OUNDLE

School

2020 Academic Scholarship

Science

Theory Paper

Time Allowed: **1 hour**

Name: ……..

Instructions

- Answers are to be written on the question paper
- Calculators may be used
- Marks are show in the brackets by each question

Biology Section

1. The photograph shows the Californian puffball.
   This is a type of fungus.

a. Which of the following is the correct way of writing the binomial name of the Californian puffball?
   Put a cross (X) in the box next to your answer.

- ☒ **A** LYCOPERDON PERLATUM
- ☒ **B** lycoperdon perlatum
- ☒ **C** *Lycoperdo nperlatum*
- ☒ **D** *lycoperdon Perlatum*

(1)

b. Which row of the table shows the correct description for a binomial name?
   Put a cross (X) in the box next to your answer.

	first part of binomial name	second part of binomial name
☒ **A**	genus	species
☒ **B**	species	genus
☒ **C**	kingdom	species
☒ **D**	kingdom	genus

(1)

c. Describe the main characteristics of the cells of organisms in the kingdom Fungi.

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(2)

d. Describe how organisms in the kingdom Fungi feed.

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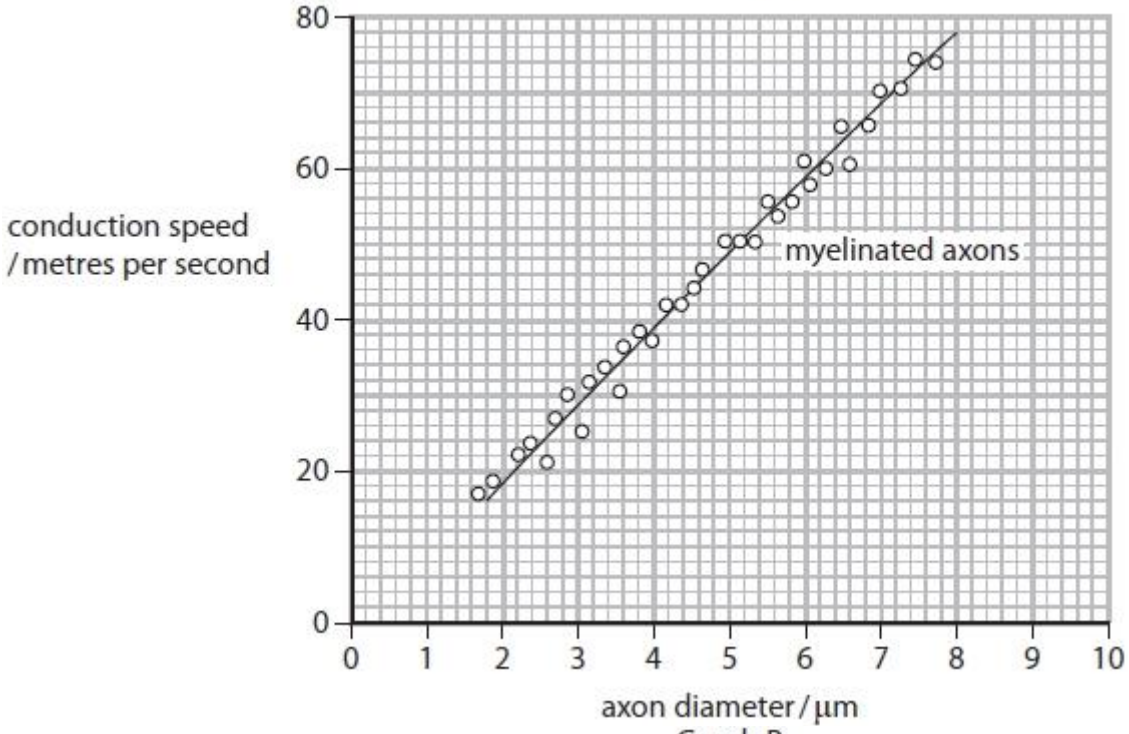
(2)

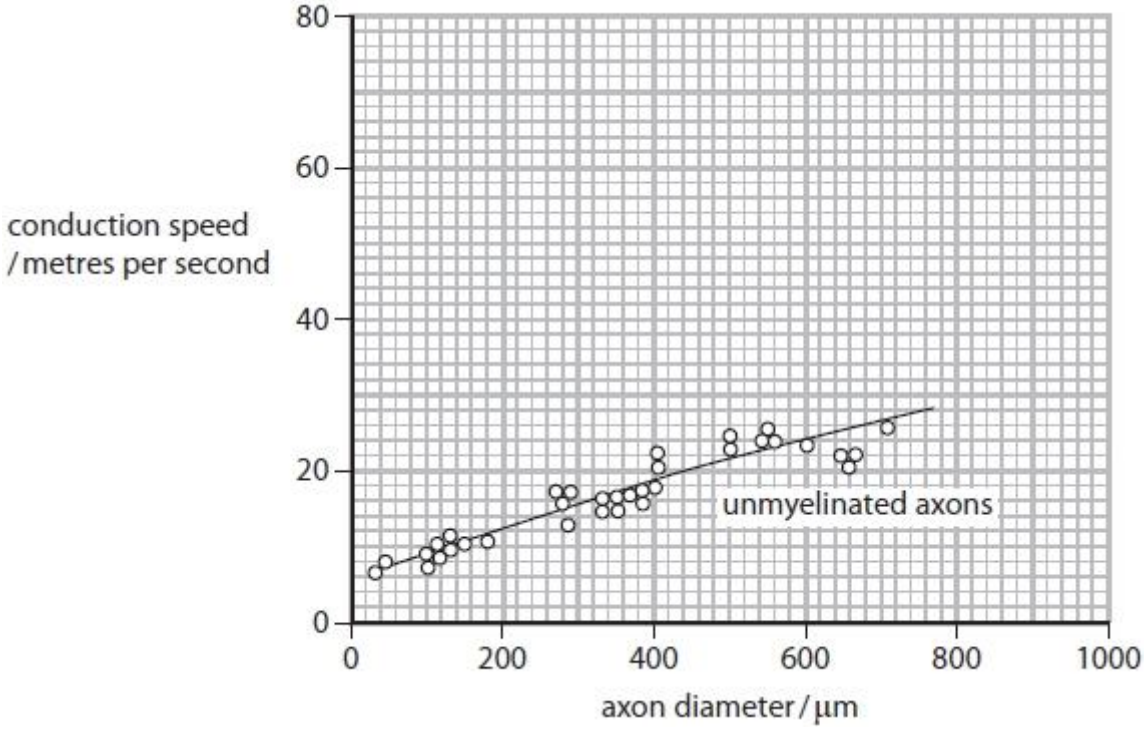
Question Total = 6 marks

2. Nerves carry electrical impulses around the body. They are specialised cells. Surrounding the long fibre (axon) that connects different parts of the nervous systems is a fatty layer that acts as insulation. This is called the myelin sheath.
Graph A shows the relationship between the conduction speed and the diameter of myelinated axons (axons with a myelin sheath).
Graph B shows the relationship between the conduction speed and the diameter of unmyelinated axons (axons without a myelin sheath).

Graph A



Graph B



Compare the conduction speed and diameter of these axons to explain the role of the myelin sheath.

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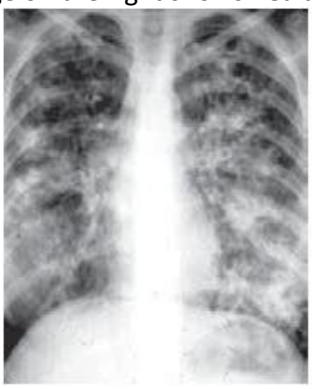
(6)

Question Total = 6 marks

3. The x-ray image on the left shows how cystic fibrosis can affect the human lungs.
The x-ray image on the right shows healthy human lungs.



cystic fibrosis lungs

healthy lungs

a. Complete the sentence by putting a cross (X) in the box next to your answer.
The lungs of a person who has cystic fibrosis can be blocked with

- ☒ **A** carbon monoxide
- ☒ **B** cilia
- ☒ **C** mucus
- ☒ **D** red blood cells

(1)

b. Explain why a person who has cystic fibrosis may have more lung infections than a person who does not have cystic fibrosis.

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(2)

c. Weight loss is a symptom of cystic fibrosis.
Use words from the box to complete the following sentence.

large intestine	enzymes	acids
pancreas	hormones	stomach

A person who has cystic fibrosis may lose weight because..... that digest insoluble food molecules are restricted from leaving the ..... to enter the small intestine.

(2)

Question Total = 5 marks

4. The bar chart shows the presence of organisms in six lakes.
Each lake has a different pH.
The bars show if a particular organism is present at a certain pH.

	pH of lake					
organism	6.5	6.0	5.5	5.0	4.5	4.0
trout						
bass						
perch						
frogs						
salamanders						
clams						
crayfish						
snails						
mayfly						

a. Describe how pH affects the variety of organisms in these lakes.

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(2)

b. Acid rain can affect the pH of a lake.
Complete the sentence by putting a cross (*X*) in the box next to your answer.
The main pollutant that causes acid rain is

- ☒ **A** carbon dioxide
- ☒ **B** carbon monoxide
- ☒ **C** oxygen
- ☒ **D** sulfur dioxide

(1)

Question Total = 3 marks

Chemistry Section

5. Mixtures of coloured substances can be separated by paper chromatography.

Paper chromatography was used to separate a mixture of blue and red inks.
A spot of the mixture was placed on chromatography paper as shown in **Figure 1**.

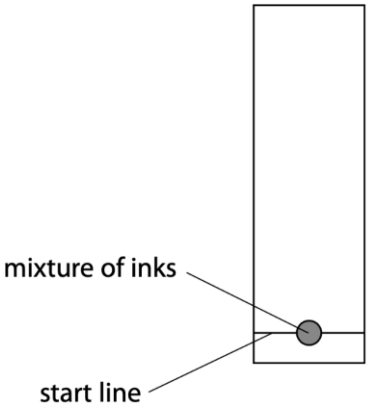

Figure 1

a. Give a reason why the start line is drawn in pencil rather than in ink.

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(1)

b. The chromatography paper, with the spot of mixture on it, was placed in a beaker with the bottom of the paper in water.
On **Figure 2**, complete the diagram showing the position of the chromatography paper with the spot of mixture at the start of the experiment.

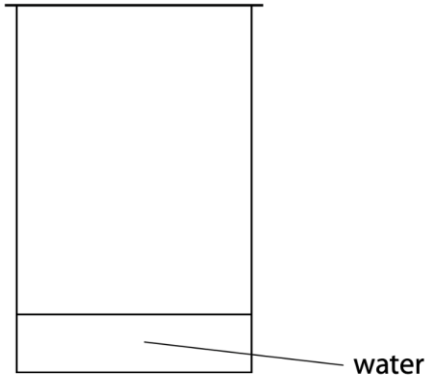

Figure 2

(1)

c. The chromatography was carried out and the result is shown in **Figure 3**.

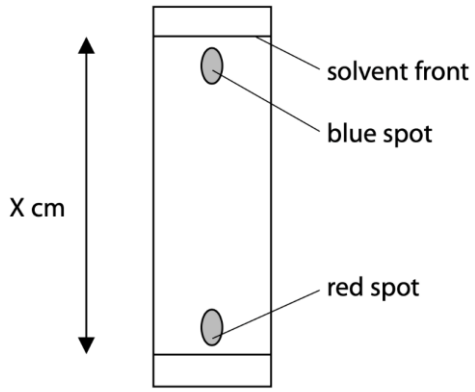

Figure 3

The blue spot had moved 14.5 cm and the solvent front had moved 15.3 cm.

Calculate the Rf value of the substance in the blue spot, giving your answer to 2 significant figures, given that the Rf value is defined as:

$$R_f \text{ value} = \frac{\text{distance travelled by a dye}}{\text{distance travelled by solvent front}}$$

(2)

d. **P**, **Q**, **R** and **S** are mixtures of food colourings.
They are investigated using paper chromatography.
Figure 4 shows the chromatogram at the end of the experiment.

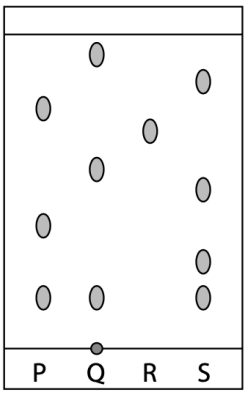

Figure 4

i. Which mixture contains an insoluble food colouring?

- ☒ **A** mixture **P**
- ☒ **B** mixture **Q**
- ☒ **C** mixture **R**
- ☒ **D** mixture **S**

(1)

ii. Give a change that could be made to the experiment to obtain an Rf value for the insoluble colouring.

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(1)

iii. Explain, by referring to Figure 4, which mixture is separated into the greatest number of soluble food colourings by this chromatography experiment.

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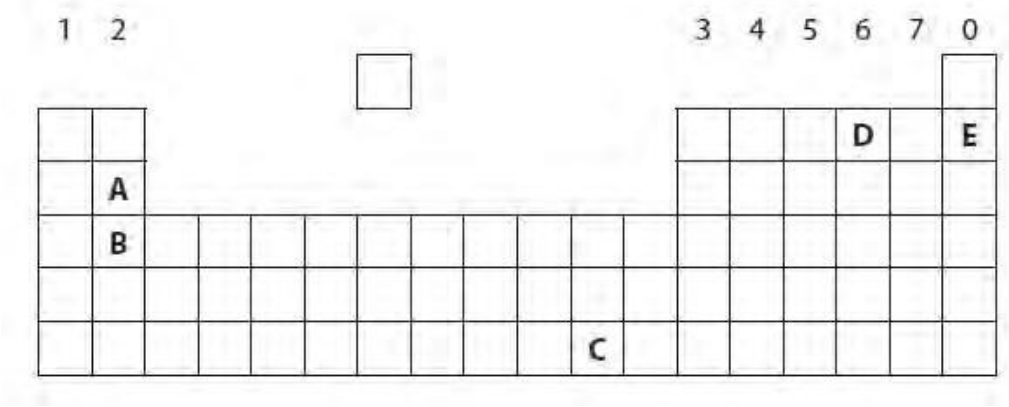
(2)

Question Total = 8 marks

6. The positions of five elements, **A**, **B**, **C**, **D** and **E**, are shown in the periodic table. These letters are not the atomic symbols of these elements.



a. Use only elements **A**, **B**, **C**, **D** and **E** to answer (i) and (ii).

i. Give the letters of **all** the elements that are metallic.

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(1)

ii. Give the letters of the **two** elements that have the most similar chemical properties.

.....

(1)

b. The element below **E** in the periodic table is used to fill filament light bulbs. Explain why this element is suitable for this use.

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(2)

c. The symbols for some atoms are given in the box.

Ca	Cl	K	N	Ne	O

From the box, choose the symbol of

i. an atom in group 2 of the periodic table

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(1)

ii. an atom that readily forms a compound with hydrogen of formula HX

.....

(1)

Question Total = 6 marks

7.

a. Complete the sentence by putting a cross (X) in the box next to your answer.
Acids are neutralised by metal hydroxides to form

- ☒ **A** salt only
- ☒ **B** salt and hydrogen only
- ☒ **C** salt and oxygen only
- ☒ **D** salt and water only

(1)

b. Acids can also be neutralised by metal carbonates.
Dilute sulfuric acid is neutralised by copper carbonate as shown in the word equation.

copper carbonate + sulfuric acid → copper sulfate + carbon dioxide + water

Copper carbonate is a green powder.
Describe what you would **see** when copper carbonate powder is added to dilute sulfuric acid.

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(2)

c. Magnesium carbonate reacts with dilute nitric acid.
Give the names of the products formed in this reaction.

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(1)

d. Write the balanced equation for the reaction between zinc oxide and dilute hydrochloric acid.

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(2)

To make pure sodium chloride from sodium hydroxide solution and dilute hydrochloric acid, a titration has to be used.
The equation for the reaction is

$$HCl\ (aq) + NaOH\ (aq) \rightarrow NaCl\ (\quad) + H_2O\ (\quad)$$

e. Write state symbols to follow NaCl and H_2O to complete the equation?

(1)

f. When sodium hydroxide solution is titrated with dilute hydrochloric acid, an acid-base indicator is used. The hydrochloric acid is added from a burette to the sodium hydroxide solution in a conical flask. At the end point the indicator changes colour.

i. Give the name of a suitable indicator to use in this titration.

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(1)

ii. State the colour change for this indicator at the end point.

from ..... to .....

(1)

Question Total = 9 marks

Physics Section

8.

a. A copper cube has a mass of 0.0717 kg.

i. Calculate the weight of this copper cube. Give the unit.

weight = ...

(2)

ii. State the equation linking density, mass and volume.

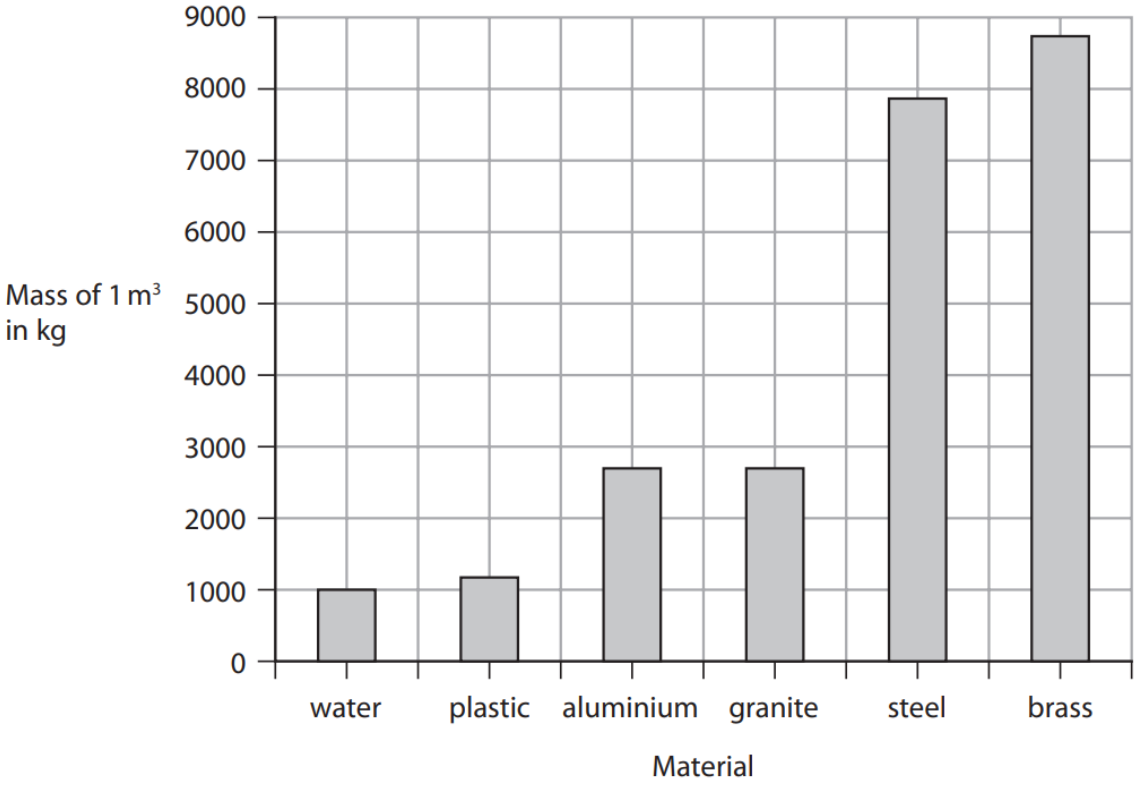
(1)

iii. The density of copper in this cube is 8960 kg/m^3. Calculate the volume of this copper cube.

volume = ...m^3

(2)

b. The graph shows the masses of some materials when their volume is 1 m^3.



i. State the type of graph shown.

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(1)

ii. Use information from the graph to compare the densities of granite and steel.

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(2)

Question Total = 8 marks

9. A car travels from Oundle to Rugby, which are 70 km apart. The driver maintains an average speed of 80 km/hr.

   a. Convert 80 km/hr into m/s

volume = ...m/s
(2)

   b. How long does the journey take? Give your answer in minutes.

.....minutes
(2)

   On the way back to Oundle from Rugby, the same driver takes 100 minutes.

   c. What was the driver's average speed on the return journey? Give your answer in km/hr.

.....km/hr
(2)

   d. What is his average speed for the whole journey (there and back)? Give your answer in km/hr.

.....km/hr
(2)

On a motorway it is increasingly common to drive through 'Average speed areas'. The average speed limit in these areas is often 80 km/hr. The average speed is monitored between two cameras placed 12 km apart. The driver of a car notes that he has travelled 8.0 km from the first camera at a speed of 100 km/hr.

e. Calculate the speed with which he has to travel the remaining 4.0 km in order that his average speed for the whole 12 km is 80 km/hr. Give your answer in km/hr.

.....km/hr
(4)

Question Total = 12 marks

10. The diameter of the Moon is approximately 5000 km.
The distance from the Earth to the Moon is approximately 400 000 km.
It is claimed that a thumb, held at arm's length, will almost exactly obscure the full moon. By estimating the size of your thumb and the distance between your eye and your thumb at arm's length, complete some calculations and discuss the validity of this claim.

Image is not to scale

Drawing a diagram might be helpful but is not required.

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(4)

Question Total = 4 marks