

### **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 repeated.	(1) (AO1) (1) (AO1)	2
(b)(i)	Carbon dioxide does not undergo combustion/stable	(1) (AO2)	1
(ii)	-2802.51367.3 x 2 or appropriate cycle -2802.5 + 2734.6 automatically 2 marks -67.9 (kJ mol <sup>-1</sup> ) 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)	$\begin{array}{c} 612 + 4 \times 413 + 2 \times 464 = 3192 \\ 5 \times 413 + 347 + 358 + 464 = 3234 \\ 3192 - 3234 = -42 \ (kJmol^{-1}) \\ numerical answer \\ All three marks if answer is correct i.e. + 42 = 3 \\ -42 = 4 \end{array}$	(1) (AO2) (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

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

(g)	Particles must possess for a collision to be successful Minimum energy	(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)	$2 \text{ H}^+ + 2 \text{ e}^- \rightarrow \text{ H}_2$	(1) (AO2)	2
	$2 \text{ Cl}^2 \rightarrow \text{Cl}_2 + 2 \text{e}^2$	(1) (AO2)	2
(b)(i)	flammable	(1) (AO1)	1
(ii)	chlorine	(1) (AO1)	1
(111)	Some method of preventing breathing fumes – allow fume		4
(iii)	cupboard despite the fact this is an industrial process	(1) (AO1)	.1
(0)(i)	58.5	(1) (AO2)	2
(c)(i)	40	(1) (AO2)	2
	585 /58.5 $117 \text{kg} \rightarrow 80 \text{kg} / 58.5 \text{kg} \rightarrow 40 \text{kg}$	(1) (AO2)	
(ii)	x 40 = 400 kg ignore units unless wrong	(1) (AO2)	2
	allow ECF from (i)		
(d)(i)	50000/2 = 25000 mark is for dividing by 2	(1) (AO2)	1
(ii)	$25000 \times 22.4 \text{dm}^3 = 560,000 \text{ ecf from (d)(i) (ignore units)}$	(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
(a)	100/80	(1) (AO2)	2
(g)	x 160 = 200 (ignore units)	(1) (AO2)	۷

Total Mark:19

#### Question 4

(a)	Any <b>three</b> 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 <b>before</b> and <b>after</b> for either then gain second mark Third mark for stating must measure mass of water, and must say before and after for <b>both</b> 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 <b>only</b> awarded if realise that m = mass of <b>water</b>	(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)	$K_c = [NH_3]^2/[H_2]^3[N_2]$ Correct fraction Correct indices	(1) (AO2) (1) (AO2)	2
(v)	mol <sup>-2</sup> dm <sup>6</sup> consequence on (iv)	(1) (AO2)	1

Total Mark: 12