



## **General Certificate of Education**

# **Applied Science**

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

**SC11      Controlling Chemical Processes**

# **Mark Scheme**

*2008 examination – June series*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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**Question 3**

(a)	Enthalpy or Heat Energy required / released to <u>break/form</u> (one mole of a particular covalent) bond	(1) (AO1)	<b>1</b>
(b)	290 + 413 = 703 347 + 366 = 713 Bonds broken – $\Sigma$ bonds made Mark is for numerical answer (10)	(1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2)	<b>4</b>
(c)	15.5-36.4 – (-90.5 +108.9) / appropriate cycle / $\Sigma \Delta H_f$ prods - $\Sigma \Delta H_f$ reactions =-20.9 -18.4 =-39.3	(1) (AO2) (1) (AO2) (1) (AO2)	<b>3</b>
(d)	Mean bond enthalpy values are an <u>average</u> for large range of molecules / not specific to these molecules	(1) (AO1)	<b>1</b>

**Total Mark: 9****Question 4**

(a)	Oxidation accept REDOX	(1) (AO2)	<b>1</b>
(b)(i)	Divide no of moles by volume Substitute numbers into expression 1.62 (to 3s.f)	(1) (AO1) (1) (AO2) (1) (AO2)	<b>3</b>
(ii)	mol <sup>-2</sup> dm <sup>6</sup>	(1) (AO2)	<b>1</b>
(c)(i)	Decreases Forward reaction is exothermic (or converse) Eqm shifts to left To reduce temperature / absorb heat / opposes change imposed	(1) (AO2) (1) (AO2) (1) (AO2) (1) (AO1)	<b>4</b>
(ii)	Lower yield But faster rate	(1) (AO2) (1) (AO2)	<b>2</b>

**Total Mark: 11****Question 5**

(a)	If slow, candidate must qualify answer Exothermic reaction/product unstable	(1) (AO2)	<b>1</b>
(b)(i)	Number of particles	(1) (AO1)	<b>1</b>
(ii)	<u>Total</u> number of particles present	(1) (AO1)	<b>1</b>
(iii)	Curve skewed to left of original <u>and</u> starting at 0 Peak higher than original and crosses original curve	(1) (AO1) (1) (AO1)	<b>2</b>
(c)(i)	Products have higher energy than reactant Positive – accept endothermic	(1) (AO2) (1) (AO1)	<b>2</b>
(ii)	Peak higher Require start and finish to be the same as original curve	(1) (AO1)	<b>1</b>
(d)(i)	Minimum energy particles must possess for a collision to be successful / to react	(1) (AO1) (1) (AO1)	<b>2</b>
(ii)	Provides alternative route/pathway requiring lower energy	(1) (AO1) (1) (AO1)	<b>2</b>

**Total Mark: 12**

**Question 6**

(a)(i)	Reactants added (at start), reaction occurs + reaction stops Reaction stops products removed /vessel washed / reaction started again	(1) (AO1) (1) (AO1)	<b>2</b>
(ii)	Advantage: low set-up / capital costs / simple technology / suitable for small scale production Disadvantage: higher labour costs / time consuming	(1) (AO1) (1) (AO1)	<b>2</b>
(iii)	Reactants added as products removed (2 marks) Not stopped and restarted (alternative for 1 mark)	(1) (AO1) (1) (AO1)	<b>2</b>
(b)(i)	109 151	(1) (AO2) (1) (AO2)	<b>2</b>
(ii)	$\frac{302}{151} \times 109$ (mk is for $\frac{302}{151} = 2$ )  = 218 kg	(1) (AO2)  (1) (AO2) (1) (AO2)	<b>3</b>
(iii)	$\frac{80}{100} \times 302 = 241.6$ or 242	(1) (AO2)	<b>1</b>

**Total Mark: 12****Question 7**

(a)(i)	The products can re-form the reactants / the reaction can take place in both directions	(1) (AO1)	<b>1</b>
(ii)	The forward and reverse reactions occur at the same rate	(1) (AO1)	<b>1</b>
(b)	Homogeneous	(1) (AO1)	<b>1</b>
(c)	Increase Less moles / particles of gas on RHS (or converse) Equilibrium shifts to RHS to relieve/counteract increase in pressure	(1) (AO2) (1) (AO2) (1) (AO2)	<b>3</b>
(d)(i)	$K_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]}$ Correct fraction Correct indices	(1) (AO1) (1) (AO1)	<b>2</b>
(ii)	Decrease	(1) (AO2)	<b>1</b>
(e)	Increase surface area So increase collisions / increase the number of particles available for collision	(1) (AO2) (1) (AO2)	<b>2</b>

**Total Mark: 11**