

CANDIDATE NAME: _____

INDEX NUMBER _____

CG _____



SERANGOON JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION 2017

BIOLOGY
Higher 1
8875

Tuesday
18 September 2017

2 hours

Additional materials:
Writing paper

READ THESE INSTRUCTIONS FIRST

Write your name and index number in the spaces at the top of this page and on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

For Section A answer **all** questions.

For Section B, answer only one question.

INFORMATION FOR CANDIDATES

The intended number of marks is given in brackets [] at the end of each question or part question.

FOR EXAMINER'S USE	
Paper 1 (MCQ)	/30
Paper 2	
Section A	
1	/10
2	/11
3	/10
4	/9
Total	/40
Section B	
6 or 7	/20
P2 Total	/60
TOTAL (P1+P2)	/90
TOTAL (100%)	/100

This question paper consists of 10 printed pages.

Section A [40 marks]

Answer **all questions** in the spaces provided.

Question 1

There have been many breakthroughs in stem cell research in recent years. It has been discovered that stem cells are involved in the replacement of worn-out cells and repair of damaged tissues. Further research is being conducted to better understand the mechanism involved in controlling the behaviour of stem cells in order to better manipulate them to treat various diseases and disorders.

- (a)** State the type of stem cells involved in the replacement of worn-out cells and repair of damaged tissues, and describe the unique properties of this type of stem cells. [2]

.....

.....

.....

Stem cells undergo cell division to produce genetically identical daughter cells. **Fig. 1.1** shows two cells, each at a different stage of cell division.

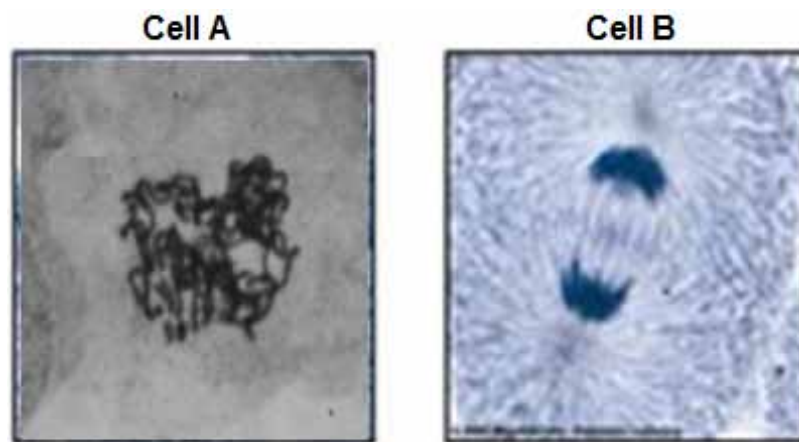


Fig. 1.1

- (b)(i)** With reference to **Fig. 1.1**, state the stages of cell division in **Cell A** and **Cell B**. [1]

Cell A:

Cell B:

- (ii) The dysregulation of cell cycle can result in cancer. Outline the checkpoints that are present in normal cells to prevent this from occurring. [2]

.....

.....

.....

Fig. 1.2 shows information about the movement of chromatids in a cell that has just started metaphase of mitosis.

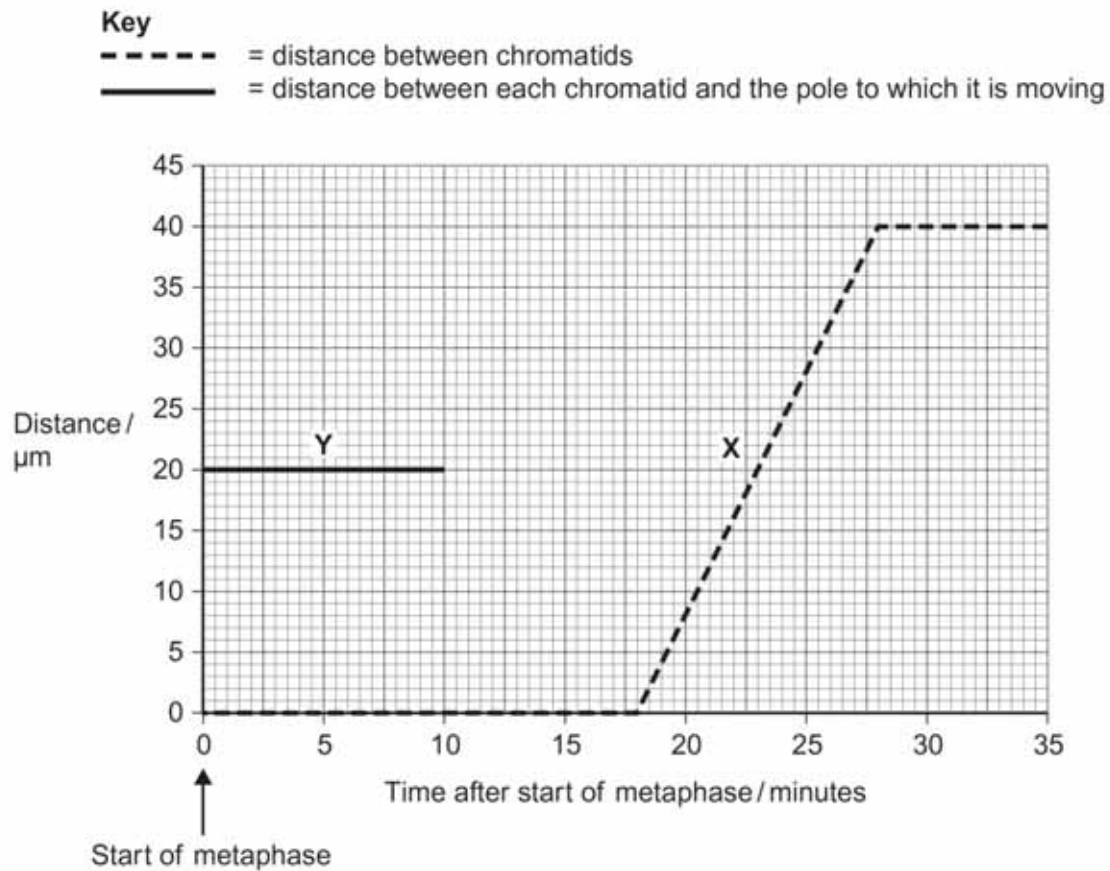


Fig. 1.2

- (c)(i) With reference to **Fig. 1.2**, state the duration of metaphase in the cell. [1]

.....

- (ii) Complete line **Y** on the graph. [1]

(iii) Account for your answer in **(c)(ii)**. [3]

.....

.....

.....

.....

[Total: 10]

Question 2

A mutation was found in the gene coding for NADP oxidase in a family of flowering plant. NADP oxidase is an enzyme that converts NADPH to NADP⁺.

(a) Explain the role of NADPH in photosynthesis. [2]

.....

.....

.....

(b) Using your knowledge of photosynthesis, predict the effect of this mutation on plants. [3]

.....

.....

.....

.....

.....

.....

Rubisco is an enzyme required in the light-independent stage of photosynthesis. **Fig. 2.1** shows the effect of increasing temperature on the activity of two variations of Rubisco, **Rubisco C** and **Rubisco S**.

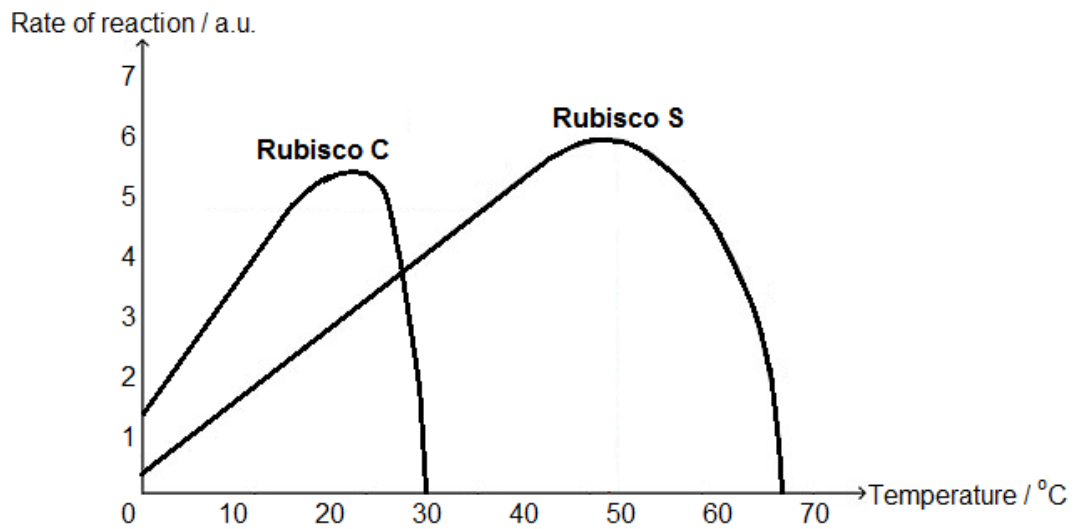


Fig. 2.1

(c) With reference to **Fig. 2.1**, compare the effect of temperature on the two enzymes. [3]

.....

.....

.....

.....

(d) Explain how different alleles give rise to different Rubisco structure. [3]

.....

.....

.....

.....

[Total: 11]

Question 3

Fig. 3.1 shows the schematic representation of a series of protein complexes found on the inner membrane of organelle **X** present in brown adipocytes.

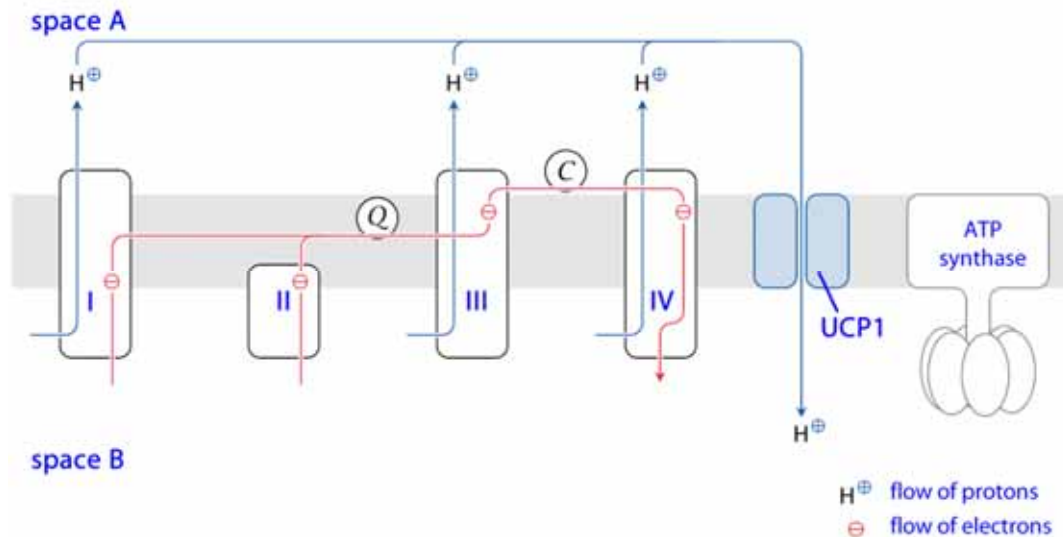


Fig. 3.1

(a)(i) State the identity of organelle **X**. [1]

.....

(ii) Outline how ATP is usually synthesised in the inner membrane of organelle **X**. [4]

.....

.....

.....

.....

.....

.....

- (b) Brown adipocytes contain a unique protein, UCP1, which is not found in organelle **X** in any other cell type.

Evaluate the impact of UCP1 on ATP synthesis and suggest the physiological significance of brown adipose tissue. [3]

.....

.....

.....

.....

- (c) In other cell types, NADH and FADH₂ are used to drive ATP synthesis by ATP synthase. Using relevant information from **Fig. 3.1**, suggest and explain why more ATP is produced from NADH. [2]

.....

.....

.....

[Total: 10]

Question 4

The table below shows the amino acid differences in the cytochrome b protein between various vertebrates.

	Human	Elephant	Platypus	Ostrich	Starling	Crocodile	Lungfish	Coelacanth	Goldfish	Shark
Human		26	40	43	41	47	83	70	68	71
Elephant			45	45	48	50	84	72	63	74
Platypus				54	52	51	89	74	70	76
Ostrich					26	36	91	75	68	73
Starling						47	91	77	67	70
Crocodile							85	78	70	77
Lungfish								90	94	86
Coelacanth									83	78
Goldfish										88
Shark										

- (a) Explain how differences in amino acid sequences in the cytochrome b chain allow the establishment of the phylogenetic tree. [2]

.....

.....

.....

- (b) Suggest why homology still features prominently in evolutionary studies despite the advantages that molecular evidence can confer. [1]

.....

.....

Giant anteaters, armadillos and Australian numbats (*Myrmecobius fasciatus*) have many similar traits. This led some to believe that they were closely related.

Table 4.1 shows the comparison of four characteristics between the three mammals.

Mammal	Characteristics			
	Diet	Body	Snout	Tongue
Armadillo	Feed on insects	Covered by bony keratinised plates	Pointy snout	Long tongues
Giant Anteater	Feed on ants and termites	Covered by hair	Elongated narrow snout	Long tongues
Numbats	Feed on termites	Covered by hair	Narrow snout	Long tongues

(c) Explain why variation is important in selection. [2]

.....

.....

.....

(d) Explain how the evolution of long tongues in numbats supports Darwin's theory of natural selection. [4]

.....

.....

.....

.....

.....

.....

[Total: 9]

Section B [20 marks]

Answer **one** question in this section.

Write your answers on the separate writing paper provided.

Your answers may be illustrated by large, clearly labeled diagrams, ONLY where appropriate.

Your answers must be in continuous prose.

Question 5

- (a) Using the induced-fit hypothesis, explain the mode of action of enzymes. [6]
- (b) With reference to haemoglobin, explain the significance of bonds in maintaining the protein's structure and function. [8]
- (c) Discuss the social implications of genetically modifying plants. [6]

OR

Question 6

- (a) Compare competitive and non-competitive inhibition of enzyme action. [6]
- (b) Describe the process of mitosis and its importance in living cells. [8]
- (c) Discuss the ethical implications of genetically modifying plants. [6]

END OF PAPER