## SEVENOAKS SCHOOL

## YEAR 9 (13+) SCHOLARSHIP

May 2023<br>for entry in September 2023

## SCIENCE 2

Your Name: $\qquad$
Your School: $\qquad$

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 .

## BIOLOGY

## Question 1

A population is the number of individuals of the same species in an area at a point in time. The Lincoln Index equation below can be used to estimate the size of a species' population. In this sampling technique, individuals are captured, marked, released back into the population and recaptured. The results are input into the equation to estimate the population size.

Total population estimate $(N)=$
Number of individuals first marked and released $\times$ Number of individuals captured in second sample
Number of marked individuals captured in second sample
a. A student used this sampling technique to estimate the population size of Roman snails (Helix pomatia) in a local woodland area. The tally chart below shows the data they collected.

| Capture number | Number of marked individuals in <br> sample | Number of unmarked individuals in <br> sample |
| :--- | :--- | :--- |
| 1 | None to start with | H HIIII |
| 2 | HI | H HIII |

Use the Lincoln Index equation and the student's tally chart results below to estimate the population size of the Roman snails in this woodland.
$\qquad$
$\qquad$
$\qquad$
b. The student chose some brightly coloured paint to mark the snails. A dot of paint was placed on the shell of the snail. Suggest one advantage and one disadvantage of using brightly coloured paint to mark the snails. [2]

Advantage: $\qquad$

Disadvantage: $\qquad$

## Question 2

Ignaz Semmelweis was a Hungarian scientist. He worked in a Viennese hospital in the mid1880s. He collected the data in Figure 5 below on two maternity clinics running at the hospital. These clinics looked after women giving birth.

| Clinic |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
|  | 1841 | 1842 | 1843 | 1844 | 1845 |
| 1 | 7.8 | 15.8 | 9.0 | 8.2 | 6.9 |
| 2 | 3.5 | 7.6 | 6.0 | 3.2 | 2.0 |

Figure 5: Puerperal fever mortality rates for the First and Second Clinic at the Vienna General Hospital 1841-1845. Adapted from https://en.wikipedia.org/wiki/Ignaz_Semmelweis
a. Semmelweis was concerned about a difference between the two clinics. Use the data provided in Figure 5 to deduce what concerned Semmelweis. [1]
b. The only major difference between the two clinics was the people who worked there. Clinic 1 was run by medical students who assisted women in childbirth as well as looking after other sick patients. Clinic 2 was run by midwives who only assisted women giving birth.

Using this information, suggest a hypothesis for the difference between the two clinics.
$\qquad$
c. Semmelweis asked the medical students to wash their hands and equipment before looking after the women in maternity clinic 1 . The graph below shows the results of his intervention.


Figure 1: Results of Semmelweis' handwashing intervention. Adapted from https://www.slideshare.net/themassmaker/semmelweiss-ms

Antibiotics are medicines that kill bacteria. They were discovered in the late 1880 s. Some bacteria are resistant to antibiotics, which means that they can survive exposure to antibiotics.
d. Name a bacterial disease. [1]
e. Predict the impact antibiotics would have had on Semmelweis' clinics had he been able to use them. [1]
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f. Explain the disadvantages of antibiotics as a scientific development. [4]
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$\qquad$

Total for BIOLOGY: 15 marks

## CHEMISTRY

## Question 1

Acid-base indicators are used to identify whether a solution is acidic or alkaline. Many acidbase indicators can be obtained from naturally occurring sources such as berries and other fruits.
a. Describe how you might obtain an aqueous solution of an indicator from some blueberries. Include the names of essential pieces of apparatus. [5]
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$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
b. Outline a simple experiment that could be used to demonstrate that the indicator produced in part (a) is able to help distinguish acidic solutions from alkaline solutions. [2]
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$\qquad$
$\qquad$
c. Complete the following word equation:

Sodium + sulfuric acid $\rightarrow$ $\qquad$

## Question 2

Atmospheric pollutants pose a major problem for the environment. Two of the main culprits are the gases carbon dioxide and sulfur dioxide.

Complete the table below by providing the following information about each gas: [6]
(i) the environmental problem it causes
(ii) the process that produces each gas
(iii) a suitable method for reducing the production or impact of each gas

| Name of Gas | Environmental <br> problem | Source | Method to reduce production <br> or impact |
| :--- | :--- | :--- | :--- |
| Carbon dioxide |  |  |  |
| Sulfur dioxide |  |  |  |

Total for CHEMISTRY: 15 marks

## PHYSICS

## Question 1

a. Describe in detail an experiment to investigate the shape and direction of a magnetic field pattern around a permanent bar magnet. You may draw a diagram to help your answer. [5]
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$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
b. The diagram shows two bar magnets.

Complete the diagram to show the shape of the magnetic field pattern and its direction. Include at least 10 field lines to gain full marks. [4]

| $N$ |
| :--- |

## Question 2

A parachutist jumps from a plane at "A" and accelerates downwards until he opens his parachute at " $B$ ".

He then slows down until " C ", from which point he falls at a constant speed all the way back to the ground.

Describe the energy transfers taking place during the entire journey from " $A$ " to the ground. [6]
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