



General Certificate of Education

Applied Science **8771/8773/8776/8779**

SC11 Controlling Chemical Processes

Mark Scheme

2008 examination – January series

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Question 1

(a)	Reactants are added, (reaction occurs) then products are removed (Vessel cleaned) and then fresh reactants added and reaction <u>repeated</u> .	(1) (AO1) (1) (AO1)	2
(b)(i)	Carbon dioxide does not undergo combustion/stable	(1) (AO2)	1
(ii)	-2802.5 - 1367.3 x 2 or appropriate cycle -2802.5 + 2734.6 automatically 2 marks -67.9 (kJ mol ⁻¹) automatic 3 marks for - 67.9	(1) (AO2) (1) (AO2) (1) (AO2)	3
(c)(i)	Process never stops = 1 Products are removed as reactants are added At same time Alternative for second mark – process never stops / constantly / continuously	(1) (AO1) (1) (AO1)	2
(ii)	Faster/lower labour costs. If cost needs to be qualified NOT large quantity	(1) (AO2)	1
(iii)	612 + 4 x 413 + 2 x 464 = 3192 5 x 413 + 347 + 358 + 464 = 3234 3192 – 3234 = -42 (kJmol ⁻¹) negative sign numerical answer All three marks if answer is correct i.e. + 42 = 3 -42 = 4	(1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2)	4
(d)	Fermentation uses renewable source or converse/uses less energy	(1) (AO2)	1
(e)	Reactants and products labelled General shape Products lower than reactants	(1) (AO1) (1) (AO1) (1) (AO2)	3

Total Mark: 17**Question 2**

(a)	Colorimetry/(measure) pH (change) / titration	(1) (AO3)	1
(b)	A substance that increases the rate of a reaction without itself being used <u>up</u> /unchanged at end	(1) (AO1) (1) (AO1)	2
(c)(i)	Rate = k[CH ₃ COCH ₃][H ⁺] 1 mark for including k, 2 marks for rest correct. 1 mark if have one of factors correct, penalise curved brackets once	(1) (AO2) (2) (AO2)	3
(ii)	Second	(1) (AO2)	1
(iii)	Multiplied by 3	(1) (AO2)	1
(d)(i)	X – second order Rate is quadrupled when <u>concentration</u> is (only) doubled	(1) (AO2) (1) (AO2)	2
(ii)	Y - zero Rate unchanged as <u>concentration</u> doubles	(1) (AO2) (1) (AO2)	2
(e)	Temperature/concentration of other reactant	(1) (AO3)	1
(f)(i)	Vertical – no. of particles / molecules Horizontal - energy	(1) (AO1) (1) (AO1)	2
(ii)	Curve skewed to right of original Peak lower than original peak	(1) (AO1) (1) (AO1)	2

(g)	Particles must possess for a collision to be successful <u>Minimum energy</u>	(1) (AO1) (1) (AO1)	2
(h)	Increase in temp gives <u>particles</u> more energy <u>More successful collisions</u> More particles / proportion of particles with energy greater than or equal to E_a	(1) (AO2) (1) (AO2) (1) (AO2)	3

Total Mark: 22**Question 3**

(a)	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$	(1) (AO2) (1) (AO2)	2
(b)(i)	flammable	(1) (AO1)	1
(ii)	chlorine	(1) (AO1)	1
(iii)	Some method of preventing breathing fumes – allow fume cupboard despite the fact this is an industrial process	(1) (AO1)	1
(c)(i)	58.5 40	(1) (AO2) (1) (AO2)	2
(ii)	585 / 58.5 117kg $\rightarrow$ 80kg / 58.5kg $\rightarrow$ 40kg x 40 = 400 kg ignore units unless wrong allow ECF from (i)	(1) (AO2) (1) (AO2)	2
(d)(i)	50000/2 = 25000 mark is for dividing by 2	(1) (AO2)	1
(ii)	25000 x 22.4dm ³ = 560,000 ecf from (d)(i) (ignore units)	(1) (AO2)	1
(e)(i)	Indirect	(1) (AO1)	1
(ii)	Direct	(1) (AO1)	1
(iii)	Capital	(1) (AO1)	1
(iv)	Direct	(1) (AO1)	1
(f)(i)	+1	(1) (AO2)	1
(ii)	-1	(1) (AO2)	1
(g)	100/80 x 160 = 200 (ignore units)	(1) (AO2) (1) (AO2)	2

Total Mark:19

Question 4

(a)	Any three from Balance allow scales Measuring cylinder/ bulb pipette/ burette Calorimeter/ copper can Thermometer stirrer	(3) (AO3)	3
(b)	Mass of butane <u>and</u> temperature If state before and after for either then gain second mark Third mark for stating must measure mass of water, and must say before and after for both temperature of water and mass of butane	(1) (AO3) (1) (AO3) (1) (AO3)	3
(c)	Any 2 from Lid on calorimeter Reduce draughts Stir water consistently Insulate calorimeter Repeat experiment	 (1) (AO3) (1) (AO3)	2
(d)	$Q = mc\Delta T$ 2 nd mark only awarded if realise that m = mass of water	(1) (AO1) (1) (AO1)	2

Total Mark: 10

Question 5

(a)	Incomplete reaction / side reactions / very slow rate	(1) (AO2)	1
(b)	Any 2 of <u>Forward</u> and <u>reverse</u> reactions (Continuously) occur at same rate Concentrations of reactants and products are constant	(1) (AO1) (1) (AO1)	2
(c)(i)	Heat given out/exothermic	(1) (AO1)	1
(ii)	Equilibrium shifts to Oppose the imposed change/constraint	(1) (AO1) (1) (AO1)	2
(iii)	Decrease More moles of gas on left (or converse) Equilibrium shifts to <u>increase pressure</u>	(1) (AO2) (1) (AO2) (1) (AO1)	3
(iv)	$K_c = \frac{[\text{NH}_3]^2}{[\text{H}_2]^3[\text{N}_2]}$ Correct fraction Correct indices	(1) (AO2) (1) (AO2)	2
(v)	$\text{mol}^{-2} \text{dm}^6$ consequence on (iv)	(1) (AO2)	1

Total Mark: 12