

- M1.** (a) Na_2O 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
- 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
- Li^+ (or Li ion) smaller than Na^+
*Must imply Li^+ ion
 Allow Li^+ has higher charge/size ratio **not** charge/mass* 1
- Attracts O^{2-} ion more strongly
*Allow stronger ionic bonding
 Allow additional attraction due to polarisation in Li_2O
 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)

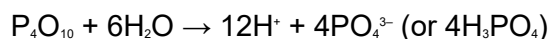
CE = 0 if ionic or macromolecular mentioned in (c)(i)

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

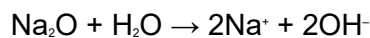


*Allow balanced equations to form HPO_4^{2-} or H_2PO_4^-
ignore state symbols*

1

Allow 12 to 14

1



*Allow $2\text{Na}^+ + \text{O}^{2-}$ on LHS, 2NaOH 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: P₄O₁₀ or SO₃ (1)*

(ii) *can form a solution with with a pH greater than 12: Na₂O (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) P₄O₁₀ is a molecular (structure) or simple covalent (1)

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

SiO₂ is a macromolecule / giant covalent / giant molecule (1)

Not giant lattice

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

4

[9]

M4.	(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	CaSO_3	1
		(iii)	Disposal of large quantities of CaSO_3 (allow CaSO_4)		1
			Produces CO_2 or uses up CaCO_3		1

[10]