

TOPICAL PAST PAPER QUESTIONS WORKBOOK

Edexcel IGCSE Chemistry (4CH1) 1C & 1CR

Exam Series: Jan 2017 – Jan 2022

Format Type B:

Each question is followed by its answer scheme



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Introduction

Each topical past paper questions workbook consists of hundreds of questions and their answer schemes, in the form of worksheets. Questions are assigned to each chapter according to their corresponding topic. Topics, in turn, are based on the items of the latest Edexcel International GCSE or A level syllabus content. This book's specifications are as follows:

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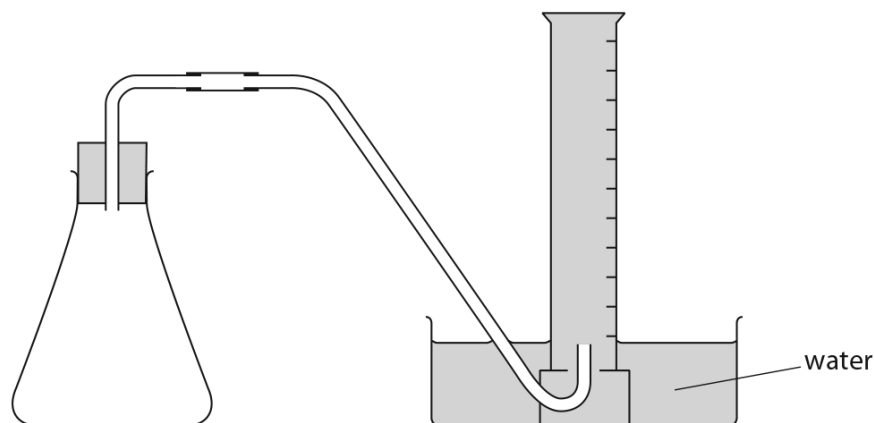
Chapter 1

Assessing Investigative / Experimental Skills

1.1 Assessing Investigative / Experimental Skills

1. 4CH0_1CR_que_20170518 Q: 5

A student uses this apparatus to investigate the rate of reaction between an excess of magnesium and two different dilute acids, X and Y.



This is the method given to the student.

- place 0.5 g of magnesium ribbon into the conical flask
- use a measuring cylinder to add 50 cm³ of dilute acid X and then replace the bung
- record the total volume of gas collected every 20 seconds for two minutes
- repeat the method using 50 cm³ of dilute acid Y instead of dilute acid X
- in each experiment, keep the temperature the same and the magnesium in excess

(a) The student decides to use a burette, rather than a measuring cylinder, to add the acid to the conical flask.

- (i) Using a burette would be an improvement only if another change is made to the method.

State the other change needed to the method.

(1)

- (ii) State the advantage of using a burette.

(1)

(b) The table shows the student's results.

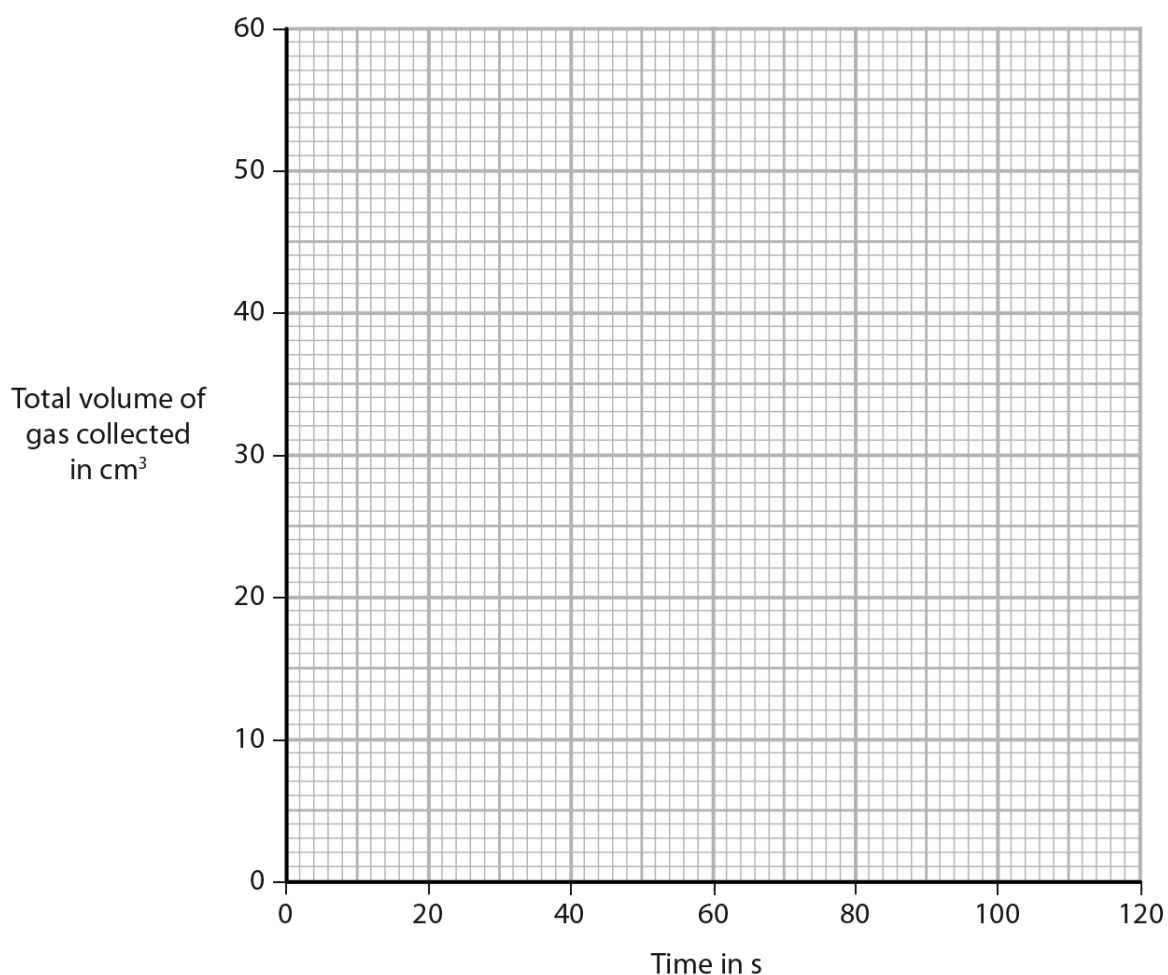
	Time in s	0	20	40	60	80	100	120
Acid X	Total volume of gas collected in cm ³	0	6	11	15	18	20	21
Acid Y	Total volume of gas collected in cm ³	0	12	22	30	37	43	48

Plot the results for each acid on the grid.

Draw a curve of best fit for each set of points.

Label each curve as acid X or acid Y.

(4)



(c) Explain how the curves show which acid has the greater concentration.

(2)

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.....

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.....

.....

(d) Use the graph to find the total volume of gas collected at 70 s for acid X.

Show on the graph how you obtained your answer.

(2)

volume of gas = cm³

(e) The average (mean) rate of the reaction for acid Y can be calculated using the expression

$$\text{average rate} = \frac{\text{total volume of gas collected}}{\text{time to collect the gas}}$$

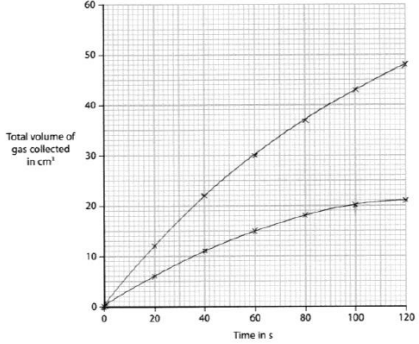
Calculate the average rate, in cm³/s, for the first 30 s for acid Y.

(2)

average rate = cm³/s

(Total for Question 5 = 12 marks)

Answer:

Question number	Answer	Notes	Marks
(a) (i)	add acid before magnesium	ORA	1
(ii)	a burette has a better resolution (than a measuring cylinder)	ALLOW greater accuracy (of data) ALLOW greater precision (of data)	1
(b)	 <p data-bbox="384 824 900 880">M1 and M2 all points plotted correctly to the nearest gridline for both experiments</p> <p data-bbox="384 1043 911 1077">M3 suitable curve of best fit drawn for acid X</p> <p data-bbox="384 1099 911 1133">M4 suitable curve of best fit drawn for acid Y</p>	Deduct one mark for each incorrectly plotted point Missing (0,0) loses 1 mark only	4

Q	Answer	Notes	Mark
(c)	<p>M1 Y (has the greater concentration)</p> <p>M2 (because) the curve (for acid Y) has a steeper slope/greater gradient (showing that the reaction is faster)</p> <p>OR (because) it produces the larger volume of gas/more gas in the same time</p>	<p>M1 DEP M2</p> <p>OWTTE</p> <p>Mark CSQ on candidate's labelling of their curves If no labelling assume steeper curve is acid Y</p>	2
(d)	<p>M1 vertical line drawn to touch curve at t = 70 s OR horizontal line drawn to touch curve at t = 70 s</p> <p>M2 value read correctly from candidate's graph to nearest gridline</p>	<p>Expected value in range 16-17 (cm³)</p>	2
(e)	<p>M1 17 (cm³)</p> <p>M2 (17 ÷ 30) = 0.57 (cm³/s)</p>	<p>ACCEPT value read correctly from candidate's graph to nearest gridline</p> <p>ACCEPT any number of sig figs e.g. 0.6, 0.567, 0.56 recurring</p> <p>Mark M2 CSQ on M1</p>	2
Total			12

2. 4CH0_1C_que_20180110 Q: 4

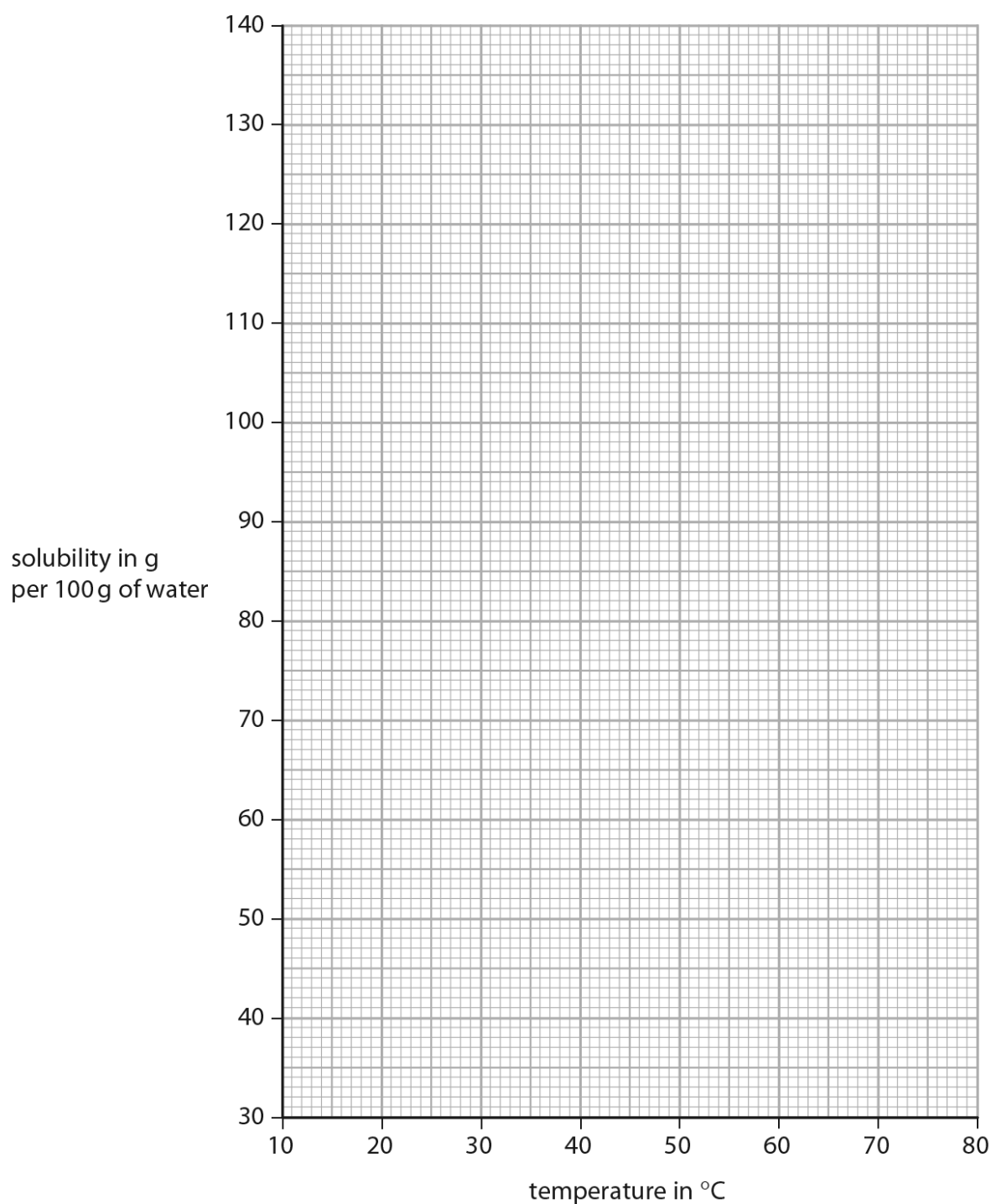
The maximum mass of a solid that dissolves in 100 g of water at a given temperature is called its solubility.

The table gives the solubility of potassium nitrate at six different temperatures.

Temperature in °C	20	30	40	50	60	70
Solubility in g per 100 g of water	41	52	65	83	106	135

(a) Plot the points on the grid and draw a curve of best fit.

(3)



(b) Extend your curve to find the solubility of potassium nitrate at 10 °C.

(2)

solubility = g per 100 g of water

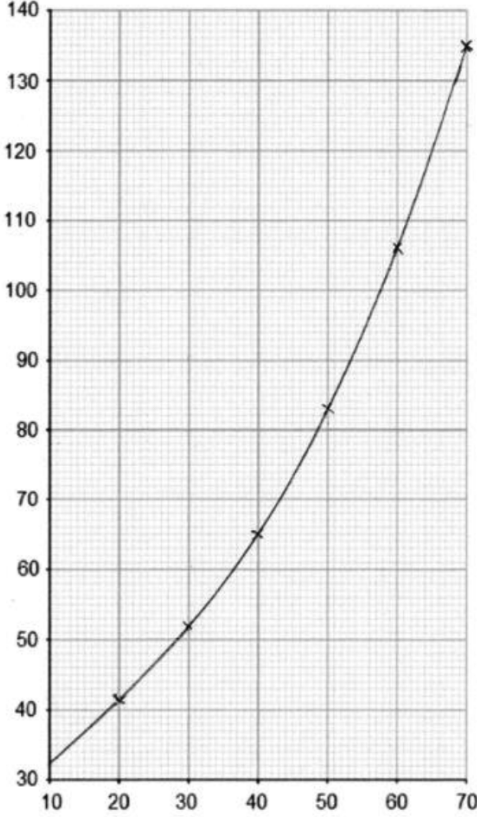
(c) Use your graph to find the maximum mass of potassium nitrate that could dissolve in 50 g of water at 35 °C.

(2)

maximum mass = g

(Total for Question 4 = 7 marks)

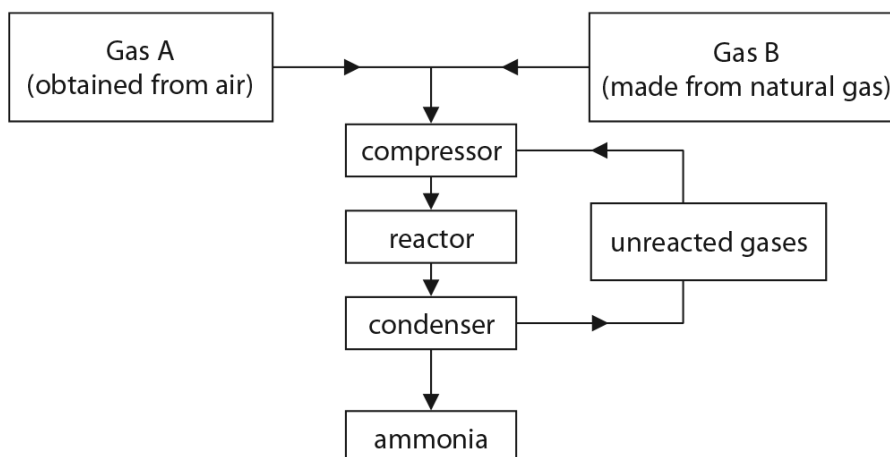
Answer:

Question number	Answer	Notes	Marks
(a)		<p>M1 and M2 all points plotted correctly to nearest gridline</p> <p>Penalise 1 mark for each point plotted incorrectly</p> <p>M3 suitable curve of best fit drawn for points plotted</p> <p>Do not consider any extrapolation of curve for M3</p>	3
(b)	<p>M1 curve correctly extrapolated to cut y axis (at 10 °C)</p> <p>M2 correct reading to nearest gridline from curve drawn</p>	<p>typical answer in range 32-33</p>	2
(c)	<p>M1 correct reading to nearest gridline at 35 °C from curve drawn</p> <p>M2 value from M1 divided by 2 and correctly evaluated</p>	<p>typical answer = 58</p>	2

Total 7 marks

3. 4CH0_1C_que_20180110 Q: 15

The flow diagram shows the main stages in an industrial process to manufacture ammonia.



(a) Give the name of this industrial process.

(1)

(b) Identify gases A and B.

(2)

gas A.....

gas B.....

(c) State the purpose of the condenser.

(1)

(d) Name the catalyst that is used in the reactor.

(1)

(e) Suggest two reasons why the unreacted gases are recycled.

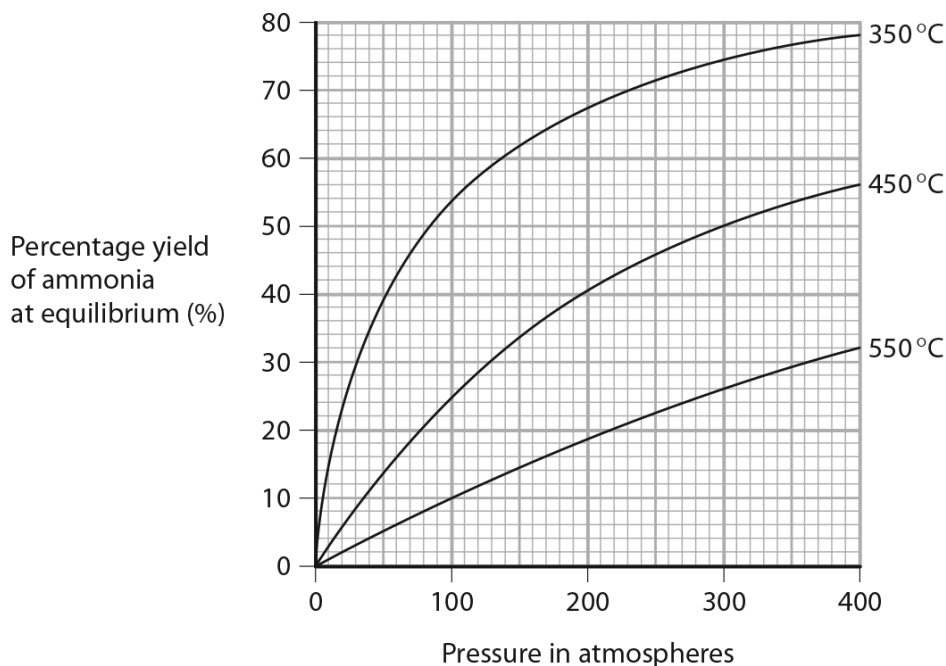
(2)

1.....

2.....

- (f) The reaction to make ammonia is reversible and can reach a position of equilibrium.

The graph shows the percentage yield of ammonia at equilibrium, and at different temperatures and pressures.



- (i) State the conditions of temperature and pressure that would produce the largest percentage yield of ammonia.

(2)

.....

- (ii) Find the percentage yield of ammonia at equilibrium, at a pressure of 200 atmospheres and a temperature of 450°C.

(1)

.....

- (iii) Suggest why, in the industrial process, the percentage yield of ammonia at 200 atmospheres and 450°C is only 15%.

(1)

.....

(Total for Question 15 = 11 marks)

Answer:

Question number	Answer	Notes	Marks
(a)	Haber (process)		1
(b)	M1 (gas A) - nitrogen/N ₂	If name and formula given both must be correct	1
	M2 (gas B) - hydrogen/H ₂	If both answers correct but in wrong order award 1 mark	1
(c)	to liquefy the ammonia	IGNORE to condense the ammonia ALLOW to separate the ammonia from the unreacted gases/nitrogen and hydrogen	1
(d)	iron		1
(e)	Any two from: M1 saves raw materials/resources M2 uses less energy M3 to produce more ammonia / to improve yield (of ammonia)	ALLOW stops raw materials/resources being wasted ACCEPT saves energy ALLOW so recycled gases/nitrogen and hydrogen/they can be reacted again IGNORE references to saves money	2
(f)	(i) M1 350 (°C)	ACCEPT low temperature	1
	M2 400 (atm)	ACCEPT high pressure	1
	(ii) 40 (%)	If numerical answers given units or indication of which is temp/pressure required ACCEPT range 40-41 (%)	1
	(iii) the reaction does not reach equilibrium		1

Total 11 marks

4. 4CH0_1C_que_20180517 Q: 11

Malachite is an ore of copper containing copper(II) carbonate and several other compounds that are insoluble in water.

You are supplied with several pieces of malachite, these chemicals and items of apparatus.

Chemicals: dilute sulfuric acid magnesium powder

Apparatus: beakers filter funnel and paper pestle and mortar

Describe how you would use the chemicals and the apparatus to obtain a sample of copper from the malachite.

(6)

(Total for Question 11 = 6 marks)

Answer:

Question number	Answer	Notes	Marks
	<p>M1 powder/crush the malachite (using the pestle and mortar)</p> <p>M2 add the malachite/powder to dilute sulfuric acid (in a beaker) OR add dilute sulfuric acid to the malachite (in a beaker)</p> <p>M3 filter (using filter funnel and paper)</p> <p>M4 add magnesium powder to the filtrate/solution/copper sulfate</p> <p>M5 method to collect/obtain/ remove the residue/copper (using filter funnel and paper)</p> <p>M6 reference to appropriate use of at least two pieces of apparatus</p>	<p>ALLOW powder/crush the ore</p> <p>ACCEPT mix the powder with dilute sulfuric acid (in a beaker)</p> <p>ALLOW decant</p> <p>IGNORE any later steps e.g. washing / evaporation</p>	6

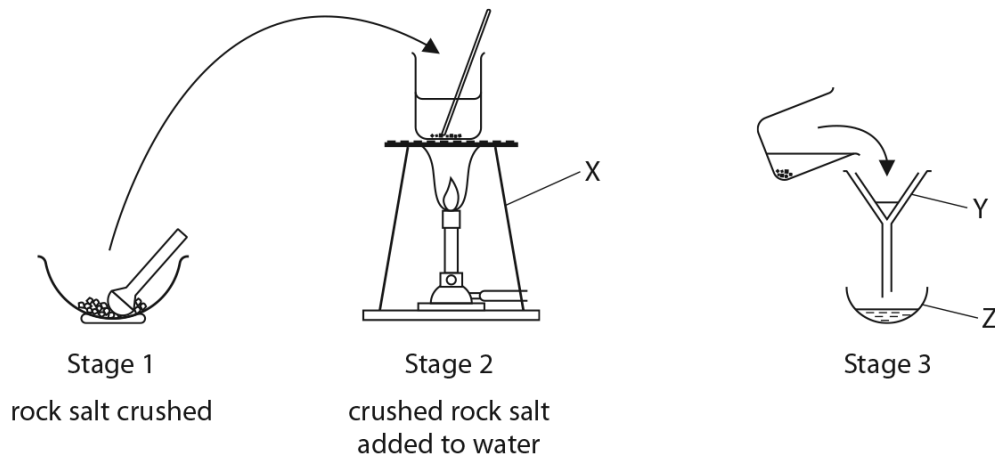
Q	Answer	Notes	Mark
	<p>OR</p> <p><u>If malachite and magnesium are both added to the acid at the same time, then:</u></p> <p>M1 powder/crush the malachite (using the pestle and mortar)</p> <p>M2 add the malachite/powder to dilute sulfuric acid and add the magnesium (in a beaker)</p> <p>M3 filter and collect/obtain the residue/copper (using filter funnel and paper)</p> <p>M4 reference to appropriate use of at least two pieces of apparatus</p>	<p>IGNORE any later steps e.g. washing / evaporation</p>	

Total for Question 11 = 6 marks

5. 4CH0_1C_que_20190110 Q: 2

Rock salt is a mixture of the soluble salt, sodium chloride, and some insoluble impurities.

The diagram shows the first three stages of a method used to obtain pure sodium chloride from rock salt.



(a) Name the pieces of apparatus labelled X, Y and Z

(3)

X

Y

Z

(b) (i) State why the mixture of rock salt and water is warmed and stirred in stage 2.

(2)

.....

.....

.....

.....

(ii) What is water in stage 2?

(1)

- A** a residue
- B** a solute
- C** a solution
- D** a solvent

(c) (i) Explain what happens to the impurities in stage 3.

(2)

.....

.....

.....

.....

(ii) What is the liquid collected at the end of stage 3?

(1)

- A** a residue
- B** a solute
- C** a solution
- D** a solvent

(Total for Question 2 = 9 marks)

Answer:

Question number	Answer	Notes	Marks
(a)	M1 tripod M2 Y (filter) funnel M3 Z evaporating basin/dish	ACCEPT correct labelling on diagram if answers not on answer lines ALLOW evaporating bowl	3
(b)(i)	M1 so the sodium chloride/salt dissolves M2 (more) quickly	REJECT so the rock salt dissolves IGNORE references to increased rate of reaction M2 dep on mention of dissolving in M1	2
(ii)	D a solvent		1
(c)(i)	M1 impurities remain in filter paper/funnel M2 because they are insoluble / do not dissolve	ALLOW impurities are filtered out/off /are the residue ACCEPT because the particles are too large to pass through (filter paper)	2
(ii)	C a solution		1

Total for Question 2 = 9 marks

Chapter 2

Principles of chemistry

2.1 States of matter

6. 4CH1_1CR_que_20190517 Q: 1

This question is about the three states of matter, solid, liquid and gas.

(a) Solids, liquids and gases can be changed from one state to another.

The box gives the names of some changes of state.

condensing	evaporation	melting	sublimation
------------	-------------	---------	-------------

Use words from the box to complete the sentences.

Each word may be used once, more than once or not at all.

(i) The change from solid to liquid is called (1)

(ii) The change from liquid to gas is called (1)

(iii) The change from solid to gas is called (1)

(b) Describe the arrangement and the movement of particles in a solid. (3)

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(Total for Question 1 = 6 marks)

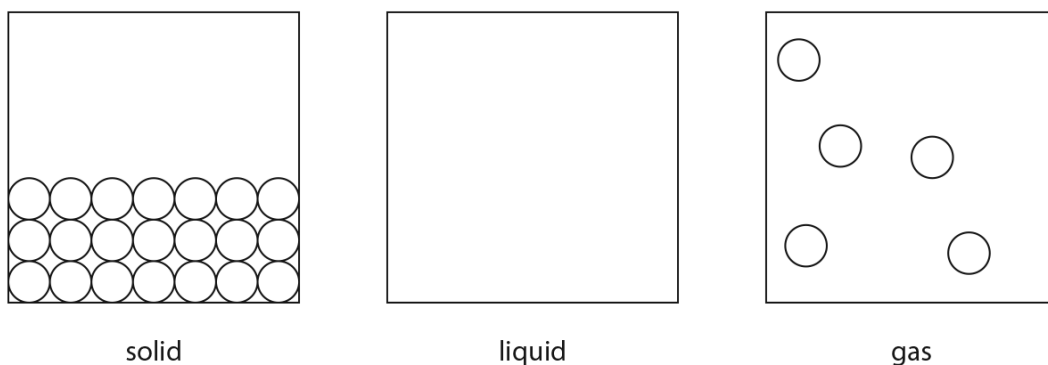
Answer:

Question number	Answer	Notes	Marks
a (i)	melting		1
(ii)	evaporation		1
(iii)	sublimation		1
b	<p>A description that refers to three of the following points</p> <p>M1 (particles) close together</p> <p>M2 (particles) regularly arranged</p> <p>M3 (particles) do not move around</p> <p>M4 (particles) vibrate (about a fixed position)</p>	<p>ALLOW tightly packed/ touching</p> <p>ALLOW arranged in a lattice</p> <p>M1 and M2 can be scored from a diagram</p> <p>ALLOW do not move freely</p> <p>IGNORE references to fixed shape and volume</p>	<p>3</p> <p>Total 6</p>

7. 4CH1_1CR_que_20200305 Q: 2

This question is about states of matter.

(a) The diagram shows how the particles of a substance are arranged in two different states.



(i) Complete the diagram to show how particles are arranged in the liquid state. (1)

(ii) Identify the state of matter in which the particles have the most energy. (1)

(b) The state symbols (s), (l), (g) and (aq) are often used in chemistry.

The table shows some physical changes.

Complete the table by giving the state symbol before and after each change.

(3)

Physical change	State symbol	
	before change	after change
water evaporates		
crystals of iodine sublime		
ice melts		

(c) Explain why hot water evaporates more quickly than cold water.

(2)

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(Total for Question 2 = 7 marks)

Answer:

Question number	Answer	Notes	Marks
(a) (i)	Particles should be close together and should fill from the bottom of the box, some particles should touch	ALLOW particles filling the whole box IGNORE the size of the particles REJECT a regular arrangement	1
(ii)	Gas	ALLOW gaseous	1
(b)	M1 (water evaporates) l to g M2 (crystals of iodine sublime) s to g M3 (ice melts) s to l	ALLOW words for M1, M2 and M3	3
(c)	M1 (particles / molecules have) more energy M2 to overcome / break the forces (between water molecules)	ALLOW water has more energy ALLOW (particles / molecules have) move faster IGNORE vibrate more ALLOW to overcome / break the bonds (between water molecules) OR to break away from one another OR so escape more easily IGNORE references to collisions or activation energy	2

8. 4CH1_1CR_que_20220108 Q: 2

(a) (i) State the meaning of the term **solute**.

(1)

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.....

(ii) State the meaning of the term **solvent**.

(1)

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.....

(b) Explain what is meant by a saturated solution.

(2)

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(c) A dark purple liquid is diluted by adding water.

The diluted liquid becomes a pale purple colour.

Explain the process that causes this change.

Refer to particles in your answer.

(2)

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(Total for Question 2 = 6 marks)

Answer:

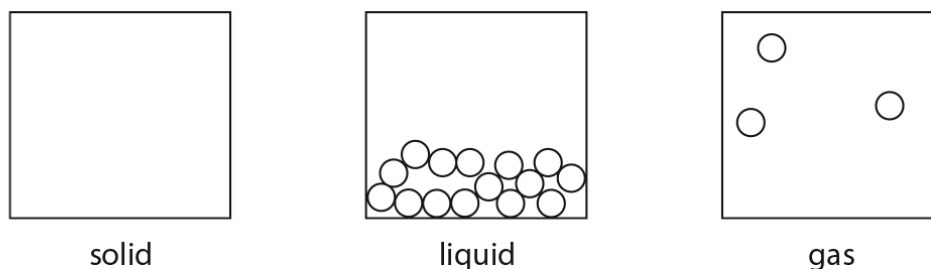
Question number	Answer	Notes	Marks
(a) (i)	(solute is) the substance/solid that dissolves (in a solvent) OWTTE		1
(ii)	(solvent is) the substance/liquid the solute/solid/substance dissolves in OWTTE		1
(b)	M1 (saturated solution) contains as much dissolved solute/solid/substance as possible OWTTE M2 at a particular temperature		2
(c)	M1 process called diffusion M2 particles spread out (evenly throughout water/solution/liquid)	ALLOW particles move from area of high concentration to area of low concentration	2

Total for Question 2 = 6 marks

9. 4CH0_1C_que_20170111 Q: 2

The diagram shows the arrangement of the molecules in two of the three states of water.

Each circle represents a molecule of water.



(a) Complete the diagram to show how the molecules of water are arranged in the solid state.

(1)

(b) Which row of the table correctly describes the arrangement and movement of molecules of water in the solid state?

(1)

	Arrangement	Movement
<input type="checkbox"/> A	regular	moving freely
<input type="checkbox"/> B	random	moving freely
<input type="checkbox"/> C	regular	vibrating
<input type="checkbox"/> D	random	vibrating

(c) Which word describes water changing from a liquid to a solid?

(1)

- A** boiling
- B** condensing
- C** freezing
- D** melting

(d) Give the word used to describe the change of state represented by this equation.



(e) Water is the name used for $\text{H}_2\text{O(l)}$.

Give the two names used for $\text{H}_2\text{O(g)}$. (2)

1

2

(Total for Question 2 = 6 marks)

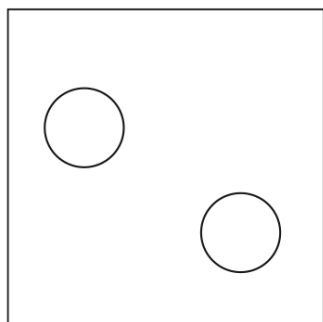
Answer:

Question number	Answer	Notes	Marks
(a)	diagram showing solid state	Accept minimum of two complete rows	1
(b)	C (regular vibrating)		1
(c)	C (freezing)		1
(d)	sublimation		1
(e)	M1 water vapour M2 steam		Accept in either order
(Total for Question 2 = 6 marks)			

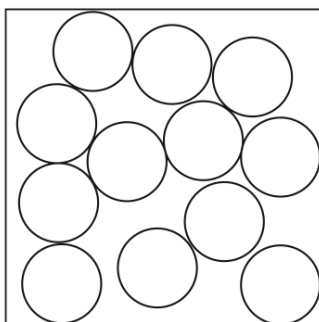
10. 4CH0_1C_que_20180110 Q: 2

The diagram shows the arrangement of particles in the three states of matter.

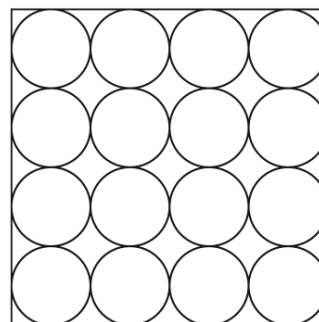
Each circle represents a particle.



X



Y



Z

- (a) Use the letters X, Y and Z to give the starting and finishing states of matter for each of the changes in the table.

The first one has been done for you.

(3)

Change	Starting state	Finishing state
ice to water	Z	Y
solid iodine to iodine gas		
molten iron to solid iron		
ethene to poly(ethene)		

- (b) Which of these changes takes place when solid iodine is heated to form iodine gas?

(1)

- A crystallisation
- B evaporation
- C melting
- D sublimation

(Total for Question 2 = 4 marks)

Answer:

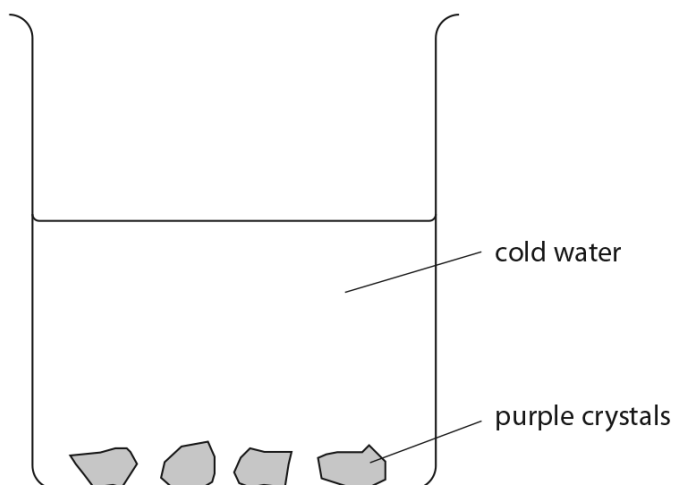
Question number	Answer			Notes	Marks
(a)	Change	Starting state	Finishing state	1 mark for each correct row	3
	ice to water				
	solid iodine to iodine vapour	Z	X		
	molten iron to solid iron	Y	Z		
	ethene to (poly)ethene	X	Z		
(b)	D (sublimation)				1

Total 4 marks

11. 4CH0_1C_que_20180110 Q: 3

A student places a few purple crystals at the bottom of a beaker containing some cold water.

The crystals start to dissolve.



(a) State how the appearance of the crystals and the water change as the crystals dissolve. (2)

crystals.....

.....

water.....

.....

(b) Which process occurs as the crystals dissolve to form a solution?

(1)

- A condensation
- B crystallisation
- C diffusion
- D melting

(c) The student repeats the experiment using hot water instead of cold water.

(i) State how the change in the appearance of the water differs when hot water is used instead of cold water.

(1)

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(ii) Explain, in terms of particles, why the change differs when hot water is used instead of cold water.

(2)

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(Total for Question 3 = 6 marks)

Answer:

Question number	Answer	Notes	Marks
(a)	M1 (crystals) - get smaller M2 (water) - turns (from colourless to) purple	ACCEPT disappear IGNORE dissolve IGNORE reference to (incorrect) colours/loses colour IGNORE mass decreases ALLOW pink IGNORE goes cloudy ALLOW (water) turns to colour of crystals REJECT other incorrect observations, e.g. fizzing, crystals change colour, only once in (a)	2
(b)	C diffusion		1
(c)(i)	(water would change colour/go purple) more quickly	ALLOW change (in appearance) /it happens more quickly ALLOW (dissolves) more quickly IGNORE cloudy/incorrect colour ALLOW references to darker purple/colour with hot water ALLOW references to faster reaction IGNORE references to collisions	1
(c)(ii)	M1 particles/molecules/ions/they have more (kinetic) energy/are moving faster (in hot water) M2 particles/molecules/ions/they diffuse/spread more quickly	ALLOW reverse argument in cold water If change is slower in (i) then ALLOW particles/molecules/ions have less (kinetic) energy/are moving slower ALLOW particles/molecules/ions/they dissolve more quickly ALLOW more particles dissolve ALLOW references to more frequent collisions between water molecules and crystals	2

Total 6 marks

12. 4CH0_1C_que_20190110 Q: 1

The three states of matter are solid, liquid and gas.

(a) Substances can be changed from one state to another.

The box lists some words relating to changes of state.

condensing	cooling	evaporation
heating	melting	sublimation

Complete the table by giving the correct word from the box for each change of state.

Each word may be used once, more than once, or not at all.

(3)

Change of state	Name of change
from solid to liquid	
from liquid to gas	
from solid to gas	

(b) The particles in a solid are closely packed, arranged in a regular pattern and vibrate about a fixed position.

Describe the arrangement and movement of the particles in a gas.

(3)

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(Total for Question 1 = 6 marks)

Answer:

Question number	Answer	Notes	Marks
(a)	M1 melting M2 evaporation M3 sublimation		3
(b)	Any three from M1 (Arrangement of particles) irregular M2 large gaps between them /far apart /widely spaced M3 random movement / move freely M4 move (very) quickly	ALLOW spread out IGNORE references to kinetic energy	3

Total for Question 1 = 6 marks

13. 4CH1_1C_que_20210304 Q: 1

This question is about states of matter.

- (a) Use the words solid, liquid or gas to give the initial and final state of matter for each of the changes listed in the table.

The first one has been done for you.

(3)

Change	Initial state	Final state
melting	solid	liquid
sublimation		
condensing		
evaporation		

- (b) Particles in a solid are closely packed, arranged in a regular pattern and vibrate about fixed positions.

Describe the arrangement and movement of the particles in a gas.

(3)

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(Total for Question 1 = 6 marks)

Answer:

Question number	Answer	Notes	Marks										
(a)	<table border="1"> <thead> <tr> <th>Start</th> <th>End</th> </tr> </thead> <tbody> <tr> <td>solid</td> <td>liquid</td> </tr> <tr> <td>solid</td> <td>gas</td> </tr> <tr> <td>gas</td> <td>liquid</td> </tr> <tr> <td>liquid</td> <td>gas</td> </tr> </tbody> </table>	Start	End	solid	liquid	solid	gas	gas	liquid	liquid	gas	Award 1 mark for each correct row ALLOW gas to solid for sublimation	3
Start	End												
solid	liquid												
solid	gas												
gas	liquid												
liquid	gas												
(b)	A description that refers to any three of the following points M1 irregular /random arrangement (of particles) M2 large gaps between them /far apart /widely spaced M3 random movement / move freely M4 move (very) quickly	ALLOW spread out IGNORE references to kinetic energy	3										
			6 marks										

2.2 Elements, compounds and mixtures

14. 4CH0_1CR_que_20170518 Q: 1

Bromine is an element in Group 7 of the Periodic Table.

(a) Which of these is the formula for a molecule of bromine?

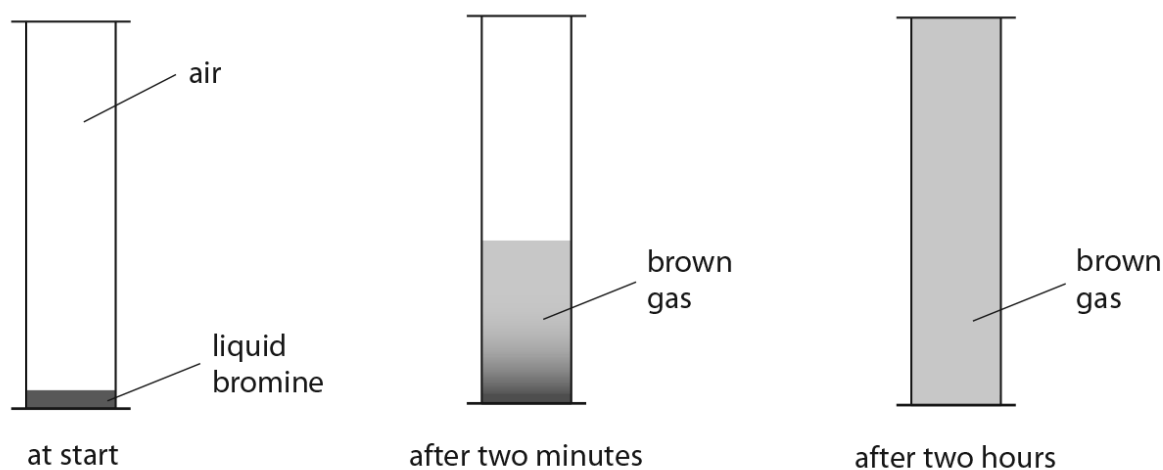
(1)

- A 2Br
- B Br²
- C Br2
- D Br₂

(b) A small amount of liquid bromine is placed in a gas jar containing air. The jar is then sealed.

After two minutes, a brown gas is seen just above the surface of the liquid.

After two hours, the whole gas jar is full of the brown gas.



(i) Which of these is the process that causes the brown gas to fill the gas jar?

(1)

- A condensation
- B diffusion
- C evaporation
- D sublimation

(ii) Explain, using the particle theory, the observations seen in the gas jar.

(2)

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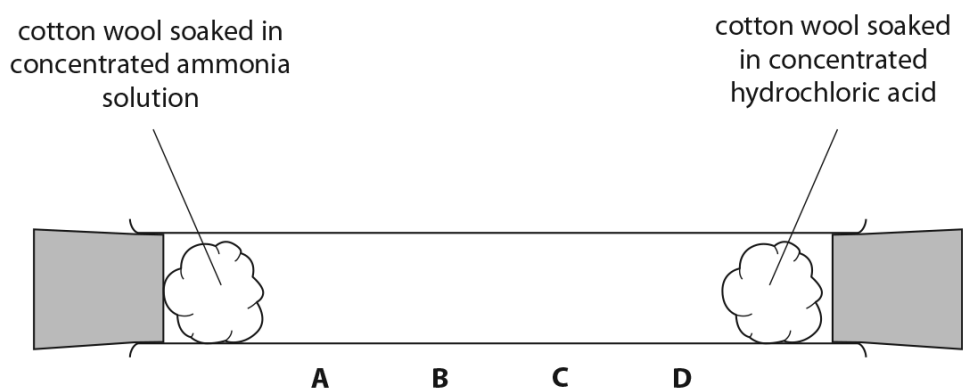
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(c) This apparatus is used to demonstrate the movement of ammonia gas and hydrogen chloride gas.



The gases are given off by the solutions at each end of the tube.

When the gases meet, they form a white solid.

Which letter shows the position where the white solid forms?

(1)

- A
- B
- C
- D

(Total for Question 1 = 5 marks)

Answer:

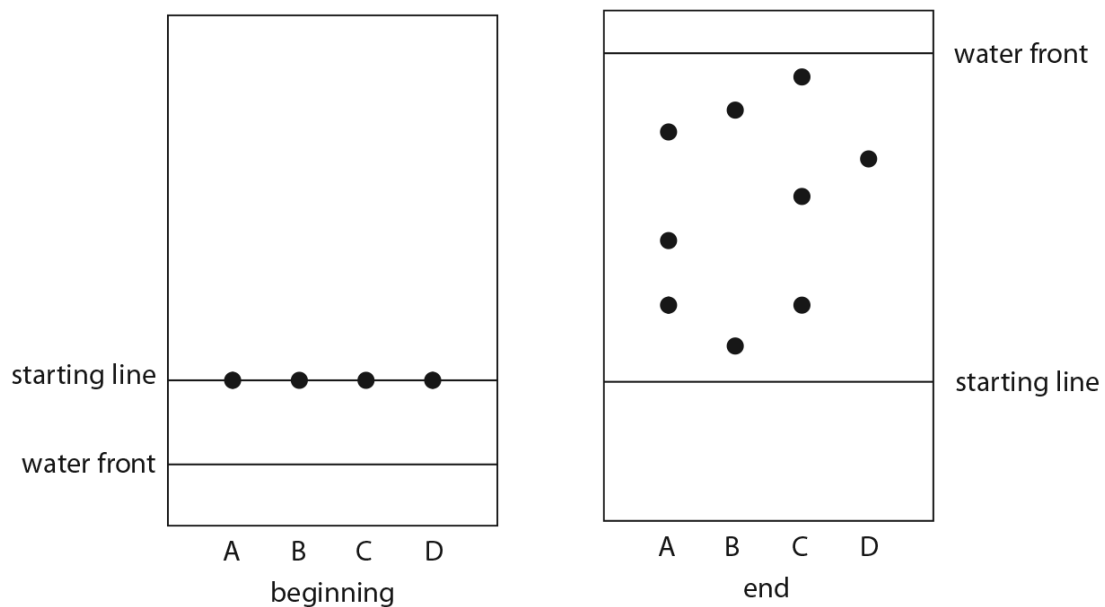
Question number	Answer	Notes	Marks
(a)	D (Br_2) The only correct answer is D A is not correct because Br is the symbol for bromine B is not correct because the 2 is a superscript not a subscript C is not correct because the 2 is not a subscript		1
(b) (i)	B (diffusion) The only correct answer is B A is not correct because condensation is the change of state from a gas to liquid C is not correct because evaporation is change of state from a liquid to gas D is not correct because the change of state from sublimation is solid to gas		1
(ii)		ALLOW particles evaporate	2

Q	Answer	Notes	Mark
	M1 the bromine/liquid evaporates / the particles escape (from the liquid) M2 (bromine fills the gas jar because) the (gas) particles move freely/randomly/constantly	ALLOW (gas) particles spread ALLOW particles move from a high concentration to low (concentration) IGNORE references to diffusion ACCEPT molecules for particles REJECT atoms once only	
(c)	C The only correct answer is C A is not correct because NH_3 gas diffuses faster HCl gas B is not correct because NH_3 gas diffuses faster HCl gas D is not correct because the position indicated is too close to the right hand end of the tube		1
		Total	5

15. 4CH0_1CR_que_20180517 Q: 3

A student uses chromatography to investigate the colourings found in four different fruit drinks, A, B, C and D.

The diagram shows the chromatography paper at the beginning and at the end of the investigation.



(a) State why the student should draw the starting line in pencil.

(1)

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(b) (i) Which drink contains only one colouring?

(1)

- A
- B
- C
- D

(ii) Explain which drink contains the most soluble colouring.

(2)

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(iii) Explain which drinks contain the same colouring.

(2)

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(Total for Question 3 = 6 marks)

Answer:

Question number	Answer	Notes	Marks
(a)	pencil/it won't dissolve (in water/solvent)	ACCEPT ink/pen would/might dissolve (in water/solvent) ALLOW pencil won't separate (in the water) ALLOW ink would mix with the food colourings/water ALLOW ink would smudge/run/separate (in the water)/interfere with the results	1
(b) (i)	D contains only one colouring A is incorrect as drink A contains three colourings B is incorrect as drink B contains two colourings C is incorrect as drink C contains three colourings		1
(ii)	M1 C M2 spot moved the furthest/greatest distance	ACCEPT has a spot nearest to water/solvent front ALLOW blob/dot/mark/point/colour/dye for spot M2 dep on M1 correct or missing	2

Question number	Answer	Notes	Marks
(iii)	M1 A and C M2 have spot at same level/travelled same distance	ALLOW spots align/have same R_f values ALLOW blob/dot/mark/point/colour/dye for spot M2 dep on M1	2

Total for Question 3 = 6

16. 4CH1_1CR_que_20190517 Q: 3

A student uses paper chromatography to investigate the dyes in five different inks, V, W, X, Y and Z.

This is what she uses.

- a beaker
- a piece of chromatography paper with a pencil line drawn near the bottom of the paper
- a solvent
- inks V, W, X, Y and Z

(a) Describe how the student should set up and carry out her experiment.

You may draw a diagram to help with your answer.

(4)

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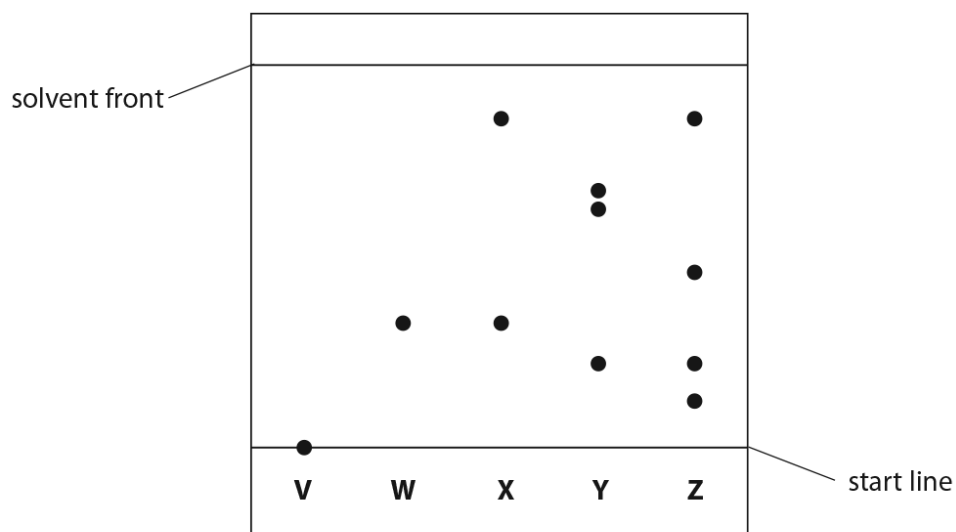
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(b) Explain why the line on the paper is drawn in pencil rather than in ink.

(2)

(c) The chromatogram shows the results for inks V, W, X, Y and Z.



(i) Explain which ink contains a dye that is insoluble in the solvent.

(2)

(ii) Explain which two inks contain the dye that is likely to be the most soluble in the solvent.

(2)

(iii) Explain which two inks may contain only one dye.

(2)

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(d) One dye in ink Y moves 4.3 cm when the solvent front moves 6.5 cm.

Calculate the R_f value for this dye.

Give your answer to 2 significant figures.

(3)

R_f value =

(Total for Question 3 = 15 marks)

Answer:

Question number	Answer	Notes	Marks
a	<p>A description/diagram which makes reference to the following points</p> <p>M1 put (separate) spots of each of the inks on the (pencil) line. OWTTE</p> <p>M2 pour some solvent into the bottom of the beaker OWTTE</p> <p>M3 place the paper in the beaker so that the spots are (just) above the level of the solvent OWTTE</p> <p>M4 leave until the solvent has risen up the paper (to the top/near the top and then take paper out) OWTTE</p>	<p>ALLOW water for solvent throughout</p> <p>If diagram shows solvent above pencil line only M1 and M2 can be scored</p> <p>DO NOT ALLOW M3 if words and diagram contradict each other</p> <p>ALLOW leave until inks stopped separating OWTTE</p> <p>ALLOW leave until spots/dyes stopped moving OWTTE</p> <p>IGNORE references to leaving for a specified length of time</p>	4

Question number	Answer	Notes	Marks
c (i)	For all parts of 3c an explanation which links each of the two points M1 V M2 as it stayed on the start line/did not move	ALLOW blob/dot/mark OWTTE for spot ACCEPT did not produce spots/did not separate ALLOW has R_f value of 0 M2 DEP on M1	2
(ii)	M1 X and Z M2 as they both have a dye/spot that travelled the furthest (up the paper)	ALLOW both have spot closest to solvent front ALLOW have highest R_f value(s) M2 DEP on M1	2
(iii)	M1 V and W M2 as they both only form one spot (on the paper)	ACCEPT as W only has one spot and cannot tell about V (as it does not move/is insoluble) ACCEPT reference to the other inks/X, Y, Z form more than one spot M2 DEP on M1	2

Question number	Answer	Notes	Marks
d	<ul style="list-style-type: none"> Working or equation for R_f value Calculating the R_f value Giving the answer to 2 significant figures <p>M1 $\frac{4.3}{6.5}$</p> <p>M2 0.6615</p> <p>M3 0.66</p>	<p>Award one mark if correct equation for finding R_f value seen</p> <p>ACCEPT any number of sig fig</p> <p>must be 2 sig fig</p> <p>0.66 with no working scores 3</p> <p>correct answer given to 3 or more sig fig with no working scores 2</p> <p>M3 subsumes M2</p> <p>can score M2 and M3 ECF provided use 4.3 and 6.5 and do a division</p>	3
			Total 15