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General Certificate of Education (A-level) Applied
January 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.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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1	(a)(i)	Rate of (reaction) is unchanged As (concentration of) C is altered owtte	(1) AO1 (1) AO1	**2**
1	(a)(ii)	2 When conc (of A) is doubled the rate quadruples 1 When conc (of B) is halved the rate halves	(1) AO2 (1) AO2 (1) AO2 (1) AO2	**4**
1	(b)(i)	Minimum amount of energy Particles require to react when they collide owtte	(1) AO1 (1) AO1	**2**
1	(b)(ii)	None	(1) AO2	**1**
1	(c)(i)	Starts at origin Skewed to left Asymptotic to x-axis at high energies	(1) AO1 (1) AO1 (1) AO1	**3**
1	(c)(ii)	On x-axis To left of E_a	(1) AO2 (1) AO2	**2**
1	(c)(iii)	Increase As a catalyst lowers the activation energy a greater proportion of particles possess an energy ≥ E_a Therefore more collisions will be successful	(1) AO2 (1) AO2 (1) AO2	**3**
2	(a)	Direct Direct Capital Indirect	(1) AO1 (1) AO1 (1) AO1 (1) AO1	**4**
2	(b)	A substance which has not been processed/found in nature owtte	(1) AO1	**1**
2	(c)(i)	Reactants are added, reaction occurs Then products are removed (and vessel is cleaned)	(1) AO1 (1) AO1	**2**

2	(c)(ii)	Reactants are added as products are removed Process is non-stop	(1) AO1 (1) AO1	**2**
2	(c)(iii)	Any two of: Faster/purer product/savings on labour	(1) AO1 (1) AO1	**2**
2	(d)	Heterogeneous	(1) AO2	**1**
2	(e)	Reactants on left, products on right Correct general shape Products higher than reactants	(1) AO1 (1) AO1 (1) AO2	**3**
2	(f)	(Carbon dioxide emitted and fossil fuels burnt so cause) global warming/climate change	(1) AO2	**1**
3	(a)(i)	$Na_2S_2O_3 + 2\,HCl \rightarrow 2\,NaCl + S + SO_2 + H_2O$ LHS correct RHS correct	 (1) AO2 (1) AO2	**2**
3	(a)(ii)	No <u>atoms</u> are lost / made (during a chemical reaction)	(1) AO1	**1**
3	(b)(i)	Thermometer Either light sensor or cross drawn on piece of paper Any one of suitable reaction vessel e.g. conical flask/stop clock/ Bunsen/measuring cylinder/bulb pipette/burette	(1) AO3 (1) AO3 (1) AO3	**3**
3	(b)(ii)	Any two of : Same concentration of acid/thiosulphate Same volume of acid/thiosulphate Same temperatures used (ie careful heating) Complete mixing	(2) AO3	**2**

<table>
<tr>
<td>3</td>
<td>(b)(iii)</td>
<td>QWC
<table>
<tr><td colspan="3">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.</td></tr>
<tr><td>Level</td><td>Marks</td><td>Descriptor
An answer will be expected to meet most of the criteria in the level descriptor</td></tr>
<tr><td>3</td><td>4-5</td><td>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.</td></tr>
<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>
<tr><td>1</td><td>0-1</td><td>Answer is largely incomplete. It may
contain some valid points which are not clearly linked to an argument structure
- unstructured answer
- errors in the use of technical terms,
spelling, punctuation and grammar
or lack of fluency</td></tr>
</table>
A good answer might include:
A pencil cross is drawn on a piece of paper.
$50cm^3$ $0.1\,mol\,dm^{-3}$ sodium thiosulfate, measured using a measuring cylinder, is poured into a conical flask. This is then heated to the desired temperature. The temperatures to be used are 20, 30, 40, 50, and 60°C. Once at the correct temperature the conical flask is placed on the pencil cross. The stopclock is started when the acid is added. The conical flask should also be swirled on this addition. The stopclock is stopped when the cross is no longer visible.
Any experimental design with objects rather than pencil cross are acceptable, as is the use of a light sensor.</td>
<td>(5) AO3</td>
<td>5</td>
</tr>
</table>

3	(b)(iv)	If in contact with the skin blisters or reddens it.	(1) AO2	**1**

3	(b)(v)	Fume cupboard	(1) AO2	**1**

4	(a)(i)	Both forward and reverse reactions occur At same rate/ concentrations of reactants and products are constant	(1) AO1 (1) AO1	**2**

4	(a)(ii)	$[HCOOCH_2CH_3][H_2O]/[HCOOH][CH_3CH_2OH]$ Correct terms (including square brackets) Correct indices and correct way around	 (1) AO2 (1) AO2	**2**

4	(b)	QWC A good answer might include: A system at equilibrium will alter the position of equilibrium to oppose the change imposed. The yield of ethyl methanoate will increase if the concentration of ethanol is increased. This is because the equilibrium will shift to the right as the rate of the forward reaction will increase for a while to decrease the concentration of ethanol.	 (2) AO1 (3) AO2	**5**

4	(c)	None/negligible Pressure will only affect the position of equilibrium if there is a different number of gas molecules in reactants and products. There are no gas molecules in the equation	(1) AO2 (1) AO2 (1) AO2	**3**

4	(d)(i)	$\Sigma\Delta H_f$(products) – $\Sigma\Delta H_f$(reactants) /appropriate Hess's cycle $\Sigma\Delta H_f$(products)= –608.2 $\Sigma\Delta H_f$(reactants = –702.1 –608.2– (–702.1)= 93.9 KJ	(1) AO2 (1) AO2 (1) AO2 (1) AO2	**4**

4	(d)(ii)	enthalpy required to break one mole of a particular covalent bond Averaged over different environments.	(1) AO1 (1) AO1	**2**

4	(d)(iii)	Σbonds broken = 5218 (or 822 if only dealing with actual bonds broken) Σbonds formed = 5218 (or 822 if only dealing with actual bonds made) Enthalpy change = Σbonds broken − ΣBonds formed =0 kJ (ignore units unless wrong)	(1) AO2 (1) AO2 (1) AO1 (1) AO2	**4**

4	(d)(iv)	Bond energies differ in different environments/. Enthalpies of formation are specific to the substance.	(1) AO1	**1**

5	(a)(i)	109 151	(1) AO2 (1) AO2	**2**

5	(a)(ii)	0.5 × 16 = 8 g paracetamol per packet 8000/8 = 1000 packets	(1) AO2 (1) AO2	**2**

5	(a)(iii)	Moles of paracetamol = 8000/151 = 52.98 Reaction is 1:1 so 52.98 moles of 4-aminophenol required Mass of 4-aminophenol = 52.98 × 109 = 5.77 kg (penalise incorrect units)	(1) AO2 (2) AO2	**3**

5	(b)(i)	Incomplete reaction/transfer losses/impure reactant/other products formed.	(1) AO1	**1**

5	(b)(ii)	7.3/20.4 × 100 = 36% (allow 35.8 NOT 35.7)	(1) AO2	**1**