1 A student uses the following method to prepare a sample of hydrated zinc nitrate crystals.

step 1 put 25 cm^3 of dilute nitric acid into a beaker

step 2 add zinc carbonate until it is in excess

step 3 separate the dilute solution of zinc nitrate from the mixture

The student then obtains crystals from the dilute solution of zinc nitrate.

(a) Name the piece of apparatus used to measure the nitric acid in step 1.

(1)

.....

(b) How would the student know when she has added an excess of zinc carbonate?

(1)

.....

.....

(c) Name the separation method used in step 3.

(1)

.....

(d) The student wants to obtain a pure, dry sample of hydrated zinc nitrate crystals from the dilute solution.

One method is to leave the solution so that all the water evaporates.

Describe another method, involving crystallisation, that the student could use.

(4)

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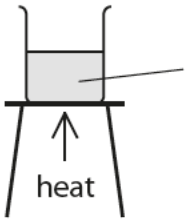
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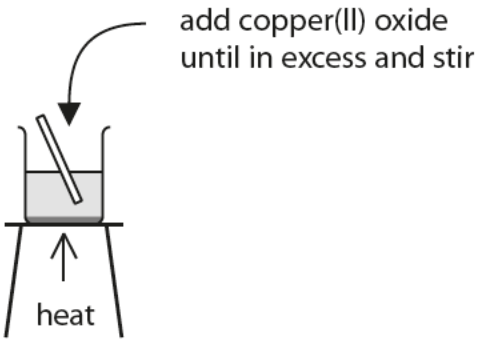
(Total for Question 1 = 7 marks)

2 The diagram shows how hydrated copper(II) sulfate crystals can be made by reacting copper(II) oxide with dilute sulfuric acid.

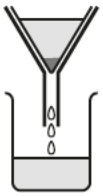
stage 1



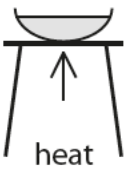
stage 2



stage 3



stage 4



stage 5



(a) Why is the sulfuric acid heated in stage 1?

(1)

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(b) How would you know when the copper(II) oxide is in excess in stage 2?

(1)

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(c) Why is the mixture filtered in stage 3?

(1)

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(d) Why do crystals form when the hot saturated solution is cooled in stage 5?

(1)

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.....

(e) State the colour of the crystals formed in stage 5.

(1)

.....

(f) The crystals are removed by filtration and then dried.

Suggest a suitable method of drying the crystals.

(1)

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.....

(Total for Question 2 = 6 marks)

3 The table shows some properties of four substances A, B, C and D.

Substance	Melting point in °C	Boiling point in °C	Conducts electricity when solid?	Conducts electricity when molten?
A	–101	–35	no	no
B	1063	2970	yes	yes
C	801	1413	no	yes
D	3550	4830	no	no

(a) Use the information in the table to identify the substance that

(i) is a metal

(1)

☒ **A** ☒ ☒ **C** ☒ **D**

(ii) could be diamond

(1)

☒ **A** ☒ **B** ☒ **C** ☒ **D**

(iii) is a gas at 20 °C

(1)

☒ **A** ☒ **B** ☒ **C** ☒ **D**

(iv) contains oppositely charged ions

(1)

☒ **A** ☒ **B** ☒ **C** ☒ **D**

(b) Some of the substances in the table are compounds.

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

(2)

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(c) (i) The electronic configurations of atoms of sodium and chlorine are

Na 2.8.1

Cl 2.8.7

Describe the changes in the electronic configurations of sodium and chlorine when these atoms form sodium chloride.

(3)

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(ii) Calculate the relative formula mass of sodium chloride (NaCl).

Use the Periodic Table on page 2 to help you.

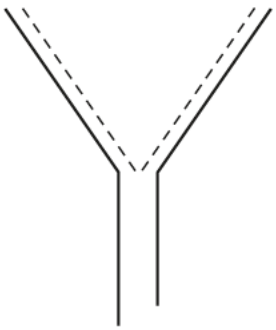
(2)

relative formula mass = ...

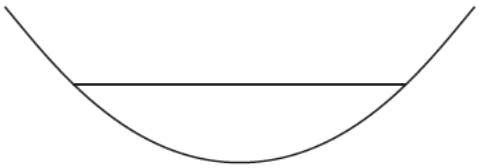
(Total for Question 3 = 11 marks)

4 The diagram shows four pieces of apparatus used in the separation of mixtures.

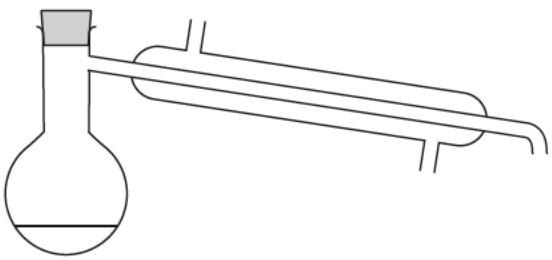
P



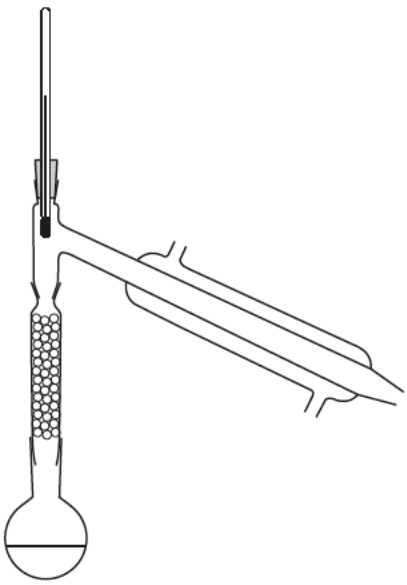
Q



R



S



(a) (i) The apparatus labelled P is used for

(1)

- ☒ **A** crystallisation
- ☒ **B** filtration
- ☒ **C** fractional distillation
- ☐ **D** simple distillation

(ii) The apparatus labelled S is used for

(1)

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

(b) (i) Which method of separation should be used to obtain sand from a mixture containing salt, sand and water?

(1)

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

(ii) Which method of separation should be used to obtain pure water from a mixture containing salt, sand and water?

(1)

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

(iii) Which method of separation should be used to obtain copper(II) sulfate from a mixture containing copper(II) sulfate and water?

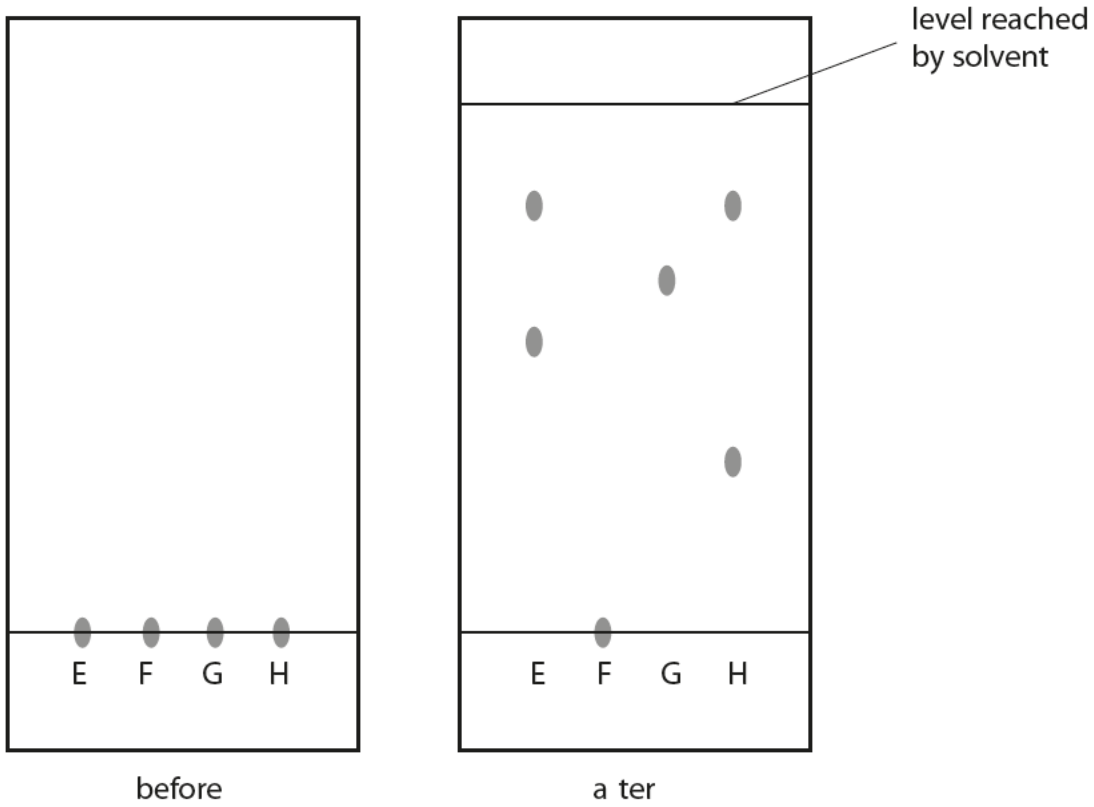
(1)

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

(c) Food colourings contain one or more food dyes.

A student used paper chromatography to separate the dyes contained in food colourings. She placed spots of three known food colourings (E, F and G) and one unknown food colouring (H) on the chromatography paper.

The diagram shows the appearance of the paper before and after her experiment.



(i) Describe how the student should complete the experiment after placing the four spots on the paper.

(3)

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(ii) Suggest why food colouring F did not move during the experiment.

(1)

.....

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(iii) How many food dyes are there in food colouring E?

(1)

.....

(iv) How many known food dyes are there in food colouring H?

(1)

.....

(v) Dyes are often identified by their R_f values.

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

Record the results for the dye in G and calculate its R_f value.

(3)

distance moved by dye in mm	
distance moved by solvent in mm	
R_f value of G	

(Total for Question 4 = 14 marks)

5 When solutions are mixed together, precipitates sometimes form.

(a) Barium carbonate is an insoluble compound. It is formed as a precipitate when solutions of the soluble compounds barium chloride and sodium carbonate are mixed.

When solutions of the soluble compounds potassium chloride and sodium sulfate are mixed, no precipitate is formed.

Complete the table to show the results of mixing solutions of some compounds.

(3)

	sodium carbonate solution	**sodium sulfate solution**
barium chloride solution	precipitate of barium carbonate	....
potassium chloride solution	....	no precipitate
calcium chloride solution	precipitate of calcium carbonate	....

(b) When solutions of lead(II) nitrate and potassium bromide are mixed, a precipitate of lead(II) bromide and a solution of potassium nitrate are produced.

The equation for the reaction is

$$Pb(NO_3)_2(.....) + 2KBr(.....) \rightarrow PbBr_2(.....) + 2KNO_3(.....)$$

Complete the equation by inserting the state symbols.

(1)

(c) In order to prepare a **pure**, **dry** sample of lead(II) bromide, a student took the mixture produced in part (b).

He then

- filtered the mixture
- washed the solid residue with distilled water
- left the solid in a warm place for several hours

(i) Why did the student filter the mixture?

(1)

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.....

.....

(ii) Why did he wash the solid residue?

(1)

.....

.....

.....

(iii) Why is it better to use distilled water rather than tap water to wash the solid residue?

(1)

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(iv) Why did he leave the solid in a warm place?

(1)

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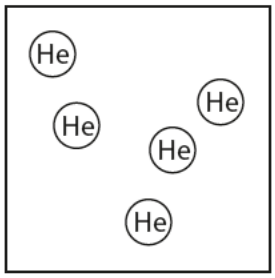
(Total for Question 5 = 8 marks)

6 (a) Substances can be classified as elements, compounds or mixtures.

Each of the diagrams below represents either an element, a compound or a mixture.

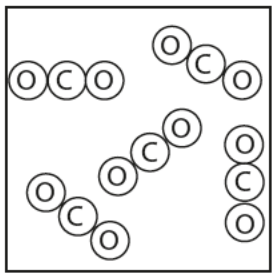
State which one of these is represented by each diagram.

(i)



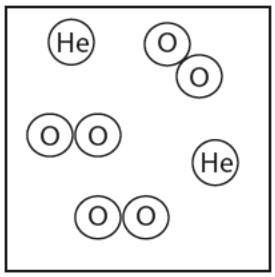
(1)

(ii)



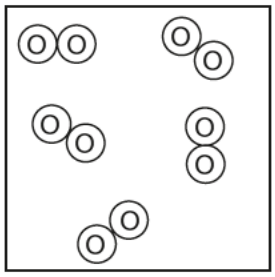
(1)

(iii)



(1)

(iv)



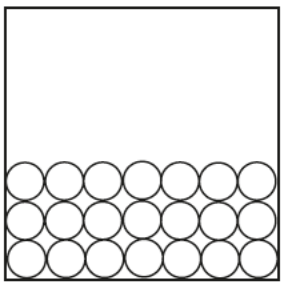
(1)

(b) Substances can also be classified as solids, liquids or gases.

Each of the diagrams below represents either a solid, a liquid or a gas.

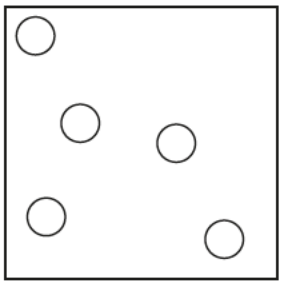
State which one of these is represented by each diagram.

(i)



(1)

(ii)



(1)

(Total for Question 6 = 6 marks)