Programme du diplôme
Programa del Diploma

Biology
Higher level
Paper 1A

12 May 2025

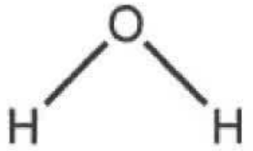
Zone A afternoon | **Zone B** afternoon | **Zone C** afternoon

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]**.

1. Which symbol indicates the polarity of the oxygen atom in the water molecule?



A. $\delta +$

B. $\delta -$

C. $+$

D. $-$

2. Which planet in the table falls within the "Goldilocks zone" and may be capable of sustaining extraterrestrial life?

	Planet	Temperature / °C	Atmosphere	Gravity / g
A.	Kepler-22b	–11 to 16	unknown	2.4

C. +

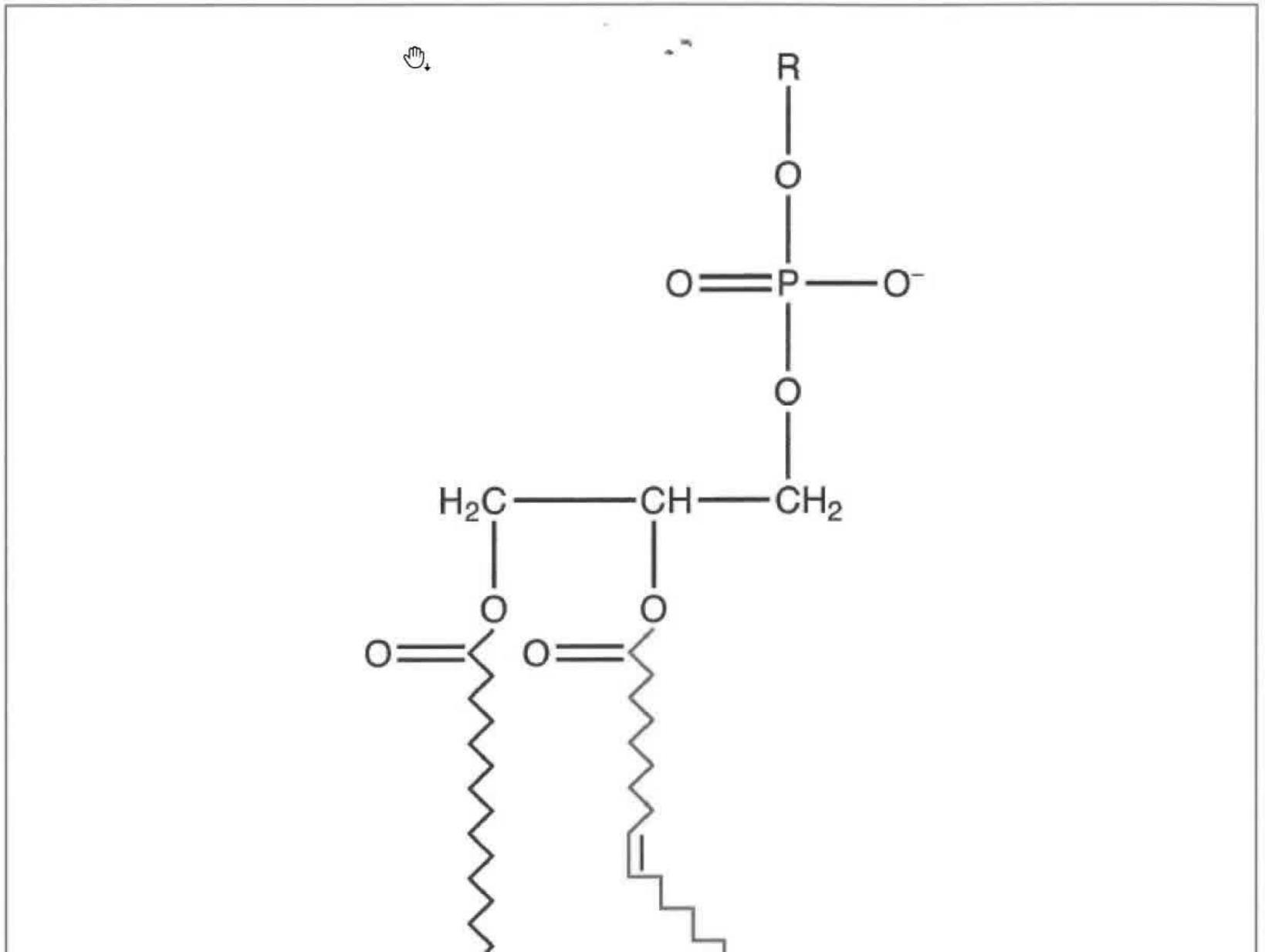
D. –

2. Which planet in the table falls within the "Goldilocks zone" and may be capable of sustaining extraterrestrial life?

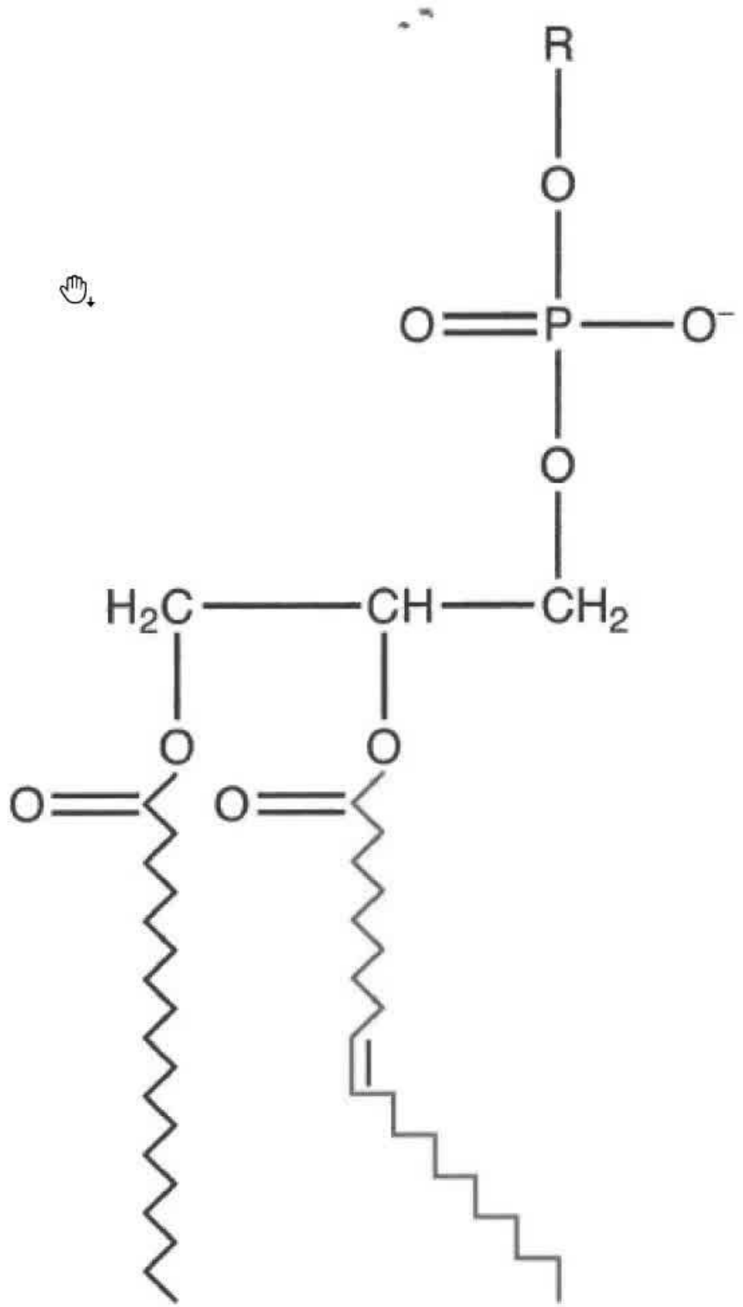
	Planet	**Temperature / °C**	**Atmosphere**	**Gravity / g**
A.	Kepler-22b	–11 to 16	unknown	2.4
B.	WASP-39b	750	hydrogen, helium and other elements	25.0
C.	Gliese 876d	50 to 80	high levels of toxic gases	20.0
D.	Kepler-16b	–100	unknown	0.9

3. Which of these molecules is amphipathic?

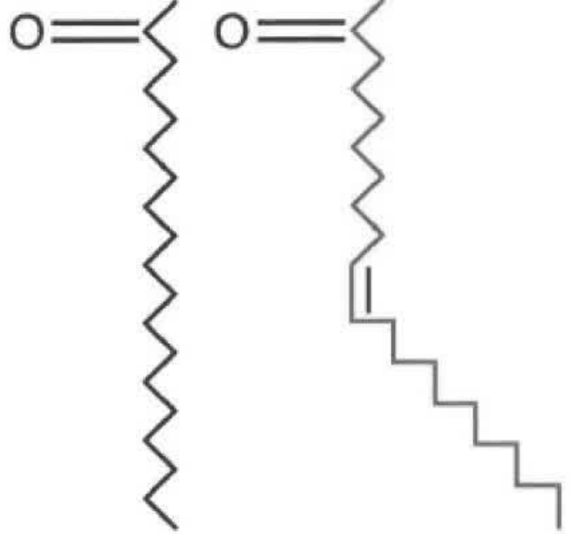
A.



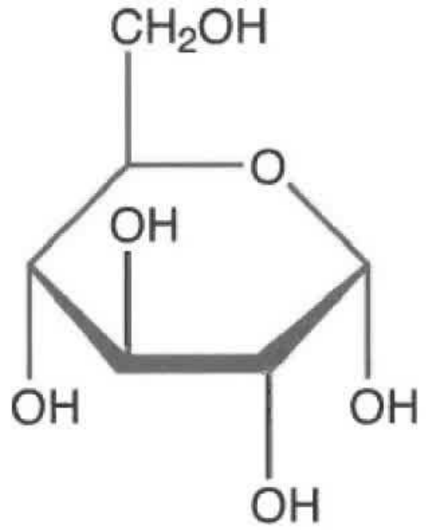
A.



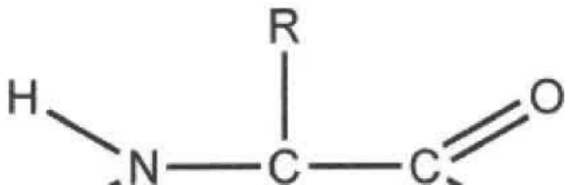
B.

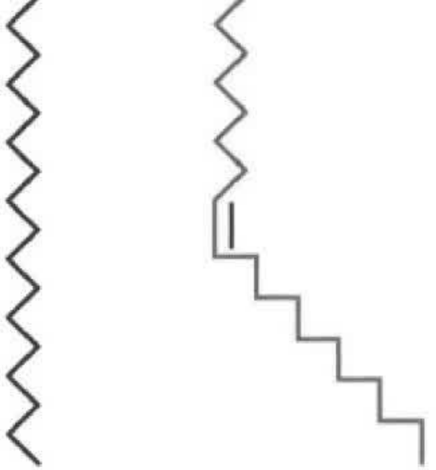


B.

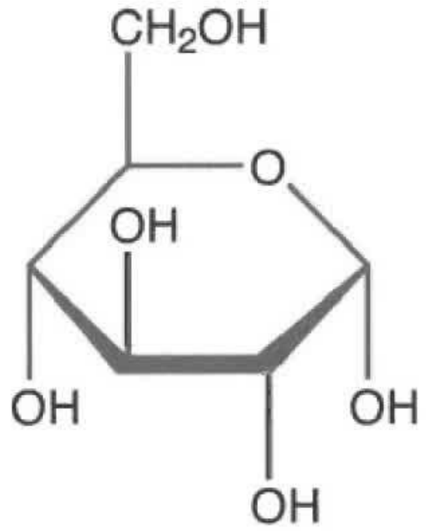


C.

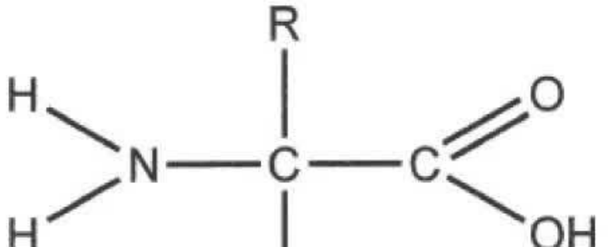




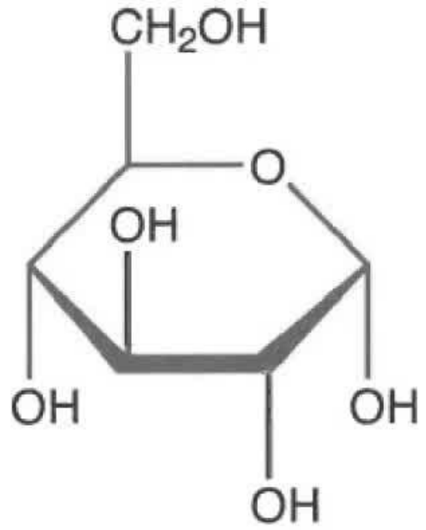
B.



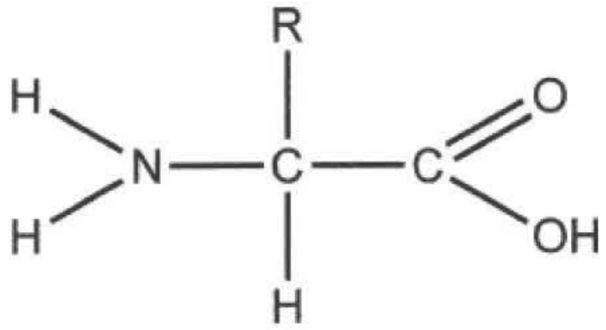
C.



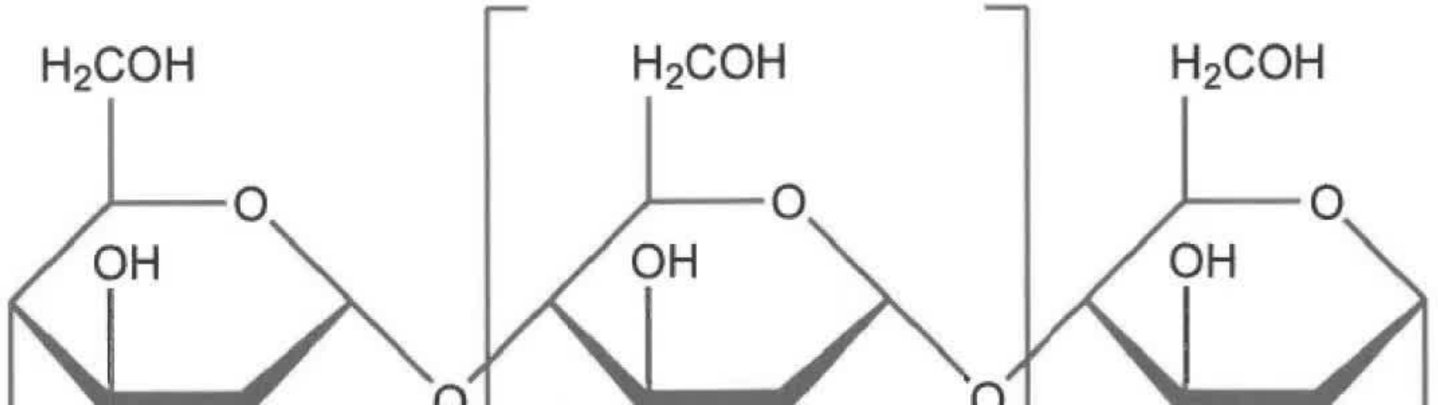
B.

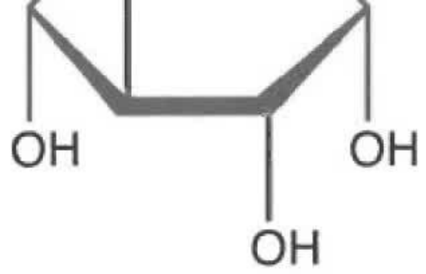

CH2OH
O
OH
OH
OH
OH

C.

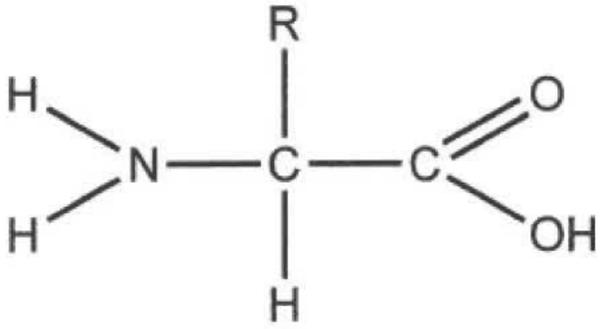

R
H
N
C
C
O
OH
H
H

D.


H2COH
H2COH
H2COH
O
O
O
OH
OH
OH
O
O


OH
OH
OH

C.


R
H
N
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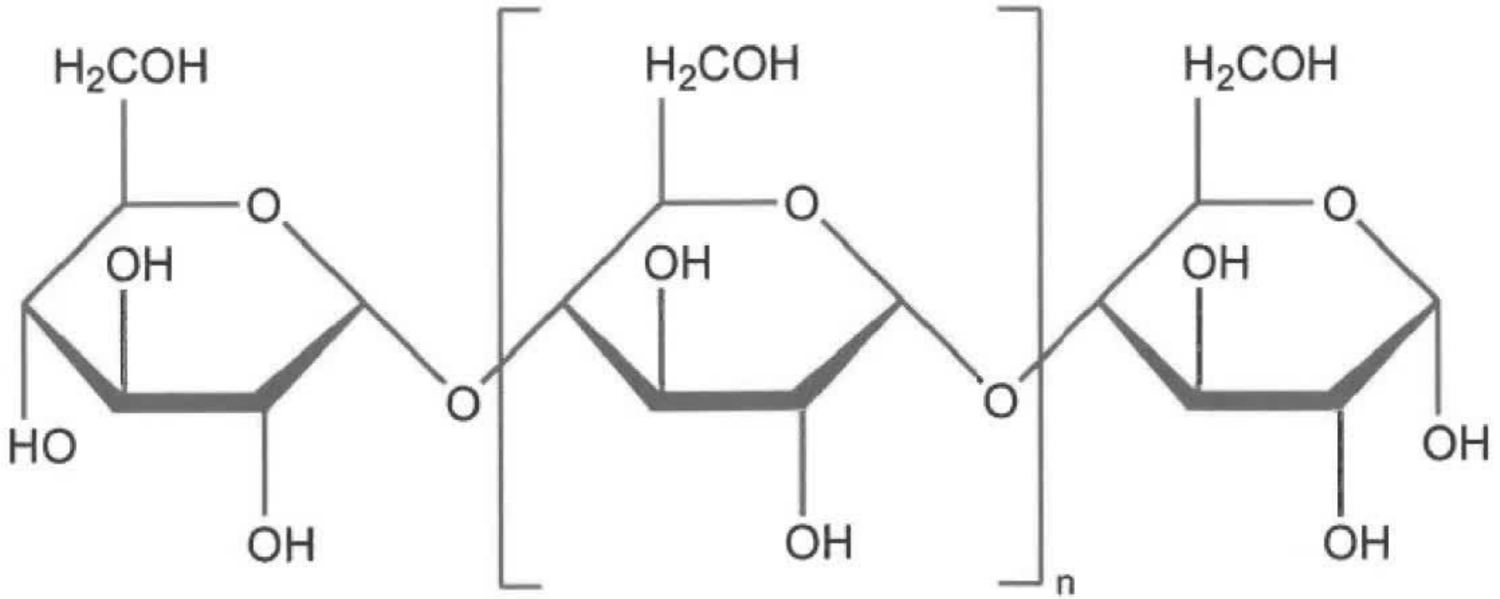
C
O
H
OH
H

D.


H2COH
O
OH
HO
OH
O
H2COH
O
OH
OH
O
H2COH
O
OH
OH
OH
n

4. Which row correctly matches the level of structure of a protein molecule with the bonds that stabilize it?

	Level of structure	Bonds
A.	primary	peptide and hydrogen bonds between amine and carboxyl groups
B.	secondary	hydrogen bonds between R-groups of amino acids
C.	tertiary	disulfide, hydrogen and ionic bonds between R-groups of amino acids
D.	quaternary	covalent bonds between hydrophobic and hydrophilic regions on the polypeptide subunits

5. The graph shows the activity of an enzyme as temperature increases.

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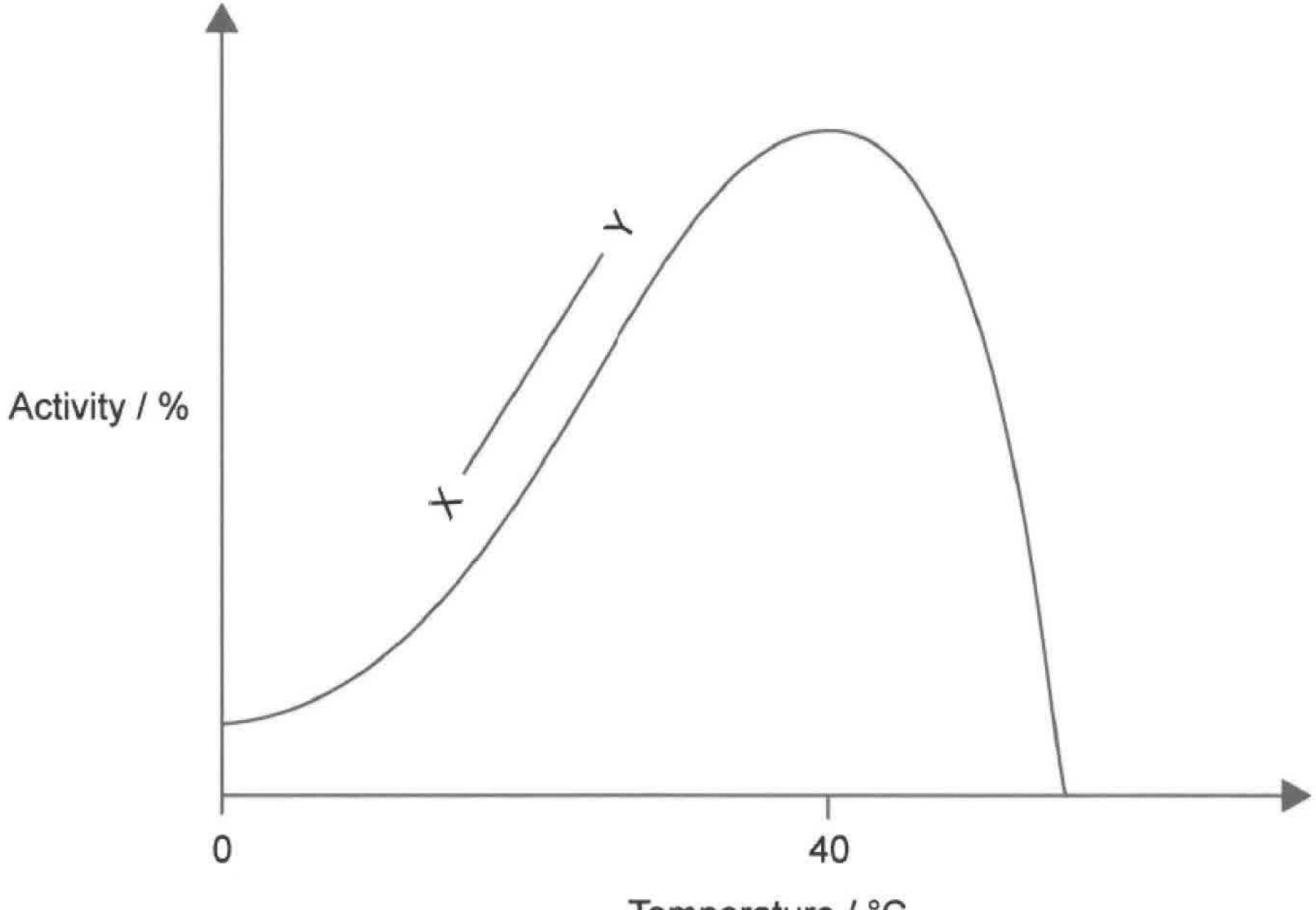
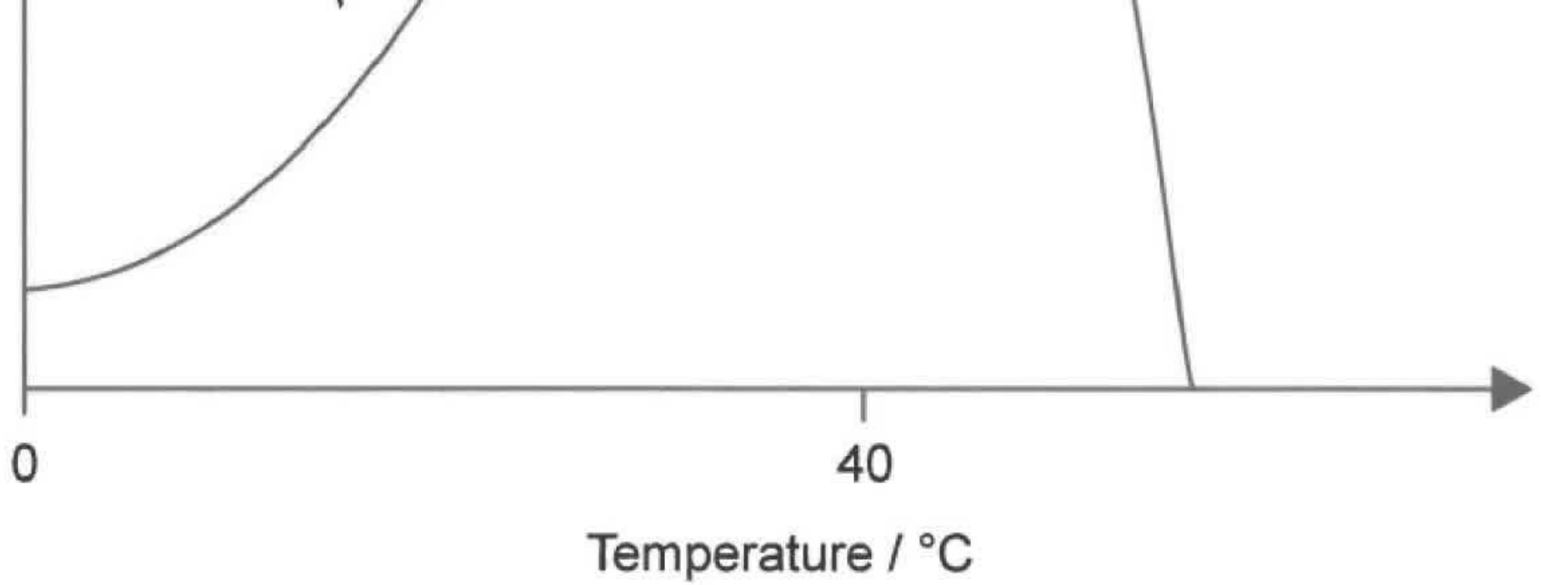




What explains the change in enzyme activity between X and Y?

A. The enzyme is denaturing as the active site changes shape.

B. Increased collisions occur as molecules are moving faster.

C. Increased product concentration speeds up the reaction.

D. An inhibitor has been added, reducing the number of active sites.

6. What is an example of an intracellular enzyme-catalysed reaction?

A. Chemical digestion in the gut

B. Glycolysis in cellular respiration

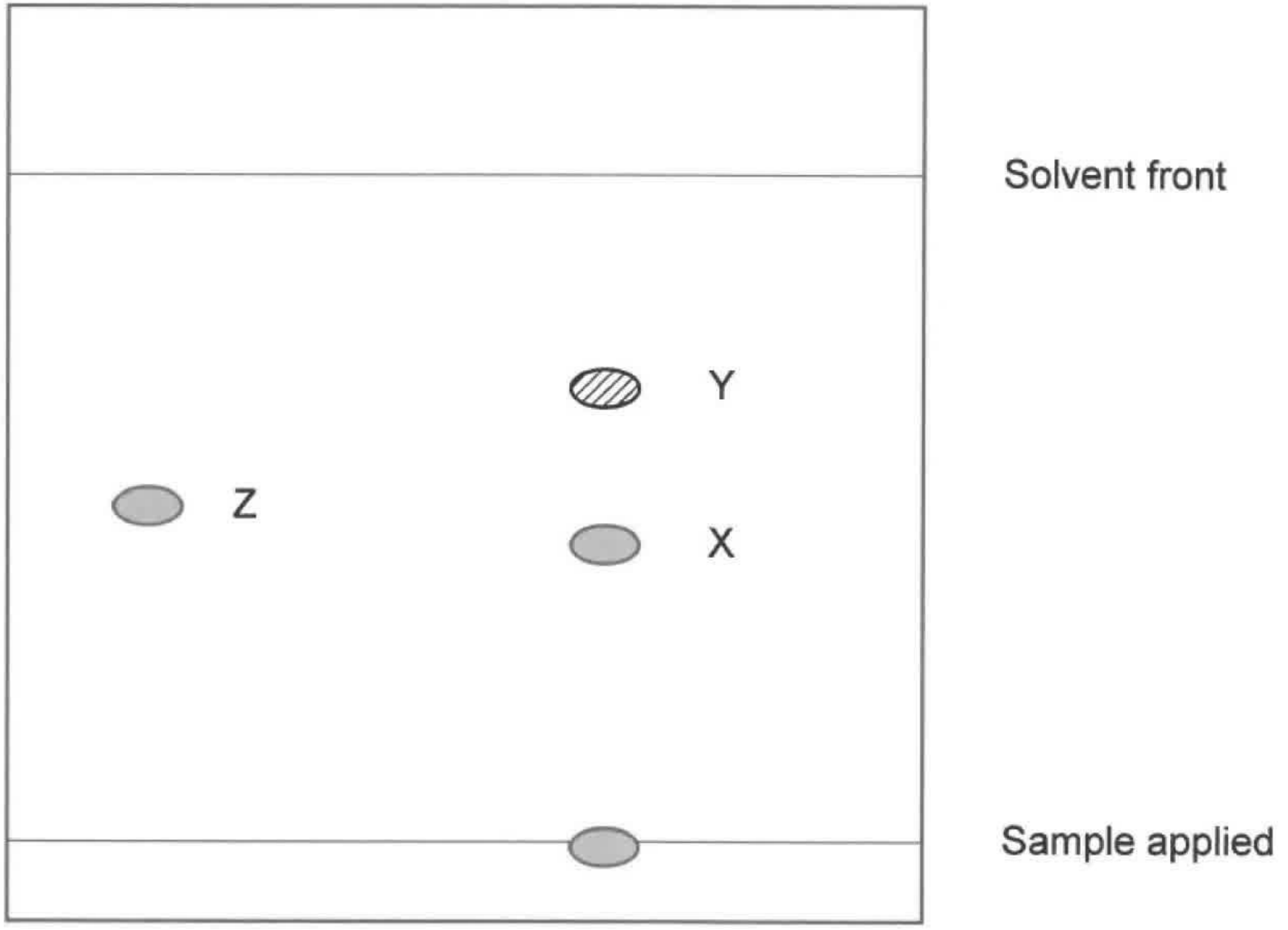
C. Blood clotting in the circulatory system

D. Recycling of acetylcholine in a synapse

7. What occurs during the stages of respiration?

	Stage of respiration	Decarboxylation	Reduced NAD produced
A.	Glycolysis	No	No
B.	Link reaction	Yes	No
C.	Krebs cycle	Yes	Yes
D.	Electron transport chain	No	Yes

8. The diagram shows a chromatogram of the pigments in a leaf. Substance Z is known to have a R_f of 0.5.



Pigment	Colour	R_f
Carotene	Yellow	0.95
Phaeophytin	Yellow-grey	0.83
Chlorophyll *a*	Blue-green	0.65
Chlorophyll *b*	Green	0.45

What are pigments X and Y?

	X	Y
A.	Chlorophyll *a*	Phaeophytin
B.	Chlorophyll *a*	Carotene
C.	Chlorophyll *b*	Carotene
D.	Chlorophyll *b*	Chlorophyll *a*

9. Which enzyme is associated with proofreading during DNA replication?

A. DNA primase

B. DNA helicase

C. DNA polymerase III

D. DNA ligase

10. What occurs during translation?

I. Polypeptides synthesised on ribosomes

II. RNA polymerase catalyses polypeptide synthesis

III. Complementary base pairing between codons and anticodons

A. I and II only

B. I and III only

C. DNA polymerase III

D. DNA ligase

10. What occurs during translation?

I. Polypeptides synthesised on ribosomes

II. RNA polymerase catalyses polypeptide synthesis

III. Complementary base pairing between codons and anticodons

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

11. A DNA sequence before and after a mutation is shown.

Before mutation 3′ TAC TCC TGC TTC 5′

After mutation 3′ TAC TGC TGC TTC 5′

The table contains mRNA codons and their associated amino acids.

mRNA codon	Amino acid
AUG	Met
AGG	Arg
ACG	Thr
AAG	Lys
UAC	Tyr
UCC	Ser
UGC	Cys

Before mutation	3′ TAC TCC TGC TTC 5′
After mutation	3′ TAC TGC TGC TTC 5′

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AUG	Met
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AAG	Lys
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UCC	Ser
UGC	Cys
UUC	Phe

What would be the effect of this mutation on the translated polypeptide?

AUG	Met
AGG	Arg
ACG	Thr
AAG	Lys
UAC	Tyr
UCC	Ser
UGC	Cys
UUC	Phe

What would be the effect of this mutation on the translated polypeptide?

A. Thr would replace Arg.

B. Cys would replace Ser.

C. There would be an extra Arg.

D. There would be no change in the amino acid sequence.

12. The Miller–Urey experiment carried out in 1952 tested the hypothesis of the chemical origin of life. What were the key findings?

A. Living cells could be produced from a mixture of chemicals.

B. Complex organic molecules could form under simulated primordial conditions.

C. Life could spontaneously emerge without external influence.

D. DNA and RNA could self-replicate in a prebiotic environment.

13. The table shows features of three types of cells (X, Y and Z).

Feature	**Cell**		
	X	**Y**	**Z**
Cell wall	absent	present	present
Centrioles	present	absent	absent
Large vacuole	absent	present	present

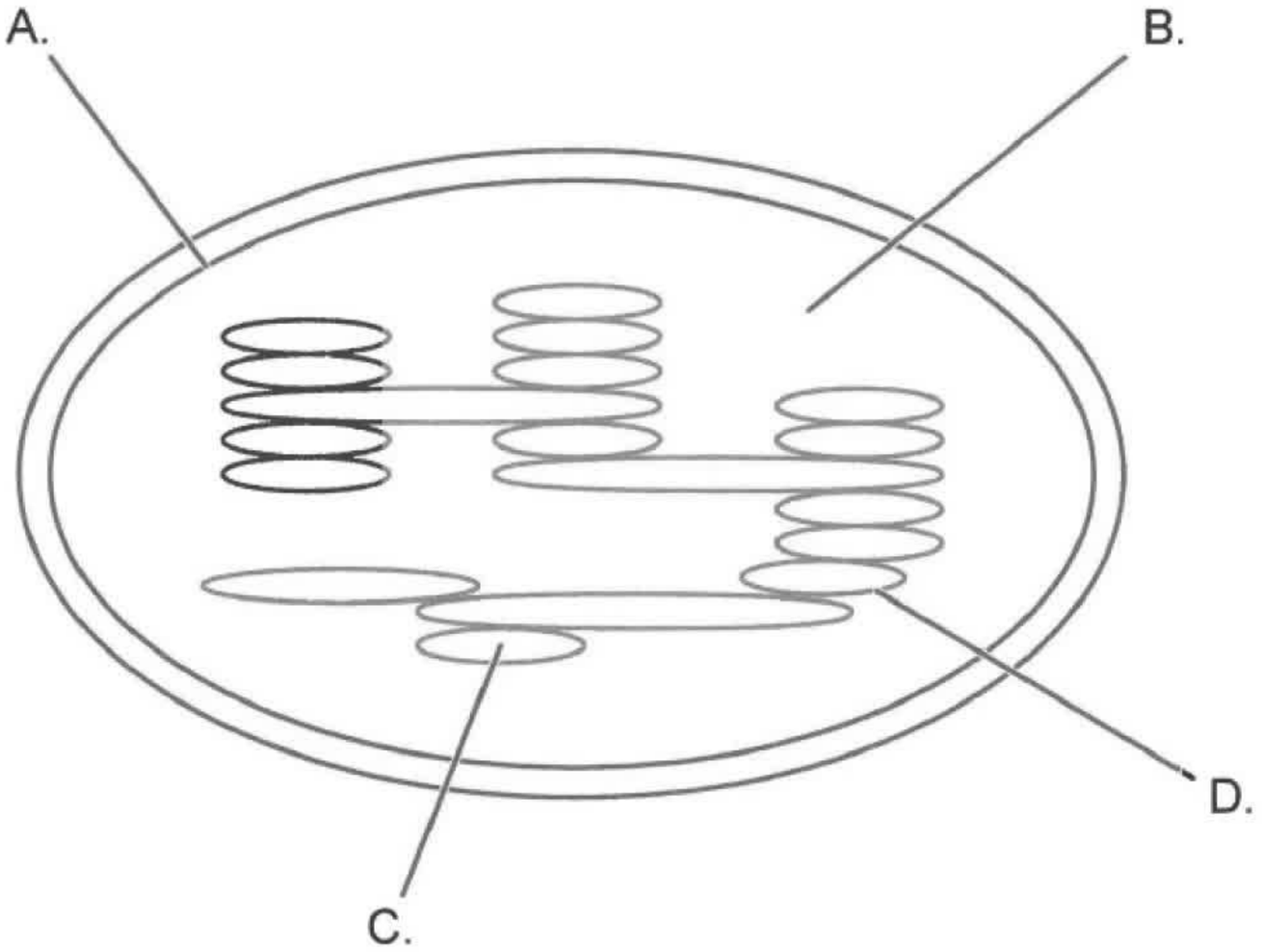
13. The table shows features of three types of cells (X, Y and Z).

Feature	Cell		
	X	Y	Z
Cell wall	absent	present	present
Centrioles	present	absent	absent
Large vacuole	absent	present	present
Plastids	absent	present	absent

To which kingdom do each of the cells belong?

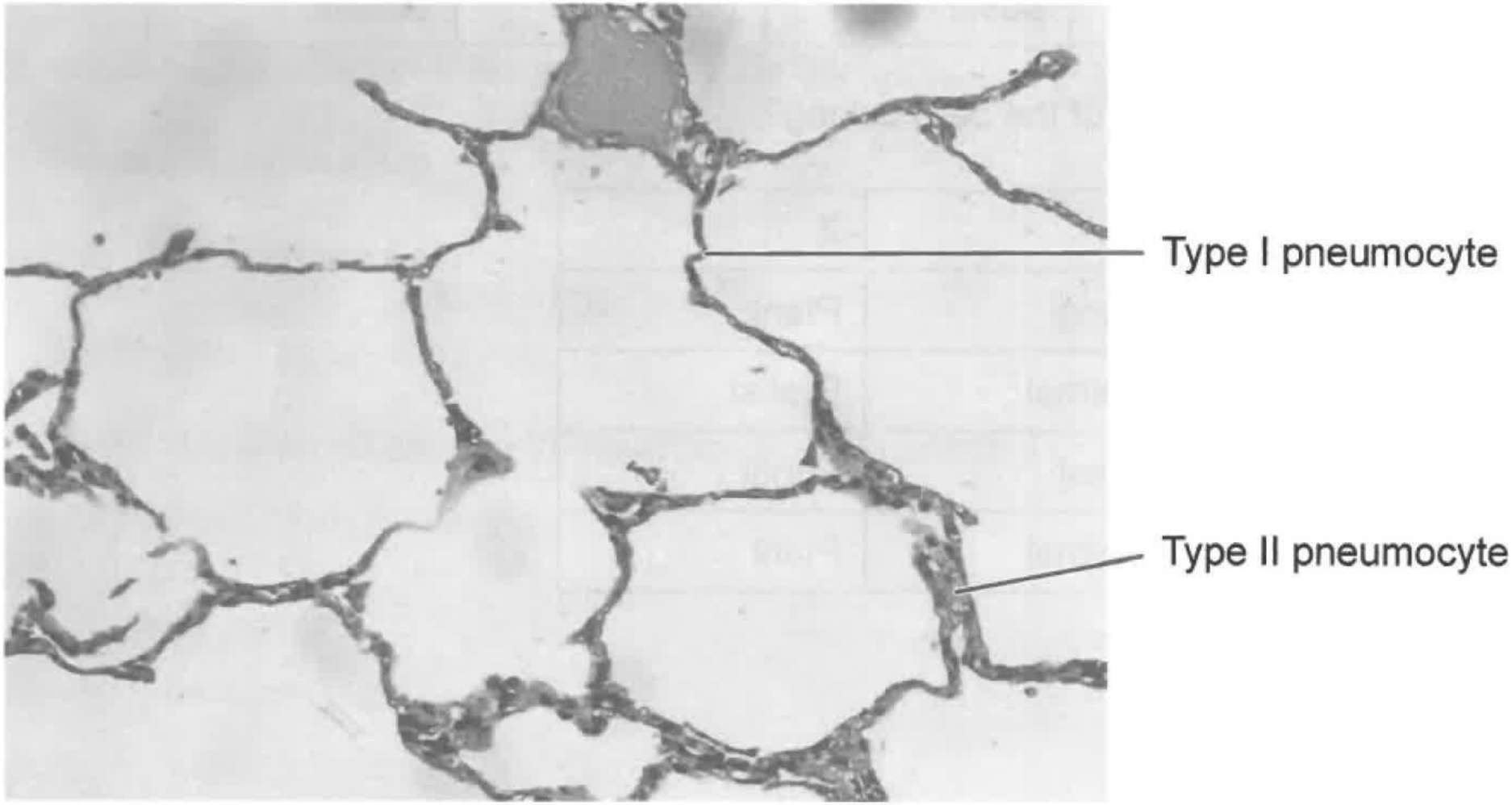
	X	Y	Z
A.	Animal	Fungi	Plant
B.	Fungi	Animal	Protist
C.	Animal	Plant	Fungi
D.	Protist	Animal	Plant

14. The diagram shows the structure of a chloroplast. Where does the Calvin cycle occur?

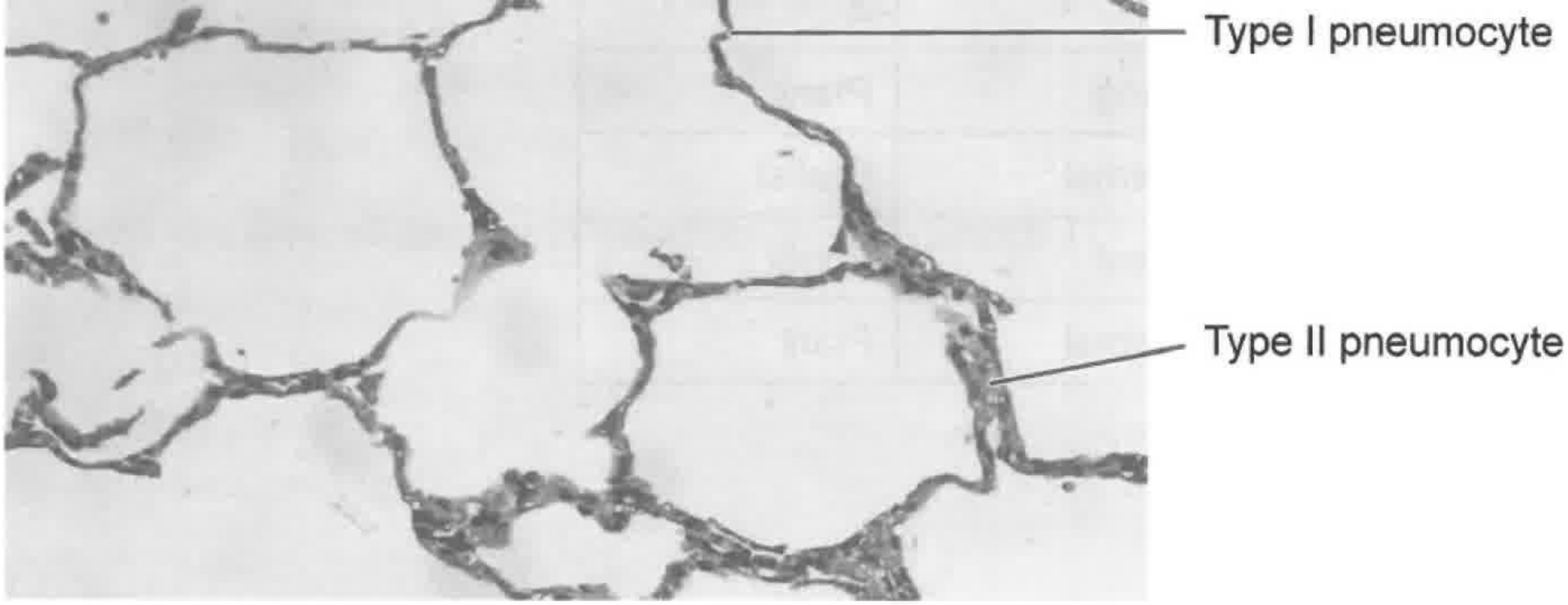


15 The micrograph shows alveoli in a human lung.

15. The micrograph shows alveoli in a human lung.



How are the pneumocytes adapted to their function?



How are the pneumocytes adapted to their function?

	Type I pneumocytes	Type II pneumocytes
A.	many secretory vesicles (lamellar bodies)	many secretory vesicles (lamellar bodies)
B.	many secretory vesicles (lamellar bodies)	large number of mitochondria
C.	large number of mitochondria	extreme thinness
D.	extreme thinness	many secretory vesicles (lamellar bodies)

16. Which term describes very early-stage embryonic stem cells in a mouse?

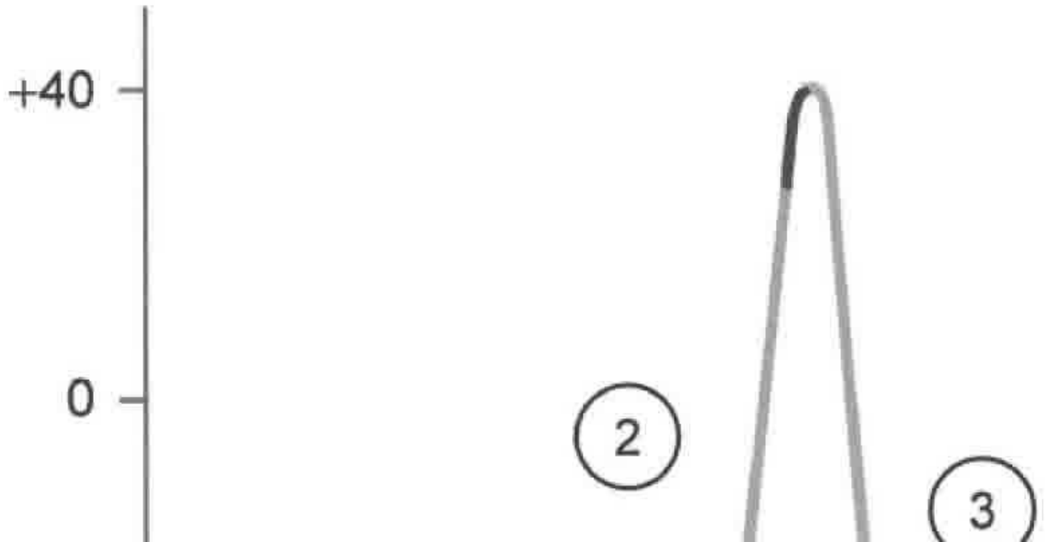
A. Totipotent

B. Pluripotent

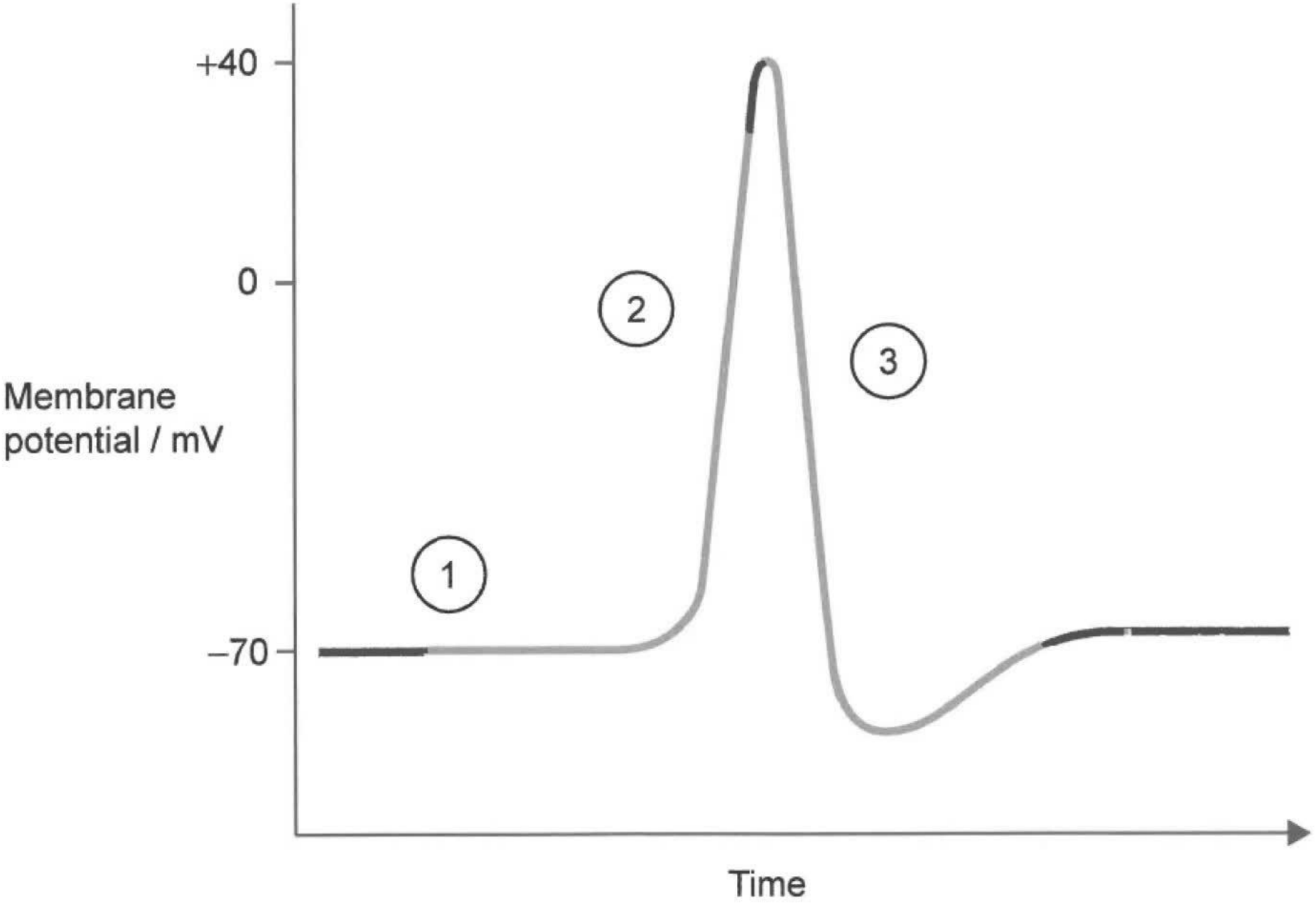
C. Multipotent

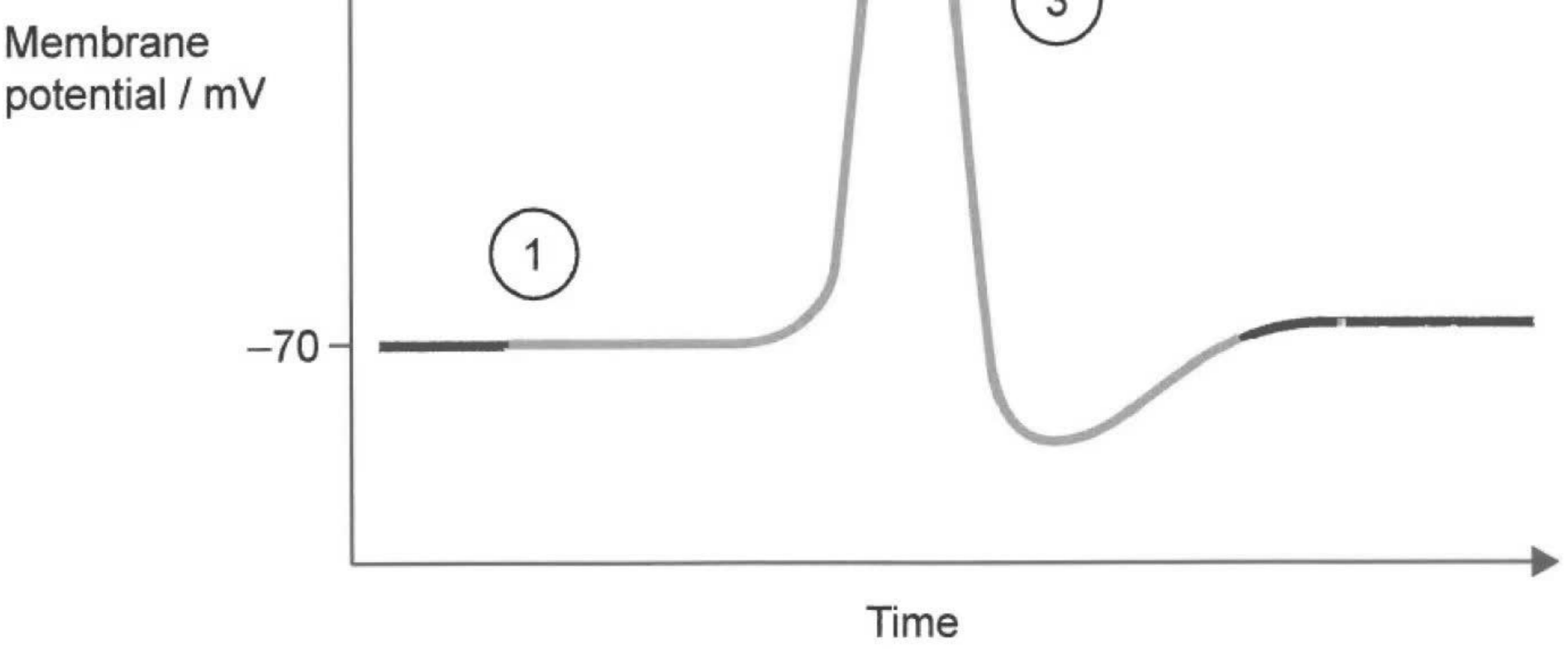
D. Unipotent

17. The graph below shows an action potential.



17. The graph below shows an action potential.





Where on the graph do the sodium channels open?

A. At 1

B. Between 1 and 2

C. At 2

D. Between 2 and 3

18. What effect does cocaine have on neural signalling?

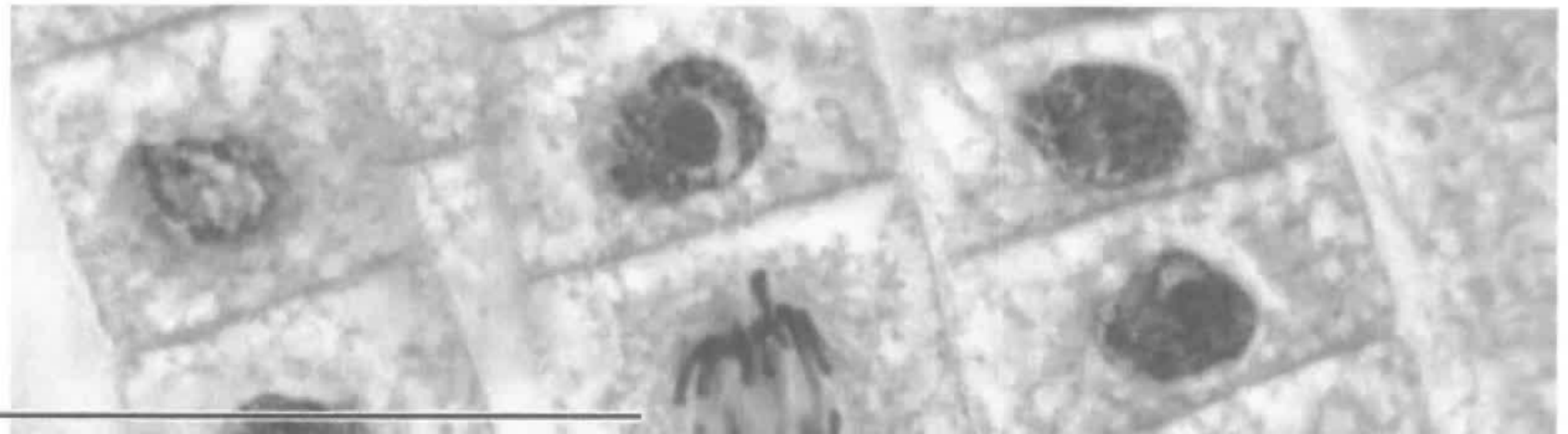
A. Blocks the reuptake of neurotransmitters in the synapse

B. Opens channels for positively charged ions to initiate an action potential

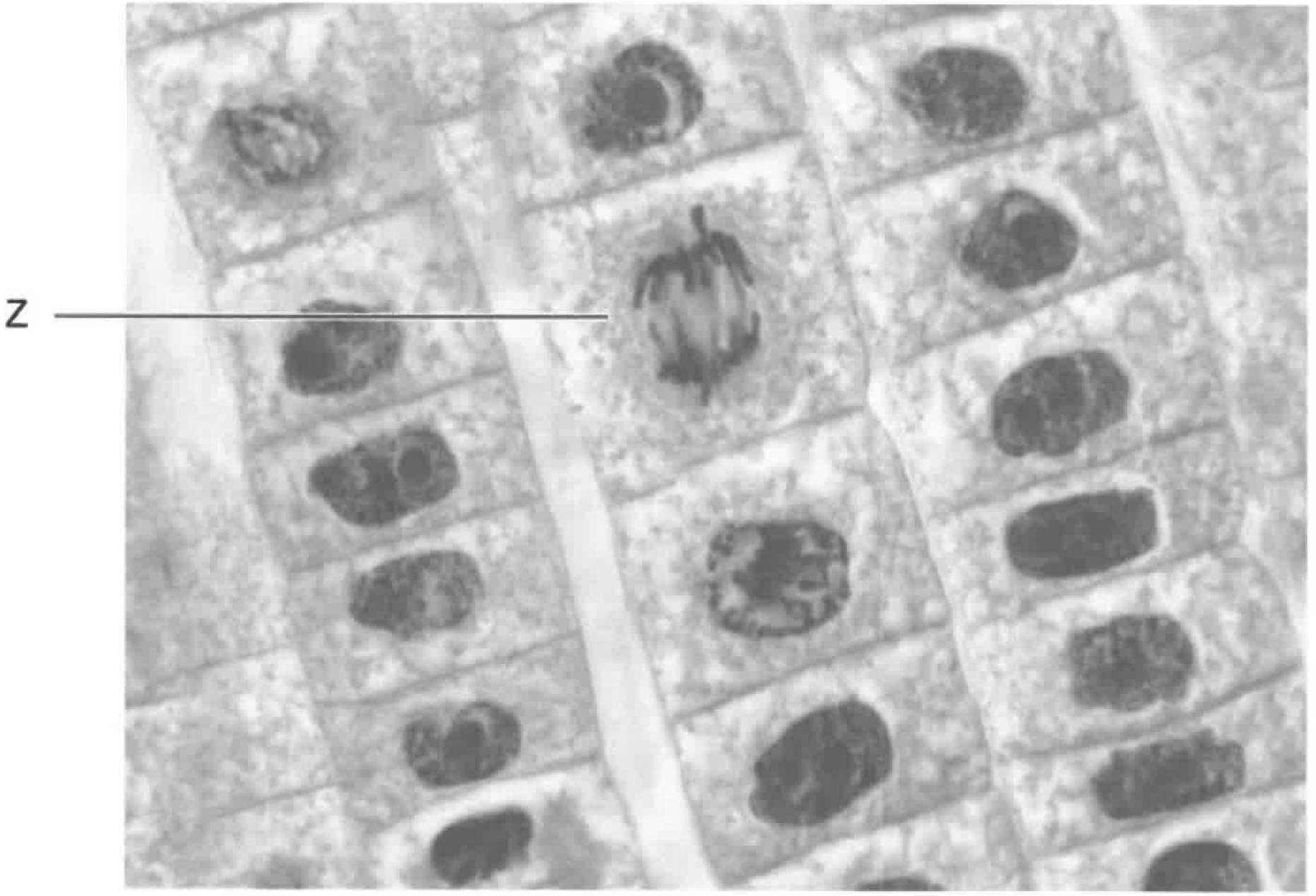
C. Acts as a non-competitive inhibitor of the sodium–potassium pump

D. Triggers an increase in saltatory conduction in the nodes of Ranvier

19. The micrograph shows onion (*Allium cepa*) root tip cells dividing by mitosis.



19. The micrograph shows onion (*Allium cepa*) root tip cells dividing by mitosis.



In which phase is cell Z?

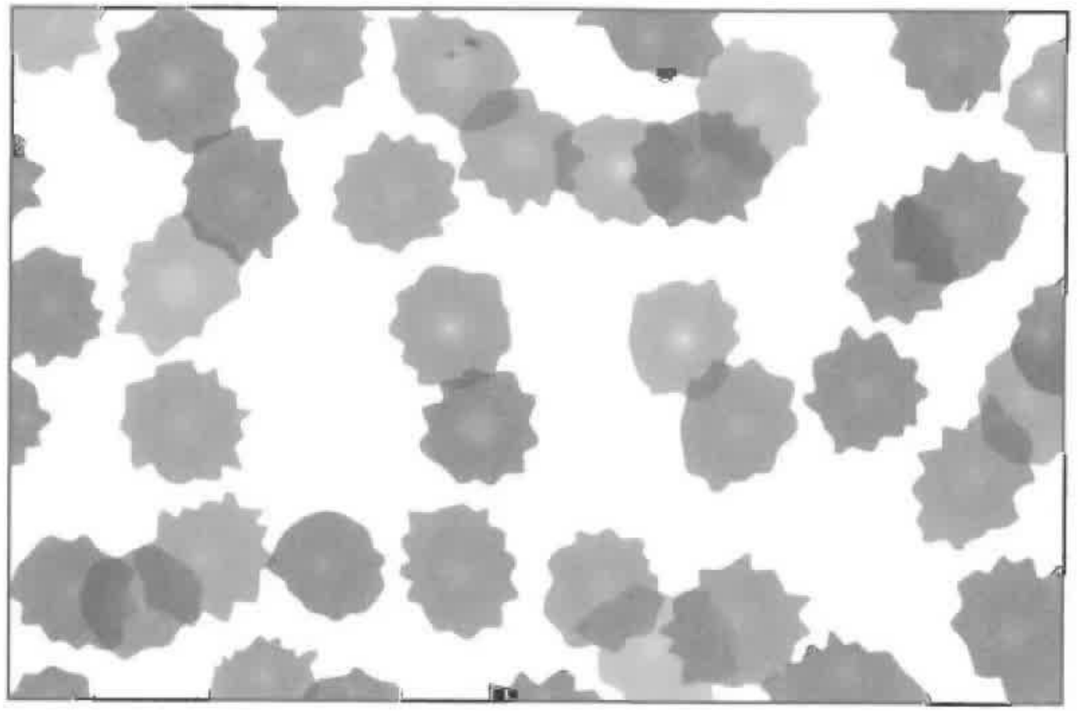
A. Interphase

B. Prophase

C. Metaphase

D. Anaphase

20. The image shows human blood cells immersed in a solution.



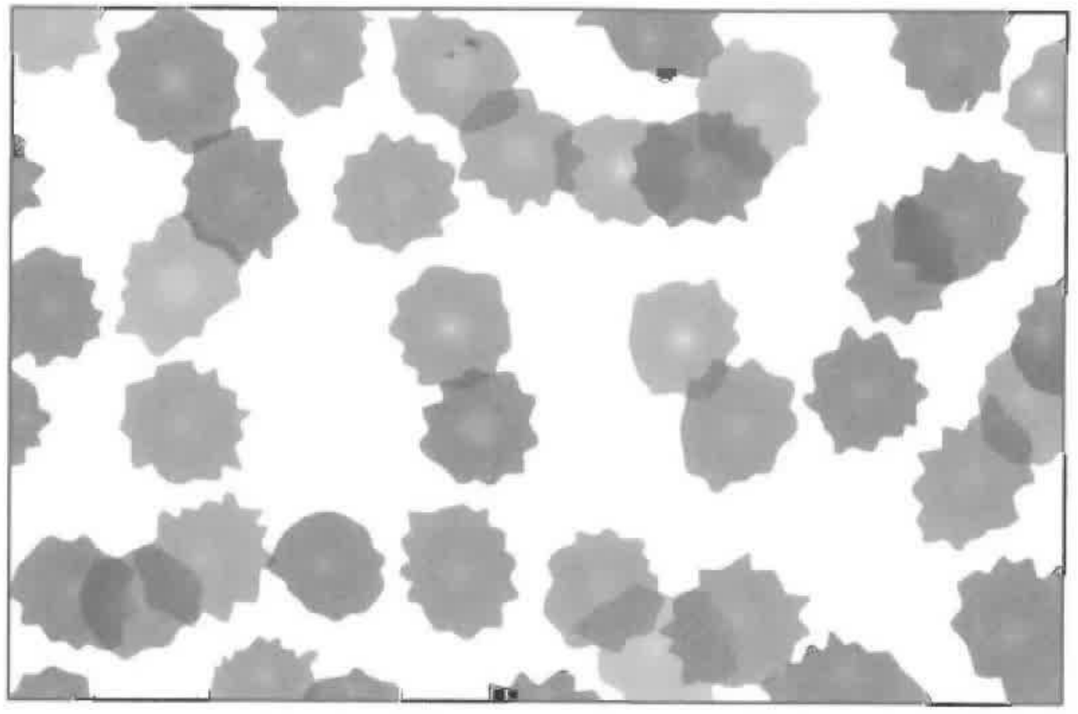
What can be deduced from the image?

A. The solution is hypotonic as the cells are crenated.

B. The solution is hypotonic as the cells are turgid.

C. The solution is hypertonic as the cells are crenated.

D. The solution is hypertonic as the cells are turgid.



What can be deduced from the image?

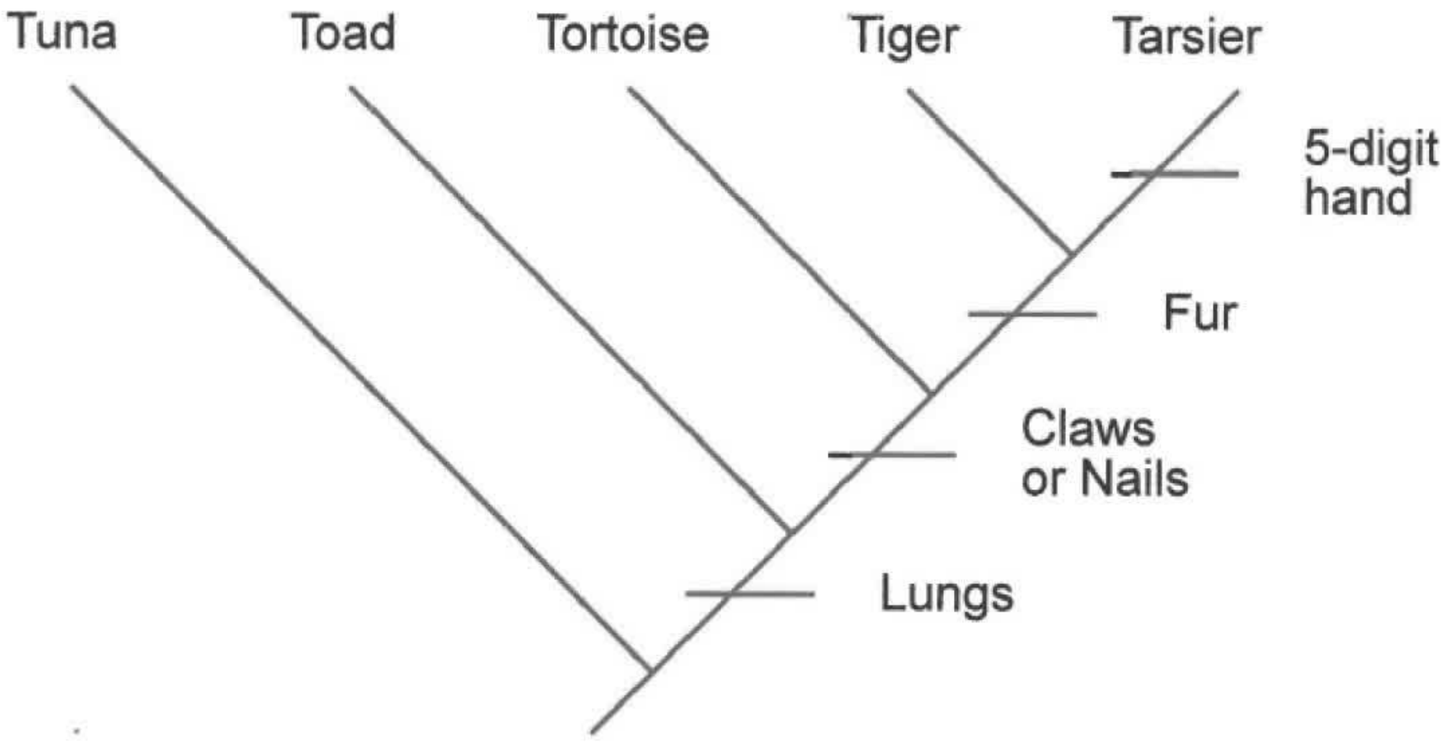
A. The solution is hypotonic as the cells are crenated.

B. The solution is hypotonic as the cells are turgid.

C. The solution is hypertonic as the cells are crenated.

D. The solution is hypertonic as the cells are turgid.

21. What can be deduced from the cladogram?



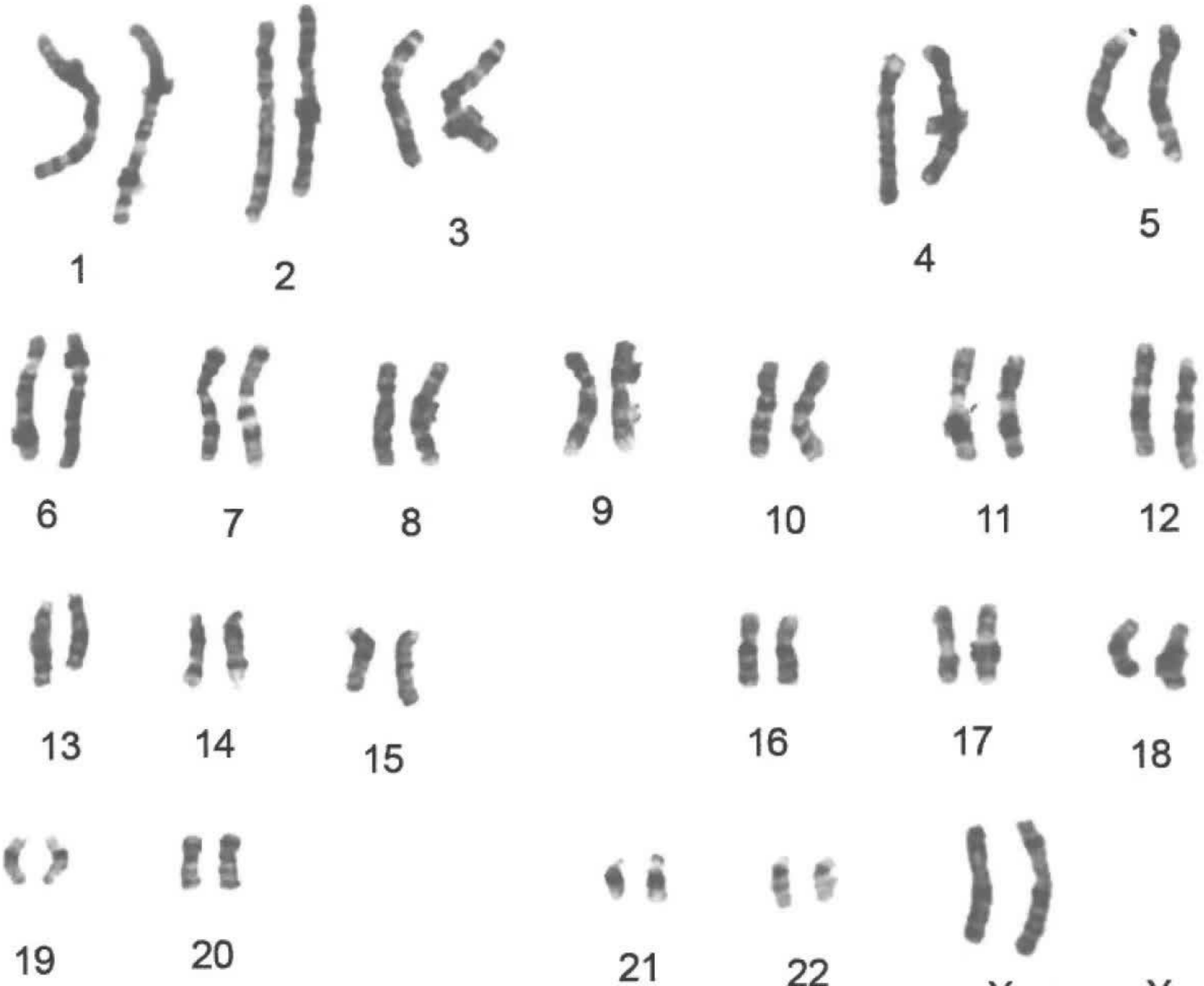
A. Tortoises do not have lungs.

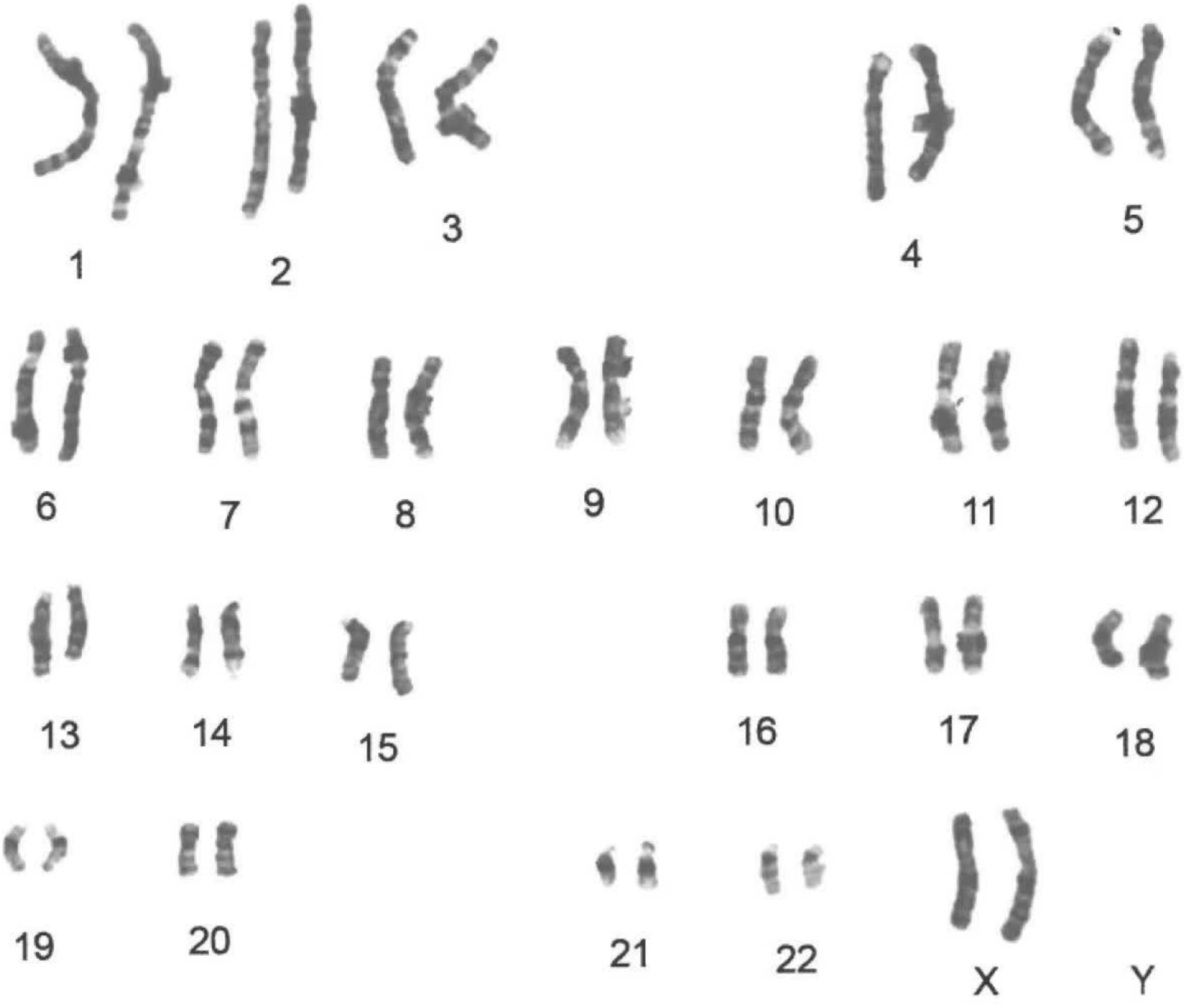
B. A tortoise and a tarsier are more closely related than a tiger and a tarsier.

C. A toad and a tuna are more closely related than a tiger and a tuna.

D. Tigers have fur and 5-digit hands.

22. The karyogram is taken from a primate.

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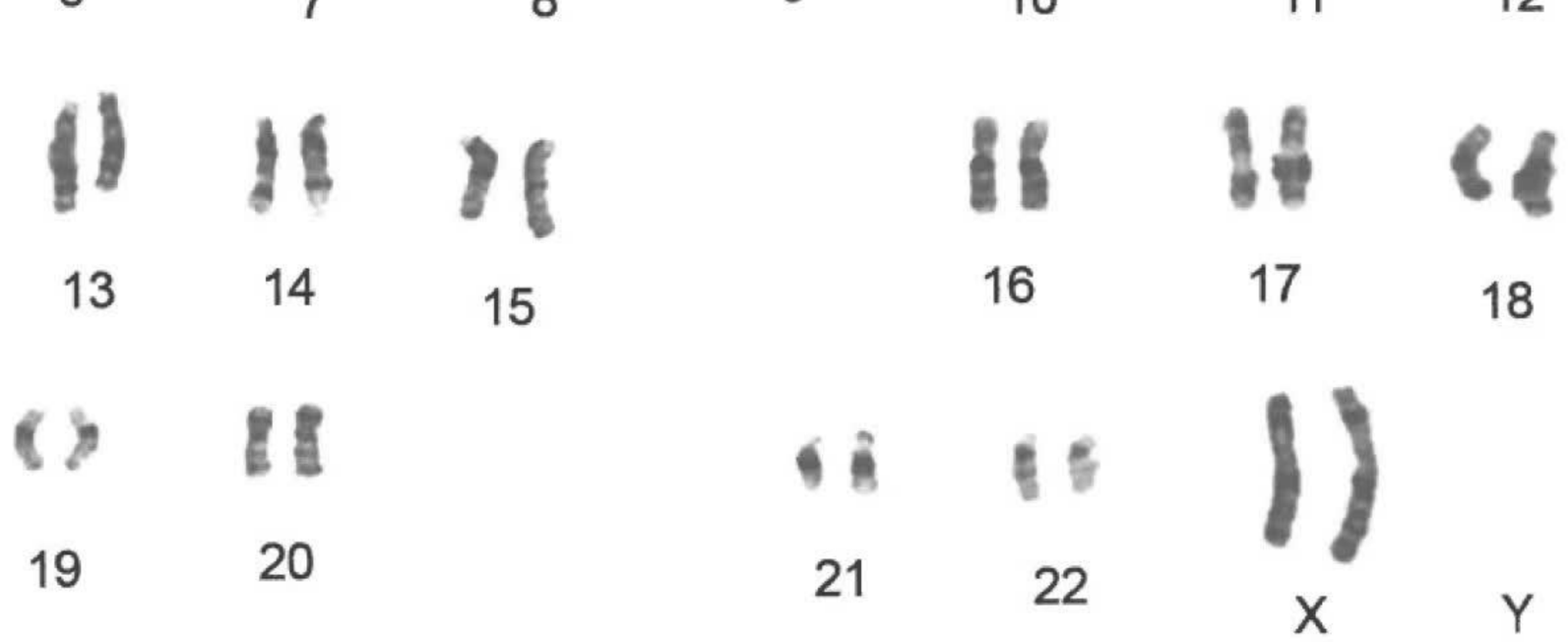
20
21
22
X
Y



All primates have the same sex determination chromosomes. From which primate is the karyogram?

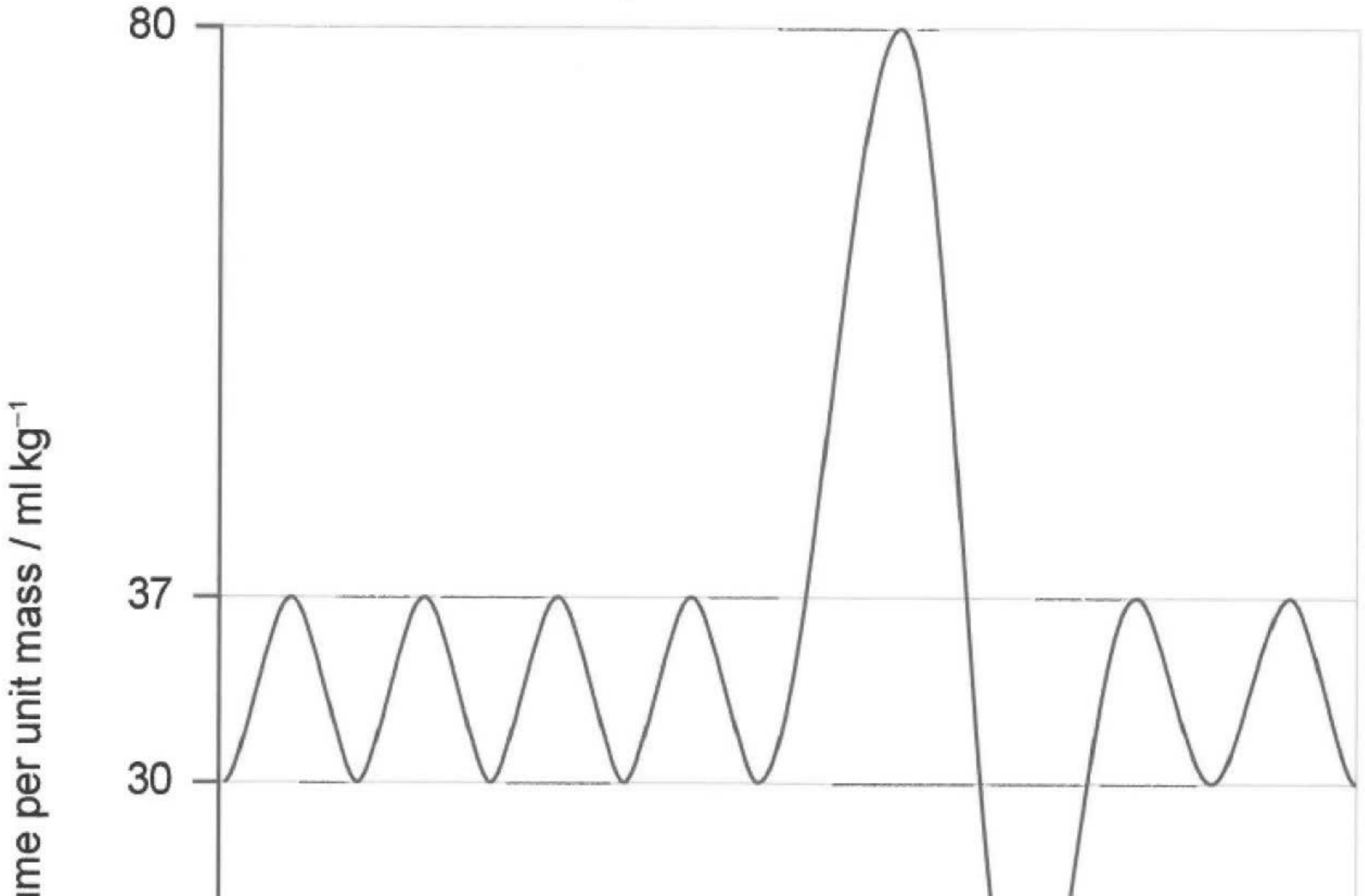
A. Human female

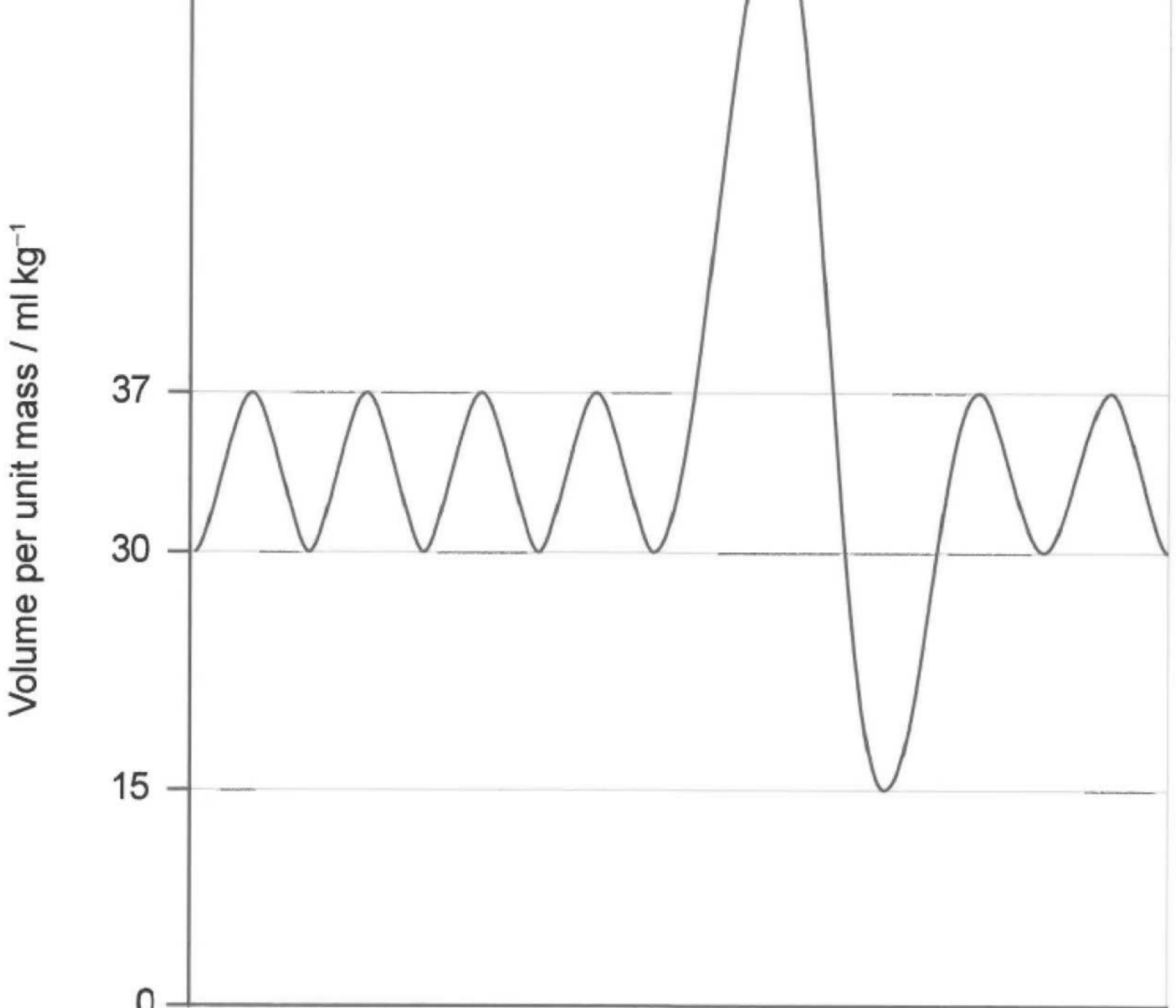
B. Chimpanzee female

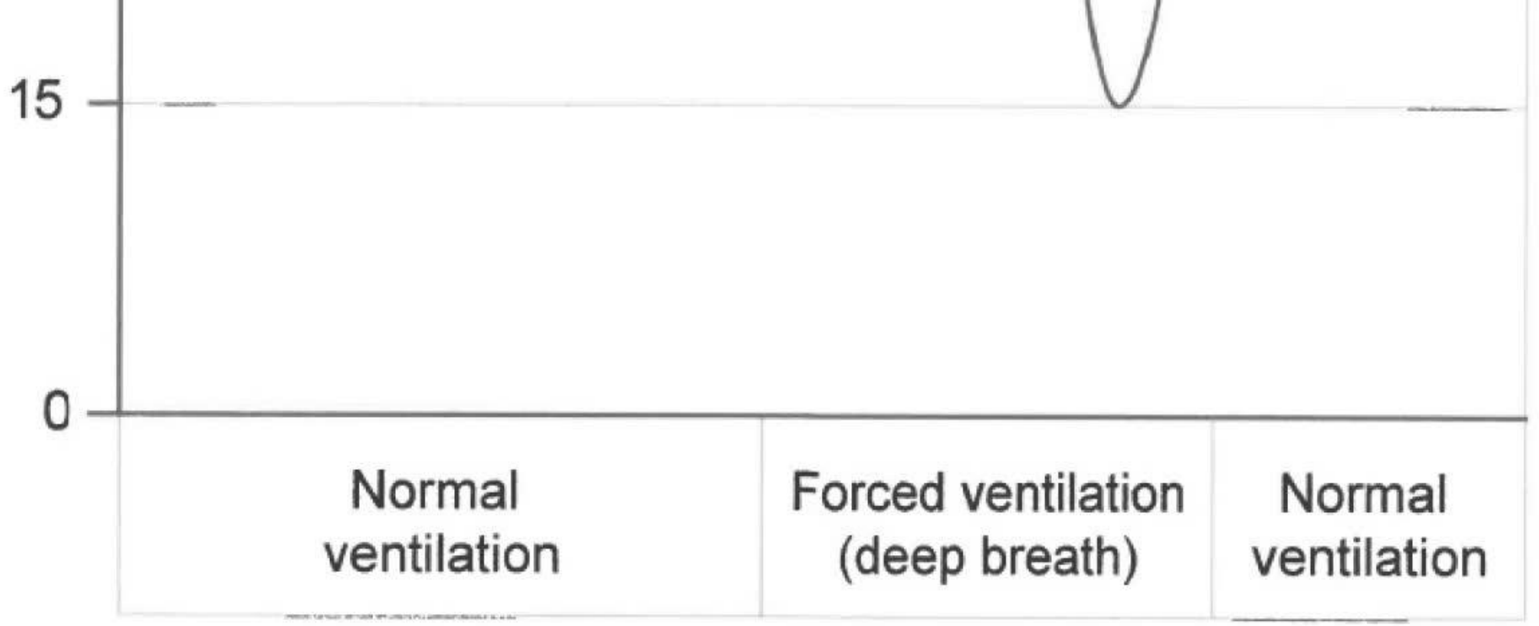
C. Human male

D. Chimpanzee male

23. The graph shows changes in lung volume during normal ventilation and forced ventilation (taking a deep breath).




Volume per unit mass / ml kg⁻¹
37
30
15
0



What is the vital capacity?

A. $7\,ml\,kg^{-1}$

B. $37\,ml\,kg^{-1}$

C. $65\,ml\,kg^{-1}$

D. $80\,ml\,kg^{-1}$

24. What increases the rate of transpiration?

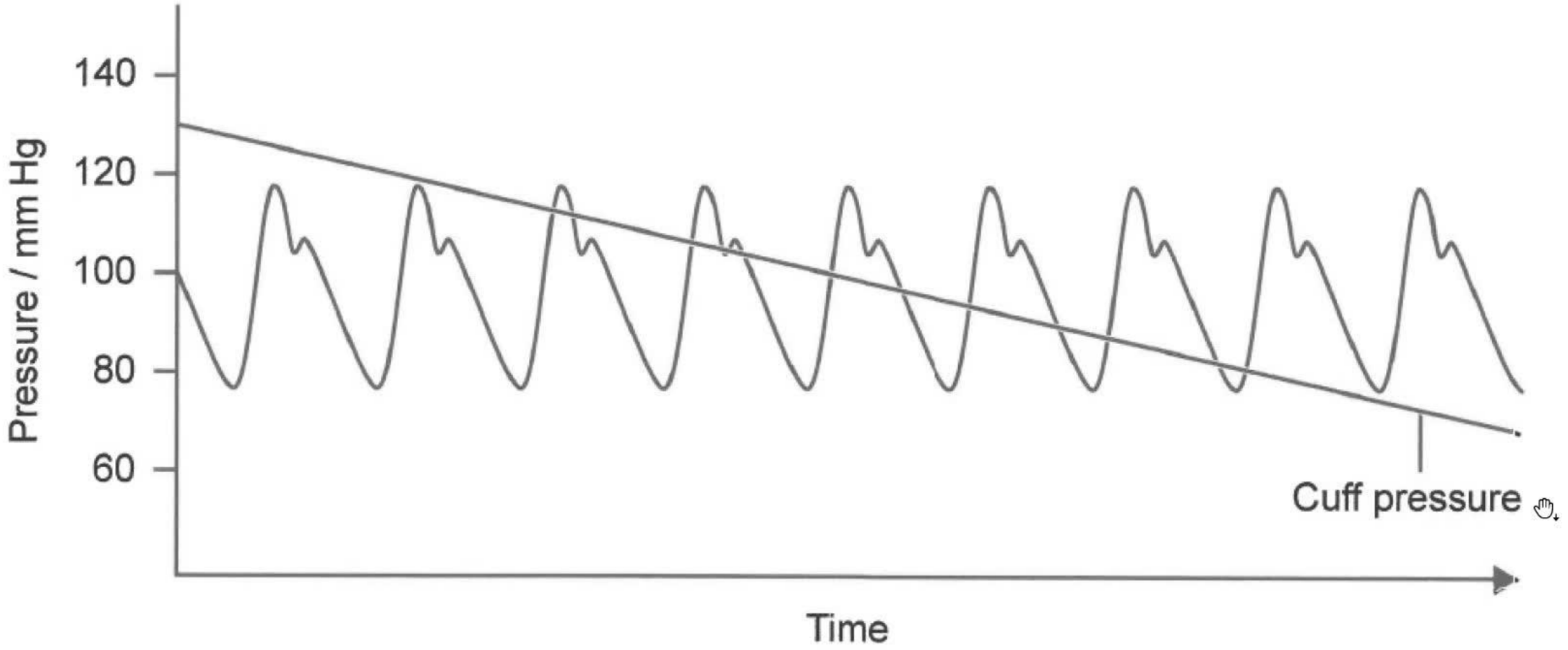
A. Increasing the humidity

B. Decreasing the temperature

C. Decreasing the light intensity

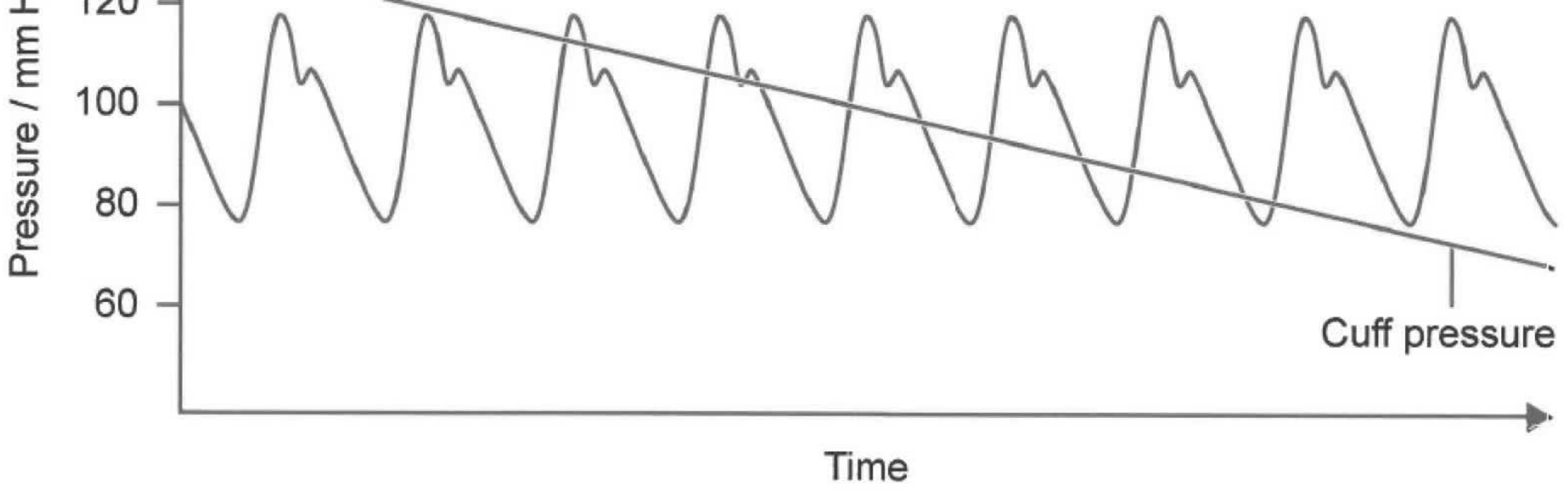
D. Increasing the wind speed

25. The graph shows changes in blood pressure during the cardiac cycle, taken using a sphygmomanometer. A cuff is attached to the upper arm, inflated to stop the blood flow in the artery, then the pressure released.



What are the values of the diastolic and systolic pressures from the graph?

	Diastolic pressure / mm Hg	Systolic pressure / mm Hg
A.	120	76
B.	130	66



What are the values of the diastolic and systolic pressures from the graph?

	Diastolic pressure / mm Hg	Systolic pressure / mm Hg
A.	120	76
B.	130	66
C.	76	120
D.	66	130

26. Which of these structures is most likely to be the effector in a pain reflex arc?

A. Grey matter

B. Skeletal muscle

C. Motor neuron

D. Pineal gland

27. Which cell type is part of the innate immune system?

A. Phagocytes

B. B-lymphocytes

C. T-lymphocytes

D. Helper T-cells

C. T-lymphocytes

D. Helper T-cells

28. Which chemical causes positive feedback to ensure rapid ripening of fruit?

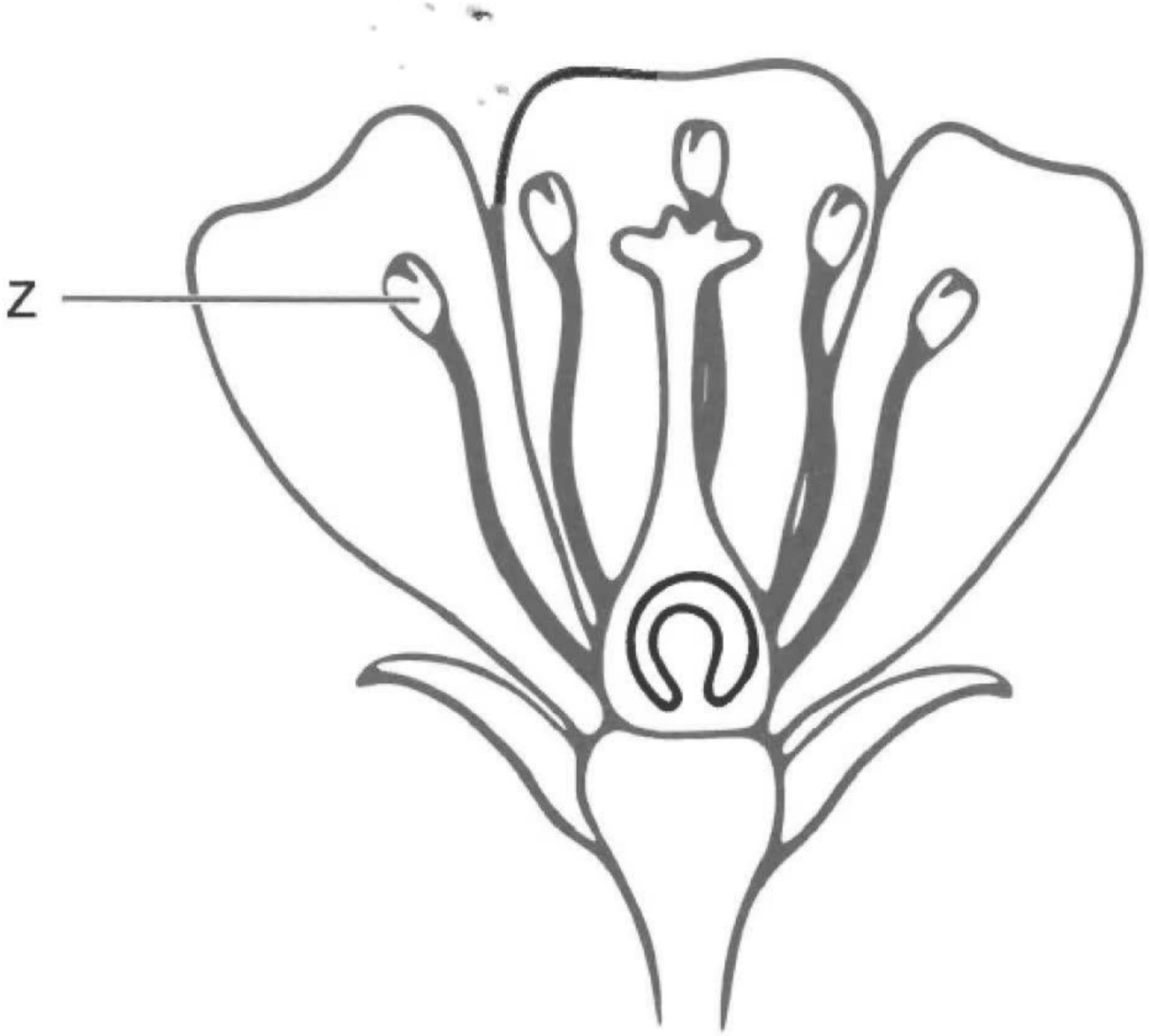
A. Auxin

B. Cytokinin

C. Epinephrine

D. Ethylene

29. The diagram shows a cross-section of a flower.



What describes the structure labelled Z?

What describes the structure labelled Z?

A. Structure Z is the anther, which is part of the stamen.

B. Structure Z is the stigma, which is part of the stamen.

C. Structure Z is the anther, which is part of the carpel.

D. Structure Z is the stigma, which is part of the carpel.

30. How is blood glucose regulated?

D. Structure Z is the stigma, which is part of the carpel.

30. How is blood glucose regulated?

	Deviation of blood glucose level from normal	**Hormone secreted by pancreas**	**Effect**
A.	higher	glucagon	muscles break down glycogen into glucose
B.	higher	insulin	small intestine slows glucose absorption
C.	lower	glucagon	liver converts glycogen to glucose
D.	lower	insulin	kidney reabsorbs more glucose

31. A *Mirabilis jalapa* plant with red flowers was crossed with one with white flowers. All plants in the F1 generation had pink flowers. What phenotype ratio would be expected in the F2 generation?

A. 100% pink

B. 50% red and 50% white

C. 25% white, 50% pink and 25% red

D. 75% red and 25% white

32. What controls the developmental changes during puberty?

I. Increased release of gonadotropin-releasing hormone (GnRH) by the hypothalamus

II. Luteinizing hormone (LH) leading to increased sex hormone production

III. Gonadotropin-releasing hormone (GnRH) triggering the onset of increased luteinizing hormone (LH)

A. I and II only

B. I and III only

C. 25% white, 50% pink and 25% red

D. 75% red and 25% white

32. What controls the developmental changes during puberty?

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C. II and III only

D. I, II and III

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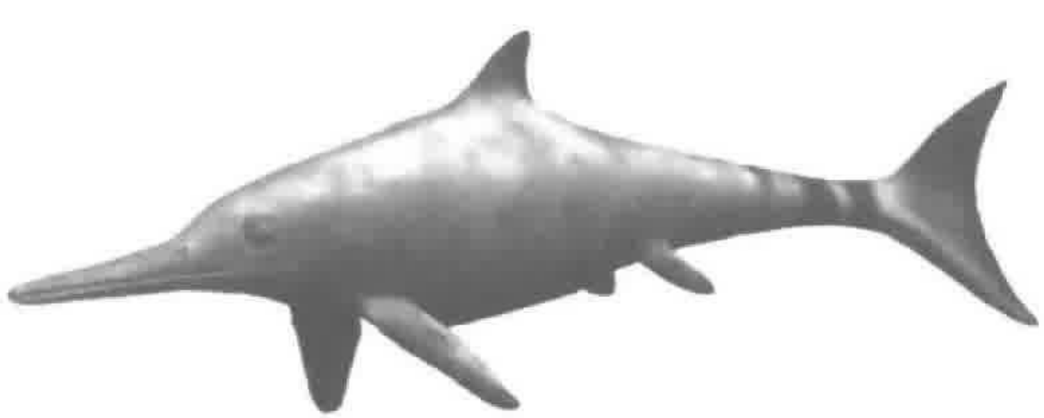
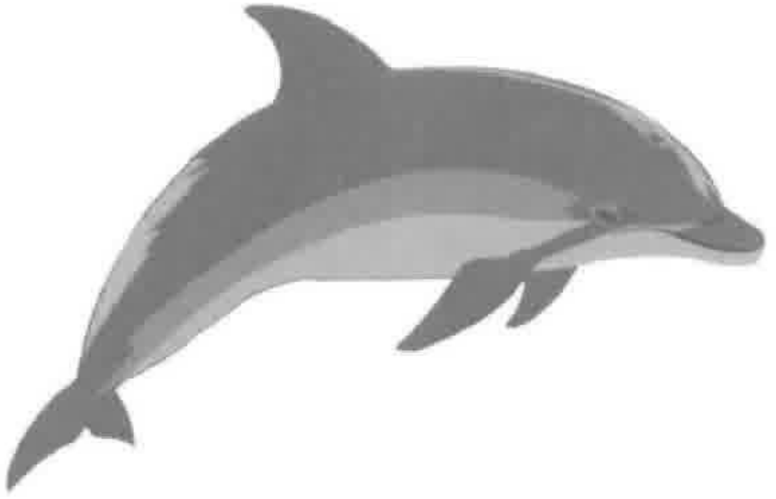
33. The images show an ichthyosaurus and a dolphin. Ichthyosaurus is an extinct aquatic reptile, known only from fossil remains. Dolphins are mammals.





How have these species evolved?

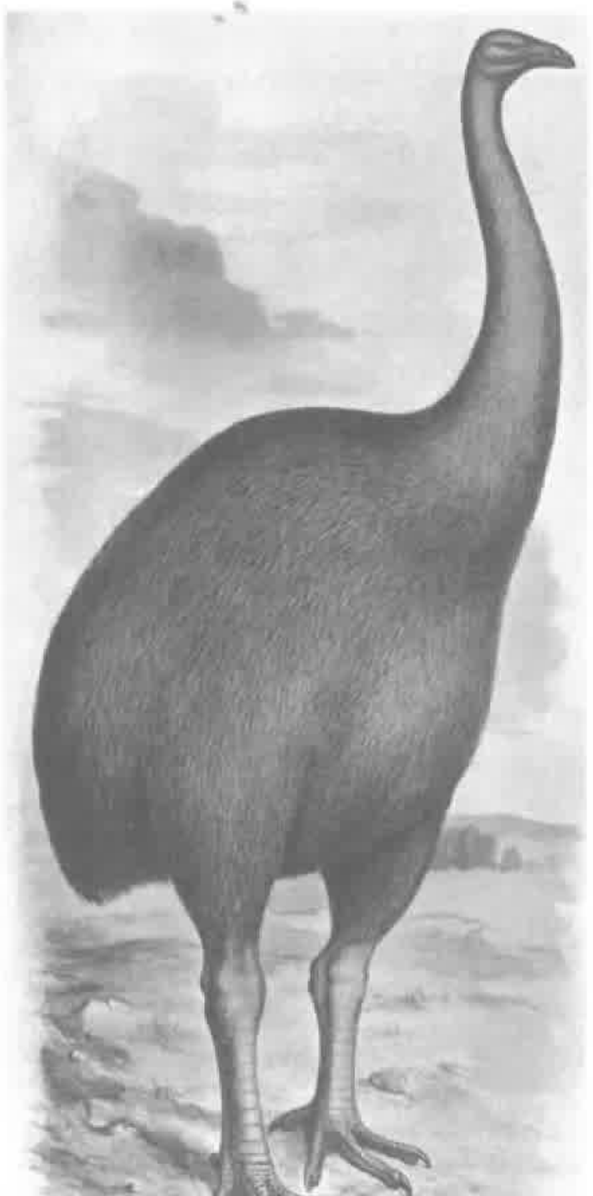
A. Their streamlined bodies show divergent evolution.

B. Their streamlined bodies are analogous structures.

C. Their pentadactyl limbs are an example of convergent evolution.

D. Their pentadactyl limbs are analogous structures.

34. The North Island giant moa (*Dinornis novaezealandiae*) went extinct some time between the arrival of humans in New Zealand and the 1800s.



What do scientists believe to be the cause of this extinction?

A. Deforestation

B. New diseases

C. Competition with other megafauna

D. Overhunting

B. New diseases

C. Competition with other megafauna

D. Overhunting

35. What occurs during competitive exclusion between two species?

I. They compete for the same resources so cannot coexist in the same niche.

II. Competing species are regulated by predators in the ecosystem.

III. Both species are restricted to a part of their fundamental niche.

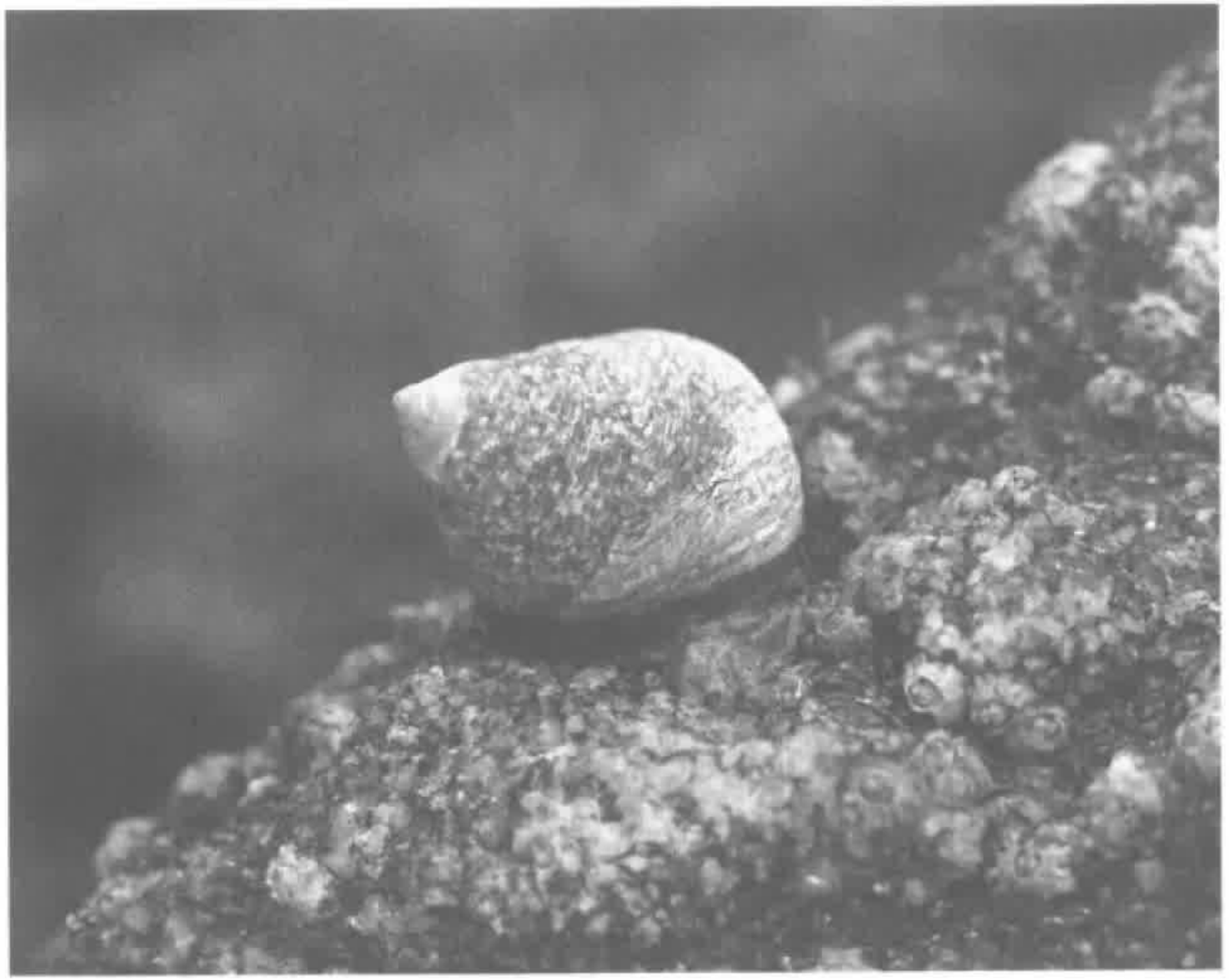
A. I and II only

B. I and III only

C. III only

D. I, II and III

36. A capture–mark–release–recapture experiment was used, together with the Lincoln index formula (population size estimate = M × N/R), to estimate the population size of common periwinkles (*Littorina littorea*) on a rocky shore. The table shows the data collected.



Individuals captured and marked initially	100

Individuals captured and marked initially	100
Individuals recaptured	50
Marked individuals recaptured	10

What is the estimated size of the population?

A. 160

B. 500

C. 1000

D. 5000

37 Which organisms use oxidation of simple inorganic substances as an energy source?

A. 160

B. 500

C. 1000

D. 5000

37. Which organisms use oxidation of simple inorganic substances as an energy source?

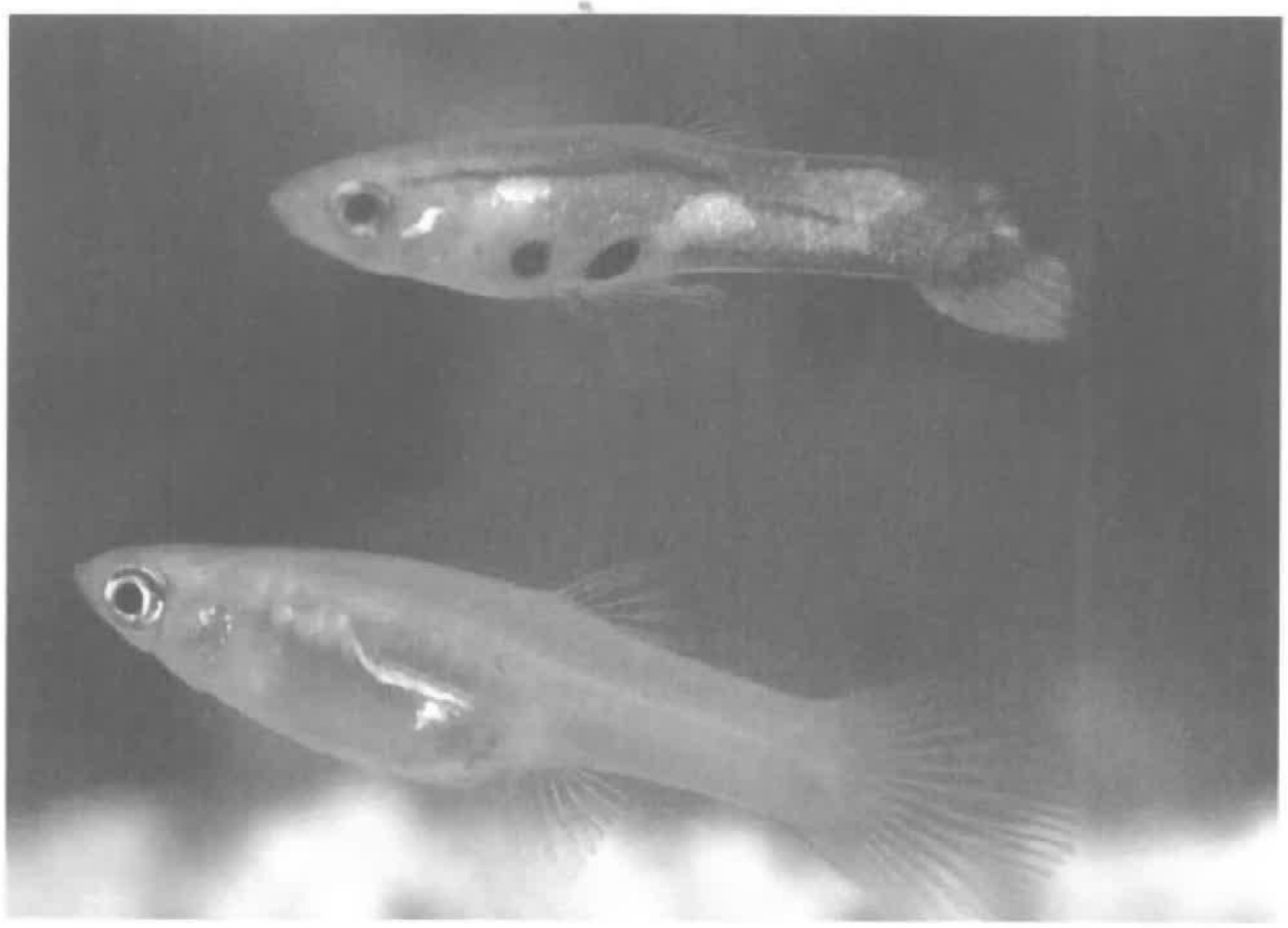
A. Photoautotrophs

B. Heterotrophs

C. Chemoautotrophs

D. Saprotrophs

38. John Endler's experiments modelled sexual and natural selection in Trinidadian guppies (*Poecilia reticulata*) by controlling selection pressures.



What did the experiments of John Endler demonstrate?

A. Guppies have no predators in their natural habitat.

What did the experiments of John Endler demonstrate?

A. Guppies have no predators in their natural habitat.

B. Male guppies prefer dull-coloured females for mating.

C. Predation influences the colour of guppies in different environments.

D. Guppies are not affected by the presence of other fish species.

39. What occurs during primary succession?

A. Saprotrophs are the first to colonize bare rock.

B. The amount of primary production remains stable.

C. There is a decrease in species diversity.

D. There is an increase in the complexity of food webs.

40. What is the main driver of contemporary climate change?

A. The burning of fossil fuels, releasing greenhouse gases into the atmosphere

B. Natural variability in solar radiation, causing periodic shifts in temperature

C. Ocean currents regulating heat distribution, influencing weather patterns

D. Volcanic eruptions heating the atmosphere