1 Sample X is added to water and made up to a total volume of 200 cm^3. This gives a solution of 0.100 mol dm^{-3} HCl.

What is X?

A 10 cm^3 of 1.00 mol dm^{-3} HCl

B 30 cm^3 of 0.90 mol dm^{-3} HCl

C 50 cm^3 of 0.40 mol dm^{-3} HCl

D 100 cm^3 of 0.30 mol dm^{-3} HCl

2 A mixture of 10 cm^3 of methane and 10 cm^3 of ethane was sparked with an excess of oxygen. After cooling, the residual gas was passed through aqueous potassium hydroxide.

All gas volumes were measured at the same temperature and pressure.

Which volume of gas was absorbed by the alkali?

A 15 cm^3 **B** 20 cm^3 **C** 30 cm^3 **D** 40 cm^3

3 Z is a compound of two elements, X and Y.

Element X shows a very large increase between its 5th and 6th ionisation energies. It has the second largest 1st ionisation energy in its group.

Element Y shows a very large increase between its 6th and 7th ionisation energies. It has the largest 1st ionisation energy in its group.

What is compound Z?

A NO_2 **B** PCl_5 **C** P_4O_{10} **D** SF_6

4 Which statement about $^{131}_{53}I$ is correct?

A A negative ion of $^{131}_{53}I$ contains 53 neutrons and 52 electrons.

B A negative ion of $^{131}_{53}I$ contains 53 neutrons and 54 electrons.

C A negative ion of $^{131}_{53}I$ contains 78 neutrons and 52 electrons.

21 The diagram shows part of the DNA sequence of a gene and a mutated sequence of the same gene.

normal DNA sequence	...CCG GAT TAT TGC GAG AAA TGG CAT TCT AGG...
mutated DNA sequence	...CCG GAT GTA TTG CGA GAA ATG CAT TCT AGG...

What are possible effects of the mutated sequence?

1 the presence of mRNA stop codons, UAG, UAA or UGA

2 a change in the sequence of amino acids

3 a non-functional protein

4 ribosomes cannot translate the mRNA

A 1, 2 and 3 **B** 1, 3 and 4 **C** 1 and 4 only **D** 2 and 3 only

22 What is correct for phloem sieve tube elements?

A Companion cells provide structural support to the phloem sieve tube elements.

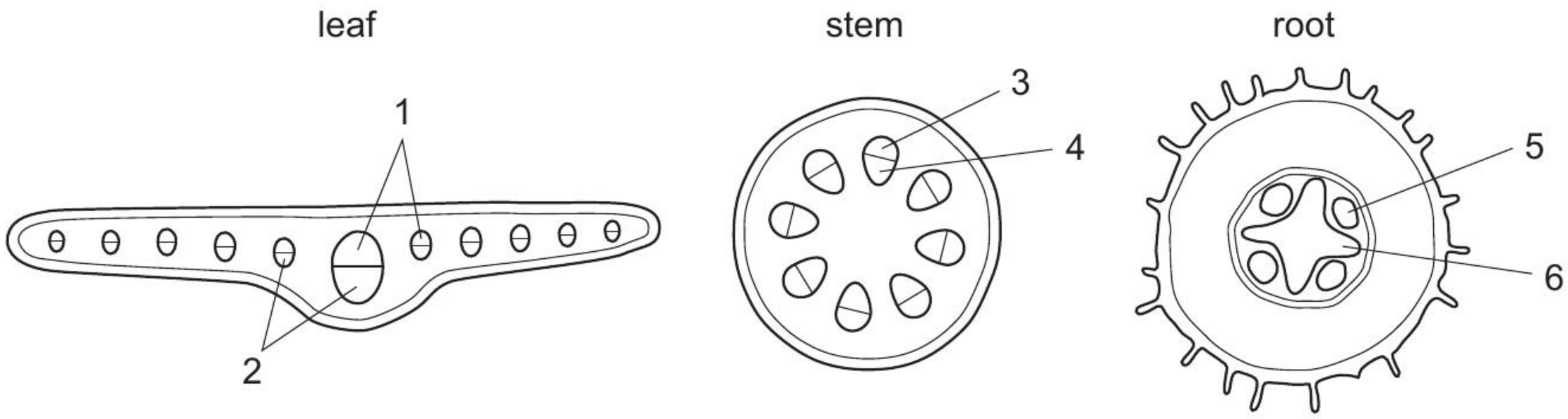
B Lignified walls of phloem sieve tube elements prevent transport of mineral salts by mass flow.

C Phloem sieve tube elements become narrower as movement of sucrose occurs.

D Plasmodesmata allow movement of water and solutes across cell walls of phloem sieve tube elements.

23 The diagrams show transverse sections of parts of a plant.

Transport tissues are labelled 1 to 6.



Which combination shows the tissues that have a main function of transporting water?

	1	2	3	4	5	6
A	✓	✓	✗	✗	✓	✓
B	✓	✗	✗	✓	✗	✓
C	✗	✓	✓	✗	✓	✗
D	✗	✓	✗	✓	✓	✗

key

✓ = transporting water is a main function

✗ = transporting water is **not** a main function

24 The statements are descriptions of how water moves across the root to the xylem vessel elements.

1 Water enters cell walls.

2 Water enters cytoplasm by osmosis.

3 Water moves from cell to cell through plasmodesmata.

4 Water moves through cell walls.

Which statements describe the apoplast pathway?

A 1, 2, 3 and 4

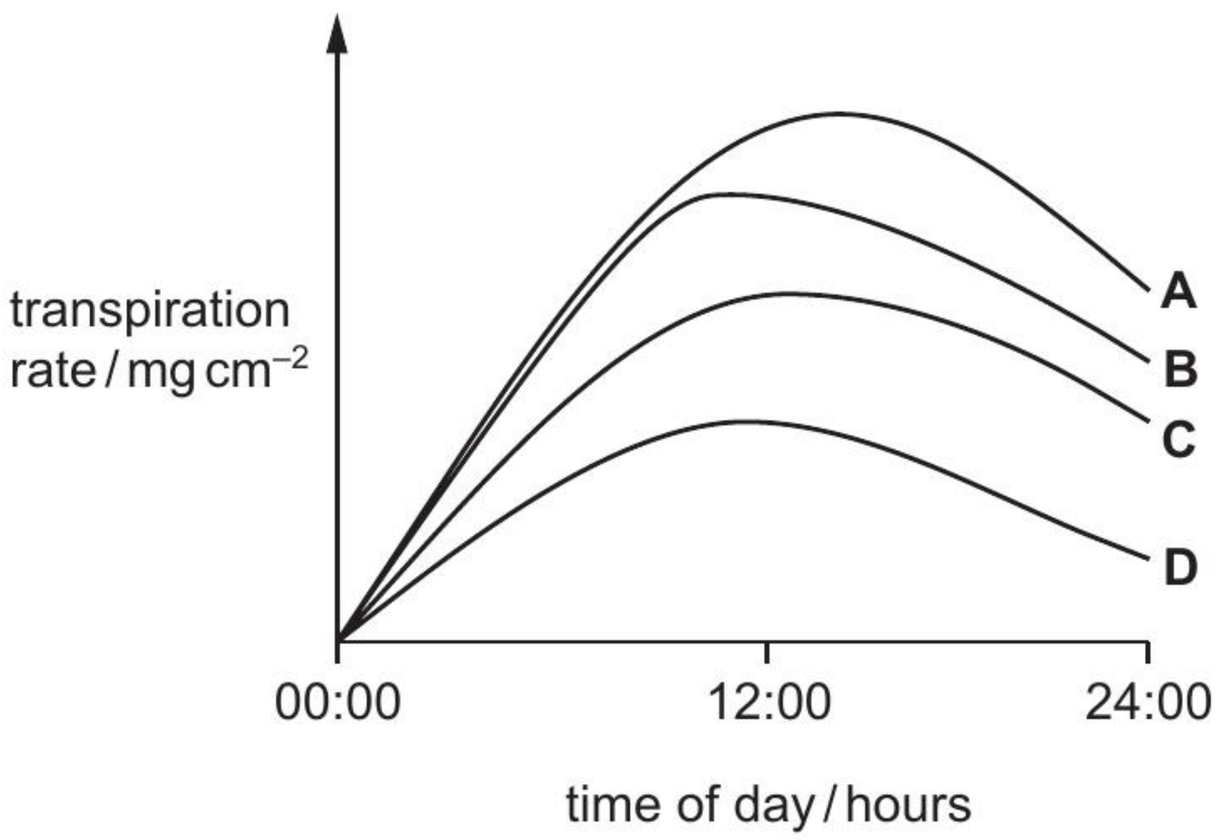
B 1, 2 and 3 only

C 1 and 4 only

D 4 only

25 Four plants, **A**, **B**, **C** and **D**, were grown in the same conditions and their transpiration rates measured.

Which plant is most likely to be a xerophyte?

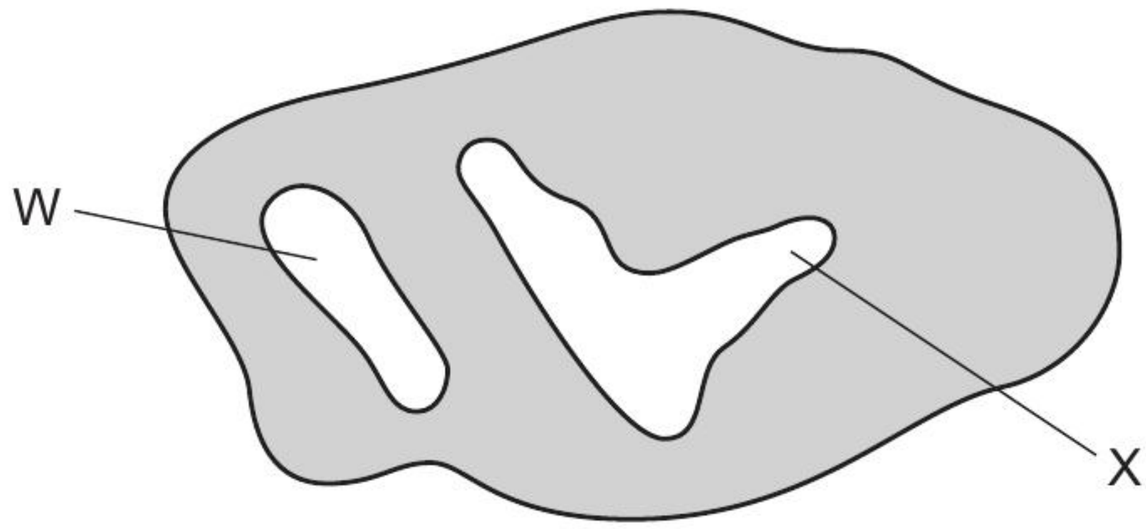


26 Sucrose moves from a mesophyll cell in a leaf into a phloem sieve tube element.

Which changes to the water potential and the volume of liquid in the phloem sieve tube element are correct?

	water potential becomes	volume of liquid
A	less negative	decreases
B	less negative	increases
C	more negative	decreases
D	more negative	increases

27 The diagram shows a cross-section through a mammalian heart.



Which chambers of the heart are represented by W and X?

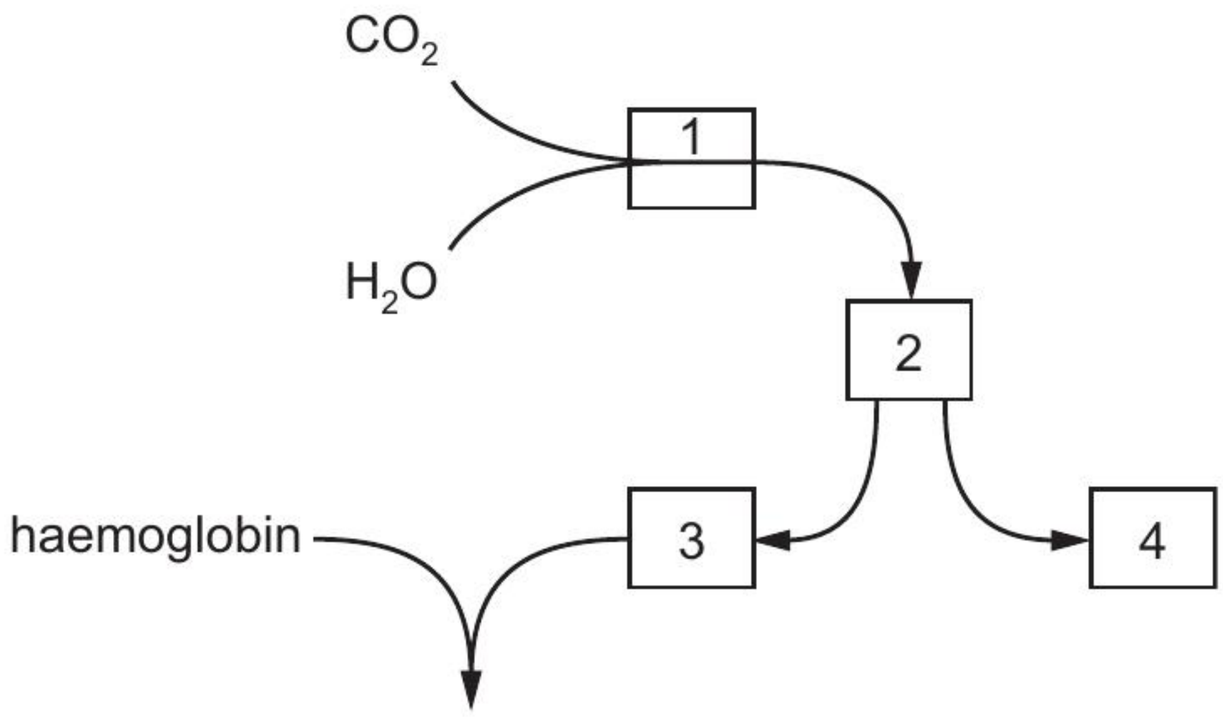
	W	X
A	left ventricle	right ventricle
B	right atrium	left atrium
C	right atrium	right ventricle
D	right ventricle	left ventricle

28 At a certain point in a cardiac cycle, the pressure in the right ventricle is lower than that in the right atrium and lower than that in the pulmonary artery.

Which row is correct?

	atrioventricular valve	semilunar valve
A	closed	closed
B	closed	open
C	open	closed
D	open	open

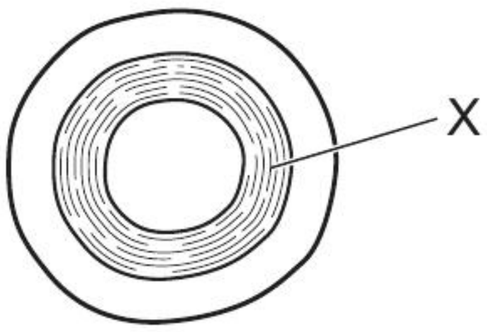
29 The diagram shows the pathway for the transport of carbon dioxide that occurs in red blood cells.



Which row is correct?

	1	2	3	4
A	carbaminohaemoglobin	haemoglobinic acid	hydrogen ions	hydrogencarbonate ions
B	carbonic anhydrase	carbonic acid	hydrogen ions	hydrogencarbonate ions
C	carboxyhaemoglobin	carbonic anhydrase	carbonic acid	carbon dioxide
D	haemoglobinic acid	carbonic acid	hydrogencarbonate ions	hydrogen ions

30 The diagram shows a transverse section through an artery.



Which statement describes the tissues present in layer X?

A collagen and smooth muscle only

B elastic fibres and collagen only

C elastic fibres and smooth muscle only

D elastic fibres, collagen and smooth muscle

31 The large arteries close to the heart have a thick elastic layer in their walls.

Which statements about this layer are correct?

1 helps to maintain the blood pressure in arteries

2 reduces friction within the arteries

3 prevents too much pressure bursting the artery wall

A 1, 2 and 3 **B** 1 and 3 only **C** 1 only **D** 2 and 3 only

32 Which tissues are present in the walls of a trachea and an alveolus?

		tissue	
		epithelium with goblet cells	smooth muscle
A	trachea	✓	✓
	alveolus	✗	✗
B	trachea	✓	✓
	alveolus	✗	✓
C	trachea	✓	✗
	alveolus	✓	✓
D	trachea	✗	✓
	alveolus	✗	✗

key

✓ = present
✗ = absent

33 The surface tension of the layer of liquid lining the alveoli tends to pull the walls inwards so alveoli could collapse.

Which statements could explain how this is prevented?

1 Alveolar fluid is moved around by cilia.

2 Elastic fibres keep the alveoli open.

3 Epithelial cells secrete a chemical that reduces the cohesion in water.

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 only

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Important values, constants and standards

molar gas constant	$R = 8.31\,\text{J K}^{-1}\,\text{mol}^{-1}$
Faraday constant	$F = 9.65 \times 10^{4}\,\text{C mol}^{-1}$
Avogadro constant	$L = 6.022 \times 10^{23}\,\text{mol}^{-1}$
electronic charge	$e = -1.60 \times 10^{-19}\,\text{C}$
molar volume of gas	$V_m = 22.4\,\text{dm}^3\,\text{mol}^{-1}$ at s.t.p. (101 kPa and 273 K) $V_m = 24.0\,\text{dm}^3\,\text{mol}^{-1}$ at room conditions
ionic product of water	$K_w = 1.00 \times 10^{-14}\,\text{mol}^2\,\text{dm}^{-6}$ (at 298 K (25 °C))
specific heat capacity of water	$c = 4.18\,\text{kJ kg}^{-1}\,\text{K}^{-1}$ ($4.18\,\text{J g}^{-1}\,\text{K}^{-1}$)

The Periodic Table of Elements

Group																	
1	2											13	14	15	16	17	18
							1 H hydrogen 1.0										2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0											5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium –	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

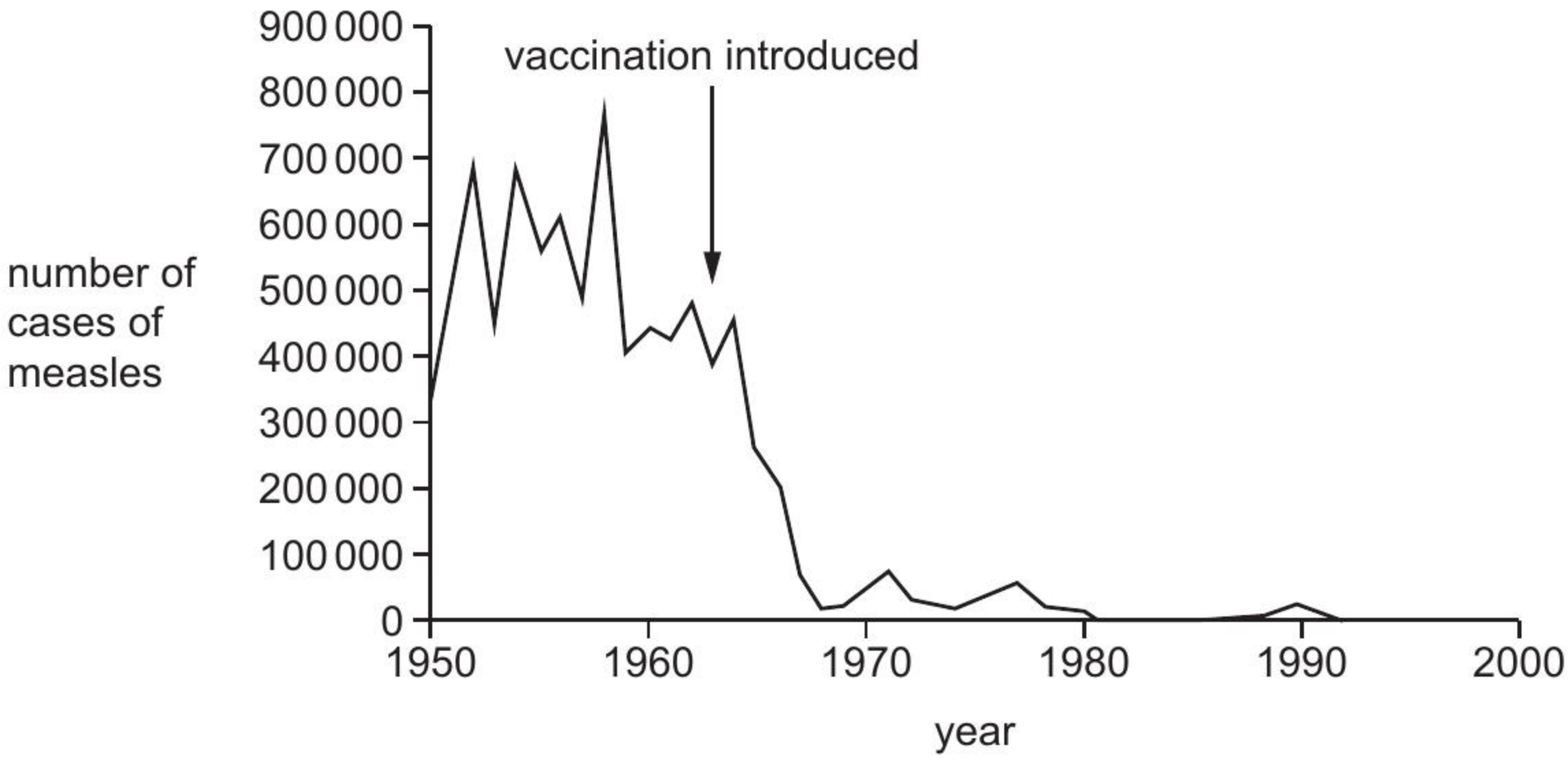
Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.4	61 Pm promethium –	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.3	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.1	71 Lu lutetium 175.0
actinoids	89 Ac actinium –	90 Th thorium 232.0	91 Pa protactinium 231.0	92 U uranium 238.0	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

40 Measles is an infectious disease caused by a virus.

The graph shows the number of cases of measles each year in a country before and after a vaccine was introduced.



What could have caused the decrease in the number of cases of measles after vaccination was introduced?

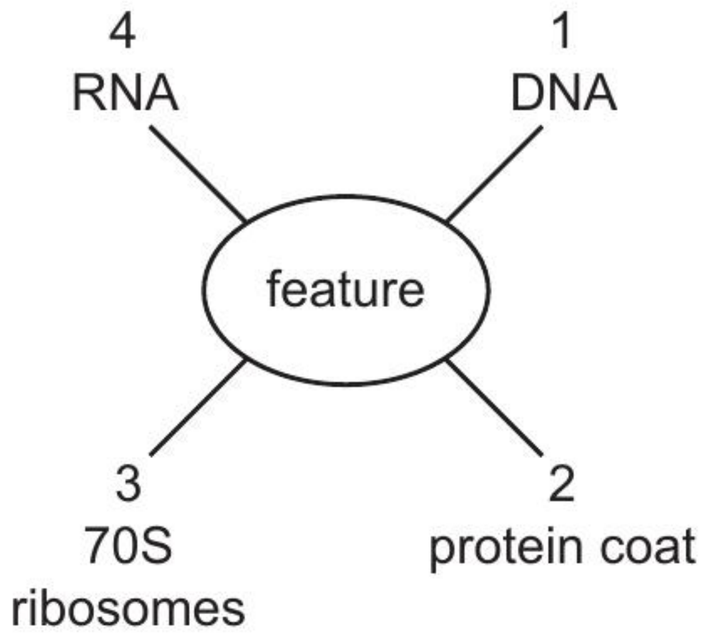
	vaccines provided artificial active immunity in people	vaccines provided artificial passive immunity in people	fewer people are able to act as hosts for the virus
A	✓	✗	✓
B	✗	✓	✓
C	✗	✓	✗
D	✓	✗	✗

key

✓ = yes

✗ = no

4 Which features shown in the diagram can be present in viruses?



A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

5 After boiling a sample of milk with Benedict's solution, a yellow colour is observed.

Which conclusion about the sample of milk is correct?

A Reducing sugars are not present.

B Reducing sugars are present.

C There is a high concentration of fructose.

D There is a low concentration of sucrose.

6 Which of the statements about polysaccharides can be used to describe amylose and cellulose?

1 contains 1,4 glycosidic bonds

2 contains 1,6 glycosidic bonds

3 polymer of glucose

A 1 and 2

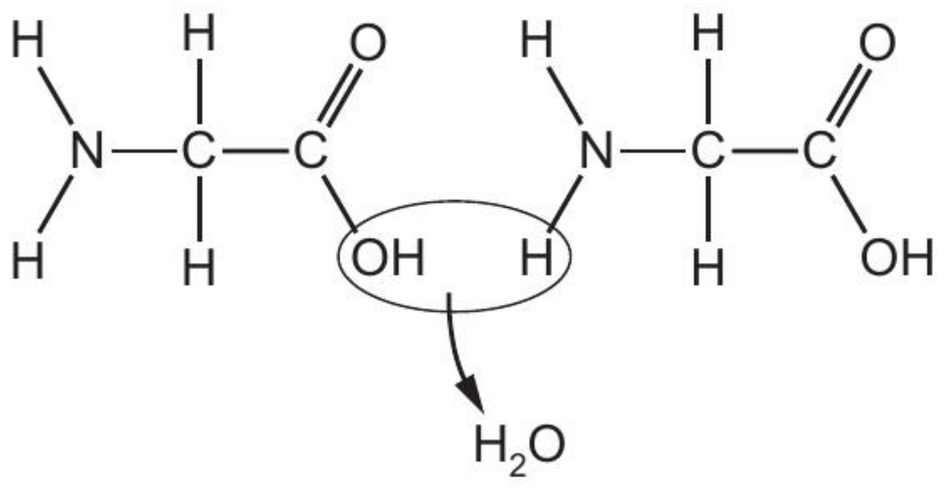
B 1 and 3

C 1 only

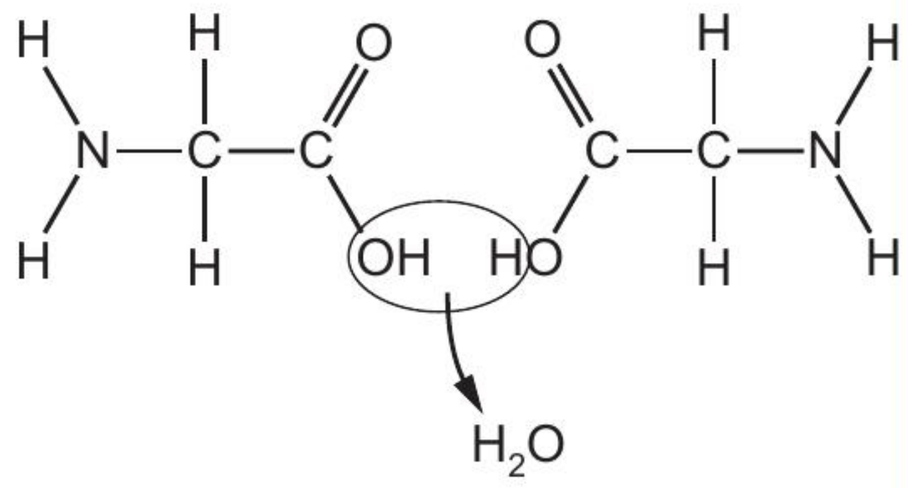
D 2 and 3

7 Which diagram shows the formation of a peptide bond?

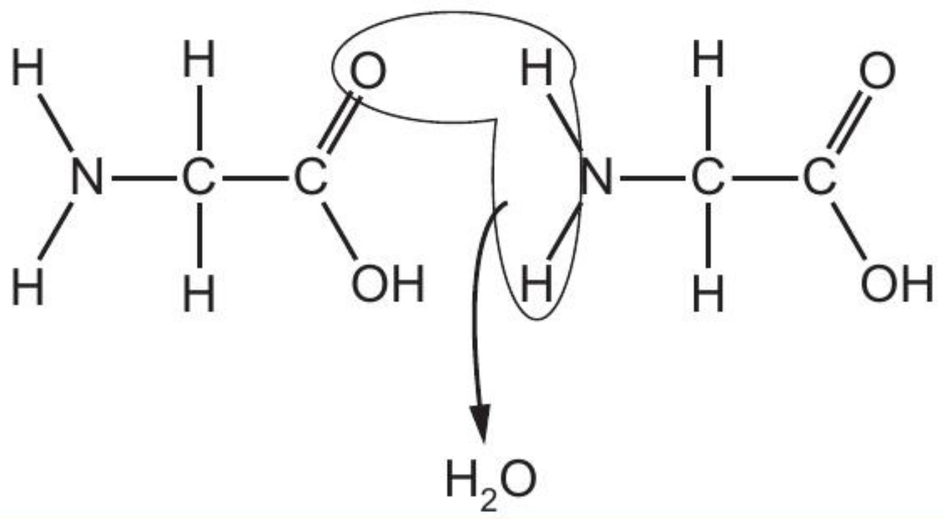
A



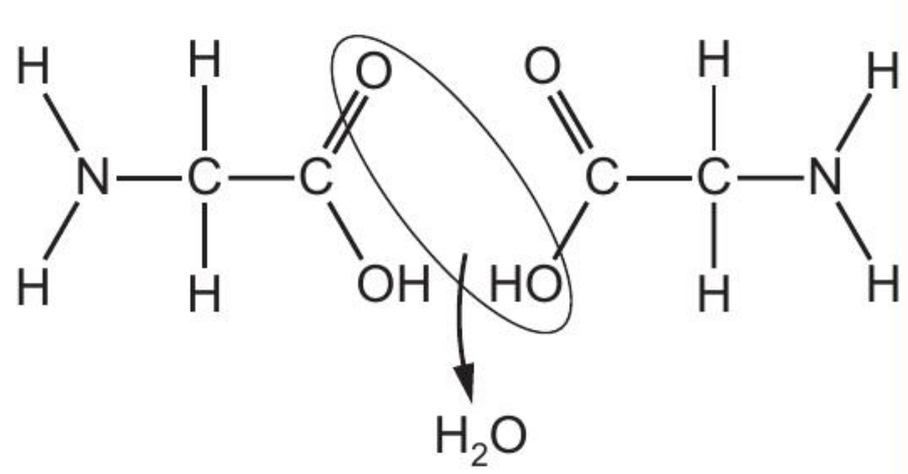
B



C



D



8 In enzyme-catalysed reactions, the position of the amino acids found at the active site is important.

During the synthesis of enzymes, amino acids are brought together in the correct position to form the active site.

Which levels of protein structure **must** be involved in forming the active site?

	level of protein structure			
	primary	secondary	tertiary	quaternary
A	✓	✓	✓	✓
B	✓	✓	✓	✗
C	✗	✓	✓	✓
D	✗	✓	✗	✓

key

✓ = involved

✗ = not involved

9 Which features affect the tensile strength of collagen?

1 the helical structure of collagen chains

2 the small R group of the amino acids in collagen

3 the insoluble nature of collagen

4 the bonds between collagen molecules

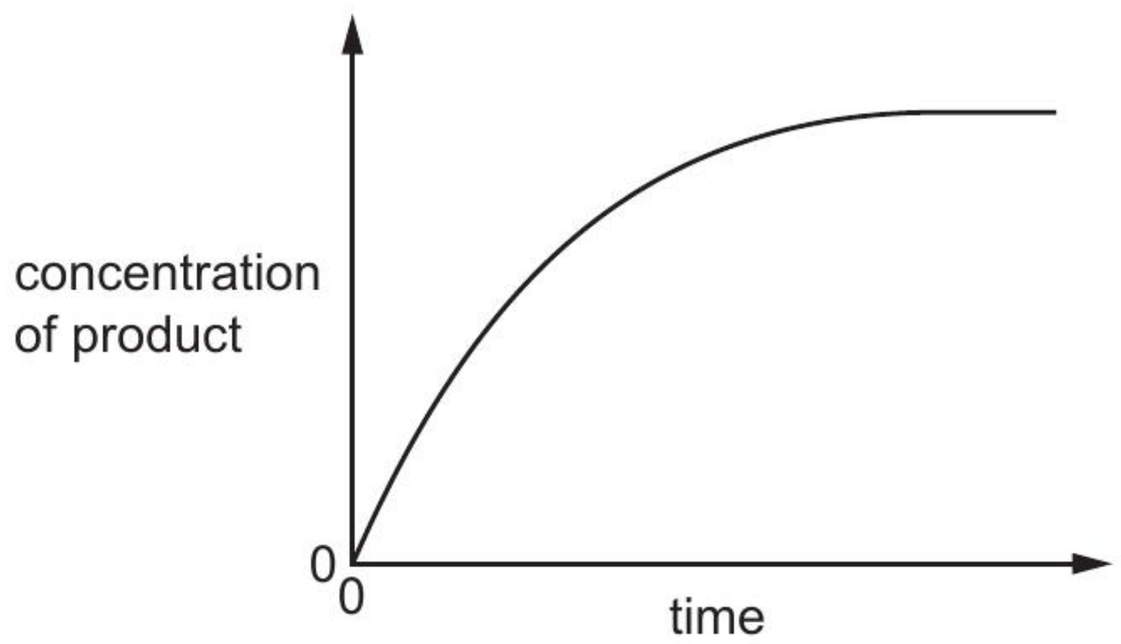
A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1 and 3 only

D 2, 3 and 4 only

10 A fixed volume of the enzyme catalase was added to a fixed volume of hydrogen peroxide solution. The diagram shows how the concentration of product changed over the course of the reaction.



What explains the shape of this graph?

A The active sites become saturated.

B The enzyme was denatured.

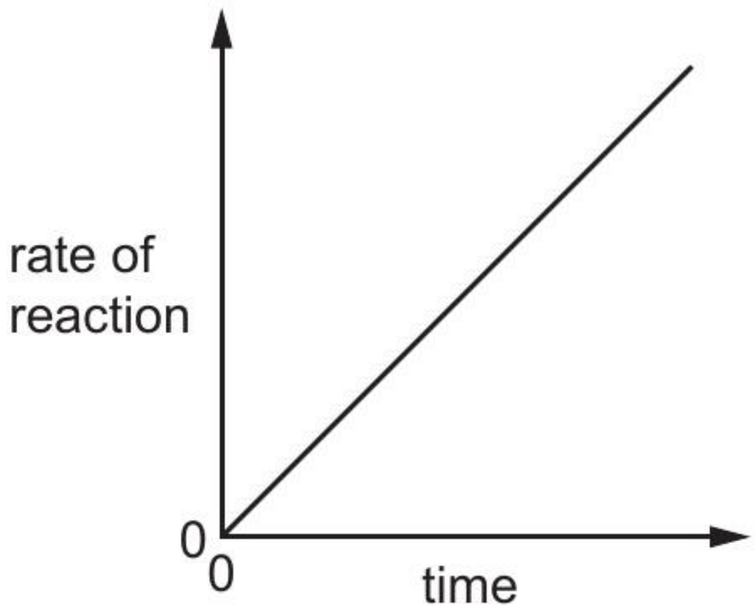
C The hydrogen peroxide inhibited the reaction.

D The substrate molecules were used up.

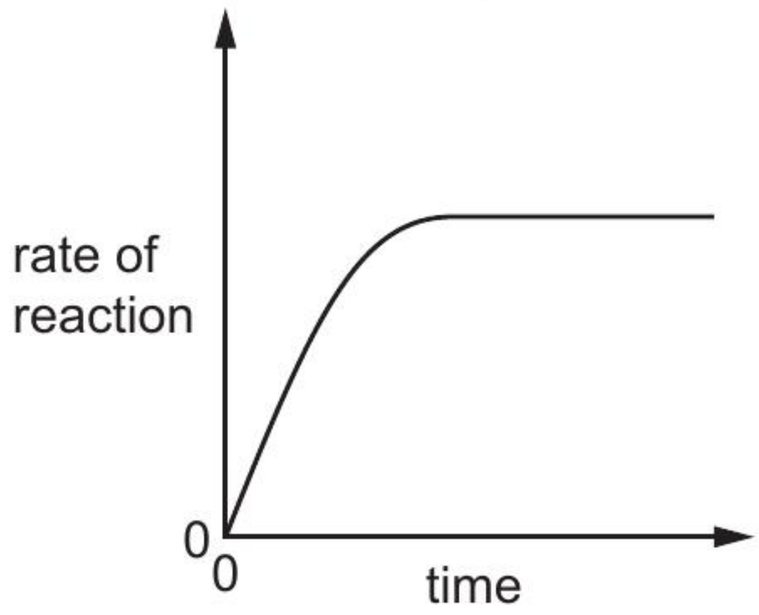
11 A fixed volume and concentration of substrate and enzyme were mixed. All other variables were kept constant. The enzyme-catalysed reaction was left until it was complete.

Which graph shows how the rate of reaction changes with time?

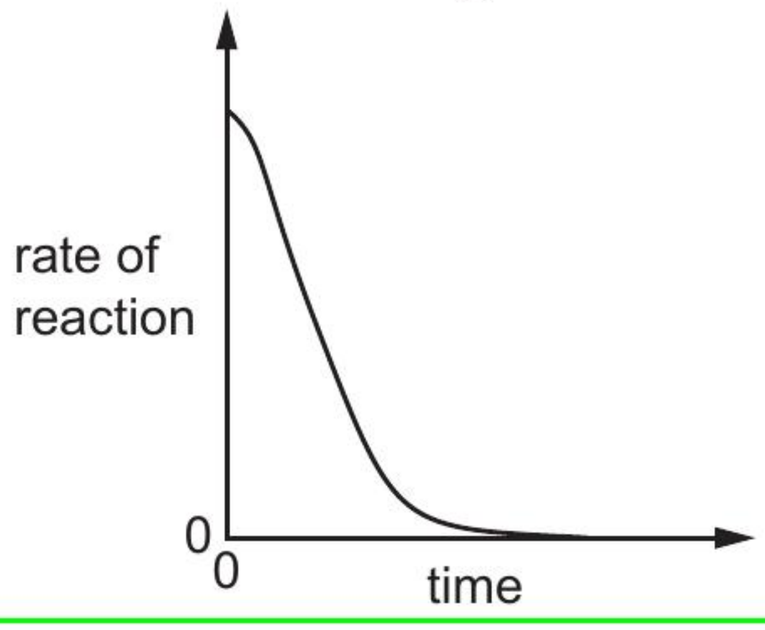
A



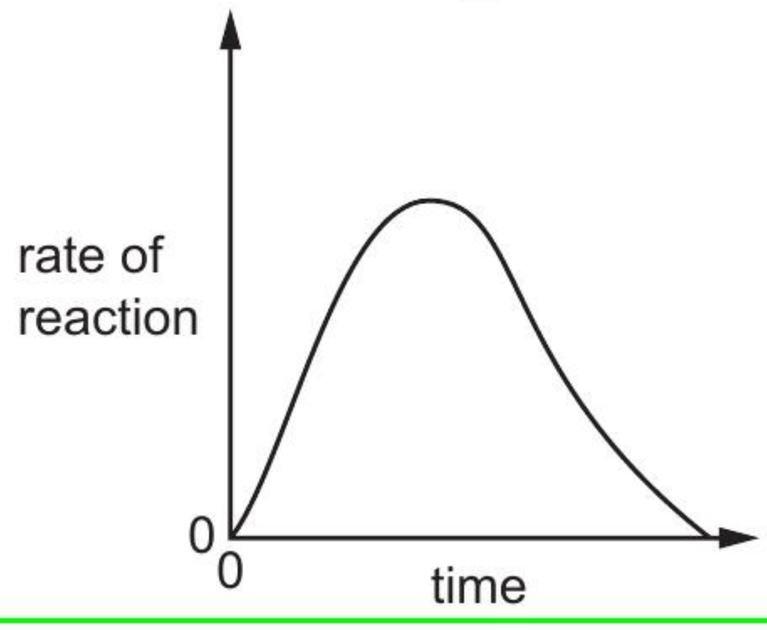
B



C

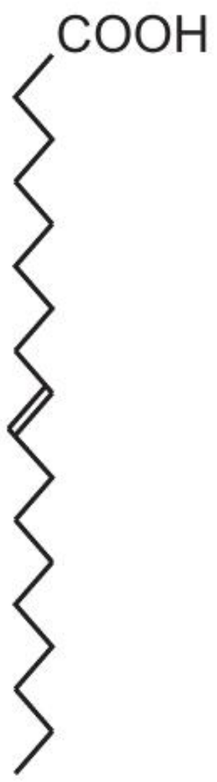


D

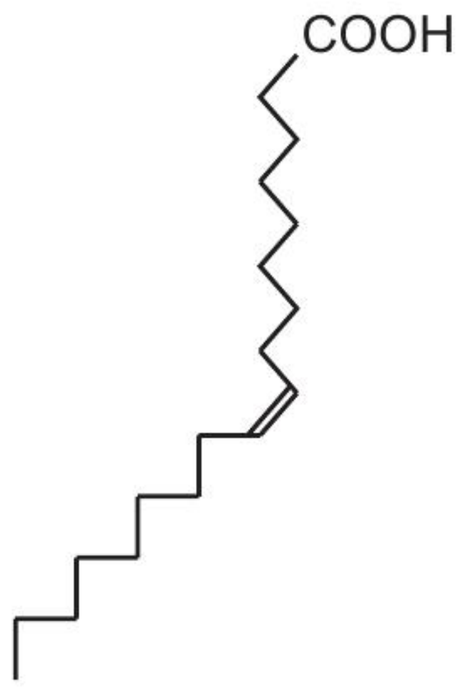


12 The fatty acids elaidic acid and oleic acid have exactly the same structural formulae, with one double bond in the chain. However, the shapes of the chains are different, as shown in the diagram.

elaidic acid



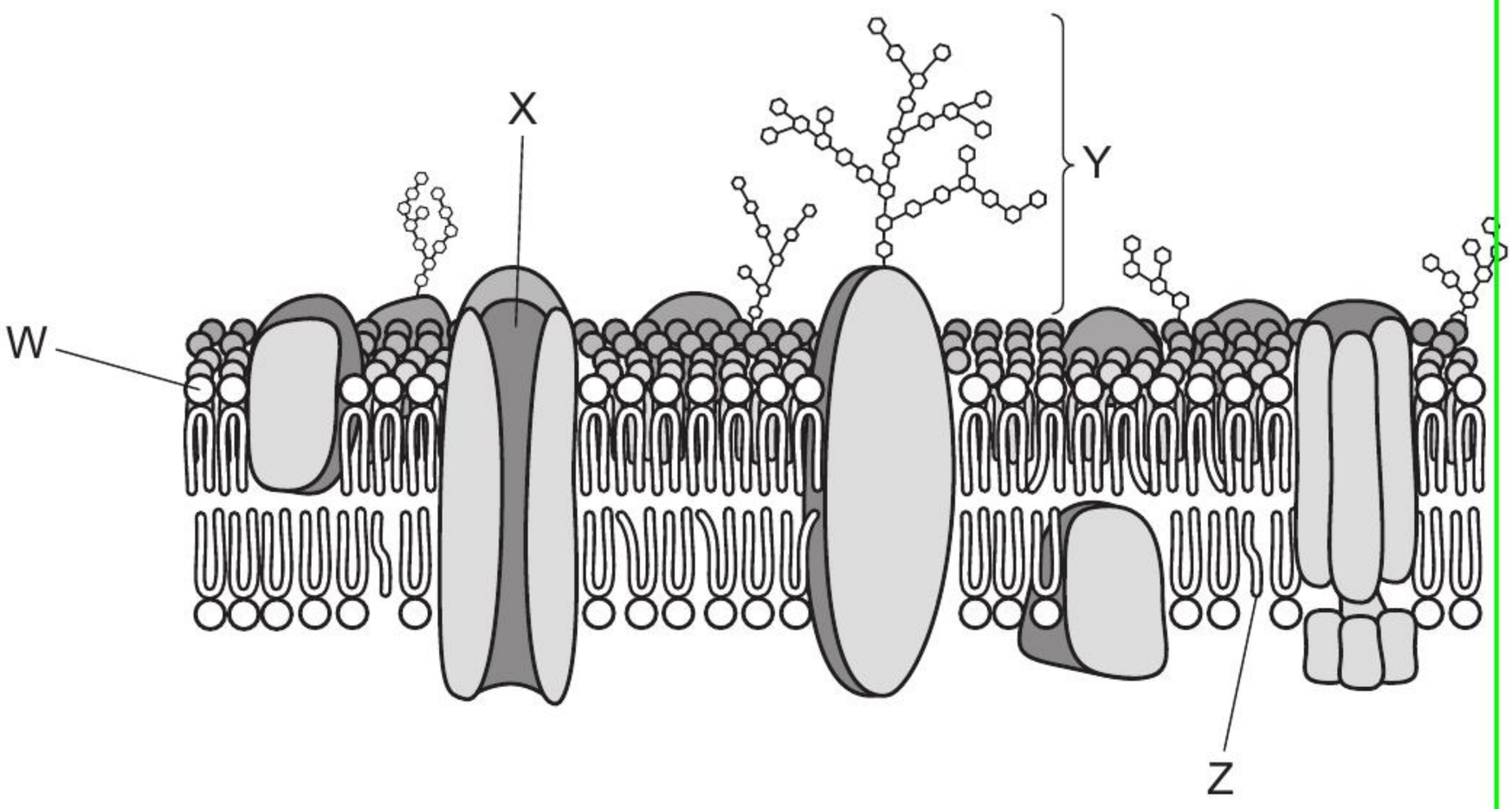
oleic acid



Which row shows the effect of the presence of these fatty acids on the structure and behaviour of a cell surface membrane?

	elaidic acid	oleic acid
A	does not fit closely with other fatty acids so that the membrane is less fluid at high temperatures	fits closely with other fatty acids so that the membrane is less fluid at low temperatures
B	does not fit closely with other fatty acids so that the membrane is more fluid at low temperatures	fits closely with other fatty acids so that the membrane is less fluid at low temperatures
C	fits closely with other fatty acids so that the membrane is less fluid at high temperatures	does not fit closely with other fatty acids so that the membrane is more fluid at low temperatures
D	fits closely with other fatty acids so that the membrane is more fluid at low temperatures	does not fit closely with other fatty acids so that the membrane is more fluid at high temperatures

13 The diagram shows a cell surface membrane.



Which is a correct role for a labelled molecule?

A W is involved in controlling membrane stability.

B X is involved in active transport.

C Y is involved in cell signalling.

D Z is involved in diffusion of ions.

14 The diagram shows a simple cell signalling pathway in which a signal molecule leads to a response, such as a secretion.

signal molecule → P → Q → response

Which row identifies P and Q?

	P	Q
A	activated enzyme in cytoplasm	target in cell surface membrane
B	lipid in cell surface membrane	extracellular enzyme
C	protein in cell surface membrane	activated enzyme in cytoplasm
D	target in cytoplasm	protein in cell surface membrane

15 Three parts of a chromosome and their functions are listed.

part	function
P1 centromere	F1 holds the coils of DNA together
P2 histone proteins	F2 holds two chromatids together
P3 telomere	F3 prevents loss of genes

Which part is matched with its correct function?

A P1 and F1 **B** P2 and F1 **C** P2 and F3 **D** P3 and F2

16 The enzyme telomerase prevents loss of telomeres after many mitotic cell cycles.

Which cells need to transcribe telomerase enzyme?

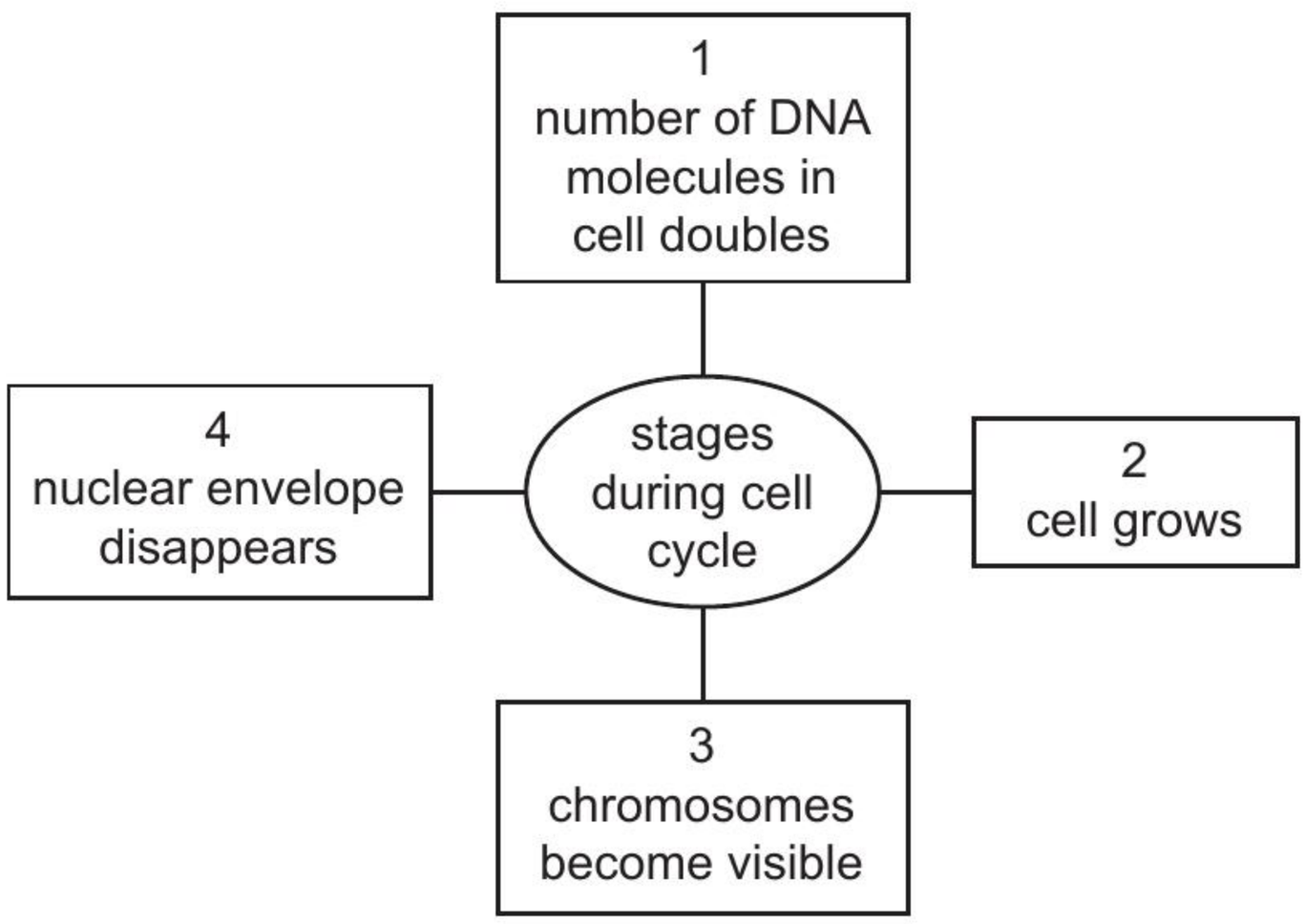
1 cancer cells

2 stem cells

3 activated memory B-lymphocytes

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

17 The diagram shows some of the stages which take place during the cell cycle.



Which two stages take place during interphase?

A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

18 Which statement correctly describes the base pairing in a molecule of DNA?

A The purine adenine forms bonds with the pyrimidine thymine.

B The purine adenine forms bonds with the pyrimidine uracil.

C The purine cytosine forms bonds with the pyrimidine guanine.

D The purine guanine forms bonds with the pyrimidine thymine.

19 Which statements about complementary base pairing are correct?

1 It allows translation to occur.

2 Purines and pyrimidines are the same size.

3 The base pairs are of equal length.

4 Uracil forms two hydrogen bonds with adenine.

A 1, 2, 3 and 4

B 1, 3 and 4 only

C 1 and 4 only

D 2 and 3 only

20 The diagram shows the possible organisation of DNA molecules after one replication.

Which organisation is correct?