Practice Paper 1B

Section A

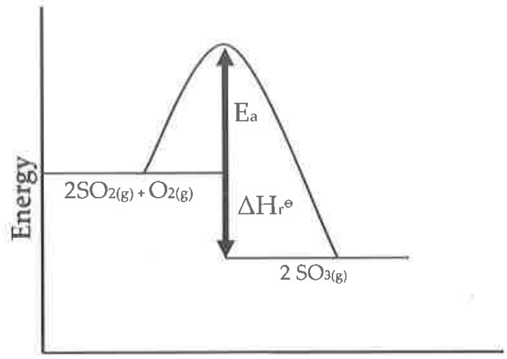
1	C	**6**	B	**11**	D
2	B	**7**	C	**12**	B
3	D	**8**	C	**13**	B
4	A	**9**	A	**14**	B
5	D	**10**	D	**15**	D

Section B

16 a) Sulfur trioxide is symmetrical, but sulfur dioxide is not ✓
Dipoles cancel out in sulfur trioxide ✓

b) i) $\Delta H_r^\ominus = 2 \times \Delta H_f^\ominus(SO_3) - 2 \times \Delta H_f^\ominus(SO_2)$ ✓ (Award for symbols or numbers)
$\Delta H_r^\ominus = (2 \times -395.7) - (2 \times -296.8)$
$\Delta H_r^\ominus = -197.8$ (kJ mol^{-1}) ✓ (Sign must be correct)

ii) Product line below reactant line and $\Delta H_r^\ominus$ line correctly drawn ✓
E_a correctly labelled (ALLOW double-headed arrow) ✓



c) i) $K_p = \frac{p(SO_3)^2}{p(O_2) \times p(SO_2)^2}$ ✓
Moles (SO_3) at equilibrium = $\frac{\text{Mass}}{M_r} = \frac{3.443}{80.1} = 0.0430$ ✓

	O_2	SO_2	SO_3
Moles (initial)	0.160	0.160	0.00
Moles (eqm)	0.117	0.0740	0.0430

✓ (Correct eqm moles)
Total moles = 0.234

	O_2	SO_2	SO_3
Partial Pressure	$\frac{0.117 \times 0.5}{0.234}$	$\frac{0.074 \times 0.5}{0.234}$	$\frac{0.043 \times 0.5}{0.234}$
Partial Pressure	0.2500	0.1581	0.0919

✓ (ALLOW ECF from incorrect moles)

$K_p = \frac{0.0919^2}{0.25 \times 0.1581^2}$

$K_p = 1.35$ ✓ ALLOW ECF from incorrect partial pressures

$K_p = \frac{kPa^2}{kPa \times kPa^2} = kPa^{-1}$ = ✓ (ALLOW Pa^{-1} if Pascals used in calculation)

ii) (Pressure is doubled, so) the partial pressures of each of the reactants and products are initially doubled ✓

Value of $\frac{p(SO_3)^2}{p(O_2) \times p(SO_2)^2}$ decreases OR denominator increases by more than the numerator (ALLOW argument made using actual figures from (i) ✓

Equilibrium shifts to the right to restore the value of K_p OR equilibrium shifts to the right to increase the numerator and decrease the denominator ✓

d) i) V_2O_5 ✓

ii) No change ✓

Catalysts speed up both the forward and reverse reactions equally ✓ (IGNORE catalysts do not affect K_p – this is credited by the first mark)

iii) At lower temperatures the reaction is slower ✓

At higher temperatures there is a lower yield ✓

Higher temperatures are more expensive OR require more fuel OR result in more pollution from emissions ✓

17 a) Side product is HCl ✓

$2Cl_2 + 2\ H_2O \rightarrow 3HCl + HClO_2$ ✓

b) Reacts to form chlorinated hydrocarbons (which have been linked to ill health effects)

OR Chlorine is toxic ✓

c) To calibrate the pH meter ✓

So readings using the pH meter can be adjusted to the correct values (using a calibration curve) ✓

d) i) Even scale that uses half the graph paper AND axes labelled AND units for volume included ✓

Points plotted correctly ✓

Smooth curve with clear vertical section ✓

ii) Bromocresol purple AND range entirely within the vertical section of the graph ✓

e) i) $K_a = 10^{-pK_a} = 10^{-1.94} = 1.148 \times 10^{-2}$ ✓

$[H^+] = \sqrt{K_a \times [HA]} = \sqrt{1.148 \times 10^{-2} \times 0.01} = 1.072 \times 10^{-2}$ mol dm^{-3} ✓

$pH = -\log_{10}[H^+] = -\log_{10} 0.01072 = 1.97$ ✓

ii) $[OH^-] = \frac{K_W}{[H^+]} = \frac{1.00 \times 10^{-14}}{1.072 \times 10^{-2}} = 9.33 \times 10^{-13}$ (mol dm^{-3}) ✓

iii) [HA] at equilibrium cannot be approximated to be the same as the initial [HA] if greater than 5 % dissociation ✓

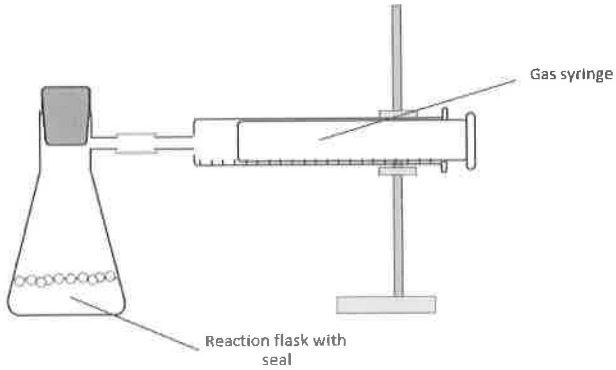
This gives a [H$^+$] that is too small ✓

18 a) (Greater concentration means) there are more particles in a given volume ✓
Therefore, there are more **frequent** (successful) collisions ✓

b)

LEVEL OF RESPONSE QUESTION	
Level 3: (5–6 marks)	The practical procedure is described in a comprehensive and logical fashion. The experimental set-up is completely viable.
Level 2: (3–4 marks)	The practical procedure is described, but omits some details or is not described in a completely logical order. The experimental set-up is mostly correct, with minor errors.
Level 1: (1–2 marks)	Some suggestions for an procedure are given, but not in a logical order. Some appropriate equipment is suggested.
0 marks	No creditworthy response.

Indicative Content



Experimental Set-up

- Experimental diagram with a set-up that allows gas collection (e.g. gas syringe or collection over water). Must be closed to prevent loss of gas to atmosphere.
- Labelled piece of equipment in diagram to measure gas production

Experimental Description

- Measure out given quantities of Fe (III) solution and H_2O_2 using a measuring cylinder / other appropriate measuring apparatus
- Add to the reaction flask and replace bung/seal
- Measure the time taken to produce a certain quantity of gas/oxygen
- Repeat for different concentrations of Fe (III)
- Identification of at least one control variable (e.g. volume of H_2O_2; concentration of H_2O_2; temperature)

c) When concentration of H_2O_2 is divided by 3, rate is divided by 3. Rate is first order with respect to H_2O_2. ✓

Rate = k $[H_2O_2]$ so $k = \frac{\text{Rate}}{[H_2O_2]}$ ✓

From reaction 1 (ALLOW use of reaction 2): $k = \frac{3.65 \times 10^{-5}}{5.00 \times 10^{-3}} = 7.3(0) \times 10^{-3}$ ✓

Units: $k = \frac{\text{mol dm}^{-3}\,\text{s}^{-1}}{\text{mol dm}^{-3}} = \text{s}^{-1}$ ✓

d) $k = \frac{\ln 2}{t_{1/2}}$ so $t_{1/2} = \frac{\ln 2}{k}$ ✓

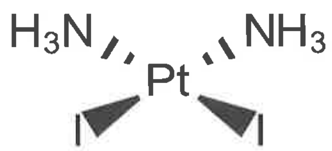
$t_{1/2} = \frac{\ln 2}{7.3 \times 10^{-3}}$ = 95.0 (accept 94.95) OR 6931(.47) from given value ✓

e) Overall order is 2 ✓
Rate is first order with respect to Fe (III) and H_2O_2 so sum of orders of individual reaction is 2. ✓

19 a) 4 ✓

b) A central metal ion surrounded by / coordinately bonded to ligands ✓

c) Correct groups bound to Pt ✓
Cis square planar complex ✓
Trans complex would have the same ligands on opposite side of the complex ✓



d) $[PtI_4]^{2-}{}_{(aq)} + 2\ NH_{3(aq)} \rightleftharpoons Pt(NH_3)_2I_{2(s)} + 2\ I^-{}_{(aq)}$ Correct, balanced species ✓ State symbols ✓

e) Binds to the DNA ✓
Stops replication ✓

f) Adverse side effects (ALLOW valid alternatives) ✓

20 a)

LEVEL OF RESPONSE QUESTION	
Level 3: (5–6 marks)	Answer is structured in an entirely ordered manner. All elements are included in discussion, with characteristics linked to explanations.
Level 2: (3–4 marks)	Answer is mostly well structured. The majority of the elements are included in the discussion, with correct characterisation of melting points in most cases, and some explanation.
Level 1: (1–2 marks)	Answer contains little order. Isolated information about different elements is given, with one or two explanations.
0 marks	No creditworthy response.

Indicative Content

- Sodium to aluminium giant **metallic**
- (Relatively) high melting points from sodium to aluminium
- Due to strong electrostatic attraction between delocalised electrons and positive ions

- Melting point increases from sodium to aluminium
- Due to increasing charge on ions, giving greater electrostatic attraction

- Silicon exists as a giant covalent lattice
- Very high melting point
- Due to network of strong covalent bonds

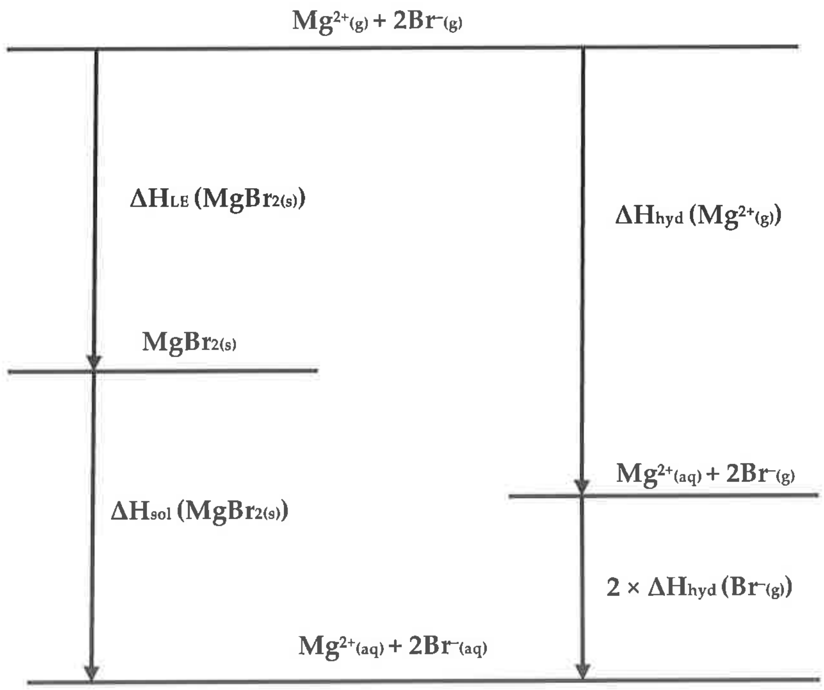
- Phosphorous, sulfur and chlorine are simple molecular / covalent lattices
- Low melting point
- Due to weak dispersion forces between **molecules**

- Argon exists as atoms
- Very low melting point
- Due to weak dispersion forces between **atoms**

b) Simple covalent / molecular ✓

c) i) (The enthalpy change when) one mole of gaseous ions is dissolved in water ✓

ii)



Arrows with correct direction ✓
Correct ΔH labels on arrows (IGNORE state symbols; IGNORE size of arrows; ALLOW hydration steps the other way round) ✓
Correct species on each line (DO NOT ALLOW incorrect state symbols) ✓

iii) ΔH_{hyd} ($Mg^{2+}_{(g)}$) = -2432 + -192 – (2 × -348) ✓
ΔH_{hyd} ($Mg^{2+}_{(g)}$) = -1928 (kJ mol^{-1})

21 a) +6 ✓ (must specify positive)

b) Zinc reacting with the acid/H^+ ✓

c)

	Titration 1	Titration 2	Titration 3	Titration 4
Start reading (cm^3)	0.00	20.90	0.00	21.30
End reading (cm^3)	20.90	41.05	20.30	41.40
Titre (cm^3)	20.90	20.15	20.30	20.10
Mean titre to 1 d.p. (cm^3)	20.1			

Correct titres calculated ✓
Correct mean titre to 1 d.p. ✓

d) $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 7H_2O + 2Cr^{3+}$ ✓
$Zn^{2+} + 2e^- \rightleftharpoons Zn$ ✓
$Cr_2O_7^{2-} + 3Zn + 14H^+ \rightleftharpoons 2Cr^{3+} + 3Zn^{2+} + 7H_2O$ ✓
Moles $Cr_2O_7^{2-}$ = 0.0201 × 0.005 = 1.005×10^{-4} ✓ (Accept ECF from incorrect titre)
Moles Zn^{2+} = 3 × 1.005×10^{-4} = 3.015×10^{-4} ✓ (Moles $Cr_2O_7^{2-}$ × 3)
Mass Zn = 3.015×10^{-4} × 65.4 = 1.972×10^{-2} ✓ (Moles Zn × 65.4)
% by mass = $\frac{\text{Mass of zinc}}{\text{Mass of tablet}} \times 100 = \frac{1.972 \times 10^{-2}}{2.5 \times 10^{-2}} \times 100$ = 78.9 % ✓(Accept ECF)

e) (Moles of $Cr_2O_7^{2-}$ would be too high) so percentage by mass of zinc would be higher than the actual value ✓

f) It needs to be repeated by someone else / by a different method ✓

