Question 18 (Answer: **D**)

- MgO and Al_2O_3 are giant ionic, and SiO_2 is giant covalent.
- P_4O_{10} exists as discrete molecules held together by weak van der Waals forces.
- That is why it is the only one of the four with a low melting point.

A-Level Chemistry: **w25 12**

Question 18 (Answer: **D**)

- It must be a solid at 25 °C, which rules out sulfur dioxide, a gas.
- It must react with water, which rules out silicon dioxide – insoluble and unreactive.
- Aluminium oxide is amphoteric and insoluble; phosphorus(V) oxide is a white solid giving phosphoric acid.

Question 23 (Answer: **B**)

- Steamy fumes are HCl, so the chloride hydrolyses – that rules out sodium and magnesium chlorides.
- A precipitate soluble in *both* acid and alkali is amphoteric.
- $Al(OH)_3$ is the amphoteric hydroxide, so E is aluminium.

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Question 16 (Answer: **A**)

- A white crystalline solid with a very high melting point must be ionic.
- The only ionic Period 3 chlorides are NaCl and $MgCl_2$ – and NaCl is neutral in water while $MgCl_2$ is slightly acidic.
- Neither can give pH 12, so the observations contradict each other: at least one must be wrong.

A-Level Chemistry: **w25 21**

2(a)(i)	**M1** nuclear charge increases (across period) **AND** similar shielding **M2** greater / stronger attraction to nucleus
2(a)(ii)	**M1** A*l* loses (3) electrons / A*l* is 3+, and P gains (3) electrons / P is 3– **M2** $Al^{(3+)}$ has (one) fewer shell (than $P^{(3-)}$)
2(b)(i)	**M1**: (+)1 | (+)2 | (+)3 | (+)4 | (+)5 | (+)6 **M2**: 12-14 | 8-10 | — | — | 0-4 | 0-4
2(b)(ii)	they are insoluble
2(c)(i)	$Na_2O + 2HCl \rightarrow 2NaCl + H_2O$
2(c)(ii)	$Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$
2(d)(i)	(thermal stability) increases (down the group)
2(d)(ii)	NO_2 **AND** O_2

A-Level Chemistry: **w25 22**

2(a)(i)	delocalised electrons move (through the structure / between layers)
2(a)(ii)	P / S / C*l* have no charge carriers **OR** (no ions and) no delocalised electrons **OR** no mobile / moving ions
2(b)	**M1** Si has (lots of) strong covalent bonds broken **M2** P / S / C*l* (only) has weak Van der Waals' (forces) broken
2(c)	**M1**: +1 | +2 | +3 | +4 | +5 **M2**: 7 | 6.5 | 0–4 | 0–4 | 0–4 **M3**: I | I | I | C | C **M4**: G | G | G | S | S
2(d)(i)	$2Al + 3Cl_2 \rightarrow 2AlCl_3$
2(d)(ii)	$PCl_5 + 4H_2O \rightarrow H_3PO_4 + 5HCl$
2(e)(i)	rate of forward and backward (reaction) are the same / equal **OR** (ratio of) concentrations of reactants and products are constant
2(e)(ii)	closed system
2(e)(iii)	**M1** (mixture / solution becomes more) yellow **M2** (forward) reaction is exothermic (equilibrium shifts left) **OR** equilibrium / reaction shifts (left) to absorb (additional) heat / energy **M3** (mixture / solution becomes more) red **M4** fewer moles of gas on right-hand side **OR** (gas on left and) no gas on the right
2(f)(i)	$MgCl_2(aq) + Na_2CO_3(aq) \rightarrow MgCO_3(s) + 2NaCl(aq)$ **M1** formulae in balanced equation **M2** state symbols
2(f)(ii)	MgO / magnesium oxide **AND** CO_2 / carbon dioxide
2(f)(iii)	(thermal stability) increases (down the group)

A-Level Chemistry: **w25 24**

2(a)	**M1** Al_2O_3 is ionic **M2** P_4O_{10} is a (simple) molecule **M3** ionic bonds are stronger than intermolecular forces
2(b)(i)	$mol^{-2}\,dm^6$
2(b)(ii)	**M1** at equilibrium: moles of CO = 0.120 **AND** moles of H_2 = 0.240 **M2** $[CH_3OH]$ = 0.056 **AND** [CO] = 0.024 **AND** $[H_2]$ = 0.048 **M3** use of K_c with correct evaluation = 1.01×10^3
2(b)(iii)	no effect **AND** K_c is not affected by pressure
2(c)(i)	increases rate by providing a different mechanism with a lower activation energy
2(c)(ii)	$2CH_3OH \rightarrow CH_3OCH_3 + H_2O$
2(c)(iii)	$P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4$