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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Applied Science 8771/8773/8776/8779

SC11 Controlling Chemical Processes

Mark Scheme

2007 examination – June series

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Question 1

(a)	Alters rate of reaction Unchanged at end	(1) (AO1) (1) (AO1)	**2**
(b)(i)	Exothermic since energy of the products is lower than that of reactants	(1) (AO1)	**1**
(ii)	Lower peak Start and finish energy unchanged	(1) (AO1) (1) (AO1)	**2**
(c)	Minimum energy Needed to start a reaction or for a reaction to occur	(1) (AO1) (1) (AO1)	**2**
(d)(i)	Starts at O,O Peak is at lower energies/ not symmetrical Does not meet x axis at higher energies	(1) (AO1) (1) (AO1) (1) (AO1)	**3**
(ii)	Ea on x axis linked Ea (cat) to left of E_a Catalyst lowers Ea - allow 1 mark	(1) (AO2) (1) (AO2)	**2**
(iii)	More particle With energy ≥ E_a (not in terms of increased rate of collisions)	(1) (AO2) (1) (AO2)	**2**

Total Mark: 14

Question 2

(a)	Electrolysis	(1) (AO1)	**1**
(b)	Avoid naked lights/sparks Wear gas mask/use in fume cupboard	(1) (AO3) (1) (AO3)	**2**
(c)(i)	NaOH 40 Na_2CO_3 106	(1) (AO1) (1) (AO1)	**2**
(ii)	(100/80) x 106 x 70% = 92.75(kg) up to 3 marks for 92.75 1 mark for 80	(1) (AO2) (1) (AO2) (1) (AO2)	**3**
(d)	NaClO +1 $NaClO_3$ + 5	(1) (AO2) (1) (AO2)	**2**
(e)	Corrosive/ caustic/ causes burns NOT irritant	(1) (AO1)	**1**

Total Mark: 11

Question 3

(a)	3 CH_2=CH_2 2 CH_3CH=CH_2	(1) (AO2) (1) (AO2)	**2**
(b)	Direct: Raw materials/ Heat energy/high temperature Indirect: Labour/maintenance/sales/transport	(1) (AO1) (1) (AO1)	**2**
(c)(i)	Both reaction continue to occur - NOT reversible reaction At same rate/ no change in concentrations	(1) (AO1) (1) (AO1)	**2**
(ii)	All of the reactants and products - NOT just 'reactants' of just 'products' In same state or phase	(1) (AO1) (1) (AO1)	**2**
(iii)	Heating the catalyst/ heating for the plant or factory/produce steam	(1) (AO2)	**1**
(iv)	Yield: decreases Forward reaction is exothermic/endothermic reaction is favoured Reverse exothermic reaction is opposes the increase in temperature	(1) (AO2) (1) (AO2) (1) (AO2)	**3**
(d)(i)	In batch: all reactants added at start :once reactants have reacted then process is stopped and products removed In continuous: reactants are constantly being added as the products are removed	(1) (AO1) (1) (AO1)	**2**
(ii)	Continuous: Advantage: faster reaction/ more responsive to demand/can be automated/lower labour costs/suitable for a large scale production Disadvantage: higher set-up/capital costs/complex technology Batch: Advantage: low set-up/capital costs/ simple technology/suitable for small scale production Disadvantage: slower reaction/higher labour costs NB costs must be specified	(1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2)	**4**
(e)	ΔH = $\Sigma \Delta H$(products) − $\Sigma \Delta H$(reactants) or cycle ΔH = [−235] − [+52.3 + (−242)] ΔH = −45.3 kJmol^{-1}	(1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2)	**4**
(f)(i)	K_c = [$CH_3COOCH_2CH_3$][H_2O]/[CH_3CH_2OH][CH_3COOH] Correct fraction Correct terms K_c = (0.4)(0.4)/(0.08)(0.5) = 4.0 no units	(1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2)	**4**
(ii)	Temperature	(1) (AO1)	**1**

Total Mark: 27

Question 4

(a)	Change in concentration linked with change in time	(1) (AO1) (1) (AO1)	**2**
(b)	Initial rates method: Add NaOH of known concentration To haloalkane Record pH (after short interval) OR titrate with acid Record volume (amount) Using a pH meter OR record volume (amount) Repeat with same concentration of haloalkane But with different concentration of NaOH Keep temperature constant Calculate concentrations from pH value OR from titration result Calculate initial rate Compare results Max 7 Graphical method Add NaOH of known concentration to aloalkane Record pH Using pH meter at regular timed intervals (at regular timed intervals, quench and) titrate with acid Record volume (or amount) Keep temperature constant Calculate concentration from pH OR from titration result Plot concentration against time graph Find rate from gradient At two different concentrations OR look at shape of concentration vs time graph to determine order Correct description of expected graph shape Max 7	(7) (AO3)	**7**
(c)	Effect: rate increases by four Each reactant double rate: 2 x 2 = 4 both needed	(1) (AO2) (1) (AO2)	**2**
(d)(i)	First order	(1) (AO1)	**1**
(ii)	None/ stays the same NaOH not in rate equation/zero order with relation to NaOH	(1) (AO2) (1) (AO2)	**2**

Total Mark: 14

Question 5

(a)	Compressor/building the plant/ vessel to withstand pressure Energy	(1) (AO1) (1) (AO1)	**2**
(b)	Decrease Less moles of gas on RHS (this mark independent of correct effect) Opposes change/increase pressure	(1) (AO2) (1) (AO2) (1) (AO2)	**3**
(c)	Increase (independent mark) Particles closer together (independent mark) Increased rate of collisions/more collisions	(1) (AO1) (1) (AO2) (1) (AO2)	**3**
(d)	None Catalyst speeds up both reactions Equally	(1) (AO1) (1) (AO2) (1) (AO2)	**3**
(e)	Mr 80 (28/80) x 100 = 35%	(1) (AO1) (1) (AO2) (1) (AO2)	**3**

Total Mark: 14