Section A (multiple choice)

Question Number	Correct Answer	Mark
1	C	**1**

Question Number	Correct Answer	Mark
2	D	**1**

Question Number	Correct Answer	Mark
3	A	**1**

Question Number	Correct Answer	Mark
4	A	**1**

Question Number	Correct Answer	Mark
5	B	**1**

Question Number	Correct Answer	Mark
6	C	**1**

Question Number	Correct Answer	Mark
7	C	**1**

Question Number	Correct Answer	Mark
8 (a)	C	**1**

Question Number	Correct Answer	Mark
8 (b)	D	**1**

Question Number	Correct Answer	Mark
8 (c)	B	**1**

Question Number	Correct Answer	Mark
9	A	**1**

Question Number	Correct Answer	Mark
10 (a)	D	**1**

Question Number	Correct Answer	Mark
10 (b)	A	**1**

Question Number	Correct Answer	Mark
10 (c)	D	**1**

Question 11: N/A
Question 12: N/A
Question 13: N/A
Question 14: N/A
Question 15: N/A

Question Number	Acceptable Answers	Reject	Mark
16 (a)(i)	**O_2** : first order as increasing $[O_2]$ x 2 increases rate x 2 / as rate is (directly) proportional to oxygen concentration **(1)** (Experiments 1 and 2 or [NO] constant) **NO:** second order as increasing [NO] x 2 increases rate x 4/ by 2^2 **(1)** (Experiments 2 and 3 or $[O_2]$ constant) Two correct orders with no explanation **(1)** only	Two correct orders based on stoichiometry	**2**

Question Number	Acceptable Answers	Reject	Mark
16 (a)(ii)	Rate = k $[O_2][NO]^2$ Rate equation must be consistent with answer in (a)(i)	Just k $[O_2][NO]^2$ i.e. no rate/R Non square brackets	**1**

Question Number	Acceptable Answers	Reject	Mark
16 (a)(iii)	Rate = k$[O_2][NO]^2$ TE from (i) k=$((5.10 \times 10^{-4})/(0.005)(0.0125)^2)$ = 652.8 / 653/650 OR k=$((10.2 \times 10^{-4})/(0.0100)(0.0125)^2)$ = 652.8 / 653/650 OR k=$((40.8 \times 10^{-4})/(0.0100)(0.025)^2)$ = 652.8 / 653/650 **(1)** TE for value of k from rate equation given $dm^6\ mol^{-2}\ s^{-1}$ (allow any order) **(1)**		**2**

Question Number	Acceptable Answers	Reject	Mark
16 (b)(i)	$NO_2 + CO \rightarrow NO + CO_2$ Allow multiples	Equation not cancelled down eg NO_3 on both sides.	**1**

Question Number	Acceptable Answers	Reject	Mark
16 (b)(ii)	Rate = $k[NO_2]^2$ OR Rate = $k[NO_2]^2[CO]^0$ OR Rate = $k[NO_2]^2[CO]^0[NO_3]^0$ **(1)** Only molecules/reactant in slow step are (2)NO_2 OR CO appears after the rate determining/slow step (and $2NO_2$ molecules in slow step) OR CO is not involved in rate determining / slow step OR Only the molecules in the slow step are in the rate equation OR Step 1 is slowest so determines rate equation **(1)** **Second mark:** **No TE on rate equation containing incorrect species. Only allow TE if k missing in correct rate equation**	Equations involving CO to power other than zero	**2**

Question Number	Acceptable Answers	Reject	Mark
17 (a)(i)	$\Delta S_{system,}$ = ((2 x 192.3) –(2 x 95.8) – (2x3x65.3)) **(1)** = **-198.8 / -199** (J mol^{-1} K^{-1}) Allow – 200 (2 SF) If units are not those in which data is given, must be correct. **(1)** *Note check working* Correct answer without working **(2)** Correct choice of multiples and data but wrong answer scores first mark **(1)** Correct value with wrong sign based on entropy of reactants – entropy of products (giving +199) **(1)** TE for second mark if multiples for hydrogen, nitrogen and ammonia are missed/ incorrect, but correct data used. or multiples correct and one error in data.	198	**2**

Question Number	Acceptable Answers	Reject	Mark
17 (a)(ii)	**If answer to (a)(i) is negative:** Disorder decreases / order increases (as reaction goes forward) **(1)** Reference to order or disorder required for the mark. As number of (gas)molecules/moles/particles decreases **(1)** OR 4 moles of gas produces 2 moles Ignore comments on number of different types of molecule in equilibrium mixture **If answer to (a)(i) is positive:** Must say this is unexpected with correct reasons to score 2 marks No marks if the positive answer is expected	Just "entropy decreases"	**2**

Question Number	Acceptable Answers	Reject	Mark
17 (b)(i)	ΔS_{surr} = -(-110.2 x 1000)/ 700 **(1)** (+157.4285) **=** (+) **157.4 / 157** (J mol^{-1} K^{-1}) OR (+) 0.1574 / 0.157 **kJ mol^{-1} K^{-1} (1)** Ignore sf except 1 Correct answer without working **(2)** Correct value with negative sign **(1)** Use of $\Delta S_{surr} = -\Delta H/T$ but wrong answer **(1)**		**2**

Question Number	Acceptable Answers	Reject	Mark
17 (b)(ii)	($\Delta S_{system} = \Delta S_{total} - \Delta S_{surr}$) =(-78.7-157.4)) = **-236.1/ -236** (J mol^{-1} K^{-1}) OR -0.2361 / -0.236 (kJ mol^{-1} K^{-1}) Allow -235.7 if 157 used and -238.7 if 160 used Ignore units unless value in kJ given as J or vice versa TE from (b)(i)	values in kJ added to values in J	**1**

Question Number	Acceptable Answers	Reject	Mark
17 (b)(iii)	Reactants predominate / more nitrogen and hydrogen (than ammonia)	Just "Equilibrium lies to the left" Just "no ammonia is present". The gases are present in ratio 1:3:2	**1**

Question Number	Acceptable Answers	Reject	Mark
17 (c)(i)	$K_p = (pNH_3)^2/ (pN_2)(pH_2)^3$ **(1)** Can be written in other formats eg p^2NH_3 etc $pH_2 = (150 - 21 - 36) =$ **93** (atm) **(1)** $K_p = ((36)^2/ (21)(93)^3) = (7.6724994 \times 10^{-5})$ $=$**7.67×10^{-5} (1)** Ignore sf except 1 TE on incorrect pH_2 atm^{-2} **(1)** TE for units on incorrect K_p expression Correct answer including units without quoting K_p **expression scores 3**	Square brackets in first mark No TE for value on incorrect K_p Expression Units other than atm	**4**

Question Number	Acceptable Answers	Reject	Mark
17 (c)(ii)	(Yield of ammonia is increased) because there are fewer moles / molecules (of gas) on the right OR System tries to reduce the pressure by going to the side with fewer moles/ molecules (of gas) Ignore comments about value of K_p changing Ignore comments about more collisions occurring/more molecules having energy greater than or equal to activation energy	Just 'equilibrium moves right'	**1**

Question Number	Acceptable Answers	Reject	Mark
***17 (c)(iii)**	**First mark** At higher temperature ΔS_{surr} is less positive/ decrease/more negative **(1)** **Second mark** making ΔS_{total} more negative / less positive/decreases No TE for 2nd mark if ΔS_{surr} is said to increase. **(1)** **Third mark** (so) K_p decreases **(1)** **Third mark depends on second mark being correct/neutral answer** **Fourth mark** so equilibrium position further left /in endothermic direction/ in reverse direction OR lower yield of ammonia / reaction is less feasible **(1)** **Fourth mark is a stand alone mark**		**4**

Question Number	Acceptable Answers	Reject	Mark
17 (c)(iv)	Rate (of reaching equilibrium)is higher / faster Ignore comments about increasing numbers of successful collisions at higher temperature		**1**

Question Number	Acceptable Answers	Reject	Mark
18 (a)	$K_a = (10^{-10.64}) =$ **2.3×10^{-11}** / 2.2909×10^{-11} (mol dm^{-3}) Ignore sf except 1		**1**

Question Number	Acceptable Answers	Reject	Mark
18 (b)(i)	$K_a = \frac{[HCOO^-][H^+]}{[HCOOH]}$ OR written as HCO_2^- and HCO_2H OR with H_3O^+ instead of H^+ Allow $K_a = \frac{[A^-][H^+]}{[HA]}$ if formula of HA and A^- given as HCOOH and $HCOO^-$	$K_a = \frac{[H^+]^2}{[HCOOH]}$ without also giving full expression	**1**

Question Number	Acceptable Answers	Reject	Mark
18 (b)(ii)	$1.6 \times 10^{-4} = \frac{[H^+]^2}{0.50}$ **(1)** $[H^+] = \sqrt{1.6 \times 10^{-4} \times 0.5}$ **(1)** $(= \sqrt{8 \times 10^{-5}} = 8.94 \times 10^{-3})$ pH = (2.048455) **= 2.05 / 2.0 (1)** Correct answer with no working **(3)** TE for third mark if $[H^+]$ calculated incorrectly No TE from incorrect K_a expression Ignore sf except 1	pH =2 pH =2.1	**3**

Question Number	Acceptable Answers	Reject	Mark
18 (b)(iii)	All H^+ comes from acid / none from water / $[H^+] = [HCOO^-]$ OR $[H^+] = [A^-]$ OR Dissociation of acid is negligible / very small OR $[HA]_{initial} = [HA]_{equilibrium}$	K_a is measured at 298K Just "dissociation of acid is partial"	**1**

Question Number	Acceptable Answers	Reject	Mark
18 (c)(i)	HCOOH $CH_3COOH_2^+$ both correct **(1)**		**1**

Question Number	Acceptable Answers	Reject	Mark
18 (c)(ii)	(HIO + CH_3COOH ⇌) $H_2IO^+ + CH_3COO^-$ / (HIO + CH_3COOH ⇌) $HIOH^+ + CH_3COO^-$ Ignore position of positive charges		**1**

Question Number	Acceptable Answers	Reject	Mark
18 (d)	(pH = 4.9) so $[H^+]$ = (1.2589254 x 10^{-5}) = **1.259×10^{-5} (1)** ($K_a = \frac{[HCOO^-]}{[H^+]\ [HCOOH]}$ = $\frac{1.6 \times 10^{-4}}{1.259 \times 10^{-5}}$) **= 12.7 (:1) / 13(:1) ($HCOO^-$ per HCOOH or base:acid)** (12.709252 from unrounded $[H^+]$ 12.708499 from $[H^+]$ rounded to 1.259 x10^{-5} 12.3 from $[H^+]$ rounded to 1.3 x10^{-5}) TE from error in **$[H^+]$** **Allow 800:63** **(1)** **Correct answer scores 2** Accept (0.0786828) = **0.079 HCOOH per $HCOO^-$ for acid:base ratio** (0.0786874) = 0.079 from rounded pH **OR** $pK_a = -\log K_a = 3.79$ $3.79 = 4.9 - \log \frac{[base]}{[acid]}$ (1) $\log \frac{[base]}{[acid]} = 1.11$ $\frac{[base]}{[acid]}$ = (12.882496) = **12.9 (:1) (1)** **Correct answer scores 2** Accept **0.0776/ 0.078 HCOOH per $HCOO^-$ for acid:base ratio** (0.0776247) TE from error in pK_a Ignore sf except 1		**2**

TOTAL FOR SECTION B = 50 MARKS

Section A (multiple choice)

Question Number	Correct Answer	Mark
19 (a)	D	**1**

Ouestion Number	Correct Answer	Mark
(b)	B	**1**

Ouestion Number	Correct Answer	Mark
(c)	A	**1**

Ouestion Number	Correct Answer	Mark
20	D	**1**

Ouestion Number	Correct Answer	Mark
21	D	**1**

Ouestion Number	Correct Answer	Mark
22	B	**1**

Ouestion Number	Correct Answer	Mark
23	C	**1**

Ouestion Number	Correct Answer	Mark
24	C	**1**

Question Number	Correct Answer	Mark
25	A	**1**

Question Number	Correct Answer	Mark
26	B	**1**

Question Number	Correct Answer	Mark
27	C	**1**

Question Number	Correct Answer	Mark
28	A	**1**

Section B

Question Number	Acceptable Answers	Reject	Mark
28 (a)	ΔS_{system} = (3x2x65.3 +197.6) – (186.2 + 188.7) Correct data for CH_4 and CO (186.2 and 197.6) **(1)** = (+) **214.5 / 215** (J mol^{-1} K^{-1}) / (+) **0.2145 / 0.215 kJ** (mol^{-1} K^{-1}) **(1)** Units must be shown if data has been converted to kJ Full marks (2) for correct answer without working Ignore sf except 1 Answer of -214.5 scores (1) Answer of +18.6 if entropy of H not doubled scores (1) Answer of –46.7 if entropy of H_2 not tripled scores (1) ALLOW TE in second mark for minor error in data e.g. writing 63.5 instead of 65.3. No TE if data used is not entropy of compounds.	**214** **0.214**	**2**

Question Number	Acceptable Answers	Reject	Mark
(b)	$(\Delta S_{surroundings}) = \frac{-\Delta H}{T}$ Expression or use of expression, $\frac{-206.1x(1000)}{298}$ **(1)** = **-691.6 J** (mol^{-1} K^{-1})/ **-0.6916 kJ** (mol^{-1} K^{-1}) **(1)** Ignore sf except 1		**2**

Question Number	Acceptable Answers	Reject	Mark
(c)	ΔS_{total} = (214.5+(-691.6)) = **-477.1** (J mol^{-1} K^{-1}) / - **0.4771** (kJ mol^{-1} K^{-1}) **(1)** ALLOW TE for answer to (a) plus answer to (b). If 214.5 is added to -0.69 no TE unless -0.69 is specified to be in joules. Ignore sf except 1 Negative / less than zero (so not spontaneous) / would be positive if spontaneous. **(1)** ALLOW "feasible" for spontaneous. If answer to calculation is positive, accept comment that it would be expected to be negative if not spontaneous	Addition of value in J to specified value in kJ Comments on kinetic stability	**2**

<table>
<tr><th>Question Number</th><th>Acceptable Answers</th><th>Reject</th><th>Mark</th></tr>
<tr><td>*28 (d) (i)</td><td>$K_p = \frac{(pH_2)^3 x (pCO)}{(pCH_4)(pH_2O)}$ (1)

4 Correct partial pressures (3)
<table>
<tr><td></td><td>CH_4</td><td>H_2O</td><td>CO</td><td>H_2</td></tr>
<tr><td>pp</td><td>0.25</td><td>0.25</td><td>0.375</td><td>1.125</td></tr>
</table>
ALLOW partial pressures as fractions

$K_p = \frac{(1.125)^3 x (0.375)}{(0.25)(0.25)}$ = 8.54 atm^2

value of K_p (1)

unit (1) (Stand alone mark)

Correct calculation without working scores the 5 calculation marks.

TE from K_p expression if inverted
Ignore sf except 1

If any partial pressures are incorrect:
Calculating total number of moles (6.4) (1)

Calculating mole fractions (0.125, 0.125, 0.1875, 0.5625 if total number of moles is correct) (1)

Multiplying mole fractions by total pressure (x 2 atm) (1)

value of K_p (1)

unit (1) (stand alone mark)

ALLOW TE in value of K_p only from incorrect partial pressures, not using values in question as not using equilibrium moles

If treated as a K_c calculation following K_p expression :
K_p expression (1)
units atm^2 (1)

Max. mark (2)</td><td>Square brackets

TE for K_p expression with addition, not multiplication</td><td>6</td></tr>
</table>

Question Number	Acceptable Answers	Reject	Mark
(d) (ii)	ΔS_{total} = (8.31 ln 8.54) = (+)**17.8** (J mol^{-1} K^{-1}) Accept any value that rounds to 17.8 TE from value in (i) K_p value of 87.48 (obtained by treating calculation in (i) as K_c) gives ΔS_{total} = **37.16 / 37.12**		**1**

Question Number	Acceptable Answers	Reject	Mark
(d) (iii)	17.8 = 225 - $\frac{206.1 \times 1000}{T}$ **(1)** T = $\frac{206.1 \times 1000}{207.2}$ = **995 / 990** (K) **(1)** Correct answer with no working shown scores 2 Correct method with wrong answer or missing 10^3 scores 1 TE from (ii) K_p value of 87.48 gives T = **1097** **OR** If ΔS_{total} is taken as zero 0 = 225 - $\frac{206.1 \times 1000}{T}$ **(1)** T = **916**K **(1)** K_p value of 87.48 gives T = **916** Ignore sf except 1		**2**

Question Number	Acceptable Answers	Reject	Mark
***28 (e)**	$\Delta S_{surroundings}$ / $\frac{-\Delta H}{T}$ becomes less negative making ΔS_{total} more positive (as T increases) **OR** $\Delta S_{surroundings}$ / $\frac{-\Delta H}{T}$ becomes less negative making ΔS_{total} greater (as T increases) **OR** (magnitude of) $\Delta S_{surroundings}$ becomes less / lower making ΔS_{total} more positive / greater (as T increases) **(1)** Because ΔS_{total} increases equilibrium constant increases **(1)** **OR** value of ΔS_{total} at new temperature is more than at 298K (1) (must be clear that the two ΔS_{total} values at the different temperatures have been considered) Because ΔS_{total} increases equilibrium constant increases (1)	Le Chatelier statements without reference to entropy changes Just 'as temperature increases ΔS_{total} increases'	**2**

Question Number	Acceptable Answers	Reject	Mark
29 (a)	pH = (-log 0.25) = 0.602 / 0.60 / 0.6 Ignore significant figures		**1**

Question Number	Acceptable Answers	Reject	Mark
(b) (i)	$K_a = \frac{[H^+][CH_3CH_2COO^-]}{[CH_3CH_2COOH]}$ ALLOW $[H_3O^+]$ for $[H^+]$ ALLOW C_2H_5 for CH_3CH_2 ALLOW $\frac{[H^+][A^-]}{[HA]}$ if HA and A^- identified	Wrong / missing charge on $CH_3CH_2COO^-$ $K_a = \frac{[H^+]^2}{[CH_3CH_2COOH]}$ unless full expression also given	**1**

Question Number	Acceptable Answers	Reject	Mark
(b) (ii)	$1.3 \times 10^{-5} = \frac{[H^+]^2}{0.25}$ / rearrangement of this expression **(1)** ($[H^+] = 1.8 \times 10^{-3}$) pH = **2.74** **(1)** Correct answer with no working scores (2) No TE for incorrect $[H^+]$ Ignore significant figures except 1 Minimum of 1 decimal place needed		**2**

Question Number	Acceptable Answers	Reject	Mark
(c) (i)	$CH_3CH_2COOH + NaOH \rightarrow CH_3CH_2COO^{(-)}Na^{(+)} + H_2O$ OR $CH_3CH_2COOH + OH^- \rightarrow CH_3CH_2COO^- + H_2O$ Accept $CH_3CH_2CO_2H$, C_2H_5COOH, $C_2H_5CO_2H$	Equations for ethanoic acid	**1**

Question Number	Acceptable Answers	Reject	Mark
(c) (ii)	$1.3 \times 10^{-5} = \frac{[H^+][5 \times 10^{-2}]}{[7.5 \times 10^{-2}]}$ (concentration ratio) OR $1.3 \times 10^{-5} = \frac{[H^+](1 \times 10^{-3})}{(1.5 \times 10^{-3})}$ (ratio by moles) (ratio by moles allowed as volumes acid and salt equal) **(1)** ($[H^+]$ = **1.95×10^{-5}**) pH = **4.7** / 4.7099654 **(1)** Second mark dependent on first Correct answer with or without working **(2)** OR $pH = pK_a - \log \left(\frac{1.5 \times 10^{-3}}{1 \times 10^{-3}}\right)$ OR $pH = pK_a - \log \left(\frac{7.5 \times 10^{-2}}{5 \times 10^{-2}}\right)$ **(1)** pH = 4.7 **(1)** Correct answer with or without working **(2)** Accept any value which rounds to 4.7		**2**

Question Number	Acceptable Answers	Reject	Mark
***29 (c) (iii)**	Mixture is a buffer **(1)** EITHER OH^- combines with H^+ in solution **(1)** Propanoic acid dissociates to replace H^+ **(1)** *Correct equations could gain these marks* OR OH^- reacts with propanoic acid **(1)** *Correct equation could gain this mark* Significant quantities of weak acid and salt are both present /ratio of acid and salt does not change **(1)** ALLOW a reservoir of weak acid and salt are present: Allow conjugate base for salt	NaOH combines	**3**

Question Number	Acceptable Answers	Reject	Mark =
(c) (iv)	S-shaped curve, vertical at 25 cm^3 (with kink at start) **(1)** Starting at pH 2-3 (TE from (b)(ii), finishing at pH 12 -13 **(1)** Vertical section between 3 and 6 units high centred round a pH of between 8 and 9 **(1)** Vertical section should not extend over more than $\pm 2.5 cm^3$ This section should start between 5.5 and 7.5 and finish between 9.5 and 11.5 but do not penalise for very small differences. Reverse curve maximum 2		**3**

Question Number	Acceptable Answers	Reject	Mark
(c) (v)	Either Need indicator changing in vertical region of curve / need indicator changing where pH changes sharply / bromocresol green changes before the vertical region **(1)** **Not** bromocresol green which changes at **3.8 – 5.4** **(1)** OR pK_{in} ±1 must be in vertical section / sharply changing section **(1)** **Not** bromocresol green because pK_{in} is **4.7** **(1)** TE from curve with vertical section including pH 3.7 – 5.7	Just "the equivalence point is outside the bromocresol green range"	**2**

Question Number	Acceptable Answers	Reject	Mark
(d) (i)	Dilute acid / dilute strong named acid or formula / NaOH(aq) followed by dilute acid /water plus dilute acid / water plus H^+	NaOH alone water any weak acid concentrated sulfuric acid HCN acid hydrolysis alone	**1**

Question Number	Acceptable Answers	Reject	Mark
(d) (ii)	$CH_3CH_2COCl + H_2O \rightarrow CH_3CH_2COOH + HCl$ / $C_2H_5COCl + H_2O \rightarrow C_2H_5COOH + HCl$ Accept displayed formula	Equations with NaOH or OH^-	**1**

Question Number	Acceptable Answers	Reject	Mark
(d) (iii)	Colour change orange to green / blue		**1**

Question Number	Acceptable Answers	Reject	Mark
(e)	Reducing agent /Reduction (of the acid) occurs **(1)** Li Al H_4 / lithium tetrahydridoaluminate / lithium aluminium hydride **(1)** Allow minor error in name if correct formula is given Ignore solvent ALLOW nucleophile AND H^- for 1 mark	Lithal without correct name or formula	**2**

Question Number	Acceptable Answers	Reject	Mark
30 (a)	Quenches reaction / stops reaction / slows reaction / freezes reaction **(1)** EITHER by neutralizing the acid / removing the acid / neutralizing the catalyst / removing the catalyst **OR** So that the acid does not react with the thiosulfate **(1)**	By neutralizing HI Just "by diluting the reaction mixture" just "by neutralizing the reaction mixture"	**2**

Question Number	Acceptable Answers	Reject	Mark
(b)	Starch (solution)		**1**

Question Number	Acceptable Answers	Reject	Mark
30 (c)	**First mark** So that [propanone] and [acid] are (virtually) constant **OR** so that the [propanone] and $[H^+]$ do not affect the rate **OR** Propanone and acid are in excess so **changes in concentration** don't affect rate **(1)** **Second mark** And therefore rate changes would only depend on [iodine] **OR** so that the overall order is not determined ALLOW [Iodine] is the limiting factor **(1)** *NOTE* "so that only the $[I_2]$ changes" scores **(2)** "so that only the I_2 concentration changes" scores **(2)** "so that only the I_2 changes" scores **(1)**	Propanone and acid are in excess, without reference to further comments	**2**

Question Number	Acceptable Answers	Reject	Mark
(d)	Zero order **(1)** (Gradient =) **rate** is constant / I_2 (concentration) doesn't affect **rate** / **rate** of change of I_2 (concentration) doesn't change with time **(1)** **Mark independently**	Just 'straight line' Or just 'gradient is constant' [Thiosulfate] or volume of Thiosulfate is proportional to time without reference to iodine Reference to half life $[I_2]$ is proportional to rate	**2**

Question Number	Acceptable Answers	Reject	Mark
(e)	Measuring cylinder quicker / Measuring cylinder can measure a variety of volumes **(1)** ALLOW Measuring cylinder can be plastic so unbreakable Comment on lower cost of measuring cylinder if qualified with a reason Pipette more accurate / (graduated) pipette more precise / pipette can be used to extract samples from a reaction mixture (for titration) **(1)**	Just "Measuring cylinder easier to use" Easier to clean Measuring cylinder can be used for large volumes Pipette more reliable Ignore references to easier	**2**

Question Number	Acceptable Answers	Reject	Mark
(f) (i)	To keep (total) volume constant / to make the (total) volume 32 cm^3 / to make concentrations proportional to volume of reactant	To keep concentrations constant	**1**

Question Number	Acceptable Answers	Reject	Mark
(f) (ii)	First order wrt propanone with explanation **(1)** First order wrt hydrogen ions/ sulfuric acid, with explanation **(1)** Explanation can be in terms of experiments 1 and 3 (propanone) or 1 and 2 (acid) and can be in terms of concentration or volume **Rate = k**$[CH_3COCH_3][H^+]([I_2]^0)$ / **Rate = k**$[CH_3COCH_3][H_2SO_4]([I_2]^0)$ **(1)** ALLOW names of propanone and sulfuric acid in place of formulae Ignore case of k in rate equation Ignore order wrt iodine even if wrong Third mark is consequential if incorrect orders of propanone and acid given.	Expressions without rate or k Expressions with K_c R / r for rate	**3**