

## F.4 Chemistry Mid-year Examination Sample Paper

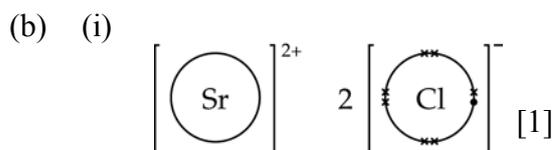
### Suggested Answers

#### Section A

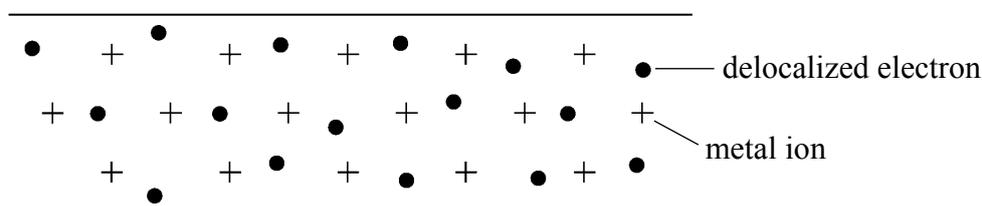
- |      |       |       |       |       |
|------|-------|-------|-------|-------|
| 1. A | 6. C  | 11. A | 16. C | 21. A |
| 2. B | 7. D  | 12. B | 17. A | 22. B |
| 3. A | 8. D  | 13. D | 18. D | 23. A |
| 4. B | 9. A  | 14. C | 19. C | 24. C |
| 5. C | 10. C | 15. B | 20. B | 25. A |

#### Section B

1. (a) (i) A: iodine [1]  
B: diamond [1]  
C: sodium chloride / potassium chloride [1]
- (ii) B has a higher melting point than A. [1]  
The atoms in solid B are held together by strong covalent bonds. [1]  
A large amount of energy is required to break the strong bonds. [1]  
The molecules in solid A are held together by weak van der Waals' forces. [1]  
Little energy is required to overcome the weak intermolecular forces. [1]
- (iii) Solid C [1]  
The ions in solid C become mobile in molten state. [1]



- (ii) Strontium has a giant metallic structure. [1]  
When a force is applied to strontium, the layers of metal ions can slide over one another and settle into new positions. [1]  
Non-directional metallic bonds continue to hold the metal ions together. [1]



Correct drawing [1]

Correct labels [1]

(iii) When a force is applied to compound X, the relative movement of the ions brings ions of the same charge close to each other. This results in repulsion. [1]

(iv) When the temperature increases, the metal ions will move faster. [1]  
It will be more difficult for the delocalized electrons to pass through the structure. [1]

(v) **xx**



**xx** [1]

2. (a) (i) (1) red solid [1]

(2) mercury [1]

Mercury vaporizes on heating and condenses on a cooler part of the test-tube. [1]

(3)  $2\text{HgO}(\text{s}) \rightarrow 2\text{Hg}(\text{l}) + \text{O}_2(\text{g})$  [1+1]

(4) Carry out the experiment in a fume cupboard. [1]

Mercury vapour is highly toxic. [1]

(ii) (1) Oxygen [1]

(2) It relights a glowing splint. [1]

(b) (i)  $\text{Zn} > \text{Y} > \text{X}$  [1]

Zinc displaces Y from the nitrate solution of Y, so Zinc is more reactive than Y. [1]

Y reacts with dilute hydrochloric acid but X does not, so Y is more reactive than X. [1]

(ii) Metal X is copper. [ $\frac{1}{2}$ ]

Metal Y is iron. [ $\frac{1}{2}$ ]

(iii) Correct diagram [1]

Correct labelling [1]

(iv) The blue copper(II) nitrate solution becomes pale blue / paler in colour / fades. [1]

(v) Metal X: No observable change and no ionic equation [1]

Metal Y:  $\text{Y} + 2\text{H}^+ \rightarrow \text{Y}^{2+} + \text{H}_2$  [1]

Y dissolves to give a pale green solution. [1]

Colourless gas bubbles are given out. [1]

3. (a) (i) A saturated solution is a solution in which a solvent has dissolved the maximum mass of a solute at a specified temperature. [2]
- (ii) Crystallization [1]
- (iii) (1) Crystals obtained by slow evaporation are usually larger in size and have regular shapes. [1]
- (2) This is because solute particles have sufficient time to arrange themselves regularly in crystals. [1]
- (iv) (1) To remove any soluble impurities on the surface of the crystals. [1]
- (2) Sodium chloride is soluble in water. [1]
- Washing the crystals with little cold distilled water reduces the loss of crystals. [1]
- (3) Water in the crystals is removed by pressing between two pieces of dry filter paper. / Standing in air [1]
- (b) (i) Perform a flame test. [1]
- Potassium chloride will burn with a lilac flame while sodium chloride will burn with a persistent brilliant golden yellow flame. [2]
- (ii) Add dilute hydrochloric acid to each sample. [1]
- Calcium carbonate will give colourless gas bubbles while calcium nitrate will dissolve only. [2]
- (c) (i)
- |              |                      |                         |
|--------------|----------------------|-------------------------|
|              | Pb                   | O                       |
| Mass         | 62.1 g               | 68.5 – 62.1 = 6.4 g [1] |
| No. of moles | 62.1 / 207.2 = 0.300 | 6.4 / 16.0 = 0.40 [1]   |
| Mole ratio   | 3                    | 4                       |
- ∴ The empirical formula of lead oxide is Pb<sub>3</sub>O<sub>4</sub>. [1]
- (ii) To prevent the leakage of flammable hydrogen gas. [1]
- To keep a continuous flow of hydrogen gas. (1)
- (iii) To prevent oxygen in air from re-oxidizing the hot metal lead [1] to lead oxide again. It affects the accuracy of finding the empirical formula.
- (iv)  $4\text{H}_2 + \text{Pb}_3\text{O}_4 \rightarrow 3\text{Pb} + 4\text{H}_2\text{O}$  [1]
4. (a) (i) No. of moles of magnesium reacted with nitrogen =  $y / 24.3$
- From the equation, mole ratio of Mg : Mg<sub>3</sub>N<sub>2</sub> = 3:1.
- No. of moles of Mg<sub>3</sub>N<sub>2</sub> formed =  $y / 72.9$  [1]
- Molar mass of Mg<sub>3</sub>N<sub>2</sub> =  $(24.3 \times 3 + 14.0 \times 2)$  g mol<sup>-1</sup> = 100.9 g mol<sup>-1</sup>
- ∴ Mass of Mg<sub>3</sub>N<sub>2</sub> formed =  $y / 72.9 \times 100.9 = 1.38 y$  g [1]
- (ii) Mass of magnesium reacted with oxygen =  $(19.44 - y)$  g

No. of moles of magnesium reacted to give MgO

$$= (19.44 - y) / 24.3 \quad [1]$$

From the equation, mole ratio of Mg : MgO = 1:1.

$$\therefore \text{No. of moles of MgO formed} = (19.44 - y) / 24.3$$

$$\begin{aligned} \text{Mass of MgO formed} &= (19.44 - y) / 24.3 \times (24.3 + 16.0) \\ &= (32.24 - 1.66y) \text{ g} \quad [1] \end{aligned}$$

$$(iii) \quad 1.38y + (32.24 - 1.66y) = 31.17$$

$$y = 3.82 \quad [1]$$

$\therefore$  the % by mass of magnesium that has reacted with nitrogen

$$= 3.82 / 19.44 \times 100\% = 19.7\% \quad [1]$$

(b) (i) Fractional distillation of liquid gases [1]

(ii) Any ONE:

- There is not enough oxygen for respiration. [1]
- There is not enough water for survival. (1)
- There is no ozone protection on Mars. UV light damages our skin. (1)

(Accept other reasonable answers.)

(iii) The iron piece on Earth would rust faster [1]

because the amounts of oxygen on Earth is larger than those on Mars. [1]

(iv) (1) Painting [1]

The paint cuts off the air and water supply from the iron surface. [1]

(2) Plastic / aluminium / zinc / other acceptable answers [1]

It is corrosion resistant / resists chemical attack/ light in weight/ less dense than iron. [1]