



OUNDL

School

2017 Academic Scholarship

Science

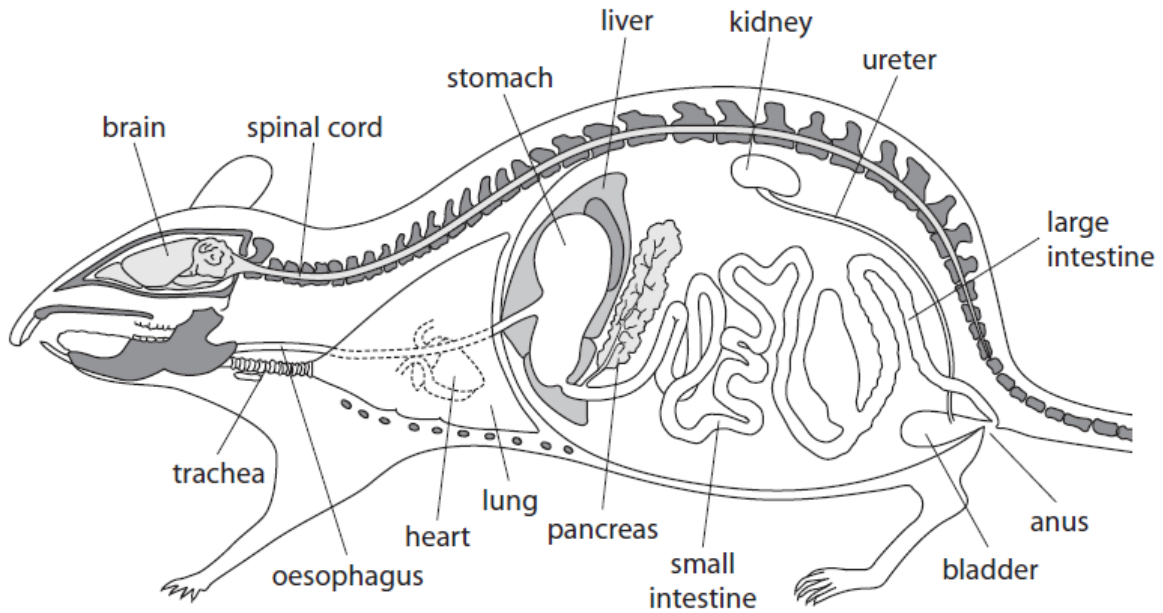
Theory Paper

Time Allowed: **1 hour**

Name:

Biology Section

1. The picture below shows the insides of a rat.



a. There are lots of different organs and structures labelled on the diagram. Can you name **three** organ systems that have all or part of their components named.

.....
.....
.....

(3)

b. What evidence in the diagram suggests that the rat is a vertebrate?

.....
.....

(1)

c. What evidence in the diagram suggests that the rat is a mammal?

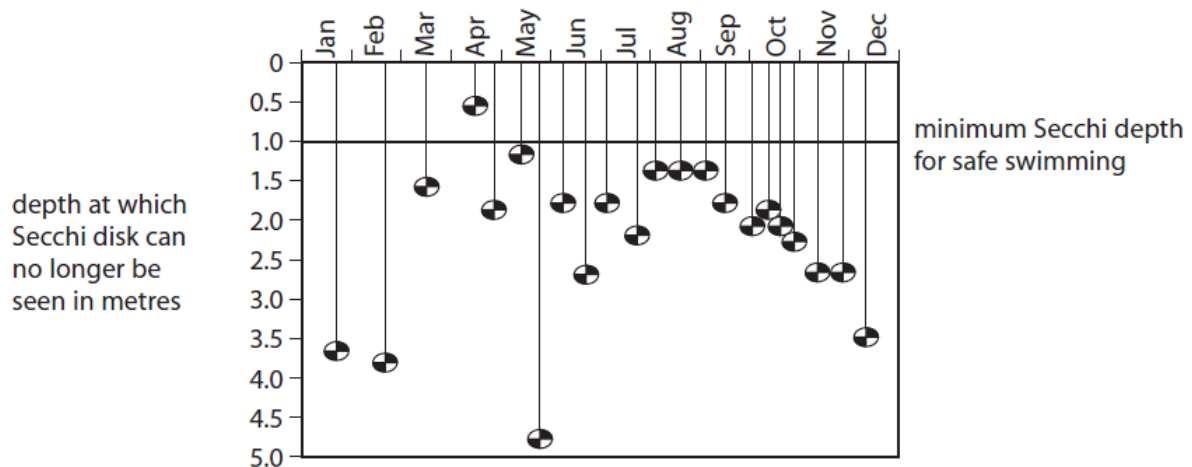
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(1)

2. Secchi disk is a black and white disc that can be lowered into lakes from a boat. An observer then records at what depth the disc cannot be seen.

A good indicator of water pollution is how cloudy the water is. The more cloudy it is, the more pollution and so the disc disappears at a shallower depth.

The data below was taken from a lake in the UK that is popular with swimmers. Polluted lakes can be dangerous to swim in as they contain microorganisms that can cause diseases.



- a. Name a type of microorganism that can cause diseases

..... (1)

- b. How many samples were taken in total from January to December?

..... (1)

- c. Why were there more samples taken during some months than others?

.....

 (1)

3. The table below shows some data about smoking and the diseases it can cause.

Cause of death	Total number of deaths	Number of these deaths caused by smoking
cancer	66 000	38 000
lung diseases	46 000	22 000
circulatory diseases	138 000	20 000

a. What was the total number of recorded deaths from smoking?

.....
(1)

b. What percentage of deaths resulted from lung diseases? Please show your working.

.....%
(2)

c. One row refers to 'circulatory diseases'. Can you name an organ that might be affected by smoking which would be part of this category?

.....
(1)

4.

- a. Plants photosynthesis and produce a sugar (carbohydrate). What is the name of the carbohydrate they produce and what can it be used for?

Name

Use

(2)

The image shows part of a bean plant that is being eaten by aphids. In turn, the aphids are eaten by ladybirds. The aphids insert their mouthparts into the tissue that transports carbohydrates around the plant. They then consume the carbohydrate themselves.



- b. What effect do you think a lot of aphids would have on the growth of the plant? Please explain your answer.

Effect on growth of plant?

.....

Explanation

.....

.....

(3)

- c. In the space below, draw a simple food web for the three organisms described in the question.

(3)

Marks for Biology Section = 20 marks

Chemistry Section

1. Calcium carbonate, CaCO_3 , is commonly known as limestone.

a. Calcium carbonate will react with acids, give the chemical name of an acid calcium carbonate will react with.

.....
(1)

b. What is the pH of a strong acid?

.....
(1)

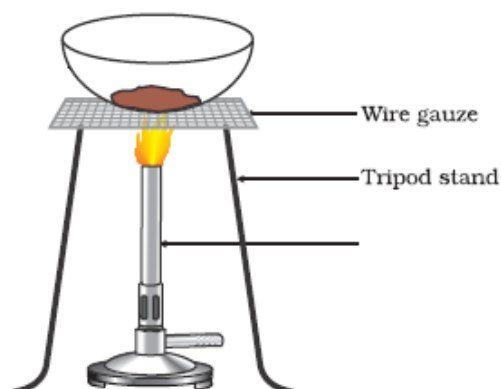
c. When an acid and calcium carbonate are mixed a colourless gas is given off. One student suggests that the gas is oxygen. Give the chemical formula of oxygen gas.

.....
(1)

d. Describe the laboratory test you could perform to identify the gas as oxygen.

.....
.....
.....
.....
.....
.....
(2)

2. The diagram shows the reaction of copper oxide and magnesium.



a. What is the name of the piece of apparatus that is used to heat the reaction?

.....
(1)

b. What type of reaction is occurring in this experiment?

.....
(1)

c. Give the name of the products of this reaction?

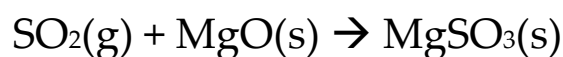
.....
.....
(2)

3.
a. Sulfur and Magnesium are two different elements with different characteristics.

Question	Sulfur	Magnesium
Is its oxide acidic or basic?		
Is it an electrical conductor or insulator?		
Is it a metal or a non-metal?		

(2)

Sulfur dioxide is a pollutant and can be removed from waste gas streams by reaction with a wet magnesium oxide 'slurry' as follows:



- b. What type of reaction is this?

.....
(1)

- c. The product of this reaction is called magnesium sulfate(IV). What state is the magnesium sulfate(IV)?

.....
(1)

- d. Suggest a formula for the compound lead sulfate(IV)?

.....
(1)

- e. Magnesium sulfate (IV) can be reacted with oxygen gas to make magnesium sulfate(VI), MgSO_4 . Give a balanced chemical equation for this reaction.

(2)

Marks for Chemistry Section = 16 marks

Physics Section

- Jonathan wants to investigate the depth of the well at the bottom of his garden (Figure 1). He decides to drop a stone into well and count how long it takes to hit the water.

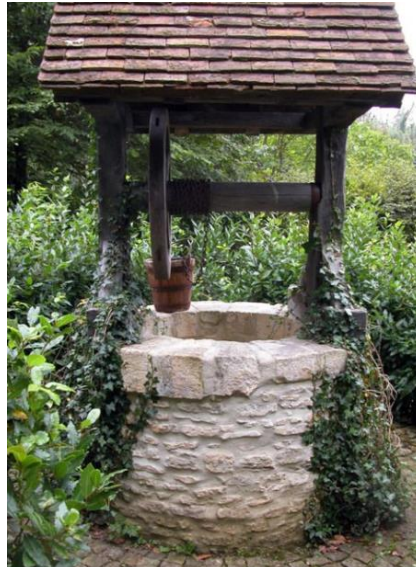


Figure 1: Water Well

- Describe the motion of the stone after it leaves Jonathan's hand in as much detail as possible.

.....

.....

.....

.....

.....

.....

b. Describe the forces acting on the stone. Consider the size, direction and type of forces acting.

.....

.....

.....

.....

.....

.....

.....

(3)

c. Describe the energy changes that take place as the stone falls.

.....

.....

.....

.....

.....

.....

(2)

- d. In order to determine the depth accurately Jonathan decides to drop four stones to improve the reliability of his results. The results he obtained are recorded in the table below.

Drop 1	Drop 2	Drop 3	Drop 4	Average time
2.18s	2.20s	1.18s	2.34s	

Calculate the average time for the stone to reach the bottom of the well. Show and explain your working and complete the table above.

.....

.....

.....

(2)

- e. Jonathan takes his results to school and asks his physics teacher for help with the calculation. Mr Sadler gives Jonathan the following formula to calculate the depth of the well.

$$D = \frac{1}{2} \times g \times (t^2)$$

where:

D is the depth of the well in metres

g is the acceleration due to gravity on Earth = 10m/s^2

t is the time it takes for the stone to hit the water

Using your result from part (d) calculate the depth of the well.

Depth of well =m
(2)

f. Use your depth to calculate the average speed of the stone. Give the correct unit.

Average speed = unit =
(2)

g. After a long wet winter Jonathan's grandfather tells him that the depth of the well is now only 15 metres. He returns to the well to perform the same experiment. Calculate how long will it take for the stone to hit the water now.

Time =s
(2)

2. In the simple circuit (Figure 2.1) a 12 volt battery is in series with a 24 ohm resistor and two meters that measure the current at that point in the circuit.

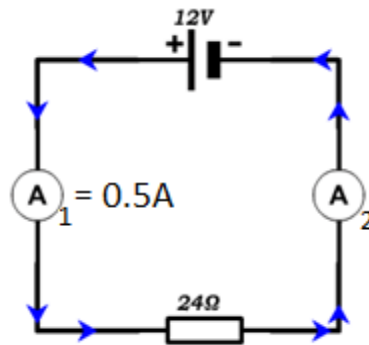


Figure 2.1

- a. What is the name of the component that measures electrical current in a circuit?

.....
(1)

- b. If the current at position 1 (A_1) is 0.5amps what is the current at position 2 (A_2)?

$A_2 = \dots\dots\dots A$
(1)

- c. A second identical battery is added to the original circuit (Figure 2.2) calculate the current in the circuit

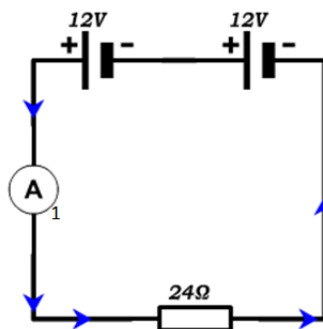


Figure 2.2

$A_1 = \dots\dots\dots A$
(1)

- d. A second identical resistor is added in series to the original circuit (Figure 2.3) calculate the current in the circuit.

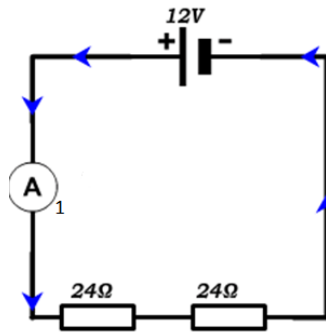


Figure 2.3

$A_1 = \dots\dots\dots A$
(1)

- e. A new circuit is built (Figure 2.4) with three identical resistors and three identical batteries.

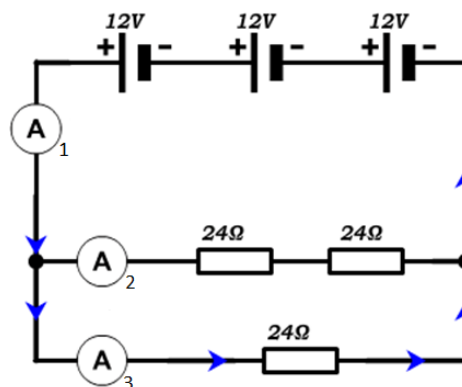


Figure 2.4

Complete the table below with current values at the positions labelled in the circuit diagram.

Meter position	Current / A
A ₁	
A ₂	
A ₃	

(2)

Marks for Physics Section = 22 marks