SEVENOAKS SCHOOL



YEAR 9 (13+) SCHOLARSHIP

May 2021 for entry in September 2021

SCIENCE 2

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 45.

PHYSICS

Question 1

1. The diagram shows a simple machine for lifting water from a river. The horizontal bar is cylindrical and you may assume that it has no weight.



a. Calculate the turning force (moment) of the bucket of water. (Show your working.) [2]

Answer _____

b. Calculate the size of the downwards force the operator must use to balance the bucket of water. [2]

c. So far, you have assumed that the horizontal bar is weightless. Calculate what its density would have to be if the operator did not need to apply any force at all to balance the bucket of water. Show all your steps clearly. (Radius of bar = 4cm) [5]

Question 2

A bowling ball (of mass 6kg) is dropped from a very high bridge into a deep lake. Describe the forces acting on it and how they influence its acceleration and velocity throughout the entire journey from being held on the bridge until it lays at rest at the bottom of the lake. [6]



BIOLOGY

Question 1

Stanley wanted to investigate whether germinating seeds produce heat. He set up the following experiment using two vacuum flasks which are insulated and non-transparent. The flask on the left contained boiled (dead) seeds and the flask on the right contained germinating seeds. He measured the temperature inside both flasks at the start and after 12 hours.



a. Describe and explain the expected results from the flask containing germinating seeds. [3]

b. Why was it important to use insulated flasks for this experiment? [2]

c. Why did Stanley include the flask containing boiled seeds in this experiment? [2]

In a second experiment, Stanley used the following apparatus with hydrogen carbonate indicator.



Hydrogen carbonate indicator has a red colour. When carbon dioxide increases, it turns yellow and when carbon dioxide decreases it turns purple. The apparatus was set up and after 12 hours the hydrogen carbonate indicator turned yellow.

d. Explain why the indicator turned yellow. [2]

e. Why was the soda lime used to absorb carbon dioxide in this experiment? [1]

Question 2

The following image shows two cheek cells viewed using a microscope.



Cells are measured using units called micrometres (μ m) and one millimetre is equal to 1000 micrometres. The magnification of this image is x 800.

a. Calculate the diameter (at the widest point) of the bottom cell in the diagram. Show your working including the measurement you take on the image. [4]

b. Suggest what the numerous small structures labelled X are in the image. [1]

Total for BIOLOGY: 15 marks

CHEMISTRY

Question 1

Anjali carried out an investigation into the reactivity of metals by adding different powdered metals to 25 cm³ of copper sulfate solution in a polystyrene cup.

In the first experiment she measured the initial temperature of the copper sulfate solution, added zinc powder, stirred rapidly and then measured the maximum temperature reached. The results of her experiment are shown in the thermometer diagrams.

Initial temperature /°C Maximum temperature /°C Maximum temperature /°C 1 1 60 55 20 50

a. State the initial and maximum temperatures in this experiment, giving your answers to one decimal place:

Initial temperature _____

Maximum temperature _____

b. Anjali then repeated the experiment with magnesium powder and iron powder. The results are shown in the table.

Metal	Initial temperature /°C	Maximum temperature /°C
magnesium	22.0	69.0
iron	23.0	38.0

i. Work out the change in temperature for each experiment:

Metal	Change in temperature /°C
zinc	
magnesium	
iron	

[1]

The amount of heat energy given out in each experiment can be worked out using the formula

Heat energy evolved (kJ/mol) = $\frac{25 \times 4.18 \times temperature change}{0.020 \times 1000}$

ii. Calculate the heat energy evolved in each experiment. [2]

Metal	Heat energy evolved / kJ/mol
zinc	
magnesium	
iron	

iii. Plot these data as a bar chart on the grid provided. [3]



iv. Explain what these results tell you about the three metals. [1]

v. The literature value for the heat evolved when zinc reacts with copper sulfate solution is 210 kJ/mol.

Suggest **one** reason why the value that Anjali calculated from her experiment is lower than the literature value. [1]

Question 2

Yi Jun carries out an investigation into limestone, which is mostly calcium carbonate (CaCO₃).

a. Yi Jun put some limestone into a beaker of hydrochloric acid. The total mass of the beaker, hydrochloric acid and limestone at the start of the experiment was 102.5 g.



i. Explain whether the reading on the balance will go up, down, or stay the same as the experiment proceeds. [2]

ii. The student tested the solution in the beaker with universal indicator paper at the beginning and end of the experiment. There was still some limestone left in the beaker at the end of the experiment.

State the colour of the universal indicator paper at the beginning and end of the experiment. [1]

Colour at beginning _____

Colour at end _____

b. The photograph below shows part of a limestone statue. Explain what form of pollution could have caused the damage to the statue and how this pollution arises. [3]



Total for CHEMISTRY: 15 marks

END OF PAPER