Version 1.0

General Certificate of Education (A-level) Applied
June 2013

Applied Science SC11

(Specification 8771/8773/8776/8777/8779)

Unit 11: Controlling Chemical Processes

Final

Mark Scheme

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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

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Further copies of this Mark Scheme are available from: aqa.org.uk

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Question	Part	Sub Part	Marking guidance		Mark	Comment
1	a		Avoid inhaling (any method for this - gas mask, fume cupboard)	(1) AO2	1	
1	b		Thermal decomposition/endothermic	(1) AO2	1	
1	c		Indirect Direct Capital Indirect	(1) AO1 (1) AO1 (1) AO1 (1) AO1	4	
1	d	i	75 177	(1) AO2 (1) AO2	2	
1	d	ii	100000/177 × 75 = 42373 g = 42.373kg (accept 42 – 42.4) Correct units 1 compensation mark for calculation	(1) AO2 (1) AO2 (1) AO1	3	
1	d	iii	Incomplete reaction/transfer losses/impure reactant	(1) AO1	1	
1	e	i	+2	(1) AO2	1	
1	e	ii	Not a redox reaction (no mark) Because the oxidation state of every element has not changed	(1) AO1	1	
1	f		100/82 × 320 = 390kg	(1) AO2 (1) AO2	2	

2	a		$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ LHS correct RHS correct	(1) AO2 (1) AO2	2	

2	b	i	Any three from: Thermometer Burette/pipette/measuring cylinder Calorimeter/copper can Balance Spirit burner	(1) AO3 (1) AO3 (1) AO3	3	

2	b	ii	The marking scheme for this part of the question includes an assessment of the Quality of Written Communication (QWC). There are no discrete marks for the assessment of written communication but QWC will be one of the criteria used to assign the answer to an appropriate level below.	(5) AO3	5	

Level	Marks	Descriptor an answer will be expected to meet most of the criteria in the level descriptor
3	4-5	-answer is full and detailed and is supported by an appropriate range of relevant points such as those given below -argument is well structured with minimal repetition or irrelevant points -accurate and clear expression of ideas with only minor errors in the use of technical terms, spelling, punctuation and grammar

<table>
<tr>
<td>2</td>
<td>b</td>
<td>ii</td>
<td>
<table>
<tr><td>2</td><td>2-3</td><td>-answer has some omissions but is generally supported by some of the relevant points below
-the argument shows some attempt at structure the ideas are expressed with reasonable clarity but with a few errors in the use of technical terms, spelling, punctuation and grammar</td></tr>
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-unstructured answer
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A good answer might include:
The mass of the spirit burner with butan-1-ol would be measured and recorded before the experiment. A known volume of water (100cm^3) would be accurately measured using a burette and placed in a copper calorimeter. The temperature of the water would be measured for a few minutes to allow the thermometer to equilibrate. The spirit burner would then be lit and used to heat the water in the calorimeter until the temperature had risen by 10^{o}C. The flame would then be extinguished and the mass of the burner, once cool, measured again.
$Q=mc\Delta T$ would then be used to calculate the enthalpy change for the experiment. Where m is the mass of water.
</td>
<td>(5) AO3</td>
<td>5</td>
<td></td>
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</table>

			The molar enthalpy change for butan-1-ol would then be calculated using Q/no of moles			
2	b	iii	Any two of: Insulate container/lid Reduce draughts (i.e. use heat shield) Stir consistently	(1) AO3 (1) AO3	2	
2	c	i	The enthalpy/heat energy change When one mole of the compound is formed From the elements in their standard states	(1) AO1 (1) AO1 (1) AO1	3	
2	c	ii	$\Sigma\Delta H_f$(products) - $\Sigma\Delta H_f$(reactants) /appropriate Hess's cycle $\Sigma\Delta H_f$(products)= 4 × –394.4 + 5 × –285.8 = – 3006.6 $\Sigma\Delta H_f$(reactants = −327.4 – 3006.6– –327.4= – 2679.2(ignore units)	(1) AO2 (1) AO2 (1) AO2 (1) AO2	4	
2	c	iii	It is an element (in its standard state)	(1) AO1	1	
2	c	iv	Incomplete combustion Heat loss	(1) AO2 (1) AO2	2	
3	a		Change in concentration (of products/reactants) In a given time	(1) AO1 (1) AO1	2	
3	b	i	3	(1) AO2	1	
3	b	ii	7.5×10^{-3} 4.8×10^{-5} 2.0×10^{-3}	(1) AO2 (1) AO2 (1) AO2	3	

3	b	iii	$k = rate/[NO]^2/[H_2] = 1.2 \times 10^{-5}/(2.0 \times 10^{-3})^2(1.5 \times 10^{-3})$ 1 mark for correct rearrangement 1 mark for correct substitution =2000	 (1) AO2 (1) AO2 (1) AO2	3	
3	b	iv	Units are $mol^{-2}dm^6s^{-1}$	(1) AO2	1	
3	c	i	Vertical axis = number of particles/molecules Horizontal axis = Energy	(1) AO1 (1) AO1	2	
3	c	ii	Peak to right And lower	(1) AO2 (1) AO2	2	
3	d	i	the <u>minimum</u> amount of energy Particles require to react when they collide	(1) AO1 (1) AO1	2	
3	d	ii	At a higher temperature the particles will move faster and so collide more frequently The proportion of particles that possess an energy greater than or equal to the Ea will increase There will therefore be more successful collisions per second	(1) AO2 (1) AO2 (1) AO2	3	
4	a		Reactants on left, products on right Correct general shape Products lower than reactants	(1) AO1 (1) AO1 (1) AO2	3	

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<td>(2) AO1
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5	a	i	Reactants are added as products are removed Process is non-stop	(1) AO1 (1) AO1	2	
5	a	ii	Reactants are added, reaction occurs Then products are removed (and vessel is cleaned)	(1) AO1 (1) AO1	2	
5	a	iii	Lower capital cost Possible to change product easily	(1) AO1 (1) AO1	2	

5	b		All reactants and products/ all substances In same state	(1) AO1	1	
5	c	i	A system at equilibrium will alter the position of equilibrium to oppose the change imposed.	(1) AO1 (1) AO1	2	
5	c	ii	Increase 4 moles of gas particles on LHS and 2 moles of gas particles on RHS Position of equilibrium will shift to side that reduces pressure. This is the side with the fewer particles.	(1) AO2 (1) AO2 (1) AO2	3	
5	c	iii	None Increases the rate of both forward and reverse reactions equally	(1) AO2 (1) AO2 (1) AO2	3	