FUKIEN SECONDARY SCHOOL
S.5 Final Examination (2020-2021)
Biology
Paper 1
(2 hours 30 minutes)

Date：8th June 2021 Name:_____
Time：8:30a.m. - 11:00a.m. Class: _____ No.: _____

SECTION B: Question-Answer Book B

INSTRUCTIONS FOR SECTION B

1. Write your student name, class and class number in the spaces provided on this page.
2. Refer to the general instructions on the cover of the Question Book for Section A.
3. Answer ALL questions.
4. Present your answers in paragraphs whenever appropriate.
5. The diagrams in this section are **NOT** necessarily drawn to scale.

SECTION B

Answer **ALL** questions. Put your answers in the spaces provided.

1. (a) Organisms can be classified as autotrophs or heterotrophs based on how they obtain energy and nutrients. Select from Column II **all** example(s) that belong(s) to the two types of organisms in Column I and put the letter(s) in the spaces provided. (2 marks)

Column I		**Column II**
(i) autotroph	_____	A. yeast
(ii) heterotroph	_____	B. moss
		C. green algae
		D. photosynthetic bacteria
		E. tapeworm

(b) Decomposers are heterotrophs that perform a crucial function in ecosystems. Describe briefly how they obtain energy and nutrients, as well as the function they perform in ecosystems. (2 marks)

_____

_____

_____

_____

2. Catalase is an enzyme that catalyses the breakdown of hydrogen peroxide, which is a waste product of cell metabolism. The reaction is represented by the equation:

$$2\ H_2O_2 \longrightarrow 2\ H_2O + O_2$$

A student conducted an investigation to study the effect of temperature on the activity of catalase extracted from pig livers. Samples of catalase solution and hydrogen peroxide solution were each kept at a number of temperatures (10 °C, 20 °C, 30 °C, 40 °C, 50 °C and 60 °C) before being mixed together. Upon mixing, a mass of bubbles were released, forming a layer of foam on top the reaction mixture. The depth of the foam formed in the reaction mixtures at different temperatures were measured and recorded in the table below.

Temperature of reaction mixture (°C)	**Depth of foam (mm)**
10	7
20	15
30	34
40	42
50	30
60	6

(a) Describe a test to show that the bubble of gas released is oxygen. (1 mark)

_____

_____

_____

(b) Plot a graph to show the effect of temperature on catalase activity. (3 marks)

(c) Based on your graph, estimate the optimum temperature of catalase. (1 mark)

(d) Suggest how this investigation could be improved to get a more accurate estimate of the optimum temperature. (1 mark)

(e) Catalase is also found in plants, including apples. A student predicted that the optimum temperature of catalase extracted from apples would be expected to be much lower than that of catalase from pig livers.

Do you agree with the student's prediction? Explain your choice. (1 mark)

_____

_____

_____

3. (a) Thomas suffers from insulin-dependent diabetes. With reference to the cause of the disease, explain why his urine contains glucose. (4 marks)

(b) Thomas adopts a daily routine to control his diabetes. He eats three meals a day: breakfast, lunch and an evening meal. He is advised to take in complex carbohydrates in his meals instead of sugar. He injects insulin once before breakfast and once before the evening meal. The injection he uses before breakfast is a mixture of two types of insulin: a slow-acting type and a fast-acting type.

	Slow-acting insulin	**Fast-acting insulin**
Onset	1 to 3 hours	10 to 15 minutes
Peak	5 to 8 hours	1 to 2 hours
Duration	Up to 18 hours	3 to 5 hours

(i) Why should diabetic patients take in complex carbohydrates in their meals instead of sugar? (2 marks)

(ii) Why is it beneficial to use both types of insulin before breakfast? (2 marks)

(iii) Thomas skipped lunch one day. Even though he had injected himself with the mixture of insulin before breakfast, his blood glucose did not fall dangerously low. Suggest a reason to explain this. (1 mark)

_____

_____

4. The photomicrograph below shows a lily flower.

(a) State one visible feature of the flower that is an adaptation for insect pollination. (1 mark)

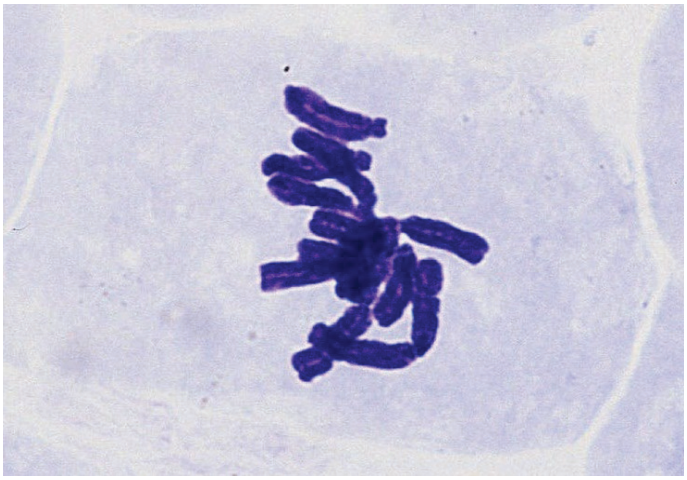
(b) You are conducting a genetic experiment that crosses two different lily plants. Describe the procedure you would follow to ensure cross-pollination, but not self-pollination to take place. (3 marks)

(c) The lily plant can also reproduce by vegetative propagation. Compare and explain the variability of the offspring produced by vegetative propagation and self-pollination. (4 marks)

5. (a) Plant seeds remain dormant in winter. State ***two*** changes in environmental conditions that enable seed germination in spring. State the importance for each change. (4 marks)

(b) After a seed has germinated, its radicle will develop into the root of the plant. Root growth occurs by mitotic cell division of a specific group of cells in the root tip. Name this group of cells. (1 mark)

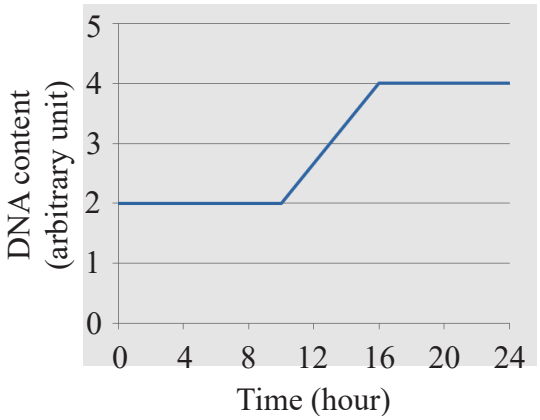
(c) The photomicrograph below shows a cell undergoing mitotic cell division.



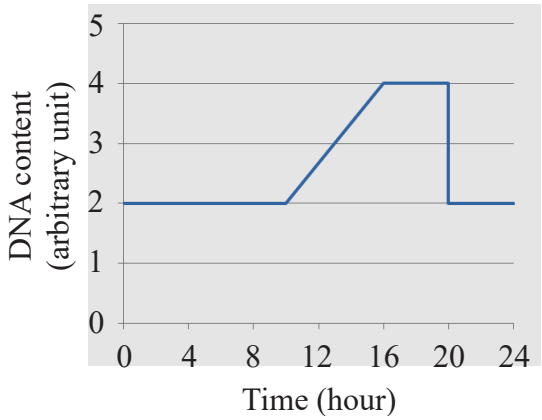
[**Photo Source:** Josef Reischig / CC-BY-SA-3.0]

Name the stage of mitotic cell division and describe what is happening to the chromosomes. (2 marks)

(d) Chemical X can prevent the formation of spindle fibres during cell division. The graphs below show the changes in DNA content of two cells treated with and without chemical X.



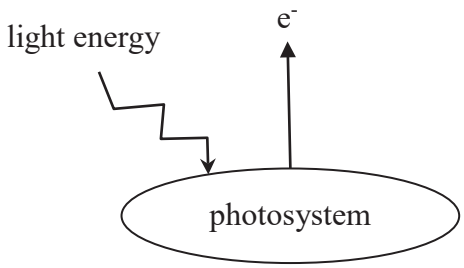
Changes in DNA content of a cell with chemical X



Changes in DNA content of a cell without chemical X

Using the graphs and your knowledge of the cell cycle, explain why chemical X may have a potential to be a drug for the treatment of cancer. (3 marks)

6. Chloroplasts contain chlorophyll molecules, which are organized into photosynthetic units called photosystems. The diagram below shows the emission of electrons from a photosystem in a chloroplast illuminated by light.



(a) Where are photosystems located in a chloroplast? (1 mark)

(b) Describe the events that cause emission of electrons from the photosystem. (2 marks)

(c) The flow of electrons can be studied using DCPIP. DCPIP is blue when oxidized and colourless when reduced:

oxidized DCPIP (blue) → reduced DCPIP (colourless)

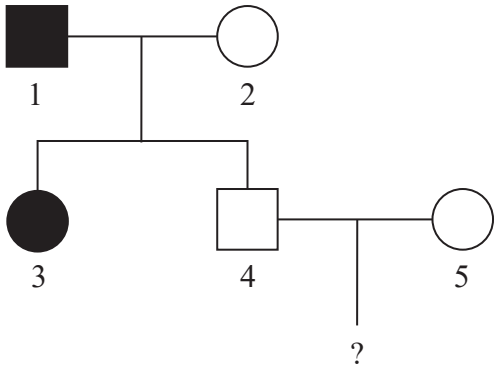
Describe and explain any colour change that would occur when blue DCPIP solution is added to a chloroplast suspension illuminated by light. (2 marks)

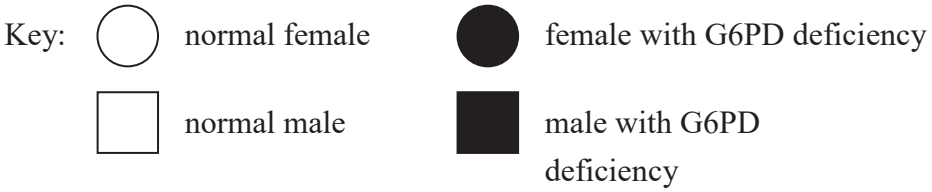
(d) Explain what normally happens to the electrons emitted from the photosystem in the chloroplast. (3 marks)

7. Glucose-6-phosphate dehydrogenase (G6PD) deficiency is a genetic disease. People with G6PD deficiency will develop acute haemolysis (sudden damage of red blood cells) when exposed to certain chemicals.

(a) Is the blood of people with G6PD deficiency suitable for use in blood transfusion? Explain your answer. (1 mark)

It is known that G6PD deficiency is caused by an X-linked recessive allele. The pedigree below shows the inheritance of the disorder in a family.

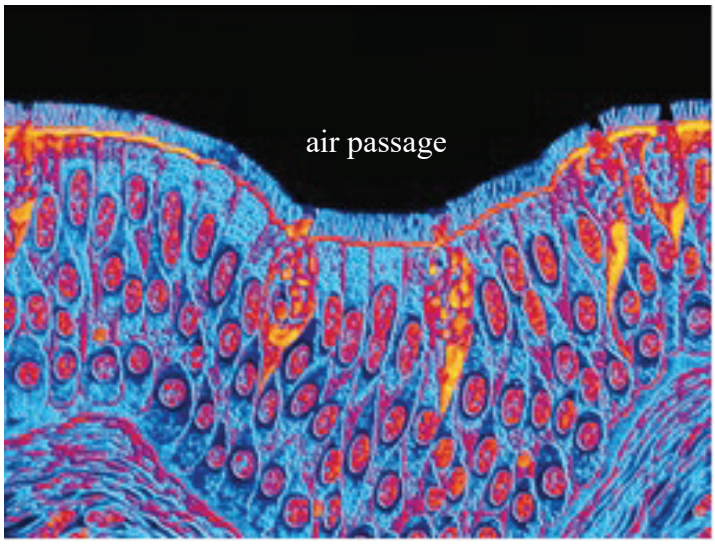




(b) Explain why individual 4 is normal even though his father, individual 1, has G6PD deficiency. (Marks will not be awarded for genetic diagrams.) (3 marks)

(c) Individual 5 is a carrier of the recessive allele for G6PD deficiency. With the aid of a genetic diagram, find the probability of individuals 4 and 5 giving birth to a son with G6PD deficiency. (5 marks)

8. (a) The photomicrograph below shows a section of the inner lining of the trachea.



(x 800)

With reference to the features shown in the photomicrograph, describe how the inner wall of the trachea helps protect against lung infections. (3 marks)

(b) SARS-CoV-2 is a novel coronavirus identified as the causative agent of coronavirus disease 2019 (COVID-19).

(i) To combat COVID-19, scientists all over the world are developing vaccines. Explain how vaccination can help to prevent viral infections. (4 marks)

(ii) A woman infected with SARS-CoV-2 during her pregnancy gave birth to a baby who has antibodies against the virus. Suggest ***two*** possible ways that babies can acquire antibodies from their mothers. (2 marks)

_____

_____

_____

_____

9. The table below shows the major events in the history of the treatment for diabetes mellitus.

Year	Events
1869	Paul Langerhans found clusters of cells with an unknown function within the pancreatic tissues when observing a pancreas under a light microscope. These cell clusters were later named islets of Langerhans, which were found to be responsible for blood glucose regulation.
1889	Oskar Minkowski and Joseph von Mering conducted experiments to show that if the pancreas is removed surgically from a dog, it will develop diabetes.
1921	Banting and Best first removed the pancreas from a dog (dog A) to make it diabetic. They then tied off the pancreatic duct of another dog (dog B). The pancreas of dog B soon partially degenerated, but the dog did not develop diabetes. They removed the pancreas and prepared an extract. The extract was injected into dog A, which then became healthy for some time.
1922	Banting and Best tested the pancreas extract on themselves. They felt dizzy and weak after the injection.

(a) In Banting and Best's experiment, tying off the pancreatic duct led to the partial degeneration of the pancreas of dog B. How would you account for this? (3 marks)

(b) Suggest why Banting and Best felt dizzy after they had the injection of the pancreas extract. (4 marks)

(c) The history of the treatment for diabetes mellitus demonstrates certain aspects on the nature of science. Complete the following table to show your understanding of the nature of science based on this history. (2 marks)

Nature of science	Elaboration
Science is affected by the technology and the types of equipment available at the time.	
	Banting and Best knew that the removal of pancreas from a dog can make it diabetic.

For the following question, candidates are required to present their answer in essay form. Criteria for marking will include relevant content, logical presentation and clarity of expression.

10. A man had a meal consisting of rice and chicken breast. Give an overview on how his body would digest and assimilate the main food substances in each of the two types of food.

(11 marks)

END OF PAPER