A Level OCR Chemistry

Chapter 9 – answers

Question	Answers	Extra information	Mark	AO Spec reference
1(a)	Appropriate scale All points plotted correctly Smooth curve of best fit	Take care to check values on Y axis as standard form	1 1 1	3.2.2 AO3
1(b)	Increasing concentration increases the number of particles in a given volume Which increases the frequency/chance of a collision Curve occurs due to heating from exothermic reaction.		1 1 1	3.2.2 AO1
1(c)	Remove oxide layer Oxide will react differently/prevent reaction with HCl		1 1	3.2.2 AO3
2(a)	The concentration of the product will increase / the system will shift to reduce that change		1	3.2.3 AO1
2(b)	A substance which lowers the activation energy By providing an alternative route/pathway		1 1	3.2.2 AO1
2(c)	Reduces the time (taken to reach equilibrium)	Must be quantified in terms of time	1	3.2.3 AO1
2(d)	No effect		1	3.2.3 AO1
2(e)	High pressure Low temperaturs		1 1	3.2.3 AO1
3(a)(i)	x axis = energy y axis = No of particles/ proportion of particles/ mole fraction		1 1	3.2.2 AO1
3(a)(ii)	Vertical line from x axis to peak		1	3.2.2 AO1
3(a)(iii)	The new peak should be to the left of the original and be higher than the original.		1	3.2.2 AO1

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3(b)	A decrease in the number / proportion of molecules with $E \geq Ea$ Fewer effective / productive / successful collisions in a given time / given period		1 1	3.2.2 AO3
3(c)	No effect Shape of graph is the same no matter pressure if temperature is the same	OR only temperature changes the shape	1 1	3.2.2 AO1
4(a)(i)	Methanoic acid		1	6.1.3 AO1
4(a)(ii)	$C_3H_7OH + HCOOH \rightleftharpoons HCOOC_3H_7$	Allow any correct formula Must have reversible arrow	1	3.2.3 AO1
4(a)(iii)	Reflux To prevent reactants or products evaporating		1 1	6.1.3 AO1
4(b)	Moles of propanoic acid at equilibrium = 0.95 Moles of methanoic acid at equilibrium = 0.45 $K_c = \frac{[HCOOC_3H_7][H_2O]}{[HCOOH][C_3H_7OH]}$ or workings $K_c = (1.05/2)^2/(0.95/2 \times 0.45/2) = 2.58$ No units	Allow completed table or can be found in K_c equation	1 1 1 1 1	5.1.2 AO2
5(a)	No effect		1	3.2.3 AO1

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5(b)	Concentration of B would increase (Forward reaction is endothermic) equilibrium would shift to the left/ exothermic To oppose the change/to heat the solution		1 1 1	3.2.3 AO1
5(c)(i)	Moles of B start = 0.66 × 0.1 = 0.066 Change in B moles = 0.066 – 0.048 = 0.018 Moles of A = $1.8\times10^{2} - (0.018/2) = 9\times10^{-3}$ (mol) Moles C = 9×10^{-3} (mol) Moles D = $(9\times10^{-3}) \times 3 = 0.027$ (mol)		1 1 1 1 1	3.2.3 AO2
5(c)(ii)	$K_c = \frac{[C][D]^3}{[A][B]^2}$ $= \frac{(0.009/0.1) \times (0.027/0.1)^3}{(0.009/0.1) \times (0.048/0.1)^2}$ = 0.0856 $mol\,dm^{-3}$	Allow e.c.f. from **07.3**	1 1 1 1 1	5.1.2
6(a)	Increase the rate of reaction Higher proportion of reactants above the activation energy so a greater proportion of collisions are successful More frequent collisions		1 1 1	3.2.3 AO1

Question	Answers	Extra information	Mark	AO Spec reference
6(b)	$K_c = \frac{[D][E]}{[X][Y]^2[X]}$ Moles at equilibrium: X = 0.90 Y = 0.80 Z = 0.20 D = 0.60 E = 0.6 $K_c = \frac{\frac{0.60}{0.5} \times \frac{0.60}{0.5}}{\frac{0.90}{0.5} \times \left(\frac{0.80}{0.5}\right)^2 \times \frac{0.20}{0.5}}$ = 0.781 $mol^{-2}\,dm^6$		1 1 1 1 1	5.1.2 AO2
6(c)	K_c will be smaller Equilibrium will shift left /towards endothermic So denominator will be larger		1 1 1	3.2.3 AO1
7(a)	$1s^2\,2s^2\,2p^6\,3s^2\,3p^4$		1	2.2.1 AO1
7(b)	Both are molecular covalent van der Waals are the intermolecular force Sulfur molecules have <u>more electrons</u> so <u>stronger van der Waals</u> More energy needed to break forces resulting in higher melting and boiling points		1 1 1 1	2.2.2 AO3
7(c)	Reversible reaction where the forwards and backwards rates are equal. So the concentrations of reactant remain constant		1 1	3.2.3 AO1

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7(d)	No effect		1	3.2.3 AO1
7(e)	12 kPa Mole fraction = partial pressure ÷ total pressure = 12/104 = 0.115	Ignore units	1 1	5.1.2 AO2
7(f)	68 kPa	Allow e.c.f. from **08.5**	1	5.1.2 AO2
7(g)	$K_P = \frac{(pSO_3)^2}{(pSO_2)^2 \times (pO_2)}$ $K_P = \frac{68^2}{24^2 \times 12} = 0.669$ kPa	Allow e.c.f. from **08.5** + **08.6**	1 1 1 1	5.1.2 AO2
7(h)	Shift to the right/ forwards/products/SO_3 Increasing pressure favours side with fewest moles		1 1	3.2.3 AO1
8(a)	Vertical line to the left of E_{grt} line labelled correctly		1	3.2.2 AO1
8(b)	Line: Overall general shape is the same but peak is lower and to the right. Line stays above original and follows the same shape. More frequent collisions Higher proportion of collisions are successful As more collisions have an energy above the activation energy		1 1 1 1	3.2.2 AO3
8(c)	Compromise as low temperature favours products Too low a temperature would make the reaction too slow		1 1	3.2.3 AO3

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Skills box answers:

a) To reduce mass lost due to spitting. It is fit loosely so that CO_2 can still escape.

(i) $2HCl + CaCO_3 \rightarrow H_2O + CO_2 + CaCl_2$

At max mass, [HCl] = 2.00 mol dm^{-3} (this is the initial amount)

Change in mass (Δ mass) = loss of CO_2

$$\text{mol}(CO_2) = \frac{\Delta(\text{mass})}{44}$$

$$2 \times \text{mol}(CO_2) = \text{mol}(HCl) = 2 \times \frac{\Delta(\text{mass})}{44}$$

$$\therefore [HCl] = \frac{\text{mol}(HCl)}{\text{volume}} = \frac{2 \times \Delta\text{mass}}{44 \times 16 \times 10^{-3}} \; (= 2.84 \times \Delta(\text{mass}))$$

(ii) Measure the half-life of the reaction. If it is constant, then it is first order wrt HCl

(iii) Measure the average half-life and then use $k = \frac{\ln(2)}{t_{1/2}}$