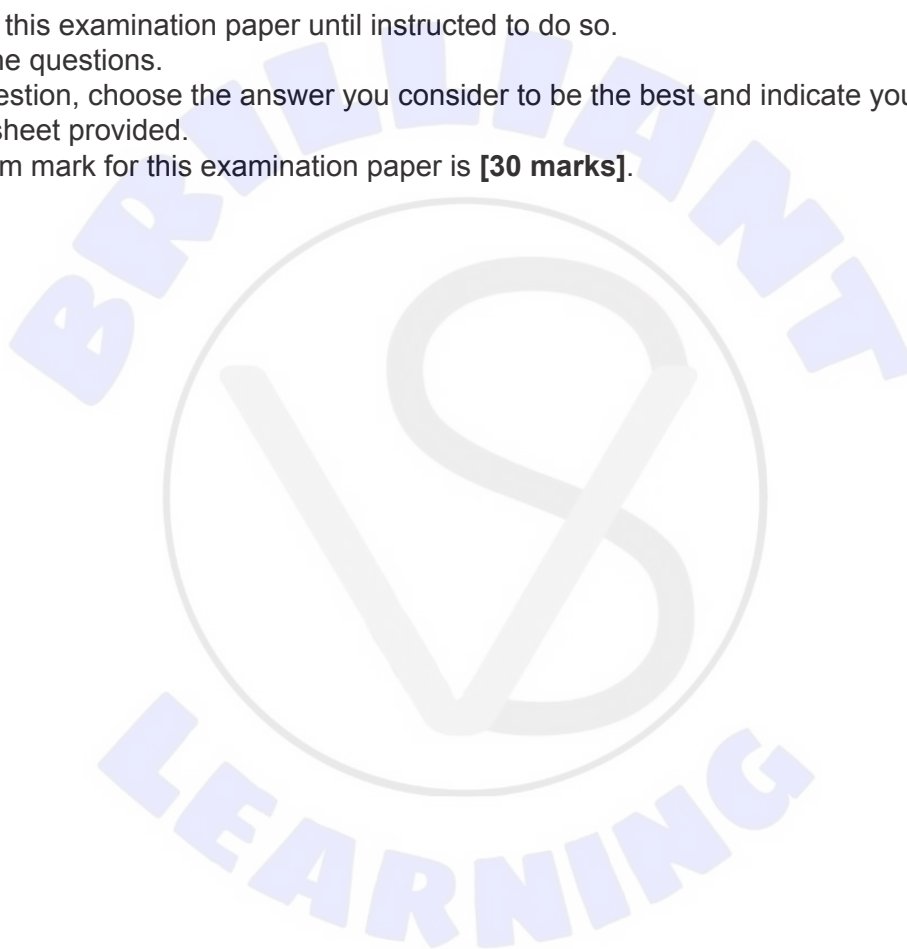
Zone A afternoon | Zone B afternoon | Zone C afternoon

45 minutes

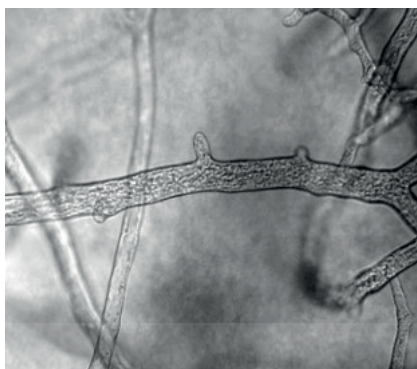
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#### Instructions to candidates

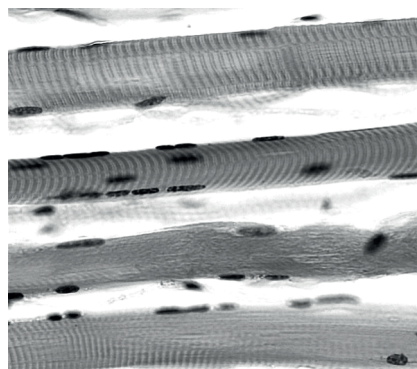
- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- The maximum mark for this examination paper is **[30 marks]**.



1. The micrographs show two examples of atypical cells.



Aseptate fungal hyphae

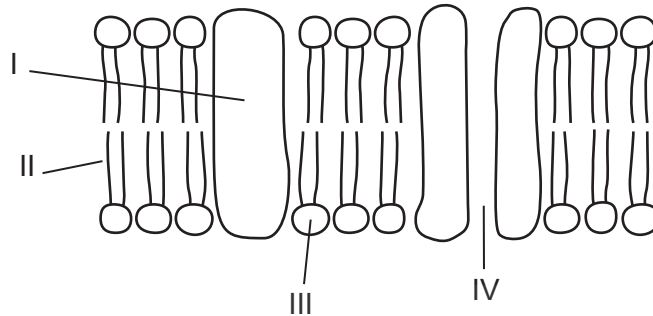


Striated muscle fibres

Which feature shared by both types of cells makes them atypical?

- A. Both have cell walls.
  - B. Both have several nuclei.
  - C. Both lack membrane-bound organelles.
  - D. Both are divided into compartments.
2. Which structure is found in animal cells?
- A. Cell wall
  - B. Chloroplast
  - C. Pili
  - D. Mitochondria

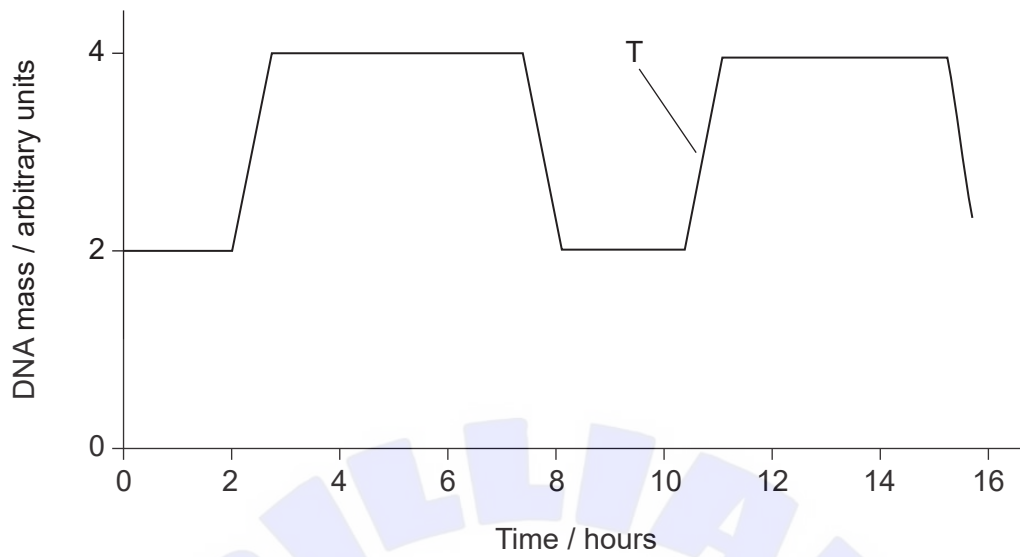
3. The diagram shows the fluid mosaic model of cell membranes. Which labelled regions are hydrophilic?



- A. I and II  
B. I and III  
C. II and IV  
D. III and IV
4. What explains the movement of glucose molecules down a concentration gradient across the cell surface membrane?
- A. They can diffuse between phospholipids due to their flexibility.  
B. They are actively transported by protein pumps due to their size.  
C. They move through hydrophilic channels because they are polar.  
D. They dissolve in the phospholipid bilayer because they are not charged.
5. How does the endosymbiotic theory explain the origin of mitochondria in eukaryotes?
- A. Autotrophic eukaryotes fused with photosynthetic bacteria.  
B. Small aerobic bacteria survived inside anaerobic prokaryotes.  
C. Anaerobic prokaryotes were engulfed by small aerobic bacteria.  
D. Invaginations occurred in large prokaryotes to increase surface area for gas exchange.

Turn over

6. The graph shows changes in the DNA mass of one cell during two mitotic cycles.



Which stage is reached at the point labelled T?

- A. S
- B. G1
- C. Mitosis
- D. Cytokinesis

7. The graph shows mean air and water temperatures recorded at the same time of day at different distances downstream from the city of Asunción on the Lower Paraguay river over an 8-day period.

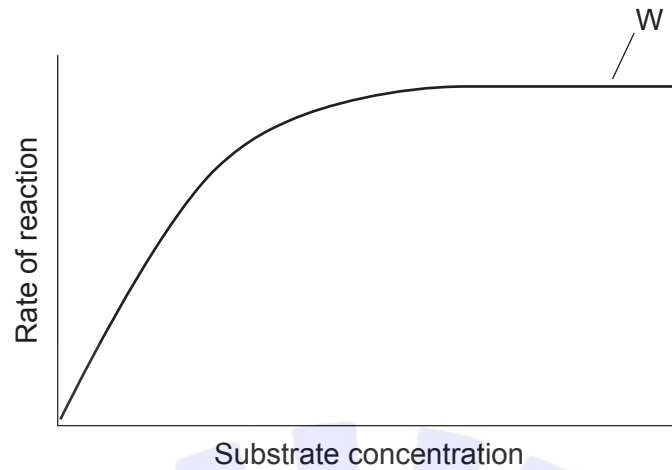
Removed for copyright reasons

What explains the differences between water and air temperatures shown in the graph?

- A. Evaporation of surface water causes an increase in the temperature of surface water.
  - B. Adhesion between water molecules prevents heat absorption, so its temperature remains lower.
  - C. Heat is rapidly lost from water due to breakage of covalent bonds.
  - D. Breakage of hydrogen bonds in water requires much heat energy.
8. What is a common feature of all polysaccharides and triglycerides?
- A. They are polymers.
  - B. They are energy stores in humans.
  - C. They are formed by condensation.
  - D. Their carbon-to-oxygen ratio is 1:1.

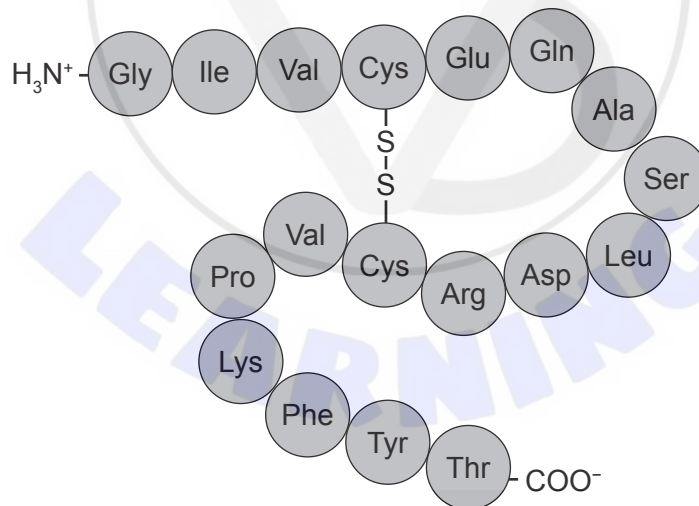
Turn over

9. The graph shows the effect of substrate concentration on the rate of an enzyme-controlled reaction.



What explains the shape of the curve at W?

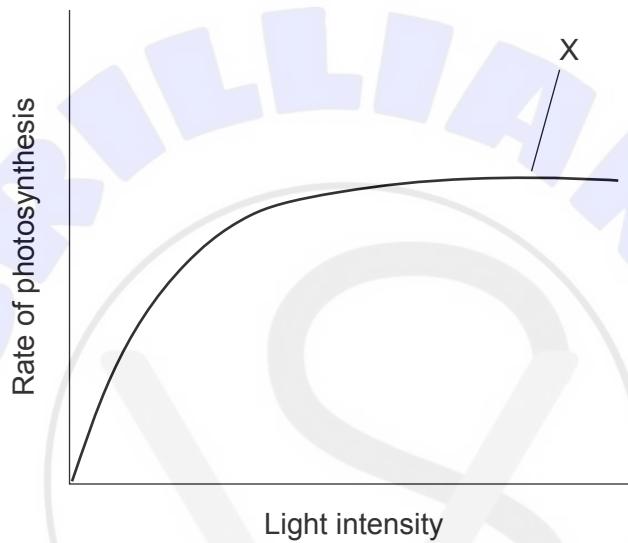
- A. The amount of substrate is limiting.
  - B. The end point of the reaction has been reached.
  - C. All active sites are occupied by substrate molecules.
  - D. Collisions between molecules have reached the fastest speed.
10. The diagram shows the structure of a peptide.



How many bases would be present in the length of an mRNA molecule coding for this peptide?

- A. 18
- B. 36
- C. 54
- D. 72

11. Bioethanol is a renewable energy source used as fuel for vehicles. How is bioethanol obtained?
- A. By fermentation of crops carried out by yeast
  - B. From the breakdown of biomass by aerobic bacteria
  - C. From the metabolism of anaerobic archaeans
  - D. By heating organic matter in the presence of acids
12. The graph shows the effect of increasing light intensity on the rate of photosynthesis during an experiment carried out at optimum temperature and normal atmospheric CO<sub>2</sub> concentration.



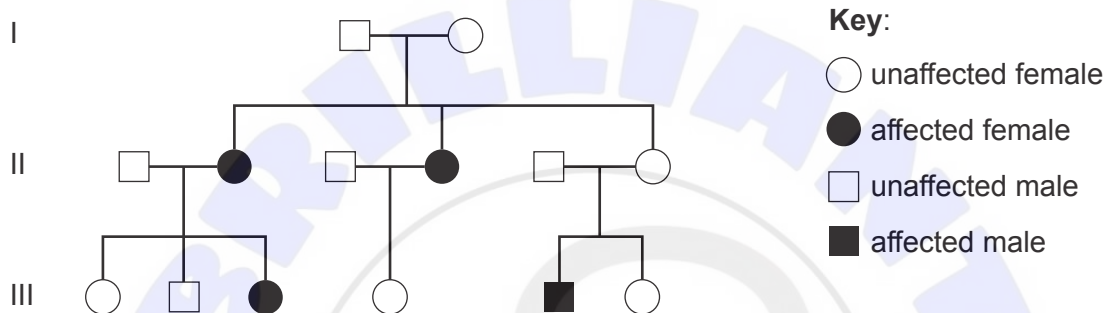
Which factor could be limiting photosynthesis at point X on the graph?

- A. Light intensity
  - B. Carbon dioxide concentration
  - C. Temperature
  - D. Nutrient availability
13. The Human Genome Project completed the sequencing of the human genome by the year 2003. Which could have been a source of the entire genome in humans?
- A. The contents of a red blood cell
  - B. The nucleus and mitochondria of a skin cell
  - C. The nucleus and acrosome of a sperm cell
  - D. The nucleus and ribosomes of any somatic cell

Turn over

14. Which process occurs in both mitosis and meiosis?
- DNA replication
  - Splitting of chromosome centromeres
  - Exchange of genetic material between chromatids
  - Pairing of homologous chromosomes at the equator of the cell

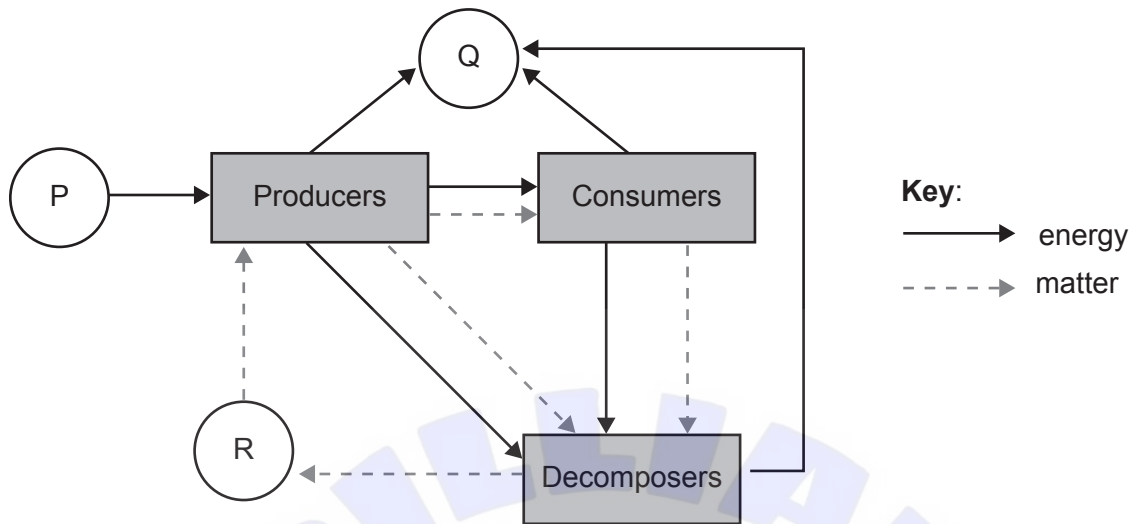
15. Nonsyndromic Hearing Loss and Deafness (DFNB1) is an inherited cause of deafness in humans. The pedigree chart shows the inheritance of DFNB1 in a family.



Where is the DFNB1 allele found in family members with this condition?

- On the Y chromosome
  - On the X chromosome
  - On one autosome only
  - On a pair of autosomes
16. Plants can be cloned by providing stem cuttings with optimum conditions for root development. A group of students designed an experiment to investigate the effect of several factors on the rooting of stem cuttings. Which procedure is recommended to ensure successful cloning?
- Cutting stem pieces at a node to ensure growth of more leaves
  - Selecting a shoot with several flowers to encourage reproduction
  - Enclosing the shoot in a clear plastic bag to reduce loss of water vapour
  - Using a stem with many leaves to manufacture sugars for root growth

17. The diagram shows flows of energy and matter in an ecosystem. What do the letters P, Q and R represent?

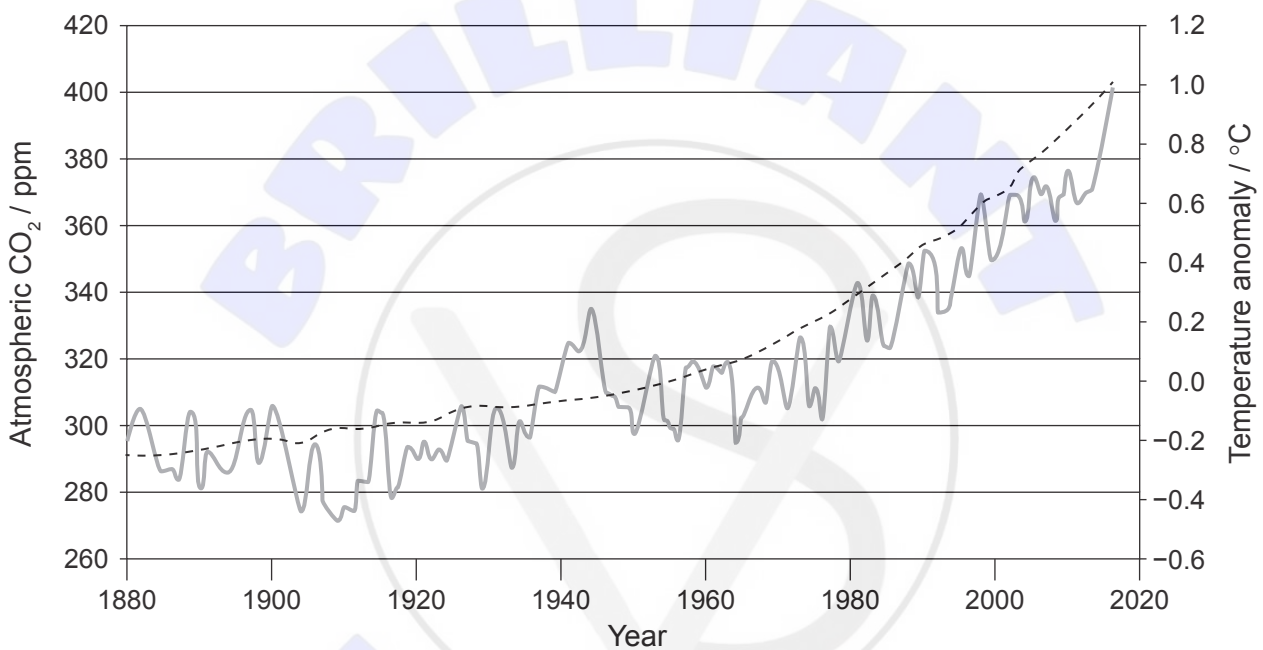


|    | <b>P</b>        | <b>Q</b>       | <b>R</b>            |
|----|-----------------|----------------|---------------------|
| A. | light           | water vapour   | nitrates            |
| B. | chemical energy | heat           | carbon dioxide      |
| C. | light           | heat           | inorganic nutrients |
| D. | chemical energy | carbon dioxide | glucose             |

18. What is required for limestone formation?

- A. Mollusc shells and alkaline conditions
- B. Fossilized plants and high temperatures
- C. Saprotrophs and waterlogged soils
- D. Bacteria and porous rocks

19. The graph shows the correlation between atmospheric carbon dioxide concentration and global temperature anomalies (deviations from mean global temperatures) since the industrial revolution to the year 2017.

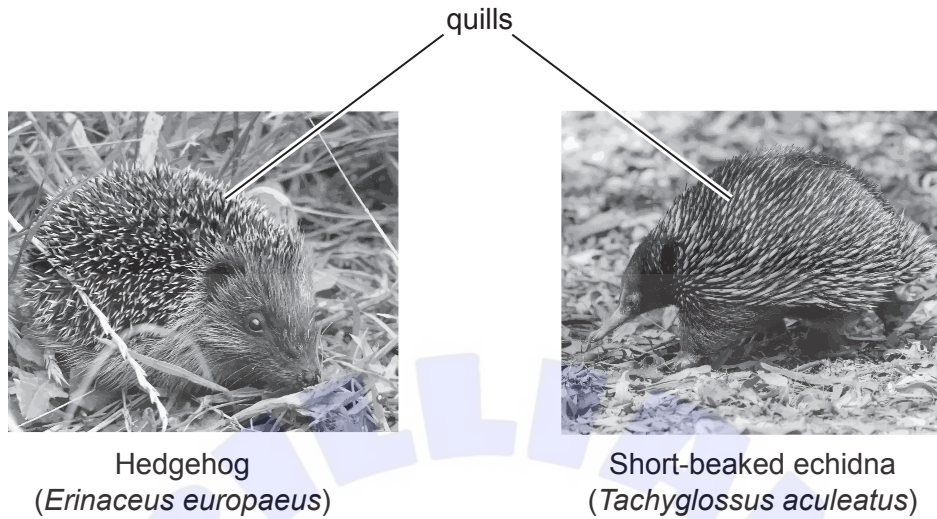


**Key:** --- atmospheric CO<sub>2</sub> / ppm    — temperature anomaly / °C

Which statement explains the correlation between atmospheric carbon dioxide concentration and temperature shown in the graph?

- A. Carbon dioxide heats up the surface of the Earth.
- B. More short wave radiation bounces back to space, causing warmer seasons.
- C. Less long wave radiation can escape the atmosphere, heating up the Earth.
- D. Less radiation is emitted by the Earth's surface, increasing seasonal fluctuations.

20. Modified hairs (quills) cover the bodies of hedgehogs (*Erinaceus europaeus*) and short-beaked echidnas (*Tachyglossus aculeatus*). However, these structures do not have the same evolutionary origin.



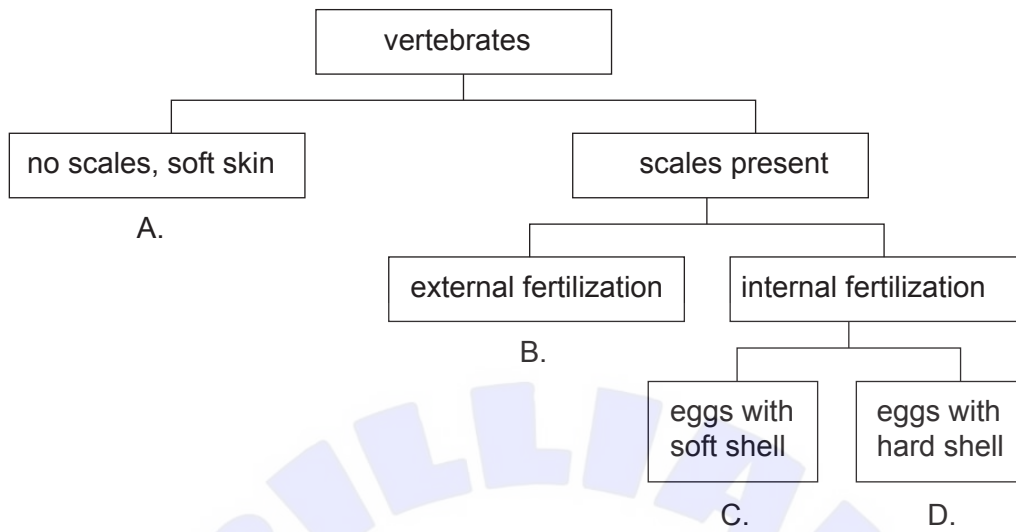
What is a possible explanation for the presence of quills in both species?

- A. Both species diverged gradually, but quills were conserved for successful survival.
  - B. Quills developed in response to similar environmental pressures.
  - C. Quills are homologous structures that result from adaptation to a similar predator.
  - D. They developed by adaptive radiation to survive in slightly different habitats.
21. Variation may result in a favourable characteristic in a species. What could be a cause of this variation and the likely effect on the frequency of other alleles for this characteristic?

|    | Cause of variation                  | Effect on frequency of other alleles |
|----|-------------------------------------|--------------------------------------|
| A. | different combinations of alleles   | increases                            |
| B. | sexual reproduction                 | increases                            |
| C. | successful acquired characteristics | decreases                            |
| D. | high mutation rates                 | decreases                            |

Turn over

22. The dichotomous key shows general features of four vertebrate classes. Which letter identifies most fish?



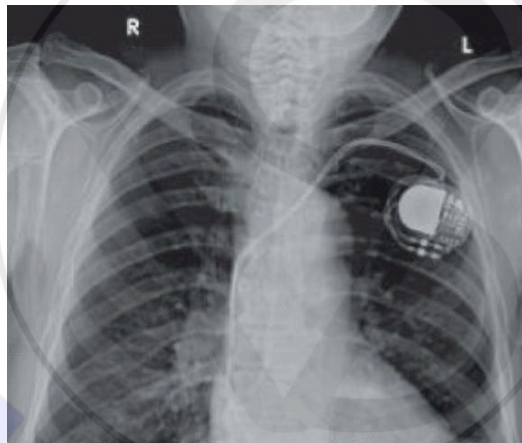
23. Which type of evidence is used as the basis for evolutionary relationships in cladistics?
- A. Sequence of appearance of organisms in the fossil record
  - B. Observation of analogous characteristics
  - C. Differences in amino acid sequences of specific proteins
  - D. History of selective breeding of domesticated breeds
24. Which substances are absorbed by villi in the small intestine?
- A. Glucose, lactose and amino acids
  - B. Vitamins, polypeptides and fructose
  - C. Glycerol, fructose and phosphate
  - D. Fatty acids, maltose and fructose

25. The table shows average systolic and diastolic blood pressures in the left ventricle of the heart and the aorta.

|                | Average systolic pressure / mmHg | Average diastolic pressure / mmHg |
|----------------|----------------------------------|-----------------------------------|
| Left ventricle | 125                              | 0                                 |
| Aorta          | 120                              | 80                                |

What explains the smaller pressure change in the aorta?

- A. Stretching and recoiling of its elastic wall evens out pressure changes.
  - B. The opening and closing of valves maintains a more constant pressure.
  - C. Its thin wall reduces larger increases in pressure.
  - D. The smooth endothelium reduces friction as blood flows at high pressure.
26. The X-ray shows an artificial pacemaker implanted under the skin of a patient.



What is a reason for implantation of an artificial pacemaker?

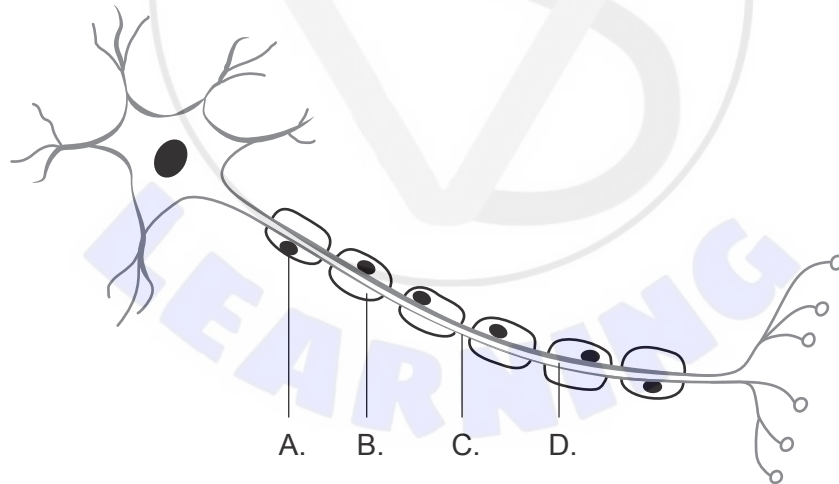
- A. Heart muscle is not responding to epinephrine.
- B. The cardiovascular centre of the brain is defective.
- C. Nerves from the medulla of the brain are damaged.
- D. The sinoatrial node does not function correctly.

Turn over

27. A cut in the skin triggers a cascade of reactions controlled by several blood components that results in the quick formation of a clot.

In which order do these blood components act to form a blood clot?

- A. platelets – clotting factors – thrombin – fibrinogen – fibrin
  - B. platelets – fibrinogen – fibrin – thrombin – clotting factors
  - C. clotting factors – platelets – thrombin – fibrinogen – fibrin
  - D. clotting factors – platelets – thrombin – fibrin – fibrinogen
28. What causes the expansion of the thorax during inspiration?
- A. Air entering the lungs
  - B. An increase in tidal volume
  - C. An increase in pressure inside the lungs
  - D. The contraction of the diaphragm and external intercostal muscles
29. The diagram shows a myelinated motor neuron. Where does depolarization occur during an action potential?



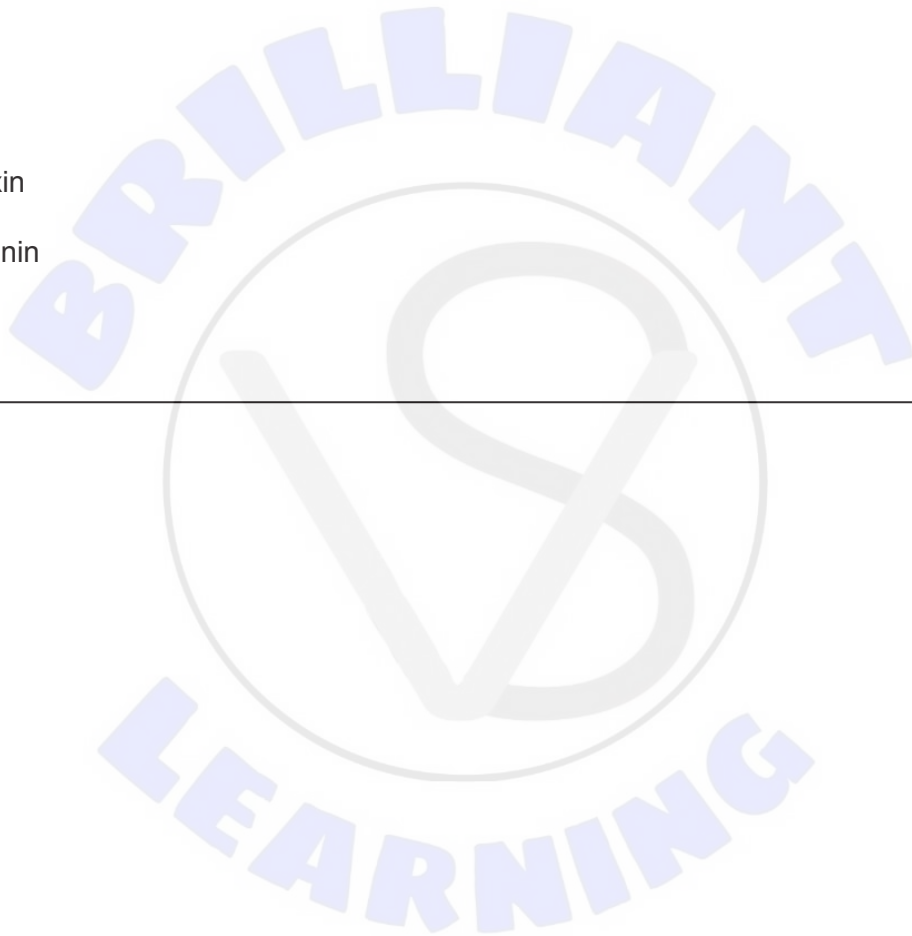
30. A doctor recorded the symptoms of a patient with a suspected hormonal deficiency.

Patient: Mr. Smith

- ✓ Has lost appetite but gained weight
- ✓ Frequently depressed
- ✓ Feels cold and tired all the time

Which hormone might this patient produce in lower quantities?

- A. Insulin
- B. Leptin
- C. Thyroxin
- D. Melatonin





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**References:**

1. Left: Clayton, Michael W., n.d., University of Wisconsin Libraries. Coenocytic hyphae of Rhizopus. [image online] Available at: <https://search.library.wisc.edu/digital/APHT7CUN235E5D8M#dci-item-details> [Accessed 31 May 2024]. Source adapted.  
Right: Berkshire Community College Bioscience Image Library. [image online] Available at: [https://commons.wikimedia.org/wiki/File:Muscle\\_Tissue\\_Skeletal\\_Muscle\\_Fibers\\_\(40153601630\).jpg](https://commons.wikimedia.org/wiki/File:Muscle_Tissue_Skeletal_Muscle_Fibers_(40153601630).jpg) Licensed under the CC0 1.0 Universal Public Domain Dedication [Accessed 1 September 2022]. Source adapted.
19. Stable Climate, n.d. Atmospheric CO<sub>2</sub> vs temperature anomalies. [online] Available at: <https://www.stableclimate.org/graphs> [Accessed 1 September 2022]. Source adapted.
20. Left: Wills, T., 2009. [https://commons.wikimedia.org/wiki/File:Young\\_hedgehog.jpg](https://commons.wikimedia.org/wiki/File:Young_hedgehog.jpg). Licensed under the CC BY-SA 3.0 Deed: <https://creativecommons.org/licenses/by-sa/3.0/deed.en>.  
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