

Mark schemes

1

(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.

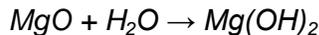
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(d) Reagent (water or acid)

Can be awarded in the equation.

1

Equation eg $\text{MgO} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2\text{O}$



Equations can be ionic but must show all of the reagent eg $\text{H}^+ + \text{Cl}^-$

Simplified ionic equation without full reagent can score M2 only.



1



Allow P_2O_5 and acid salts.

Must be NaOH not just hydroxide ions.

1

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2

(a) Na_2O is an ionic lattice / giant ionic / ionic crystal

CE= 0 if molecules, atoms, metallic mentioned

Mention of electronegativity max 1 out of 2

1

With strong forces of attraction between ions

Allow strong ionic bonds / lots of energy to separate ions

1

(b) SO_3 is a larger molecule than SO_2

Allow greater M_r / surface area

1

So van der Waals' forces between molecules are stronger

Any mention of ions, CE= 0

1

(c) Ionic

Do not allow ionic with covalent character

1

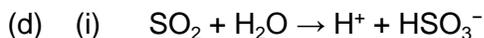
Contains O^{2-} ions / oxide ions



1

These / O^{2-} ions (accept protons to) form OH^- / hydroxide / water (must score M2 to gain M3)

1



Allow $2\text{H}^+ + \text{SO}_3^{2-}$ but no ions, no mark

Only score (d)(ii) if (d)(i) correct

1

- (ii) Reaction is an equilibrium / reversible reaction displaced mainly to the left / partially ionised / dissociated

Allow reaction does not go to completion

1

- (e) SiO_2 reacts with bases / NaOH / CaO / CaCO_3

Ignore incorrect formulae for silicate

1

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3

- (a) To prevent it coming into contact/reacting with oxygen/air

Allow because it reacts with air/oxygen

And because with air/oxygen it forms an oxide. (Oxide, if identified, must be correct :- P_4O_{10} , P_2O_5 , P_4O_6 , P_2O_6)

1

- (b) One molecule contains 4P and 10O/the molecular formula is P_4O_{10}

Allow exists as P_4O_{10}

Do not allow reference to combination of two P_2O_5 molecules

Ignore any reference to stability

1

- (c) P_4O_{10} is a bigger molecule (than SO_3)/greater M_r /more electrons/ greater surface area

Penalise SO_2 for one mark (max 1)

CE = 0 if mention of hydrogen bonding/ionic/ giant molecule/breaking of covalent bonds

1

Van der Waals / vdW forces between molecules are stronger/require more energy to break

Do not allow just more vdW forces

Ignore any reference to dipole-dipole forces

1

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

Allow correct ionic equations

Ignore state symbols

1

pH must be in the range -1 to +2

Allow -1 to +2

Mark independently

1

- (e) (i) $3\text{MgO} + 2\text{H}_3\text{PO}_4 \rightarrow \text{Mg}_3(\text{PO}_4)_2 + 3\text{H}_2\text{O}$
 OR $\text{MgO} + 2\text{H}_3\text{PO}_4 \rightarrow \text{Mg}(\text{H}_2\text{PO}_4)_2 + \text{H}_2\text{O}$
 OR $\text{MgO} + \text{H}_3\text{PO}_4 \rightarrow \text{MgHPO}_4 + \text{H}_2\text{O}$
Allow $\text{MgO} + 2\text{H}^+ \rightarrow \text{Mg}^{2+} + \text{H}_2\text{O}$
Allow magnesium phosphates shown as ions and ionic equations
Ignore state symbols 1
- (ii) MgO is sparingly soluble/insoluble/weakly alkaline
Excess/unreacted MgO can be filtered off/separated 1
- (iii) An excess of NaOH would make the lake alkaline/toxic/kill wildlife
Allow pH increases 1

[9]

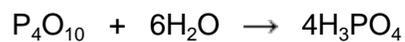
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- (a) (i) Ionic lattice / solid / giant ionic
CE = 0/2 if molecules / IMFs / atoms / metallic 1
- Strong (electrostatic) forces/attraction between ions
Allow strong ionic bonds for M2 only
Allow lot of energy to break ionic bonds 1
- (ii) Molecular/molecules 1
- Weak dipole-dipole and/or van der Waals forces between molecules
 QoL
Type of force must be mentioned 1
- (b) P_4O_{10} bigger molecule/has larger surface area than SO_2
Allow M_r of P_4O_{10} greater than for SO_2
If P_4O_{10} macromolecule/ionic, CE = 0/2 1
- van der Waals forces between molecules stronger
Allow stronger IMF 1
- (c) $\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{Na}^+ + 2\text{OH}^-$
Allow 2NaOH 1

14

Allow 12–14

1



Allow ions

1

0

Allow –1 to +2

1



Allow ionic

Allow correct formula of product with atoms in any order

1

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5

(a) (i) white flame / white light

Mark flame independent of other observations

1

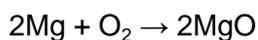
solid / powder / smoke / ash / white fumes

penalise precipitate

penalise wrong colour

if more than one observation for M2 apply list principle. (If an observation is incorrect, the incorrect observation negates a correct one)

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ignore state symbols

allow multiples

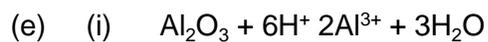
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ionic

do not allow reference to covalent character

1

- (ii) blue flame
do not allow any other colour
Mark flame independent of other observations 1
- fumes or misty or pungent/choking/smelly gas
do not allow incorrect smell (e.g. bad eggs)
apply list principle as in (a) (i)
do not allow just 'gas' or 'colourless gas'
- $S + O_2 \rightarrow SO_2$
ignore state symbols
allow multiples and S_8 1
- covalent
penalise giant covalent 1
- (b) ionic
If covalent, can only score M3 1
- O^{2-} / oxide ion reacts with water / accepts a proton
M2 requires reference to O^{2-} / oxide ion 1
- forming OH^- ions/ NaOH / sodium hydroxide
 (can show in equation from Na_2O even if incorrect)
allow 1
- $O^{2-} + H_2O \rightarrow 2OH^-$ or
 $O^{2-} + H^+ \rightarrow OH^-$ to score M2 & M3
also allow equations with spectator Na^+ ions on both sides. 1
- (c) (heat until) molten
or dissolve in molten cryolite
do not allow solution in water 1
- conducts electricity / can be electrolysed / electrolyse and
 identify Al / O_2 at an electrode
M2 can only be gained if M1 scored 1
- (d) insoluble (in water)
allow oxide impermeable to air / water
or oxide is unreactive / inert 1



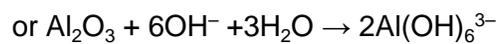
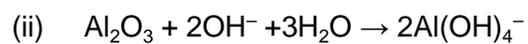
allow $\text{O}^{2-} + 2\text{H}^+ \rightarrow \text{H}_2\text{O}$

and formation of aquated Al^{3+} species

allow spectator Cl^- ions

penalise HCl (not ionic!)

1



allow formation of $\text{Al}(\text{H}_2\text{O})_2(\text{OH})_4^-$

allow Na^+ spectator ions

penalise NaOH (not ionic!)

1

[16]