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]**.

8825 – 6007

22 pages

1. Which characteristic of the ringed seal (*Pusa hispida*) is a consequence of the viscosity of water?

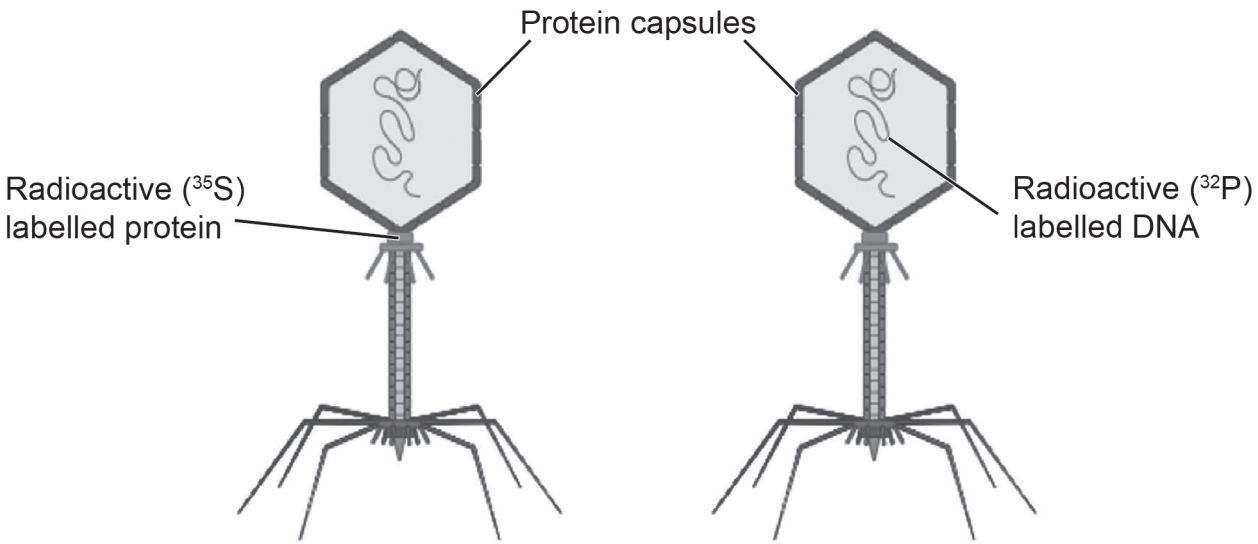
A. Streamlined body

B. Sharp teeth

C. Claws

D. Lungs

2. Hershey and Chase used bacteriophages to investigate the chemical nature of genes. The phosphorus in the DNA and the sulphur in the protein of the bacteriophages were radioactively labelled.



The data obtained after the infection and then centrifugation of bacterial cells is shown in the table.

Sample source	Supernatant	Pellet
Concentration of radioactive sulphur	high	low
Concentration of radioactive phosphorus	low	high

What did Hershey and Chase conclude from their experiment?

A. Viral DNA was found within the bacterial cells.

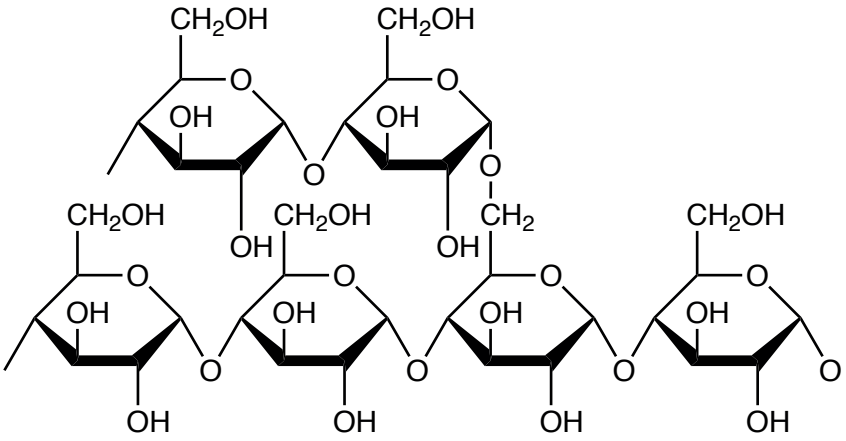
B. Viruses infect bacterial cells with proteins.

C. DNA was mainly outside the bacterial cells.

D. Neither protein nor DNA were chemicals making up genes in viruses.

3. Which molecular diagram shows a phospholipid molecule?

A.



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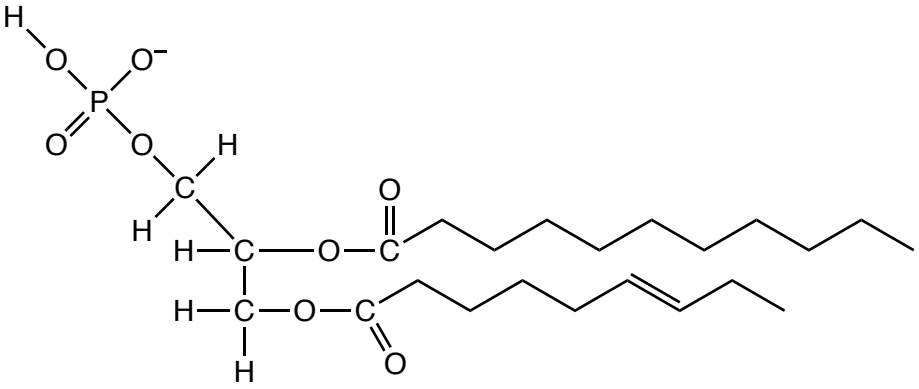

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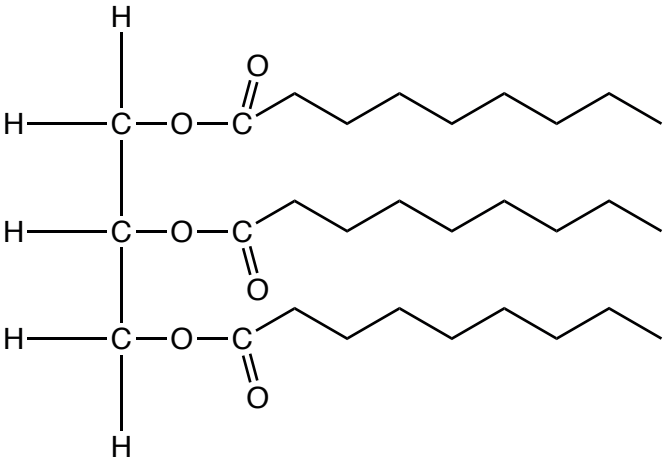

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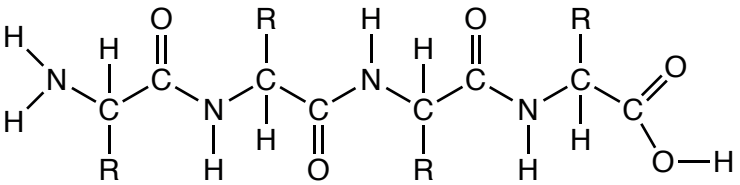
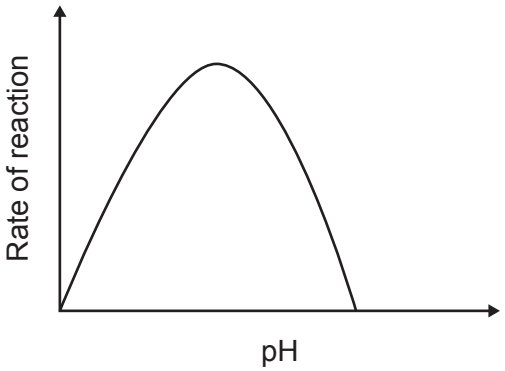


4. Which molecule is paired with the component of the cell membrane that allows it to pass through the membrane?

	Molecule	Component of the cell membrane
A.	insulin	aquaporin
B.	glycogen	channel protein
C.	oestradiol	phospholipid bilayer
D.	carbon dioxide	pump protein

5. Which graph shows the effect of pH on the rate of most enzyme-catalysed reactions?

A.



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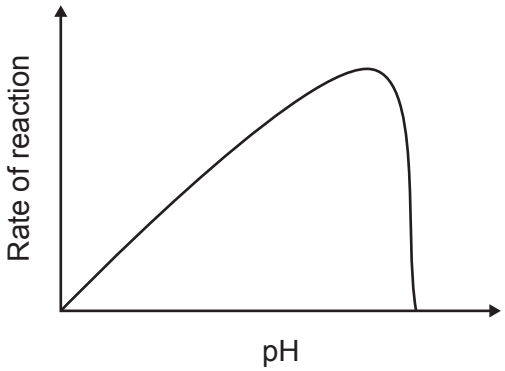

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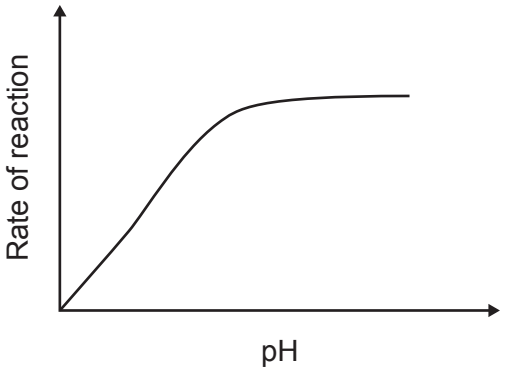
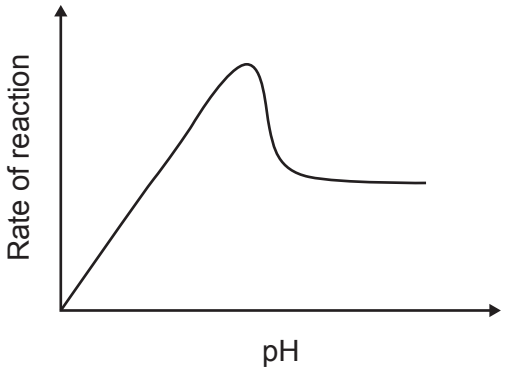
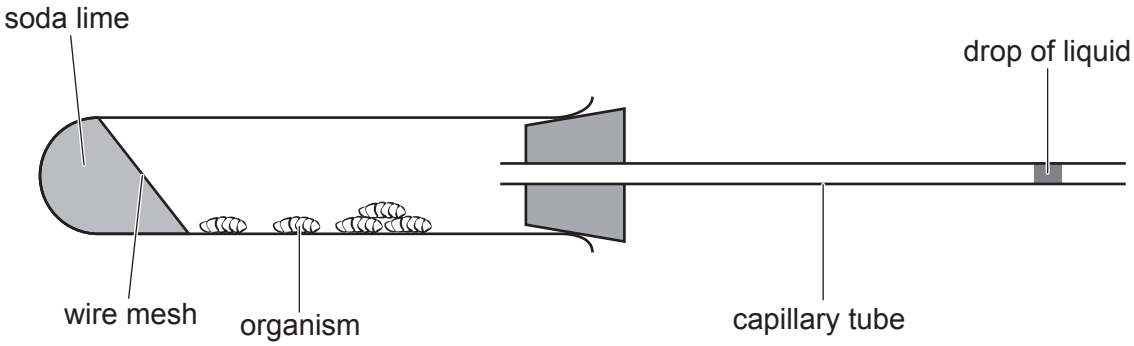


D.



6. The diagram shows a simple respirometer used to measure the rate of respiration. Soda lime is used to absorb carbon dioxide.



Which way will the drop of liquid move if the organisms are respiring aerobically?

A. The drop of liquid will not move as the volume of oxygen used in respiration equals the volume of carbon dioxide produced.

B. The drop of liquid will move left as oxygen is used up by the respiring organisms.

C. The drop of liquid will move right as carbon dioxide is produced by respiring organisms.

D. The drop of liquid will move right as carbon dioxide is produced and then left as oxygen is consumed.

7. Which of the following statements describes part of the Krebs cycle?

A. Reduced NAD is converted back to NAD.

B. A 4-carbon citrate binds with acetyl-CoA to form a 6-carbon intermediate.

C. Two decarboxylation reactions occur.

D. One ATP molecule is used in one stage of the cycle.

8. What occurs in photosynthesis?

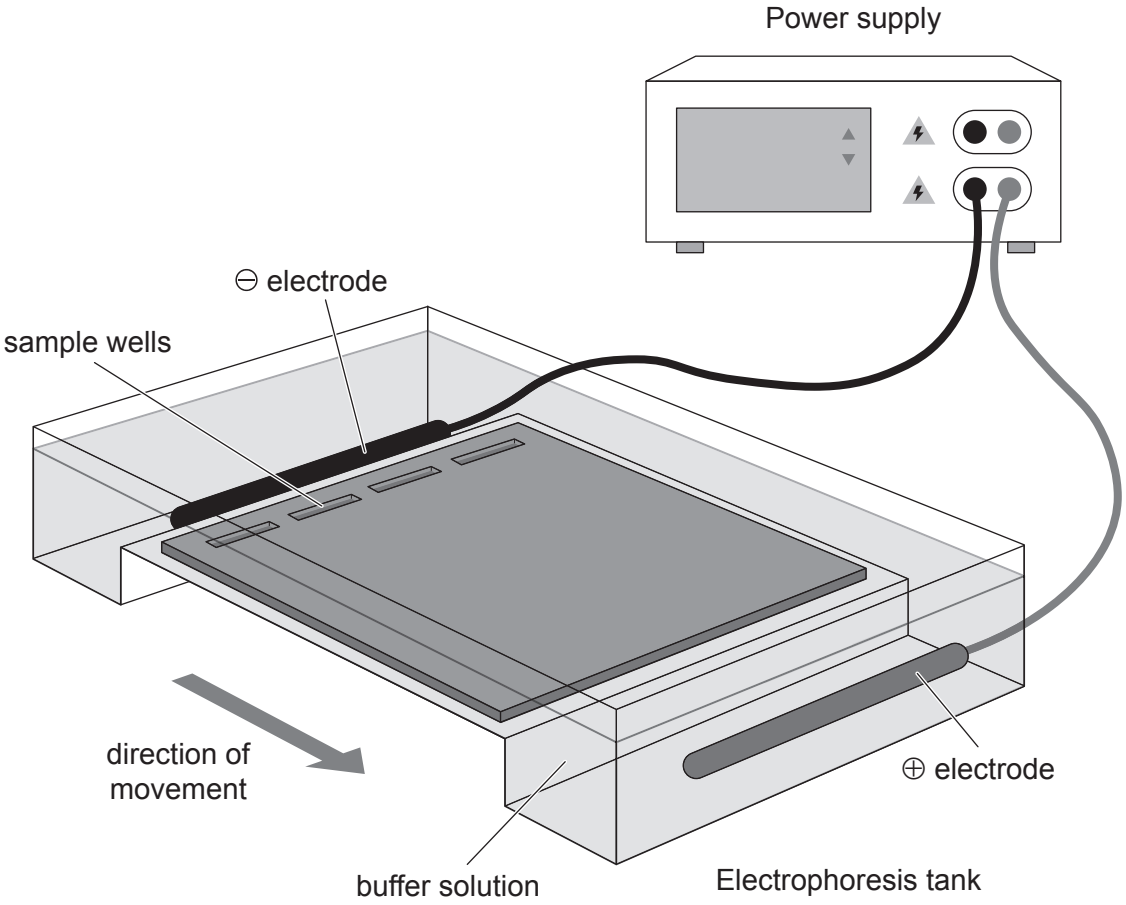
A. Photolysis occurs in photosystem I.

B. Electron transport chain synthesises ATP in the outer membrane of the chloroplast.

C. Oxidation of NADP occurs in photosystem I.

D. Photosystems I and II emit excited electrons.

9. Samples of DNA can be separated by gel electrophoresis.



Which fragments of DNA would travel the furthest on the gel?

	Fragment size / kB	Fragment charge
A.	4	negative
B.	10	negative
C.	10	positive
D.	2	positive

10. The table shows information on the genetic code of four different mRNA sequences. Which sequence demonstrates degeneracy in the genetic code?

	mRNA sequence	Amino acids
A.	UUU UUA UCU	Phe Leu Ser
B.	CUU CCU CUU	Leu Pro Leu
C.	AUG ACG AAG	Met Thr Lys
D.	GUU GGU GUG	Val Gly Val

11. Two DNA sequences are shown.

Sequence 1 CACGTGGACTGAGGACTCCTC

Sequence 2 CACGTGGACTGAGGACACCTC

What type of mutation is occurring between sequence 1 and sequence 2?

A. Substitution

B. Polyploidy

C. Insertion

D. Deletion

12. What mode of existence do viruses exhibit?

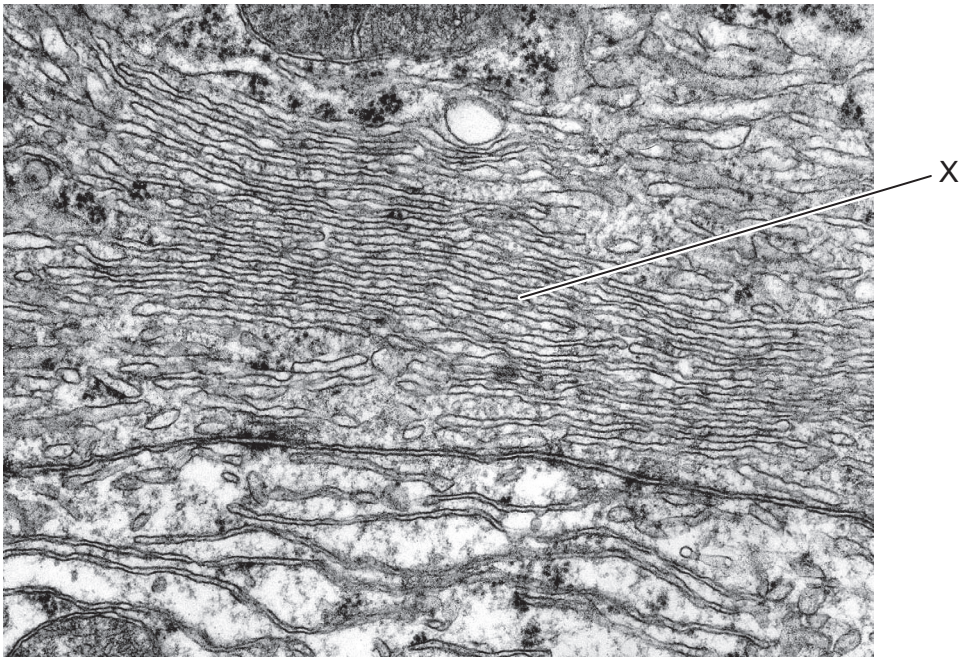
A. Obligate parasite

B. Facultative parasite

C. Obligate heterotroph

D. Predator

13. The electron micrograph shows part of a eukaryotic cell.



What is the organelle labelled X?

A. Mitochondrion

B. Smooth endoplasmic reticulum

C. Lysosome

D. Nucleus

14. Which type of protein uses energy from ATP to transfer particles across membranes against a concentration gradient?

A. Glycoprotein

B. Pump protein

C. Aquaporin

D. Channel protein

15. The table shows two types of gated ion channels in neurons. How are they gated?

	Nicotinic acetylcholine receptors	Potassium channels
A.	voltage	neurotransmitter
B.	neurotransmitter	voltage
C.	voltage	voltage
D.	neurotransmitter	neurotransmitter

16. Eukaryotic cells have membrane-bound organelles. What is a property of one of these organelles?

A. The rough endoplasmic reticulum synthesises lipids for use outside the cell.

B. The nucleus has a double membrane to allow vesicle formation for intracellular transport.

C. The mitochondrion has enzymes and substrates of the Krebs cycle compartmentalized in the matrix.

D. The Golgi apparatus uses ribosomes to synthesise proteins for export from the cell.

17. What is an example of quorum sensing?

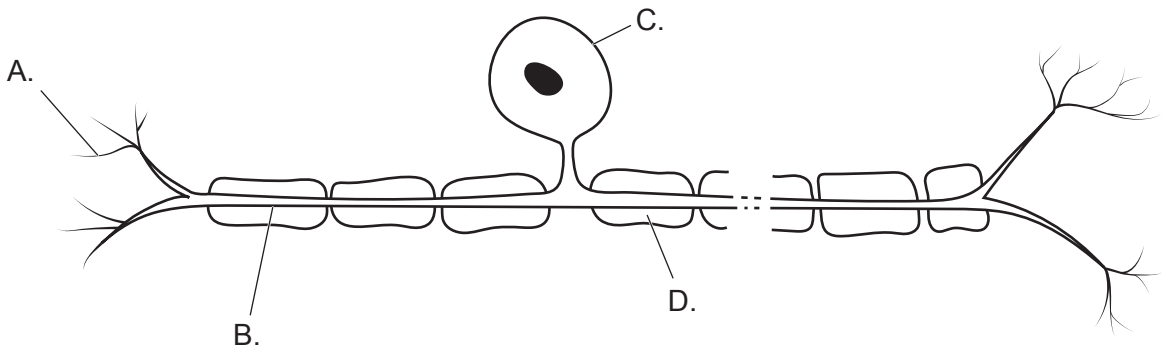
A. Expression of incomplete dominance by *Mirabilis jalapa* flowers

B. Spring growth of the Arctic mouse-ear chickweed *Cerastium arcticum*

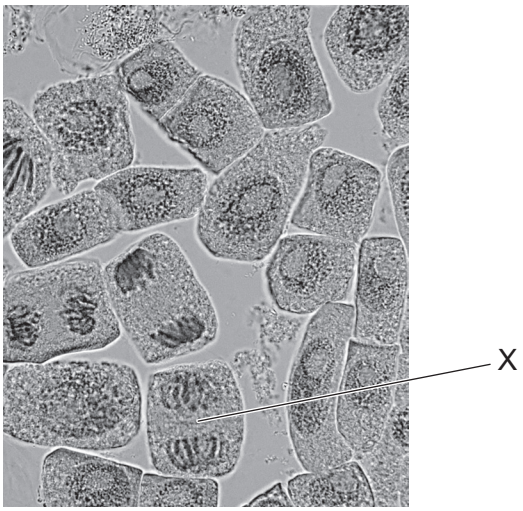
C. Bioluminescence in the marine bacterium *Vibrio fischeri*

D. Biochemical control of lactase synthesis in *Escherichia coli* bacteria

18. The image shows a neuron. Which letter shows a dendrite?



19. The micrograph shows cells in an onion root (*Allium cepa*) undergoing mitosis.



What is happening at X?

A. Unequal cytokinesis by budding

B. Assembly of cell membrane and cell wall by vesicles

C. Contraction of a ring of actin and myosin proteins

D. Movement of chromosomes by microtubules

20. The water potential of a plant cell is –0.24 kPa. If the pressure potential of the cell is 0.46 kPa, what is the solute potential of that cell?

$$\Psi_w = \Psi_s + \Psi_p$$

A. 0.22 kPa

B. –0.22 kPa

C. 0.70 kPa

D. –0.70 kPa

21. The table shows the binomial naming of four species.

Organism	Genus	Species
W	*Felis*	*catus*
X	*Conus*	*catus*
Y	*Ameiurus*	*catus*
Z	*Felis*	*silvestris*

What can be concluded?

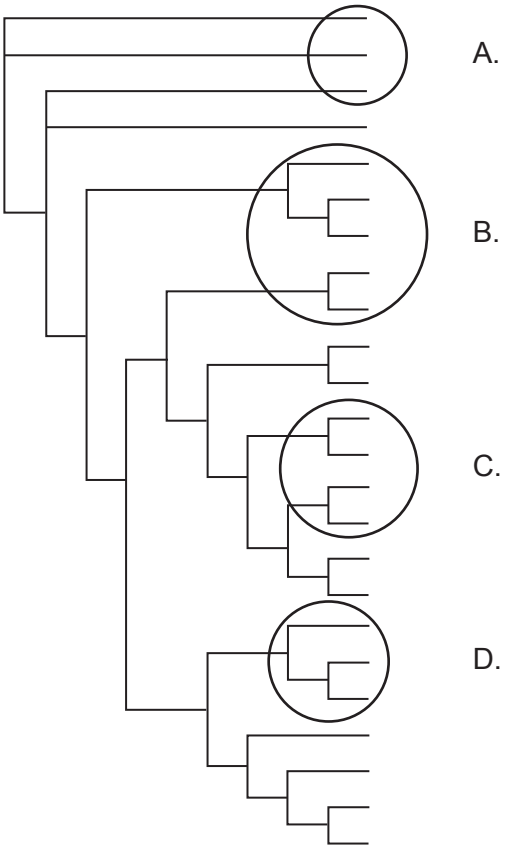
A. W, X and Y are the most closely related.

B. X and Y are the most closely related.

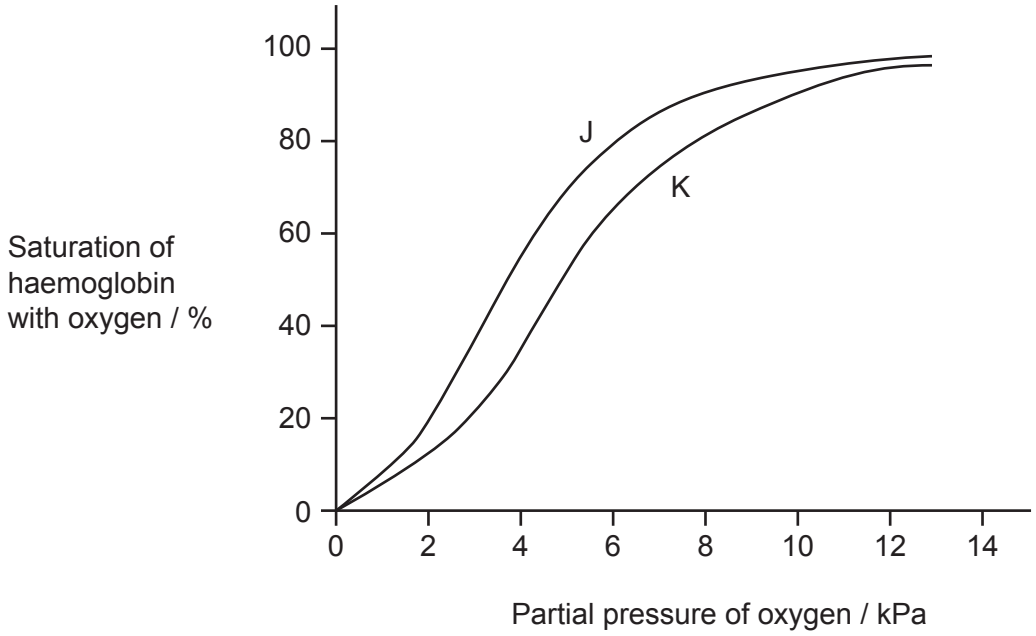
C. W and Z are the most closely related.

D. W is equally related to all the other species.

22. Which encircled area shows a clade?



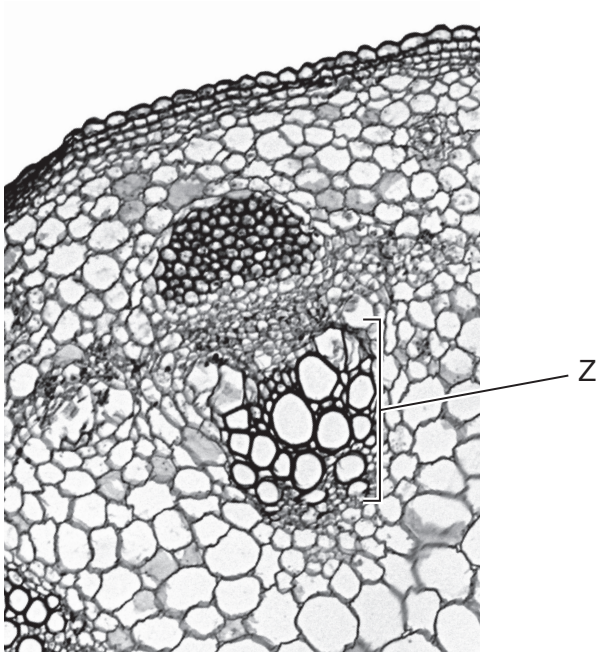
23. The graph shows the Bohr shift.



What causes the shift from J to K?

	Carbon dioxide concentration	pH
A.	decrease	higher
B.	decrease	lower
C.	increase	higher
D.	increase	lower

24. The micrograph shows part of the stem of the common sunflower (*Helianthus annuus*) in cross section.



What is the name and function of the structure labelled Z?

	Name	Function
A.	xylem	transport water
B.	phloem	transport water
C.	xylem	transport sugars
D.	phloem	transport sugars

25. How is the phloem adapted for transport?

A. Sieve tube elements have many mitochondria for active transport.

B. Plasmodesmata between companion cells and sieve tube elements aid transport between them.

C. Phloem tubes unload carbon compounds at sources by pressure flow.

D. Companion cells have reduced cytoplasm to enhance loading of carbon compounds.

26. Which is the effector in a pain reflex arc?

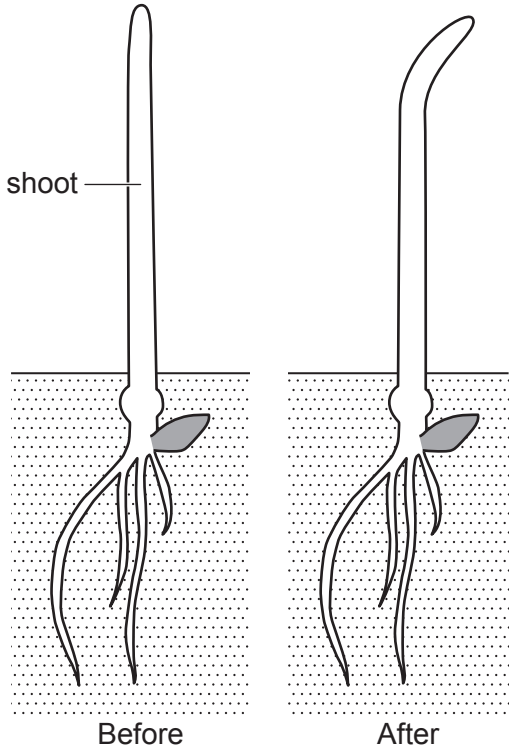
A. Skeletal muscle

B. Sensory nerve ending

C. Pituitary gland

D. Grey matter of spinal cord

27. The image shows the response of a plant shoot to light exposure.



[Source: Kutschera, Ulrich & Niklas, Karl. (2009). Evolutionary plant physiology: Charles Darwin's forgotten synthesis. *Naturwissenschaften*. 96. 1339–1354, Springer Nature. Available at https://link.springer.com/article/10.1007/s00114-009-0604-z.]

What facilitates this response?

I. Auxin efflux carriers are located on one side of the cell.

II. Auxin promotes hydrogen ion secretion.

III. Cell walls become acidified and cellulose cross links are loosened.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

28. Which function is primarily associated with helper T-cells in the immune system?

A. Phagocytosis of pathogens

B. Activation of other cells in the immune system

C. Antibody production

D. Retention as memory cells

29. Oogenesis and spermatogenesis produce gametes. What is the sequence of events in gamete formation?

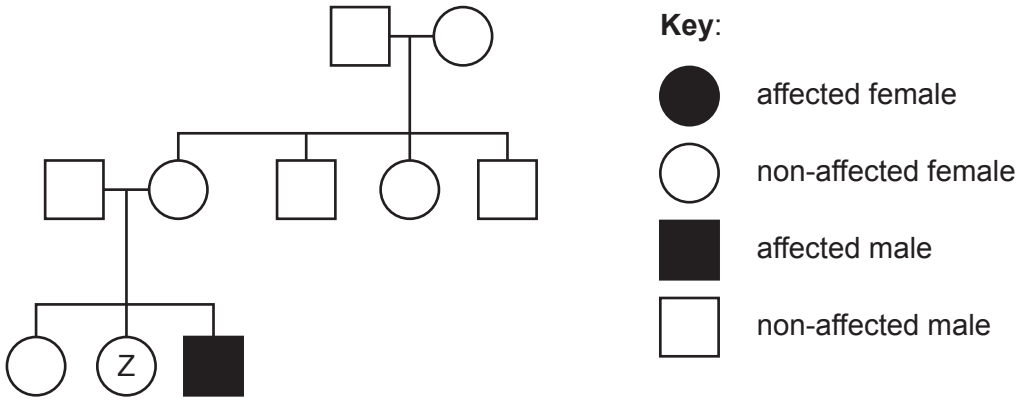
A. Mitosis → differentiation → meiosis → cell growth

B. Meiosis → differentiation → mitosis → cell growth

C. Mitosis → cell growth → meiosis → differentiation

D. Meiosis → cell growth → mitosis → differentiation

30. The pedigree chart shows the incidence of colour blindness in three generations of a family. Colour blindness is caused by a sex-linked recessive allele.



What could the genotype of individual Z be?

A. X^BX^B only

B. X^BX^b only

C. X^BX^B or X^BX^b

D. X^bX^b or X^BX^b

31. A heterozygous fruit fly (*Drosophila melanogaster)* with straight wings and red eyes was crossed with a curly-winged, sepia-eyed homozygous fruit fly. The offspring produced are shown in the table.

Phenotype	Number of offspring
straight wings, red eyes	25
straight wings, sepia eyes	24
curly wings, red eyes	26
curly wings, sepia eyes	25

What conclusions can be drawn from this experiment?

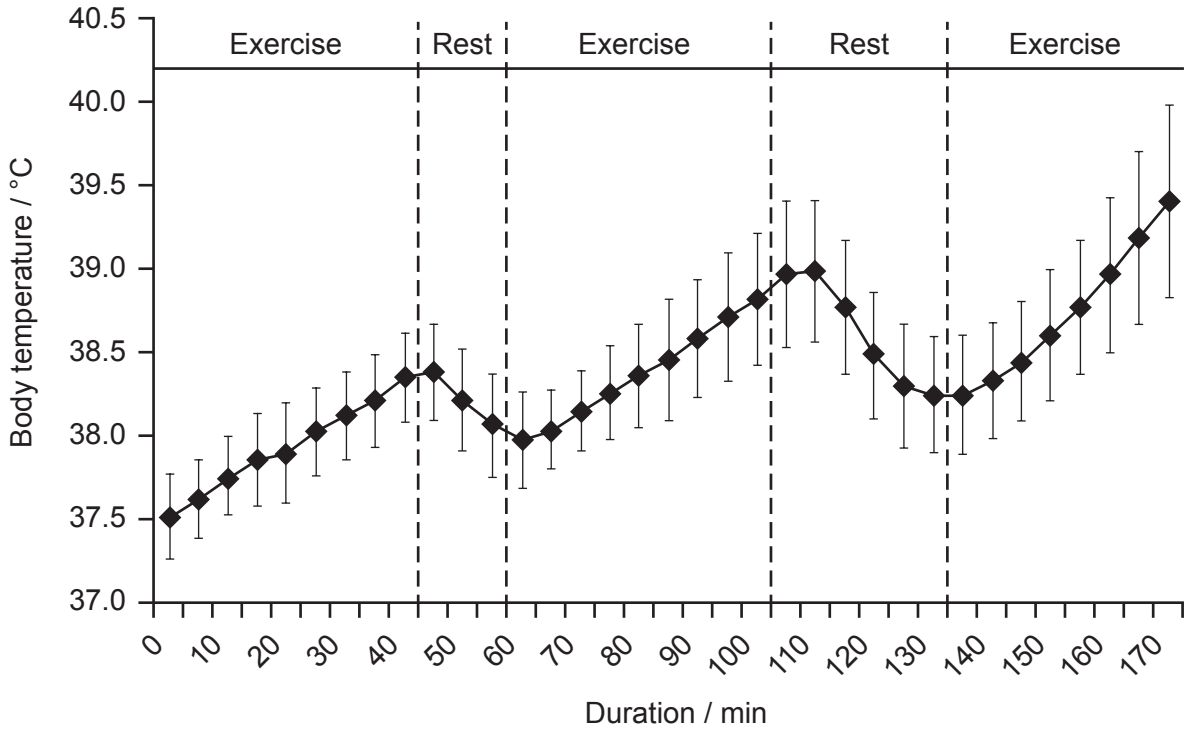
A. The wing shape and eye colour genes are on the same chromosome.

B. The alleles of both genes are codominant.

C. Individuals with straight wings and sepia eyes must be the result of crossing over.

D. The genes for wing shape and eye colour are not linked.

32. These results were obtained by measuring the body temperature of people exercising on a hot and humid day.



What mechanism could result in the changes seen during rest periods?

A. Shivering

B. Uncoupled respiration in brown adipose tissue

C. Vasodilation in the skin

D. Hair erection

33. What is evidence for evolution?

I. Homologous structures such as pentadactyl limbs

II. Domestication of dogs from wolves

III. Inheritance of acquired characteristics

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

34. What could minimize the loss of biodiversity?

A. Increase the rate of deforestation

B. Introduce species into new environments to control predation

C. Reduce the use of renewable energy

D. Rewilding of degraded ecosystems

35. What describes holozoic nutrition?

	Nutrition type	Digestion
A.	chemoautotrophic	none
B.	photoautotrophic	none
C.	saprotrophic	external
D.	heterotrophic	internal

36. In the mutualistic relationship between mycorrhizae and Orchidaceae, what role do mycorrhizae play?

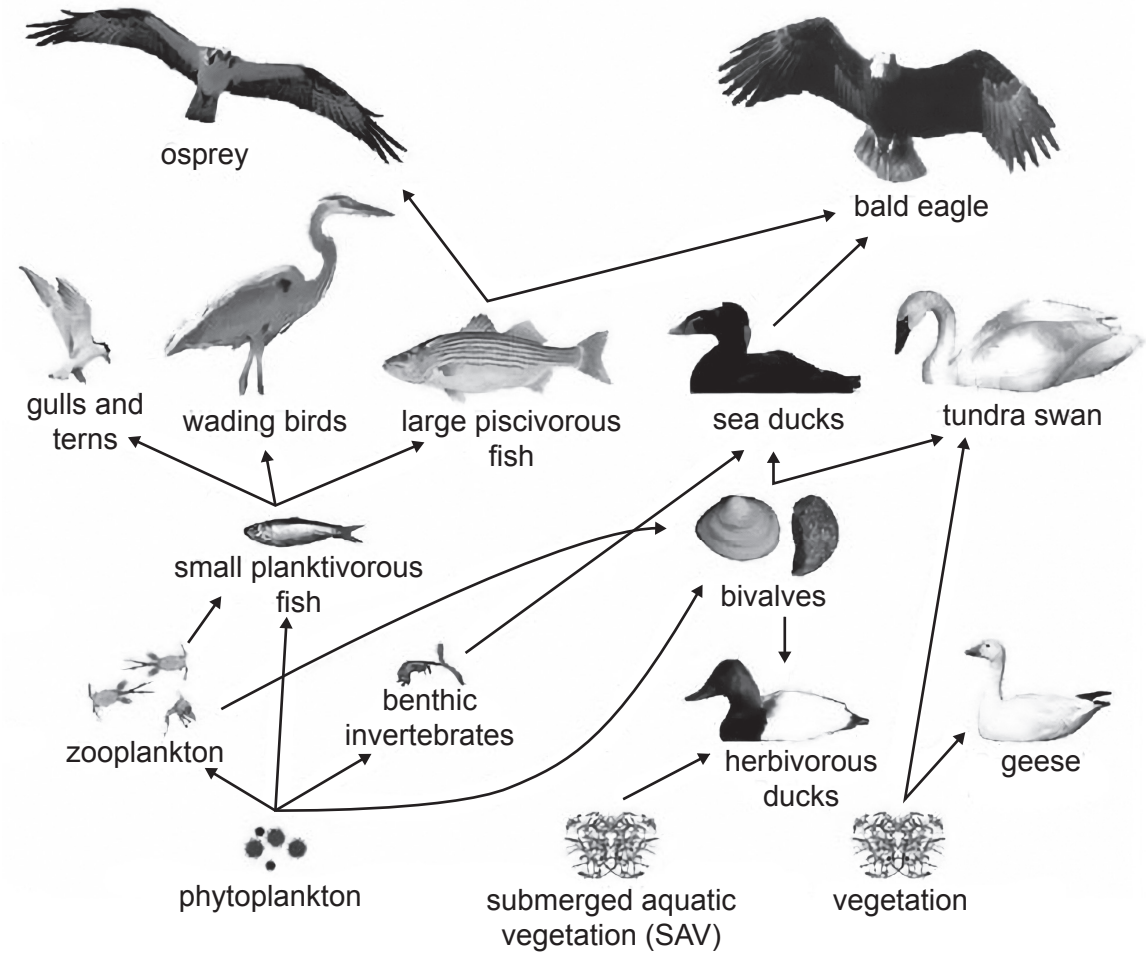
A. Nutrient absorption

B. Photosynthesis

C. Carbon dioxide production

D. Providing shelter

37. The image shows a food web from Chesapeake Bay, USA.



Which organisms are tertiary consumers in at least one food chain?

A. Small planktivorous fish and tundra swans

B. Herbivorous ducks and bald eagles

C. Wading birds and geese

D. Ospreys and benthic invertebrates

38. What is an outcome of selection?

A. Directional selection increases the size of the gene pool.

B. Stabilizing selection increases allele frequencies of phenotypic extremes.

C. Disruptive selection increases genetic variance in a population.

D. Sexual selection leads to allopatric speciation.

39. Surtsey, a volcanic island approximately 32 km from the south coast of Iceland, is a new island formed by volcanic eruptions that took place from 1963 to 1967. It has been legally protected since its formation and is free from human interference.

What changes are likely to have been observed since the formation of Surtsey?

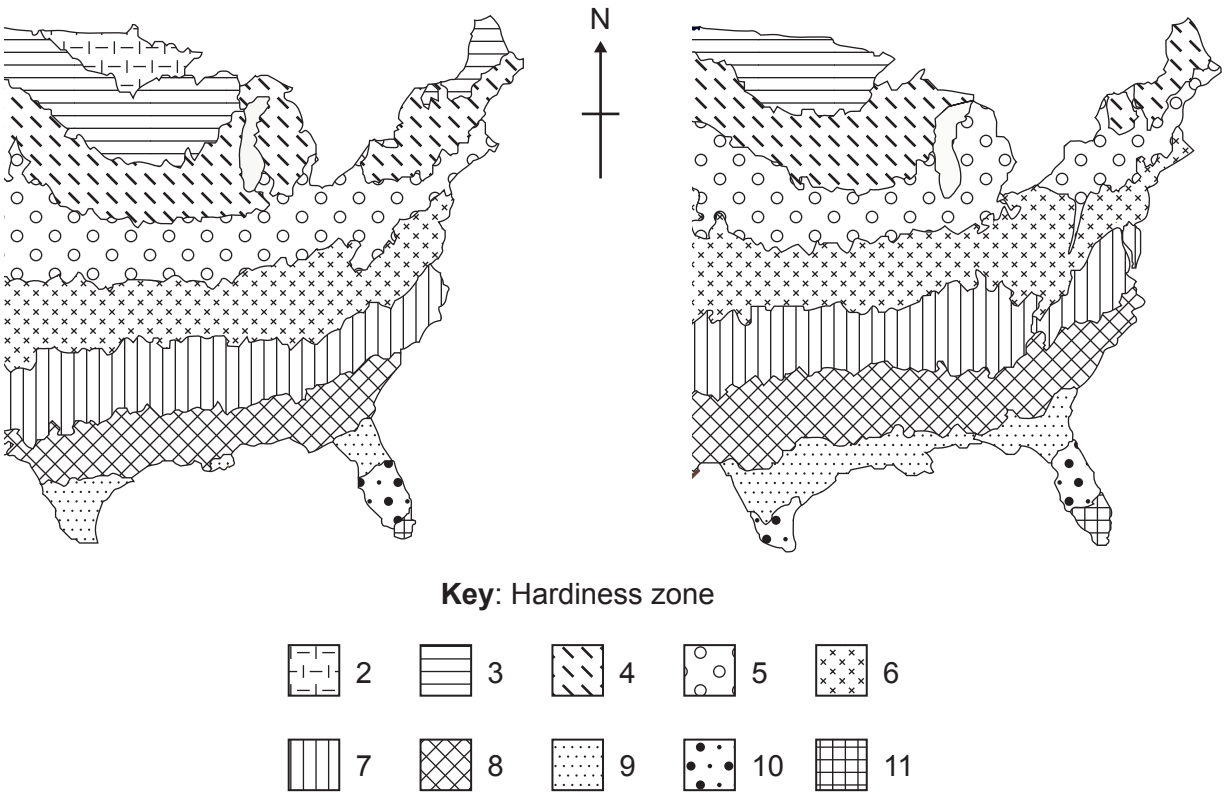
A. Cyclical succession as the climax community changes

B. Secondary succession when animal species arrived

C. Arrested succession due to the drainage of wetlands

D. Primary succession including an increase in size of plants

40. The data shows how the hardiness zones in part of North America are predicted to change over the next 25 years. A hardiness zone is an area that has a certain average annual minimum temperature, a factor relevant to the survival of many plants. The lower the number, the more cold-resistant the plants must be.



What is a likely consequence of this change for tree species?

A. Tree species will spread northwards as climate changes.

B. Tree species that are not cold-resistant will decline.

C. There will be no change in the distribution of the tree species.

D. Tree species that currently live in the north will outcompete other tree species.

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References:

2. Mishra, V., Bankar, N., Tiwade, Y., and Ugemuge, S., 2024. *How Phage Therapy Works, Its Advantages and Disadvantages: Mini Review*. [online] Available at: https://www.researchgate.net/publication/378685128_How_Phage_Therapy_Works_Its_Advantages_and_Disadvantages_Mini_Review. Licensed under CC BY 4.0 licence https://creativecommons.org/licenses/by/4.0/. [Accessed 3 December 2025]. Source adapted.

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13. Medcell/Yale University, n.d. [*Micrograph*]. [online] Available at: https://medcell.org/histology/cell_lab/smooth_endoplasmic_reticulum_em.php. [Accessed 24 September 2024].

19. Sinhyu, 2023. *Mitosis cell in the Root tip of Onion under a microscope*. [image online] Available at: https://www.gettyimages.co.uk/detail/photo/mitosis-cell-in-the-root-tip-of-onion-under-a-royalty-free-image/1487638300?phrase=mitosis&adppopup=true [Accessed 24 September 2024]. Source adapted.

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24. PeterHermesFurian, 2024. *Sunflower stem, Helianthus annuus, cross section, 8X light micrograph*. [image online] Available at: https://www.gettyimages.co.uk/detail/photo/sunflower-stem-helianthus-annuus-cross-section-8x-royalty-free-image/1985211048?adppopup=true [Accessed 25 September 2024]. Source adapted.

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37. U.S. Geological Survey/illustration by Auer, T., 2017. Figure 14.1 from *Circular 1316*. [image online] Available at: https://www.usgs.gov/media/images/chesapeake-bay-waterbird-food-web-illustration-circular-1316 [Accessed 25 September 2024]. Source adapted.

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