Mock Examination (2019-2020)

Biology Paper I

F6 Name:_____

Time allowed for Section A and B: 2 hours 30 minutes Class: _____ No: _____

Section B : Question-Answer Book

Instructions for Section B

1. Answer **ALL** questions. The questions in this Question-Answer Book carry 84 marks.
2. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins.
3. Supplementary answer sheets will be supplied on request. Write your name, class and class number on each sheet and tie them loosely but securely with a string with this Question-Answer Book.
4. Rough work sheets will be supplied on request. You can plan and organize your answer before writing on the Question-Answer Book.
5. The diagrams in this paper are **NOT** necessarily drawn to scale.

Question No	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

Section	Marks
A	
B	
Paper Total	

1. Figure 1 shows a transverse section of part of a leaf and Figure 2 shows the lower epidermis of a leaf.

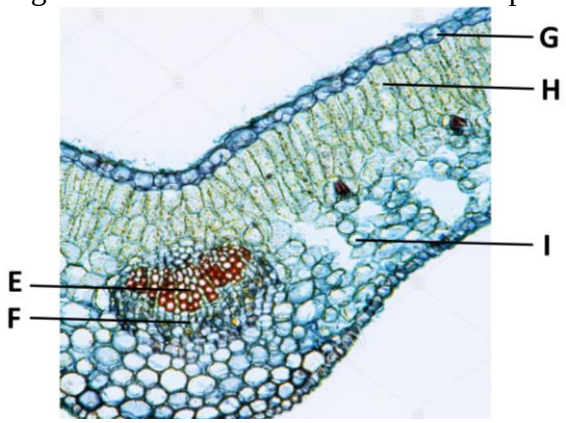


Figure 1

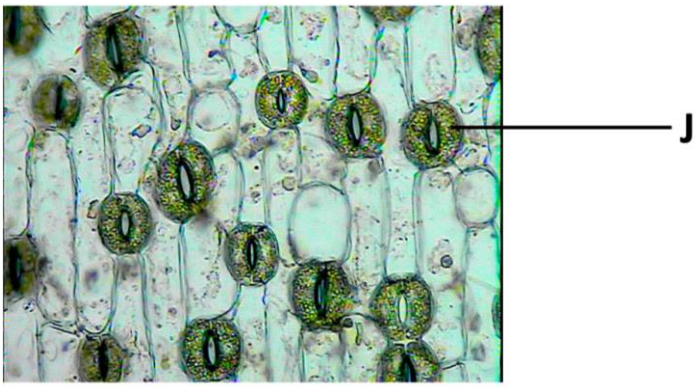


Figure 2

(a) Complete the table below, which shows the functions of some of the labelled parts of a leaf. (3 marks)

Part(s) of a leaf	Function
J	(i)
(ii)	site of photosynthesis
E	(iii)

(b) Two plants, X and Y, of the same species with similar height were put into different soils and grown for 12 weeks. All other conditions were kept the same.

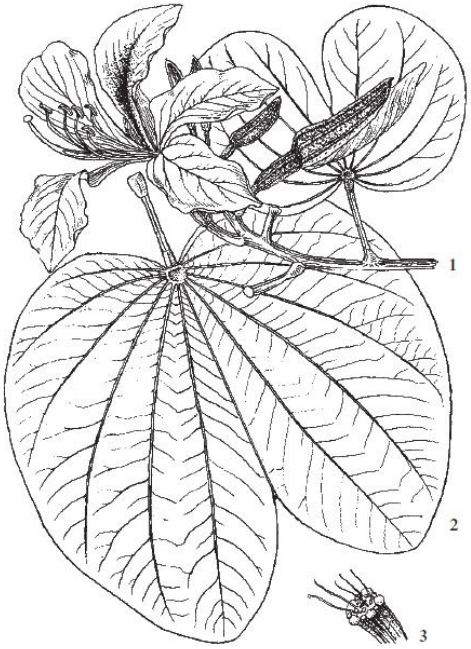
The table below shows some information about the plants after 12 weeks.

	Plant X	Plant Y
Height/cm	35	34
Number of leaves	25	27
Appearance of new leaves	large and green	small and yellow

Name the mineral which was lacking from the soil in which plant Y was grown. Explain your answer. (2 marks)

(c) Explain how the addition of egg shells to the soil can improve soil fertility. (2 marks)

2. The following diagram shows the appearance of a flowering plant, *Bauhinia purpurea*:



(a) State ***one*** feature of *Bauhinia purpurea* observable in the above diagram that identifies it as a dicotyledonous plant. (1 mark)

_____

(b) Complete the table below which shows the taxonomic groups into which *Bauhinia purpurea* is classified: (3 marks)

Taxonomic group	Group of organisms
Kingdom	(i)
(ii)	Tracheophyta
Class	Magnoliopsida
Order	Fabales
Family	Fabaceae
Genus	(iii)
Species	*Bauhinia purpurea*

(c) *Bauhinia variegata* and *Bauhinia purpurea* can cross to form an infertile hybrid, *Bauhinia blakeana*, the Hong Kong Orchid Tree.

With reference to the process of meiotic cell division, suggest why *Bauhinia blakeana* cannot produce gametes. (2 marks)

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(d) Explain why *Bauhinia blakeana* is more vulnerable to extinction when compared to other species of bauhinia when infected with a deadly infectious disease. (3 marks)

3. Figure 1 shows a piece of green alga, *spirogyra* and Figure 2 shows the structures of *spirogyra*.

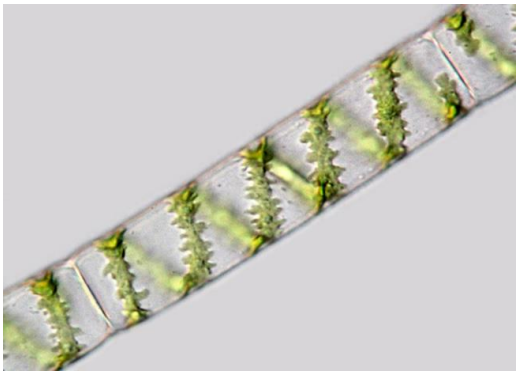

Figure 1

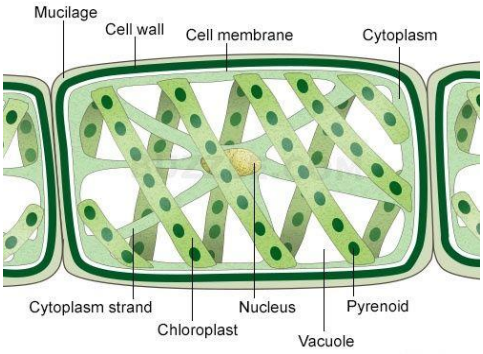

Figure 2

(a) With reference to ***figure 1***, explain why *spirogyra* is not classified as a plant. (1 mark)

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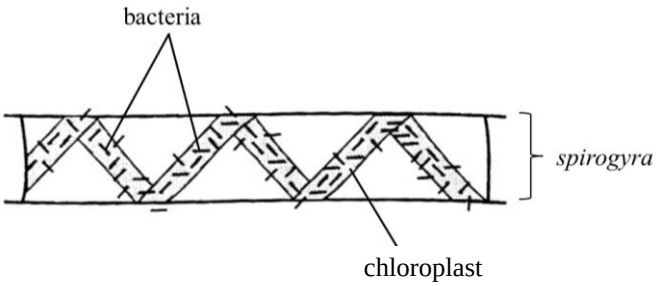
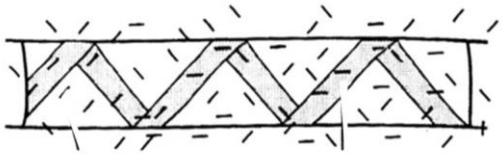
In an investigation, Mary placed a piece of *spirogyra* on a slide with a suspension of aerobic bacteria. She then observed the distribution of the bacteria under two different conditions. The results are shown in the diagram below:



set-up X: under bright light



set-up Y: in darkness

(b) (i) Account for the observations in set-up X with reference to the process of photochemical reaction. (4 marks)

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(ii) What was the purpose of having set-up Y? (1 mark)

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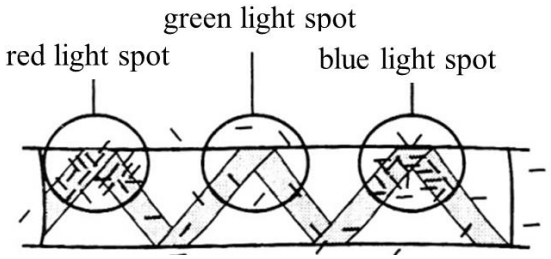
3(c) The experiment is repeated by exposing different regions of *spirogyra* to red, green and blue lights respectively.



(i) State ***one*** controlled variable in this investigation. (1 mark)

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(ii) What conclusion can be drawn from the above results? (2 marks)

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4. Rheumatoid arthritis is an autoimmune disorder that primarily affects joints. The immune system attacks the synovial membrane of movable joints in the body by producing antibodies and destroys the synovial membranes. This creates inflammation that causes the synovial membrane to thicken.

(a) Account for the following symptoms of rheumatoid arthritis. (2 marks)

Redness: _____

Pain:_____

(b) Describe how antibodies against the synovial membranes are produced in rheumatoid arthritis. (2 marks)

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(c) If inflammation continues, structures around the joint can also be damaged. Name the structure at a movable joint that is damaged when the following symptoms are shown. Explain your answer. (4 marks)

Dislocation during movement: _____

_____

_____

Joint is not able to bend:_____

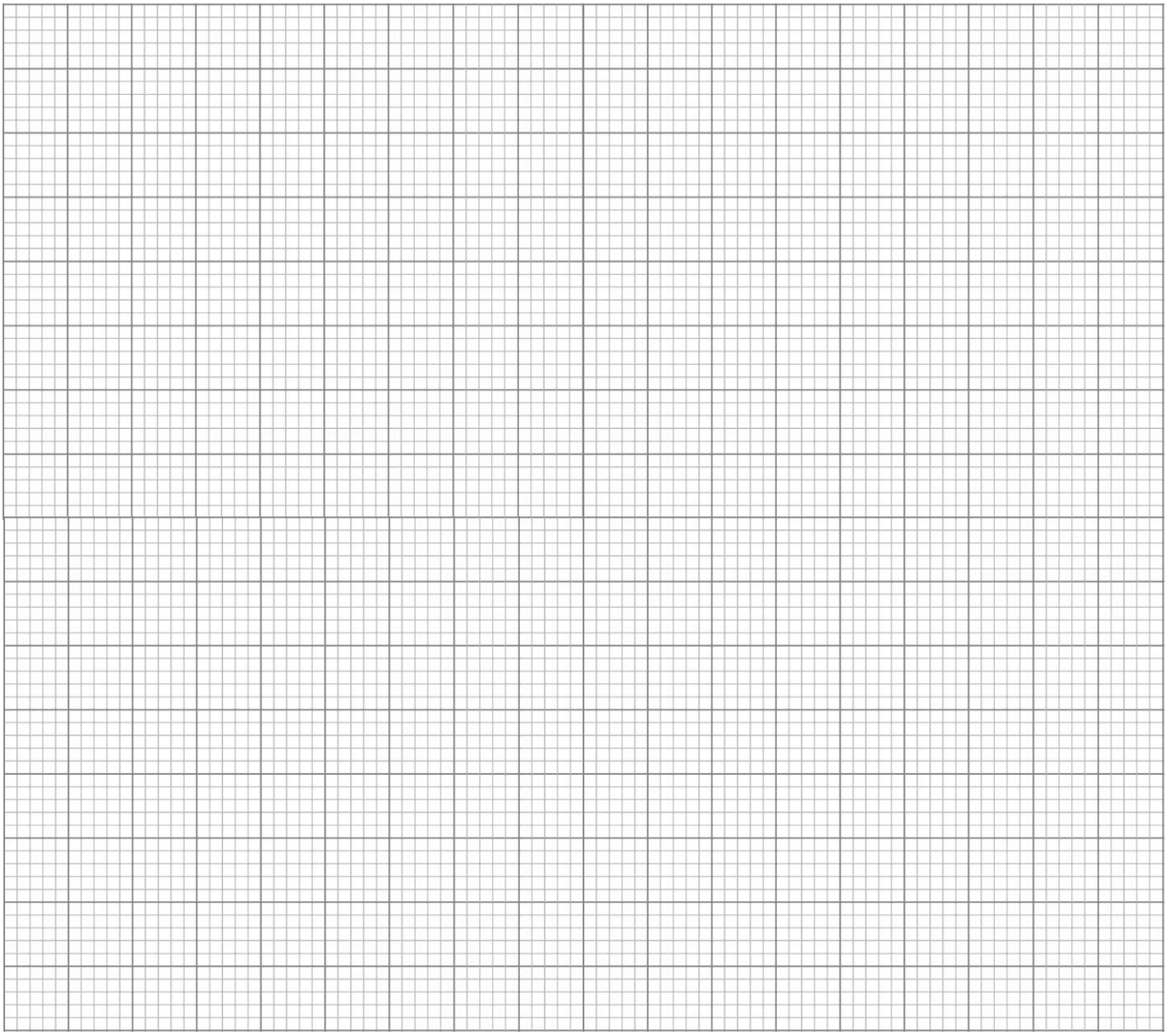
_____

_____

5. In a study of the growth of mung bean seedlings, 20 mung bean seeds were grown under sunlight for 30 days. The same number of seedlings was collected from each group every 6 days. The average dry mass of the seedlings of each group was determined and the results are shown below:

Time of growth (day)	Average dry mass of seedlings (g)
0	1
6	0.7
12	0.5
18	0.8
24	1.5
30	2.9

(a) Use the graph paper below, plot a graph to show the results of the experiment. (4 marks)



5(b) Account for the changes in average dry mass of the seedlings from day 0 to day 12. (2 marks)

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(c) State ***one*** function of water during seed germination. (1 mark)

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(d) Describe how the dry mass of the seedlings can be obtained. (1 mark)

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(e) The experiment is repeated by placing the set-up in darkness.

(i) On the graph on ***page 8***, sketch a curve to show the changes in average dry mass of the seedlings from day 0 to day 30. (1 mark)

(ii) Hence, explain the results. (4 marks)

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6. Rice is often grown in fields that are flooded with water for part of the growing season.

(a) The roots of young rice plants are highly tolerant of ethanol. Explain how this feature helps them to survive when the fields are flooded. (2 marks)

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(b) The table below shows the nutrient content of samples of white rice and brown rice.

	Nutrient content per 100 g	
	white rice	***brown rice***
lipid/g	0.8	2.4
dietary fibre/g	0.6	2.8
calcium/mg	8	12
vitamin B_1/mg	0.07	0.26
protein/g	6.0	7.4
carbohydrate/g	82.0	77.7

Explain why it is recommended to consume brown rice for better intestinal health. (4 marks)

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(c) Briefly describe how starch is digested in the human body. (2 marks)

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7. Below are some milestones in the developments in the knowledge of diabetes mellitus.

The work of some scientists showed that diabetes mellitus was caused by the lack of a hormone secreted by islets of Langerhans in the pancreas.

↓

Frederick Banting and Charles Best injected an extract of fresh pancreas into some diabetic dogs.
The dogs were not recovered.

↓

Banting read an article from a medical journal.
Moses Baron wrote that when the pancreatic duct was blocked by gallstones, pancreatic cells that secrete digestive enzymes degenerated. The islets of Langerhans remains unaffected.

↓

Banting and Best tied off the pancreatic ducts in healthy dogs.
Ten weeks later, pancreases from the dogs were removed for preparing an extract.
The scientists injected the extract into some diabetic dogs.
The symptoms of diabetes mellitus disappeared for a short time.

↓

A purer extract was prepared and diabetes mellitus was successfully controlled in humans.

(a) Why did the extract of fresh pancreas have no effect on curing diabetes mellitus? (1 mark)

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(b) Explain why blocking the pancreatic duct would lead to the degeneration of the pancreatic cells that secrete digestive enzymes. (3 marks)

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(c) Using your biological knowledge, explain why symptoms of diabetes mellitus disappeared in dogs after injecting the extract. (2 marks)

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7(d) Give ***one*** aspect about the nature of science that can be demonstrated in the developments in the knowledge of diabetes mellitus. (1 mark)

_____

(e) Complete the table below that compares type 1 and type 2 diabetes mellitus. (2 marks)

	Type 1 diabetes mellitus	**Type 2 diabetes mellitus**
Major risk factor		
Can it be treated by the regular injection of insulin?		

8. Cystic fibrosis is a recessive genetic disease caused by a mutation in the CFTR gene that results in the formation of a defective transmembrane protein channel. This protein channel is involved in the transport of chloride ions.

(a) State the property of the cell membrane that prevents chloride ions from moving across. (1 mark)

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(b) The sequence of the coding strands of the normal allele and the allele for cystic fibrosis are shown below:

^{1} ^{18}
normal allele: …ATC ATC TTT GGT GTT TCC…
mutated allele: …ATC ATT GGT GTT TCC…

(i) What is the nucleotide sequence of the mRNA for the normal allele? (1 mark)

_____

(ii) Using the universal codon table on ***page 13***, give the corresponding amino acid sequence of the part of the normal allele shown above. (1 mark)

_____

8(b) (iii) With reference to the universal codon table below, explain why the transmembrane protein channel encoded by the mutated allele is defective. (3 marks)

Universal codon table

First base in the codon	Second base in the codon				thrid base in the codon
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Stop	Stop	A
	Leu	Ser	Stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Glu	Arg	A
	Leu	Pro	Glu	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

(U, C, A and G stand for the 4 different bases in nucleotids)

(The various amino acids are represented by their short forms in the table.)

(c) In a family, both the father and the mother are normal but their daughter suffers from this genetic disease. Without using genetic diagrams, deduce whether the CFTR gene is located on the X-chromosome. (3 marks)

8(d) Explain why a mutation in the CFTR gene does not necessarily lead to the formation of a defective transmembrane protein channel. (2 marks)

9. Throughout history, human activities have directly and indirectly triggered evolutionary changes to other species. Explain how human activities, using selective breeding as an example, can result in the formation of new species from its wild type. Hence, discuss how the study of the structures of the same type of proteins produced by different organisms can allow scientist to deduce their evolutionary relationship. (10 marks)

**** END OF PAPER I ****