

- M1.** (a)  $\text{Na}_2\text{O}$  ionic  
*mention of molecules/intermolecular forces/delocalised electrons, CE = 0* 1
- Strong forces between ions/strong ionic bonding  
*Allow lots of energy to break bonds provided M1 scored* 1
- $\text{SiO}_2$  macromolecular  
*Allow giant molecular/giant covalent.  
 If ions mentioned, CE = 0* 1
- Strong covalent bonds (between atoms)  
*Allow lots of energy to break covalent bonds  
 If breaking intermolecular forces are mentioned, CE = 0 for M4* 1
- (b) Higher 1
- $\text{Li}^+$  (or Li ion) smaller than  $\text{Na}^+$   
*Must imply  $\text{Li}^+$  ion  
 Allow  $\text{Li}^+$  has higher charge/size ratio **not** charge/mass* 1
- Attracts  $\text{O}^{2-}$  ion more strongly  
*Allow stronger ionic bonding  
 Allow additional attraction due to polarisation in  $\text{Li}_2\text{O}$   
 M3 can only be scored if M2 gained* 1
- (c) (i) Molecular  
*Do not allow simple covalent BUT simple covalent molecule scores M1 and M2* 1
- Covalent bonds (between P and O)  
*Ignore reference to van der Waals' or dipole-dipole* 1

- (ii) Weak van der Waals' forces and/or dipole-dipole forces between molecules

*Allow weak inter-molecular forces – can score “between” molecules in (c)(i)*

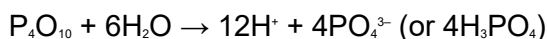
*CE = 0 if ionic or macromolecular mentioned in (c)(i)*

*Must state van der Waals' forces are weak OR low energy needed to break van der Waals' forces*

1

- (d) Allow –1 to +2

1

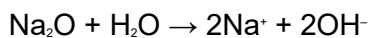


*Allow balanced equations to form  $\text{HPO}_4^{2-}$  or  $\text{H}_2\text{PO}_4^-$   
ignore state symbols*

1

Allow 12 to 14

1



*Allow  $2\text{Na}^+ + \text{O}^{2-}$  on LHS,  $2\text{NaOH}$  on RHS, ignore s.s.  
Mark independently*

1

- (e)  $6\text{Na}_2\text{O} + \text{P}_4\text{O}_{10} \rightarrow 4\text{Na}_3\text{PO}_4$

1

Acid-base

*Allow neutralisation, mark independently of M1  
Do not allow Acid + Base  $\rightarrow$  Salt + Water*

1

[16]

- M2.** (a) Electronegativity increases

1

Proton number increases (increase in nuclear charge)

1

Same number of electron shells/levels

*Or same radius or Shielding of outer electrons remains the*

- 1
- 1
- (b) Big difference in electronegativity leads to ionic bonding, smaller covalent  
*Lose a mark if formula incorrect* 1
- Sodium oxide ionic lattice 1
- Strong forces of attraction between ions 1
- $P_4O_{10}$  covalent molecular  
*Must have covalent and molecular (or molecules)* 1
- Weak (intermolecular) forces between molecules  
*Or weak vdW, or weak dipole–dipole between molecules* 1
- melting point  $Na_2O$  greater than for  $P_4O_{10}$   
*Or argument relating mpt to strength of forces* 1
- (c) Moles NaOH =  $0.0212 \times 0.5 = 0.0106$   
*M1 moles of NaOH correct* 1
- Moles of  $H_3PO_4$  =  $1/3$  moles of NaOH (= 0.00353)  
*M2 is for 1/3* 1
- Moles of P in 25000 l =  $0.00353 \times 10^6 = 3.53 \times 10^3$   
*M3 is for factor of 1,000,000* 1
- Moles of  $P_4O_{10}$  =  $3.53 \times 10^3/4$   
*M4 is for factor of 1/4 (or 1/2 if  $P_2O_5$ )* 1
- Mass of  $P_4O_{10}$  =  $3.53 \times 10^3/4 \times 284 = 0.251 \times 10^6$  g  
 = 251 kg  
*(Or if  $P_2O_5$   $3.53 \times 10^3/2 \times 142$ )*  
*M5 is for multiplying moles by M, with correct units*  
*allow conseq on incorrect M4*

(allow 250-252)

1

[15]

**M3.** (a) (i) *can form a solution with pH less than 3: P<sub>4</sub>O<sub>10</sub> or SO<sub>3</sub> (1)*

(ii) *can form a solution with with a pH greater than 12: Na<sub>2</sub>O (1)*

penalise any wrong answer to zero

2

(b) (i)  $\text{MgO} + 2\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2\text{O}$  or an ionic equation (1)

i.e.  $\text{MgO} + 2\text{H}^+ \rightarrow \text{Mg}^{2+} + \text{H}_2\text{O}$

not  $\text{O}^{2-} + 2\text{H}^+ \rightarrow \text{H}_2\text{O}$

(ii)  $2\text{NaOH} + \text{SiO}_2 \rightarrow \text{Na}_2\text{SiO}_3 + \text{H}_2\text{O}$  or ionic equation (1)

i.e.  $\text{SiO}_2 + 2\text{OH}^- \rightarrow \text{SiO}_3^{2-} + \text{H}_2\text{O}$

(iii)  $3\text{Na}_2\text{O} + 2\text{H}_3\text{PO}_4 \rightarrow 2\text{Na}_3\text{PO}_4 + 3\text{H}_2\text{O}$  etc or ionic equation (1)

i.e.  $\text{Na}_2\text{O} + 2\text{H}^+ \rightarrow 2\text{Na}^+ + \text{H}_2\text{O}$

3

(c) P<sub>4</sub>O<sub>10</sub> is a molecular (structure) or simple covalent (1)

Weak intermolecular forces or van der Waals forces (between molecules) (1)

SiO<sub>2</sub> is a macromolecule / giant covalent / giant molecule (1)

*Not giant lattice*

(Strong) covalent bonds (between atoms) must be broken (1)

4

[9]

<b>M4.</b>	(a)	(i)	Oxide 1	B	1
			Oxide 2	E	1
			Explanation	Low melting point or weak van der Waals' forces between molecules	1
		(ii)	Chemical test Add water or flame test		1
			Test pH or flame colour		1
			Observation	pH = 13/14 or colour yellow	1
	(b)	(i)	Equation	$\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}$	1
		(ii)	Product	$\text{CaSO}_3$	1
		(iii)	Disposal of large quantities of $\text{CaSO}_3$ (allow $\text{CaSO}_4$ )		1
			Produces $\text{CO}_2$ or uses up $\text{CaCO}_3$		1

[10]