B

Form Six Mock Examination 2017-2018

DSE BIOLOGY PAPER 1

SECTION B: Question-Answer Book B

This paper must be answered in English

INSTRUCTIONS FOR SECTION B

(1) Write your name, class and class number in the space 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) Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

(5) Supplementary answer sheets will be provided on request. Write your name, class, class number and question number on each sheet, and fasten them with string **INSIDE** this Question-Answer Book.

(6) Present your answers in paragraphs whenever appropriate.

(7) The diagrams in this section are **NOT** necessarily drawn to scale.

Candidate number	

Question No.	Marks
1	/ 3
2	/2
3	/ 10
4	/ 7
5	/ 8
6	/ 5
7	/ 8
8	/ 10
9	/ 7
10	/13
11	/11
Total:	**/ 84**

SECTION B

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

1. For each of the structures in a plant cell listed in Column I, select from Column II one phrase that correctly describes it. Put the letter in the space provided. (3 marks)

Column I		***Column II***
Cell membrane	____	A. Helps in the synthesis and transport of lipids
Vacuole	____	B. Helps in the synthesis and transport of proteins
Smooth endoplasmic reticulum	____	C. Control the movement of substances into or out of a cell
		D. Provide a site for chemical reactions to take place
		E. Support the cell

2. The table below shows how a bird called the bluethroat (*Luscinia svecica)* is classified by biologists.

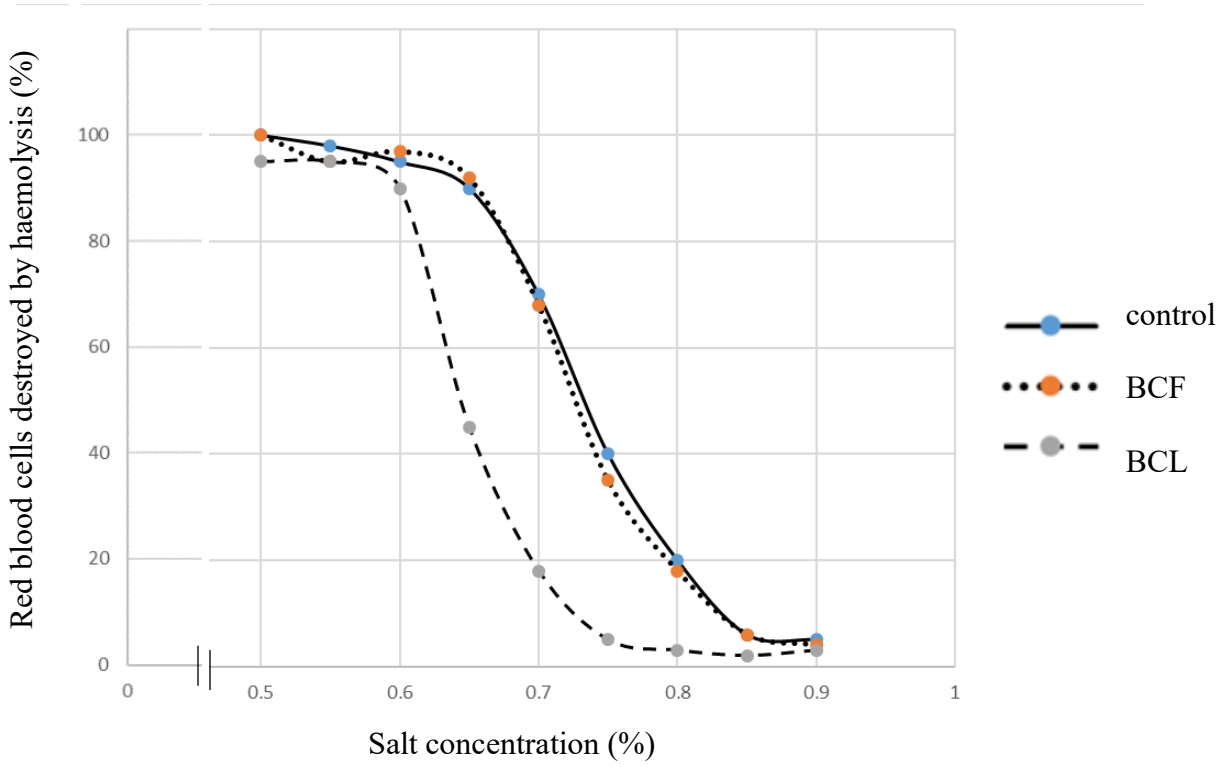
Taxonomic group	***Name***
Domain	Eukaryota
Kingdom	Animalia
Phylum	Chordata
Class	Aves
----------	Passeriformes
Family	Muscicapidae
Genus	----------
Species	----------

Complete the table by filling in the blanks with the correct terms. (2 marks)

3, An investigation was carried out to study whether antioxidants in blackcurrant leaf extract (BCL) and blackcurrant fruit extract (BCF) can protect the pig's red blood cells from haemolysis.

Pig's red blood cells, upon removing from plasma, were divided into three groups. The experimental groups were suspended in an isotonic solution containing the respective plant extracts while the control group was suspended in an isotonic solution instead. All groups of cells were kept at 37°C for 1 hour. After that, the three groups of cells were removed from their solutions by centrifugation and were placed in salt solution from 0.5% to 0.9% separately. The percentage of cells destroyed by bursting (haemolysis) was recorded and the results were shown in the graph below.

Percentage of haemolysis of cells modified with BCL and BCF extract at salt solution of different concentration



(a) Explain, in terms of water potential, why some red blood cells burst when placed in 0.7% salt solution. (3 marks)

(b) Suggest why some red blood cells did not burst in 0.7 % salt solution. (1 mark)

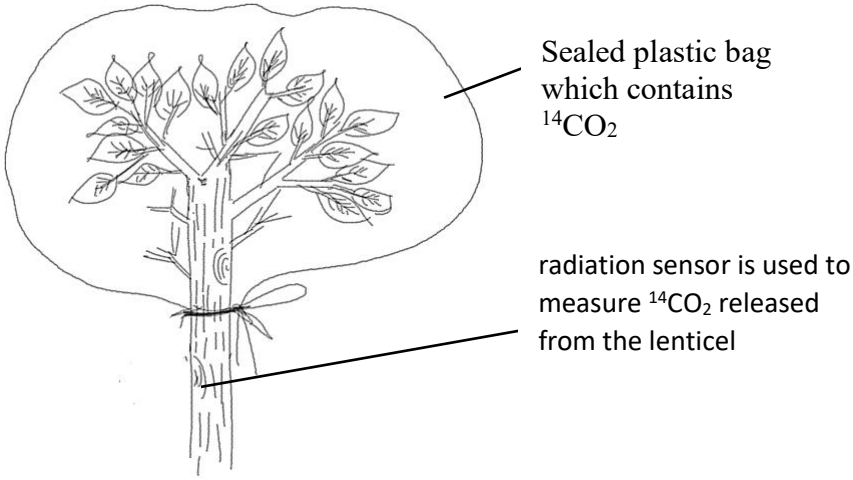
(c) Based on the information shown in the graph, can the blackcurrant leaf extract (BCL) and the blackcurrant fruit extract (BCF) protect the red blood cells from haemolysis? Give an evidence to support your answer. (3 marks)

(d) The investigator suggested that the antioxidant in the blackcurrant plant (leaf/fruit) bind to the membrane superficially to modify the membrane without inducing haemolysis.

(i) Based on your knowledge about the membrane structure, to which region of the cell membrane will the antioxidants bind to if the investigator is correct? (1 mark)

(ii) Justify the investigator's suggestion by giving one evidence from the graph. (2 marks)

4. Scientists measured the rate of translocation in the phloem of trees by using carbon dioxide labelled with radioactive ^{14}C. They put a large, clear plastic bag over the leaves and branches of each tree and added $^{14}CO_2$ as the diagram shown below. The main trunk of the trees was not in the plastic bag. At regular intervals after adding the $^{14}CO_2$ to the bag, the scientists measured the amount of $^{14}CO_2$ released from lenticels from the main trunk of the tree using sensor.



(a) Describe the pathway through which the $^{14}CO_2$ in the plastic bag entered mesophyll cells. (2 marks)

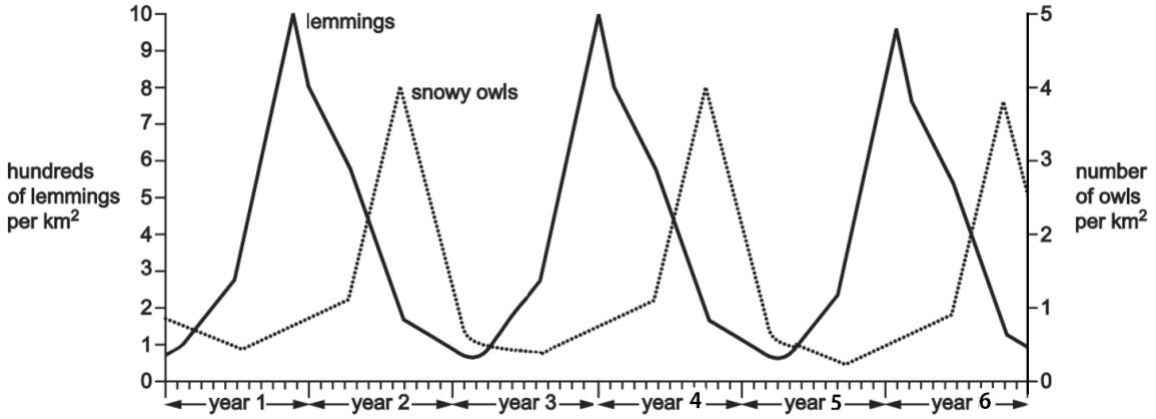
(b) Briefly describe the cellular processes in which the $^{14}CO_2$ in mesophyll cells can be utilized and detected by the sensor. (5 marks)

5. In the Arctic, snowy owls are predators of lemmings. The lemmings eat Arctic plants.

(a) Draw the food chain for this Arctic ecosystem. (1 mark)

(b) Suggest a method how researchers can identify the food sources of snowy owls. (1 mark)

(c) The graph below shows changes in the populations of snowy owls and lemmings over a six-year period.



Describe and explain the periodic fluctuation of population sizes of snowy owls and lemmings in the graph. (4 marks)

(d) A student said, "A simple food web in the ecosystem is less stable in environmental fluctuation than a complex food web." Using the food chain in (a) as an example, justify why the student's claim is correct. (2 marks)

6. The cold receptor protein is encoded by a gene called T. If gene T is mutated, it is possible for the cold receptor to become less sensitive to coldness. Some of the variations in the triplet codes on the coding strand in an important region of gene T are shown below. A mRNA codon table is given for assistance.

Original sequence:	-CTT-CTA-TGG-CAC-TAC-
Variant 1:	-CTT-CTA-TGG-CAT-TAC-
Variant 2:	-CTT-CTT-TGA-CAC-TAC-
Variant 3:	-CTT-CTT-ATG-ACA-CTA-

Amino acids	**mRNA codons**
Leucine	CUA, CUU, CUC
Tryptophan	UGG
Histidine	CAU, CAC
Tyrosine	UAU, UAC
Threonine	ACA, ACU
Stop codon	UGA, UAA
Methionine	AUG

(a) Identify the variant(s) with substitution mutation. (1 mark)

(b) With respect to processes in protein synthesis, explain why variant 2 should cause the most drastic change in the function of the cold receptor. (4 marks)

7. In 1920s, Otto Meyerhof did an experiment: If an isolated frog leg is stimulated electrically, the leg muscles can contract several times but soon became fatigue. During and after the stimulation, lactic acid level in the leg muscle cells increases.

(a) Explain why the cells in the isolated leg muscle soon became deoxygenated before the experiment. (1 mark)

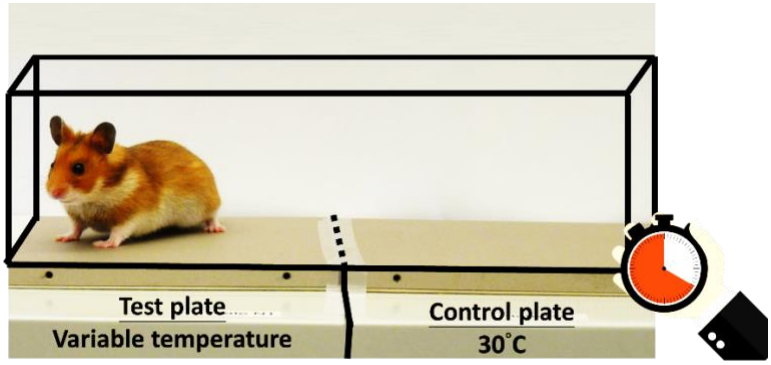
(b) Describe how stimulation of leg muscles leads to lactic acid production. (3 marks)

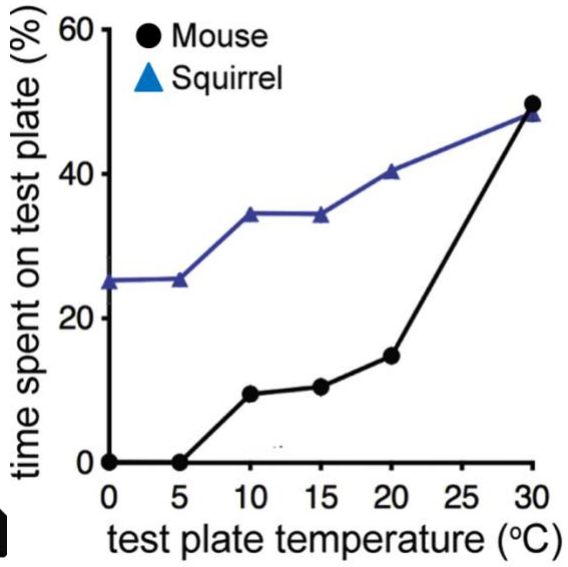
(c) From the experiment, Otto Meyerhof believed lactic acid accumulation leads to muscle fatigue and can be used to explain why people feel prolonged muscle fatigue after exercises. However in 1970s, George Brook found out that when different carbohydrates (i.e. lactic acid, glucose, glycogen and starch) are injected into a living rat, lactic acid is the fastest carbohydrate that can be broken down completely in the presence of oxygen.

(i) Describe how lactic acid is broken down completely in the liver. (2 marks)

(ii) The finding from George Brook eventually helps to disprove Meyerhof's hypothesis that lactic acid accumulation is the main reason for muscle fatigue. What nature of science can be demonstrated by George Brook's disproval on Meyerhof's hypothesis? Elaborate your answer. (2 marks)

8. An experiment was performed to investigate the cold sensitivity of animals. Each time two metal plates are provided to an animal, one in 30˚C (control plate) while another in variable temperature (test plate). The time animal spent on each metal plate is then measured. Below show the experimental setup (left) and a graph showing the results for mouse and squirrel (right).





(a) With reference to the graph, compare the cold sensitivity between mouse and squirrel. (2 marks)

_____

_____

_____

(b) Hibernation is a behavior in which animals lower their metabolic rate when food availability is low (i.e. during winter). During hibernation, animals do not wake up. One of the crucial requirements for successful hibernation is that animals should not be over sensitive to certain external stimulus.

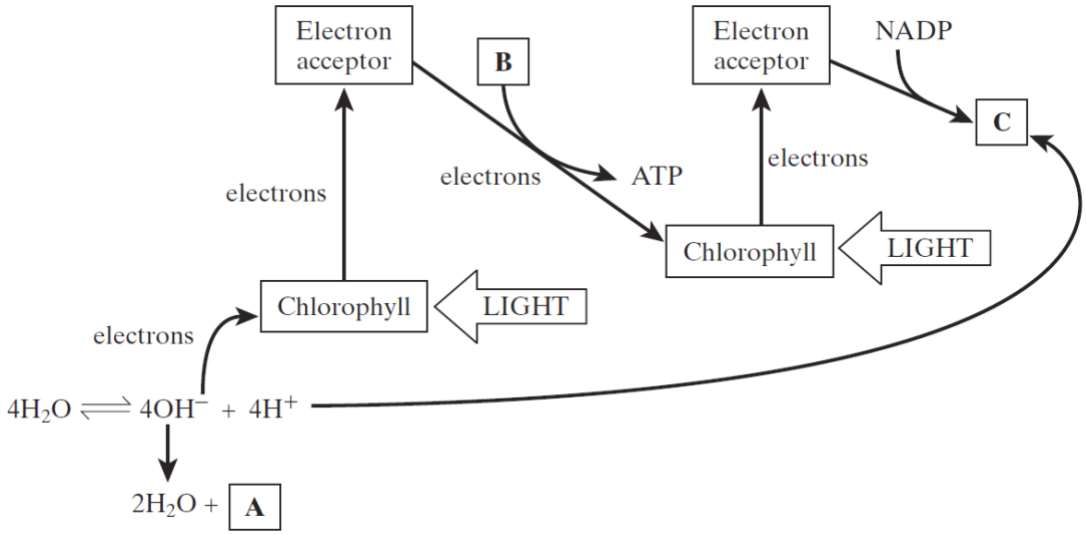
(i) State which animal, mouse or squirrel, should have a higher chance to hibernate successfully? (1 mark)

_____

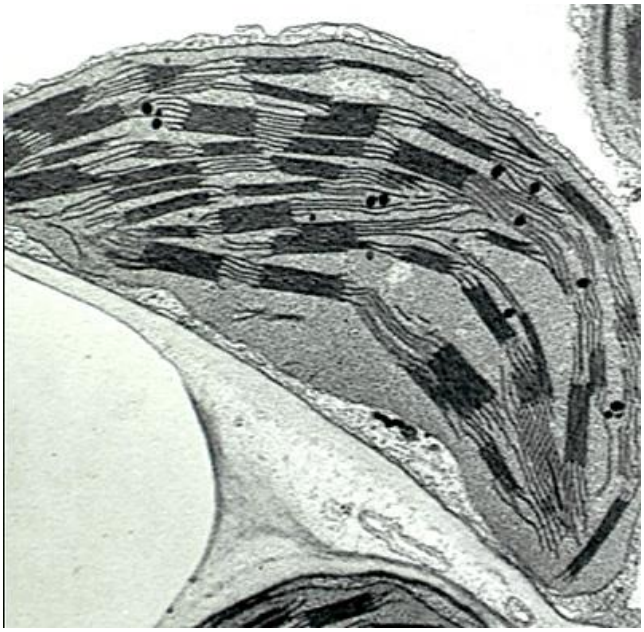
(ii) Explain how the hibernation behavior enables animals to survive in stressful condition like winter. (3 marks)

(c) Both squirrels and their ancestors can be found in polar region where temperature was moderate and food supply was good 20 000 years ago. According to the theory of natural selection and the above information, propose how squirrel might gain the ability to survive in polar region even in present days. (4 marks)

9. The diagram shows the light- dependent reactions of photosynthesis.



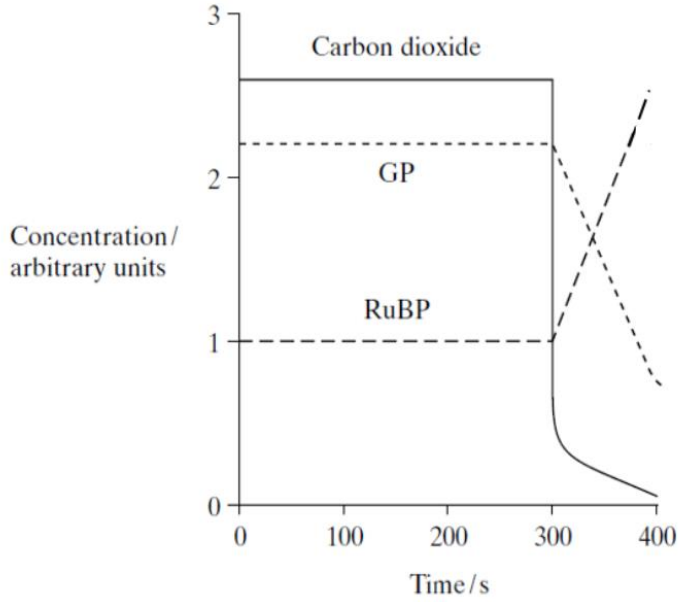
(a) Name and label the part of chloroplast in which light dependent stage is carried out in the electromicrograph below. (1 mark)



(b) What is the significance of substrate B and product C to the whole photosynthetic process?

(2 marks)

(c) In an investigation, single- celled algae were kept in bright light and were supplied with carbon dioxide containing radioactive carbon atom. After 300 seconds, the carbon dioxide supply was turned off. The graph shows how the concentrations of carbon dioxide, glycerate 3- phosphate (GP) and ribulose bisphosphate (RuBP) were changed.



(i) What is the biological significance of higher concentration of GP than RuBP in photosynthesis? (2 marks)

(ii) Explain the increase of RuBP level between 300 – 380 seconds. (2 marks)

10. A scientist investigated the role of light, sucrose and fungi in seed germination rate of *D. fuchsii,* an orchid commonly found in UK.

The scientist hypothesized as follows:

(1) The germination rate increases with the presence of light.
(2) The germination rate increases with the presence of fungi.
(3) The germination rate increases with the presence of sucrose.

120 seeds were collected and sterilized. The seeds were separated into 6 groups and set into germination in separate agar plates under different treatment. Water was supplied in each set up. The table below shows the conditions in each set up and the average change in length of the plumule after 20 days of germination. Given the initial lengths of the plumules were the same.

Treatment	A	B	C	D	E	F
Presence of sucrose	x	√	x	x	√	x
Presence of fungi	√	x	x	√	x	x
Presence of light	x	x	x	√	√	√
Average change of the length of plumule after 20 days (cm)	10	7.8	6.2	4	2.5	1

(a) (i) State the importance of water in seed germination. (1mark)

(ii) Explain why the scientist sterilized the surface of the seeds and the agar plates before the investigation. (2 marks)

(b) (i) Suggest whether hypothesis 1 is supported with the data given in the table and explain your claim. (3 marks)

(ii) Which factor, the presence of sucrose or fungi, has a more profound effect on the germination rate of *D. fuchsii*? Elaborate your choice with evidence provided by the table. (2 marks)

(iii) A student suggested to use the change of dry mass for measuring the seed germination rate instead. He dried the plumule in an oven at 103 °C for 3 days.
Suggest what he should have done during the drying process to be sure that all water had been removed from the plant samples. (1 mark)

(c) The scientist investigated further on the ecological relationship of fungi and *D. fuchsii* by isolating the fungal hyphae from *D. fuchsii* and grew under different conditions. The fungal hyphae length was measured after 8 days as an indicator of fungal growth and the results as shown below:

Treatment	G	H	I	J
Presence of *D. fuchsia* seed	√	√	x	x
Presence of light	x	√	x	√
The increase in length of fungal hyphae (mm)	45	30	38	15

(i) Based on the table above, suggest the possible ecological relationship between the fungi and *D. fuchsii.* (1 mark)

(ii) Fungi usually grow in shady environment. Propose a mechanism on the effect of light on the change in length of fungal hyphae attached on *D. fuchsia* and hence the germination rate of *D. fuchsia*. (3 marks)

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

11. 'Long-term health problems can be brought about if a person takes in a diet that is high in fat, sugar and sodium (salt) but low in dietary fibers.' Give an account of the biological basis for this statement. (11 marks)

END OF PAPER