DIFFUSION

1.2.1

(a) Different gases diffuse at different speeds.

(i) What is meant by the term *diffusion*?

.....

..... [1]

(ii) What property of a gas molecule affects the speed at which it diffuses?

..... [1]

(b) Helium is a gas used to fill balloons. It is present in the air in very small quantities. Diffusion can be used to separate it from the air.

Air at 1000 °C is on one side of a porous barrier. The air which passes through the barrier has a larger amount of helium in it.

(i) Why does the air on the other side of the barrier contain more helium?

..... [1]

(ii) Why is it an advantage to have the air at a high temperature?

.....

..... [1]

(a) (i) (particles) spread to fill total available volume / move from high concentration to low concentration / moves down a concentration gradient (1) [1]

(ii) mass or M_r (1) [1]

(b) (i) helium atoms / molecules are lighter than molecules in air or N_2 **and** O_2
or helium is less dense than air or N_2 **and** O_2.
or helium diffuses (through the porous barrier) faster than air or N_2 **and** O_2. (1) [1]

(ii) faster rate of diffusion / molecules move faster (at high temperatures). (1) [1]

1.2.2

Gases diffuse, which means that they move to occupy the total available volume.

(i) Explain, using kinetic particle theory, why gases diffuse.

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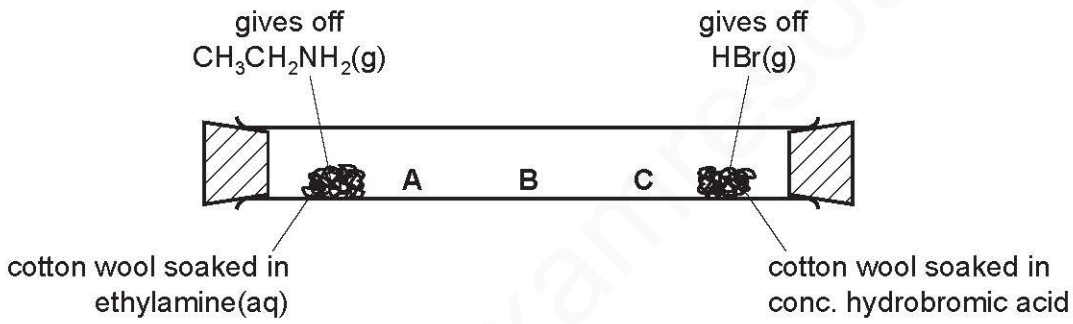
..... [2]

(ii) When the colourless gases hydrogen bromide and ethylamine come into contact, a white solid is formed.

$$CH_3CH_2NH_2(g) + HBr(g) \rightarrow \underset{\text{white solid}}{CH_3CH_2NH_3Br(s)}$$

The following apparatus can be used to compare the rates of diffusion of the two gases ethylamine and hydrogen bromide.



Predict at which position, **A**, **B** or **C**, the white solid will form. Explain your choice.

.....

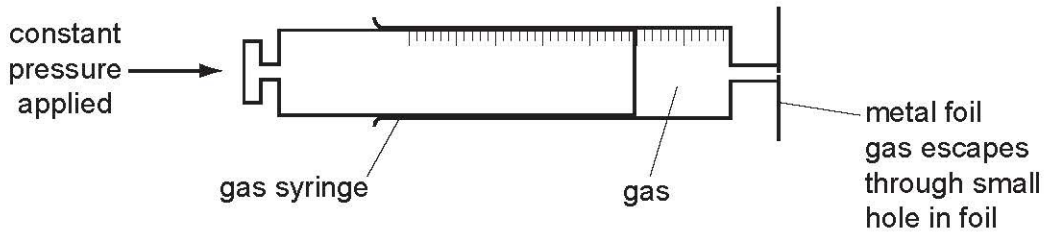
.....

..... [3]

)(i)	*Any **two** from:* (particles move in) random motion; (particles) collide; (particles) move from a region of high concentration to low concentration;	**2**	**A** alternative phrases for collide **A** down a concentration gradient
(ii)	C; M2 it has a lower (relative) molecular mass (than HBr); M3 ethylamine diffuses faster (than HBr);	**3**	**A** ethylamine is less dense **A** ethylamine is a lighter molecule but **I** 'ethylamine is lighter' **I** ethylamine is a smaller molecule **A** ethylamine **molecules** or **particles** move faster **A** ECF for M2 and M3 if A is given e.g. HBr diffuses faster for M3 because it is a lighter molecule for M2 **A** ECF for M2 if B is given e.g. they diffuse at same rate for M3 because molecules weigh the same for M2

1.2.3

(ii) The following apparatus can be used to measure the rate of diffusion of a gas.



The following results were obtained.

gas	temperature / °C	rate of diffusion in cm^3 / min
nitrogen	25	1.00
chlorine	25	0.63
nitrogen	50	1.05

Explain why nitrogen diffuses faster than chlorine.

.....

..... [2]

Explain why the nitrogen diffuses faster at the higher temperature.

..... [1]

(ii) (1) nitrogen has small**er** M_r / light**er** molecules / low**er** density [1]
nitrogen **molecules** / **particles** **move** fast**er** (than chlorine molecules) [1]

(2) at higher temperature nitrogen **molecules or particles** (not atoms) move faster / have more energy [1]

1.2.4

(a) A small amount of liquid bromine is added r=to a container which is sealed

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

$$Br_2(l) \rightarrow Br_2(g)$$

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.

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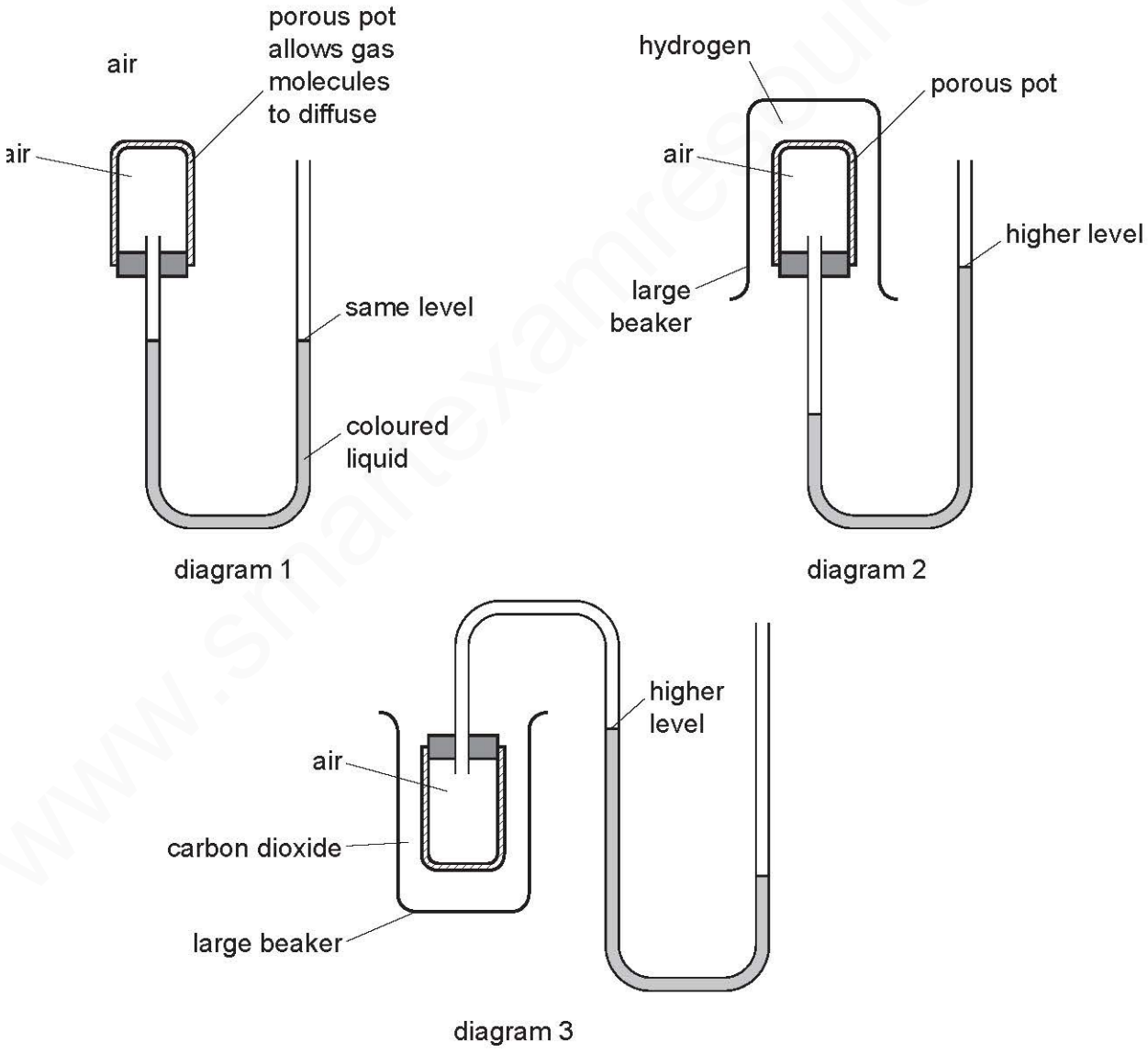
..... [3]

(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

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..... [3]

Diagram 3

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..... [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]

1.2.5

Traces of chlorine can be separated from bromine vapour by diffusion.
Which gas would diffuse the faster and why?

.....

..... [2]

chlorine **[1]**

COND lower M_r **or** lower density **or** lighter molecules **or** molecules move faster **[2]**

OR lighter **or** based on A_r MAX [1]
smaller with no additional comment **or** sieve idea [0]
N.B. a total of [3] not [2]