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General Certificate of Education (A-level) Applied
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Applied Science SC11

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

Unit 11: Controlling Chemical Processes

Final

Mark Scheme

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Question	Part	Subpart	Marking guidance	AO	Mark	Comment
1	(a)	(i)	Capital Direct Indirect	1 AO1 1 AO1 1 AO1	**3**	
1	(a)	(ii)	The cost per unit of the product is not directly proportional to this cost.	1 AO1 1 AO1	**2**	
1	(b)	(i)	Reactants are added, reaction occurs Then products are removed (and vessel is cleaned)	1 AO1 1 AO1	**2**	
1	(b)	(ii)	Faster/ less downtime purer product	1 AO1 1 AO1	**2**	
1	(c)	(i)	Loss of oxygen/decrease in oxidation state/gain of electrons	1 AO1	**1**	
1	(c)	(ii)	160	1 AO2	**1**	
1	(c)	(iii)	No of moles Fe = 8000000/56 = 142857 1 mole of Fe_2O_3 gives 2 moles of Fe therefore no of moles of Fe_2O_3 = 142857/2 = 71429 Mass of Fe_2O_3 = 71429 × 160 = 11428571g or 11.4 tonnes	1 AO2 1 AO2 1 AO2	**3**	
1	(d)	(i)	Thermal decomposition/endothermic/heterogeneous	1 AO2	**1**	
1	(d)	(ii)	(+)4 (+)4	1 AO2 1 AO2	**2**	
1	(d)	(iii)	slag	1 AO2	**1**	
2	(a)		Both forward and reverse reactions occur At same rate/concentrations of reactants and products are constant	1 AO1 1 AO1	**2**	

2	(b)	(i)	$[CH_4][H_2O]/[CO][H_2]^3$ Correct terms (including square brackets) Correct indices	 1 AO2 1 AO2	**2**	
2	(b)	(ii)	$Mol^{-2}\ dm^6$	1 AO2	**1**	
2	(c)	(i)	QWC: A good answer might include: A system at equilibrium will alter the position of equilibrium to oppose the change imposed. The yield of methane will increase if temperature is decreased. This is because the forward reaction is exothermic. If the temperature is reduced the equilibrium will shift to the right to increase the temperature again.	 2 AO1 3 AO2	**5**	
2	(c)	(ii)	Increase 2 gaseous molecules on RHS and 4 gaseous molecules on LHS System will shift to right to reduce the pressure	1 AO2 1 AO2 1 AO2	**3**	
2	(d)	(i)	A substance that alters the rate of reaction Without being used up itself	1 AO1 1 AO1	**2**	
2	(d)	(ii)	None A catalyst speeds up forward and reverse reactions <u>equally</u>	1 AO2 1 AO1 1 AO1	**3**	
3	(a)		No naked flame Contain vapour/breathing apparatus	1 AO1 1 AO1	**2**	
3	(b)		Energy Reactants and products labelled General shape Products lower than reactants	1 AO1 1 AO1 1 AO1 1 AO2	**4**	

3	(c)		Bonds broken = 432 + 2×413 + 838 = 2096 Bonds made = 3 × 413 + 346 + 612 = 2197 Bonds broken – bonds formed = 2096−2197 = −101 kJ	1 AO2 1 AO2 1 AO2 1 AO2	**4**	

3	(d)		The <u>enthalpy change</u> OR <u>heat energy released</u> when <u>one mole</u> of a compound is burnt completely.	1 AO1 1 AO1	**2**	

3	(e)		$\Sigma\Delta H_c$ (reactants) - $\Sigma\Delta H_c$(products) /appropriate Hess's cycle $\Sigma\Delta H_c$(products) = −5540.3 $\Sigma\Delta H_c$(reactants) = −6003.1 −6003.1 + 5540.3 = −462.8 (ignore units) Divide by 4 = −115.7	1 AO2 1 AO2 1 AO2 1 AO2 1 AO2	**5**	

4	(a)	(i)	Any three of: Burette Bulb pipette Conical flask stopclock thermometer suitable reaction vessel eg round bottomed/conical flask	3 AO3	**3**	

4	(a)	(ii)	QWC: A good answer might include After 1 minute 10 cm^3 of the mixture is removed using a bulb pipette and delivered into the conical flask. A few drops of phenolphalein indicator is added and the mixture is titrated . 1.00 mol dm^{-3} hydrochloric acid would be used in the burette. The mixture is swirled as the acid is delivered from the burette. When near to the endpoint the acid is added dropwise. The endpoint occurs when no pink colouration can be seen. The volume of hydrochloric acid added is then recorded. 10cm^3 portions are taken after every subsequent minute and the titration procedure repeated.	5 AO1	**5**	

4	(a)	(iii)	So number of moles of NaOH present at that instant can be determined.	1 AO2	**1**	
4	(a)	(iv)	Once portion is removed reaction is still proceeding	1 AO3	**1**	
4	(a)	(v)	Increase reliability	1 AO3	**1**	
4	(b)		The minimum amount of energy Particles require to react when they collide 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 AO1 1 AO1 1 AO2 1 AO2 1 AO2	**5**	
5	(a)		Change in concentration (of products/reactants) Over time	1 AO1 1 AO1	**2**	
5	(b)	(i)	Rate would halve	1 AO2	**1**	
5	(b)	(ii)	2	1 AO2	**1**	
5	(b)	(iii)	Rate = $k[CH_3COCH_3][H^+]$ complete answer gains 3 marks Inclusion of k $[CH_3COCH_3]$ $[H^+]$	1 AO2 1 AO2 1 AO2	**3**	
5	(c)		Altering the concentration does not affect the rate	1 AO1	**1**	
5	(d)	(i)	0.52/0.4 = 1.3	1 AO2	**1**	
5	(d)	(ii)	Rearranged equation ie $[Y] = [Z]/[X]^2 K_c$ 1.45×10^5 Or if alternative value used 3.00×10^5	1 AO2 1 AO2	**2**	