



SIR ARTHUR LEWIS COMMUNITY COLLEGE
ACADEMIC YEAR (2024/2025) – SEMESTER ONE
END OF SEMESTER EXAMINATION

COURSE CODE : BIO107 / BIO108

COURSE TITLE : Cell and Reproductive Biology
Cell and Molecular Biology

LECTURER(S) : Jeannine Monplaisir-Gaillard

DATE : 16th December 2024

TIME : 9 a.m. to 11:30 a.m.

DURATION : 2 ½ Hours

STUDENT ID # : _____

GENERAL INFORMATION AND INSTRUCTIONS

- Students must sign **IN** and **OUT** on the examination class list.
- Write your ID number on the question paper.
- This paper consists of **TWO** (2) Sections A and B.
- Answer **ALL** questions.
- Section A consists of 20 multiple-choice questions. Circle the letter corresponding to the correct response on the question paper. Each correct response will be awarded one mark.
- Section B consists of 6 questions. Answer all questions in the space provided.
- Marks are given in brackets [] at the end of each question or part question.
- This document consists of fifteen [15] printed pages, including this cover page.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A

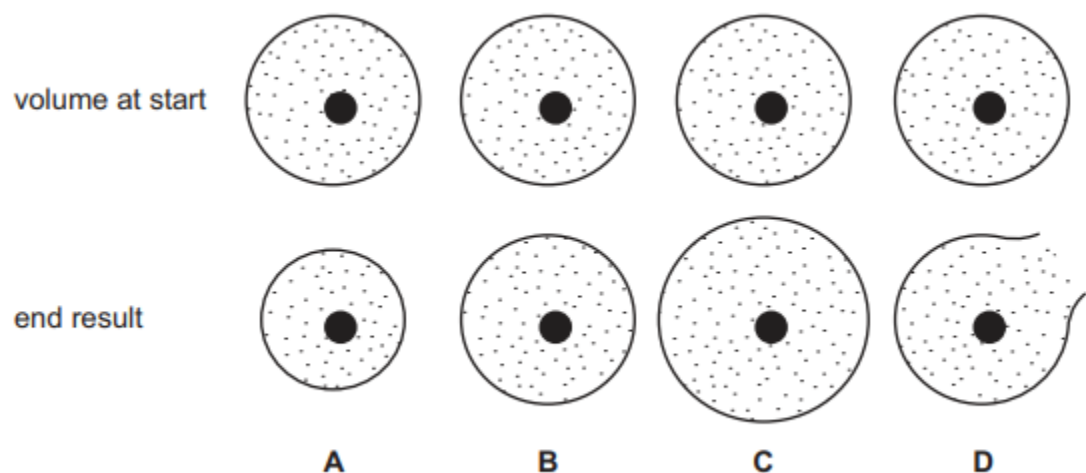
1. Which statement correctly explains why blood plasma with a high concentration of water can be maintained at a stable temperature?
 - A. It has a low specific heat capacity.
 - B. It has a high specific heat capacity.
 - C. It has a low latent heat of vaporisation.
 - D. It has a high latent heat of vaporisation.
2. What describes cellulose?
 - A. a branched chain of 1-4 α -glucose
 - B. a branched chain of 1-4 β -glucose
 - C. an unreactive linear chain of 1-4 α -glucose
 - D. an unreactive linear chain of 1-4 β -glucose
3. Some foods contain hydrogenated vegetable fats. These are unsaturated fats that have been converted to saturated fats.
Which property of the fats will have changed?
 - A. Their hydrocarbon chains will contain more carbon atoms.
 - B. Their solubility in water will increase.
 - C. They will have more double bonds in the molecule.
 - D. They will become solid at room temperature.
4. Which part of the structure of haemoglobin carries oxygen?
 - A. four polypeptide chains
 - B. haem groups
 - C. hydrogen bonds
 - D. hydrophilic R groups
5. What identifies a cell as a prokaryote?
 - A. The DNA is associated with protein.
 - B. The DNA is in a circular form.
 - C. The DNA is in the form of a double spiral.
 - D. The DNA is surrounded by a membrane system.
6. What describes resolution in microscopy?
 - A. the ability to distinguish between two objects that are very close together
 - B. the clarity of the image formed by the microscope
 - C. the number of times the image has been magnified by the objective lens
 - D. the power of the microscope to focus on very small objects
7. What is a function of the smooth endoplasmic reticulum?
 - A. aerobic respiration
 - B. intracellular digestion
 - C. synthesis of steroids
 - D. transport of proteins

8. The three main factors that affect the rate of diffusion across a membrane can be expressed by the relationship shown.

$$\text{rate of diffusion is proportional to } \frac{\text{surface area} \times \text{concentration difference}}{\text{thickness of membrane}}$$

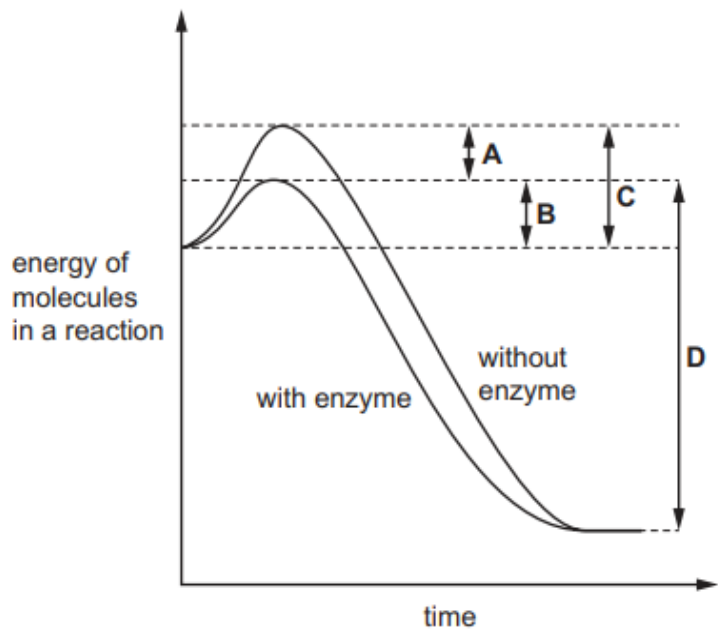
Which changes in the factors would result in the rate of diffusion doubling?

- 1 Surface area has doubled.
 - 2 Concentration difference has halved.
 - 3 Thickness of membrane has doubled.
 - 4 Thickness of membrane has halved.
- A. 1, 2 and 4
B. 1 and 3
C. 1 and 4 only
D. 2 and 3
9. Identical animal cells were placed in solutions of differing water potentials. The diagram shows the volume of the cells at the start and the end result. Which cell was placed in the solution with the lowest (most negative) water potential?

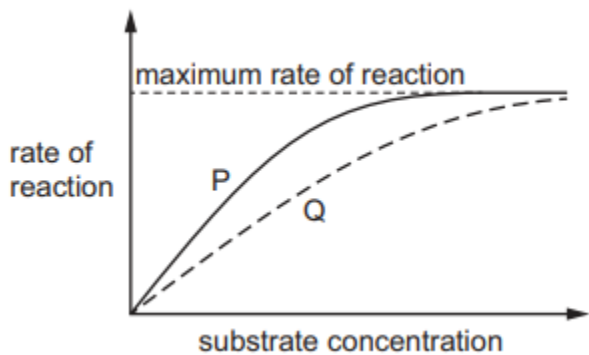


10. Which molecule prevents the cell surface membrane from becoming too fluid or too rigid?
- A. Cholesterol
B. Glycolipid
C. Glycoprotein
D. Phospholipid

11. Which region on the graph shows the activation energy of an enzyme-catalysed reaction?



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



Line P represents the result when the enzyme is used at its optimum pH and optimum temperature and without an inhibitor.

Line Q represents the result when the reaction conditions are changed.

Which descriptions of changes to the reaction conditions could result in line Q if all other conditions were kept the same?

- 1 Add an inhibitor that attaches to a site other than the active site.
- 2 Add an inhibitor that has a similar shape to the substrate.
- 3 Add an inhibitor that blocks the active site of the enzyme.
- 4 Carry out the reaction at a higher temperature.

- A. 1, 3 and 4
- B. 1 and 4 only
- C. 2, 3 and 4
- D. 2 and 3 only

13. Which of the following is the BEST example of anabolism?

- A. Glycogen is converted to glucose.
- B. Peptide bonds are hydrolysed by peptidases.
- C. Amino acids joined by peptide bonds to form polypeptide.
- D. Amylose and amylopectin combine to form starch molecules.

14. Which structures are involved in transcription only?

	DNA template strand	anticodons	RNA polymerase	key ✓ = involved x = not involved
A	✓	✓	x	
B	✓	x	✓	
C	x	✓	x	
D	x	x	✓	

15. One gene provides the code for the production of which type of molecule?

- A. amino acid
- B. DNA
- C. nucleotide
- D. polypeptide

16. One of the codons for the amino acid phenylalanine is UUC.
Which diagram shows how the tRNA carrying phenylalanine pairs with the corresponding section of mRNA?

- A. tRNA AAG
 mRNA UUC
- B. tRNA TTG
 mRNA UUC
- C. tRNA UUC
 mRNA AAG
- D. tRNA UUC
 mRNA TTG

17. Which of the following is found in both DNA and transfer RNA?

- A. Uracil
- B. Ribose
- C. Sugar-phosphate backbone
- D. Double helix structure

18. What happens to chromosomes in prophase of mitosis?

- A. They are formed by replication of DNA.
- B. They attach to the spindle fibres.
- C. They divide to form chromatids.
- D. They shorten and become visible.

19. The diagram shows the chromosomes of one cell which has been squashed during mitosis.



Which stage of mitosis is shown and what is the haploid chromosome number in the species?

	stage of mitosis	haploid chromosome number
A	anaphase	5
B	anaphase	10
C	metaphase	5
D	metaphase	10

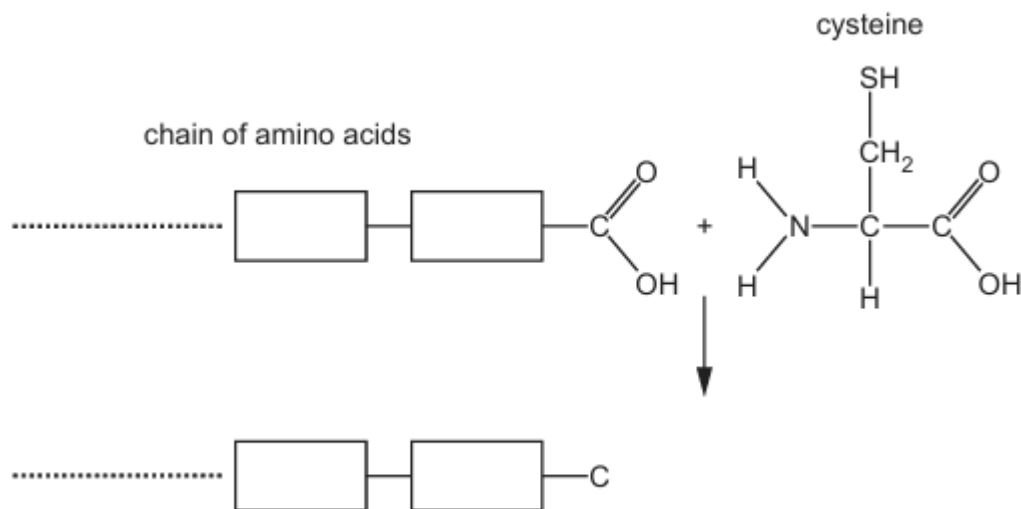
20. Which of the following is NOT characteristic of meiosis?

- A. Two daughter nuclei containing identical sets of chromosomes.
- B. Homologous chromosomes come together and crossing over occur.
- C. Four daughter nuclei containing half the number of chromosomes.
- D. Homologous chromosomes move apart during anaphase.

SECTION B

1. (a) During protein synthesis, a polypeptide is synthesised when amino acids are added to a growing chain of amino acids.

Figure 1.1 shows part of a growing chain of amino acids and the amino acid cysteine.



- (i) Complete Figure 1.1 by showing the formation of the bond between cysteine and the growing chain of amino acids in the process of translation. [3]
- (ii) State the name of the covalent bond that forms when cysteine is added to the growing chain of amino acids.

-----[1]

- (b) Fig. 1.2 is a ribbon diagram showing the three-dimensional structure of a protein from the bacterium *Streptococcus*.

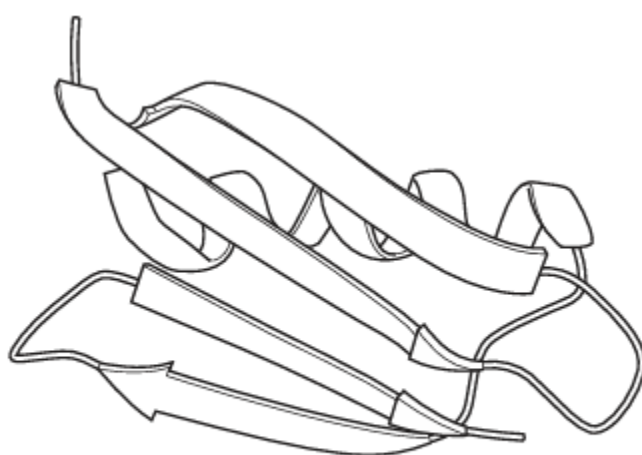


Fig. 1.2

- (i) Give one example of a type of secondary structure shown in Figure 1.2.

-----[1]

- (ii) Explain why the protein shown in Fig. 1.2 has tertiary structure, but not quaternary structure.

 -----[2]

- (iii) Name three types of interactions or bonds that holds Figure 1.2 in its tertiary structure.

 -----[3]

- (c) Figure 1.3 shows four biological molecules A, B, D and E.

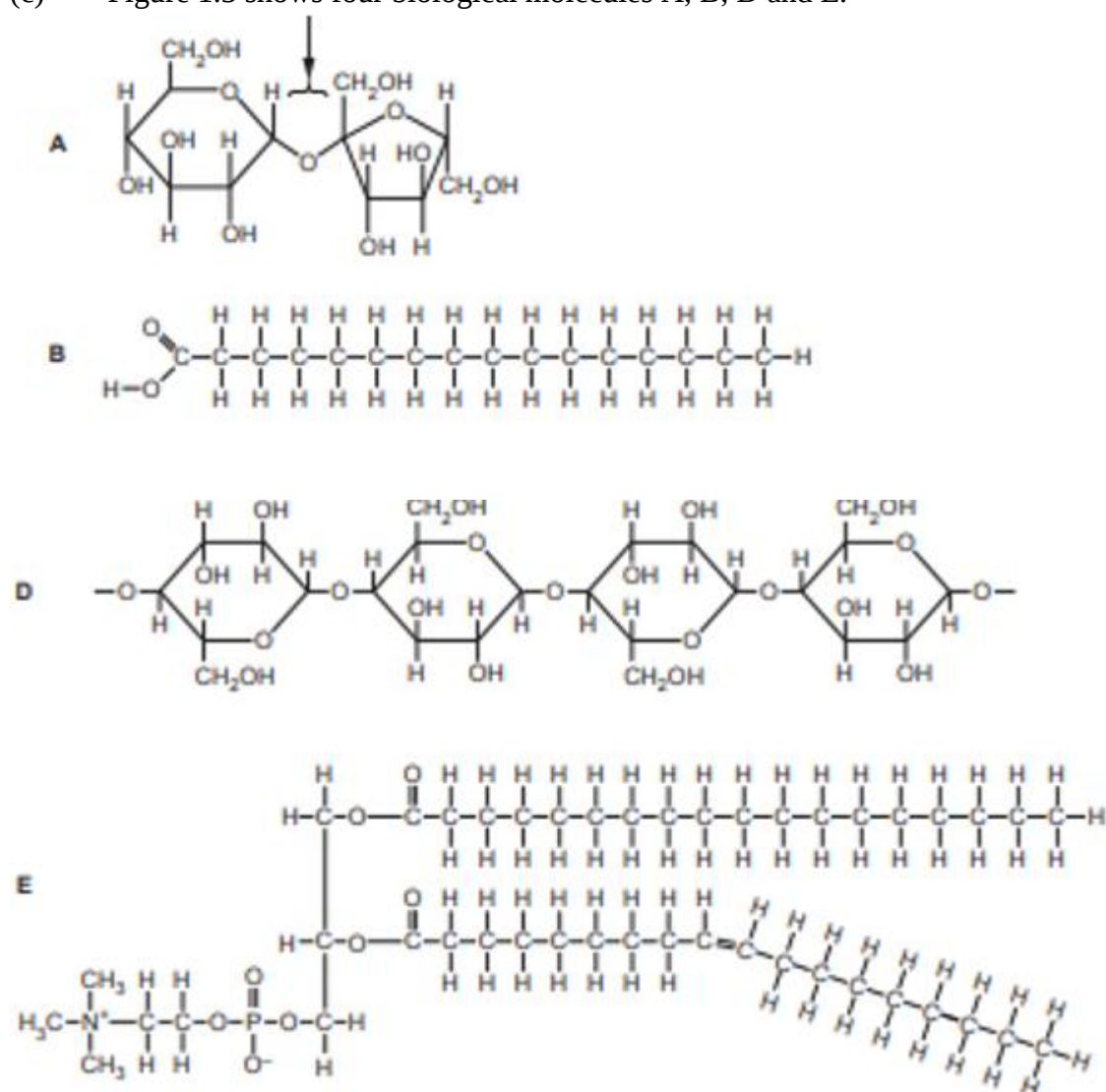


Figure 1.3

- (i) State the name of the bond in molecule A indicated by the arrow.

-----[1]

- (iv) Molecule B is described as a saturated fatty acid.

State why molecule B is described as a saturated fatty acid.
-----[1]

(v) Molecule D is a polymer.
State the name of the monomer that is used to synthesize this polymer.
-----[1]

(vi) State the letter of the molecule that forms part of the cell surface membranes of eukaryotic cells.
-----[1]

[Total: 14]

2. Figure 2 is a summary diagram of events that occur in a white blood cell ingesting bacteria to destroy them.

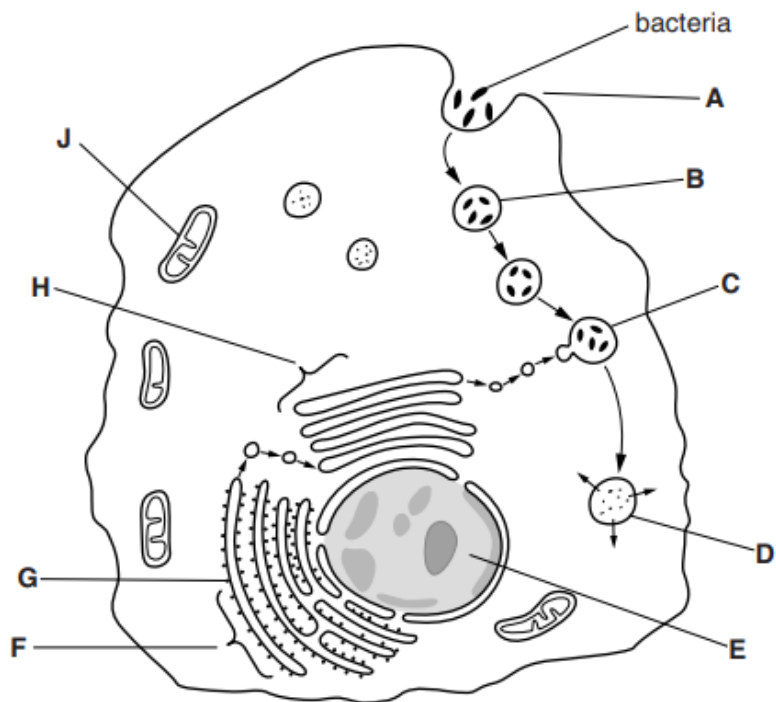


Fig. 2.1

(a) (i) Name the process at A.
-----[1]

(ii) Name the stages of protein synthesis that occur at E and at F.
E-----
F-----[2]

(iii) Name organelles B, G, H and J.
B-----
G-----
H-----
J-----[4]

(b) Describe what happens to the bacteria between C and D.

-----[2]

(c) Measure the length of structure J within the white blood cell shown in Figure 2.1 and use this to determine the magnification of the image of the white blood cell.

The actual length of structure J is 0.5 micrometers.

Length of structure J in millimeters-----mm

Length of structure J in micrometers -----µm

Magnification of image of white blood cell -----

Show your working. [3]

[Total:12]

3. Figure 3.1 shows a section of a cell surface membrane.

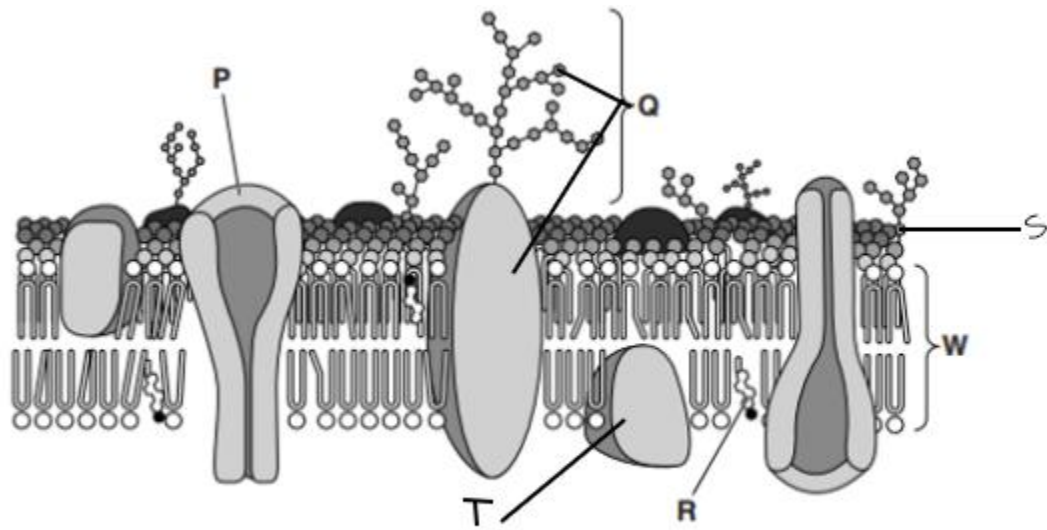


Figure 3.1

(a) Name the structures P, Q and R.

P-----

Q-----

R-----

S-----

W-----[5]

(b) Circle the width of the membrane shown as W in Fig. 5.1.

17.0 μm 1.7 μm 0.7 μm 70.0 nm 17.0 nm 7.0 nm 0.7 nm [1]

(b) Figure 3.2 shows the movement of molecules across the cell membrane by THREE mechanisms.

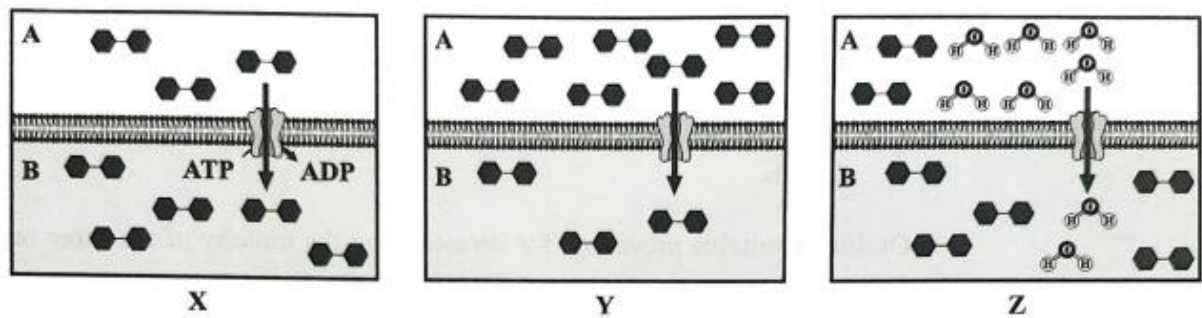


Figure 3.2 The movement of molecules across cell membranes

Name the mechanisms by which the molecules move directly from A across the membrane to B, for each of the illustrations labelled X -Z

X -----

Y-----

Z -----[3]
[Total: 9]

4. (a) The induced-fit hypothesis and the lock-and-key hypothesis are used to describe the mode of action of enzymes.
Explain the induced-fit hypothesis.

-----[3]

Students investigated the effect of increasing the concentration of hydrogen peroxide on the activity of peroxidase extracted from radish.

A line graph showing the initial rate of reaction (in $\mu\text{mol min}^{-1}$) on the y-axis versus the concentration of hydrogen peroxide (in mmol dm^{-3}) on the x-axis. The y-axis ranges from 0 to 6 with major grid lines every 1 unit and minor grid lines every 0.2 units. The x-axis ranges from 0.00 to 0.60 with major grid lines every 0.10 units and minor grid lines every 0.02 units. The curve starts at the origin (0,0) and rises steeply, passing through approximately (0.10, 2.8), (0.20, 5.0), and (0.30, 5.5). It then levels off, approaching a horizontal asymptote at approximately 5.8 $\mu\text{mol min}^{-1}$ as the concentration increases towards 0.60 mmol dm^{-3} .

Explain the effect of increasing the concentration of hydrogen peroxide on the initial rate of reaction as shown in Fig. 4.1.

[3]

[Total: 6]

5. Figure 5.1 shows part of a DNA molecule.

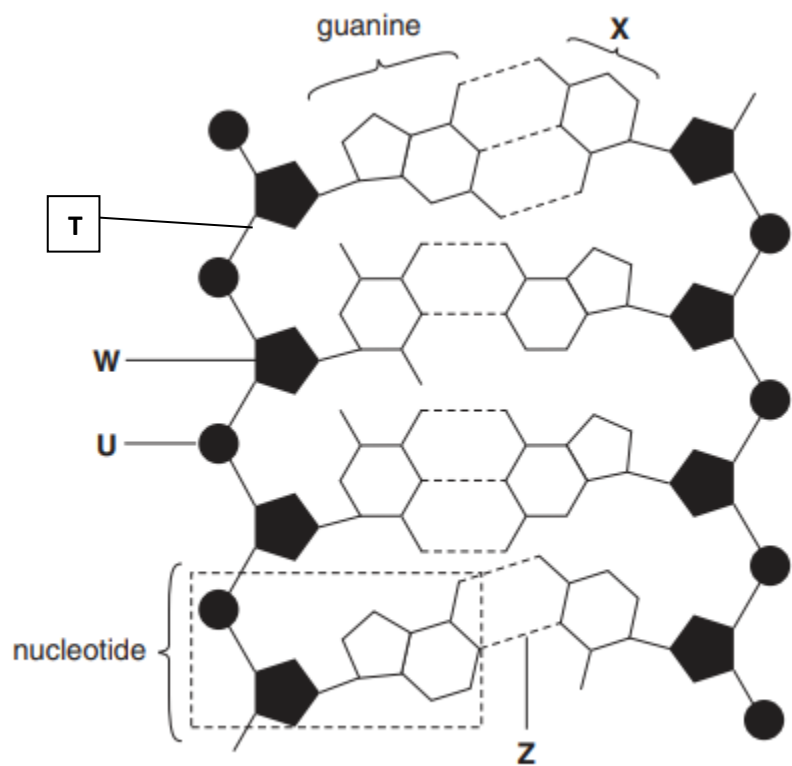


Fig. 5.1

(a) (i) Name U to X.

U-----

W-----

X-----[3]

(ii) Name the bonds indicated by T and Z.

T-----

Z -----[2]

(b) Figure 6.1 shows the formation of a polypeptide during translation in a eukaryotic cell.

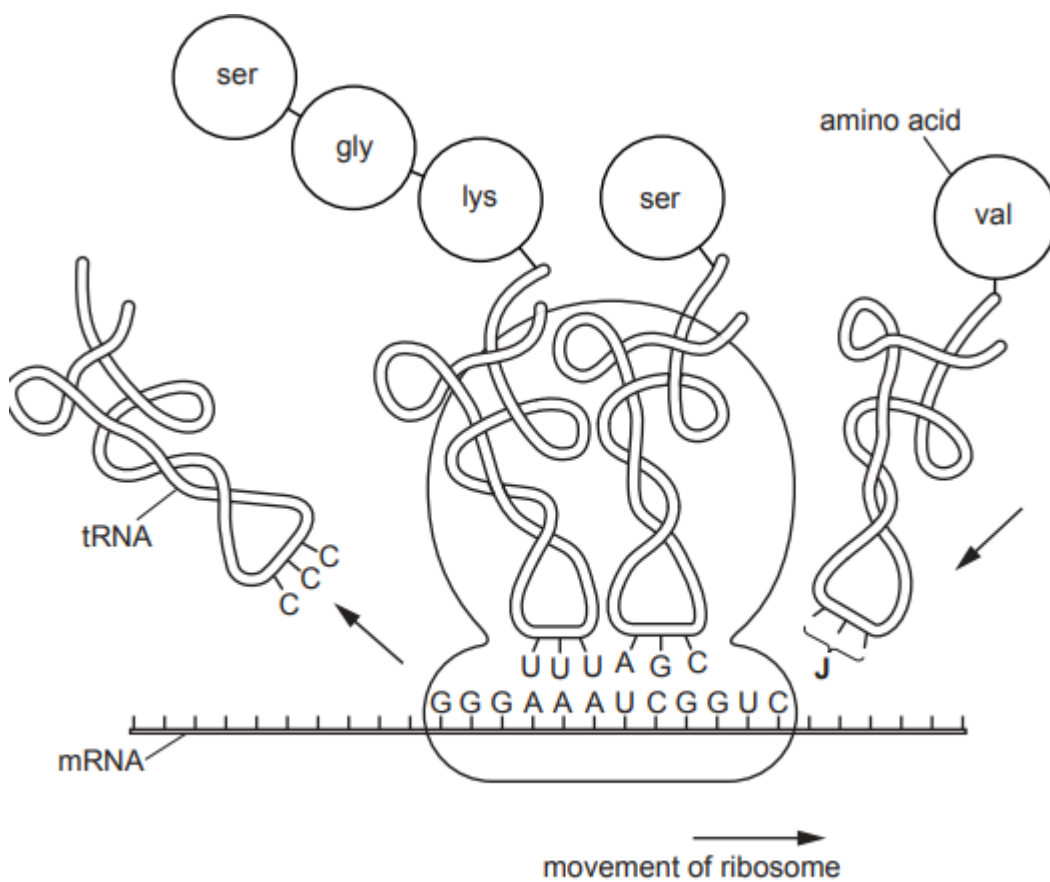


Fig. 6.1

(i) Name the pyrimidine bases shown in Fig. 6.1.

-----[1]

(ii) State the name given to the group of three bases found at J on the tRNA molecule.

-----[1]

(iii) Identify the three bases at J.

-----[1]

(iv) State how the three bases at J on tRNA interact with the bases on mRNA.

-----[1]

[Total: 9]

6. (a) State the name of the stage of interphase in the cell cycle when DNA replication occurs.

..... [1]

- (b) Fig. 6.1 is a diagram of chromosome 11 at metaphase of mitosis.

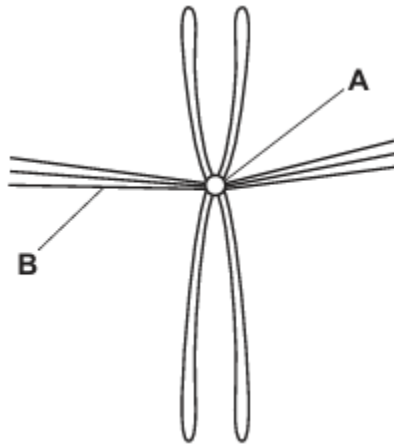


Figure 6.1

- (i) State the names and functions of structures A and B.

Structure A.....

Function.....

.....

Structure B.....

Function.....

..... [4]

(ii) Complete Fig. 6.2 to show what happens to chromosome 11 in anaphase, so that the daughter nuclei are genetically identical.

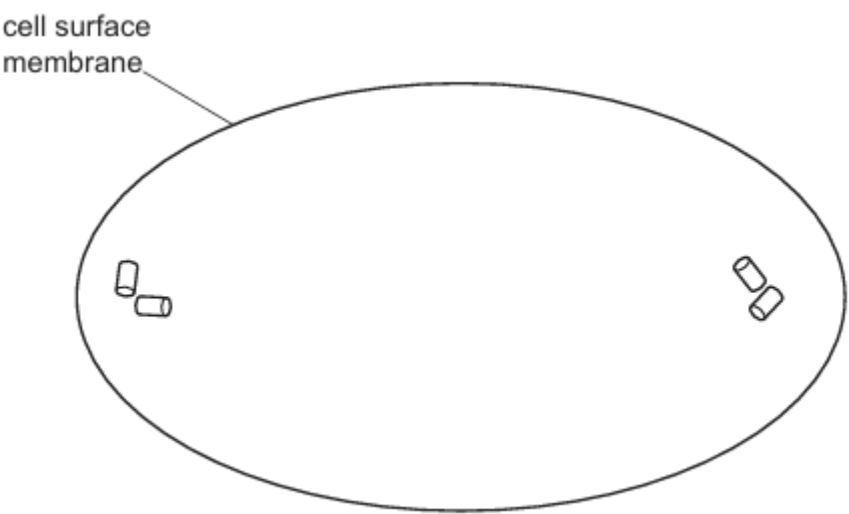


Figure 6.2

[3]

[Total: 8]

END OF TEST