AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.8.1 PURITY, FORMULATIONS AND CHROMATOGRAPHY (PACK 2)

SCORE	PERCENTAGE
/146	%

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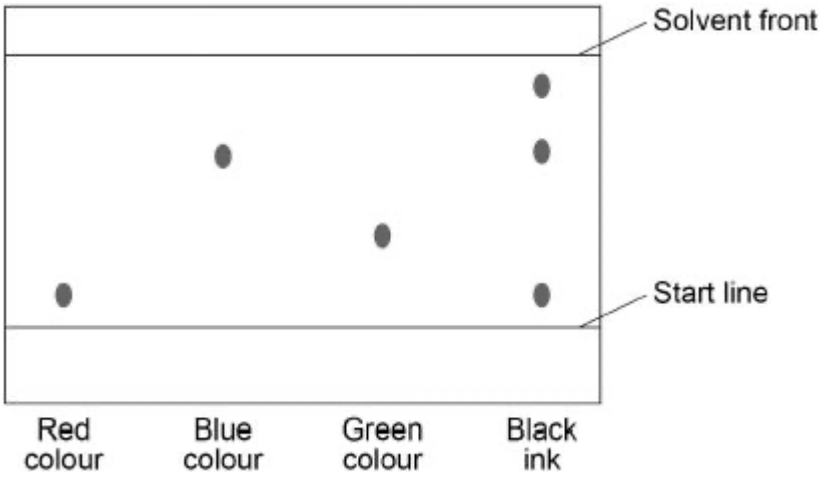
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Q1.

A student used paper chromatography to identify the colours in a black ink.

The diagram below shows the student's results.



(a) What colours are in the black ink?

_____

_____

(2)

(b) Suggest which colour is least soluble in the solvent.

Give a reason for your answer.

Colour _____

Reason _____

_____

(2)

(c) Use the diagram above to complete the table below.

	Distance in mm
Distance moved by green colour	
Distance moved by solvent	

Calculate the R_f value for the green colour.

Use the equation:

$$R_f = \frac{\text{distance moved by green colour}}{\text{distance moved by solvent}}$$

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_____

_____

_____

_____

R_f value = _____

(4)

(Total 8 marks)

Q2.

(a) What percentage of the Earth's atmosphere is nitrogen?

Tick **one** box.

5% ☐ 20% ☐ 50% ☐ 80% ☐

(1)

(b) During the first billion years of the Earth's existence the amount of nitrogen in the atmosphere increased.

Give **one** source of this nitrogen.

_____

(1)

(c) Nitrogen is used to make ammonia.

The word equation for the reaction is:

nitrogen + hydrogen _____ ammonia

Write the correct symbol in the equation to show that it is a reversible reaction.

(1)

(d) A reversible reaction can reach equilibrium.

Complete the sentence.

Equilibrium is reached when the forward reaction and the reverse reaction happen at the same _____ .

(1)

(e) Fertilisers are formulations containing nitrogen.

What is a formulation?

_____

_____

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(1)

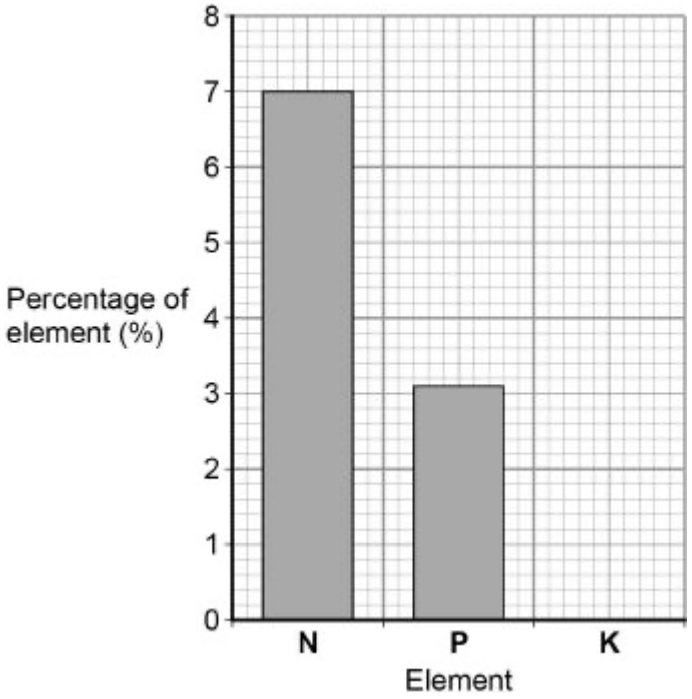
(f) The table below shows percentages of chemical elements in a fertiliser.

Element	**Percentage (%)**
Nitrogen (N)	7.0
Phosphorus (P)	3.1
Potassium (K)	5.8

Draw the bar for potassium on **Figure 1**

Use the information in the table above.

Figure 1



(1)

(g) A fertiliser contains 0.225 g of iron per 3.0 g of fertiliser.

Which calculation gives the percentage of iron in the fertiliser?

Tick **one** box.

$\frac{0.225}{3.0 \times 100}$ ☐

$\frac{3.0 \times 100}{0.225}$ ☐

$\frac{0.225 \times 3.0}{100}$ ☐

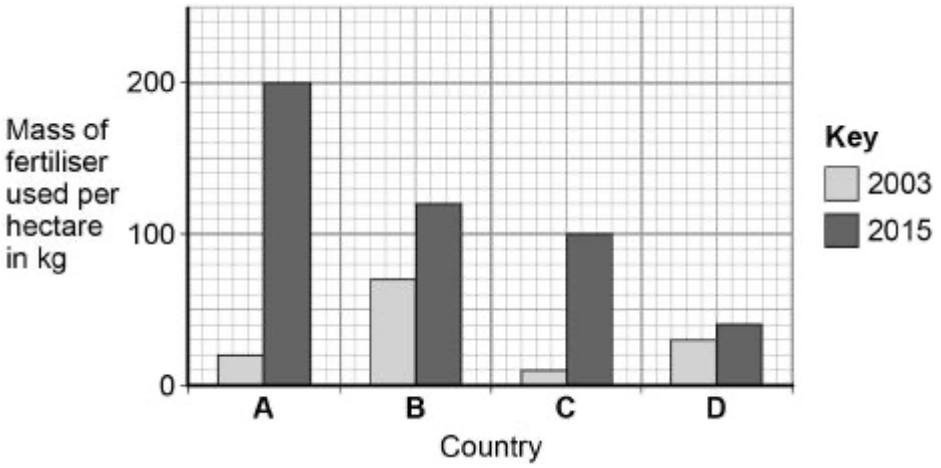
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$$\frac{0.225 \times 100}{3.0}$$ ☐

(1)

(h) **Figure 2** shows the use of fertiliser in four different countries, **A**, **B**, **C** and **D**, in 2003 and 2015

Figure 2



A student said:

'**much** more fertiliser was used in 2015 than in 2003'

Is the student correct?

Use data from **Figure 2** to justify your answer.

_____

_____

_____

_____

_____

_____

(3)

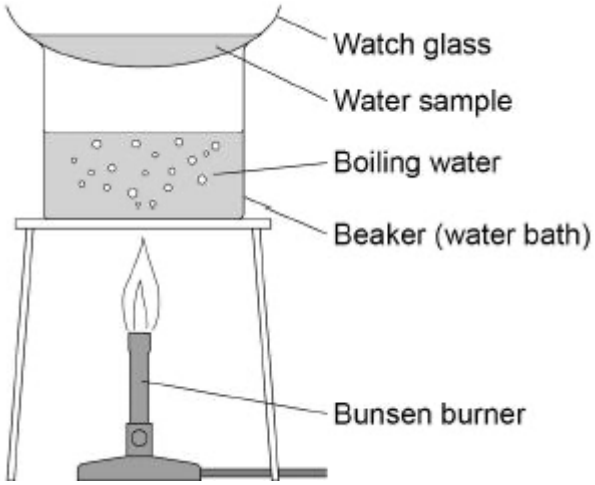
(Total 10 marks)

Q3.

A student investigated the mass of dissolved solids in 5 cm^3 samples of water.

The diagram below shows the apparatus.

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The table below shows the student's results.

Type of water	Mass in g			
	Watch glass	**Watch glass and dissolved solids**	**Dissolved solids in 5 cm^3 of water**	**Dissolved solids in 1000 cm^3 of water**
Sea water	9.34	9.48	0.14	28.00
River water	9.15	9.23	0.08	**X**
Rainwater	8.93	8.93	0.00	0.00

(a) Calculate mass **X** in the table above.

_____

_____

Mass **X** = _____ g

(1)

(b) 5 cm^3 is a small volume of water for each experiment.

Give **one** advantage and **one** disadvantage of using a larger volume.

Advantage _____

_____

Disadvantage _____

_____

(2)

(c) Potable water is **not** pure water.

Describe the difference between potable water and pure water.

_____

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_____

_____

(1)

(d) Potable water is obtained from both groundwater **and** from sea water.

Describe how groundwater and sea water are treated to produce potable water.

_____

_____

_____

_____

_____

_____

(3)

(e) The percentage by mass of dissolved solids in a 6.50 g sample is 2.2%

Calculate the mass of the dissolved solids.

_____

_____

_____

_____

Mass of dissolved solids = _____ g

(2)

(Total 9 marks)

Q4.

Fertilisers are formulations.

(a) What is a formulation?

_____

_____

(1)

(b) A bag of fertiliser contains 14.52 kg of ammonium nitrate (NH_4NO_3).

Relative formula mass (M_r): NH_4NO_3 = 80

Calculate the number of moles of ammonium nitrate in the bag of fertiliser.

Give your answer in standard form to 2 significant figures.

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Moles of ammonium nitrate = _____ mol

(4)

(c) The fertiliser also contains potassium chloride.

Explain why potassium chloride has a high melting point.

(4)

(Total 9 marks)

Q5.

Some students tested a red cabbage leaf for starch.

This is the method used.

1. Boil the leaf in ethanol.
2. Rinse the leaf in water.
3. Add the reagent to test the leaf for starch.

(a) Give **one** safety precaution the students should take in this test.

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(1)

(b) Which reagent is used to test the boiled leaf for starch?

Tick **one** box.

- Benedict's solution ☐
- Biuret solution ☐
- Iodine solution ☐
- Sodium chloride solution ☐

(1)

(c) What colour will be seen if the test for starch is positive?

Tick **one** box.

- Blue-black ☐
- Pale pink ☐
- Orange ☐
- Red ☐

(1)

The students then used paper chromatography to investigate the coloured pigments in a red cabbage leaf.

(d) Complete the sentences.

Choose answers from the box.

distil	**evaporate**	**filter**	**mobile**	**separate**	**solid**

Chromatography can be used to _____ mixtures.

In paper chromatography, the paper is part of the stationary phase.

The solvent is called the _____ phase.

(2)

Table 1 shows the students' results.

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The distance each pigment moved was measured from the start line.

	Distance moved in mm	**R_f value**
Yellow-green pigment	17	**X**
Yellow pigment	46	0.42
Orange pigment	100	0.91

The R_f value is calculated using the equation:

$$R_f = \frac{\text{distance moved by pigment}}{\text{distance moved by solvent}}$$

(e) The solvent moved 110 mm from the start line.

Calculate R_f value **X** in **Table 1**.

Give your answer to 2 significant figures.

_____

_____

_____

_____

R_f value **X** = _____

(2)

(f) The known ranges of R_f values of some pigments are shown in **Table 2**.

Table 2

Pigment	**R_f value range**
Carotene	0.89 to 0.98
Chlorophyll a	0.24 to 0.30
Chlorophyll b	0.20 to 0.26
Xanthophyll	0.04 to 0.28

The R_f value for the orange pigment in red cabbage leaves is 0.91

What is this orange pigment most likely to be?

Tick **one** box.

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Carotene ☐

Chlorophyll a ☐

Chlorophyll b ☐

Xanthophyll ☐

(1)

(Total 8 marks)

Q6.

Some students investigated the compounds in a green lettuce leaf and a red cabbage leaf.

The students placed each leaf in boiling ethanol and then tested each leaf for starch.

(a) The boiling point of ethanol is 78 °C

Ethanol is flammable so should not be directly heated with a Bunsen burner.

Give **one** way ethanol can be boiled safely.

Do **not** refer to wearing goggles in your answer.

_____

_____

(1)

(b) Describe how the students could test the leaves for starch.

Give the result if starch is present.

Test _____

_____

Result _____

(2)

(c) The students used paper chromatography to investigate the coloured pigments in both types of leaf.

Explain how paper chromatography causes the different pigments to separate.

_____

_____

_____

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(3)

Table 1 shows the students' results. The distance the solvent and each pigment moved was measured from the start line.

Table 1

	Green lettuce		Red cabbage	
	Distance moved in mm	R_f value	Distance moved in mm	R_f value
Solvent front	120	−	113	−
Yellow-green pigment	18	0.15	14	0.12
Bright green pigment	24	0.20	Not found	Not found
Yellow pigment	40	0.33	46	0.41
Orange pigment	120	1.00	113	1.00

Table 2 shows the known R_f value ranges of some pigments.

Table 2

Pigment	**R_f value**
Carotene	0.89 −0.98
Pheophytin a	0.42 −0.49
Pheophytin b	0.33 −0.40
Chlorophyll a	0.24 −0.30
Chlorophyll b	0.20 −0.26
Xanthophyll	0.04 −0.28

(d) One pigment was found in the green lettuce leaf, but was **not** found in the red cabbage leaf.

Describe why it is **not** possible to be certain what this pigment is.

Use the information in **Table 1** and **Table 2** to help you.

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(1)

(e) The experiment was repeated and the solvent front travelled 140 mm from the start line.

Calculate the range of distances where the pigment carotene would be seen.

Use the equation for calculating R_f values and the information in **Table 2** to help you.

From _____ mm to _____ mm

(5)

(f) Different coloured pigments absorb light at different wavelengths.

Explain how plants could have evolved to contain more than one pigment in their leaves.

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_____

_____

(6)

(Total 18 marks)

Q7.

Tablets to cure indigestion contain a mixture that has been designed as a useful product.

(a) Complete the sentence.

Choose the answer from the box.

catalyst	**formulation**	**hydrocarbon**	**solvent**

Tablets to cure indigestion are an example of a _____ .

(1)

The table shows the substances in one tablet.

Substance	**Mass in mg**
Sodium hydrogencarbonate	64
Calcium carbonate	522
Magnesium carbonate	68

(b) The total mass of these substances in the tablet is 654 mg

What is the approximate fraction of magnesium carbonate in the total mass of these substances?

Tick **one** box.

$\frac{1}{10}$ ☐ $\frac{1}{100}$ ☐ $\frac{1}{1000}$ ☐ $\frac{1}{10\,000}$ ☐

(1)

(c) The tablets also contain sugar.

Suggest why.

_____

_____

(1)

(d) Sodium hydrogencarbonate cures indigestion by reacting with acid in the stomach.

What type of reaction is this?

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Tick **one** box.

Combustion ☐

Displacement ☐

Neutralisation ☐

(1)

A student adds an indigestion tablet to dilute hydrochloric acid.

(e) The gas produced is bubbled through limewater.

The gas turns the limewater milky.

Name the gas produced.

_____

(1)

(f) Water is also produced.

Which **two** statements are reasons why water is a liquid at room temperature?

Tick **two** boxes.

Water has a boiling point of 100 °C ☐

Water has a giant covalent structure ☐

Water has a melting point lower than room temperature ☐

Water has delocalised electrons ☐

Water is made of ions ☐

(2)

(g) Calcium chloride is also produced.

- The formula for a calcium ion is Ca^{2+}
- The formula for a chloride ion is Cl^{-}

What is the formula of calcium chloride?

Tick **one** box.

CaCl ☐ Ca_2Cl ☐ $CaCl_2$ ☐ Ca_2Cl_2 ☐

(1)

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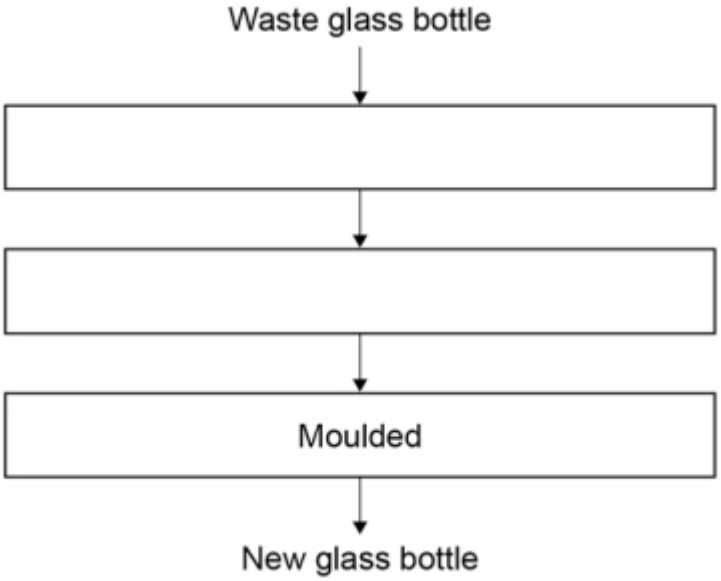
(h) The tablets are stored in glass bottles.

The flow chart shows part of a flowchart for recycling glass.

Complete the flow chart.

Choose the answers from the box.

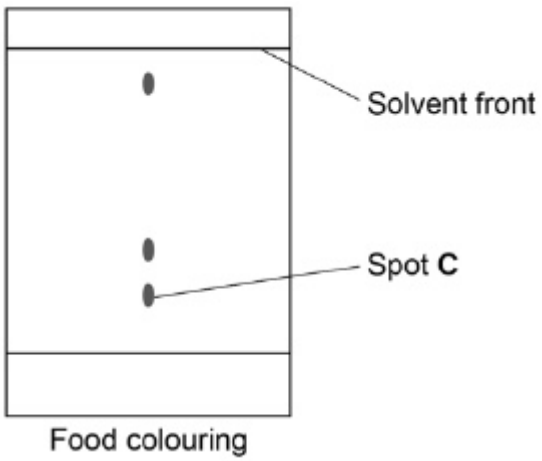
crushed	**electrolysed**	**frozen**	**melted**	**oxidised**



(2)
(Total 10 marks)

Q8.

The diagram shows a chromatogram for a food colouring.



(a) How does the chromatogram show that the food colouring is a mixture?

_____

_____

(1)

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(b) A student makes measurements for spot **C**.

The table shows the results.

	Distance in mm
Distance moved by spot **C**	7
Distance moved by solvent	39

Calculate the R_f value for spot **C**.

Give your answer to 2 significant figures.

Use the results in the table.

R_f value = _____

(3)

(c) Plan a chromatography experiment to investigate the colours in an ink.

(6)

(Total 10 marks)

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Q9.

Race horses may be given drugs to improve their perfomance in races.

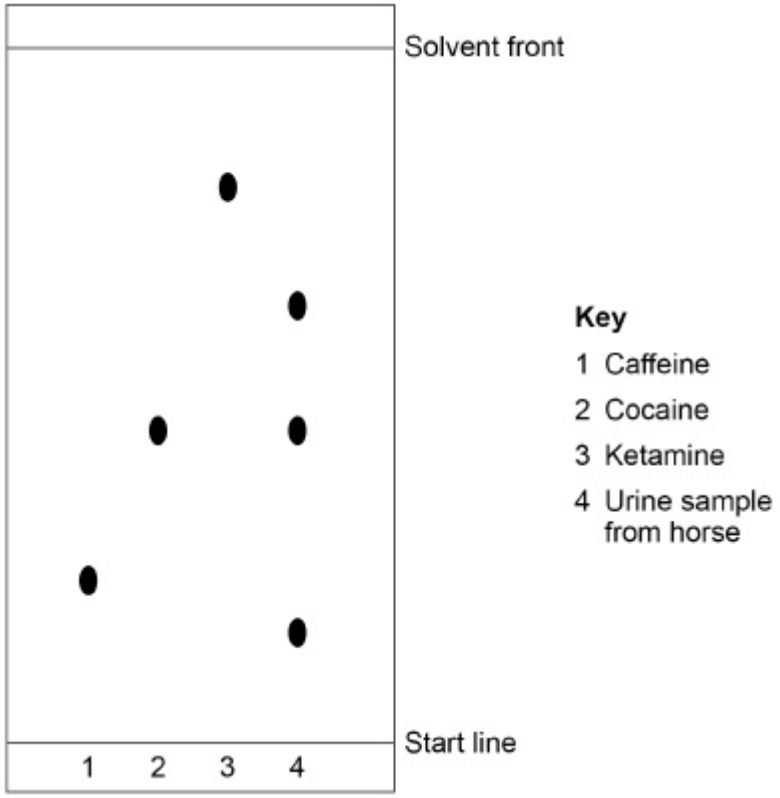
This is illegal in the UK.

After races, urine samples are collected from the horses.

These samples are tested for drugs.

Chromatography is one of the tests used to identify drugs in urine.

The diagram shows a chromatogram.



(a) How do we know that sample 1 was a **pure** sample of caffeine?

_____

_____

(1)

(b) Calculate the R_f value for cocaine.

Give your answer to 2 significant figures.

Use information from the diagram.

Use the equation:

$$R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}}$$

_____

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_____

_____

_____

_____

R_f value of cocaine = _____

(4)

(c) Give **three** conclusions about the urine sample from the horse.

Use information from the diagram.

1. _____

_____

2. _____

_____

3. _____

_____

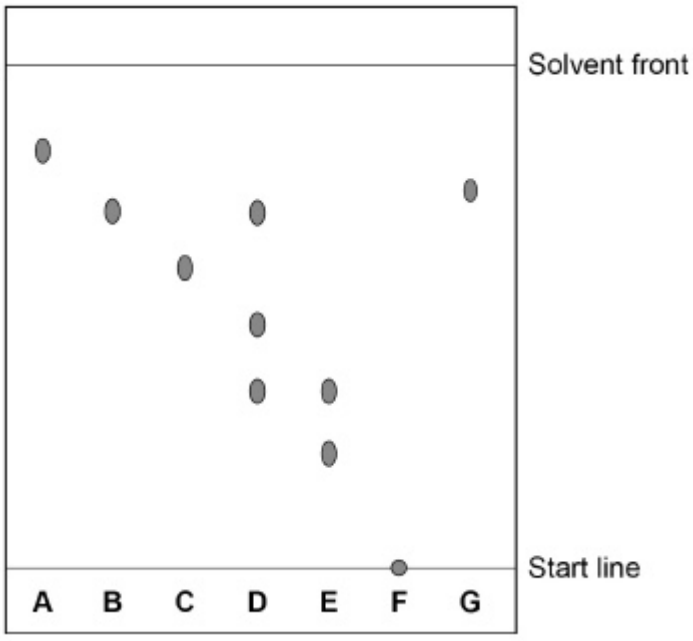
(3)

(Total 8 marks)

Q10.

Chromatography can be used to find out what substances a drug contains.

The diagram shows a chromatogram for seven different drugs.



(a) Calculate the R_f value of drug **G**.

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R_f value = _____

(4)

(b) Describe what the diagram shows about drug **D**.

(3)

(c) Which substance is most soluble in the solvent used in this chromatogram?

Give a reason for your answer.

(1)

(d) Explain the result for drug **F**.

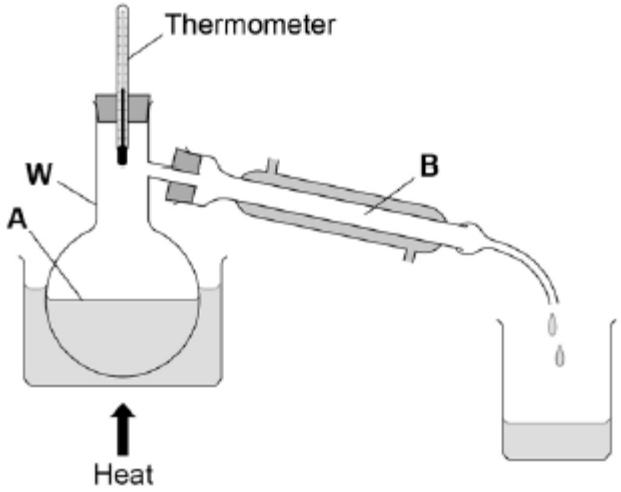
(2)

(Total 10 marks)

Q11.

The apparatus in the figure below is used to separate a mixture of liquids in a fuel.

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(a) What is apparatus **W** on above the figure above?

Tick **one** box.

Beaker ☐

Boiling Tube ☐

Flask ☐

Jug ☐

(1)

(b) What is the name of this method of separation?

Tick **one** box.

Crystallisation ☐

Electrolysis ☐

Filtration ☐

Distillation ☐

(1)

(c) Name the changes of state taking place at **A** and **B** in the figure above.

Use words from the box.

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boiling	condensing	freezing	melting

Change of state at **A**: _____

Change of state at **B**: _____

(2)

(d) **Table 1** shows the boiling points of the hydrocarbons in the fuel.

Table 1

Hydrocarbon	Boiling point in °C
Pentane	36
Hexane	69
Heptane	98
Octane	125

Which hydrocarbon will be the last to collect in the beaker?

Tick **one** box.

Pentane ☐

Hexane ☐

Heptane ☐

Octane ☐

(1)

(e) The fuel is a mixture of liquids that has been designed as a useful product.

What name is given to this type of mixture?

Tick **one** box.

Catalyst ☐

Formulation ☐

Polymer ☐

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Solvent ☐

(1)

(f) Describe how this fuel is different from crude oil.

_____

_____

_____

_____

(2)

(g) A student measured the melting point of a solid hydrocarbon four times.

The student's results are in **Table 2**.

Table 2

	Trial 1	**Trial 2**	**Trial 3**	**Trial 4**
Melting point in °C	35	48	37	37

Calculate the mean melting point of the hydrocarbon, leaving out any anomalous result.

Give your answer to two significant figures.

_____

_____

Mean melting point = _____ °C

(2)

(Total 10 marks)

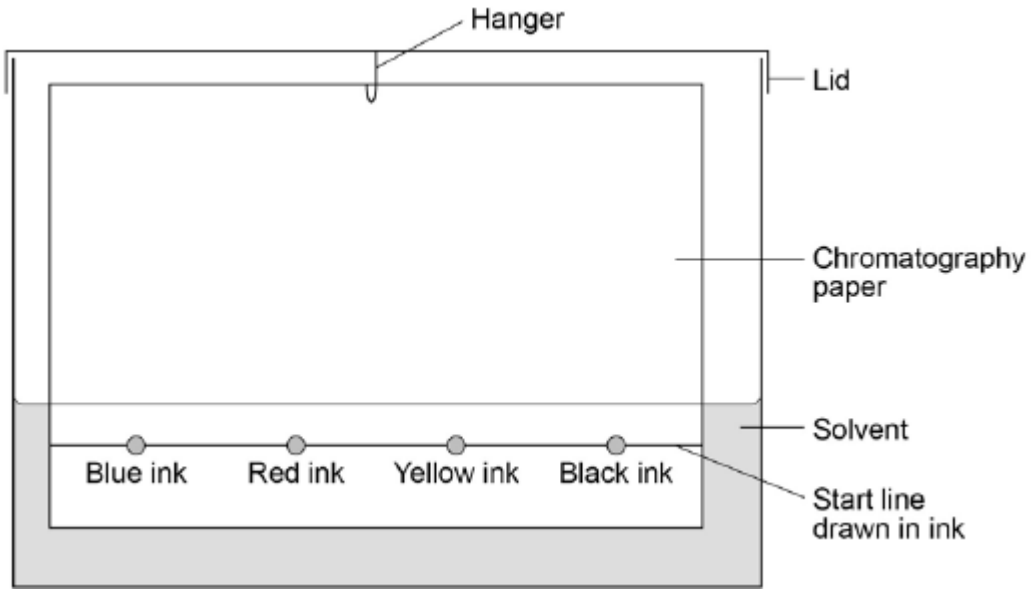
Q12.

A student used paper chromatography to investigate the colours in different inks.

Figure 1 shows the apparatus the student used.

Figure 1

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(a) The student made **two** mistakes in setting up the apparatus.

Identify the **two** mistakes.

Describe the problem each mistake would cause.

Mistake 1 _____

Problem _____

_____

_____

Mistake 2 _____

Problem _____

_____

_____

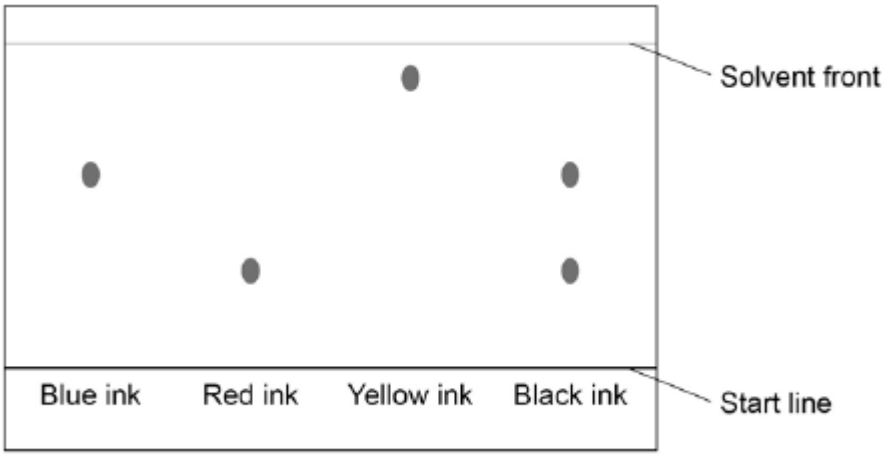
(4)

(b) The student then set up the apparatus without making any mistakes.

Figure 2 shows his results.

Figure 2

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What colours are in the black ink?

_____

_____

(1)

(c) Which of the inks is the most soluble in the solvent?

Give a reason for your answer.

Ink _____

—

Reason _____

–

_____

(2)

(d) Use **Figure 2** to complete the table below, then calculate the Rf value for red ink.

	Distance in mm
Distance moved by red ink	_____
Distance from start line to solvent front	_____

The R_f value for red ink is calculated using the equation.

$$R_f = \frac{\text{distance moved by red ink from the start line}}{\text{distance moved by solvent from the start line}}$$

Give your answer to two significant figures.

_____

_____

R_f value = _____

(5)

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(e) How can you tell from **Figure 2** that the R_f value for the blue ink is greater than the Rf value for the red ink?

_____

_____

(1)

(Total 13 marks)

Q13.

Aqamed is a medicine for children.

(a) The medicine is a formulation.

What is meant by a formulation?

_____

_____

(1)

(b) Children often do not like taking medicine.

Suggest a substance that could be added to Aqamed to increase the desire for children to take it.

Give a reason for your suggestion.

Substance _____

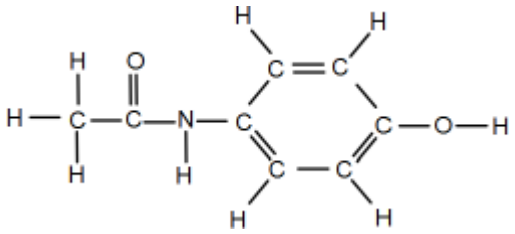
Reason _____

_____

(2)

(c) The main ingredient in Aqamed is a painkiller called paracetamol.

The figure below represents a molecule of paracetamol.



Give the molecular formula of paracetamol.

Calculate its relative formula mass (M_r).

Relative atomic masses (A_r): H = 1; C = 12; N = 14; O = 16

Molecular formula _____

Relative formula mass _____

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_____

M_r = _____

(2)

(d) Aspirin is a medicine for use by adults.

An aspirin tablet contains 300 mg of acetylsalicylic acid.

Calculate the number of moles of acetylsalicylic acid in one aspirin tablet.

Give your answer in standard form to three significant figures.

Relative formula mass (M_r) of aspirin = 180

_____

_____

_____

_____

_____

_____

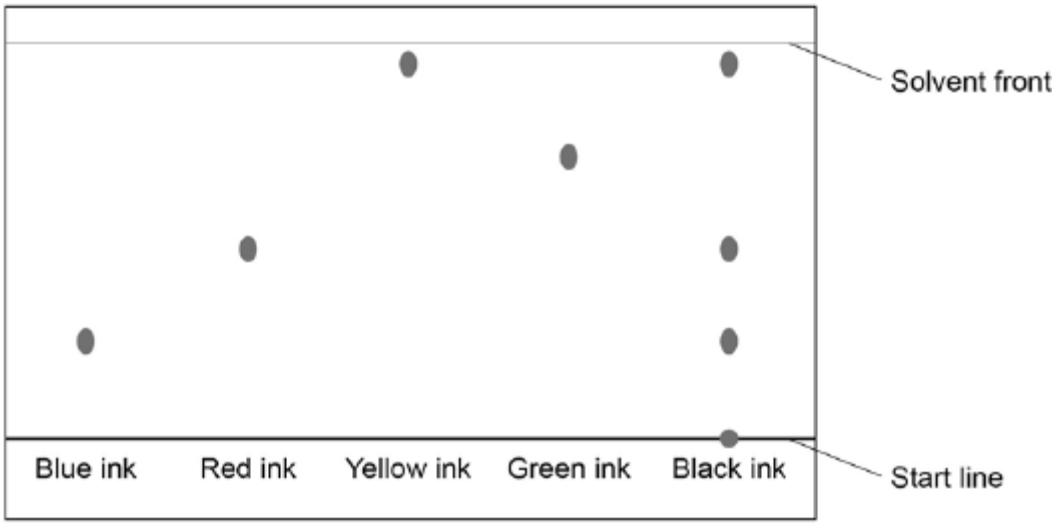
Number of moles = _____

(4)

(Total 9 marks)

Q14.

The figure below shows a paper chromatogram of five different inks.



(a) Explain how paper chromatography separates substances.

_____

_____

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(3)

(b) Analyse the chromatogram. Describe and explain the result for black ink.

(4)

(c) Use the figure above to calculate the R_f value of the blue ink.

R_f value = _____

(3)

(Total 10 marks)

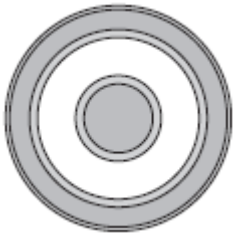
Q27.

Scientists in the 16th century used the symbol shown in **Figure 1** for gold.

Figure 1

Gold

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The scientists thought platinum was made from gold and silver, so they used the symbol for gold in the symbol for platinum. The symbol for platinum is shown in **Figure 2**.

Figure 2

Platinum



(a) Gold and platinum are elements.

What is meant by the term **element**?

_____

_____

(1)

(b) Why is it incorrect to represent platinum as shown in **Figure 2**?

_____

_____

(1)

(c) Scientists now use a formula such as Ag_2O to represent a substance.

What does the formula Ag_2O tell you about this substance?

_____

_____

_____

_____

(2)

(Total 4 marks)

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