Diploma Programme
Programme du diplôme
Programa del Diploma

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]**.

2221 – 6010

13 pages

1. In mammals, mature red blood cells are specialized in that they lack nuclei, mitochondria or ribosomes. Which statement applies to red blood cells?

A. No chemical reactions take place within their cytoplasm.

B. They cannot produce new enzymes.

C. Materials cannot enter red blood cells.

D. Materials cannot exit red blood cells.

2. What do chloroplasts and mitochondria have in common?

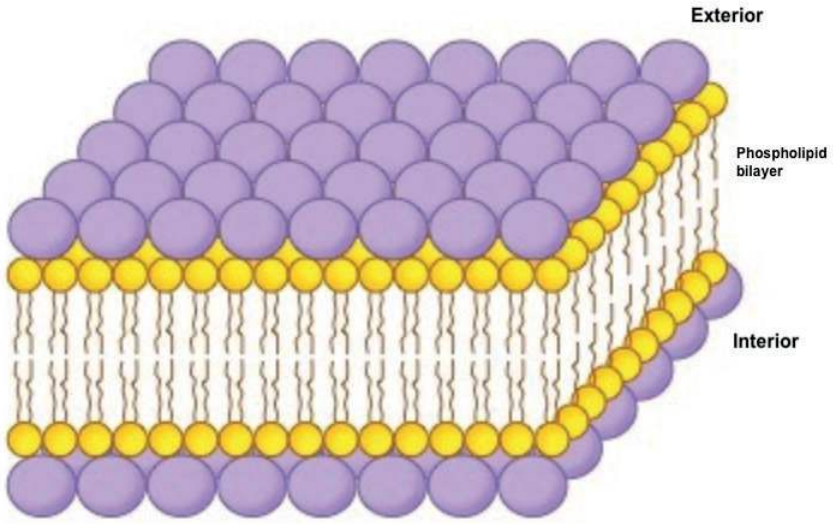
A. Both are found in the cells of Filicinophyta.

B. Both contain grana.

C. Both occur in all eukaryotic cells.

D. Both are found in a *Paramecium*.

3. The Davson–Danielli model of membrane structure proposed that membranes were composed of a phospholipid bilayer that lies between two layers of globular proteins, as shown in this diagram.



What evidence supported this model?

A. An electron micrograph that showed two dark lines with a lighter band in between

B. Freeze-fracture electron microscopy

C. Evidence that all membranes are identical

D. The hydrophobic regions of protein would be in contact with water

4. A human organ is being prepared for transplant. In what type of solution must it be bathed?

A. A hypertonic solution

B. A hypotonic solution

C. Pure water containing no solutes

D. A solution with the same osmolarity as the organ tissue

5. Which living structure is an exception to the cell theory?

A. Striated muscle fibres

B. A single-celled alga carrying out all of the functions of life

C. The artificial synthesis of the organic molecule urea

D. A multicellular organism with cells undertaking specialized roles

6. Which statement applies to cholesterol?

A. It is hydrophobic and found on the outside of the phospholipid bilayer.

B. It is hydrophilic and found inside the phospholipid bilayer.

C. It impacts membrane fluidity.

D. It is transported in association with glucose in the blood.

7. A tissue sample was examined under the microscope in order to determine a mitotic index. The number of cells in each stage of the cell cycle was determined and the data were entered into a table.

Stage of life cycle	Interphase	Prophase	Metaphase	Anaphase	Telophase	Total
Number of cells	120	20	10	8	2	160

What is the mitotic index?

A. 0.125

B. 0.25

C. 0.75

D. 1.00

8. What distinguishes cellulose from glycogen and starch?

A. Only cellulose is found in plants.

B. Only cellulose is made up of glucose monomers.

C. Cellulose is far more branched than starch and glycogen.

D. Cellulose has a structural role whereas starch and glycogen function in energy storage.

9. The hydrolysis of a pure sample of an organic molecule produces a pentose sugar, thymine, guanine and cytosine. What other substances could be expected to be present in the hydrolysed sample?

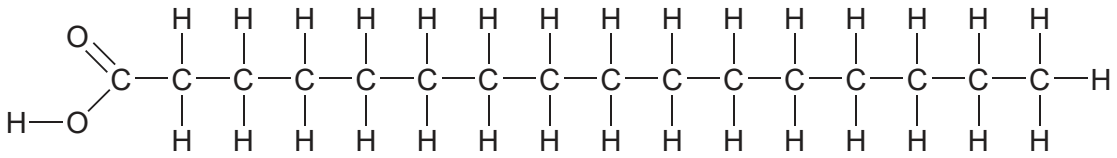
A. RNA

B. Uracil

C. Phosphate

D. ATP

10. Which molecule is depicted in the diagram?



A. A saturated fatty acid

B. An unsaturated fatty acid

C. A trans fat

D. A vegetable oil

11. What is a difference between aerobic respiration and anaerobic respiration in yeast?

A. Anaerobic respiration requires enzymes, aerobic respiration does not.

B. Anaerobic respiration requires glucose, aerobic respiration does not.

C. Anaerobic respiration produces ethanol, aerobic respiration does not.

D. Anaerobic respiration does not produce oxygen, aerobic respiration does.

12. What is the term for the attraction of water molecules to other water molecules?

A. Surface tension

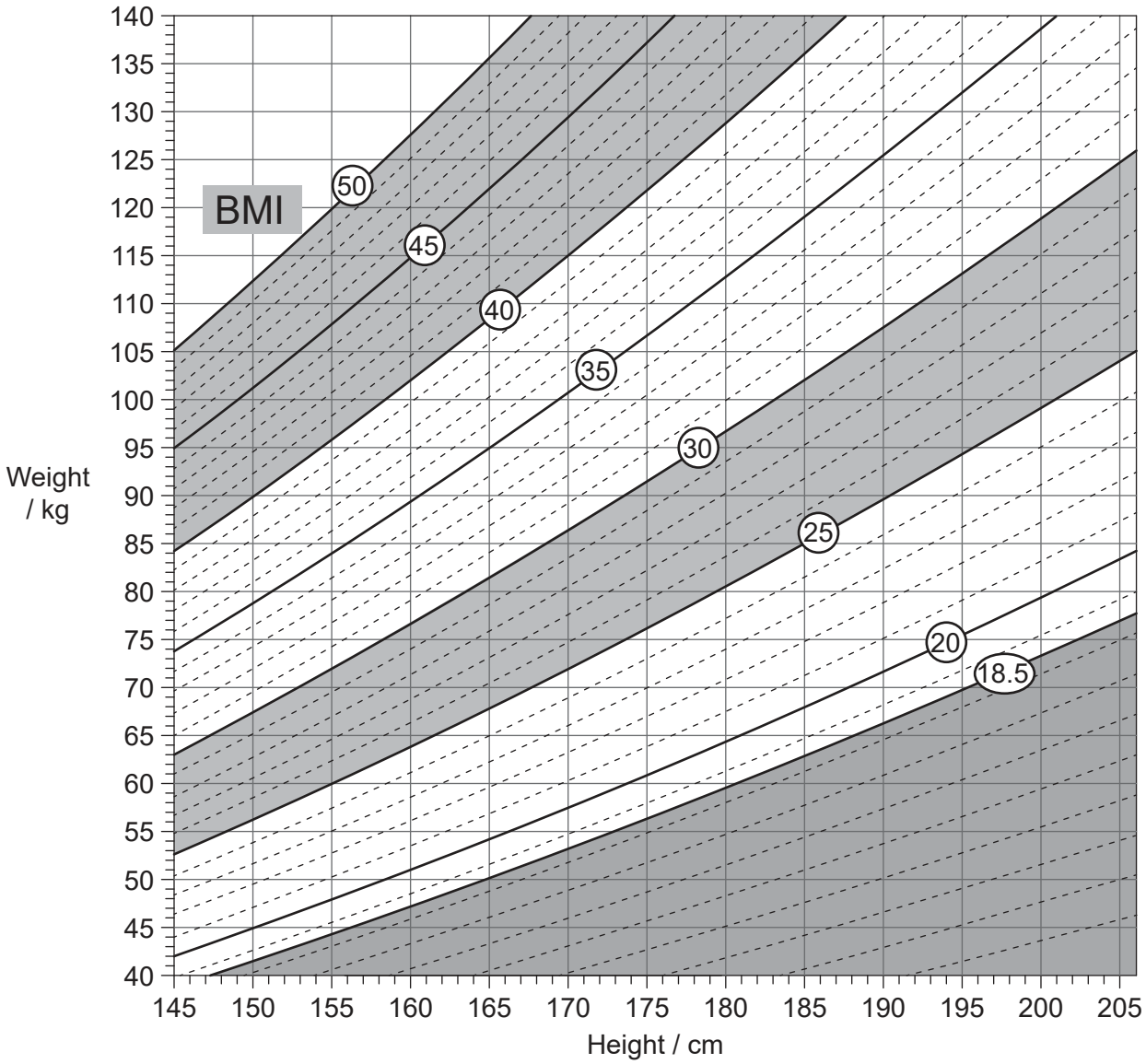
B. Capillary action

C. Cohesion

D. Adhesion

13. The table shows the range and classification of body mass index (BMI) values, as shown in the nomogram.

BMI value	**Less than 18.5**	**18.5 to 24.9**	**25.0 to 29.9**	**30.0 or more**
Classification	underweight	normal weight	overweight	obese



What is the approximate reduction in body mass that a person of height 155 cm and mass 95 kg would have to lose to reach normal body mass?

A. 10 kg

B. 22 kg

C. 36 kg

D. 54 kg

14. Which statement applies to enzymes?

A. Enzyme function depends on collisions between substrate and active sites.

B. One active site typically binds to a broad range of substrates.

C. The active site on the substrate is specific to one enzyme.

D. When enzymes are immobilized they stop working.

15. Which enzyme is matched to its function?

	Enzyme	Function
A.	helicase	forms a DNA helix
B.	DNA polymerase	forms a covalent bond between DNA nucleotides
C.	restriction endonuclease	seals nicks in recombinant DNA
D.	ligase	unwinds the double helix

16. If a plant is exposed to light, which colour of light would lead to the lowest rate of oxygen release by a green plant?

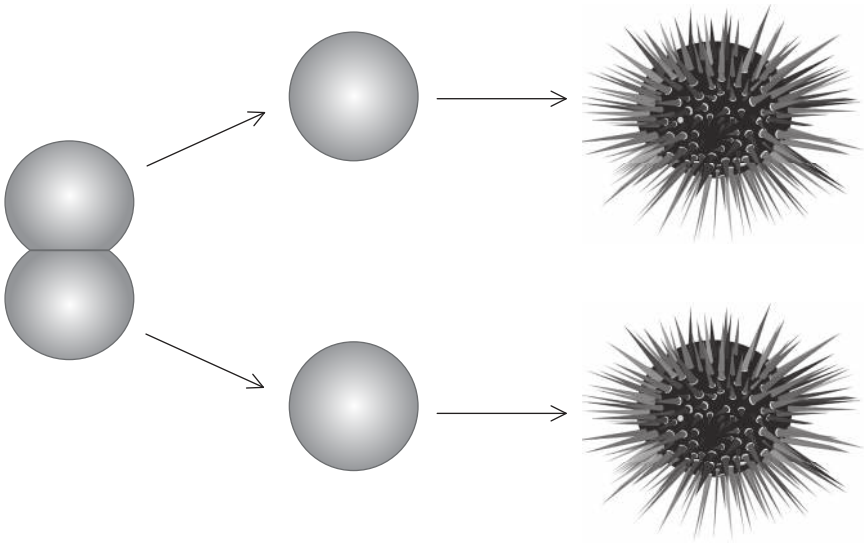
A. Blue

B. Red

C. Green

D. White

17. A two-cell sea urchin (*Echinoidea*) embryo was physically separated by scientists into two cells. Each cell, through further embryonic development, became an adult sea urchin.



What is the relationship between the two adult sea urchins?

A. They are equivalent to non-identical twins.

B. Half of the genes would be the same.

C. Both adults would have haploid cells.

D. They are clones.

18. Which genotype would be normally found in a gamete?

A. Rr

B. RS

C. rStt

D. TUt

19. Which statement applies to meiosis and mitosis?

A. Meiosis occurs in a greater number of locations in the body compared to mitosis.

B. Separation of chromatids occurs in both meiosis and mitosis.

C. Recombination occurs in both meiosis and mitosis.

D. Reduction in chromosome number occurs in both meiosis and mitosis.

20. Over time, the hull of a sunken ship may become colonized by a wide range of marine organisms. What term is used to describe all of the organisms living in and on a sunken ship?

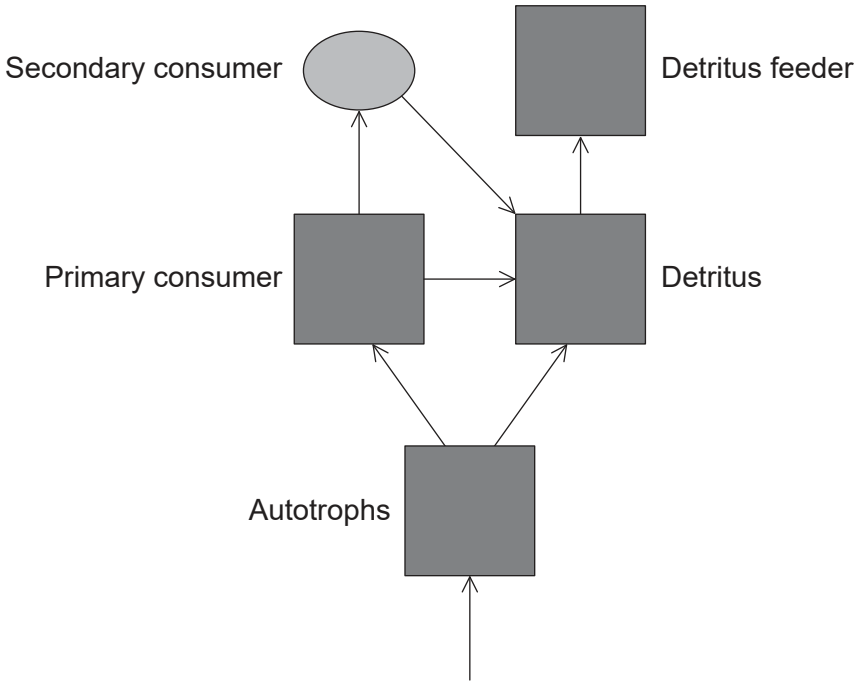
A. A community

B. An ecological niche

C. A population

D. An ecosystem

21. The diagram shows the energy flow between five “sinks” in a terrestrial ecosystem.



In a typical terrestrial ecosystem, which trophic level would have the highest biomass?

A. Autotrophs

B. Primary consumers

C. Secondary consumers

D. Detritus feeders

22. Which process results in decreased variation?

A. Meiosis

B. Mutation

C. Sexual reproduction

D. Natural selection

23. A locust is an arthropod. For invertebrate groups, which recognition feature is found only in arthropods?

A. Bilateral symmetry

B. Jointed appendages

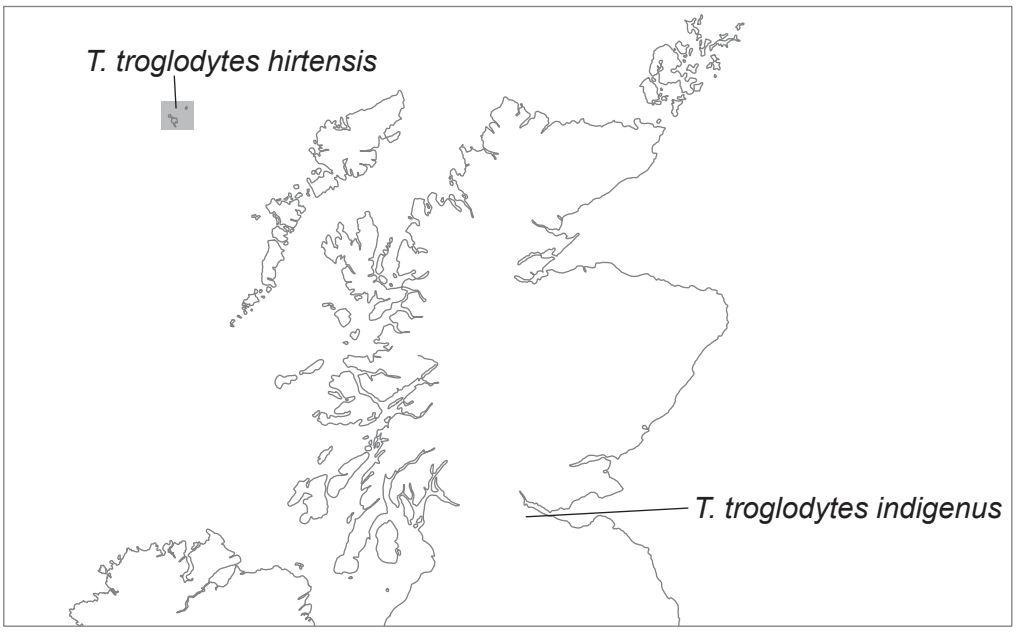
C. Wings

D. Segmented body

24. A dichotomous key can be used to distinguish four types of plant. Which of the plants could be a bryophyte?

1. Vascular tissue present . . . . . go to 2
   Vascular tissue not present . . . . . Plant A.
2. Produces seeds . . . . . go to 3
   Does not produce seeds . . . . . Plant B.
3. Seeds found in cones . . . . . Plant C.
   Seeds found in fruit . . . . . Plant D.

25. On the islands of the St Kilda chain, off the coast of Scotland, there are small birds called St Kilda wrens (*Troglodytes troglodytes hirtensis*). They look similar to wrens on the mainland of Scotland (*Troglodytes troglodytes indigenus*), but they are larger and there are differences in the colour of their feathers.



What is the most likely explanation for these differences?

A. Convergent evolution

B. Stabilizing natural selection

C. Gradual divergence

D. Exposure to similar selection pressures

26. A fluid sample is taken from the digestive tract of a mammal. The sample is basic (alkaline) and able to digest starch and proteins. From which part of the digestive tract was the fluid taken?

A. Mouth

B. Stomach

C. Small intestine

D. Gall bladder

27. What is a property of arteries?

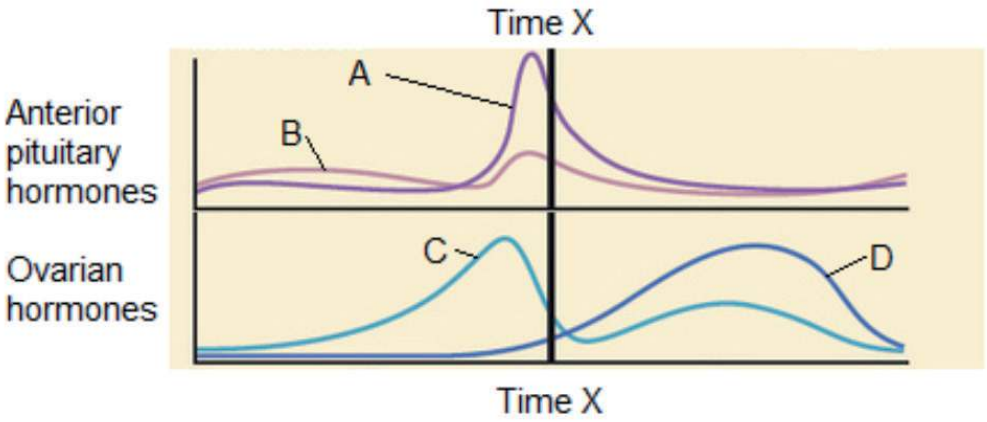
A. Arteries have elastic walls.

B. Arteries have valves.

C. All arteries carry oxygenated blood.

D. Arteries receive blood from the atria.

28. The graph shows the blood levels of hormones associated with the menstrual cycle.



Which line on the graph represents progesterone?

A. Line A

B. Line B

C. Line C

D. Line D

29. What blood flow does the right semilunar valve prevent?

A. Backflow of blood to the right atrium during ventricular contraction

B. Blood flowing from the aorta back into the heart when the ventricle is filling

C. Blood flowing from the pulmonary artery to the right ventricle when the heart is relaxing

D. Blood flowing from the right atrium to the vena cava when the right atrium contracts

30. Which reaction occurs in blood clotting?

A. $\text{fibrinogen} \xrightarrow{\text{thrombin}} \text{fibrin}$

B. $\text{fibrin} \xrightarrow{\text{platelets}} \text{fibrinogen}$

C. $\text{thrombin} \xrightarrow{\text{fibrin}} \text{fibrinogen}$

D. $\text{platelets} \xrightarrow{\text{fibrinogen}} \text{fibrin}$

References:

3. Cornell, B. 2016. https://ib.bioninja.com.au/standard-level/topic-1-cell-biology/13-membrane-structure/membrane-models.html.

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