M1.(a) $Mg + H_2O \rightarrow MgO + H_2$

ignore state symbols

1

White solid / powder / ash / smoke

ignore precipitate

ignore fumes

1

(Bright) white light / flame

allow glow

penalise effervescence under list principle

1

(b) $2Na + \frac{1}{2} O_2 \rightarrow Na_2O$ / $4Na + O_2 \rightarrow 2Na_2O$

Allow multiples, ignore state symbols

Allow $2Na + O_2 \rightarrow Na_2O_2$

1

white / yellow solid / ash / smoke

ignore precipitate

ignore fumes

1

orange / yellow flame

1

[6]

M2.(a) (i) 1500

1

(ii) Ionic lattice / giant ionic

Mention of vdW / covalent bonding / molecules / atoms / metal etc. CE = 0

1

Strong attraction between oppositely charged ions / Na^+ and O^{2-}
OR
lots of energy required to separate / overcome attraction between oppositely charged ions / Na^+ and O^{2-}

Do not allow incorrect formulae for ions.

1

(iii) 200 (K)

Allow range 10−273 (K)

CE = 0 if temperature >573 K, otherwise mark on

Allow correct answers in °C but units must be given.

1

SO_2 smaller (molecule) (than P_4O_{10}) (or converse)

also SO_2 has lower M_r / less surface area / less polarisable / fewer electrons

penalise SO_3 and P_2O_5 for M2 only

1

vdW forces between molecules are weaker / require less energy to separate molecules

ignore dipole−dipole

If covalent bonds broken lose M2 and M3 but can gain M1

1

(b) $SO_2 + H_2O \rightarrow H_2SO_3 / H^+ + HSO_3^- / 2H^+ + SO_3^{2-}$

can be equilibrium sign instead of arrow

1

1

Allow values between 1−3

mark independently

1

(c) Reacts with / neutralises bases / alkalis

Allow any given base or alkali including OH^-

1

$SiO_2 + 2NaOH \rightarrow Na_2SiO_3 + H_2O$

Allow $CaO + SiO_2 \rightarrow CaSiO_3$ or equation with any suitable base

M2 can score M1 even if equation unbalanced or incorrect

1

[10]

M3.(a) MgO is ionic

If not ionic, CE = 0

1

Melt it

If solution mentioned, cannot score M2 or M3

1

(Molten oxide) conducts electricity

Allow acts as an electrolyte.

Cannot score M3 unless M2 is correct.

1

(b) Macromolecular

CE = 0 if ionic, metallic or molecular.

Allow giant molecule.

1

Covalent bonding

Giant covalent scores M1 and M2

1

Water cannot (supply enough energy to) break the covalent bonds / lattice

Hydration enthalpy < bond enthalpy.

1

(c) (Phosphorus pentoxide's melting point is) lower

If M1 is incorrect, can only score M2

1

Molecular with covalent bonding

M2 can be awarded if molecular mentioned in M3

1

Weak / easily broken / not much energy to break intermolecular forces
OR weak vdW / dipole-dipole forces of attraction between molecules

Intermolecular / IMF means same as between molecules.

1

(d) Reagent (water or acid)

Can be awarded in the equation.

1

Equation eg $MgO + 2HCl \rightarrow MgCl_2 + H_2O$

$MgO + H_2O \rightarrow Mg(OH)_2$

Equations can be ionic but must show all of the reagent eg H^+ + Cl^-

Simplified ionic equation without full reagent can score M2 only.

Allow $6MgO + P_4O_{10} \rightarrow 2Mg_3(PO_4)_2$

1

(e) $P_4O_{10} + 12NaOH \rightarrow 4Na_3PO_4 + 6H_2O$

Allow P_2O_5 and acid salts.

Must be NaOH not just hydroxide ions.

1

[12]

M4.(a) The number of protons increases (across the period) / nuclear charge increases

1

Therefore, the attraction between the nucleus and electrons increases

Can only score M2 if M1 is correct

1

(b) S_8 molecules are bigger than P_4 molecules

Allow sulfur molecules have bigger surface area and sulfur molecules have bigger M_r

1

Therefore, van der Waals / dispersion / London forces between molecules are stronger in sulfur

1

(c) Sodium oxide contains O^{2-} ions

1

These O^{2-} ions react with water forming OH^- ions

$O^{2-} + H_2O \longrightarrow 2OH^-$ scores M1 and M2

1

(d) $P_4O_{10} + 12OH^- \longrightarrow 4PO_4^{3-} + 6H_2O$

1

[7]

M5.(a) White powder / solid / ash / smoke

Ignore ppt / fumes

1

Bright / white light / flame

Allow glows white / glows bright

1

$Mg + H_2O \rightarrow MgO + H_2$

Ignore state symbols

Ignore reference to effervescence or gas produced

1

(b) Mg^{2+} / magnesium ion has higher charge than Na^+

Allow Mg^{2+} ions smaller / greater charge density than Na^+ ions

Allow Mg atoms smaller than Na (atoms)

Allow magnesium has more delocalised electrons

Must be a comparison

Ignore reference to nuclear charge

1

Attracts <u>delocalised / free / sea of</u> electrons more strongly / metal–metal bonding stronger / metallic bonding stronger

Wrong type of bonding (vdW, imf), mention of molecules CE = 0

1

(c) **Structure:** Macromolecular / giant molecule / giant covalent

Mark independently

1

Bonding: Covalent / giant covalent

1

Physical Properties:

Any **two** from: Hard/
Brittle / not malleable
Insoluble
Non conductor

Ignore correct chemical properties

Ignore strong, high boiling point, rigid

2

(d) **Formula:** P_4O_{10}

Mention of ionic or metallic, can score M1 only

1

Structure: Molecular

If macromolecular, can score M1 & M3 only

1

Bonding: Covalent / shared electron pair

1

van der Waals' / dipole–dipole forces <u>between molecules</u>

Allow vdW, imf and dipole–dipole imf but do not allow imf alone

1

(e) $SO_2 + H_2O \rightarrow H^+ + HSO_3^-$

Products must be ions

Allow $SO_2 + H_2O \rightarrow 2H^+ + SO_3^{2-}$

Allow two equations showing intermediate formation of H_2SO_3 *that ends up as ions*

Ignore state symbols

Allow multiples

1

(f) $P_4O_{10} + 6MgO \rightarrow 2Mg_3(PO_4)_2$

OR $P_4O_{10} + 6MgO \rightarrow 6Mg^{2+} + {}_4PO_4^{3-}$

OR $P_2O_5 + 3MgO \rightarrow Mg_3(PO_4)_2$ etc

Ignore state symbols

Allow multiples

1

[15]