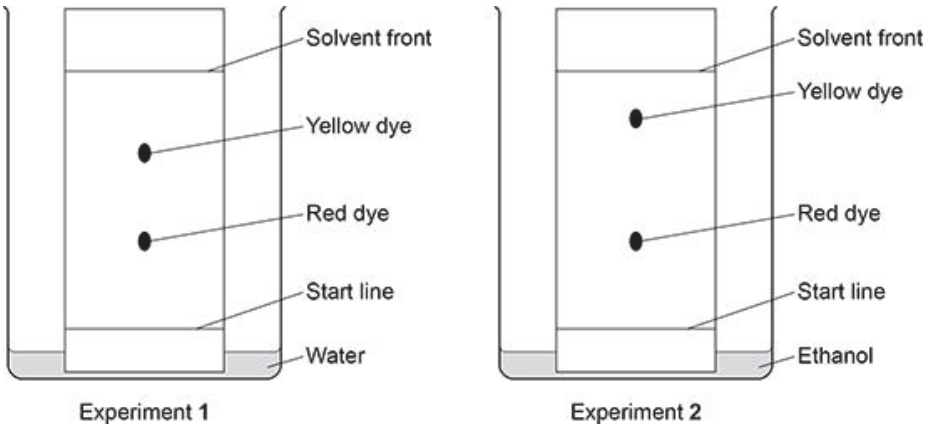
All questions are for separate science students only

Q1.

A student investigated an orange dye (**A**) using paper chromatography.

Figure 1 shows the results of Experiment **1** and Experiment **2** using orange dye **A**.

Figure 1



(a) Explain why the yellow dye and red dye travel different distances in Experiment **1**.

Refer to forces of attraction between the dyes and the chromatography paper in your answer.

_____

_____

_____

_____

(2)

(b) The student used the same type of chromatography paper in Experiment **1** and in Experiment **2**.

Explain why the yellow dye is in different positions in Experiment **1** and in Experiment **2**.

Use **Figure 1**.

_____

_____

_____

_____

_____

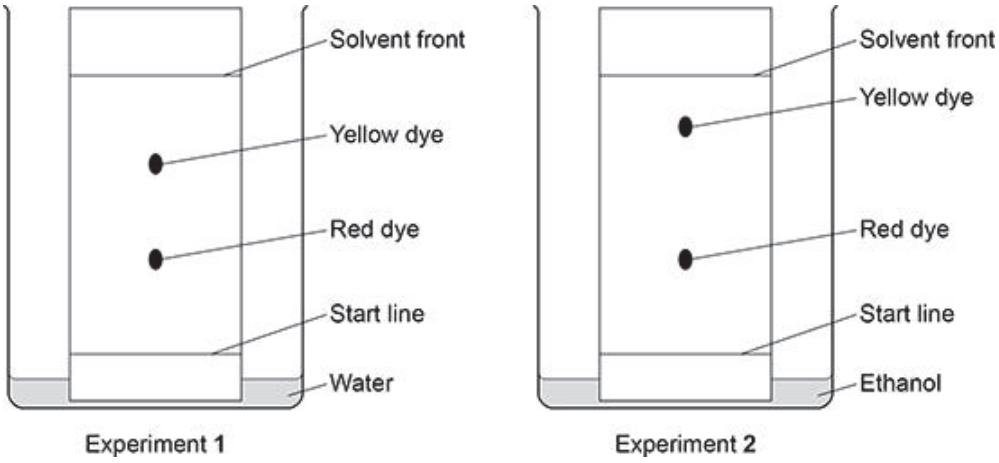
_____

(3)

Figure 1 is repeated below.

Figure 1 shows the results of Experiment **1** and Experiment **2** using orange dye **A**.

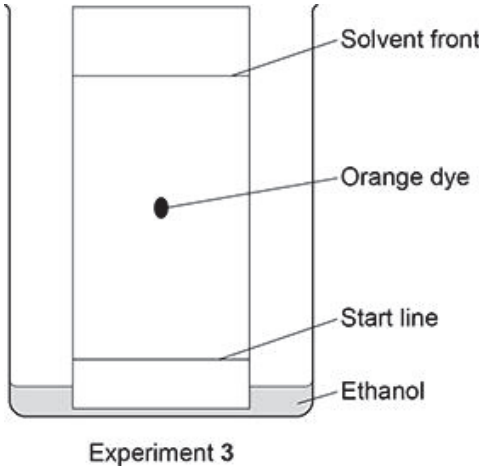
Figure 1



The student investigated a different orange dye (**B**).

Figure 2 shows the results of Experiment **3** using orange dye **B**.

Figure 2



(c) Compare the purity of the orange dyes **A** and **B**.

Give reasons for your answer.

Use **Figure 1** and **Figure 2**.

_____

_____

_____

_____

(2)

(d) The student calculated that the R_f value of the orange dye in the experiment shown in **Figure 2** was 0.48

Calculate the distance moved by the solvent front when the orange dye had moved 5.4 cm.

_____

_____

_____

_____

_____

Distance moved by solvent front = _____ cm

(3)

(e) Why is the R_f value of a dye **not** affected by how far the solvent front is allowed to travel?

_____

_____

(1)

(f) Another type of chromatography is called gas chromatography.

Gas chromatography is an instrumental method of chemical analysis.

Scientists tested the orange dyes using gas chromatography.

Suggest **two** advantages of using the instrumental method of gas chromatography rather than paper chromatography. **(chemistry only)**

1 _____

_____

2 _____

_____

(2)

(Total 13 marks)

Q2.

This question is about sulfuric acid.

(a) Sulfuric acid contains sulfate ions.

Describe the test for the presence of sulfate ions in sulfuric acid.

Give the result of the test. **(chemistry only)**

Test _____

_____

Result _____

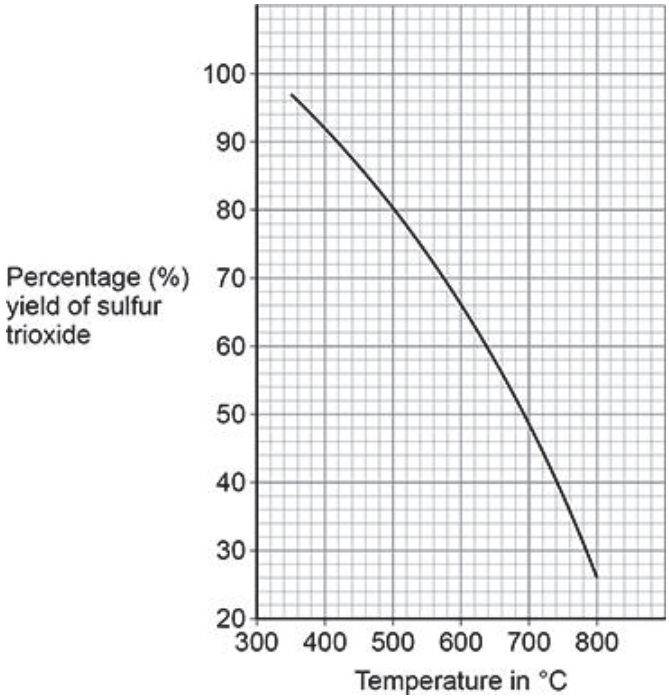
_____

(2)

One stage in the industrial production of sulfuric acid is the reaction of sulfur dioxide with oxygen to produce sulfur trioxide.

This reversible reaction reaches dynamic equilibrium.

The figure below shows the percentage yield of sulfur trioxide in this reaction at different temperatures.



(b) Which statement about the forward reaction is correct? **(HT only)**

Use the above figure.

Tick (✓) **one** box.

The yield is greater at higher temperatures because the reaction is exothermic.	☐
The yield is greater at higher temperatures because the reaction is endothermic.	☐
The yield is smaller at higher temperatures because the reaction is exothermic.	☐
The yield is smaller at higher temperatures because the reaction is endothermic.	☐

The equation for the reaction is:

$$2\ SO_2(g) + O_2(g) \rightleftharpoons 2\ SO_3(g)$$

(1)

(c) Explain why the percentage yield of sulfur trioxide in this reaction is greater if the pressure is higher. **(HT only)**

_____

_____

_____

_____

(2)

(d) In industry, the reaction is done at 450 °C and atmospheric pressure.

Under these conditions the yield of sulfur trioxide is 86%.

Suggest **two** reasons why a higher pressure is **not** used. **(HT only)**

1 _____

_____

2 _____

_____

(2)

(e) This reaction uses a catalyst to increase the rate of the reaction.

The catalyst is a metal oxide.

Which is the most likely metal in the metal oxide catalyst?

Use the periodic table. **(chemistry only)**

Tick (✓) **one** box.

Aluminium (Al) ☐

Barium (Ba) ☐

Potassium (K) ☐

Vanadium (V) ☐

(1)

(Total 8 marks)

Q3.

Copper is extracted from metal ores.

Chalcopyrite is a metal ore containing a compound with the formula $CuFeS_2$

(a) $CuFeS_2$ reacts with oxygen to produce copper(II) sulfate and iron(II) sulfate.

Complete the equation for this reaction.

You should balance the equation.

$$CuFeS_2 + \_\_\_\_\_ \rightarrow CuSO_4 + FeSO_4$$

(2)

(b) Calculate the percentage by mass of copper in $CuFeS_2$

Relative atomic masses (A_r): S = 32 Fe = 56 Cu = 63.5

_____

_____

_____

_____

_____

Percentage by mass = _____ %

(3)

(c) Describe a test to show the presence of copper(II) ions in a solution of copper(II) sulfate.

Give the result of the test. **(chemistry only)**

Test _____

_____

Result _____

_____

(2)

(d) Copper can be extracted from low-grade ores by bioleaching.

Describe what is meant by bioleaching. **(HT only)**

_____

_____

_____

_____

(2)

(Total 9 marks)