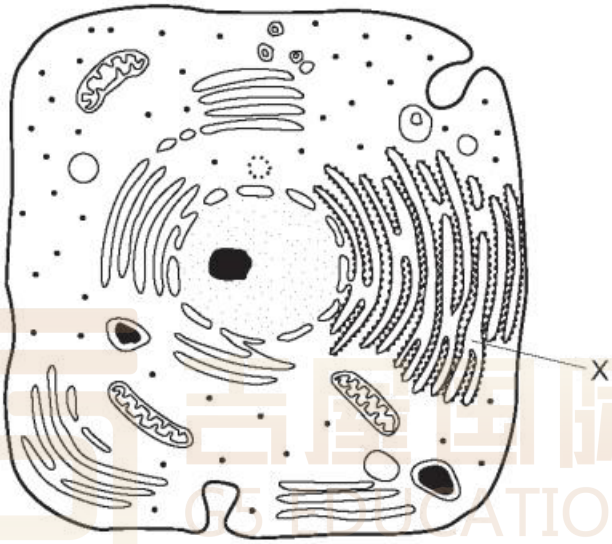
1.

The diagram is a drawing from an electron micrograph of a typical animal cell.



What is the function of the membrane system labelled X?

A lipid synthesis only

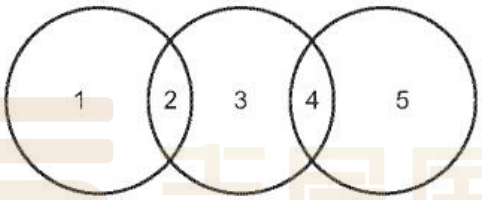
B protein synthesis and transport

C protein synthesis only

D protein transport only

2.

The diagram shows the relationship between various cells and their components.



Which row is correct?

	1	2	3	4	5
A	80S ribosome	eukaryotic cell	mitochondrion	70S ribosome	prokaryotic cell
B	chloroplast	plant cell	cell wall	prokaryotic cell	80S ribosome
C	circular DNA	nucleus	eukaryotic cell	mitochondrion	70S ribosome
D	prokaryotic cell	circular DNA	chloroplast	membrane bound	70S ribosome

3.

A student was told that the actual length of a cell structure is 5 μm.

The student was asked to state an equation that can be used to calculate the magnification of an electron micrograph of this cell structure. The student used some of the letters q to u in the equation.

q = the length of the cell structure image on the micrograph in centimetres

r = the length of the cell structure image on the micrograph in millimetres

s = 1000

$t = \frac{1}{5}$

u = 5

Which is the correct equation to calculate the magnification?

A $\frac{q}{s} \times u$ **B** $q \times s \times t$ **C** $\frac{r}{s} \times u$ **D** $r \times s \times t$

4.

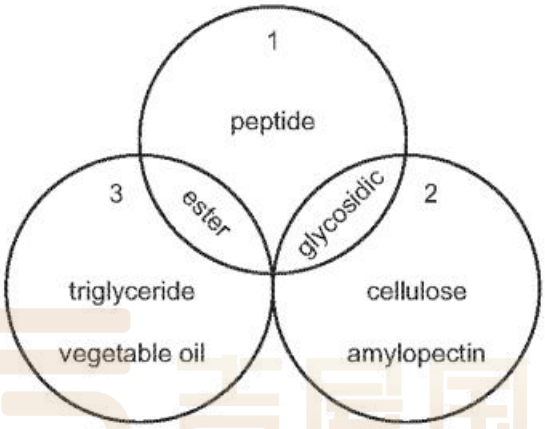
A student was asked to estimate the concentration of glucose in a solution using the Benedict's test. The student was provided with a 1.0 mol dm^{-3} glucose solution and was told to make a 0.6 mol dm^{-3} solution by proportional dilution.

Which row shows the correct volumes of both 1.0 mol dm^{-3} glucose solution and distilled water needed to make the 0.6 mol dm^{-3} solution?

	volume of 1.0 mol dm^{-3} glucose solution / cm^3	volume of distilled water / cm^3
A	12	8
B	10	10
C	8	12
D	6	14

5.

The diagram shows relationships between some important molecules and bonds.

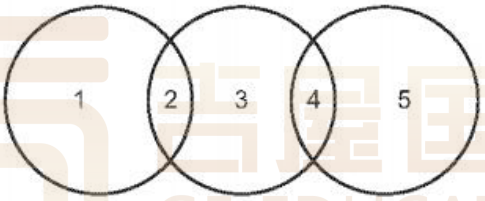


What is represented by circles numbered 1, 2 and 3?

	1	2	3
A	bonds formed by condensation	carbohydrates	lipids
B	bonds formed by condensation	lipids	carbohydrates
C	bonds formed by hydrolysis	carbohydrates	lipids
D	bonds formed by hydrolysis	lipids	carbohydrates

6.

The diagram shows the relationship between some biological molecules.



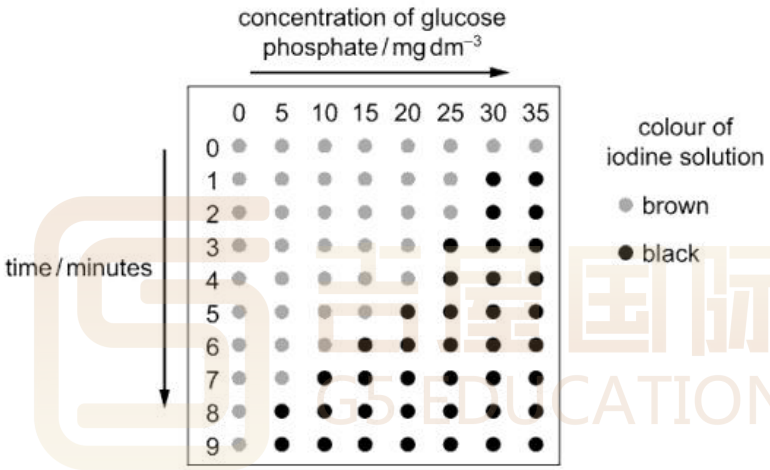
Which row is correct?

	1	2	3	4	5
A	α-glucose	carbohydrate	sucrose	monomer	fructose
B	cellulose	polymer	starch	carbohydrate	amylase
C	fructose	reducing sugar	β-glucose	monomer	amino acid
D	haemoglobin	protein	amylose	polymer	cellulose

7.

In an investigation, the same concentration of the enzyme phosphorylase was added to different concentrations of glucose phosphate and incubated at 30 °C. At 1 minute intervals, one drop of the reaction mixture was removed and added to a drop of iodine solution on a white tile.

The diagram shows the results of this investigation.



What explains the trend in the results of this investigation?

A Phosphorylase catalyses a reaction converting glucose phosphate to starch.

B The maximum rate of reaction is reached at 20 mg dm^{-3} of glucose phosphate.

C Substrate concentration is limiting at concentrations of glucose phosphate 25 mg dm^{-3} or less.

D Enzyme concentration is limiting at concentrations of glucose phosphate 25 mg dm^{-3} or less.

8.

The enzyme β-galactosidase can catalyse the hydrolysis of four substrates, **A**, **B**, **C** and **D**, with similar structures.

Each substrate has a different K_m value.

For which substrate does β-galactosidase have the **lowest** affinity?

A $K_m = 4 \times 10^{-3}$ mol dm^{-3}

B $K_m = 1 \times 10^{-3}$ mol dm^{-3}

C $K_m = 2 \times 10^{-4}$ mol dm^{-3}

D $K_m = 1 \times 10^{-4}$ mol dm^{-3}

9.

Which is correct for competitive inhibitors of enzymes?

1 They occupy the active site of an enzyme.

2 They have exactly the same shape as the substrate.

3 They can be used to control the rate of enzyme activity.

4 They can bind to a site on an enzyme other than the active site.

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

10.

An indicator is colourless in acid and pink in alkali.

In an experiment a petri dish of agar was prepared using an acidic solution of this indicator.

A disc of agar 1 cm in diameter was removed from the centre to create a well.

A white card showing circular marker lines 1 cm apart was placed underneath the petri dish.

1 cm^3 alkali solution was put into the well in the agar and a stop-watch was started.

A circular disc of pink colour appeared and spread through the agar. It reached the first marker line in a short time but took longer to reach the second marker line and a very long time to reach the third marker line.

What explains these observations?

A facilitated diffusion of alkali solution

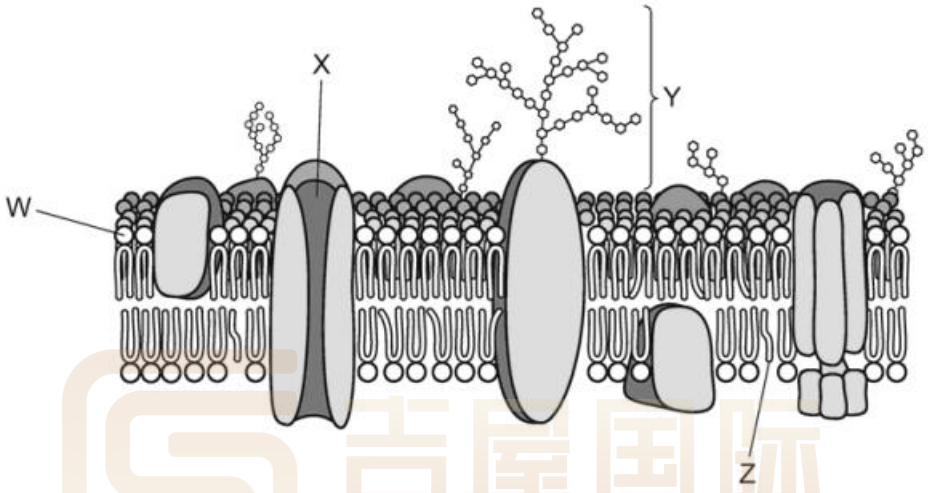
B facilitated diffusion of the indicator

C simple diffusion of alkali solution

D simple diffusion of the indicator

11.

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.

12.

The cell surface membranes of some cells are largely made up of phospholipids and cholesterol, with few proteins.

Which transport mechanisms will be reduced across these membranes?

1 facilitated diffusion

2 active transport

3 diffusion

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

13.

Which statement about the behaviour of chromosomes during mitosis is correct?

A They attach to the spindle fibres to contain them within the nucleus.

B They condense to prevent further translation of genes.

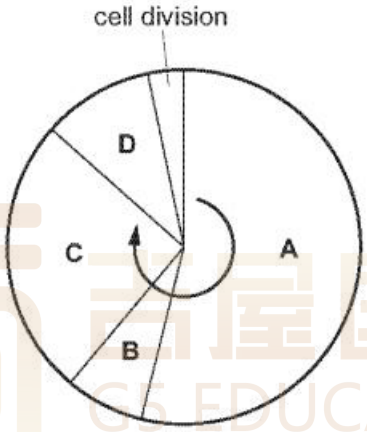
C They reach the poles of the cell and become longer and thinner.

D They replicate to produce sufficient DNA to form two new nuclei.

14.

The diagram shows the cell cycle.

During which phase do chromosomes condense and become visible?



15.

One of the chromosomes in a nucleus has a telomere which contains many repeats of the base sequence TTAGGG.

This chromosome was extracted from four different cells and the total number of bases in the telomere was determined.

Which total number of bases was found in the cell that had undergone the most mitotic divisions?

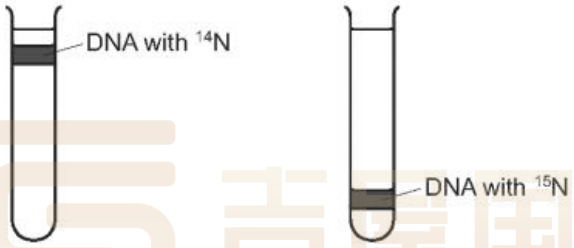
A 5548 **B** 5580 **C** 5645 **D** 5700

16.

Two sets of bacteria were grown using different types of nitrogen-containing growth media.

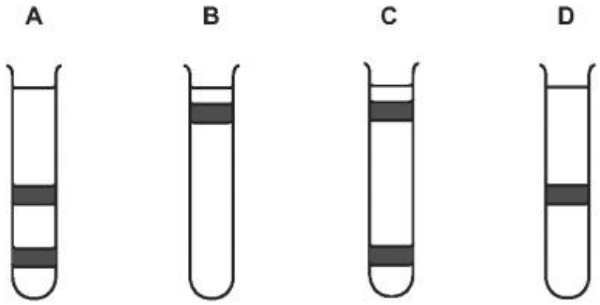
One set was grown in a medium containing the 'heavy' isotope of nitrogen, ^{15}N, until all the DNA was labelled. The other set was grown in a medium containing the 'light' isotope of nitrogen, ^{14}N, until all the DNA was labelled.

The DNA from each set of bacteria was extracted and centrifuged. The diagram shows the position in the centrifuge tubes of this DNA.



Bacteria with ^{15}N labelled DNA were transferred to a medium containing ^{14}N and allowed to reproduce once. The DNA of the new generation of bacteria was extracted and centrifuged.

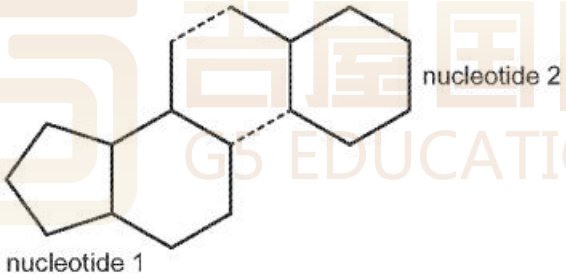
Which tube shows the position of DNA from this new generation of bacteria?



17.

The diagram shows the outline structure of two nucleotide bases which occur in DNA.

This pair is held together by two hydrogen bonds, shown as dashed lines.



Which row correctly identifies these two nucleotide bases?

	nucleotide 1	nucleotide 2
A	adenine	thymine
B	cytosine	guanine
C	guanine	cytosine
D	thymine	adenine

18

The diagram shows the nucleotide sequence of a small section of a gene which is transcribed.

GCGCGCGGCGCG

The table shows the amino acids coded for by 10 mRNA codons.

mRNA codon	amino acid
AAG	Lys
ACG	Thr
CGG CGC CGU	Arg
CCG	Pro
GCC GCG	Ala
GGC	Gly
UGC	Cys

What is the order of the four amino acids in the polypeptide translated from this small section of a gene?

A Ala-Ala-Cys-Ala

B Ala-Arg-Gly-Ala

C Arg-Ala-Pro-Arg

D Arg-Arg-Thr-Arg

1.

Sucrose phosphorylase is an enzyme found in some species of bacteria. One function of this enzyme is for the production of compounds that help to protect the cell from harmful osmotic changes in the external environment.

Fig. 5.1 shows the reversible reaction that takes place within the bacterial cell.

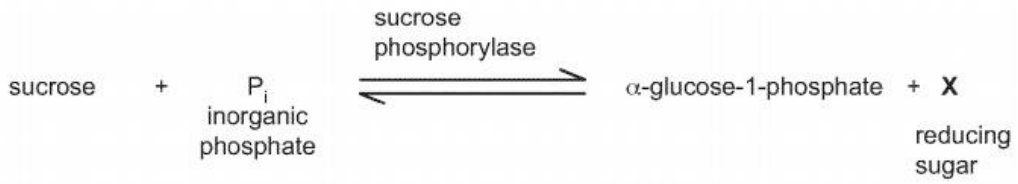


Fig. 5.1

(a) Name reducing sugar **X** in Fig. 5.1.

.....

[1]

(b) In the absence of sucrose phosphorylase as a catalyst, the reaction shown in Fig. 5.1 would take too long to occur to allow the bacterial cell to function efficiently.

Explain why the reaction shown in Fig. 5.1 proceeds at a much faster rate in the presence of the enzyme.

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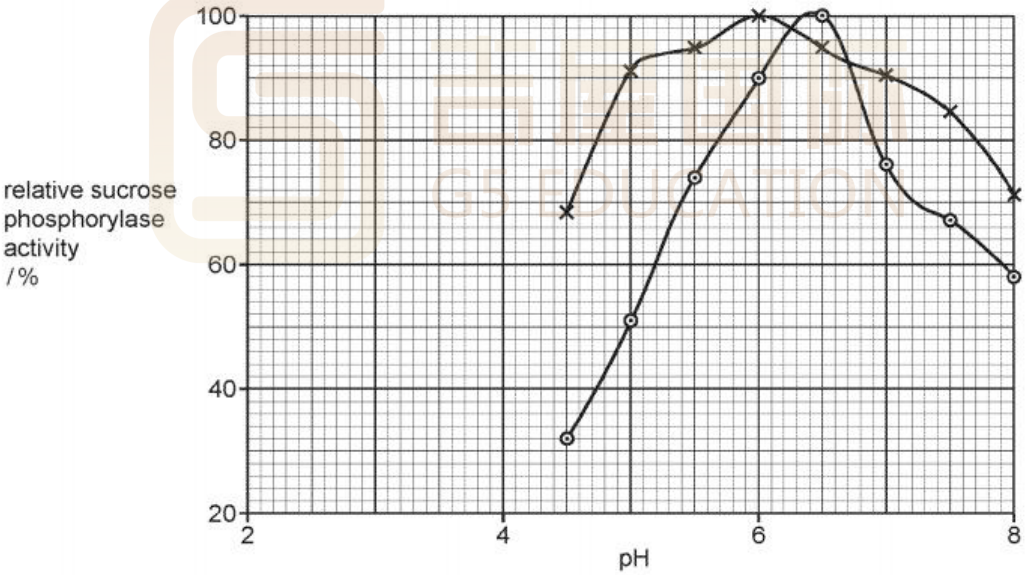
..... [2]

(c) An enzyme that catalyses a reaction of commercial interest needs to be investigated to see if it is suitable for use in industry.
For example:

- immobilised enzymes may be used as they have a longer shelf-life than the enzyme free in solution
- many industrial reactions are carried out at higher temperatures to minimise contamination of products by microorganisms.

Fig. 5.2 shows the results of an investigation to compare the activity of sucrose phosphorylase free in solution (free enzyme) with immobilised sucrose phosphorylase (immobilised enzyme) at different pHs.

Fig. 5.3 shows the activity of the free enzyme and immobilised enzyme at different temperatures.



Key

⊙ free enzyme
× immobilised enzyme

Fig. 5.2

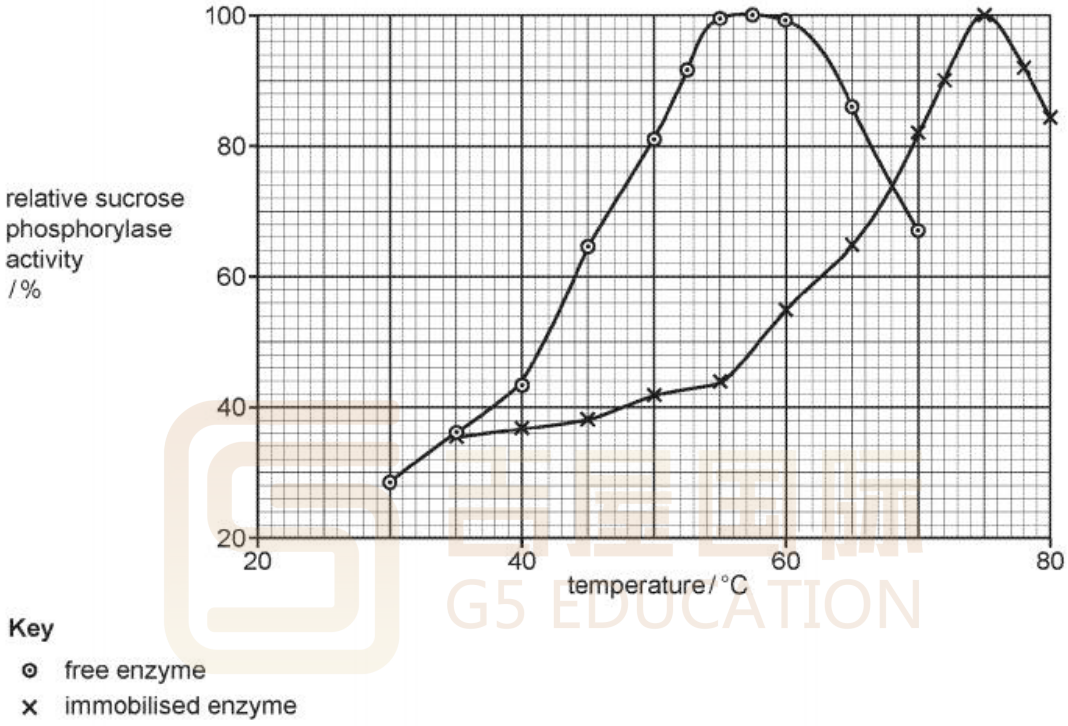


Fig. 5.3

With reference to the results shown in Fig. 5.2 and Fig. 5.3, discuss which sucrose phosphorylase enzyme, free or immobilised, is better for use in industrial reactions.

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..... [4]

2.

Meristematic tissue is found in the growing region of plants, such as root tips.

Fig. 2.1 shows a section through the meristematic region of a root tip of onion, *Allium cepa*.

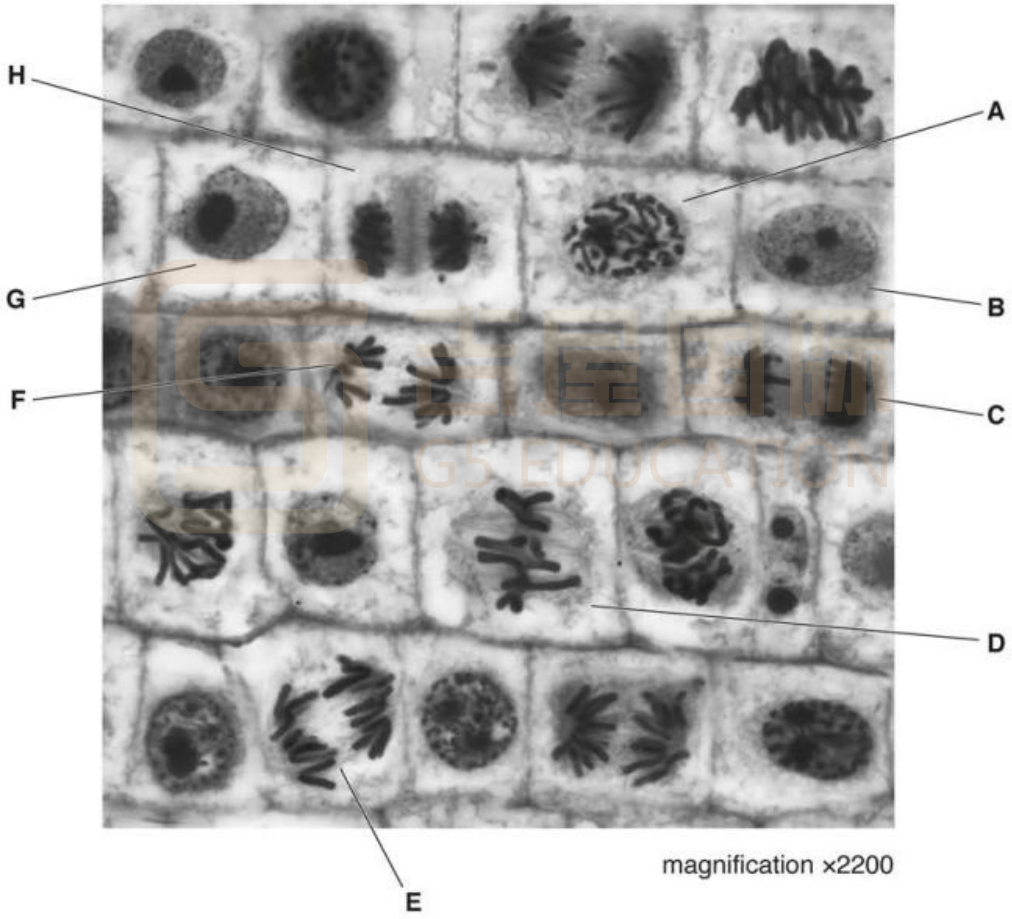

Fig. 2.1

Table 2.1 shows the numbers of cells in different stages of the cell cycle that were observed in sections of the meristematic regions of root tips of *A. cepa*.

Table 2.1

stage of cell cycle	one example of cell from Fig. 2.1	number of cells counted in each stage			
		replicate 1	replicate 2	replicate 3	mean
interphase		4686	4709	4808	4734
prophase		148	159	155	154
metaphase		38	47	40	42
anaphase		25	33	28	29
telophase		38	47	39	41
				total	5000

(a) Complete Table 2.1 by using the letters **A** to **H** from Fig. 2.1 to identify **one** cell in each stage of the cell cycle. [3]

(b) The total length of time taken for meristematic cells of *A. cepa* to complete one cell cycle at 25 °C is 12 hours.

Using sections similar to the one in Fig. 2.1, the length of time spent in each stage of the cell cycle can be estimated. To obtain the estimate, the percentage of cells in that stage is calculated.

Using the data in Table 2.1, calculate:

- the percentage of cells in anaphase
- the mean length of time in **minutes** for anaphase.

Show your working.

percentage of cells in anaphase = ... %

mean length of time in anaphase = ... min
[2]

(c) State **one** event that occurs during cytokinesis in the cell cycle of plant cells, such as those shown in Fig. 2.1.

.....

..... [1]

3.

Fig. 1.1 is a diagram showing the structure of a section of a DNA molecule.

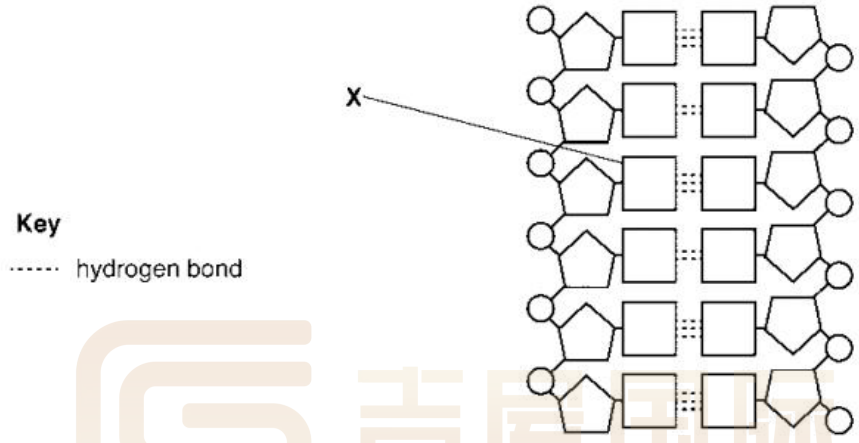

Fig. 1.1

(a) Draw a circle around **one** monomer of DNA in Fig. 1.1. [1]

(b) Name the two bases forming the base pair at **X** in Fig. 1.1 **and** give a reason for your answer.

bases .....

reason .....

.....

.....

..... [2]

(c) The statements 1–5 describe events that occur during DNA replication.

1 DNA polymerase forms a phosphodiester bond
2 DNA double helix forms
3 hydrogen bonds break
4 hydrogen bonds form
5 two strands of the double helix separate

Write the numbers 1 to 5 in the spaces below to show the order in which these events occur. The first one has been done for you.

3 .... [1]

(d) The telomere is a region found at the end of a chromosome.

Outline the function of telomeres.

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..... [2]