



Raffles Institution
Year 5 H2 Chemistry 2025
Tutorial 12a – The Periodic Table 1

Suggested Answers to Practice Questions

8 Answer: D

Strategy

1. Observe x-axis (electrical conductivity)

The metals (Na, Mg and Al) have high electrical conductivity (lie to the right of the axis) and increases from Na to Mg to Al i.e. Al would be most far right.

⇒ Reject **A** and **B**.

2. Observe y-axis (1st ionisation energy)

Using data from data booklet, P has the highest first IE ⇒ Reject **C**.

9 Answer: D

A Cl₂ molecule has less electrons than P₄ molecule. Hence Cl₂ has weaker instantaneous dipole-induced dipole interactions and has a lower melting point.

B Na has a lower melting point than Mg due to weaker metallic bonding in Na.

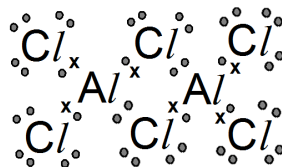
C S₈ molecule has more electrons than P₄ molecule. Hence S₈ has stronger instantaneous dipole-induced dipole interactions and has a higher melting point.

D S₈ molecule has more electrons than P₄ molecule. Hence S₈ has stronger instantaneous dipole-induced dipole interactions and has a higher melting point. SiO₂ is also the only insoluble oxide amongst the three elements.

10 Answer: A

W is Silicon. **X** is Aluminium. **Y** is either Phosphorus or Sulfur. **Z** is Sodium.

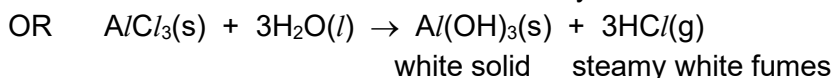
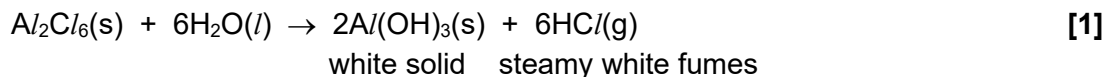
11 (a) Molecular formula of the vapour: Al₂Cl₆



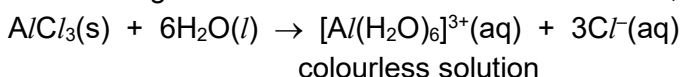
Note: 2 molecules of AlCl₃ dimerise to form Al₂Cl₆ which is more stable (as Al is electron deficient in AlCl₃).

[1+1]

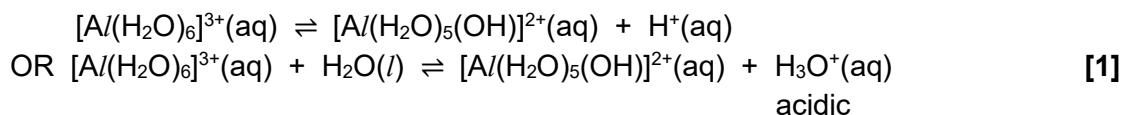
(b) When only a few drops of water are added to the solid, steamy white fumes of HCl are evolved and together with the formation of Al(OH)₃, a white solid, which is insoluble in water. **[1]**



When a large amount of water is added to the solid, [Al(H₂O)₆]³⁺(aq) is formed.



[Al(H₂O)₆]³⁺(aq) undergoes hydrolysis as shown below.



Al^{3+} ions, with high charge density and hence high polarising power, are able to distort the electron cloud of the water molecules, weakening the O–H bond. As a result, the O–H bond undergoes heterolytic fission readily to release H^+ . [1]

Note:

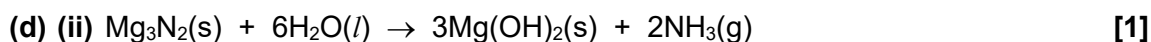
- yellow–white solid can be denoted by $AlCl_3$ or Al_2Cl_6



$Na_2O(s)$ dissolves to produce $NaOH(aq)$.

The litmus solution turns from purple to blue due to the presence of OH^- ions. [1]

(d) (i)

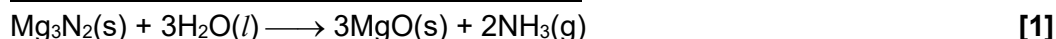


$$\text{Amount of } Mg_3N_2 = \frac{2.0}{3(24.3) + 2(14.0)} = 0.01982 \text{ mol}$$
 [1]

$$\text{Amount of } Mg(OH)_2 = 3 \times 0.01982 = 0.05946 \text{ mol}$$
 [1]

$$\text{Mass of } Mg(OH)_2 = 0.05946 \times (24.3 + 2(16.0 + 1.0)) = 3.47 \text{ g}$$
 [1]

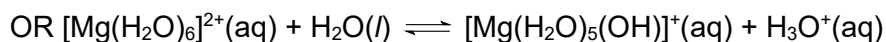
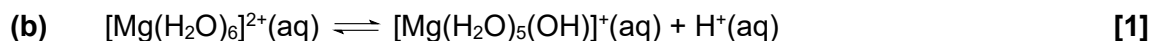
Alternative answer MgO can be accepted:



$$\text{Amount of } Mg_3N_2 = \frac{2.0}{3(24.3) + 2(14.0)} = 0.01982 \text{ mol}$$
 [1]

$$\text{Amount of } MgO = 3 \times 0.01982 = 0.05946 \text{ mol}$$
 [1]

$$\text{Mass of } MgO = 0.05946 \times (24.3 + 16.0) = 2.40 \text{ g}$$
 [1]



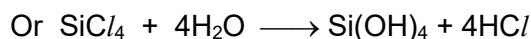
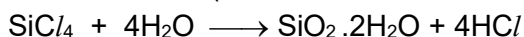
Mg^{2+} ions, with high charge density and hence high polarising power, are able to distort the electron cloud of the water molecules, weakening the O–H bond. As a result, the O–H bond undergoes heterolytic fission readily to release H^+ . [1]

13 (a) (i) Giant covalent structure / Giant molecular structure [1]

(a) (ii) To melt the elements, strong covalent bonds between the atoms have to be broken. From C to Ge, the valence orbitals become more diffuse. The overlap of those orbitals becomes less effective. Strength of covalent bond decreases and hence less energy is required for melting. [2]



Alternative answer (this answer is also accepted):



[Teacher's note: Based on b(ii), inertness of CCl_4 to water is not due to C-Cl bond being too strong and not broken]

(b) (iii) The electron deficient carbon atom in CCl_4 is attached to four large chlorine atoms which hinder the approach of the H_2O nucleophile.

OR C does not have low-lying vacant orbitals to accept the lone pair of electrons from water during hydrolysis. [1]

14 First, add HCl(aq) to a sample of the white powder. If the solid is insoluble in acid, it must be the acidic oxide SiO_2 .

If the solid dissolves in acid, add NaOH(aq) to a fresh sample of the white powder. If the solid is insoluble in NaOH(aq) , it must be the basic oxide MgO . If the solid dissolves in both acid and base, it must be the amphoteric oxide Al_2O_3 .

	sample is		
When HCl(aq) is added,	insoluble	soluble	soluble
When NaOH(aq) is added,		insoluble	soluble
Identity	SiO_2	MgO	Al_2O_3

Equations:

