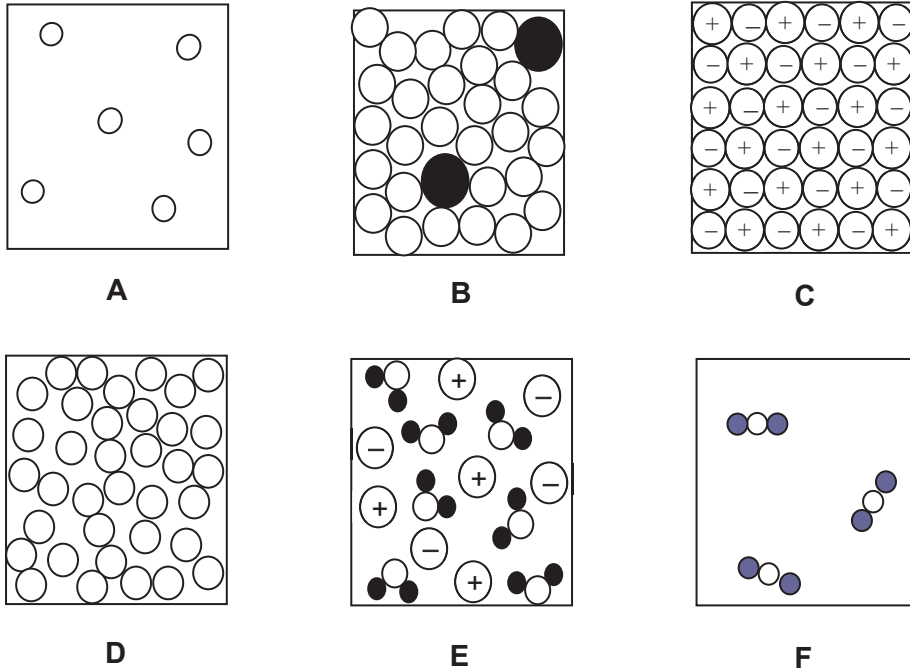


## Section A

Answer **all** the questions in the spaces provided.

1 Fig. 1.1 shows the particles in six substances.



**Fig 1.1**

(a) Which diagram best represents

- (i) carbon dioxide, .....
- (ii) molten copper, .....
- (iii) solid sodium chloride, .....
- (iv) helium, .....
- (v) brass. ....

[5]

(b) Which of the above substances, **A – F**, represents an element?

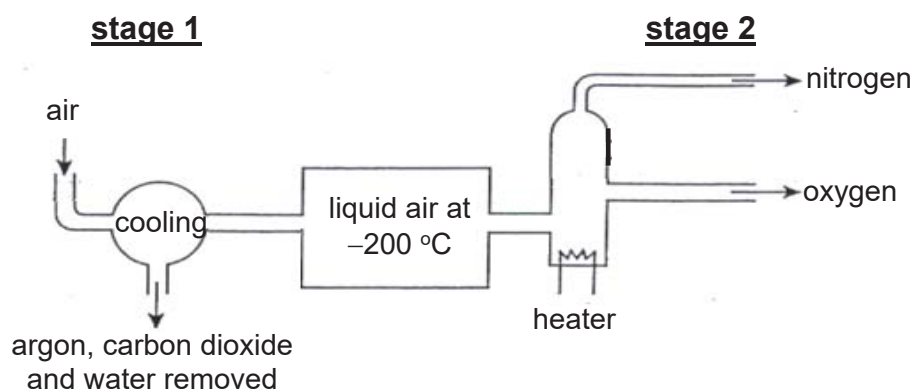
.....[1]

2 Table 2.1 gives some information on the component gases of clean air in the atmosphere.

**Table 2.1**

gas	melting point / °C	boiling point / °C
nitrogen	-210	-196
oxygen	-218	-183
argon	-189	-186
other noble gases		
carbon dioxide	sublimes at $-78\text{ }^{\circ}\text{C}$	
water vapour	0	100

Separating air into its component gases is an important process in the industries. Air is first cooled to liquid at  $-200\text{ }^{\circ}\text{C}$  before it is gradually warmed up and separated into its component gases, as illustrated in Fig. 2.1.



**Fig. 2.1**

(a) Describe the arrangement and movement of the particles in the liquid air.

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

(b) Explain why argon, carbon dioxide and water can be removed when air is compressed and cooled to  $-200\text{ }^{\circ}\text{C}$  in **stage 1**.

.....[1]

(c) Name the method used to separate the components of liquid air in **stage 2**.

.....[1]

(d) Which component will be collected last in **stage 2**? Explain your answer.

.....[2]

(e) Which component will have the largest volume collected in **stage 2**?

.....[1]

3 (a) Sir James Jeans, who was a great populariser of science, once described an atom of carbon as being like six bees buzzing around a space the size of a football stadium.

(i) Suggest what were represented by the six bees in this description.

.....[1]

(ii) What is missing from Jeans' description when applied to an atom of carbon?

.....[1]

(b) Carbon has two isotopes which have the symbols  $^{12}_6\text{C}$  and  $^{13}_6\text{C}$ .

(i) State, in terms of atomic structure, the difference between the two isotopes of carbon.

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

(ii) Draw a diagram to show the arrangement of electrons in an atom of the  $^{12}_6\text{C}$  isotope.

[1]

4 Chromatography is often used to solve crimes involving forgery.

In an investigation of a case which involves a bank cheque issued with a forged signature, the sample of ink from the forged signature was tested together with inks from the pens of five suspects **V**, **W**, **X**, **Y** and **Z**. Fig. 4.1 shows the chromatogram that was obtained with the use of an organic solvent.

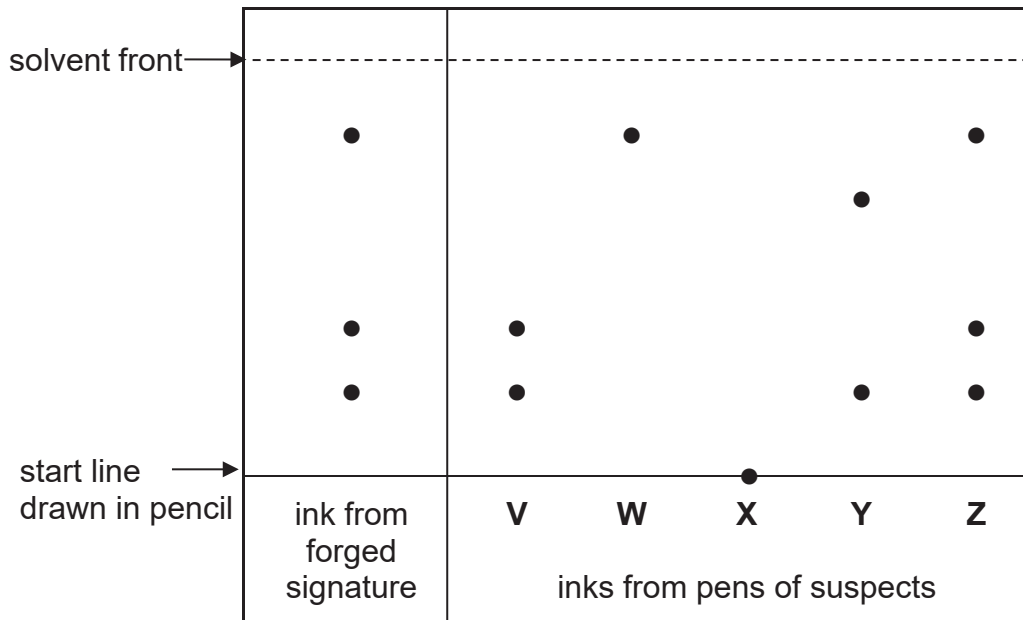


Fig. 4.1

(a) Which suspect is most likely to have forged the signature in the bank cheque?

.....[1]

(b) Suggest why the ink from the pen of suspect **W** gives only one spot on the chromatogram.

.....[1]

(c) Explain why the start line is drawn in pencil but not in pen.

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

(d) Suggest a reason why water would probably **not** be a suitable solvent to use for this chromatography.

.....[1]

- 5 Haematite, a common ore used for the extraction of iron, contains the compound, iron(III) oxide. Iron is produced in the blast furnace by heating a mixture of iron(III) oxide, coke and limestone with air. Fig. 5.1 gives the outline of a blast furnace in which iron is extracted from its ore.

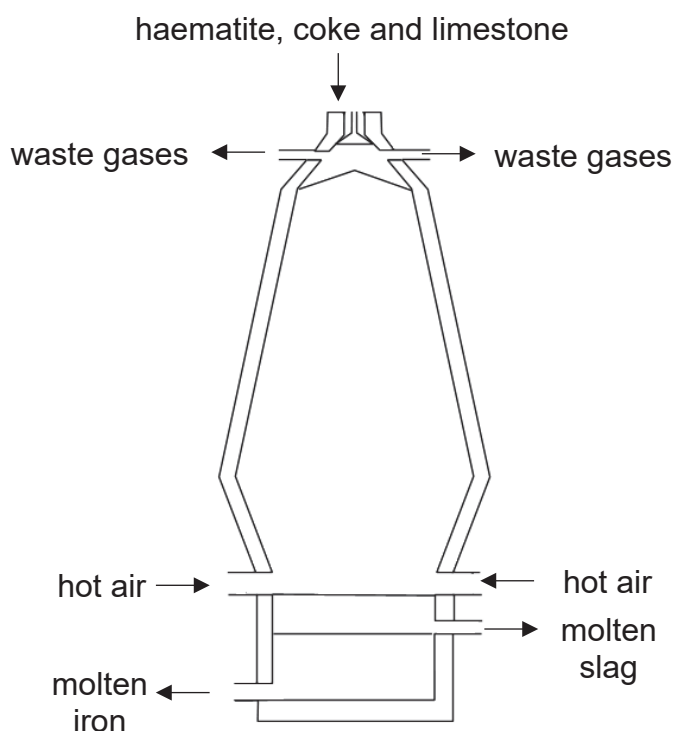
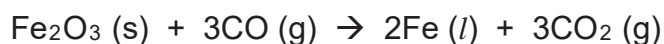


Fig. 5.1

- (a) Describe how carbon dioxide is produced under high heat in the blast furnace.

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

- (b) The chemical equation for the production of iron in the blast furnace is shown.



- (i) State the oxidation state of iron in iron(III) oxide.

.....[1]

- (ii) Explain, in terms of oxidation states, whether iron(III) oxide is oxidised or reduced.

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

- 6 (a) A 500 cm<sup>3</sup> aqueous sample contains 37.6 g of copper(II) nitrate. Calculate the concentration of the copper(II) nitrate solution in mol/dm<sup>3</sup>.

[Relative atomic masses: A<sub>r</sub>, Cu, 64; N, 14; O, 16]

concentration = .....mol/dm<sup>3</sup> [2]

- (b) When a piece of zinc is added to the copper(II) nitrate solution, a reddish brown solid is formed. Explain the observation.

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

- 7 Fig. 7.1 describes some of the properties and reactions of solution Z.

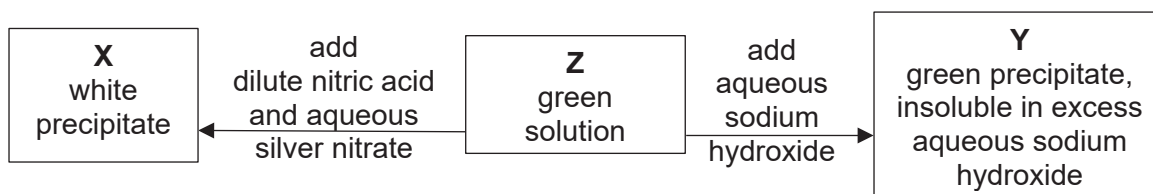


Fig. 7.1

- (a) Give the identities of X, Y and Z.

X .....

Y .....

Z .....

[3]

- (b) Write a balanced chemical equation for any **one** of the reactions in Fig. 7.1.

.....[2]

- 8 (a) Complete Table 8.1 by filling in the **five** blanks.

**Table 8.1**

name of substance	chemical formula	solubility in water
sodium carbonate		soluble
calcium nitrate	$\text{Ca}(\text{NO}_3)_2$	soluble
	$\text{K}_2\text{SO}_4$	soluble
barium chloride		soluble
lead(II) chloride	$\text{PbCl}_2$	
iron(III) carbonate		insoluble

[5]

- (b) (i) Give the names of the two reagents in Table 8.1 that can be used to prepare a white precipitate of calcium carbonate.

1.....

2.....

[1]

- (ii) Describe the process of how you could prepare a pure dry sample of calcium carbonate from the two reagents you have given in (b)(i).

.....

.....

.....

.....[3]