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Biology
Standard level
Paper 1

Wednesday 19 May 2021 (morning)

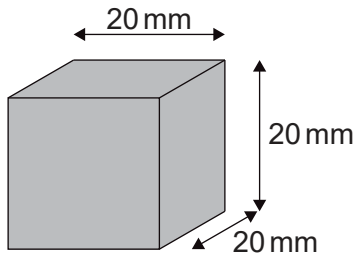
45 minutes

Instructions to candidates

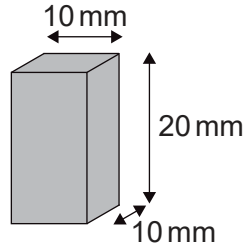
- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- The maximum mark for this examination paper is **[30 marks]**.

1. The diagrams represent cells with the same concentration of dissolved substances in their cytoplasm. If all the cells were placed in the same hypertonic sucrose solution, which cell would show the greatest rate of change in the concentration of its cytoplasm?

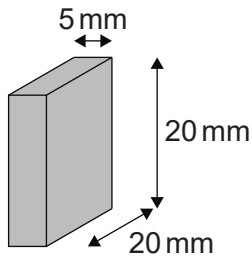
A.



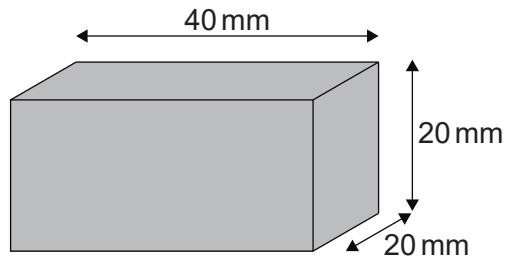
B.



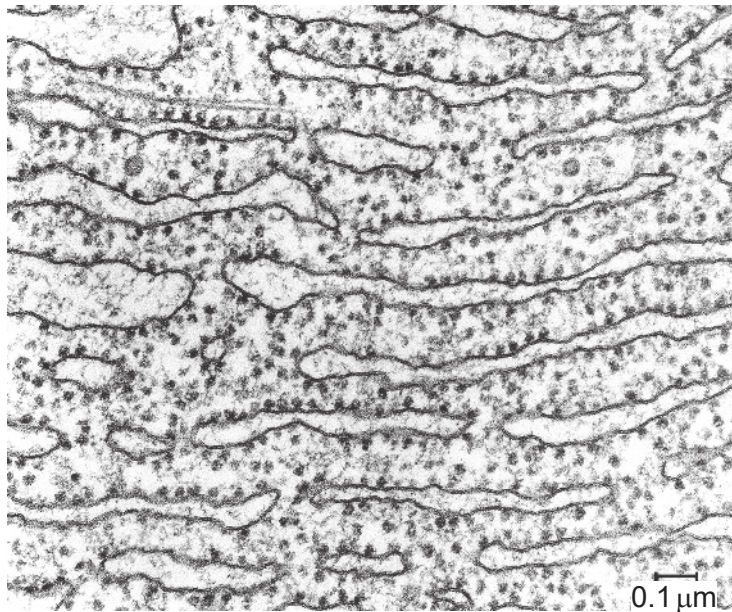
C.



D.



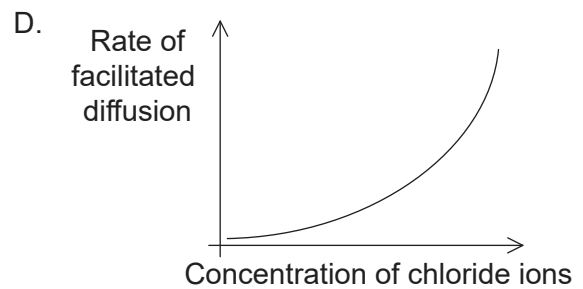
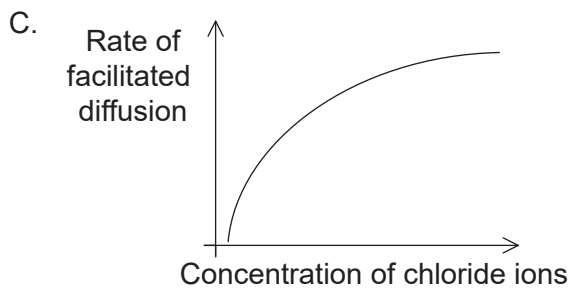
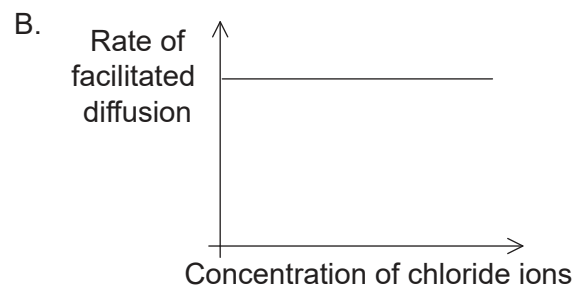
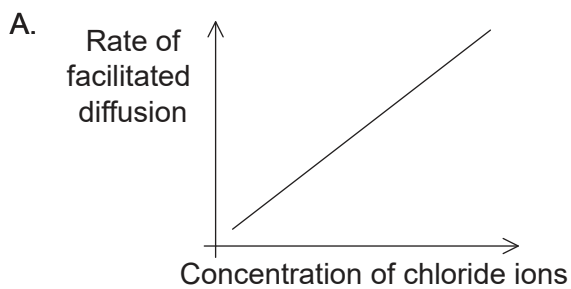
2. What function is performed by the part of the cell shown in the electron micrograph?



- A. Locomotion
- B. Synthesis of proteins
- C. Movement of chromosomes
- D. Breakdown of cellular organelles

3. What special property of phospholipid molecules explains their ability to spontaneously assemble into a lipid bilayer?
- A. They are hydrophobic.
 - B. They are amphipathic.
 - C. They are saturated.
 - D. They are hydrophilic.

4. Which graph best represents the relationship between the concentration of chloride ions in the external environment of a cell and the rate at which the chloride ions move by facilitated diffusion into the cytoplasm of the cell?

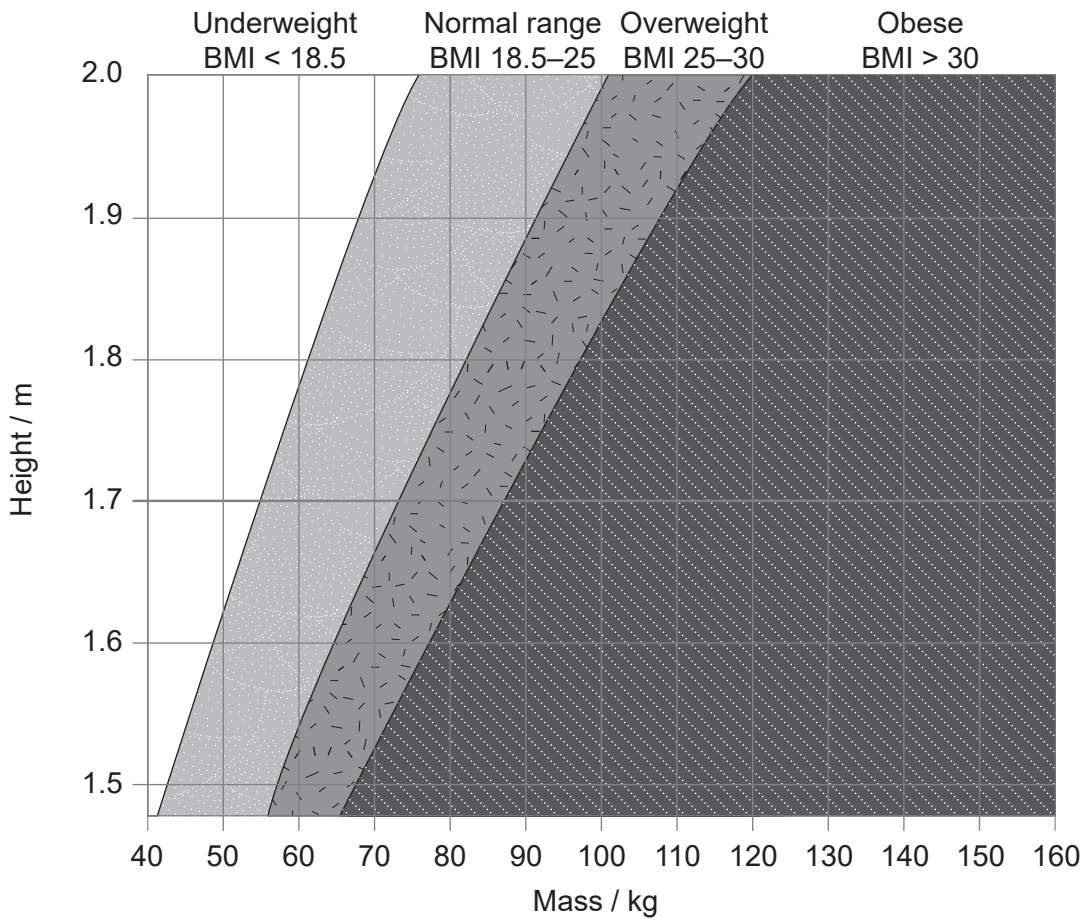


5. Which statement is evidence for the endosymbiotic theory?
- A. Chloroplasts contain 70S ribosomes.
 - B. Protein synthesis occurs in the cytoplasm.
 - C. Organic molecules can be synthesised abiotically.
 - D. RNA is self-replicating.

Turn over

6. Which process is an example of catabolism?
- A. Translation of mRNA
 - B. Replication of DNA
 - C. Hydrolysis of protein
 - D. Synthesis of a disaccharide
7. What property of water accounts for its usefulness as a coolant in sweat?
- A. High specific heat capacity
 - B. High latent heat of vaporization
 - C. High boiling point
 - D. High melting point

8. The chart classifies individuals according to their height and mass.

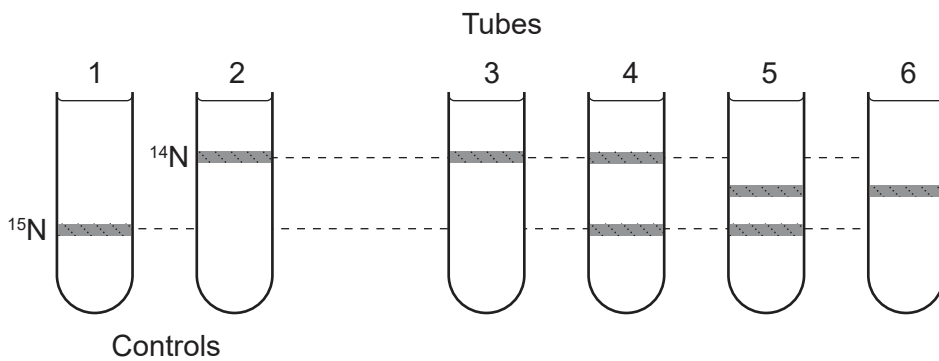


Based on the information provided, which individual is most at risk of diseases associated with the accumulation of excessive body fat?

| | Mass / kg | Height / m |
|----|-----------|------------|
| A. | 95 | 1.95 |
| B. | 60 | 1.55 |
| C. | 75 | 1.50 |
| D. | 80 | 1.70 |

Turn over

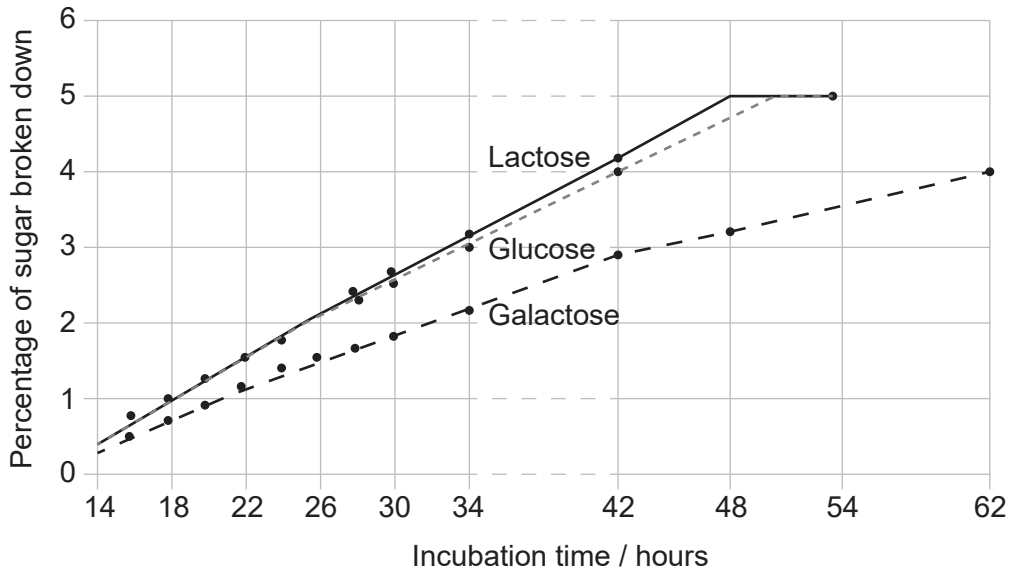
9. Which feature is common to both mRNA and DNA?
- A. Covalent bonds between adjacent nucleotides
 - B. Hydrogen bonds between guanine and cytosine
 - C. Ribose sugar attached to phosphate
 - D. Antiparallel arrangement of polynucleotide strands
10. Bacteria cultured in a medium containing only ^{15}N were transferred to a medium containing only ^{14}N and allowed to complete one round of replication. The DNA in bacteria produced as a result of replication on the ^{14}N medium was extracted and subjected to caesium chloride centrifugation which separates DNA molecules according to their density.



Which centrifuge tube shows the arrangement of bands observed after one round of replication?

- A. Tube 3
- B. Tube 4
- C. Tube 5
- D. Tube 6

11. The graph shows the results of an experimental investigation that compared the rates at which lactose, glucose and galactose are broken down in the process of anaerobic cellular respiration by the yeast *Torulopsis cremoris*.

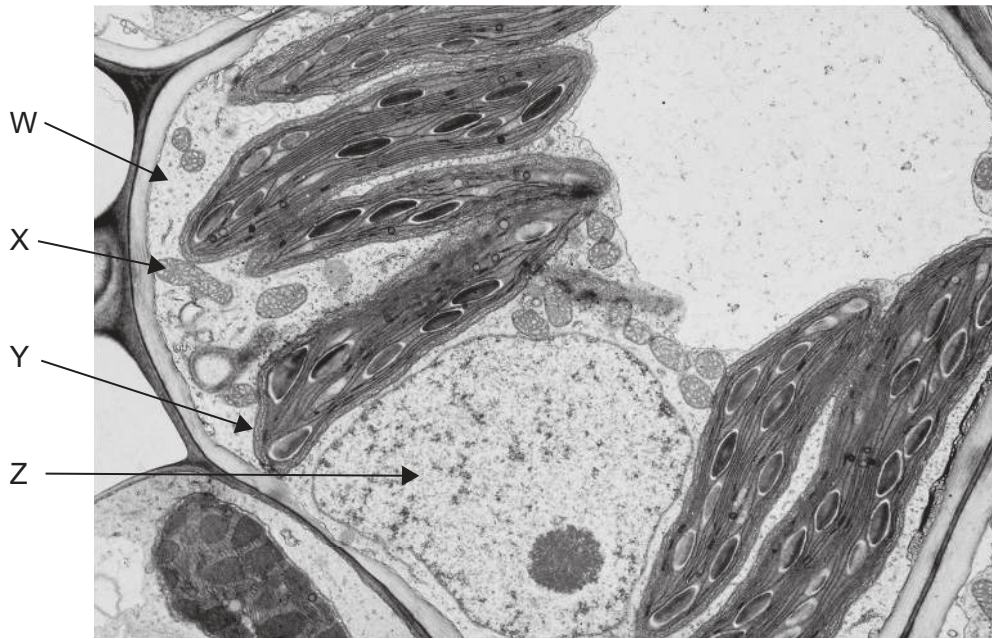


What can be concluded from these results?

- A. Cellular respiration of lactose involves the production of glucose and galactose.
 - B. The breakdown of glucose and galactose occurs more slowly in the presence of lactose.
 - C. The rate of cellular respiration is greater for glucose than for lactose and galactose.
 - D. The percentage of sugar remaining after 42 hours is greater for galactose than glucose.
12. What does the R_f value in thin layer chromatography represent?
- A. The distance travelled by the pigment front in a fixed time period
 - B. The distance from the origin to the solvent front at the end of the experiment
 - C. The ratio of distances travelled by the pigment and solvent fronts
 - D. The concentration of the pigment applied to the chromatography plate

Turn over

13. The electron micrograph shows a section through a plant cell.



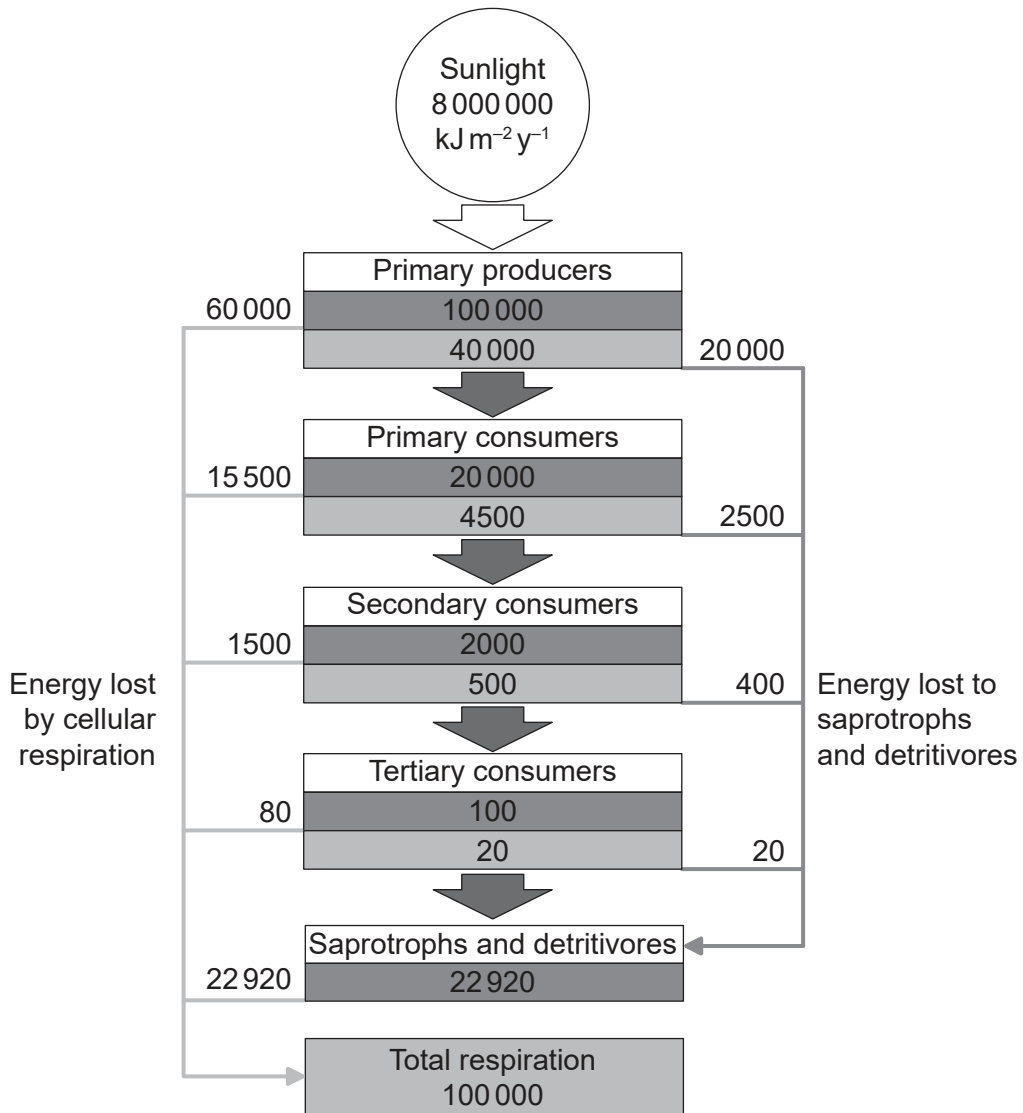
In which structure(s) is the genome of the cell contained?

- A. Z only
 - B. X, Y and Z only
 - C. W and X only
 - D. X and Y only
14. What feature of eukaryotic chromosomes distinguishes them from the chromosomes of prokaryotes?
- A. Histone proteins
 - B. Circular DNA
 - C. Double-stranded DNA molecules
 - D. Multiple genes along the length of each chromosome

15. A woman with blood type A has three children with a man who has blood type AB. The first child has blood type B. What is the probability that the second child born to the couple will have blood type AB?
- A. 0.75
 - B. 0.50
 - C. 0.25
 - D. 0.00
16. What benefit is derived from the use of Bt crops?
- A. It can lead to an increase in genetic diversity of crop species.
 - B. Genetically modified species can interbreed with native species.
 - C. The numbers of monarch butterflies can be permanently reduced.
 - D. It can lead to a reduction in the use of pesticides.
17. Which organism would be classified as a saprotroph?
- A. A single-celled eukaryote that obtains its carbon compounds by photosynthesis and ingestion of other single-celled organisms
 - B. A jellyfish that uses the stinging cells in its tentacles to paralyse its prey, which is passed to an internal gastric cavity through a single opening
 - C. A fungus that feeds by secretion of digestive enzymes onto its food and absorption of digested material
 - D. A dung beetle that feeds on the fecal material left behind by other animals

Turn over

18. The diagram shows the flow of energy through an ecosystem in $\text{kJ m}^{-2} \text{y}^{-1}$.



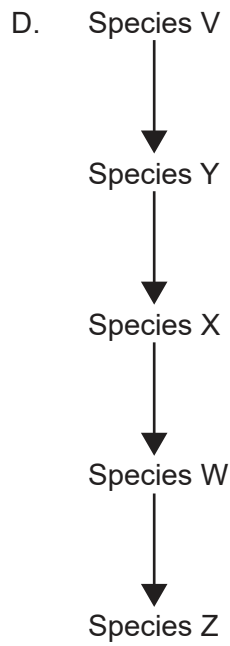
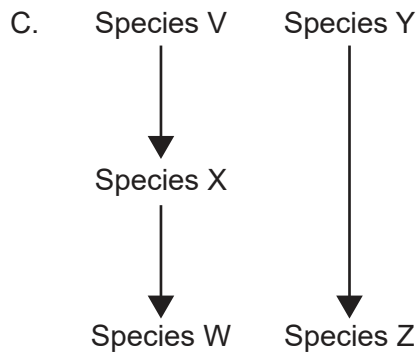
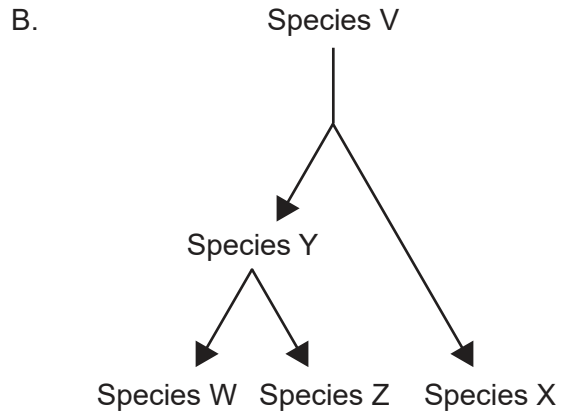
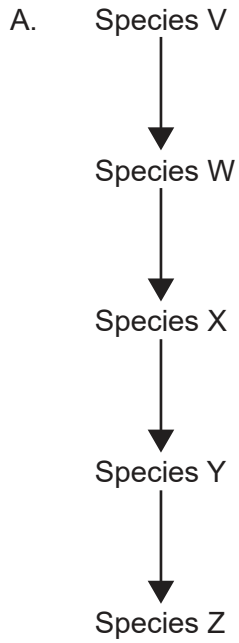
Key: Gross productivity: the amount of chemical energy that is stored as biomass per unit time
 Net productivity: the amount of chemical energy that is stored as biomass per unit time after cellular respiration

What percentage of the energy passed from primary producers to primary consumers is lost to cellular respiration by tertiary consumers?

- A. 0.001 %
- B. 0.08 %
- C. 0.2 %
- D. 0.4 %

19. Which gases have made the most significant contributions to global warming?
- A. Water and carbon dioxide
 - B. Carbon dioxide and methane
 - C. Methane and nitrous oxide
 - D. Carbon dioxide and ozone
20. Which is an example of speciation?
- A. Selective breeding to produce new varieties of the wheat *Triticum aestivum* with higher crop yield
 - B. Evolution of different courtship behaviours in separate populations of the cricket *Gryllus rubens*
 - C. Natural selection leading to an increase in the frequency of darker individuals of *Biston betularia*
 - D. Selective feeding by koalas (*Phascolarctos cinereus*) on *Eucalyptus* species

21. Which evolutionary pathway is most likely to result in the evolution of analogous structures in Species W and Z?

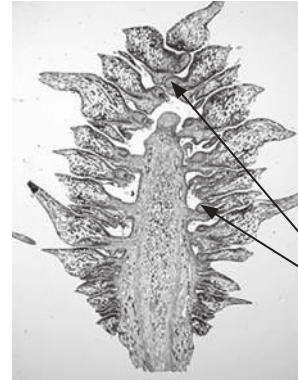


22. The images show a structure found on members of a phylum of green plants.

Whole structure



Structure sectioned longitudinally



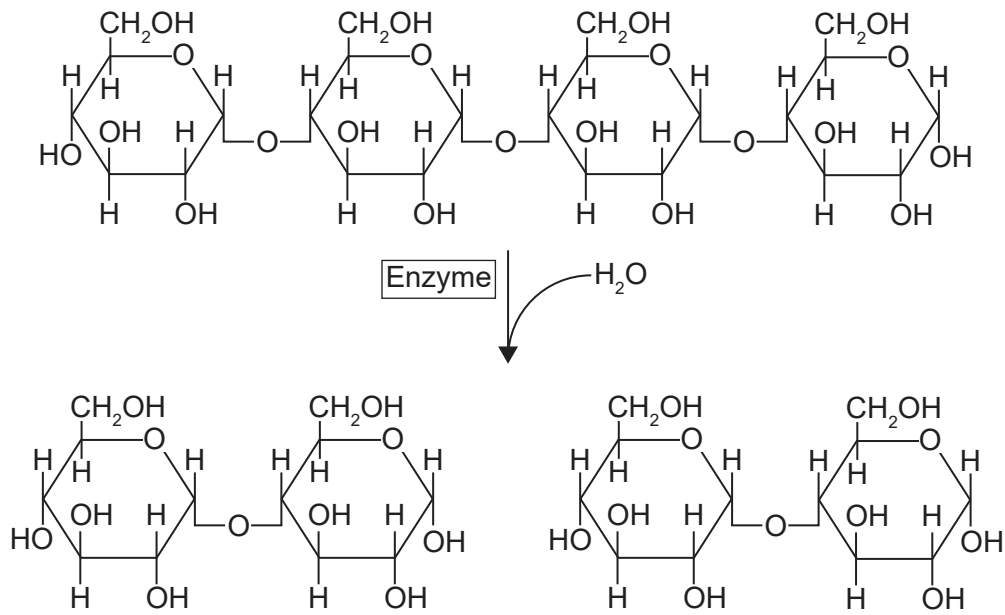
Ovules containing female gametes

What is the name of the phylum to which the organisms belong?

- A. Coniferophyta
 - B. Angiospermophyta
 - C. Filicinophyta
 - D. Bryophyta
23. What information can be deduced from the sequence of nodes in a cladogram?
- A. The geological period in which the species in the clade diverged from their common ancestor
 - B. The probable sequence of divergence among the species in the clade
 - C. The number of characteristics the species have in common
 - D. The number of mutations that have occurred since the species shared a common ancestor

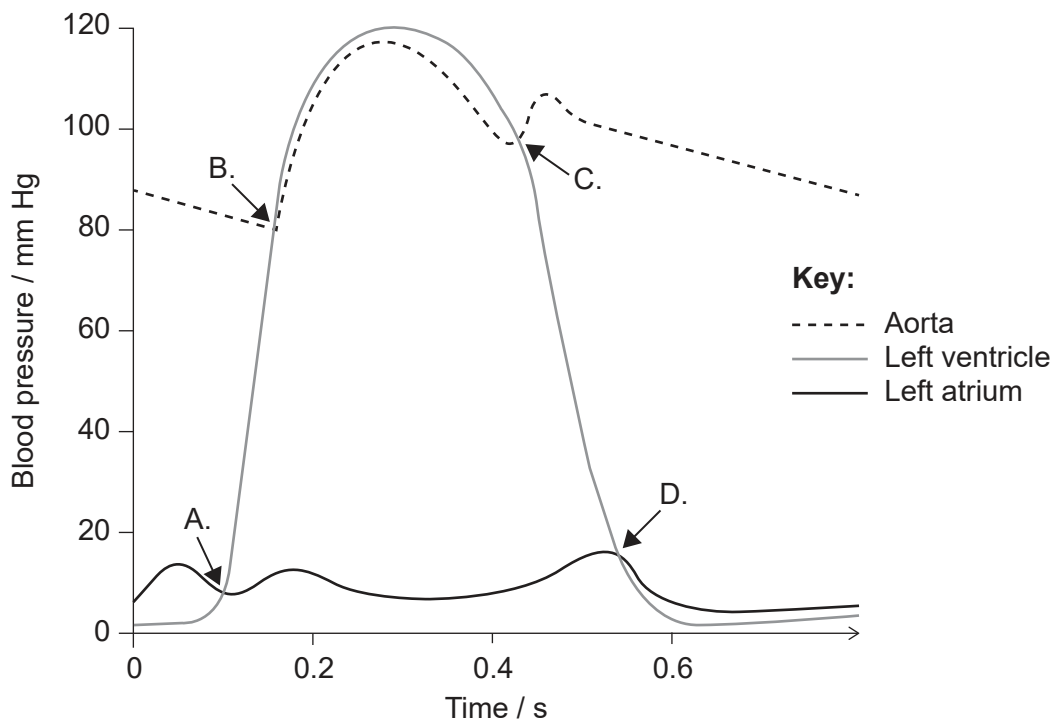
Turn over

24. What is the name of the enzyme in the diagram?



- A. Amylase
- B. Maltase
- C. Glucosidase
- D. Sucrase

25. The diagram shows changes in pressure in the left atrium, left ventricle and aorta during a single cardiac cycle. At what point during the cycle does the atrioventricular valve close?



26. Which cells are subject to attack by HIV?
- A. Lymphocytes
 - B. Erythrocytes
 - C. Platelets
 - D. Phagocytes
27. Which is an adaptation to increase rates of gas exchange in the lung?
- A. Small surface area
 - B. Dry surface
 - C. High vascularization
 - D. Muscular alveoli
28. Where in the body are type I pneumocytes found?
- A. Alveoli
 - B. Nephrons
 - C. Capillaries
 - D. Trachea

Turn over

29. What is the function of the hormone leptin?
- A. Increase the uptake of glucose from the blood
 - B. Reduce appetite
 - C. Increase metabolic rate
 - D. Promote sleep
30. What is a similarity between the testes of males and the ovaries of females in humans?
- A. They produce gametes throughout the life of the individual.
 - B. They secrete hormones into the blood stream.
 - C. Their development is controlled by a gene on the Y chromosome.
 - D. They release products to the outside of the body directly through the urethra.
-

References:

- 2. George E. Palade Electron Microscopy Slide Collection Harvey Cushing/John Hay Whitney Medical Library Yale University Library.
- 8. InvictaHOG, 2006. *Body mass index chart*. [chart online] Available at: <<https://commons.wikimedia.org/w/index.php?curid=1208092>> [Accessed: 4 April 2019].
- 11. Rogosa, M., 1948 Mechanism of the Fermentation of Lactose by Yeasts. *Journal of Biological Chemistry*, 175, p.418. (CC BY 4.0) <https://creativecommons.org/licenses/by/4.0/>.
- 13. Photo © E. Newcomb.
- 18. "Energy flow: Figure 3," (<https://cnx.org/contents/24nl-KJ8@24.18:fbNheNoN@8/Energy-Flow>) by OpenStax College, Biology CC BY 4.0 (<https://creativecommons.org/licenses/by/4.0/>).
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