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**Biology**  
**Higher level**  
**Paper 1**

Wednesday 11 May 2022 (afternoon)

1 hour

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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 **[40 marks]**.

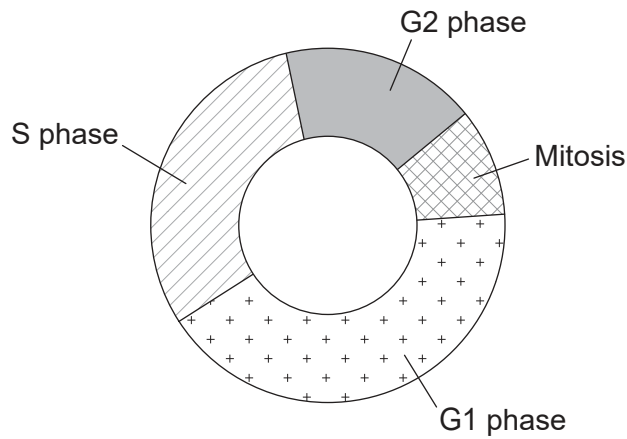
1. Two cells have the following characteristics.

	Cell I	Cell II
Ribosomes	✓	✓
Nucleus	✗	✓
Cell wall	✓	✓
Cytoplasm	✓	✓
Cell respiration	✓	✓
Ability to photosynthesize	✓	✗

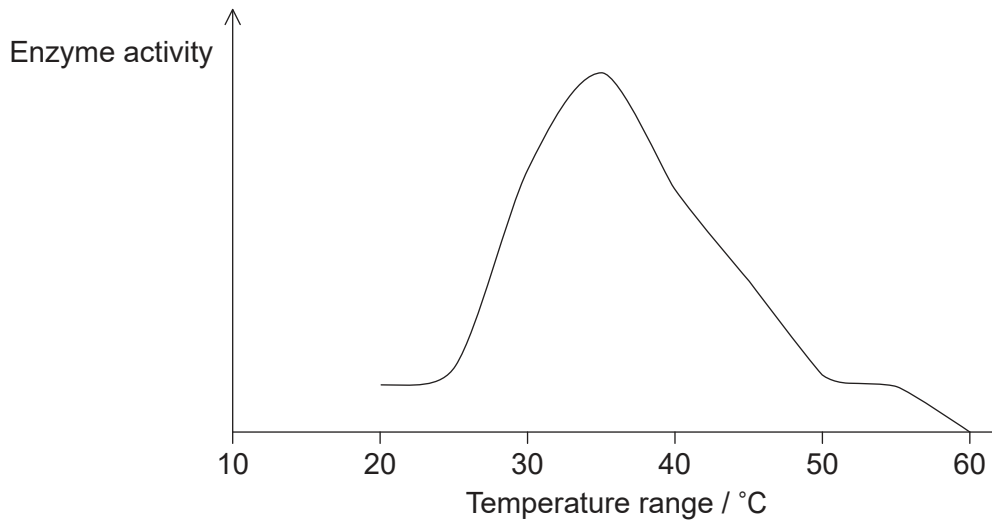
Which deduction is supported by this information?

- A. Both cells are from plants.
  - B. Cell I is more complex than cell II.
  - C. Cell II is an animal cell.
  - D. Cell I is prokaryotic.
2. More than 90% of cellular cholesterol is located in the cell's plasma membrane. What is the main role of cholesterol in the plasma membranes of mammalian cells?
- A. To regulate membrane fluidity
  - B. To increase membrane solubility
  - C. To increase membrane permeability
  - D. To regulate membrane temperature
3. Which cell component arose first during the formation of the earliest cells?
- A. Chloroplast
  - B. Plasma membrane
  - C. Mitochondria
  - D. Cell wall

4. In which stage of the cell cycle are chromosomes duplicated?



- A. G1 phase
  - B. G2 phase
  - C. S phase
  - D. Mitosis
5. The graph shows the activity of an enzyme at various temperatures. The pH of the experiment was kept constant at pH 8.

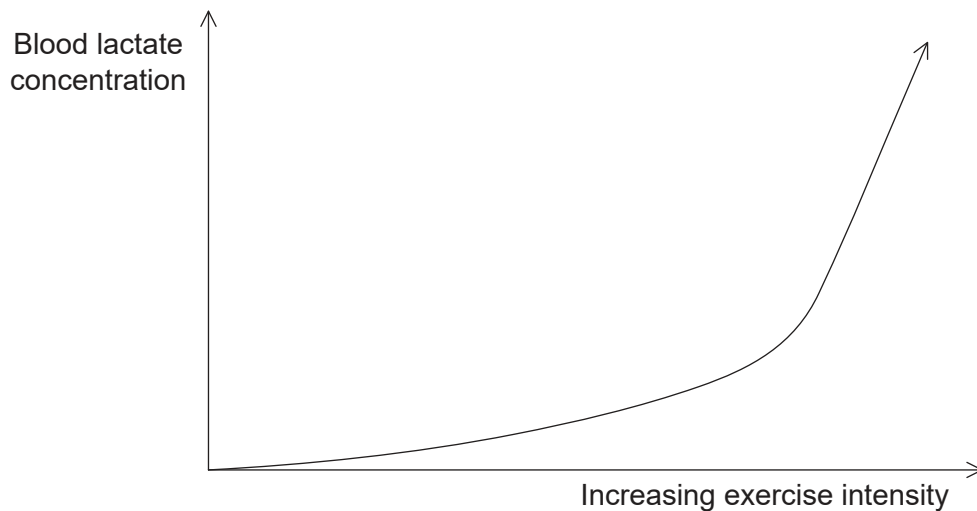


Based on the data, what would the result be if the experiment was repeated at pH 9?

- A. The enzyme activity would be higher.
- B. The results of the enzyme activity would be almost the same.
- C. The enzyme activity would be lower.
- D. There is not enough information to make a reliable prediction.

Turn over

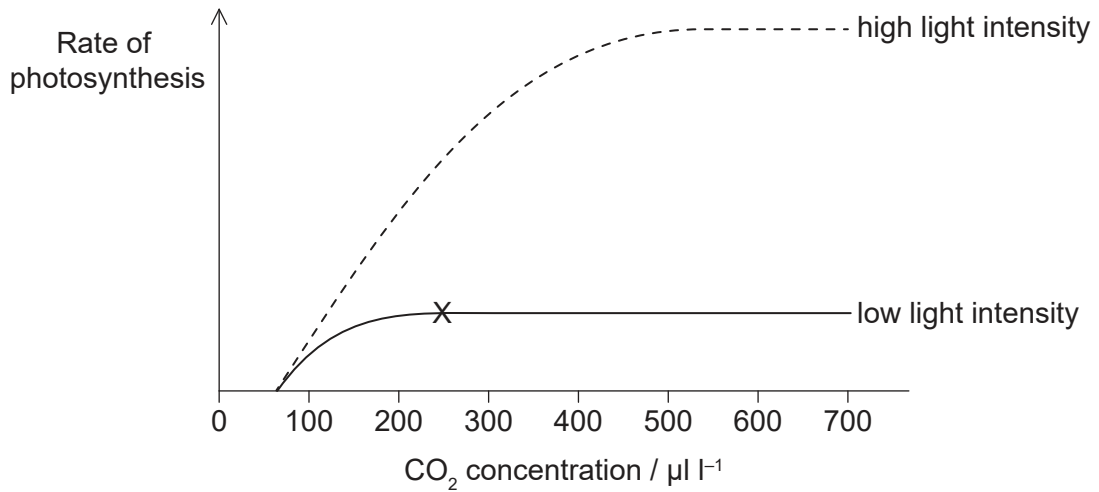
6. A molecule of DNA is found to contain 200 guanine bases, representing 25% of the total number of bases. How many phosphate groups does this molecule of DNA contain?
- A. 50
  - B. 200
  - C. 800
  - D. 1000
7. What is a universal characteristic of the genetic code?
- A. There are more than 64 different anticodons.
  - B. There are more nucleotides than codons.
  - C. There are more codons than amino acids.
  - D. There are two or more amino acids for each codon.
8. The graph shows the changes in lactate measured in an athlete's blood during exercise.



Which hypothesis provides the most likely explanation for the curve?

- A. As exercise intensity increases, lactate is converted back to glucose.
- B. Anaerobic exercise results in high levels of lactate.
- C. Lactate provides energy for intense exercise.
- D. Under anaerobic conditions the body produces less lactate.

9. The graph shows how the rate of photosynthesis of a green plant varies with CO<sub>2</sub> concentration at two different light intensities. The temperature is kept constant at 20 °C.



What is the limiting factor at X?

- A. Chlorophyll
  - B. Light intensity
  - C. Temperature
  - D. CO<sub>2</sub> concentration
10. The table shows the estimated total number of genes in several organisms.

Species	Estimated number of genes
<i>Saccharomyces cerevisiae</i> (a yeast)	6000
<i>Escherichia coli</i> (a bacterium)	3200
<i>Drosophila melanogaster</i> (fruit fly)	14 000
<i>Canis familiaris</i> (domestic dog)	19 000
<i>Oryza sativa</i> (rice)	51 000
<i>Homo sapiens</i> (human)	25 000

What can be deduced from the information in this table?

- A. Throughout evolution, the number of genes increases.
- B. The domestic dog is more closely genetically related to the fruit fly than to the human.
- C. The number of genes does not determine evolutionary success.
- D. Humans produce about half as many proteins as rice.

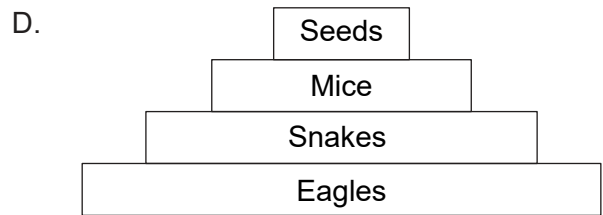
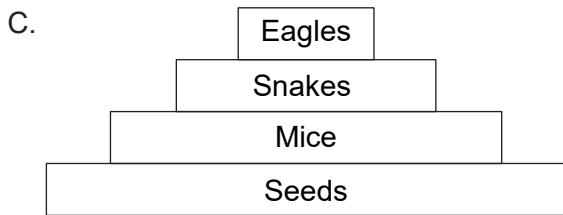
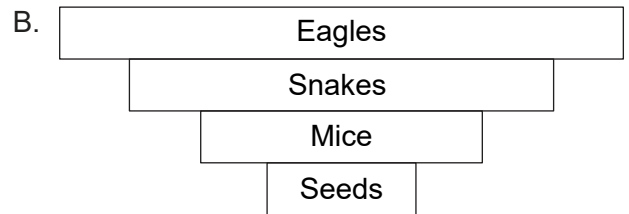
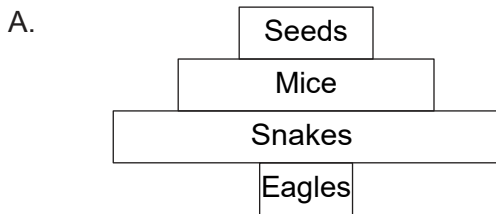
Turn over

11. Chromosome numbers vary between species. Which statement refers to humans?
- A. An egg cell has 22 autosomes.
  - B. A sperm cell has 23 autosomes.
  - C. An egg cell has two X chromosomes.
  - D. A zygote has two autosomes.
12. Which process occurs in meiosis but not in mitosis?
- A. Attachment of spindle fibres to the centromeres of each chromosome
  - B. Movement of homologous chromosomes to opposite ends
  - C. Replication of DNA prior to the start of cell division
  - D. Separation of sister chromatids during anaphase
13. Huntington's disease is an autosomal dominant genetic disease. What are the chances of two parents that are heterozygous for the gene having a child with Huntington's disease?
- A. 25 %
  - B. 50 %
  - C. 75 %
  - D. 100 %

14. The table contains information about the diet of some animals.

Animal	Diet
Snakes	Mice
Eagles	Snakes
Mice	Seeds

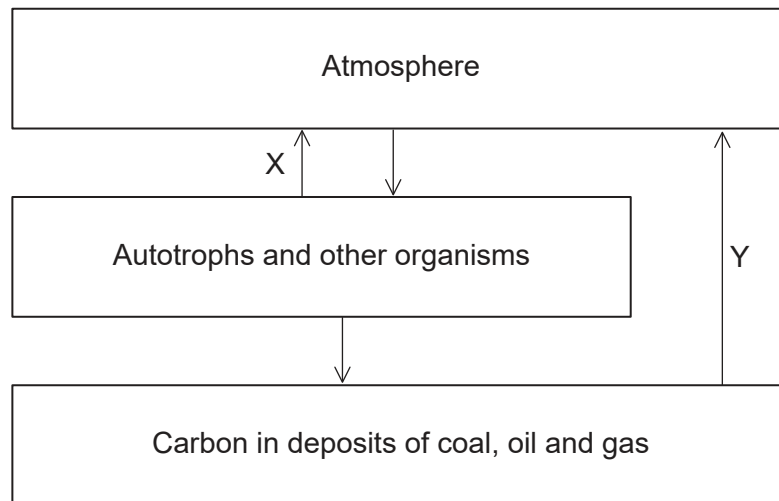
Which pyramid of energy represents this information?



Turn over



15. The diagram shows a simplified carbon cycle.



Which processes are taking place at X and Y?

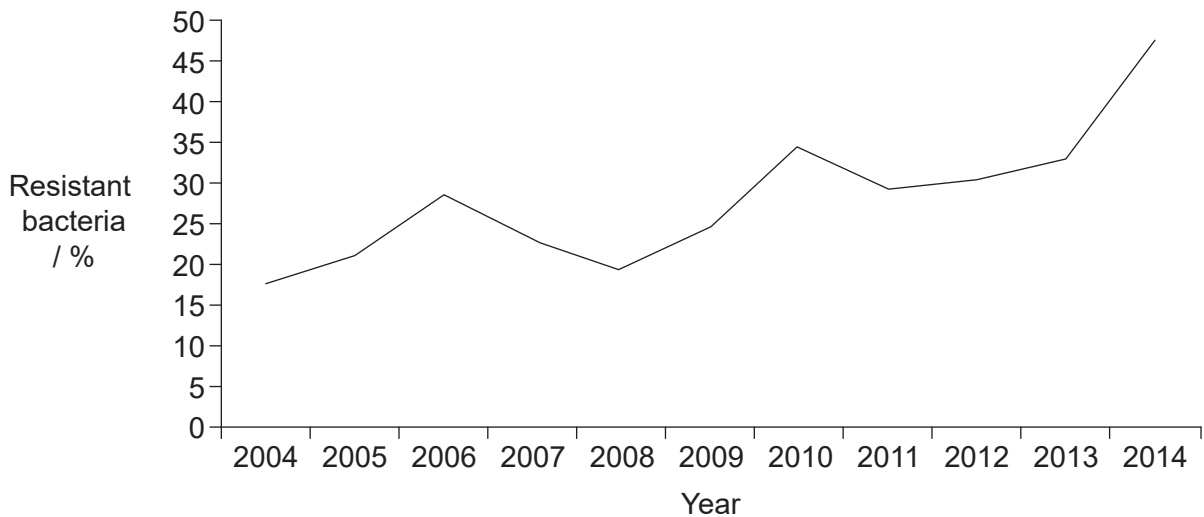
	<b>X</b>	<b>Y</b>
A.	photosynthesis	fossilization
B.	respiration	fossilization
C.	photosynthesis	combustion
D.	respiration	combustion

16. What is a potential consequence of the rise in global temperatures?

- A. Increased exposure to UV light due to ozone depletion
- B. Increase in ocean pH threatening the survival of marine organisms that require calcium carbonate
- C. Decrease in the number and severity of storms due to the increased evaporation
- D. Changes to circulating ocean currents

17. What could be used as evidence for evolution?
- I. Selective breeding of domesticated animals
  - II. The fossil record
  - III. Homologous structures
- A. I and II only
  - B. I and III only
  - C. II and III only
  - D. I, II and III

18. The graph shows the proportion of a bacterial population of *Neisseria gonorrhoeae*, displaying resistance to the antibiotic tetracycline.



What can be deduced from this graph?

- A. Bacteria with beneficial adaptations survive and pass on their genes.
- B. Immunity to tetracycline is triggered by over-use of the antibiotic.
- C. Genetic variation in this bacterial population is increasing.
- D. Use of tetracycline inhibits the growth of antibiotic-resistant *N. gonorrhoeae*.

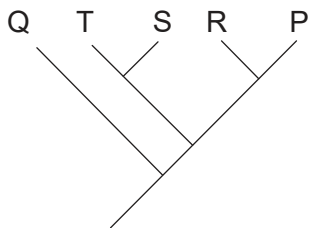
Turn over

19. Data regarding the presence (+) or absence (-) of five traits in several different species are shown in the table.

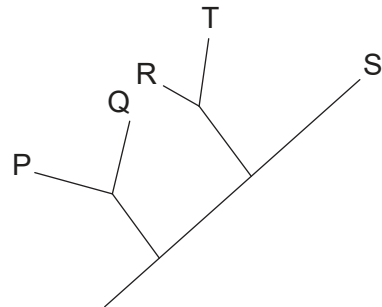
Species	Traits				
	1	2	3	4	5
P	+	-	-	+	+
Q	-	-	-	-	-
R	+	-	-	-	+
S	+	+	+	-	-
T	+	+	-	-	-

Which cladogram best represents the relationship between the five species?

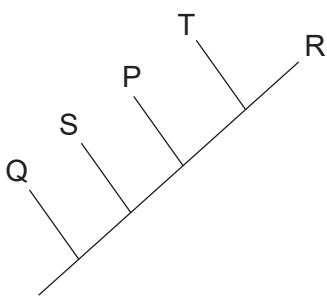
A.



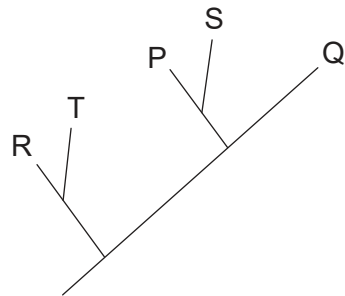
B.



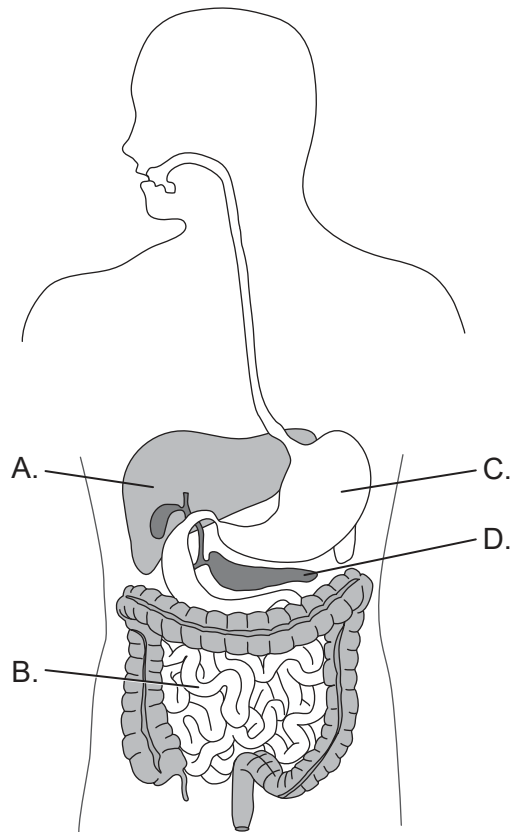
C.



D.

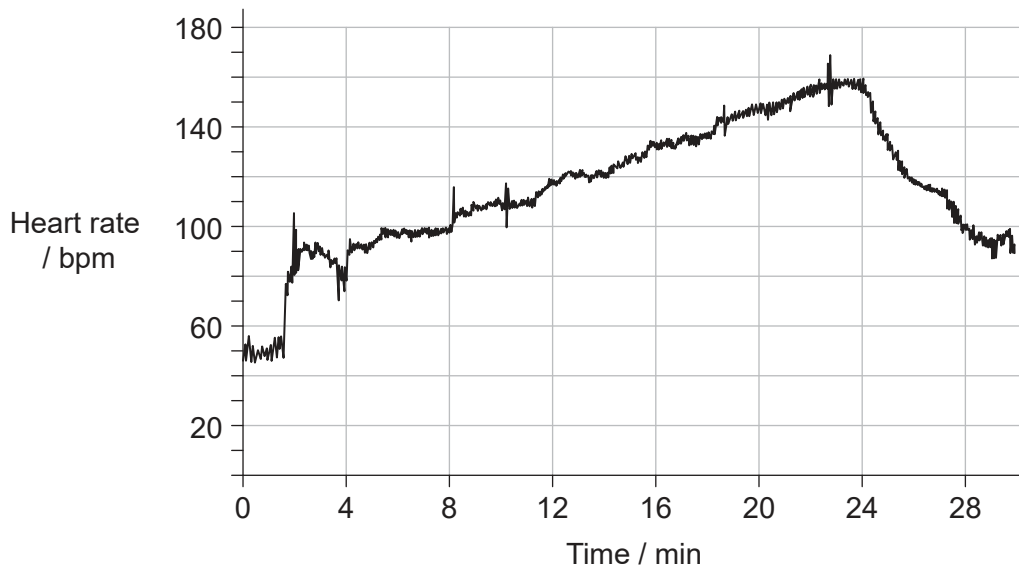


20. Where in the digestive system are lipids broken down?



Turn over

21. The image shows the changes in heart rate of an athlete during exercise.



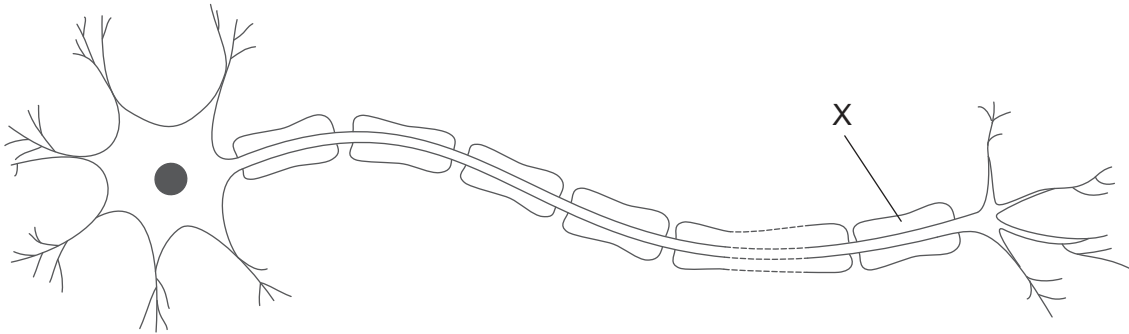
What is likely to have occurred between 0 and 4 minutes and between 24 and 28 minutes?

	Between 0 and 4 minutes	Between 24 and 28 minutes
A.	Epinephrine is secreted	More blood is sent to the rest of the body than to the lungs
B.	More blood is sent to the lungs than to the rest of the body	Epinephrine is secreted
C.	Epinephrine is secreted	Impulses are sent from the medulla of the brain to the heart
D.	Impulses are sent from the medulla of the brain to the heart	Epinephrine is secreted

22. Blood clotting involves a cascade of reactions. Which statement describes the blood-clotting process?

- A. Red blood cells release clotting factors that result in the production of fibrin.
- B. Clotting factors trigger the conversion of the inactive thrombin to prothrombin.
- C. Insoluble fibrinogen is converted into soluble fibrin.
- D. Fibrin forms a mesh that traps platelets and blood cells.

23. A cell from the lungs, observed under the microscope, contains a large number of secretory organelles. Which conclusion can be drawn about the cell?
- A. It is a type I pneumocyte.
  - B. It is a type II pneumocyte.
  - C. It could be either a type I or type II pneumocyte.
  - D. It is a red blood cell.
24. The image shows a neuron.



What is the function of X?

- A. Increases the speed of transmission along the axon
- B. Increases the rate of exchange of sodium and potassium ions
- C. Holds bundles of neurons together to form a nerve
- D. Determines the direction of the action potential

Turn over

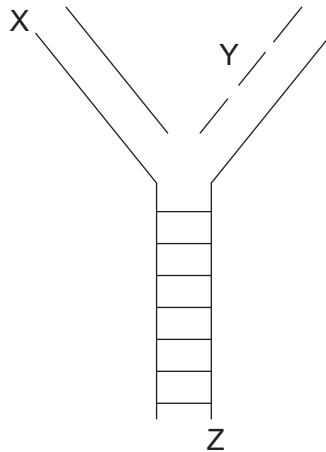
25. Leptin helps to regulate body mass in humans and mice. The image shows an obese mouse (O) and a normal mouse (N).



What hypothesis could account for the differences between the mice?

- A. The hypothalamus of mouse O stopped producing leptin.
- B. Adipose cells of mouse O are continuously producing leptin.
- C. Mouse N has a defective leptin receptor.
- D. Leptin binds to receptors in the hypothalamus of mouse N.

26. The image shows a replication fork.



Which row identifies X, Y and Z in the diagram?

	<b>X</b>	<b>Y</b>	<b>Z</b>
A.	5' end	DNA leading strand	5' end
B.	3' end	Okazaki fragment	3' end
C.	3' end	DNA leading strand	5' end
D.	5' end	Okazaki fragment	3' end

27. During modification in eukaryotes, mRNA is spliced. What is splicing of mRNA?

- A. Separation of mRNA from DNA during transcription
- B. The removal of non-coding RNA sections in prokaryotic cells
- C. Linking together exons
- D. Replacement of primers with RNA bases

Turn over



28. This DNA sequence was used to synthesize a polypeptide.

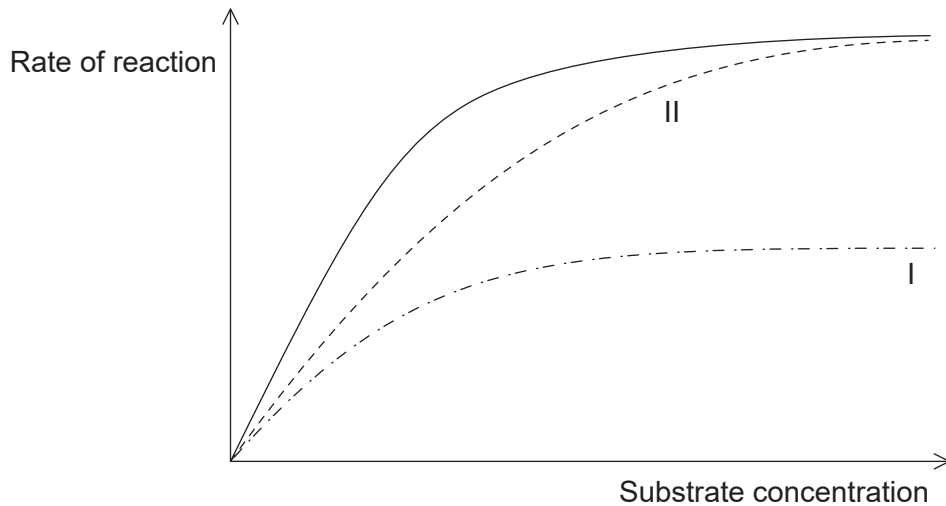
DNA (sense strand): 3' T A C T G A 5'

DNA (template strand): 5' A T G A C T 3'

Which are the bases of the tRNA (anticodons)?

- A. T A C T G A
- B. U A C U G A
- C. A U G A C U
- D. A T G A C T

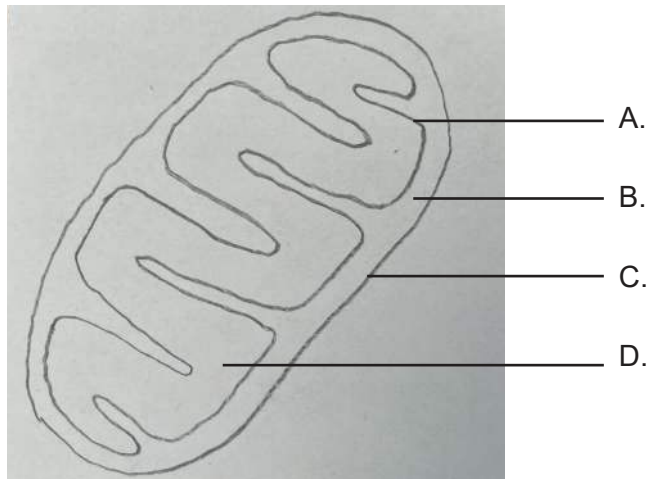
29. The graph shows the effect of increasing substrate concentration on the rate of an enzyme-catalysed reaction.



Which type of inhibition corresponds to the labelled curves?

	I	II
A.	Competitive inhibition	No inhibition
B.	Non-competitive inhibition	Competitive inhibition
C.	Competitive inhibition	Non-competitive inhibition
D.	No inhibition	Competitive inhibition

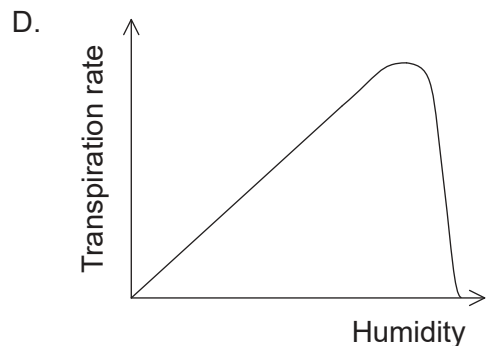
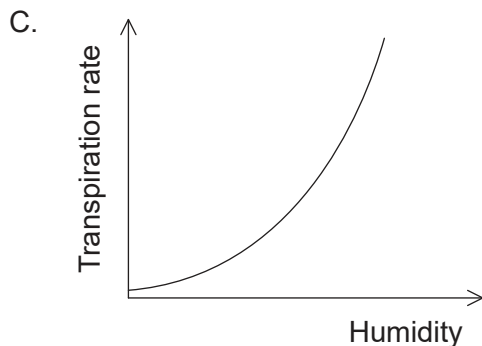
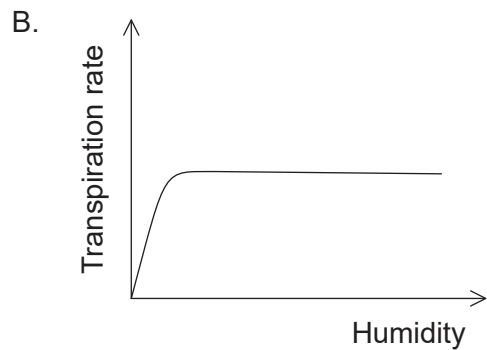
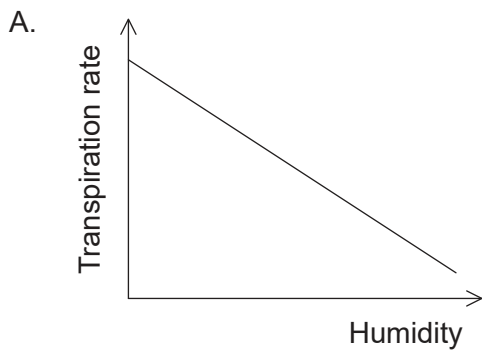
30. Where in the mitochondrion does the formation of acetyl CoA occur?



31. Which products of the light-dependent reactions are used in the Calvin cycle?

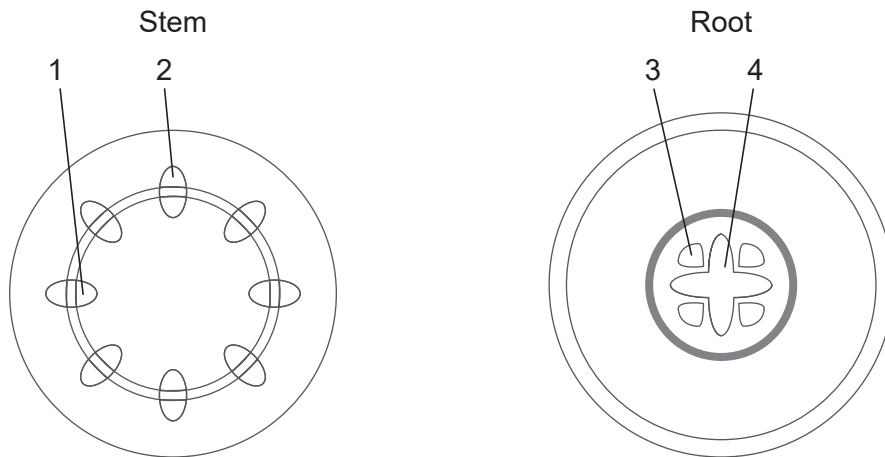
- A.  $O_2$  and hydrogen ions
- B. ATP and  $CO_2$
- C. Electrons and reduced NADP
- D. ATP and reduced NADP

32. Which graph represents the effect of humidity on the transpiration rate in plants?



Turn over

33. The diagrams represent cross sections of the stem and root of a plant.



Which tissues transport water in the stem and the root?

	Stem	Root
A.	1	3
B.	2	3
C.	1	4
D.	2	4

34. What is an aspect of indeterminate growth in plants?

- A. The shoot apex retains undifferentiated cells that can divide repeatedly to produce new leaves.
- B. The shoot can grow in any direction to maximize absorption of light for photosynthesis.
- C. Some buds on the stem grow to produce side-shoots but others never develop.
- D. Some plants grow faster than others.

35. What is polyploidy?

- A. Having an extra set of chromosomes
- B. Having an extra sex chromosome
- C. Having an extra autosome
- D. Having two or more nuclei

36. An individual is heterozygous for two linked genes  $\frac{AB}{ab}$ .

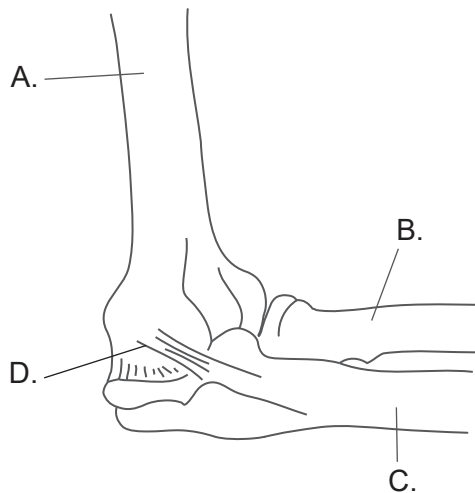
To investigate the frequency of crossing over, a test cross is carried out between the individual and another that is homozygous recessive for both genes. What are the possible recombinants in the offspring of this cross?

- A.  $\frac{Ab}{ab}$  and  $\frac{Ab}{ab}$
- B.  $\frac{AB}{ab}$  and  $\frac{Ab}{aB}$
- C.  $\frac{Ab}{ab}$  and  $\frac{aB}{ab}$
- D.  $\frac{AA}{aa}$  and  $\frac{BB}{bb}$

37. Which mechanism prevents polyspermy?

- A. Polar body formation
- B. The acrosome reaction
- C. Spermatogenesis
- D. The cortical reaction

38. The diagram shows the side view of the human elbow. Which structure is the radius?



Turn over

39. Glucose moves from the filtrate in the nephron into the bloodstream during normal kidney function. Which location and method describe this movement of glucose?

	Location	Method
A.	Glomerulus	Ultrafiltration
B.	Proximal convoluted tubule	Ultrafiltration
C.	Glomerulus	Active transport
D.	Proximal convoluted tubule	Active transport

40. What is the role of HCG in early pregnancy?

- A. It prevents the degeneration of the corpus luteum in the ovary.
- B. It initiates the development of the uterus lining.
- C. It inhibits the production of estrogen.
- D. It stimulates uterine contractions.

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**References:**

- 4. M11lx, 2019. Cell cycle simple pl. [online] Available at: [https://commons.wikimedia.org/wiki/File:Cell\\_cycle\\_simple\\_pl.png](https://commons.wikimedia.org/wiki/File:Cell_cycle_simple_pl.png) This file is licensed under the Creative Commons Attribution-Share Alike 4.0 International license. <https://creativecommons.org/licenses/by-sa/4.0/deed.en> [Accessed 1 August 2019].
- 18. © All rights reserved. *Canadian Antimicrobial Resistance Surveillance System Report, 2016*. Public Health Agency of Canada. Adapted and reproduced with permission from the Minister of Health, 2022.
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- 25. [Obesity in mice]. [image online] Available at: <https://commons.wikimedia.org/wiki/File:Fatmouse.jpg> Oak Ridge National Laboratory, U.S. Department of Energy.

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