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Chapter 1

The particulate nature of matter

1.1 The particulate nature of matter

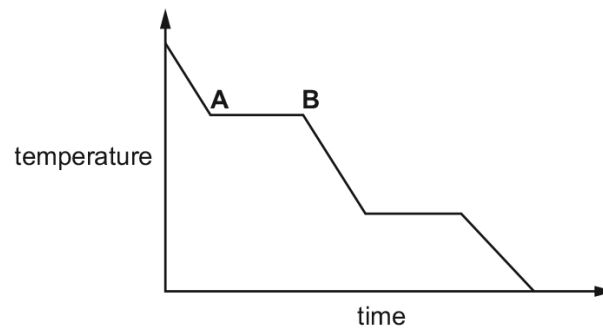
1. 0620_s20_qp_43 Q: 5

(a) Complete the table about solids, liquids and gases.

	particle separation	particle arrangement	type of motion
solid		regular	vibrate only
liquid	touching		random
gas	apart	random	

[3]

(b) The graph shows the change in temperature as a sample of a gas is cooled.



Name the change of state taking place between **A** and **B**.

..... [1]

(c) A bottle of liquid perfume is left open at the front of a room.

After some time, the perfume is smelt at the back of the room.

Name the **two** physical processes taking place.

1

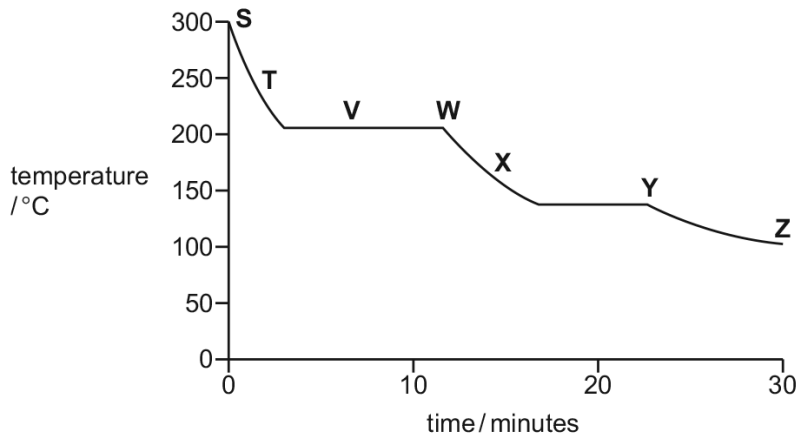
2

[2]

[Total: 6]

2. 0620_w17_qp_41 Q: 2

The graph shows how the temperature of a substance changes as it is cooled over a period of 30 minutes. The substance is a gas at the start.



Each letter on the graph may be used once, more than once or not at all.

- (a) Which letter, **S, T, V, W, X, Y** or **Z**, shows when
- (i) the particles in the substance have the most kinetic energy,
..... [1]
 - (ii) the particles in the substance are furthest apart,
..... [1]
 - (iii) the substance exists as both a gas and a liquid?
..... [1]
- (b) Use the graph to estimate the freezing point of the substance.
..... °C [1]
- (c) Name the change of state directly from a solid to a gas.
..... [1]
- (d) When smoke is viewed through a microscope, the smoke particles in the air appear to jump around.
- (i) What term describes this movement of the smoke particles?
..... [1]
 - (ii) Explain why the smoke particles move in this way.
.....
.....
..... [2]

[Total: 8]

3. 0620_w16_qp_42 Q: 1

Particles behave differently when in different physical states.

- (a) Solids have a fixed volume and a definite shape.
Gases have no fixed volume and take the shape of the container.

Describe the volume and shape of liquids.

.....
..... [1]

- (b) Complete the table to show the separation, arrangement and movement of particles in each physical state.

state	separation of particles	arrangement of particles	movement of particles
solid			
liquid	touching one another	randomly arranged	move over one another
gas			

[6]

- (c) Name the following changes of state.

- (i) Ice turning into water.

..... [1]

- (ii) Solid carbon dioxide turning directly into gaseous carbon dioxide at room temperature.

..... [1]

[Total: 9]

5. 0620_w12_qp_33 Q: 3

(a) A small amount of liquid bromine is added to a container which is then sealed.



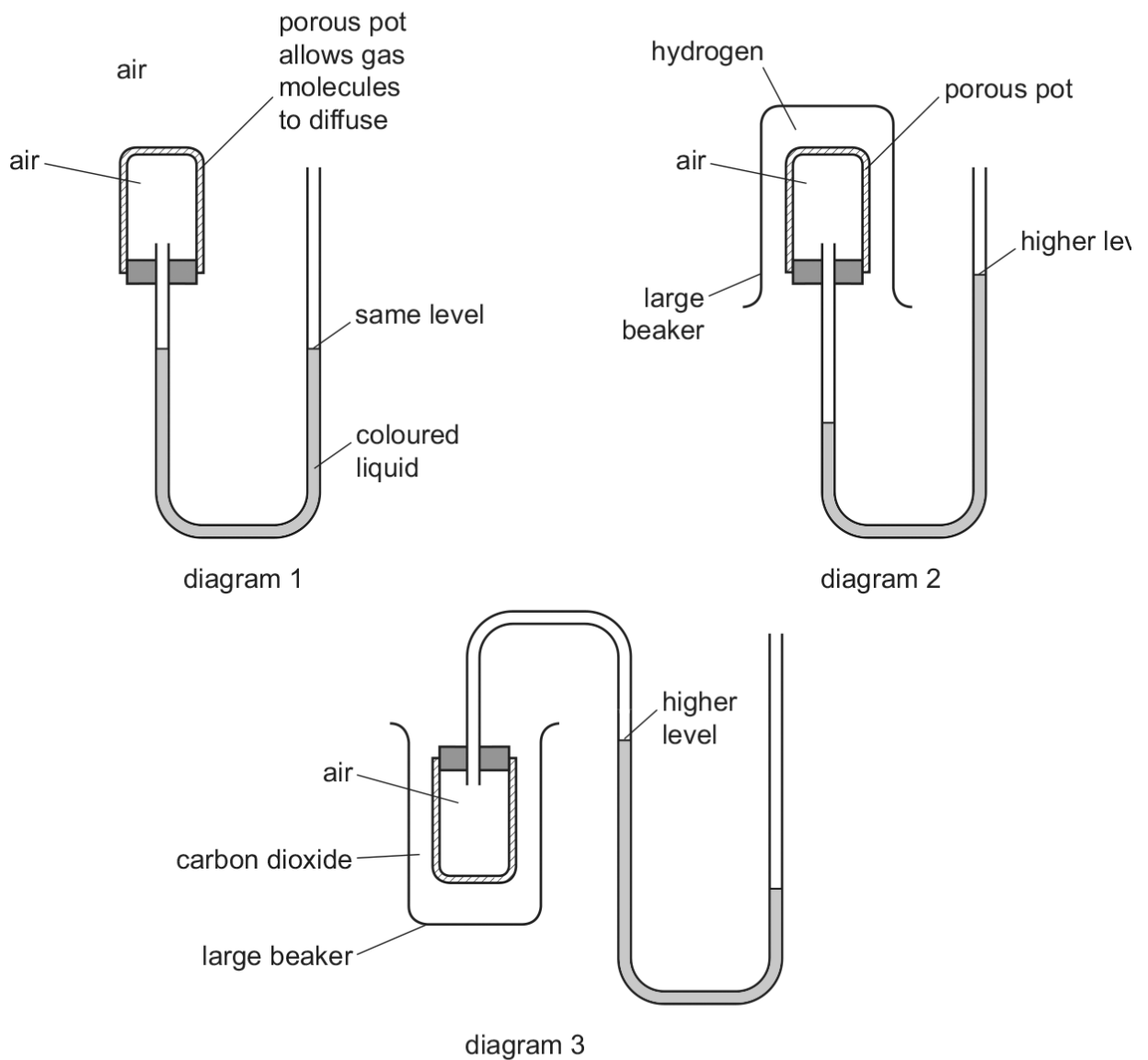
Use the ideas of the Kinetic Theory to explain why, after about an hour, the bromine molecules have spread uniformly to occupy the whole container.

.....

.....

.....

(b) The diagrams below show simple experiments on the speed of diffusion of gases.



Complete the following explanations. Diagram 1 has been done for you.

Diagram 1

There is air inside and outside the porous pot so the rate of diffusion of air into the pot is the same as the rate of diffusion of air out of the pot. The pressure inside and outside the pot is the same so the coloured liquid is at the same level on each side of the tube.

Diagram 2

.....
.....
.....
..... [3]

Diagram 3

.....
.....
.....
..... [3]

[Total: 9]

Chapter 2

Experimental techniques

2.1 Measurement

6. 0620_s18_qp_41 Q: 1

Substances can be classified as elements, compounds or mixtures.

(a) What is meant by the term *compound*?

.....

 [2]

(b) Mixtures can be separated by physical processes.

A sequence of physical processes can be used to separate common salt (sodium chloride) from a mixture containing sand and common salt only.

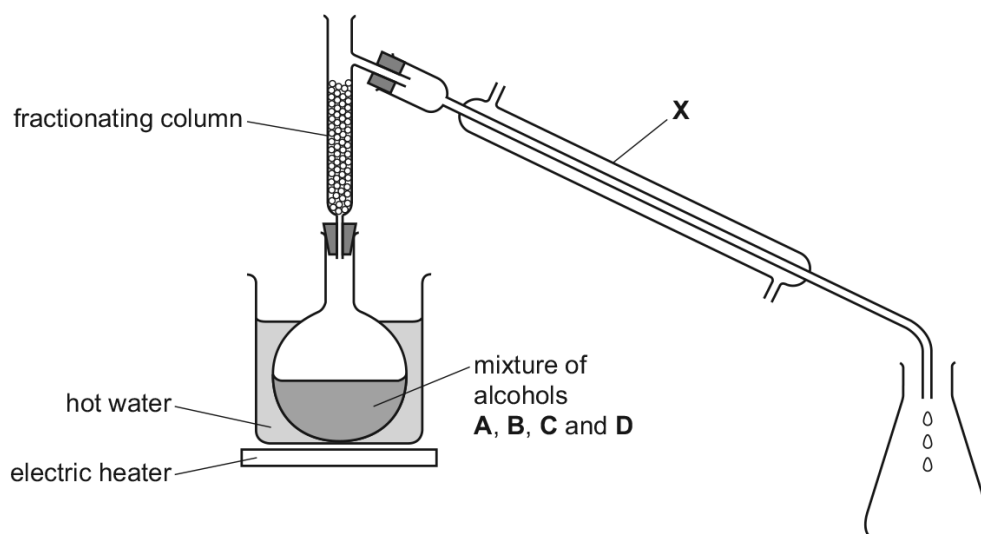
Give the order and the correct scientific term for the physical processes used to separate the common salt from the mixture.

1
 2
 3 [4]

The boiling points of four different alcohols, **A**, **B**, **C** and **D**, are shown.

alcohol	A	B	C	D
boiling point/°C	56	78	122	160

(c) A student suggested that the apparatus shown could be used to separate the mixture of alcohols.



(i) Apparatus X needs to have cold water flowing through it.

- Draw an arrow on the diagram to show where the cold water enters apparatus X.
- Name apparatus X.

..... [2]

(ii) Part of the fractionating column is missing. This means that the experiment will not work.

- Draw on the diagram the part of the fractionating column which is missing.
- Explain why the experiment will **not** work with this part of the fractionating column missing.

.....
..... [2]

(iii) Suggest why a Bunsen burner is **not** used to heat the flask.

..... [1]

(iv) A hot water bath cannot be used to separate alcohols C and D.

Explain why.

.....
.....
..... [2]

[Total: 13]

2.2 Purity

7. 0620_w12_qp_31 Q: 1

A list of techniques used to separate mixtures is given below.

filtration
diffusion
fractional distillation
simple distillation
crystallisation
chromatography

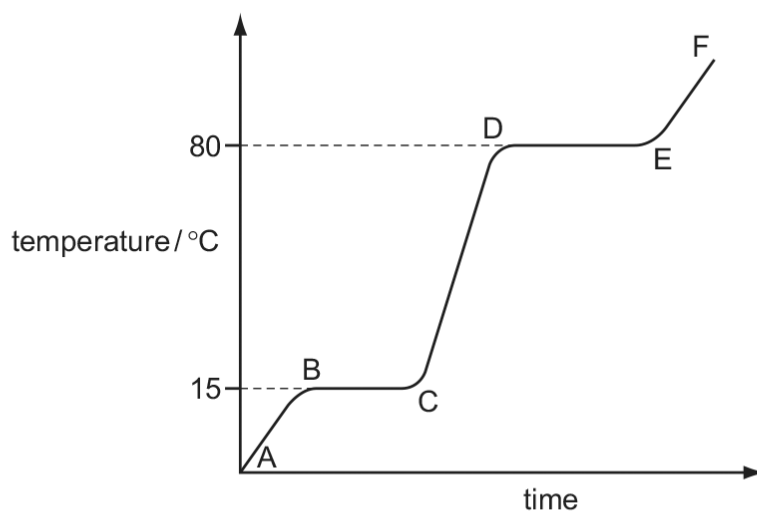
From this list, choose the most suitable technique to separate the following mixtures.
A technique may be used once, more than once or not at all.

- (a) butane from a mixture of propane and butane [1]
(b) oxygen from liquid air [1]
(c) water from aqueous magnesium sulfate [1]
(d) potassium chloride from aqueous potassium chloride [1]
(e) silver chloride from a mixture of silver chloride and water [1]
(f) glucose from a mixture of glucose and maltose [1]

[Total: 6]

8. 0620_w12_qp_32 Q: 2

The diagram shows a heating curve for a sample of compound X.



(a) Is X a solid, a liquid or a gas at room temperature, 20 °C?

..... [1]

(b) Write an equation for the equilibrium which exists in region BC.

..... [2]

(c) Name the change of state which occurs in region DE.

..... [1]

(d) Explain how the curve shows that a pure sample of compound X was used.

.....
 [2]

[Total: 6]

Chapter 3

Atoms, elements and compounds

3.1 Atomic structure and the Periodic Table

9. 0620_p20_qp_40 Q: 2

The table gives the composition of three particles.

particle	number of protons	number of electrons	number of neutrons
A	15	15	16
B	15	18	16
C	15	15	17

(a) What is the evidence in the table for each of the following?

(i) Particle **A** is an atom.

.....
 [1]

(ii) **A**, **B** and **C** are all particles of the same element.

.....
 [1]

(iii) Particles **A** and **C** are isotopes of the same element.

.....
 [2]

(b) (i) What is the electronic structure of particle **A**?

..... [1]

(ii) Is element **A**, a metal or a non-metal? Give a reason for your choice.

.....
 [1]

[Total: 6]

10. 0620_m19_qp_42 Q: 2

(a) The table gives information about some atoms or ions, **A**, **B** and **C**.

Complete the table.

	number of protons	number of electrons	electronic structure	charge
A	11	10	2,8	
B		18		0
C		10	2,8	-1

[4]

(b) (i) Carbon is an element.

Define the term *element*.

.....

..... [1]

(ii) $^{12}_6\text{C}$, $^{13}_6\text{C}$ and $^{14}_6\text{C}$ are isotopes of carbon.

Complete the table.

	number of protons	number of neutrons
$^{12}_6\text{C}$		
$^{13}_6\text{C}$		
$^{14}_6\text{C}$		

[2]

[Total: 7]

11. 0620_s19_qp_41 Q: 1

This question is about the structures of atoms and ions.

(a) Define the term *proton number*.

.....
 [2]

(b) (i) Complete the table to show the number of protons, neutrons and electrons present in atoms of ${}^{24}_{12}\text{Mg}$ and ${}^{26}_{12}\text{Mg}$.

	number of protons	number of neutrons	number of electrons
${}^{24}_{12}\text{Mg}$			
${}^{26}_{12}\text{Mg}$			

[2]

(ii) What term is used to describe atoms of the same element, such as ${}^{24}_{12}\text{Mg}$ and ${}^{26}_{12}\text{Mg}$?

..... [1]

(iii) Explain why the chemical properties of ${}^{24}_{12}\text{Mg}$ and ${}^{26}_{12}\text{Mg}$ are the same.

.....
 [2]

(c) Complete the table to identify the atoms and ions which have the following numbers of protons, neutrons and electrons.

	number of protons	number of neutrons	number of electrons
${}^{23}_{11}\text{Na}^+$	11	12	10
	4	5	4
	17	20	18

[4]

(d) State the electronic structure of the following atom and ion.

Al

S^{2-}

[2]

[Total: 13]

Appendix A

Answers

1. 0620_s20_MS_43 Q: 5

(a)		particle separation	particle arrangement	type of motion	3
	solid	touching			
	liquid		random		
	gas			random	
(b)	condensing				1
(c)	evaporation diffusion				2

2. 0620_w17_MS_41 Q: 2

(a)(i)	S	1
(a)(ii)	S	1
(a)(iii)	V	1
(b)	any value in the range 130–145 °C	1
(c)	sublimation	1
(d)(i)	Brownian motion	1
(d)(ii)	nitrogen / oxygen / carbon dioxide / air molecules hit / bombard the smoke particles	1
	(the bombarding particles) move randomly	1

3. 0620_w16_MS_42 Q: 1

(a)	fixed volume AND take the shape of the container			1	
(b)	solid	touching	regular	vibrate	6
	liquid				
	gas	not touching	random	random	
(c)(i)	melting			1	
(c)(ii)	sublimation			1	

4. 0620_s14_MS_33 Q: 2

(a) any **three** from:
 particles have more energy (1)
 move faster (1)
 collide more frequently (1)
 more particles have energy greater than E_a [3]
guidance: more colliding molecules have enough energy to react is worth (2)

(b) particles move in all directions/randomly in both liquids and gases (1)
 no bonds/very weak forces between particles in gases (1)
 molecules can move apart/separate (to fill entire volume) (1)
OR
 bonds/forces/IMF between particles in liquids (1)
 molecules cannot move apart/separate (so fixed volume in liquids) (1) [3]

[Total: 6]

5. 0620_w12_MS_33 Q: 3

- (a) explanation of evaporation e.g. particles (or molecules) with a lot of energy leave the liquid / bromine particles break free from each other / forces or bonds between bromine molecules broken / molecules (in liquid) have weak forces holding them together / weak intermolecular forces / Van der Waals forces between molecules (don't have to be stated as weak) / (weak intermolecular forces alone scores this mark);
allow: particles (or molecules) of bromine escape from liquid [1]
- diffusion / diffuse / movement of particles; [1]
- explanation of diffusion involving qualified movement of molecules / particles i.e. random movement of molecules / particles move in all directions; [1]
- (b) air more dense / heavier / higher M_r than hydrogen; [1]
hydrogen diffuses faster (than air diffuses out); [1]
accept: diffusion in is faster than out (without naming gases)
pressure inside pot is greater (than outside); [1]
air less dense / lighter / lower M_r than carbon dioxide; [1]
- air diffuses / moves faster (than carbon dioxide); [1]
accept: diffusion out is faster than in (without naming gases)
- pressure inside pot less (than outside); [1]
- ORA in both parts

[Total: 9]

6. 0620_s18_MS_41 Q: 1

(a)	a substance made from two (or more) elements	1
	chemically combined	1
(b)	dissolving	1
	filtration	1
	evaporation / crystallisation	1
	three correct stages in the correct order	1
(c)(i)	condenser	1
	arrow pointing into lower aperture only	1
(c)(ii)	stopper shown in diagram	1
	gases or vapours escape	1
(c)(iii)	(mixture is) (in)flammable	1
(c)(iv)	water bath cannot exceed 100 (°C)	1
	C AND D have a boiling point above 100 (°C)	1

7. 0620_w12_MS_31 Q: 1

- (a) diffusion or fractional distillation;
- (b) fractional distillation;
- (c) simple distillation;
- (d) crystallisation;
- (e) filtration;
- (f) chromatography;

[Total: 6]

8. 0620_w12_MS_32 Q: 2

- (a) liquid; [1]
- (b) (l) and (s); [1]
reversible sign; [1]
accept: X in equation
ignore: any compounds just look for state symbols
must be the same compound on both sides of equation
- (c) boiling / condensation; [1]
accept: evaporation or vaporisation
- (d) (in region BC) solid melts / liquid boils (in region DE); [1]
at one / fixed / sharp / single / specific temperature; [1]

[Total: 6]

9. 0620_p20_MS_40 Q: 2

- (a) (i) same number of protons and electrons [1]
- (ii) all have the same number of protons / same proton number / same atomic number [1]
- (iii) same number of protons / same proton number / same atomic number; [1]
different number of neutrons / different nucleon number / different mass number; [1]
- (b) (i) 2, 8, 5 [1]
- (ii) non-metal because it accepts electrons / needs 3e to complete outer energy level /
because it is in Group V or 5e in outer shell [1]
note: need both non-metal and reason for one mark

10. 0620_m19_MS_42 Q: 2

(a)	number of protons	electrons	electronic structure	charge on particle	4
	11	10	2,8	M4 1+ / +1(1)	
	M1 18(1)	18	M3 2,8,8(1)	0	
	M2 9(1)	10	2,8	1-	
(b)(i)	<i>element</i> EITHER (substance) made of atoms with the same atomic number / number of protons / proton number OR a substance that cannot be split up / broken down into two or more simple(r) substances by chemical means				1
(b)(ii)	M1 6 protons in all three rows(1) M2 6,7 and 8 neutrons(1)				2

11. 0620_s19_MS_41 Q: 1

(a)	number of protons (1) protons in the nucleus (of an atom) (1)	2
(b)(i)	12p 12n 12e (1) 12p 14n 12e (1)	2
(b)(ii)	isotope(s)	1
(b)(iii)	same number of electrons (1) (same number) of electrons in the outer shell (1)	2
(c)	${}^9_4\text{Be}$ any element symbol with a single negative charge (1) use of Cl (1) use of ${}^{37}_{17}$ (1)	4
(d)	2 8 3 (1) 2 8 8 (1)	2