SEVENOAKS SCHOOL

YEAR 9 (13+) SCHOLARSHIP

May 2023
for entry in September 2023

SCIENCE 1

Your Name: _____

Your School: _____

Time allowed: 1 hour

Equipment needed: Pen, pencil, and ruler.
You may use an eraser and a calculator if needed.

Information for candidates:

1. Write your name and school on this page.
2. Write all of your answers on the question papers in the space provided. If you need additional paper then please ask the invigilator. Please put your name on the sheets of paper you use.
3. The marks for each question or part question are shown in square brackets [ ] after the question.
4. Answer **ALL QUESTIONS**.
5. The total mark for this paper is 60.

BIOLOGY

Question 1

The cell in Figure 1 below contains structures which could be found in animal or plant **cells.**

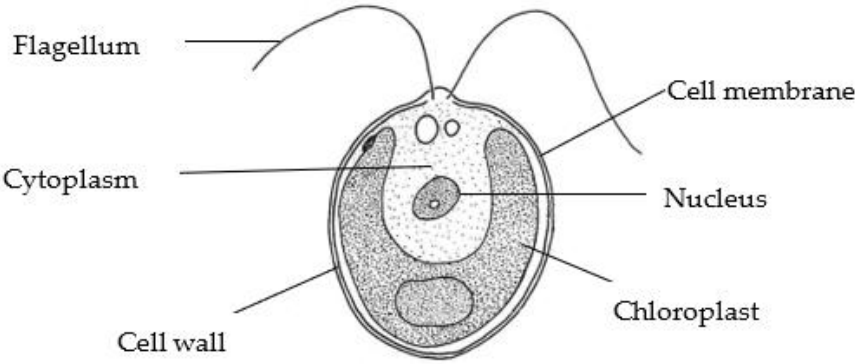


Figure 1: Structure of Chlamydomonas.
Adapted from http://www.biology-resources.com/drawing-chalmy-01.html

a. Using the diagram, identify one structure you would expect to find in a plant cell but not in an animal cell. [1]

_____

b. Using the diagram, explain whether this organism is a producer or a consumer. [3]

_____

_____

_____

Question 2

The nutrients in Figure 2 below are listed on a bottle of whole milk.

Typical Values	Per 100ml
Energy	276kJ / 66kcal
Fat	3.7g
Saturates	2.4g
Carbohydrate	4.7g
Sugars	4.7g
Fibre	0g
Protein	3.5g
Salt	<0.01g
Vitamin B12	0.30µg
Potassium	162mg
Calcium	124mg
Iodine	32.0µg

Figure 2: Nutrients in a bottle of whole milk.
Adapted from https://www.tesco.com/groceries/en-GB/products/252207566

a. The recommended daily intake of protein for an adult is 56g. An adult drinks a 200ml glass of whole milk. What percentage of their daily recommended intake of protein have they consumed? Use Figure 2 to help you and show your working. [3]

_____

_____

_____

b. Outline why proteins are an important dietary nutrient. [1]

_____

c. Ethanol can be used to test for fats. Outline the most important safety precaution that should be taken when using ethanol in a laboratory. [1]

_____

Question 3

Aquascaping is the craft of making an aquarium look beautiful. Some aquascapers like to include plant species with green leaves and plant species with red leaves in their aquaria. They also like to shine different coloured lights on their aquaria.

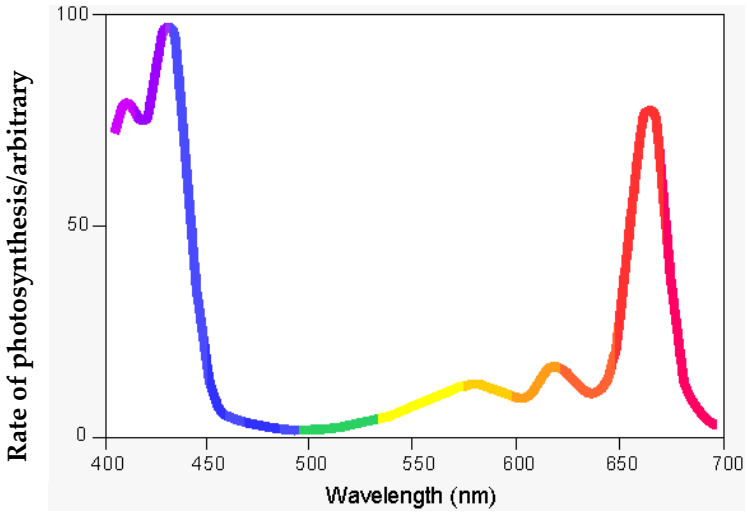
a. Plants need to photosynthesize to survive. Write the word equation for photosynthesis. [2]

_____

b. Name the green pigment plants use to absorb light for photosynthesis. [1]

_____

c. Figure 3 below shows the rate of photosynthesis at different colours (wavelengths) of light for this green pigment.



Colour	Approximate wavelength (nm)
Violet	400 - 440
Blue	440 – 490
Green	490 – 530
Yellow	530 – 575
Orange	575 – 650
Red	650 - 700

Figure 3: Action spectrum for the green pigment.
Adapted from https://www.ch.ic.ac.uk/local/projects/steer/chloro.htm

(i) Identify the colour of light at which photosynthesis happens at the slowest rate. [1]

_____

(ii) A different pigment is responsible for the red colouration of leaves in some species. Explain whether the plant species with red leaves would survive better with a red light shining on it or a green light shining on it. [3]

_____

_____

_____

Question 4

Figure 4 below shows a bell jar model of the human ventilation system.

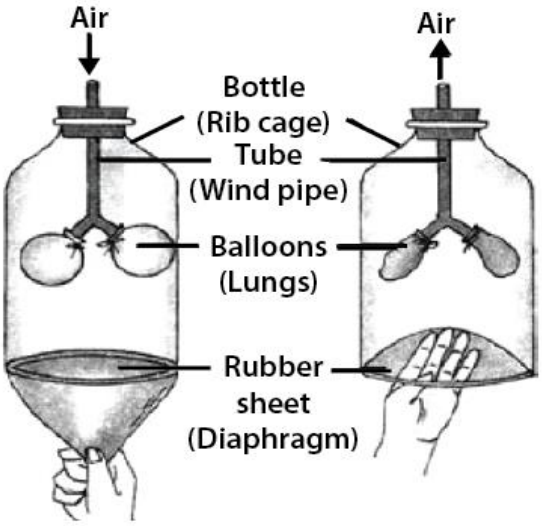


Figure 4: The bell jar model.
Adapted from https://www.toppr.com/ask/en-pk/question/the-given-figure-shows-a-model-demonstrating-the-mechanismof-breathing-what-is-incorrect-about-the/

a. Discuss whether this is a good model to show the process of breathing in humans. [4]

Total for BIOLOGY: 20 marks

CHEMISTRY

Question 1

The burning of fuels has been, and continues to be, an essential part of human survival and society. Burning is a chemical process in which a fuel combines with oxygen.

a. What type of chemical reaction is the burning of a fuel? [1]

_____

b. Gasoline/petrol is a hydrocarbon fuel whose principal chemical component is the compound octane.

(i) What is meant by the term *compound?* [2]

_____

_____

(ii) State the names and molecular formulas of two compounds produced when octane, C_8H_{18}, is burned in air. [2]

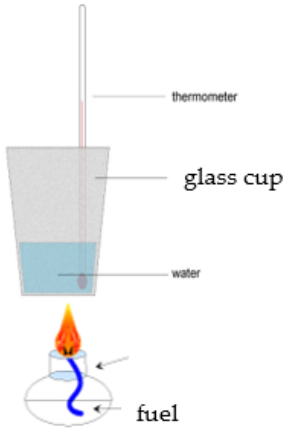
_____

_____

(iii) Under certain conditions, soot may be produced when octane is burned. This produces an orange and smoky flame. Suggest the conditions under which this might occur? [1]

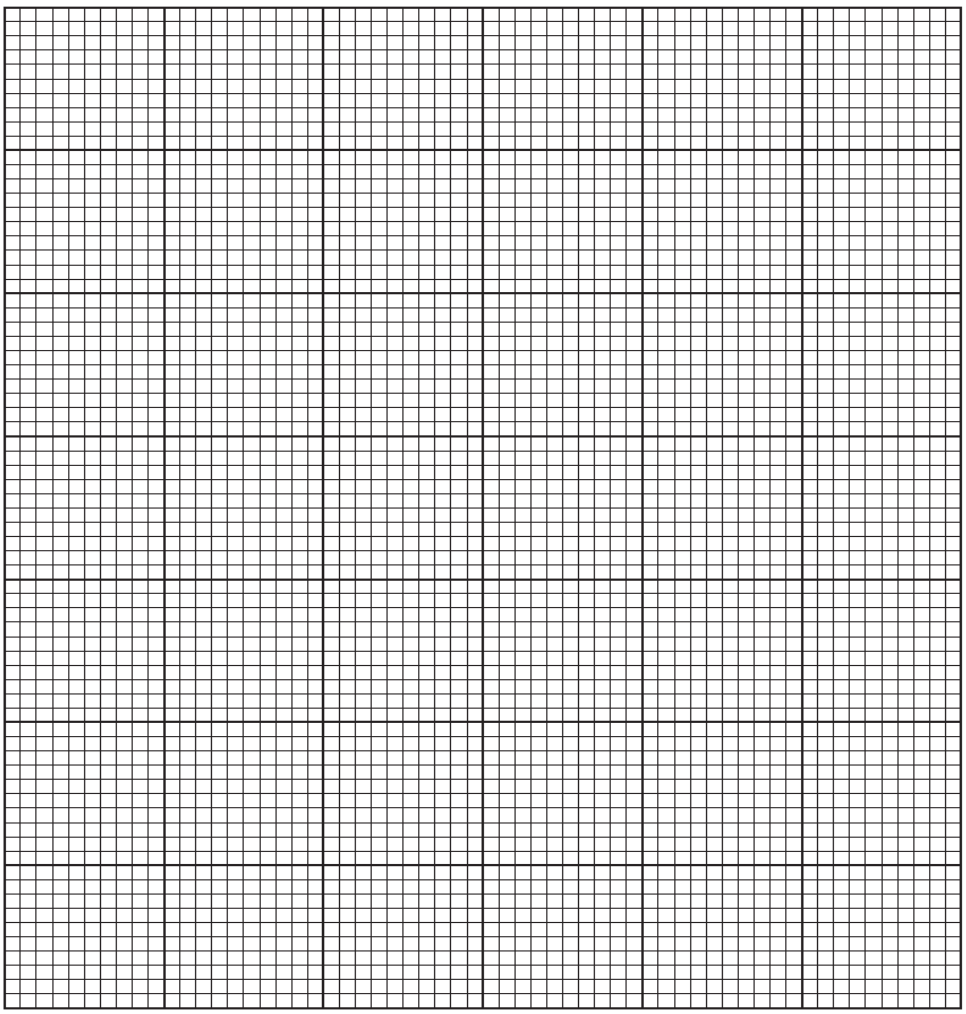
_____

c. Burning fuels releases large amounts of heat energy. The amount of heat energy released can be measured using the apparatus below:



0.8 g of ethanol is completely burned using the apparatus shown above, with a glass cup filled with 100 g of water. The temperature of the water is recorded over a 30 second period. The flame is extinguished after 30 seconds.

(i) Plot a suitable graph showing the temperature versus time and add an appropriate line of best fit. [5]



Time (s)	Temperature (°C)
0	20
5	32
10	41
15	45
20	47
25	47
30	47

(ii) Determine the temperature change of the water sample, ($\boldsymbol{\Delta T}$), using your graph. [1]

_____

(ii) Calculate the rate at which the temperature changes during the first 5 seconds of the experiment. Include the units. [2]

_____

_____

(iii) State and explain what would happen to the temperature recorded if more measurements were taken beyond 30 seconds? [2]

_____

_____

The following equation can be used to find the amount of heat energy released by a fuel.

$q = m \times c \times \Delta T$

q is the amount of heat energy released in joules
m is the mass of water heated in grams
c is the specific heat capacity of water (4.2 J/g/°C)
ΔT is the temperature change of the water in °C

(iv) Using the equation provided, calculate the total heat energy released **per gram** of ethanol burned. [2]

_____

_____

(v) A student discovers that their answer to (v) is only about 30% of the true value for the amount of heat energy released. Suggest a reason why the experimental value calculated is so much lower than the expected value. [1]

_____

_____

(vi) Suggest an improvement that could be made to achieve a more accurate experimental value. [1]

_____

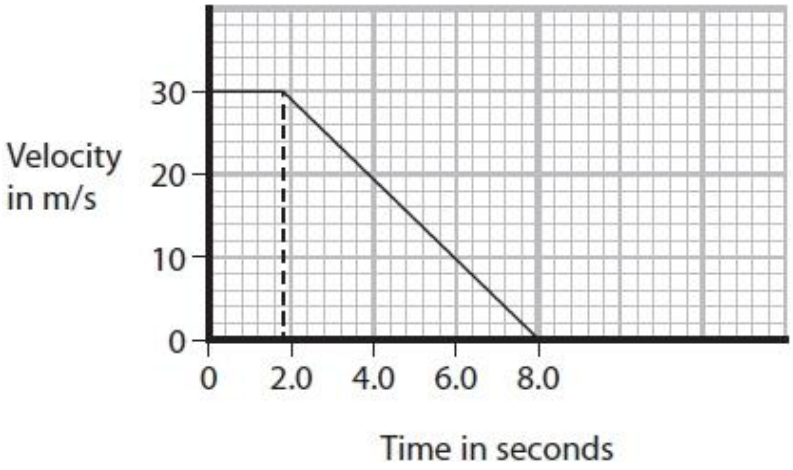
_____

Total for CHEMISTRY: 20 marks

PHYSICS

Question 1

The diagram shows a velocity-time graph for a car from the time the driver sees an obstacle in the road until the car comes to rest.



a. Calculate the acceleration of the car between 1.8 and 8.0 seconds. [2]

_____

_____

acceleration = _____ m/s^2

b. Calculate the braking distance of the car. [2]

_____

_____

braking distance = _____ m

c. Explain the effect, if any, of increased driver tiredness on the thinking distance and on the braking distance of the car. [2]

thinking distance

_____

_____

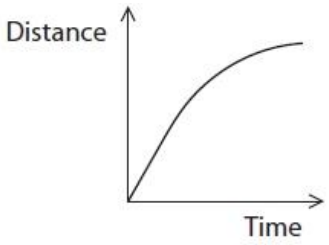
braking distance

_____

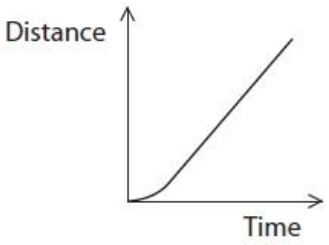
_____

d. Which of these represents the distance-time graph for the car? [1]

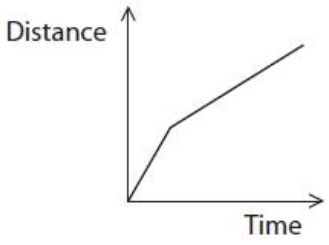
☐ **A**



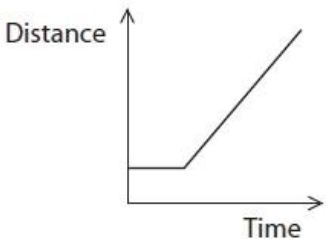
☐ **B**



☐ **C**

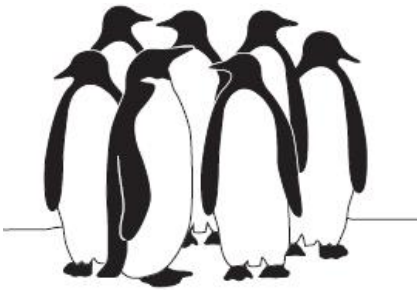


☐ **D**



[Total for question = 7 marks]

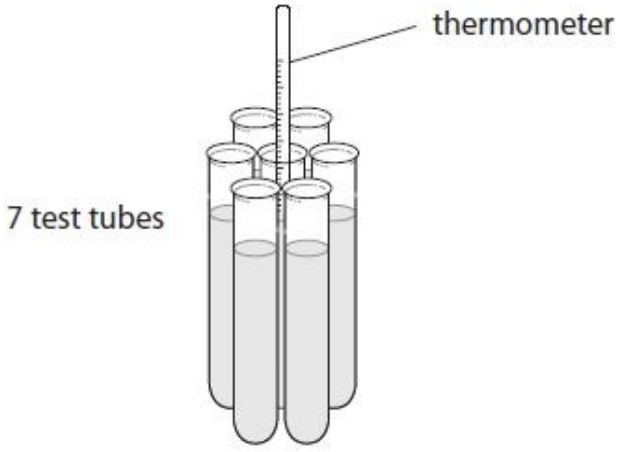
Question 2



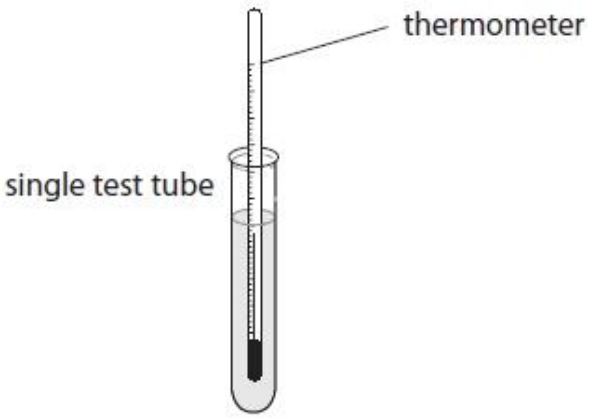
Penguins have adapted to survive in cold conditions.

The adaptations help them to maintain a constant body temperature of 39 °C. Penguins also crowd together in groups of many penguins.

A student wants to investigate how the temperature of a penguin is affected when they crowd together in groups.
She uses this apparatus.
Each test tube represents a penguin.



represents a huddle of 7 penguins



represents a single penguin

a. These statements describe the method she should use but the statements are in the wrong order.

Put them into the correct order by numbering the boxes.
Some have been done for you. [3]

Statements	Order
record the data in a table	8
take the temperature of the two test tubes	
tie 7 test tubes together	1
heat the water to 90 °C	2
take the temperatures every minute	
place equal volumes of water in all test tubes	
put thermometers into the middle test tube and single test tube	
record data for 15 minutes	

b. The student draws a table to record her results.
Add suitable headings to her table. [2]

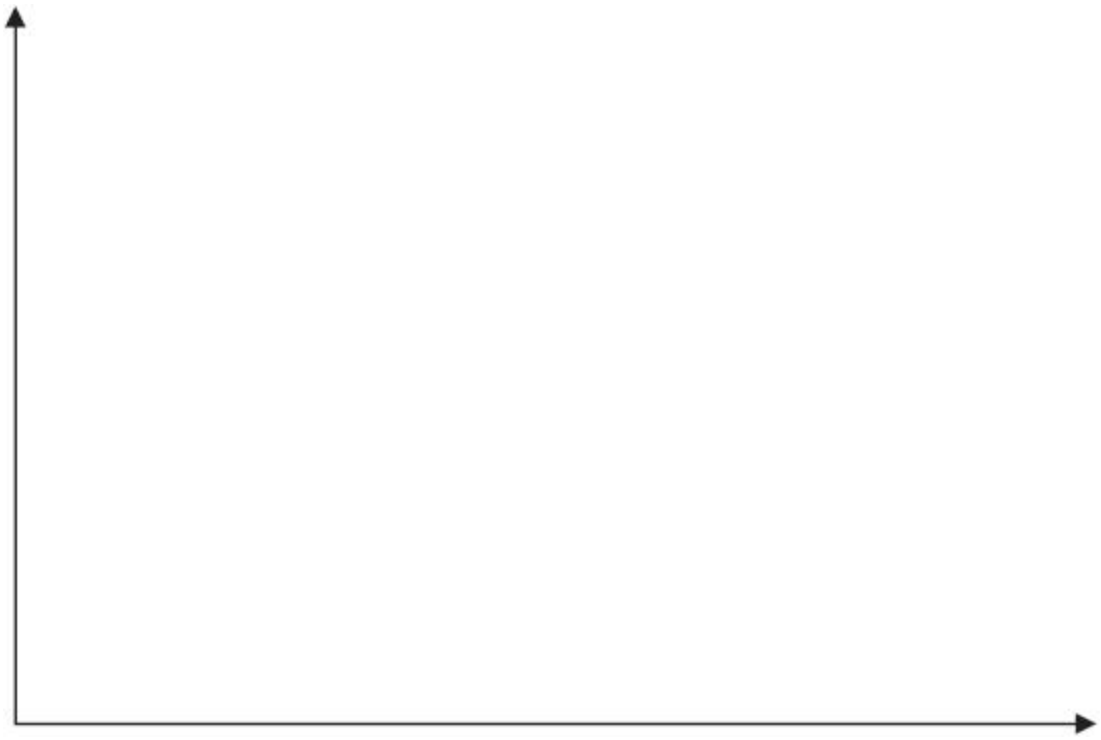
Time/	.....	
	.....	.....

c. Predict how the temperature change for the single test tube will differ from the temperature change for the group of test tubes. [1]

_____

_____

d. Draw a sketch graph of the results you predict the student will obtain.
Remember to name both axes, put suitable units and draw two lines on the graph: one for the huddled penguin and one for the single penguin. Clearly show which one is which. [4]



e. Explain your prediction using ideas about thermal energy transfer. [3]

Total for PHYSICS: 20 marks