Questions

Q1.

Some questions must be answered with a cross in a box (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).

Potable water is water that is suitable for drinking.

River water can be treated to make it potable.
Chlorination, filtration and sedimentation are three of the processes involved in making the river water potable.

(i) Which row of the table shows these three processes in the order in which they are carried out?

(1)

		first	second	third
☒	**A**	chlorination	sedimentation	filtration
☒	**B**	chlorination	filtration	sedimentation
☒	**C**	sedimentation	filtration	chlorination
☒	**D**	sedimentation	chlorination	filtration

(ii) State the reason why chlorine is added during the water treatment.

(1)

.....

.....

(iii) Describe how sedimentation is carried out.

(2)

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.....

(iv) Figure 5 shows the results of an analysis of a sample of potable water.

ion	concentration in mg dm^{-3}
chloride	60.70
fluoride	0.24
nitrate	24.90
sulfate	71.40
copper	0.05
magnesium	9.10

Figure 5

Using this information, explain why this sample of potable water is not the same as pure water.

(2)

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(Total for question = 6 marks)

Q2.

Inks contain coloured dyes.
Samples of four inks, **W**, **X**, **Y** and **Z**, were separated using paper chromatography.
Figure 5 shows the chromatogram obtained.

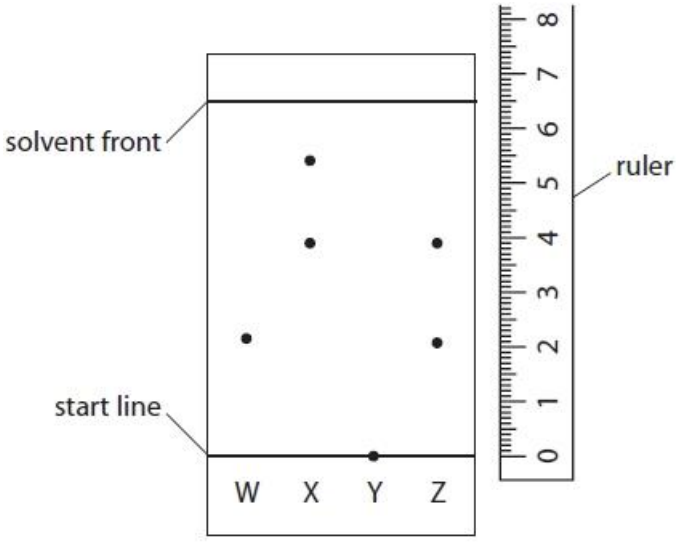

Figure 5

(i) In the experiment, the solvent front moved 6.5 cm.

Calculate the R_f value of the dye that is present in both inks **X** and **Z**.

(1)

.....

.....

R_f = ...

(ii) State what could be changed in the experiment to make the R_f value more accurate.

(1)

.....

.....

(iii) In this experiment, ink sample **Y** did not move from the start line.

Explain a change to the experiment that would be needed to separate the dyes in ink sample **Y**.

(2)

.....

.....

.....

(Total for question = 4 marks)

Q3.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

A sample of potable water contains impurities.

Why is this sample of water potable even though it contains impurities?

(1)

- ☐ **A** the impurities have no smell
- ☐ **B** the impurities are colourless
- ☐ **C** the impurities are harmless
- ☐ **D** the impurities are soluble

(Total for question = 1 mark)

Q4.

The apparatus for a simple distillation is shown in Figure 1.

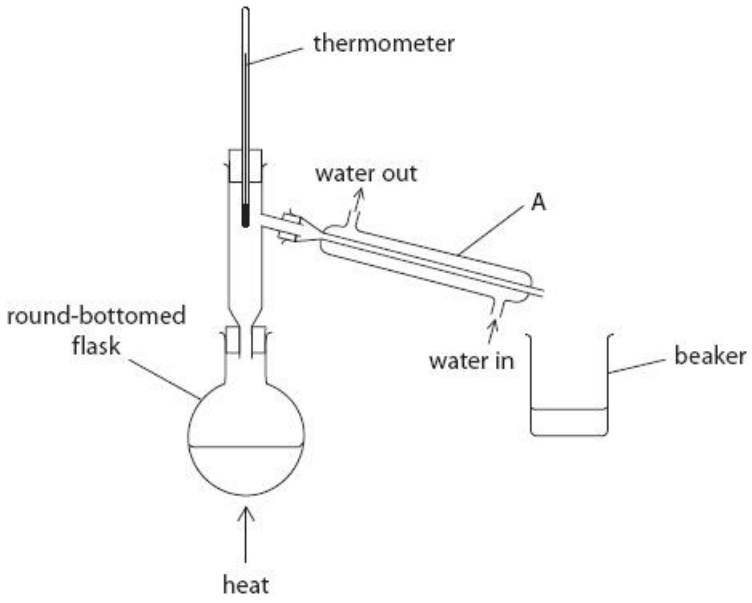

Figure 1

(i) Use words from the box to complete the sentences.

You may use each word once, more than once, or not at all.

condensation	distillate	evaporation
gas	residue	solid

(3)

Simple distillation is used to separate a liquid from a .....

In the apparatus labelled A, vapour is cooled to form liquid.

This process is called .....

The liquid collected in the beaker is known as the .....

(ii) Pure water collects in the beaker.

Explain how the apparatus will show that the liquid collected is pure water.

(2)

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.....

.....

.....

(Total for question = 5 marks)

Q5.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Waste water can be used to produce drinking water.
The processes used include sedimentation, filtration and chlorination.

(i) What is sedimentation?

(1)

- ☐ **A** the waste water is heated so the impurities evaporate
- ☐ **B** the waste water has an acid added to remove impurities
- ☐ **C** the impurities in the waste water settle to the bottom of their container
- ☐ **D** the impurities in the waste water are bleached

(ii) State why the waste water is filtered.

(1)

.....

.....

(iii) State the reason for chlorination.

(1)

.....

.....

.....

(Total for question = 3 marks)

Q6.

A sample of rock salt contains a mixture of sodium chloride and some insoluble substances.

The rock salt is added to water and the mixture stirred.

The mixture is then filtered to obtain a filtrate of sodium chloride solution.

(i) Draw a labelled diagram of the apparatus used to filter the mixture and collect the sodium chloride solution.

(2)

(ii) Describe how a sample of pure, dry sodium chloride crystals can be obtained from the filtrate.

(3)

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.....

(Total for question = 5 marks)

Q7.

In a different method of obtaining nickel, the process produces a mixture of the liquids nickel tetracarbonyl and iron pentacarbonyl.

The boiling point of nickel tetracarbonyl is 43 °C.
The boiling point of iron pentacarbonyl is 103 °C.
These two liquids mix together completely.

Describe the process used to separate these two liquids.

(3)

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(Total for question = 3 marks)

Q8.

* A sample of water was contaminated with a dissolved solid.

Devise a plan to separate pure water from this mixture, including a test to show that the water obtained is neutral.

You may use some or all of the apparatus shown in Figure 11 and any other laboratory apparatus.

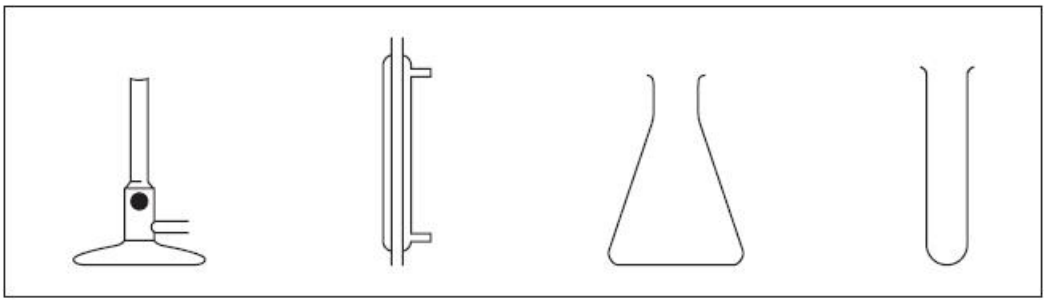

Figure 11

(6)

(Total for question = 6 marks)

Q9.

A student set up the apparatus shown in Figure 4 to obtain pure water from sea water by distillation.

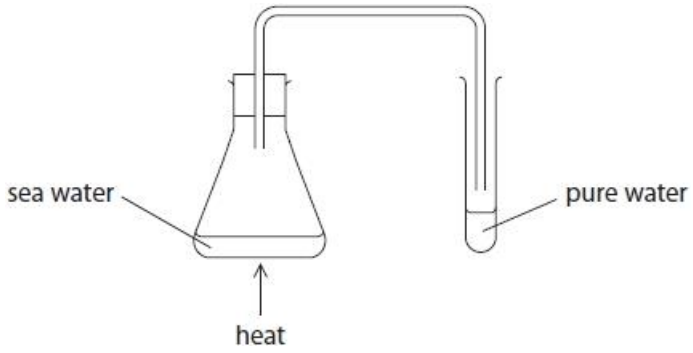

Figure 4

(i) Explain how the water in sea water separates to produce the pure water in this apparatus.

(2)

.....

.....

.....

.....

(ii) Explain how the apparatus could be improved to increase the amount of pure water collected from the same volume of sea water.

(2)

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.....

.....

.....

(Total for question = 4 marks)

Q10.

Potable water is water that is suitable for drinking.

A student wanted to distil a sample of potable water.
Figure 6 shows apparatus the student used.

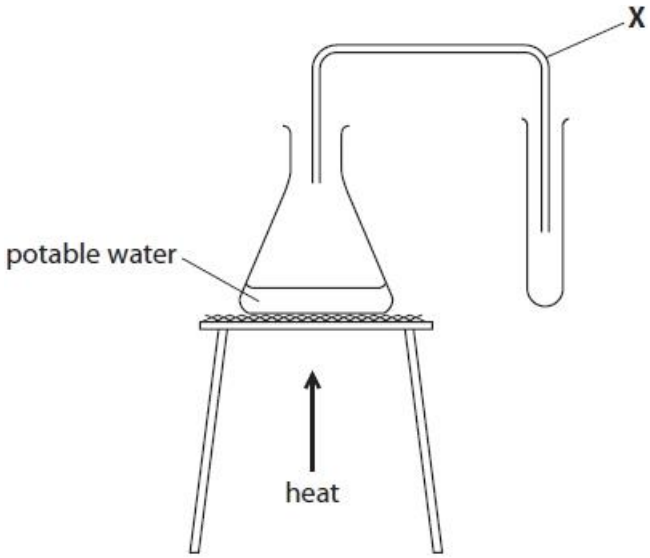

Figure 6

(i) Name the piece of equipment labelled **X** in Figure 6.

(1)

.....

(ii) The student made an error when setting up the equipment in Figure 6.
This error meant no water could be collected in the test tube.

Explain what the student needs to do so water can be collected.

(2)

.....

.....

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.....

(Total for question = 3 marks)

Q11.

In analysis, tests are carried out on solids dissolved in water.

Explain why it is important that the water used is pure.

(2)

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(Total for question = 2 marks)

Q12.

Figure 2 shows a label from a bottle of drinking water.

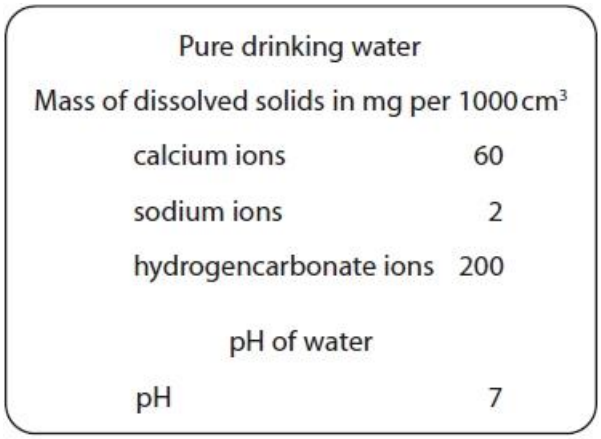

Figure 2

(i) Explain why this drinking water should not be described as pure water.

(2)

.....

.....

(ii) State the information from Figure 2 that shows that the drinking water is neutral.

(1)

.....

(iii) Calculate the mass of calcium ions in 250 cm^3 of this drinking water.

(2)

.....

.....

mass = ... mg

(Total for question = 5 marks)

Q13.

Mixtures of substances can be separated using different techniques.

Figure 5 shows the apparatus that a student set up to obtain pure water from ink.

There are three mistakes in the way the apparatus has been set up.

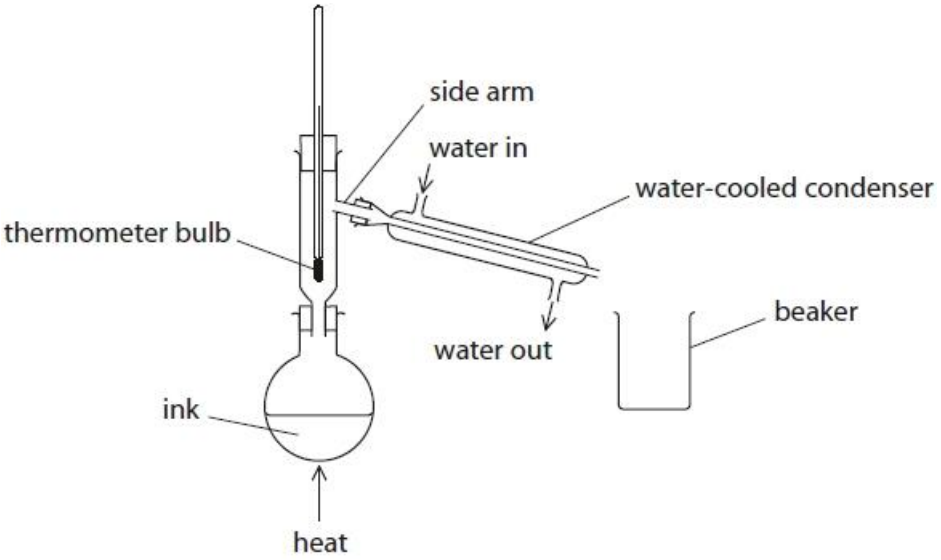

Figure 5

(i) One mistake is that the bulb of the thermometer is too low.

The bulb of the thermometer should be level with the side arm.
Give a reason why the bulb of the thermometer should be level with the side arm.

(1)

.....

.....

.....

(ii) State **one** other mistake in Figure 5.

(1)

.....

.....

(Total for question = 2 marks)

Q14.

Filtration is a method used to separate insoluble solids from liquids.

Figure 9 shows the apparatus used for filtration.

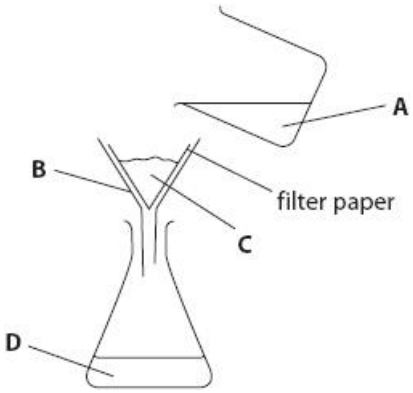

Figure 9

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

(i) Which letter shows the filtrate?

(1)

☐ **A**

☐ **B**

☐ **C**

☐ **D**

(ii) The filter paper has been labelled.

Explain how the filter paper separates the insoluble solid from the liquid.

(2)

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.....

(Total for question = 3 marks)

Q15.

Some food colourings are a mixture of soluble, coloured substances. Mixtures of soluble substances can be separated by paper chromatography.

Paper chromatography was used to try to separate the coloured substances in five food colourings, **V**, **W**, **X**, **Y** and **Z**.

Figure 10 shows the spots for the five food colourings on the chromatography paper at the start of the experiment.

The paper was placed in a beaker with the bottom of the paper in the solvent.

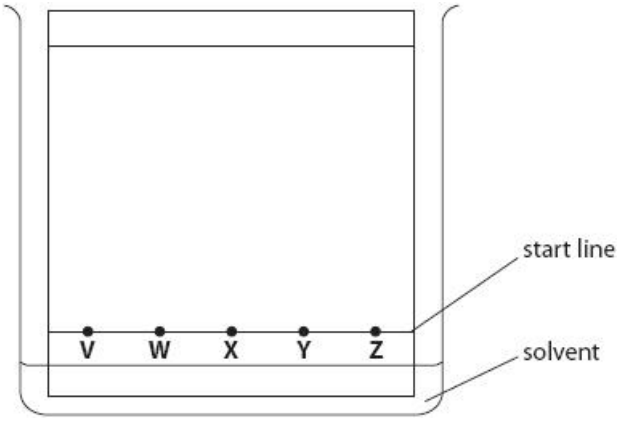

Figure 10

(i) Identify the stationary phase in this experiment.

(1)

.....

(ii) Give a reason why the spots of the food colourings must be above the level of the solvent, when the paper is placed in the solvent.

(1)

.....

.....

.....

(iii) Figure 11 shows the chromatogram at the end of the experiment.

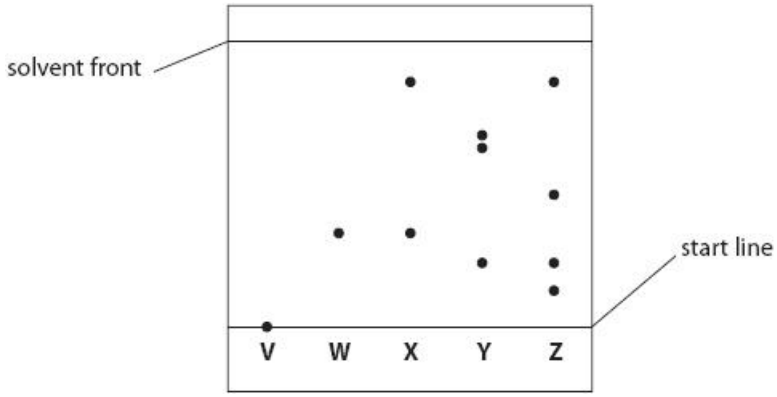

Figure 11

Give the reason why the spot of food colouring **V** has not moved during the chromatography experiment.

(1)

.....

.....

(iv) Explain, by referring to Figure 11, which food colouring contained the greatest number of soluble, coloured substances.

(2)

.....

.....

.....

.....

(v) One coloured substance in food colouring **X** moved 5.8 cm when the solvent front moved 6.6 cm.

Calculate the R_f value for this substance, giving your answer to two significant figures.

(2)

R_f value = ...

(Total for question = 7 marks)

Q16.

Mixtures of substances can be separated using different techniques.

Which of the following is a mixture of substances?

(1)

- ☒ **A** air
- ☒ **B** carbon dioxide
- ☒ **C** gold
- ☒ **D** titanium

Q17.

Mixtures of substances can be separated using different techniques.

Paper chromatography is used to separate the substances in five different food colourings, **P**, **Q**, **R**, **S** and **T**.

Figure 6 shows the chromatogram at the end of the experiment.

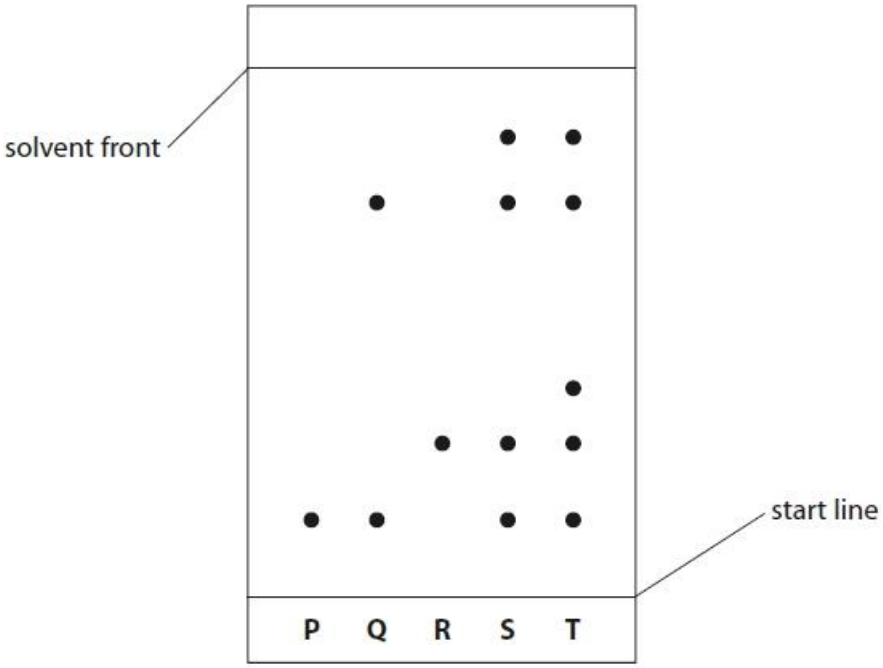

Figure 6

(i) The steps needed to carry out the chromatography experiment are listed below.
They are not in the correct order.

1 leave the solvent to rise up the paper
2 put solvent in the beaker
3 draw a start line on the piece of paper
4 place the paper in the beaker
5 remove the paper when the solvent is near the top
6 put small spots of the food colourings on the start line

List the steps in the correct order.
The first two steps have been done for you.

(2)

2	3				

(ii) Explain, using Figure 6, which food colouring contains the greatest number of coloured substances.

(2)

.....

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.....

.....

(iii) During chromatography of the food colourings, the solvent front moved 8.00 cm and the food colouring **R** moved 2.30 cm.

Calculate the R_f value for food colouring **R**.
Give your answer to two significant figures.

(2)

.....

.....

.....

.....

R_f value = ...

(Total for question = 6 marks)

Q18.

An ink is a mixture of coloured substances dissolved in water.

The apparatus shown in Figure 9 can be used to separate water from ink.

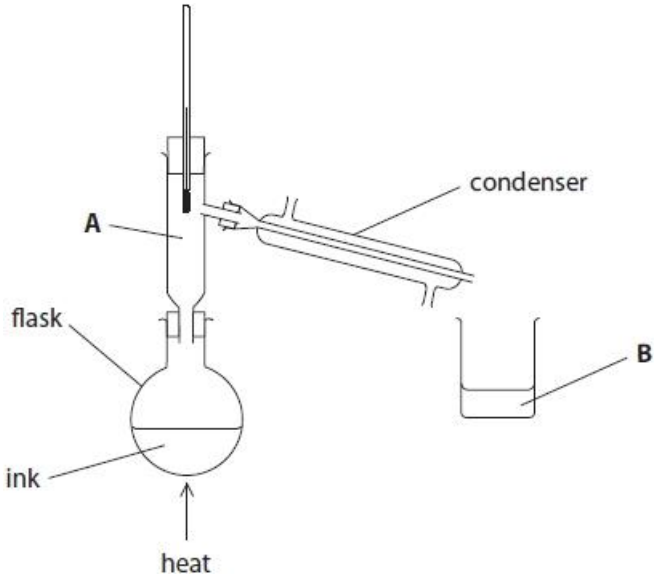

Figure 9

(i) Cold water flows through the condenser.

On Figure 9 use arrows to show where the water should flow in and where it should flow out.

(1)

(ii) Explain why a condenser is used.

(2)

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.....

.....

.....

(iii) The flask was heated with a Bunsen burner.

Give the name of an alternative piece of apparatus that could be used to heat the flask.

(1)

.....

.....

(Total for question = 4 marks)

Q19.

An ink is a mixture of coloured substances dissolved in water.

Which method is used to separate the coloured substances in the ink?

(1)

- ☒ **A** chromatography
- ☒ **B** crystallisation
- ☒ **C** filtration
- ☒ **D** fractional distillation

(Total for question = 1 mark)

Q20.

After this reaction, there is a mixture of the solids magnesium, titanium and magnesium chloride.

Titanium does not react with dilute hydrochloric acid.

Suggest a simple method to separate titanium from the mixture.

(2)

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.....

.....

(Total for question = 2 marks)

Q21.

Titanium is extracted from its ore in several stages.

In the first stage, titanium chloride is formed as a gas.

The gas is cooled to form liquid titanium chloride containing **dissolved** impurities.

Suggest how pure titanium chloride could be separated from the impurities.

(1)

.....

(Total for question = 1 mark)

Q22.

Some salts can be added to waste water to remove impurities.
In an experiment, different masses of salt **A** were added to 1000 cm^3 samples of waste water.
The experiment was repeated with salt **B**.
The percentages of impurities removed from the waste water are shown in Figure 10.

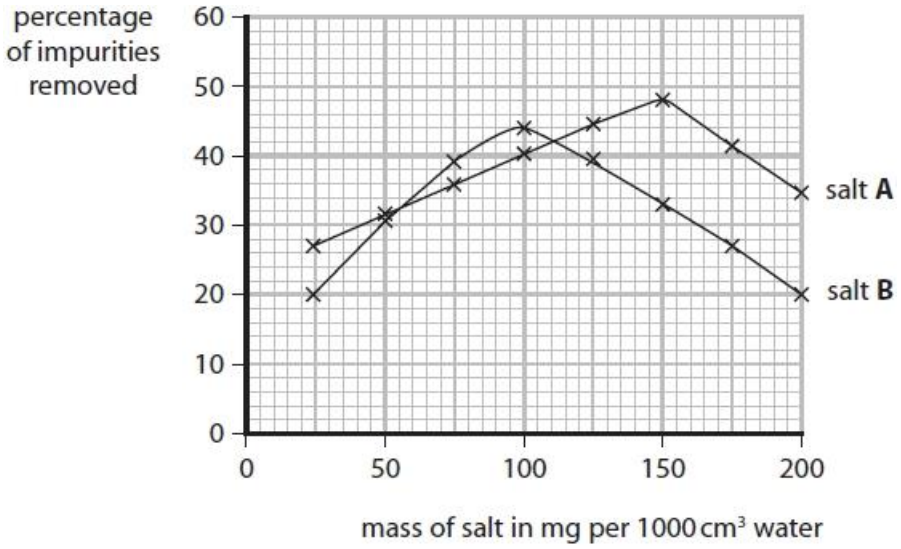

Figure 10

It was concluded that the best way to purify 1000 cm^3 of the waste water is to add 100 mg of salt **B**.

Use the information about salt **A** and salt **B** in Figure 10 to evaluate this conclusion.

(3)

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(Total for question = 3 marks)

Mark Scheme

Q1.

Question number	Answer	Mark
(i)	**C** sedimentation filtration chlorination is the only correct answer **A** and **B** are incorrect as sedimentation is the first step **D** is incorrect as chlorination is the last step	**(1) AO1-1**

Question number	Answer	Additional guidance	Mark
(ii)	to kill {bacteria / microorganisms / microbes / pathogens}	ignore germs / diseases allow viruses allow 'remove' / 'get rid of' / eliminate for kill allow to sterilise / disinfect (the water) ignore to clean / purify / bleach / make water clear	**(1) AO1-1**

Question number	Answer	Additional guidance	Mark
(iii)	A description including: • (put waste) water in tank / left to (stand / settle) (1) • {particles / dirt / impurities / sediment / solid} fall to bottom (1)	 allow any put in suitable large or small container e.g. container / beaker allow for MP1 add a substance that causes clumping / aluminium sulfate must have idea that particles sink reject large(r) pieces e.g– sand / rocks / branches etc - that would be filtered ignore any references to filtration before or after sedimentation	**(2) AO1-1**

Question number	Answer	Additional guidance	Mark
(iv)	an explanation linking: • (the water) contains {chlor**ide** / fluor**ide**, nitr**ate** / sulf**ate** / copper / magnesium / ions / salts } (1) • (therefore) <u>more than</u> just water (molecules) / it does not contain <u>just</u> water / which are impurities / pure substances contain <u>only</u> one substance / pure water does not contain ions (1)	allow chemicals / minerals / substances ignore particles / metals / elements / molecules / things allow pure water is just H_2O / contains hydrogen and oxygen only reject pure substances contain only one element allow pure water does not contain any of {ions in the table / these ions / specifically named ions from table} for 2 marks	**(2)** **AO3** **2a – 1** **2b – 1**

Q2.

Question number	Answer	Additional guidance	Mark
(i)	0.6 or <u>3.9</u> 6.5		**(1)**

Question number	Answer	Additional guidance	Mark
(ii)	longer paper/ different {medium/ paper}	ignore repeat experiment ignore more accurate ruler	**(1)**

Question number	Answer	Additional guidance	Mark
(iii)	An explanation linking use a different solvent (1) so that the ink will dissolve (1)	 allow any suitable named solvent allow because the ink does not dissolve in water	**(2)**

Q3.

Question number	Answer	Mark
	C the impurities are harmless **C** is the only correct answer. **A**, **B** and **D** are incorrect as the properties are not relevant	(1) AO2

Q4.

Question number	Answer	Mark
(i)	solid (1) condensation (1) distillate (1)	(3)

Question number	Answer	Mark
(ii)	An explanation that combines identification - application of knowledge (1 mark) and reasoning/justification - application of understanding (1 mark): (use a) thermometer (1) the temperature is {the boiling point of water / 100°C} (1)	(2)

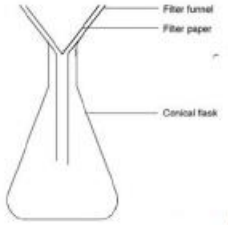
Q5.

Question number	Answer	Mark
(i)	**C** the impurities in the waste water settle to the bottom of their container **C** is the only correct answer. **A**, **B** and **D** are incorrect because no sediment is formed	(1) AO1

Question number	Answer	Additional guidance	Mark
(ii)	to remove {insoluble substances / solids}	allow named solid substances eg sand ignore materials removed by initial screening eg twigs, debris etc ignore to produce clean/pure water reject remove bacteria	(1) AO1

Question number	Answer	Additional guidance	Mark
(iii)	to kill {bacteria / microorganisms}	ignore to cleanse, purify, clean, make safe allow to remove bacteria / germs	(1) AO1

Q6.

Question number	Answer	Additional guidance	Mark
(i)	 (2) OR diagram: funnel with separate filter paper and (conical) flask (1) labels: (filter) **funnel and filter paper and** (conical) flask (1)	reject diagram with funnel 'closed' at bottom/top but can score MP2 allow 'closed' filter paper allow any suitable apparatus for conical flask e.g. beaker 'flask' label should be appropriate to apparatus drawn ignore labelling of filtrate/residue etc	(2)

Question number	Answer	Additional guidance	Mark
(ii)	a description including any three from: • heat solution (to concentrate) (1) then either • leave solution {in warm place / to crystallise} (1) • scrape crystals (from container) / pat dry between filter papers (1) OR • leave solution {to crystallise / to cool} (1) • filter off crystals / decant liquid from the crystals / pat dry between filter papers / dry in oven (1)	if no other marks are scored , allow max 1 for crystallisation (1)	(3)

Q7.

Question number	Answer	Additional guidance	Mark
	An answer that describes the following points of application of knowledge and understanding to provide a logical description: • (fractional) **distillation** (1) • heat/ boil (1) • nickel tetracarbonyl {{boils/evaporates} off first / is obtained from top of column/ vapour is condensed by condenser} ORA (1)	answers describing simple or fractional distillation are allowed Fully labelled correct diagram would score MP1 (and MP2 if heat indicated) allow 'raise temp. to 50°C' etc. (temp >42 and <90) allow lower boiling point liquid for nickel tetracarbonyl	(3)

Q8.

Question number	Indicative content	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **SEPARATION** • distillation • solution in flask • heat • water evaporates • water vapour into condenser • cooling water jacket • water vapour condensed back to liquid • water collected in beaker • solid remains in flask • boiling point = 100 °C **TEST** • take distilled water in a test tube • add a few drops of neutral litmus/Universal Indicator • correct neutral colour OR • pH probe • pH = 7	**(6)** **AO1** **AO3**

Level	Mark	Descriptor	Additional Guidance
	0	No rewardable material.	Read whole answer and ignore all incorrect material/ discard any contradictory material then:
Level 1	1–2	Additional Guidance	Gives simple parts of the plan or describes the test to show the water is neutral. e.g. heat the solution (1) use the Bunsen burner to heat the solution (2) use universal indicator to test the water, it should turn green (2)
Level 2	3–4	Additional Guidance	Gives a more detailed plan or a simple part of the plan with the test to show the water is neutral. e.g. heat the solution with a Bunsen burner, the water evaporates at 100ºC (3) Heat the solution in a flask, the water will evaporate and move into the condenser where it turns back to a liquid (4) Heat the solution to evaporate the water and then use the condenser, use universal indicator to test the water which should turn green. (4)
Level 3	5–6	Additional Guidance	Gives a more detailed plan **and** the test to show the water is neutral. e.g. heat the solution, the water will evaporate and move to the condenser where it will cool and turn back to a liquid. Test the water neutral litmus paper (5) Use distillation, heat the solution in a flask, the water vapour moves to the condenser where it cools and turns back to a liquid. The water can be tested with a pH meter the reading should be pH 7 (6)

Q9.

Question Number	Answer	Additional guidance	Mark
(i)	An explanation linking • water {boils / evaporates} (to form steam / water vapour / leaving salt behind) (1) • (steam / water vapour) condenses (to form pure water) (1) allow alternative wording for evaporate and condense	ignore sea water evaporates sea water evaporates and condenses scores 1 overall mark independently	**(2)** AO 1 1

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation linking • use a (Liebig) condenser / surround test tube with (beaker of) {iced/cold} water / wrap delivery tube with cold cloth (1) • to increase effectiveness of cooling / amount of condensation / remove the heat energy more effectively / ensure all the water vapour condenses (1)	ignore anti bumping granules / fractionating column allow alternative suitably described methods / prevent water vapour escaping / cools water vapour faster ignore sea water vapours a closed system scores 0 overall mark independently	(2) AO 3 3b

Q10.

Question number	Answer	Additional guidance	Mark
(i)	(delivery) tube	allow {glass / rubber / plastic} tube	(1) AO2-1

Question number	Answer	Additional guidance	Mark
(ii)	an explanation linking: add bung / cork (to top of flask) (1) (so) {water / vapour / gas / steam} cannot escape (from top of flask) / will go into {(delivery) tube/ X} (1)	ignore seal / block / lid / cover etc allow stopper allow incorrect naming of flask ignore 'so water is collected' allow incorrect naming of delivery tube mark independently for max 1 allow replacement of X with a (Liebig) condenser / cooling of delivery tube / ice bath around test tube (1)	(2) AO3 3b

Q11.

Question number	Answer	Additional guidance	Mark
	An explanation that combines identification - knowledge (1 mark) and reasoning/justification - understanding (1 mark): pure water has no other {ions/substances/contaminants} present (1) (other ions) may give a {false/incorrect} result (1)	 ORA allow otherwise results are not {reliable /accurate} ORA ignore unfair/fair test	**(2)**

Q12.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking • pure water contains {only water (molecules)/ only one substance} / impure water contains more than one substances (1) • identification <u>from label</u> of impurity: dissolved solids/ calcium (ions) / sodium (ions) / hydrogencarbonate (ion) / ions	ignore all references to pH	**(2)** **AO3**

Question number	Answer	Mark
(ii)	pH (=7)	**(1)** **AO2**

Question number	Answer	Mark
(iii)	15 mg with or without working scores 2 • 250/1000 (1) (=0.250) • 60 x 250/1000 (1) (=15) OR • 1000/250 (1) = 4 • 60/4 (1) (=15)	**(2)** **AO2**

Q13.

Question number	Answer	Additional guidance	Mark
(i)	to measure the temperature of the {water vapour / steam / gas} passing into the condenser	to measure the boiling point of the water / the vapour should be at 100 °C when collected allow does not measure accurate boiling point where thermometer is on the diagram (or words to that effect)	(1)
(ii)	beaker not under condenser exit / water entering condenser in wrong place / water flow in condenser wrong way round	ignore references to no Bunsen burner / clamps shown allow beaker not under where (condensed) water comes out / no {anti-bumping granules / chips} allow beaker {is too far away (from the condenser exit)/ too far to the right / is not in the right place / needs to be closer} reject water out (without reference to end of condenser)	(1)

Q14.

Question number	Answer	Mark
(i)	D	(1)

Question number	Answer	Additional guidance	Mark
(ii)	An explanation that combines identification - knowledge (1 mark) and reasoning/justification - understanding (1 mark): liquid goes through the paper (1) solid does not pass through (1)	allow only liquid passes through (2)	(2)

Q15.

Question number	Answer	Additional guidance	Mark
(i)	water (in the paper) (1)	allow (chromatography/filter) paper	(1)

Question number	Answer	Additional guidance	Mark
(ii)	EITHER so that the solvent will run through the spots OR otherwise the spots transfer into the solvent	ignore spots will smudge allow water in place of solvent allow spots {soak/mix/dissolve/wash} into water allow spots will not rise up the paper/ spots will not separate allow (food) colourings/dyes/colours/dots for spots throughout	**(1)**

Question number	Answer	Additional guidance	Mark
(iii)	(V is) insoluble (in the solvent)	ignore immiscible allow doesn't contain any soluble substances	**(1)**

Question number	Answer	Additional guidance	Mark
(iv)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion/reasoning (1 mark): • (mixture) Z (1) • because it gives {the greatest number of / the most / 4} spots (1)	ignore 'greatest number of soluble coloured substances' allow dots for spots 2nd mark dependent on 1st	**(2)**

Question number	Answer	Additional guidance	Mark
(v)	• $R_f = \frac{5.8}{6.6}$ (1) (=0.8787..) • = 0.88 (1) (to 2 sig fig)	award full marks for correct numerical answer to 2 sig figs without working. 0.87878787 rounded to any other no of sig figs (1) any manipulation of the 2 numbers with working rounded to 2sf (1) ignore any units	**(2)**

Q16.

Question number	Answer	Mark
	A air The only correct answer is **A**. **B** is incorrect since carbon dioxide is a compound and not a mixture. **C** and **D** are incorrect because gold and titanium are both metallic elements and not mixtures.	(1)

Q17.

Question Number	Answer	Additional guidance	Mark
(i)	(2) (3) **6 4 1 5** (2) any **two** in the correct order and adjacent to each other max (1)	64 / 15 / 41 next to each other in this order in any position (1)	(2)

Question number	Answer	Additional guidance	Mark
(ii)	An explanation linking • mixture **T** (1) • because it gives {the greatest number / 5} spots (1)	allow dots or other suitable descriptor allow more {spots / separated (coloured) substances} ignore coloured substances (alone) / colours / references to spots moving further up the paper	(2)

Question Number	Answer	Additional guidance	Mark
(iii)	0.29 with or without working scores 2 $R_f = \frac{2.30}{8.00}$ (= 0.2875) (1) = 0.29 (1)	allow $\frac{8.00}{2.30}$ = 3.5 (1) (other way round for 1 mark) 8.00 + 2.30 = 10 (1) 8.00 – 2.30 = 5.7 (1) (2 sf) 8.00 x 2.3 (= 18) (2 sf)	(2)

Q18.

Question Number	Answer	Additional guidance	Mark
(i)	arrows drawn to show water going in the condenser in the bottom and out the condenser at the top	reject arrows drawn coming out of the middle of the condenser	**(1)** AO 1 2

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation linking • to cool (1) • so (water) {vapour/gas} turns to liquid (1)	 allow water for liquid allow steam for vapour if cooling the ink max 1 for first marking point only	**(2)** AO 1 2

Question Number	Answer	Additional guidance	Mark
(iii)	electric heater / heating mantle	allow spirit burner allow hot plate/heated plate allow blow torch ignore heater alone ignore Bunsen burner ignore hot water bath	**(1)** AO 2 2

Q19.

Question Number	Answer	Mark
	A chromatography **The only correct answer is A** ***B*** *is not correct this would not separate colours* ***C*** *is not correct because this would not separate colours* ***D*** *is not correct because this would not separate colours in best way*	**(1)** AO 1 1

Q20.

Question number	Answer	Additional guidance	Mark
	A description to include either • add dilute hydrochloric acid (to solid mixture sample to react with the magnesium to form magnesium chloride solution) (1) • filter the mixture (to remove titanium) / filter off the titanium (1) or • filter the mixture (to remove titanium) / filter off the titanium (1) • wash the titanium (1)		(2) AO3

Q21.

Question number	Answer	Additional guidance	Mark
	(simple) distillation	allow fractional distillation	(1) AO2

Q22.

Question number	Answer	Additional guidance	Mark
	An answer including • best amount of **A** is 150 (mg) (1) • 150 mg **A** removes more than 100 (mg) **B** (1) • so it is better to use salt **A** than salt **B** (1) OR • because (at peak activity) **B** removes a higher percentage per gram than **A** (1) • so less salt would be needed / more efficient (1) • so it is better to use salt **B** than salt **A** (1) OR • 150 mg of A removes 48% impurities • 100 mg of B removes 44% impurities • so salt **A** is better (than salt **B**) as more impurities are removed (1) OR • 100 mg of A removes 40% impurities • 100 mg of B removes 44% impurities • so salt B is better (than salt A) as more impurities are removed for same mass of salt (1)	ignore incorrect units of mass • allow so salt B is more effective in smaller quantities	**(3)** **AO3**