

# THE PARTICULATE NATURE OF MATTER-QP-MS

- 1 (a) Table 11.1 contains data about some elements.

Table 11.1

element	relative molecular mass	colour	physical state at room temperature
fluorine	38		
chlorine	71	greenish-yellow	gas
bromine	160	red-brown	liquid

- (i) Predict the colour and physical state of fluorine at room temperature.

Explain your answers.

colour .....

physical state .....

explanation .....

.....

[3]

- (ii) Explain why the relative molecular mass of fluorine is 38.

[A<sub>r</sub>: F, 19]

.....

..... [1]

(b) Fig. 11.1 shows a gas jar filled with nitrogen over a gas jar filled with bromine gas. The gases are separated by a glass plate.

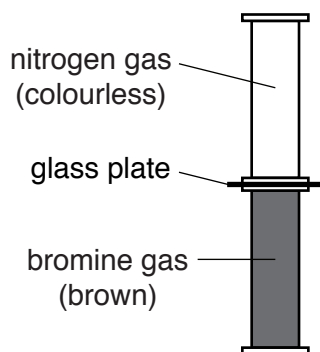


Fig. 11.1

The glass plate is removed.

Fig. 11.2 shows the colour changes in the gas jars after 15 minutes and after 30 minutes.

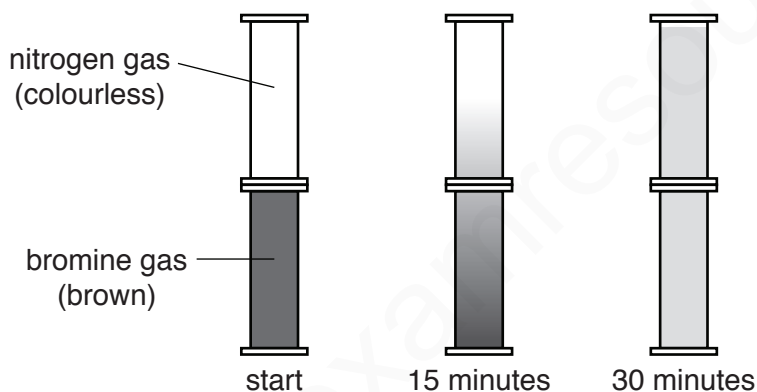


Fig. 11.2

(i) Describe the process that causes the effect in Fig. 11.2.

Explain this process in terms of movement of molecules.

process .....

explanation .....

.....

.....

[2]

(ii) Predict how the results of the experiment would be different if chlorine is used instead of bromine.

.....

..... [1]

[Total: 7]

**MARKING SCHEME:**

(a)(i)	pale yellow / lighter than chlorine ; gas ; use of trend to predict property ;	<b>3</b>
(a)(ii)	fluorine is diatomic / formula is F <sub>2</sub> ;	<b>1</b>
(b)(i)	diffusion ; molecules move from high concentration to low concentration / molecules move randomly ;	<b>2</b>
(b)(ii)	shorter times / greater rate of diffusion ;	<b>1</b>

- 2 (a) Ammonia,  $\text{NH}_3$ , is made by the reaction between nitrogen gas and hydrogen gas in the Haber process.

Construct the symbol equation for this reaction.

..... [2]

- (b) Identify a substance that displaces ammonia gas from ammonium chloride.

..... [1]

- (c) Ammonia gas reacts with hydrogen chloride gas to form solid ammonium chloride.

Fig. 2.1 shows apparatus a teacher uses to demonstrate this reaction.

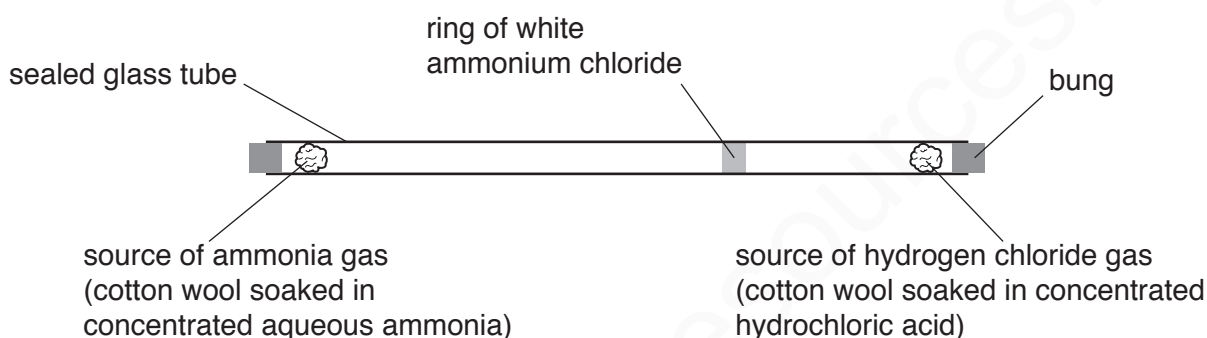


Fig. 2.1

Ammonia molecules and hydrogen chloride molecules start to diffuse away from the cotton wool plugs at the same time.

The ring of white ammonium chloride forms after 1 minute.

- (i) Define the term *diffusion*.

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

- (ii) The glass tube is 0.9 m long. The speed of each molecule is more than 1 m/s.

Suggest why it takes more than 1 minute for the white ring to form.

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

(iii) Show that the relative molecular mass of ammonia,  $\text{NH}_3$ , is 17.

[ $A_r$ : H,1; N,14]

[1]

(iv) The relative molecular mass of hydrogen chloride,  $\text{HCl}$ , is 36.5.

Explain how this experiment shows that the rate of diffusion depends on molecular mass.

.....

.....

.....

..... [2]

[Total: 9]

## MARKING SCHEME:

(a)	$N_2 + 3H_2 \rightarrow 2NH_3$ formulae ; balancing ;	2
(b)	any named base ;	1
(c)(i)	the (net) movement of particles from a region of their higher concentration to a region of their lower concentration / down a concentration gradient ; as a result of their random movement ;	2
(c)(ii)	collisions between molecules (which slows progress through tube) ;	1
(c)(iii)	$14 + (3 \times 1) (= 17)$ ;	1
(c)(iv)	white ring closer to HCl / right of centre / NH <sub>3</sub> diffuses further than HCl (in the same time) ; NH <sub>3</sub> diffuses faster than HCl ; rate of diffusion decreases with increasing molecular mass ; <b>max 2</b>	2