

**MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD**  
**UNIVERSITY OF MALTA, MSIDA**  
**MATRICULATION EXAMINATION**  
**ADVANCED LEVEL**  
**MAY 2017**

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**SUBJECT:** BIOLOGY  
**PAPER NUMBER:** I  
**DATE:** 8<sup>th</sup> May 2017  
**TIME:** 4.00 p.m. to 7.05 p.m.

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**Directions to Candidates**

- Write your index number in the space at the top left-hand corner of this page.
- Answer **ALL** questions. Write all your answers in the spaces provided in this booklet.
- The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.
- You are reminded of the necessity for good English and orderly presentation in your answers.
- In calculations you are advised to show all the steps in your working, giving your answer at each stage.
- The use of electronic calculators is permitted.

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**For examiners' use only:**

Question	1	2	3	4	5	6	7	8	9	10	Total
Score											
Maximum	6	12	10	10	13	10	14	6	10	9	<b>100</b>

## DO NOT WRITE ABOVE THIS LINE

- 1 This question concerns cell division.

Complete the following table using the terms **TRUE** or **FALSE**.

	True or False
Chiasmata can form during Prophase II of meiosis.	
Centromeres divide only in meiosis.	
Mitotic division involves the pairing-up of homologous chromosomes.	
In Meiosis II, pairs of chromatids line up on the equator of the spindle.	
Crossing-over brings about variation.	
In eukaryotic cells, DNA replication occurs during the S phase of interphase.	

(Total: 6 marks)

- 2 This question is about autotrophic nutrition.

A bizarre microbe found deep in a gold mine in South Africa could provide a model for how life might survive in seemingly uninhabitable environments. *Desulforudis audaxviator*'s habitat is devoid of the things that power the vast majority of life on Earth—light, oxygen, and carbon. Instead, this “gold mine bug” gets energy from radioactive uranium in the depths of the mine.

- a. What is the biological term for organisms that synthesise organic compounds using energy derived from the oxidation of inorganic molecules?

\_\_\_\_\_ (1)

- b. Name **ONE** common inorganic molecule that *D. audaxviator* might use as a source of energy.

\_\_\_\_\_ (1)

DO NOT WRITE ABOVE THIS LINE

Unlike *D. audaxviator*, plants are photosynthetic and therefore need light to synthesise organic compounds. Figure 1 shows a cross-section through the leaves of two plant species – one taken from an open grassland (left) and the other taken from the undergrowth of a woodland (right).

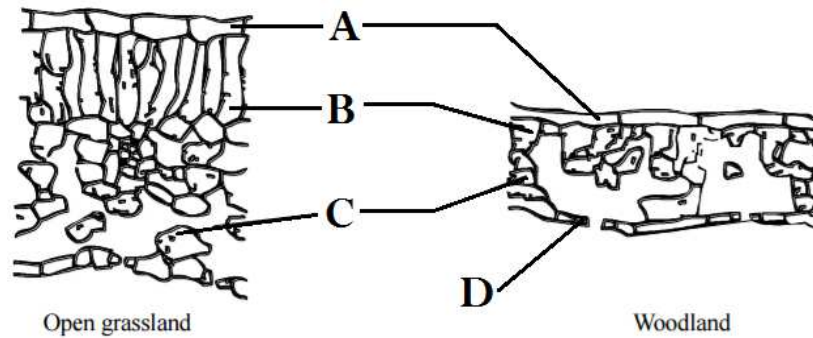


Figure 1: Cross section through the leaves of two species

c. Name cells B and D.

B: \_\_\_\_\_ D: \_\_\_\_\_ (2)

d. Use the diagram to explain how the leaf of such a woodland species is adapted for its habitat.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (2)

e. Plants need light for non-cyclic photophosphorylation. Briefly explain this statement.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (3)

*Question continues on next page*

DO NOT WRITE ABOVE THIS LINE

- f. The graphs in Figure 2 below show what happened to the carbon dioxide uptake of both plants when the light intensity was increased.

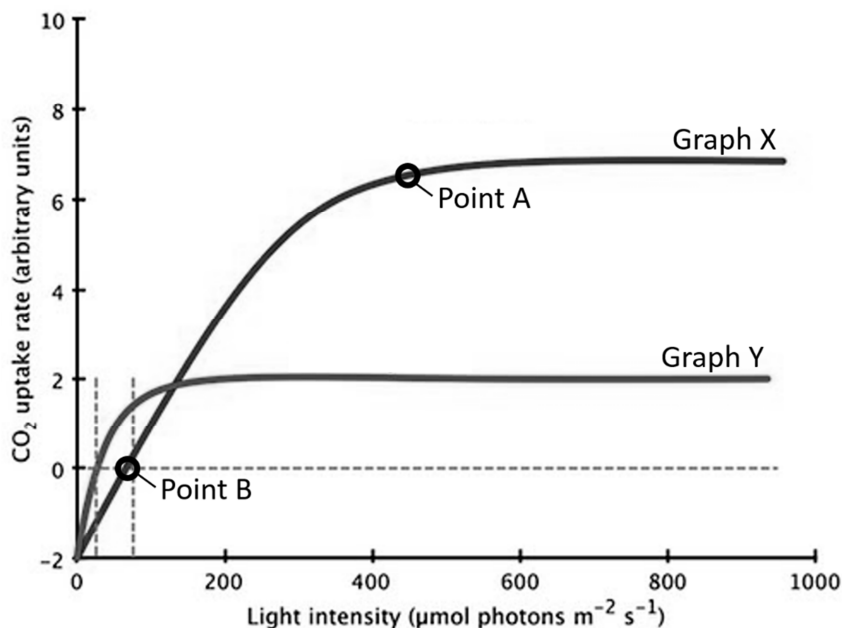


Figure 2: Graphs showing changes in CO<sub>2</sub> uptake with increased light intensity  
 (Source: <http://www.plantedtank.net/forums/10-lighting/141847-photo-period-vs-light-intensity.html>)

- (i) Which graph (X or Y), do you think, represents the woodland plant? Give **ONE** reason for your answer.

\_\_\_\_\_

\_\_\_\_\_ (1)

- (ii) Suggest what might have happened at point A and point B.

Point A: \_\_\_\_\_

Point B: \_\_\_\_\_ (2)

**(Total: 12 marks)**

DO NOT WRITE ABOVE THIS LINE

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3 This question is about locomotion and support.

a. Skeletal muscles are attached to bones. Their cells contain myofibrils that are made up of sarcomeres.

(i) Name the tissue responsible for attachment of muscle to bones.

\_\_\_\_\_ (1)

(ii) Name the region of a sarcomere that remains constant in size during contraction.

\_\_\_\_\_ (1)

b. For skeletal muscles to contract, actin must slide over myosin. Name **TWO** other proteins that play a role in human locomotion and for each, give a brief description of its function.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (4)

c. Briefly outline the roles of ATP in generating muscle contractions.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

*Question continues on next page*

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- d. One ATP molecule is required to move one actin filament 40 nm. During contraction of a sarcomere, a single actin filament moves 0.8  $\mu\text{m}$ . How many molecules of ATP are required to produce this movement? Show your working.

Answer: \_\_\_\_\_(2)  
**(Total: 10 marks)**

4 This question is about plant reproduction.

a. After fertilisation has occurred, name the structure that forms from the following:

- (i) The nucleus of the ovule \_\_\_\_\_(1)
- (ii) The polar nuclei \_\_\_\_\_(1)
- (iii) The ovary \_\_\_\_\_(1)
- (iv) The ovule \_\_\_\_\_(1)
- (v) The integuments around the ovule \_\_\_\_\_(1)

b. Distinguish between protandry and protogyny in plants.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_(2)

c. What is the ultimate aim of protandry and protogyny in flowering plants?

\_\_\_\_\_  
\_\_\_\_\_(1)

DO NOT WRITE ABOVE THIS LINE

d. Explain where each of the following four parts of an angiosperm flower develop:

(i) Male gamete \_\_\_\_\_(1/2)

(ii) Female gamete \_\_\_\_\_(1/2)

(iii) Microspore \_\_\_\_\_(1/2)

(iv) Megaspore \_\_\_\_\_(1/2)

**(Total: 10 marks)**

5 This question is about inheritance.

a. Is the ABO blood group system an example of codominance or of incomplete dominance?

\_\_\_\_\_ (1)

b.  $I^A$ ,  $I^B$  and  $I^O$  are alleles that form the ABO blood group system. What term is given when more than two alleles for a trait exist in a population?

\_\_\_\_\_ (1)

c. A man is suing his wife for divorce on the case of infidelity. Their first and second children have blood groups O and AB respectively.

(i) Fill in the following table giving the possible genotypes for each blood group.

	<b>Blood Group</b>	<b>Possible Genotypes</b>
<b>First child:</b>	O	
<b>Second child:</b>	AB	

(2)

(ii) The third child who the man disclaims is blood type B. Give his possible genotypes.

\_\_\_\_\_ (2)

*Question continues on next page*

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(iii) Given your genotype answers to part (i) and (ii), can this information support the man's case? Explain.

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d. 120 individuals were tested for their blood group. Table 1 shows the total number of individuals in each blood group.

Table 1: Total number of individuals in each blood group

Blood group A	24
Blood group B	32
Blood group AB	38
Blood group O	26
Total	120

$\chi^2$  test can be used to test the hypothesis that there is no significant difference between the observed results and the expected 1:1:1:1 ratio.

(i) Complete the table below to calculate  $\chi^2$  for the values given in Table 1.

Blood Group	Observed	Expected	(O-E)	(O-E) <sup>2</sup>	$\frac{(O - E)^2}{E}$
Blood group A	24				
Blood group B	32				
Blood group AB	38				
Blood group O	26				
$\chi^2 = \sum \frac{(O - E)^2}{E}$		$\chi^2 =$			

(3)



DO NOT WRITE ABOVE THIS LINE

- (ii) The critical value for  $\chi^2$  with 3 degrees of freedom at the 0.05 probability level is 7.82. What can be deduced from the calculated value of  $\chi^2$ ?

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(2)

(Total: 13 marks)

- 6 This question is about population ecology and biotechnology.
- a. In classical biotechnology experiments, bacteria are grown on agar. Bacterial growth follows the principles of population ecology.

You are given the following bacterial growth curve in Figure 3:

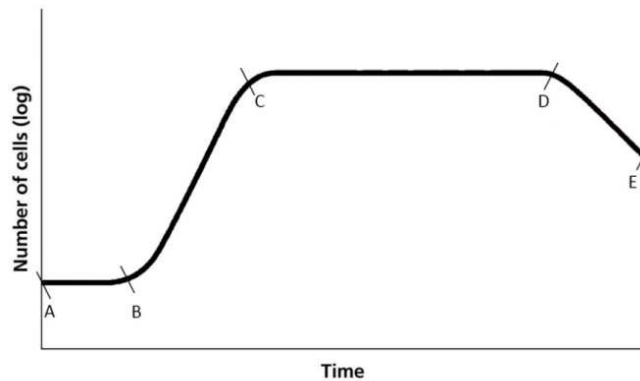


Figure 3: Bacterial growth curve

- (i) Name the phase between:

A and B: \_\_\_\_\_

B and C: \_\_\_\_\_

C and D: \_\_\_\_\_

D and E: \_\_\_\_\_ (2)

*Question continues on next page*

DO NOT WRITE ABOVE THIS LINE

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- (ii) Suggest explanations for the pattern of growth of the bacteria between each of the following time intervals:

A to B:

\_\_\_\_\_  
\_\_\_\_\_(1)

B to C:

\_\_\_\_\_  
\_\_\_\_\_(1)

C to D:

\_\_\_\_\_  
\_\_\_\_\_(1)

D to E:

\_\_\_\_\_  
\_\_\_\_\_(1)

- b. In recent years, the use of agricultural animals in the field of transgenic technology has increased significantly. An example of this is the use of transgenic goats in the production of ATryn®, the brand name of antithrombin.

- (i) Define transgenic technology.

\_\_\_\_\_  
\_\_\_\_\_(1)

- (ii) Why are transgenic goats ideal for production of antithrombin?

\_\_\_\_\_  
\_\_\_\_\_(1)

DO NOT WRITE ABOVE THIS LINE

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(iii) What is 'antithrombin deficiency' and what does it cause?

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(2)

**(Total: 10 marks)**

7 This question is about human reproduction.

a. For each of the following hormones, state where it is produced and its main function in the menstrual cycle.

(i) Luteinising hormone

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(2)

(ii) Follicle stimulating hormones

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(2)

(iii) Oestrogen

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(2)

(iv) Progesterone

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(2)

b. Which **TWO** hormones released by the anterior pituitary gland are involved in the production of sperm? Briefly explain their role in the production of sperm.

Hormone 1: \_\_\_\_\_

Role in the production of sperm:

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(2)

*Question continues on next page*

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Hormone 2: \_\_\_\_\_

Role in the production of sperm:

\_\_\_\_\_  
\_\_\_\_\_ (2)

c. Briefly explain the acrosome reaction.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

**(Total: 14 marks)**

8 This question is about excretion.

a. Ammonia is a toxic substance; however, it is a nitrogenous excretory product. How are bony fish able to use ammonia as a nitrogenous excretory product?

\_\_\_\_\_  
\_\_\_\_\_ (1)

b. Uric acid is not very toxic and is poorly soluble in water. How is poor solubility an advantage to insects?

\_\_\_\_\_  
\_\_\_\_\_ (1)

c. Urea is much less toxic than ammonia and can be excreted in a moderately concentrated dilution. In humans, what disadvantage is associated with the production of urea?

\_\_\_\_\_  
\_\_\_\_\_ (1)

DO NOT WRITE ABOVE THIS LINE

d. List **TWO** main functions of the kidney.

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(2)

e. Explain the term deamination.

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(1)

**(Total: 6 marks)**

9 This question is about thermoregulation.

Figure 4 shows the metabolic rates of two organisms (Organism A and Organism B) in relation to the changes in environmental temperature.

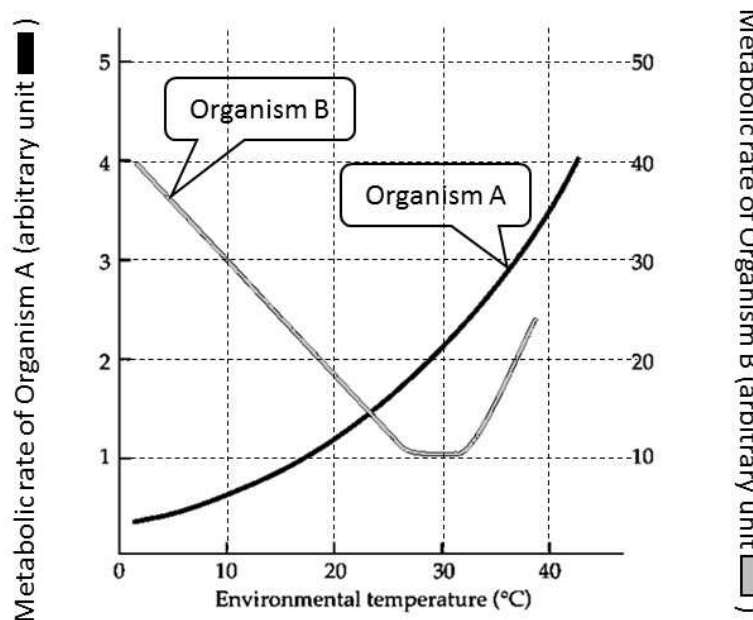


Figure 4: The metabolic rates of two organisms (Organism A and Organism B) in relation to the changes in environmental temperature  
*Modified from Sadava et al. (2012).*

*Question continues on next page*

DO NOT WRITE ABOVE THIS LINE

- a. With reference to Figure 4, distinguish which organism is an ectotherm and which organism is an endotherm. Briefly explain your answer.

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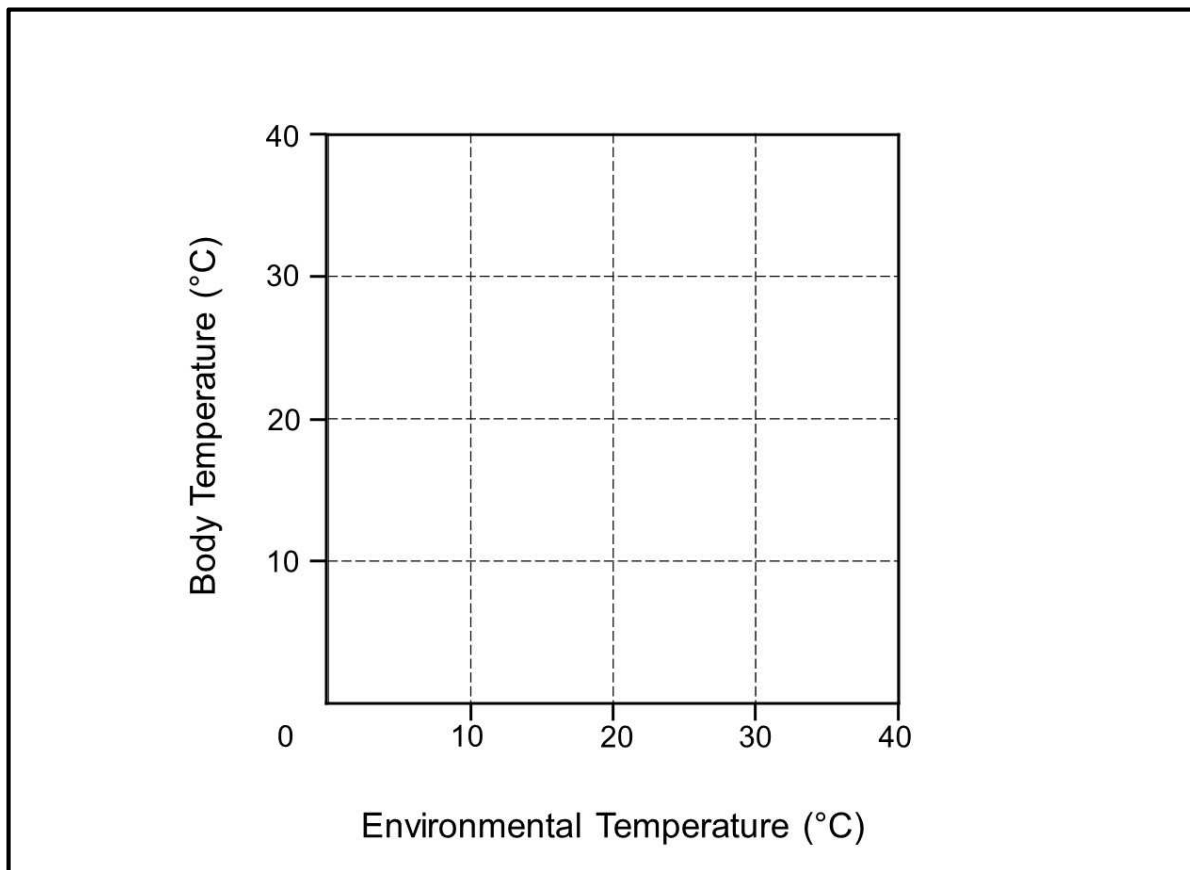
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(4)

- b. In the space provided, sketch the response of the body temperatures of a lizard and a mouse of the same body size to changes in environmental temperature.



(2)

- c. How is the mammalian skin adapted in order to maintain a constant body temperature in a cold environment?

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(2)

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d. How is aestivation different from hibernation?

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(2)

**(Total: 10 marks)**

10 This question is about evolution.

a. What is the principle of the Hardy-Weinberg equilibrium?

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(1)

b. Before the Hardy-Weinberg equations can be applied, several assumptions must be made. Give **FOUR** of these assumptions.

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(4)

c. A sample of a population was tested for the ability to taste a chemical called phenylthiourea. The ability to taste this chemical is determined by the allele T which is dominant to the allele t. An analysis of the sample of people showed that 9% of the sample were non-tasters. Using the Hardy-Weinberg equations, calculate:

(i) The frequency of the t allele. Show your working.

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(1)

*Question continues on next page*

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(ii) The frequency of the T allele. Show your working.

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(1)

(iii) The proportion of this population that is heterozygous for this gene. Show your working.

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(2)

**(Total: 9 marks)**



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UNIVERSITY OF MALTA, MSIDA

MATRICULATION EXAMINATION  
ADVANCED LEVEL  
MAY 2017

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<b>SUBJECT:</b>	BIOLOGY
<b>PAPER NUMBER:</b>	II
<b>DATE:</b>	9th May 2017
<b>TIME:</b>	4:00 p.m. to 7:05 p.m.

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**Directions to Candidates**

- Answer the question in Section A, any **TWO** questions from Section B and **ONE** question from Section C. Write all your answers in the separate booklet provided.
  - If more than two questions from Section B are attempted, only the first two answers shall be taken into consideration.
  - If more than one question from Section C is attempted, only the first answer shall be taken into consideration.
  - The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.
  - You are reminded of the necessity for good English and orderly presentation in your answers.
  - In calculations you are advised to show all the steps in your working, giving your answer at each stage.
  - The use of electronic calculators is permitted.
-

## SECTION A

### This section is obligatory

1. Read carefully the following extract. Then using the information provided and your knowledge of biology, answer the questions that follow. The numerals in the left-hand margin are the line numbers.

#### **Distribution, habitat preferences and behaviour of the critically endangered Maltese top-shell** *Gibbula nivos*

The Maltese top-shell, *Gibbula nivos*, is a critically endangered marine gastropod which has been recorded from the Maltese Islands on numerous occasions but not from any other locality in the Mediterranean, despite extensive searches for populations of this species by shell collectors. *G. nivos* is thus considered to be endemic to the Maltese Islands. Such a situation is practically unique amongst molluscs within the whole Mediterranean region as well as amongst the marine invertebrates of Malta; although a handful of other marine species are also known only from the Maltese Islands, none of these have been extensively searched for throughout the Mediterranean, as in the case of *G. nivos*.

Given the small size of the Maltese Islands, *G. nivos* has a very narrow geographical range, which makes this species very rare on a regional scale. However, *G. nivos* is also rare within the Maltese Islands themselves. For a point-endemic species, local extinction would be equivalent to global extinction, which renders *G. nivos* in dire need of proper conservation. In particular, factors that could lead to its decline need to be identified and addressed.

Despite calls for biologists and shell collectors to refrain from collecting this species, *G. nivos* started to appear in the catalogues of professional shell dealers and was subsequently afforded protection via international conventions. The species is also protected by Maltese legislation. By rendering the collection and trade of *G. nivos* illegal, such legislation has contributed to ensuring survival of this species.

Accumulations of cobbles and pebbles can support *G. nivos*. In fact, the snails were found to be more abundant in the upper layer of the cobble or pebble bed despite predation by fish being expected to be higher in this area. This suggests that *G. nivos* shows a preference for the upper strata due to factors other than predation. These may include the avoidance of anoxic conditions and waterborne silt particles that may be present in basal layers of the cobble/pebble bed and the proximity to the surface where microflora would have the highest nutritive value.

The foraging behaviour of *G. nivos* can be described as a '**ranging pattern**' where movement is not oriented in a specific direction and the snails do not return to their previous shelter after a foraging bout. '**Homing behaviour**' is not required since shelter is readily available beneath the same cobbles/pebbles. Despite snails being slow-moving prey, such avoidance behaviour still reduces the risk of an attack by a fast-moving predator since it involves a response to a distant threat.

*Adapted from: Evans, J., Borg, J.A. and Schembri, P.J. (2011). "Distribution, habitat preferences and behaviour of the critically endangered Maltese top-shell Gibbula nivos" Marine Biology, 158:603–611.*

- a. Explain what is meant by the term 'critically endangered' (line 1). (2)
- b. Find a term from the text which refers to the ecological state of a species being unique to a defined geographic location. (2)
- c. Give the phylum and class of *Gibbula nivos*a. (2)
- d. Define 'invertebrate' (line 6). (2)
- e. Explain what is meant by the term 'population' (line 3). (2)
- f. Mention **TWO** selective pressures that could influence the activity of the molluscan *G. nivos*a. (2)
- g. What is the implication of having a species that 'has a very narrow geographical range...[and which is also] ... very rare on a regional scale'. (lines 9,10) Explain. (3)
- h. It is claimed that *G. nivos*a shows a preference for the upper strata in cobble and/or pebble beds due to factors other than predation. Give **THREE** possible explanations, mentioned in the text, for this. (3)
- i. Explain what is meant by 'ranging pattern' (line 25) and 'homing behaviour' (line 27). (4)
- j. (i) Give **ONE** anthropogenic factor, not mentioned in the text, which can lead to the decline of *G. nivos*a. (1)  
(ii) Explain how the factor given as an answer to part j (i) may lead to the decline of *G. nivos*a. (2)

**(Total: 25 marks)**

## SECTION B

**Answer any TWO questions from this section; your answers should take the form of essays. Each question carries twenty five marks.**

- 2 The autonomic nervous system is a control system that acts largely unconsciously. Comment on the main integrating centre of this system and discuss the structure and functions of its **TWO** main subsystems.
- 3 Even though deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) have different molecular structures, they both carry genetic information. **Briefly** describe the structures of both nucleic acids and explain **in detail** the characteristics of the genetic code.

*Questions continue on next page.*

- 4 It is possible that organelles such as the mitochondria and plastids were separate organisms that developed a symbiotic relationship with larger host organisms. Explain the evidence and implications of this statement.
- 5 Some metabolic pathways operate in cyclic ways. Describe in detail **THREE** metabolic cycles, highlighting the importance of such cycles.

**(Total: 50 marks)**

### SECTION C

Answer **ONE** question from this section.

- 6 Use your knowledge on evolution to distinguish between the following pairs:
- a. balanced and transient polymorphism; (5)
  - b. pre-zygotic and post-zygotic isolating mechanisms; (5)
  - c. stabilising and directional selection; (5)
  - d. allopatric speciation and sympatric speciation; (5)
  - e. genetic drift and gene flow. (5)
- 7 Use your knowledge of Biology to explain the following statements.
- a. The human eye is capable of detecting different colours. (5)
  - b. A community is a result of the relationship between different organisms. It is made of a number of species that complement one another whether spatially or temporally. (5)
  - c. Proteins within the cell membrane have different functions. (5)
  - d. The lac Operon is an inducible operon which regulates the encoding of enzymes required to metabolise lactose. (5)
  - e. Fluid is continuously leaking out of the capillaries; however, blood volume is still maintained. (5)

**(Total: 25 marks)**

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UNIVERSITY OF MALTA, MSIDA**

**MATRICULATION EXAMINATION  
ADVANCED LEVEL  
MAY 2017**

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<b>SUBJECT:</b>	BIOLOGY
<b>PAPER NUMBER:</b>	III
<b>DATE:</b>	10 <sup>th</sup> May 2017
<b>TIME:</b>	4.00 p.m. to 5.35 p.m.

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**Directions to Candidates**

- Write your index number in the space at the top left-hand corner of this page.
  - Answer all questions. Write all your answers in the spaces provided in this booklet.
  - The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.
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  - The use of electronic calculators is permitted.
- 

**For examiners' use only:**

<b>Question</b>	1	2	3	<b>Total</b>
<b>Score</b>				
<b>Maximum</b>	12	21	17	<b>50</b>

1 This question concerns classification.

a. This part concerns Figure 1 below:

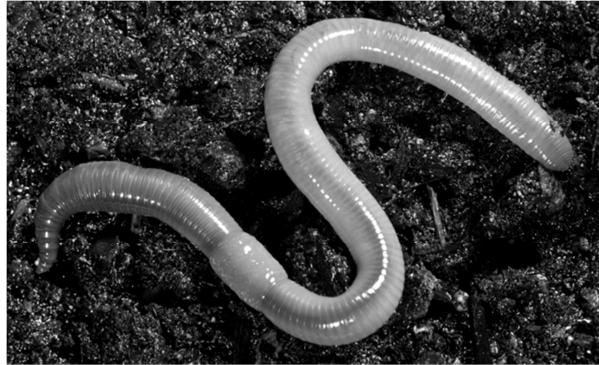


Figure 1

(Source: <http://static.guim.co.uk/sys-images/Guardian/Pix/pictures/2014/5/27/1401185342046>)

(i) Name the Phylum.

\_\_\_\_\_ (1)

(ii) Name the Class.

\_\_\_\_\_ (1)

(iii) Name and describe the segmentation exhibited by this organism.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

b. This part refers to Figure 2 below:



Figure 2

(Source: [https://farm8.static.flickr.com/7062/6965052021\\_9b1812c758\\_b.jpg](https://farm8.static.flickr.com/7062/6965052021_9b1812c758_b.jpg))

(i) Name the Phylum.

\_\_\_\_\_ (1)

(ii) Name the Class.

\_\_\_\_\_ (1)

(iii) Give **ONE** visible characteristic feature of this organism.

\_\_\_\_\_ (1)

*Question continues on next page.*

c. Answer the following questions on Figure 3 below:



Figure 3

(Source: [http://3.bp.blogspot.com/-WyiPtEq9Kmo/TsRHO7ZAgQI/AAAAAAAAAP1c/aFuw4rnA9wg/s1600/Eyprepocnemis\\_plorans\\_Albufera\\_151011.jpg](http://3.bp.blogspot.com/-WyiPtEq9Kmo/TsRHO7ZAgQI/AAAAAAAAAP1c/aFuw4rnA9wg/s1600/Eyprepocnemis_plorans_Albufera_151011.jpg))

(i) Name the Phylum.

\_\_\_\_\_ (1)

(ii) Name the Class.

\_\_\_\_\_ (1)

(iii) Organisms belonging to this phylum are characterised by tagmata. Identify the **THREE** tagmata of this organism.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (3)

**(Total: 12 marks)**



2 This question is about water potential in plants.

Water potential is the measure of potential energy in water and it is represented by the following equation:

$$\Psi_w = \Psi_s + \Psi_p$$

Where:

- $\Psi_w$  is the water potential;
- $\Psi_s$  is the solute potential and
- $\Psi_p$  is the pressure potential.

You are provided with the following apparatus and materials:

- 1 M sucrose solution;
- distilled water;
- 6 potato strips (each 2 mm thick and 5 mm long) cut from the same potato tuber;
- 6 test tubes;
- pipettes;
- mass balance;
- plotting paper;
- plastic paraffin film.

a. Describe how you would use these items to carry out an experiment aimed at measuring the water potential of potato parenchyma tissues.

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(7)

*Question continues on next page.*

- b. Mention **TWO** possible sources of error associated with this method.

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(2)

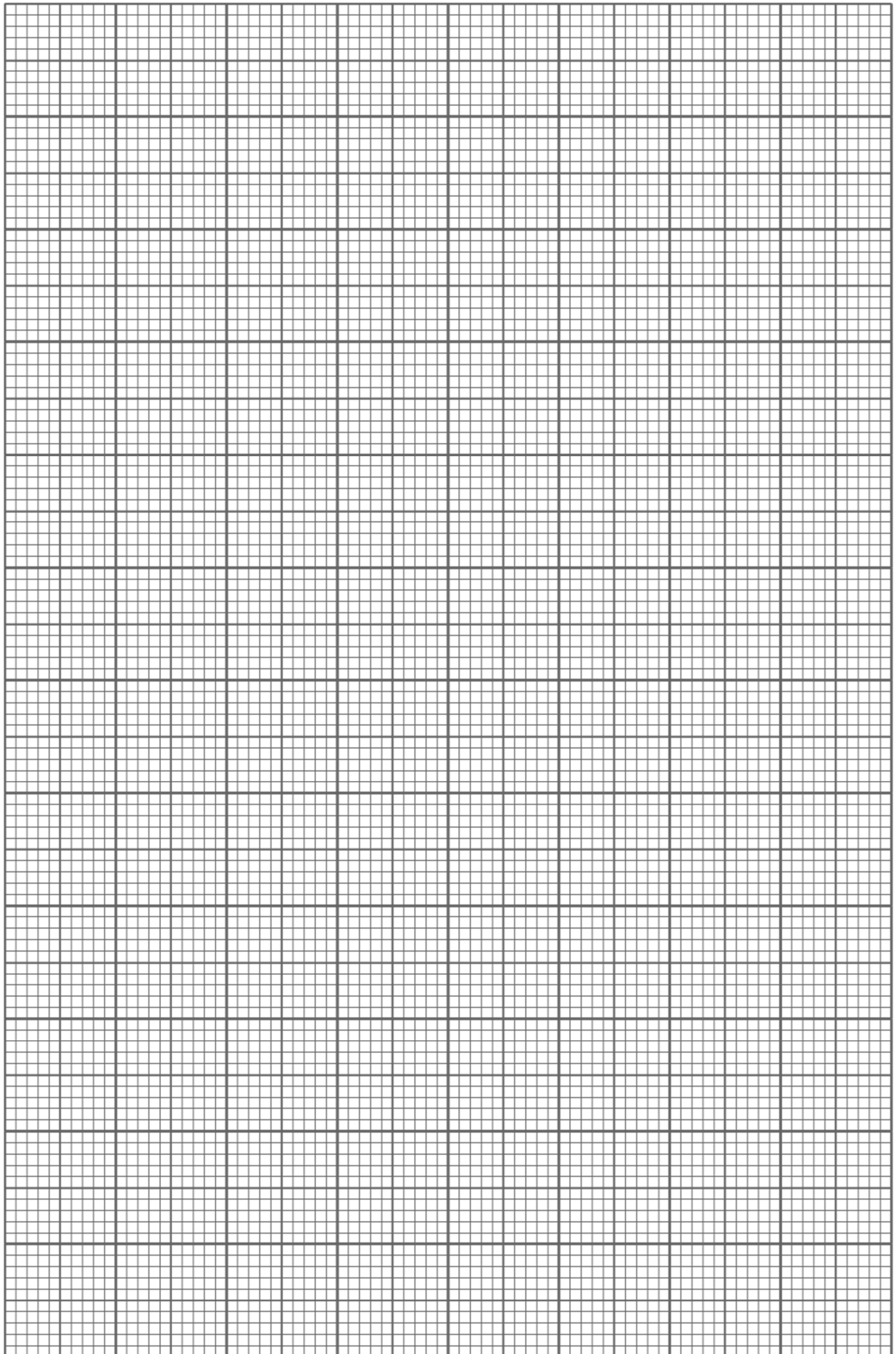
Table 1 shows the percentage change in potato weight recorded in this experiment, and the water potential values of the sucrose concentrations.

Table 1: Results showing percentage change in potato weight recorded and the water potential values of the sucrose concentrations.

Test Tube	Molarity of Solution	$\Psi_w$ (kPa)	% change in potato weight
A	0.00 M	0.000	15%
B	0.15 M	-0.366	7%
C	0.25 M	-0.609	4%
D	0.35 M	-0.853	0%
E	0.45 M	-1.100	-5%
F	0.55 M	-1.340	-12%

- c. Use the graph paper (next page) to plot a graph of the percentage change in weight of potato strips with the water potential values of the different solute concentrations used in this experiment. (5)

*Question continues on pages 7 and 8.*



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d. Increased potato weight occurs when potato parenchyma cells are put in hypotonic solutions.

(i) Explain this statement in terms of  $\Psi_w$  and  $\Psi_s$ .

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(2)

(ii) Use the graph to identify the hypotonic sucrose solutions.

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(1)

e. Using the experiment results shown in the graph, what can you deduce about the turgor pressure of the potato parenchyma cells put in test tubes E and F? Explain your answer.

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(2)

f. At which solute concentration are the parenchyma cell contents and the sucrose solution isotonic?

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(1)

g. Use the graph to determine the water potential of the potato parenchyma tissue used in this experiment.

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(1)

**(Total: 21 marks)**

3 This question is about enzymes.

Trypsin is a proteolytic enzyme that hydrolyses casein; one of the major milk proteins. This enzyme works best at pH range of 7.8 to 8.7. A white opaque suspension of powdered milk becomes translucent following complete hydrolysis by the enzyme. This reaction was used in an experiment to study the effect of different temperatures on the kinetics of casein – trypsin digestion.

The following two colour standards were prepared and labelled:

- Standard A, containing 5 cm<sup>3</sup> milk suspension and 5 cm<sup>3</sup> of distilled water, and
- Standard B, containing 5 cm<sup>3</sup> milk suspension and 5 cm<sup>3</sup> of dilute hydrochloric acid.

A water bath was set at 5 °C. One test-tube containing 5 cm<sup>3</sup> of milk suspension and one test-tube containing 5 cm<sup>3</sup> of enzyme solution were acclimatized in the water bath for 5 minutes. The enzyme solution was then mixed with the milk suspension and the mixture was incubated. The time taken for the end point of the reaction to be reached was noted. The procedure was repeated to obtain a more accurate estimate. The experiment was then carried out using five other different temperatures, and the time taken for the completion of the reactions was noted and tabulated in Table 2 below.

Table 2: Experimental results

Temperature (°C)	Time (T) to end point (minutes)			Rate of Reaction (1/T) (minute <sup>-1</sup> )
	1 <sup>st</sup> Reading	2 <sup>nd</sup> Reading	Average	
5	12.78	13.42	13.10	
20	1.50	1.54	1.52	
35	0.78	0.72	0.75	
50	0.75	0.87	0.81	
65	0.86	1.00	0.93	
80	no reaction after 20 minutes			

- a. Calculate the rate of the reaction for the different temperatures (as indicated in Table 2) and fill in your answers in the Table 2. (5)

*Question continues on next page.*

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b. What is the purpose of setting colour standards A and B?

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(2)

c. What colours would these standards show?

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(1)

d. State the reason for the separate acclimatization of the enzyme and the substrate prior to incubating them together.

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(1)

e. Sketch the pattern of the graph that emerges from the results in Table 2. Label the axes.



(2)

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f. Interpret these results in terms of the effect of temperature on enzyme action.

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(4)

g. How would you expect the casein-trypsin digestion to be affected if carried out in an acidic solution? Give reasons for your answer.

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(2)

**(Total: 17 marks)**

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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD  
UNIVERSITY OF MALTA, MSIDA

MATRICULATION EXAMINATION  
ADVANCED LEVEL  
MAY 2017

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**SUBJECT:** BIOLOGY  
**PAPER NUMBER:** IV – *Practical*  
**DATE:** 9<sup>th</sup> June 2017  
**TIME:** 1 hr 35 min

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**Directions to Candidates**

- Write your index number in the space at the top left-hand corner of this page.
  - Answer all parts of the question. Write all your answers in this booklet. Drawings of biological material and graphical representations of data are to be made on the appropriate pages within this booklet.
  - The marks allotted to parts of question are indicated.
  - You are reminded of the necessity for good English and orderly presentation in your answers.
  - In calculations you are advised to show all the steps in your working, giving your answer at each stage.
  - The use of electronic calculators is permitted.
- 

**For examiners' use only:**

<b>Question</b>	<b>Total</b>
<b>Score</b>	
<b>Maximum</b>	<b>40</b>

1. Vitamins are an integral part of a balanced diet. Many people consume fruit juices as there is a perception that fruit juices are rich in vitamins. Vitamin C, also known as ascorbic acid, is a vitamin that is normally found in fruit juices. The concentration of vitamin C in fruit juice can be measured using starch-iodine indicator. Vitamin C changes the colour of the starch-iodine indicator from blue to colourless.

You are required to devise and implement an experimental procedure to compare the level of vitamin C in different types of fruit juices.

You are provided with the following materials:

- starch-iodine indicator;
- 0.1% solution of ascorbic acid;
- orange juice;
- apple juice;
- pineapple juice;
- grapefruit juice;
- other laboratory apparatus as required.

**Candidates are advised to use 2 cm<sup>3</sup> of the fruit juice samples in this experiment.**

- a. What is the aim of your biological investigation?

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(1)

- b. Suggest suitable null and alternative hypotheses for this investigation.

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(2)



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- d. List and justify **TWO** precautions that should be taken before the start of the experiment.

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(4)

*Carry out the investigation that you devised and record the results in part (e).*

- e. Record your results in the space provided below. *Marks will be awarded for the structure and the organisation of the results obtained.*

(4)

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f. There is 1 mg vitamin C in 1 cm<sup>3</sup> of the vitamin C solution provided. Use this information to calculate the amount of Vitamin C found in each of the four juices.

(i) Orange juice:

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(2)

(ii) Apple juice:

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(2)

(iii) Pineapple juice:

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(2)

(iv) Grapefruit juice:

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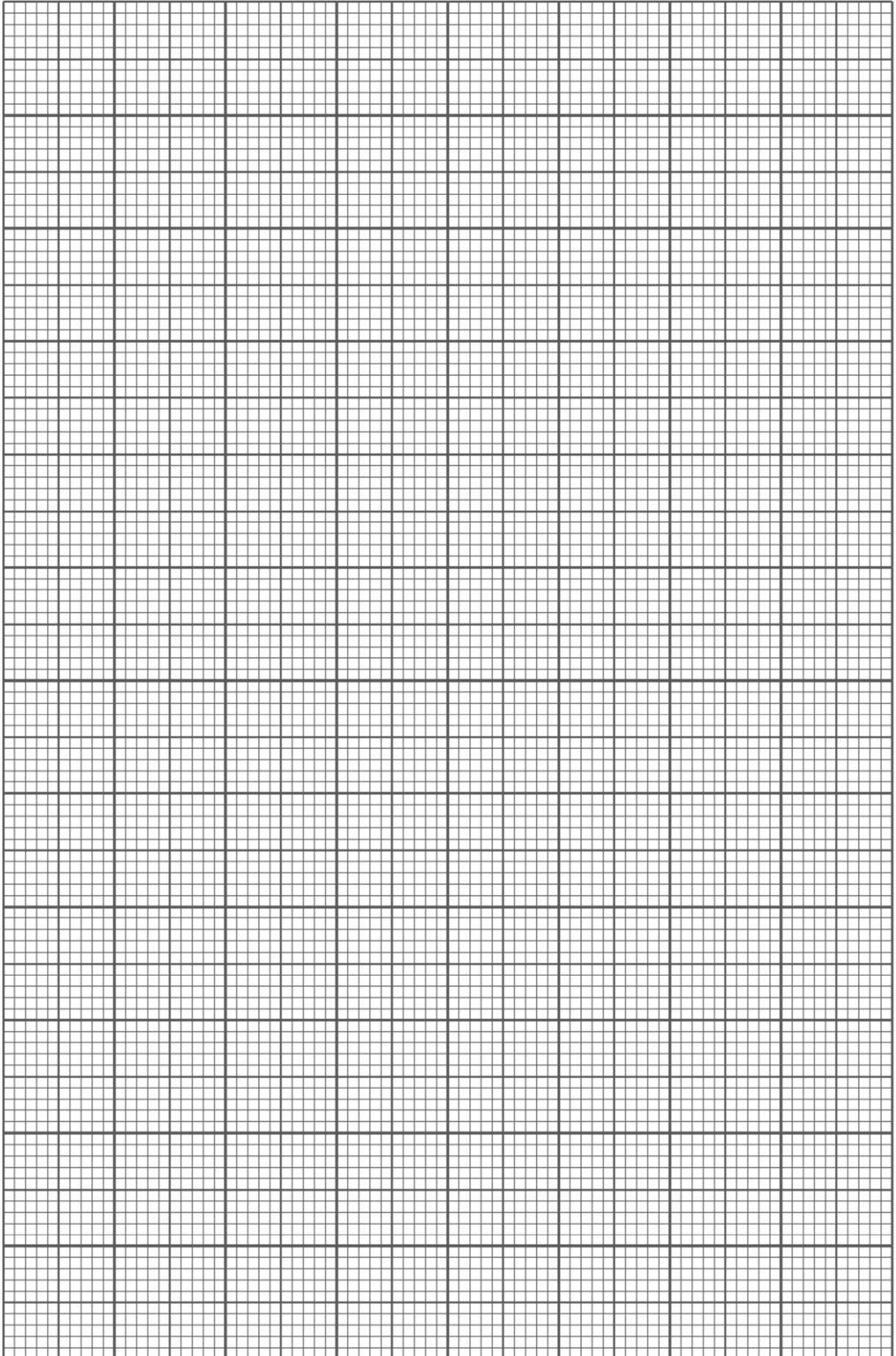
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(2)

*Question continues on next page.*

g. Use the graph paper below to draw a bar chart to represent your results.

(6)



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h. What conclusions can be drawn from the results?

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(3)

i. List **TWO** possible sources of error in your investigation.

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(2)

**(Total: 40 marks)**

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