

Question 18 (Answer: D)

- MgO and Al₂O₃ are giant ionic, and SiO₂ is giant covalent.
- P₄O₁₀ 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.

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.

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 MgCl₂ – and NaCl is neutral in water while MgCl₂ is slightly acidic.
- Neither can give pH 12, so the observations contradict each other: at least one must be wrong.

2(a)(i)	M1 nuclear charge increases (across period) AND similar shielding M2 greater / stronger attraction to nucleus						
2(a)(ii)	M1 Al loses (3) electrons / Al 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 ₂ O + 2HCl → 2NaCl + H ₂ O						
2(c)(ii)	Al ₂ O ₃ + 2NaOH → 2NaAlO ₂ + H ₂ O						
2(d)(i)	(thermal stability) increases (down the group)						
2(d)(ii)	NO ₂ AND O ₂						

2(a)(i)	delocalised electrons move (through the structure / between layers)					
2(a)(ii)	P / S / Cl 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 / Cl (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)					

2(a)	M1 Al ₂ O ₃ is ionic M2 P ₄ O 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 ₃ OH] = 0.056 AND [CO] = 0.024 AND [H ₂] = 0.048 M3 use of <i>K_c</i> with correct evaluation = 1.01 × 10 ³
2(b)(iii)	no effect AND <i>K_c</i> 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)	$P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4$