

Name:

School:



TONBRIDGE SCHOOL

Scholarship Examination 2017

Science II – Physics, Chemistry and Biology

Wednesday, 26th April 2017

9:30 am

Time allowed: 1 hour 15 minutes

Please write your name at the top of the Chemistry and Physics sections, as indicated.

Answer all the Questions.

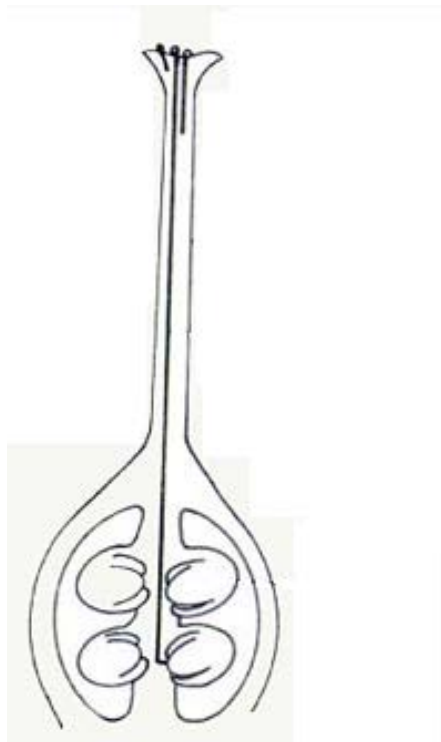
You may use a calculator.

The entire paper is worth 60 marks and the number of marks for each question is shown in brackets.

Section A: Biology

1. Plants use flowers to reproduce sexually.

a) Add **stamens** and **petals** to this incomplete diagram of a flower. [2]



Petals can be used for attracting insects.

b) Why would a flower want to attract insects? [2]

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c) Large petals might be more effective than small petals in attracting insects. Briefly outline how you could investigate whether this was true. Include details of what you would change, what you would measure and what you should keep the same. [4]

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d) Plants are found at the bottom of food chains. Draw a food chain with at least four different organisms in it. [2]

[Total 10 marks]

2. The common European frog, *Rana temporaria*, is an amphibian. During their life cycle frogs undergo a significant change in shape from tadpoles to adult frogs.

Tadpoles are mainly herbivores, whereas adult frogs are carnivorous.

Tadpoles feed exclusively in water, whereas adult frogs usually feed out of the water.



- a) What is the name of the process in which tadpoles become adults? [1]

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- b) Suggest why it might be good for the species if the adults and the young feed on different things and in different places. [2]

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[Total 3 marks]

3. A person has had a very good Christmas, but afterwards they are concerned about the food they have eaten over the festive period – in particular the sugar content.

a) Outline how they could test a mince pie for sugar. [3]

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b) The food eaten over Christmas contains many different nutrients. Fill in the blanks in the following table. [3]

Nutrient	Use in the Body
Protein	
	Used for strong bones and teeth
	Used for thermal insulation and as a store of energy

c) A few months after Christmas they notice that their weight has reduced to normal. Thinking about ways in which people can lose weight suggest how the weight has left their body. [1]

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[Total 7 marks]

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4. This question is about the industrial production of sulphuric acid.

Read the passage below, which gives details of the production of sulphuric acid.

The industrial production of sulphuric acid requires three raw materials: sulphur, air (oxygen) and water.

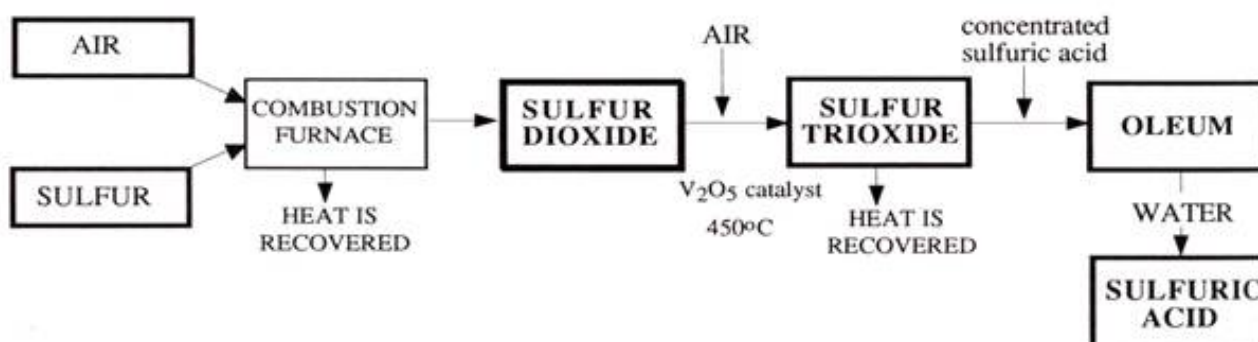
The four stages in the process are shown below;

Stage 1 sulphur is burnt in air to form sulphur dioxide.

Stage 2 sulphur dioxide is converted to sulphur trioxide.

Stage 3 sulphur trioxide is converted into a compound called oleum.

Stage 4 oleum is added to water to give sulphuric acid.



a) Suggest why air is used as a raw material in stage 1, rather than pure oxygen. [1]

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b) State whether **Stage 2** best represents:

neutralisation, reduction, oxidation, decomposition. [1]

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c) Stage 2 requires a catalyst called vanadium(V) oxide (V_2O_5).

Suggest a reason why a catalyst is needed.

[1]

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d) It is important to prevent any sulphur dioxide and sulphur trioxide from entering the atmosphere.

Use your knowledge of neutralisation reactions to suggest how the sulphur dioxide and sulphur trioxide gases can be prevented from escaping into the laboratory. [2]

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[Total 5 marks]

5. A student attempted to produce sulphuric acid in a laboratory.

3 g of sulphur was burnt in air and 5.4 g of sulphur dioxide was obtained.



a) Calculate the percentage of oxygen (by mass) in the sulphur dioxide produced. [2]

Answer: %

b) Explain why it is not possible to obtain less than 3 g of sulphur trioxide from burning 3 g of sulphur. [1]

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The student then tried to improve upon the reaction by passing air over a heated catalyst mixed with 3 g of sulphur. The resulting sulphur trioxide gas was bubbled through water to produce a solution of sulphuric acid.

c) Draw a labelled diagram showing the apparatus that could have been used. [3]

d) The student knew that if copper sulphate solution could be made from the final acid solution it would prove that sulphuric acid had indeed been made.

Give outline details of how you would attempt to make a solution of copper sulphate using the acid solution.

Include:

- items of key apparatus,
- any other chemicals that are needed
- details of the expected observations.

[3]

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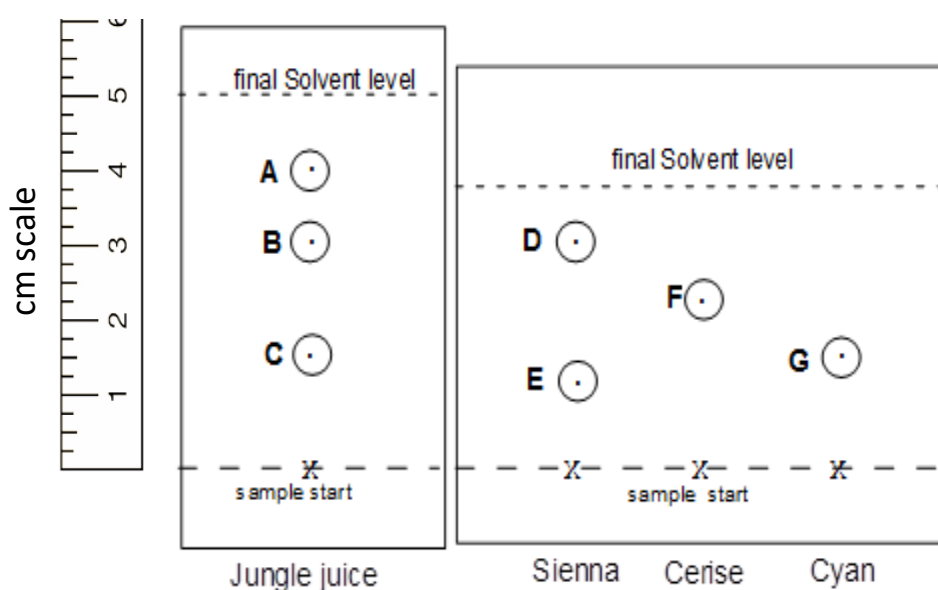
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[Total 9 marks]

6. This question is about using chromatography to identify substances.

Oliver and Ruth set out to investigate the colourings used in a drink called “Jungle Juice”. Their results, on two separate pieces of chromatography paper, are shown below.

- Oliver obtained the results on the left, using Jungle Juice.
- Ruth obtained the results on the right, using three food colourings; “sienna”, “cerise” and “cyan”.
- They both used the same solvent (propanone) and the same kind of chromatography paper.



a) Why might the solvent have risen by a different amount in Ruth’s experiment, compared to Oliver’s? [1]

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- b) For each spot on the chromatography paper, it is possible to calculate something called an R_f value. R_f is the proportion of the distance travelled by the solvent which the spot travelled. It is always the same for a given dye in the same solvent, even if the total distances travelled change.

$$R_f = \frac{\textit{Distance moved by spot}}{\textit{Distance moved by solvent}}$$

Work out the R_f values for spots A and D, and hence show that they are the same substance.

[3]

- c) What can you conclude about spot B?

Justify your answer carefully, using the scale and R_f values.

[2]

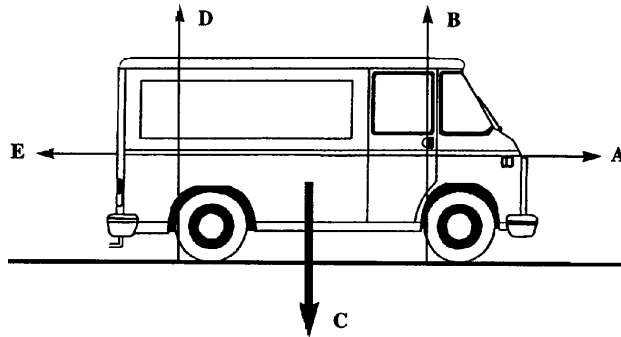
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[Total 6 marks]

7. Five forces, **A**, **B**, **C**, **D** and **E** act on a van.



a) Complete the following sentences by choosing the correct forces from **A** to **E**. [3]

Force is the forward force from the engine.

Force is the force resisting the van's motion.

Force is the weight of the van.

The van has a fault and leaks one drop of oil **every second**. The diagram below shows the oil drops left on the road as the van moves from **W** to **Z**.



b) Describe the motion of the van as it moves from:

W to **X** [1]

X to **Y** [1]

Y to **Z** [1]

c) Using the scale 1cm equals 2m calculate the speed of the van between X and Y [3]

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[Max 9 marks]

8. The speed a wave travels is related to the frequency of the wave and its wavelength by the formula:

$$c = f \times \lambda$$

where c is the speed, f is the frequency and λ is the wavelength.

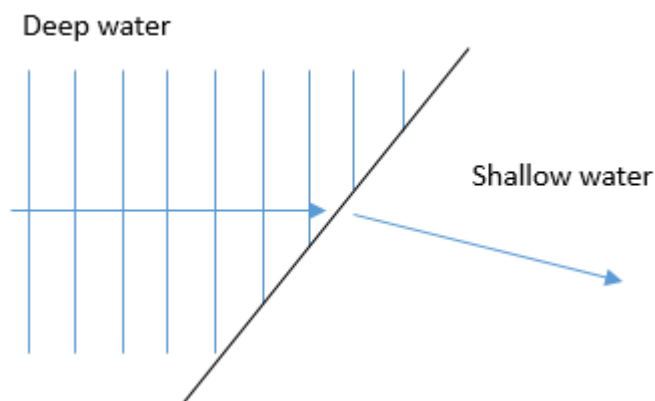
- a) What is the wavelength of a water wave with speed 30m/s and frequency 4Hz? [2]

Answer:

The speed a water wave travels at depends on the depth of the water, when the water is shallow the wave slows down. This can cause their direction to change.

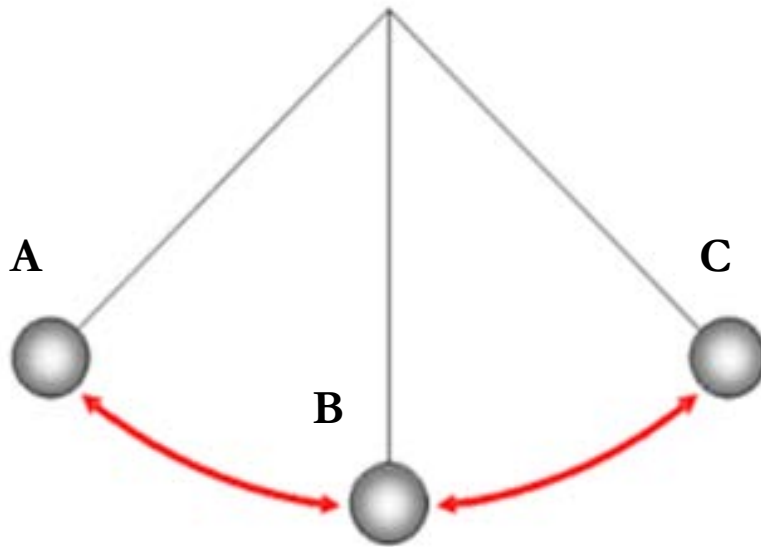
The diagram below shows water waves approaching an underwater sandbank where the water depth is less. The lines represent the peak of the subsequent waves.

- b) Complete the diagram to show what happens to the waves after they pass into the shallower water. [3]



[Total 5 marks]

9. A pendulum swings backwards and forwards:



- a) Label with an X the location where the pendulum has the greatest amount of kinetic energy. [1]
- b) Label with a Y a location where the pendulum has the greatest gravitational potential energy. [1]
- c) The pendulum is still swinging. Draw and label the two forces acting on the pendulum as it passes B. [2]
- d) Over time, the pendulum comes to a stop. What happens to the energy of the pendulum? [2]

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[Total 6 marks]

End of Paper - Now check your answers.