



## **General Certificate of Education**

# **Applied Science**

## **8771/8773/8776/8779**

**SC11      Controlling Chemical Processes**

# **Mark Scheme**

*2009 examination – June series*

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**Question 1**

(a)	Products are removed at same time as reactants are added Process never stops	(1) (AO1) (1) (AO1)	<b>2</b>
(b)(i)	capital	(1) (AO1)	<b>1</b>
(ii)	indirect	(1) (AO1)	<b>1</b>
(iii)	direct	(1) (AO1)	<b>1</b>
(iv)	indirect	(1) (AO1)	<b>1</b>
(c)(i)	Toxic / conserve resources / reduce costs	(1) (AO1)	<b>1</b>
(ii)	Any method of ensuring no naked flame	(1) (AO1)	<b>1</b>
(d)(i)	0 +5	(1) (AO2) (1) (AO2)	<b>2</b>
(ii)	NaOH= 40 NaClO <sub>3</sub> =106.5	(1) (AO2) (1) (AO2)	<b>2</b>
(iii)	100000/40 = 2500 Reaction is 6:1 so 2500/6 = 416.7 moles of NaClO <sub>3</sub> produced 416.7 x 106.5 = 44375g or 44.4kg	(1) (AO2) (1) (AO2)  (1) (AO2)	<b>3</b>
(iv)	Incomplete reaction / other products formed	(1) (AO2)	<b>1</b>

**Total Mark: 16****Question 2**

(a)	Change in concentration (of product / reactant) Over time	(1) (AO1) (1) (AO1)	<b>2</b>
(b)(i)	Vertical – no. of particles Horizontal - energy	(1) (AO1) (1) (AO1)	<b>2</b>
(ii)	Curve skewed to left of original Peak higher than original	(1) (AO1) (1) (AO1)	<b>2</b>
(c)	Minimum energy particles must possess for a collision to be successful / to react	(1) (AO1)  (1) (AO1)	<b>2</b>
(d)	decrease in temp means particles possess less energy less successful / effective collisions less particles with energy greater than or equal to E <sub>a</sub>	(1) (AO2) (1) (AO2) (1) (AO2)	<b>3</b>
(e)	A substance that alters the rate of a reaction But remains chemically unchanged overall	(1) (AO1) (1) (AO1)	<b>2</b>
(f)(i)	Products lower energy than reactants	(1) (AO2)	<b>1</b>
(ii)	Peak higher than original Curve joins original at reactants and products	(1) (AO2) (1) (AO1)	<b>2</b>

**Total Mark: 16**

## Question 3

(a)	The enthalpy change / heat energy released When <u>one mole</u> of a compound undergoes <u>complete</u> combustion	(1) (AO1) (1) (AO1)	<b>2</b>
(b)	<u>Negative</u> as <u>exothermic</u>	(1) (AO2)	<b>1</b>
(c)(i)	9O <sub>2</sub> 6CO <sub>2</sub> + 8H <sub>2</sub> O ] or multiples of whole equation	(1) (AO2) (1) (AO2)	<b>2</b>
(ii)	Any <b>three</b> from Balance Measuring cylinder / bulb pipette / burette Calorimeter / copper can Thermometer Spirit burner Stirrer Answers can be derived from a <u>diagram</u>	(3) (AO3)	<b>3</b>
(iii)	Mass of propan-1-ol and temperature of water If state <u>before</u> and <u>after</u> for either then gain second mark Third mark for stating must measure mass of water, and must say before and after for <u>both</u> temp and mass of propan-1-ol	(1) (AO3) (1) (AO3) (1) (AO3)	<b>3</b>
(iv)	Q = mcΔT gives energy released in experiment 2 <sup>nd</sup> mark <u>only</u> awarded if state that m = mass of <u>water</u> Q/No of moles of propan-1-ol used in experiment (calculated using moles = mass/M <sub>r</sub> )	(1) (AO1) (1) (AO1) (1) (AO1)	<b>3</b>
(v)	<b>Any 3 from</b> Use pure propan-1-ol More sensitive apparatus Lid on calorimeter Reduce draughts Stir water consistently Insulate calorimeter NOT repeating	(3) (AO3)	<b>3</b>

Total Mark: 17

## Question 4

(a)	<u>All</u> reactants and products <u>All</u> substances in <u>same</u> state / phase	(1) (AO1) (1) (AO1)	<b>2</b>
(b)	Closed system	(1) (AO1)	<b>1</b>
(c)(i)	$K_c = \frac{[C_2F_4][HCl]^2}{[CHClF_2]^2}$ terms (including right way) indices	(1) (AO2) (1) (AO2)	<b>2</b>
(ii)	$\frac{0.5 \times 0.9^2}{0.25^2}$ = 6.48	(1) (AO2) (1) (AO2)	<b>2</b>
(iii)	mol dm <sup>-3</sup> or consequential on (c)(i)	(1) (AO2)	<b>1</b>
(d)	increase equilibrium will shift to right as <u>endothermic</u> and so <u>reduces the temperature / opposes the change</u>	(1) (AO2) (1) (AO2) (1) (AO2)	<b>3</b>
(e)	Decrease <u>More moles of gas on right</u> (or converse) <u>Equilibrium shifts to left to reduce pressure</u>	(1) (AO2) (1) (AO2) (1) (AO2)	<b>3</b>
(f)(i)	$2(2 \times 467 + 346 + 413) = 2 \times 1693 = 3386$ $4 \times 467 + 612 + 2 \times 432 = 3344$ $3386 - 3344 = +42 \text{ kJ mol}^{-1}$ numerical answer Sign correct	(1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2)	<b>4</b>
(ii)	mean bond enthalpies are an average of the bond energy in several different compounds	(1) (AO1)	<b>1</b>
(g)(i)	$1.4/2 = 0.7$	(1) (AO2)	<b>1</b>
(ii)	$0.7 \times 22.4 = 15.68$ ecf	(1) (AO2)	<b>1</b>

Total Mark: 21

## Question 5

(a)(i)	Reactants are added, reaction occurs then products are removed	(1) (AO1) (1) (AO1)	<b>2</b>
(ii)	Lower labour cost / faster / lower energy cost / less downtime	(1) (AO1)	<b>1</b>
(b)	Titration / colorimetry	(1) (AO3)	<b>1</b>
(c)(i)	1	(1) (AO2)	<b>1</b>
(ii)	4	(1) (AO2)	<b>1</b>
(iii)	Quadruple As order with respect to [H <sup>+</sup> ] is 2	(1) (AO2) (1) (AO2)	<b>2</b>
(iv)	<u>Increase</u> temperature	(1) (AO2)	<b>1</b>
(v)	mol <sup>-3</sup> dm <sup>9</sup> s <sup>-1</sup>	(1) (AO2)	<b>1</b>

Total Mark: 10