

CHEMISTRY**9701/22**

Paper 2 AS Level Structured Questions

May/June 2017

MARK SCHEME

Maximum Mark: 60

Published

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Question	Answer						Marks
1(a)	atomic number	nucleon number	number of electrons	number of protons	number of neutrons	symbol	2 1 1
		6		3	3		
						${}_{26}^{58}\text{Fe}^{3+}$	
1(b)(i)	<p>EITHER mass of an atom / isotope relative / compared to 1/12 (the mass) of (an atom of) C-12 OR on a scale in which a C-12 (atom / isotope) has (a mass of exactly) 12 (units)</p> <p>OR mass of one mol (of atoms) of an isotope relative / compared to 1/12 (the mass) of 1 mol of C-12 OR on a scale in which one mol C-12 (atom / isotope) has a mass of (exactly) 12 g</p>						2 1 1
1(b)(ii)	$\frac{(10.0129 \times 19.78) + (80.22x)}{100} = 10.8$						1
	x = 10.9941						1
	Total:						6

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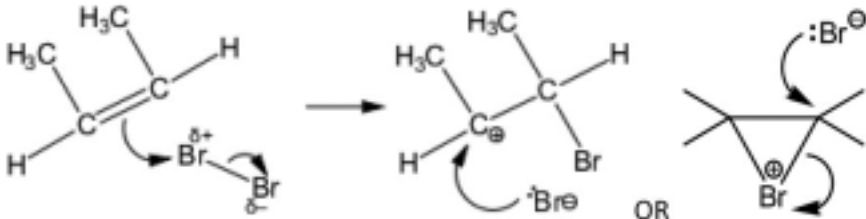
Question	Answer	Marks
2(a)	strong triple bond	1
	non-polar / no dipole	1
2(b)(i)	Any 2 points covered correctly scores 2 marks Any 1 point covered correctly scores 1 mark <ul style="list-style-type: none"> • nitrogen (and oxygen) from the air / atmosphere (react): • high temperature (of internal combustion engine) / (engine) produces enough OR a lot of heat (energy) : • (so) breaks (strong) bond(s) in nitrogen (and oxygen) : 	2
2(b)(ii)	reduction / decomposition of NO _x using a catalyst / catalytic convertor	1
	2NO ₂ + 4CO → 4CO ₂ + N ₂ OR 2NO + 2CO → 2CO ₂ + N ₂	1
2(b)(iii)	(acts as a homogeneous) catalyst OR oxidising agent	1
	SO ₂ + NO ₂ → SO ₃ + NO	1
	NO + ½O ₂ → NO ₂ OR SO ₃ + H ₂ O → H ₂ SO ₄	1
2(b)(iv)	2NO ₂ + H ₂ O → HNO ₂ + HNO ₃ OR 4NO ₂ + 2H ₂ O + O ₂ → 4HNO ₃	1
2(c)	fertiliser / nitrates dissolve in (river water) OR fertiliser / nitrates are washed / leached out / flows into (river water)	1

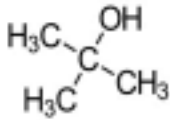
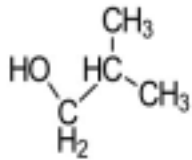
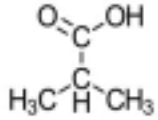
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Question	Answer	Marks
	algal bloom / promote algal growth / explosion of plant growth AND EITHER sunlight is blocked out (preventing photosynthesis) / plants can no longer carry out photosynthesis (and die) OR bacteria break down or decay dead organisms / plants / algae	1
	drop in oxygen (concentration)	1
	Total:	13

Question	Answer	Marks
3(a)	(+) 103	1
3(b)(i)	general shape of the curve and peak are displaced to right of original and starts at origin	1
	the peak is lower and curve crosses once only finishing above original	1
3(b)(ii)	rate increases AND correct explanation in terms of 'more collisions'	1
	at higher T area above E_a is greater / more molecules with $E \geq E_a$	1
	higher frequency of successful collisions OR more successful collisions per unit time / higher chance of successful collisions per unit time / higher proportion of successful collisions per unit time	1
3(b)(iii)	increases (%) decomposition (of HBr)	1
	(increasing T) shifts equilibrium to the right / in the forward direction / endothermic direction / towards $H_2 + Br_2$	1
	to oppose the change or oppose the increase in temperature OR to absorb (additional) energy / heat OR to decrease the temperature	1
3(b)(iv)	H-I bond strength less than H-Br OR less energy needed to break H-I <i>ora</i>	1
	I (atom) is big(ger) (than Br) OR I (atom) has more shielding (than Br) <i>ora</i>	1
	Br (atom) has greater (%) orbital / outer shell overlap OR attraction (of nucleus in iodine) for shared (pair of) electrons is weak(er) OR attraction (of nucleus in iodine) for bonding pair (or electrons) is weak(er) <i>ora</i>	1

Question	Answer	Marks
3(c)(i)	$H_2 = 0.015$ (mol)	1
	$HCl = 0.27$ (mol)	1
3(c)(ii)	$HCl = 9/10$ AND $x_{H_2} = 1/20$ AND $C_{l_2} = 1/20$ OR $HCl = 0.9(0)$ AND $H_2 = 0.05$ AND $C_{l_2} = 0.05$	1
3(d)(i)	$(K_p =) \frac{p_{H_2} \times p_{Cl_2}}{p_{HCl}^2}$	1
3(d)(ii)	equal number of moles (of gas) on either side (of equation) / (total) pressure cancels	1
3(d)(iii)	4.649×10^{-3}	1
	Total:	18

Question	Answer	Marks
4(a)(i)	(A =) 	1
4(a)(ii)	(A / straight chain) has strong(er) (temporary dipole-) induced dipole (attractions) <i>ora</i>	1
	(because A / straight chain has) bigger (surface) area / more (points of) contact (in unbranched isomer) <i>ora</i> OR (so) more energy required to break the intermolecular forces <i>ora</i>	1
4(a)(iii)	CH ₃ CHCHCH ₃ OR CH ₃ CH=CHCH ₃	1
4(a)(iv)	No rotation / restricted / limited rotation of C=C / (carbon) double bond	1
	One (of the two) methyl groups / one (of the two) H (atoms) is on each C (of C=C)	1
4(a)(v)	 <p>arrow from the C=C double bond drawn to the bromine</p>	1
	dipole on Br ₂ in correct orientation AND arrow from the Br-Br bond to the Br ^{δ-}	1
	correct carbocation / bromonium ion from the structure with C=C drawn	1
	Br ⁻ with lone pair, negative charge AND arrow from lone pair to the carbon atom of intermediate OR using both arrows shown (in alternative diagram)	1
4(a)(vi)	electrons in pi bond induce it (the dipole) OR (high) electron density in pi bond / double bond / C=C repels electrons (away from nearest Br) OR polarised by (high) electron density in pi bond / double bond / C=C	1

Question	Answer	Marks
4(b)(i)	<p>C = (2-)methylpropan-2-ol / $(\text{CH}_3)_3\text{COH}$ / any unambiguous structure</p> <p>D = (2-)methylpropan-1-ol / $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$ / any unambiguous structure</p> <p>E = (2-)methylpropanoic acid / $(\text{CH}_3)_2\text{CHCO}_2\text{H}$ / any unambiguous structure</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>C</p> </div> <div style="text-align: center;">  <p>D</p> </div> <div style="text-align: center;">  <p>E</p> </div> </div>	<p style="text-align: right;">1</p> <p style="text-align: right;">1</p> <p style="text-align: right;">1</p>
4(b)(ii)	$2\text{C}_4\text{H}_8\text{O}_2 + \text{Na}_2\text{CO}_3 \rightarrow 2\text{C}_4\text{H}_7\text{O}_2\text{Na} + \text{H}_2\text{O} + \text{CO}_2$	1
4(c)(i)	triiodomethane	1
4(c)(ii)	F = $\text{CH}_3\text{CH}_2\text{CH}_2\text{COCH}_3$	1
	G = $\text{C}_2\text{H}_5\text{CH}(\text{CH}_3)\text{CHO}$	1
4(c)(iii)	<p>a (tetrahedral) atom with four different groups / atoms / substituents attached</p> <p>OR</p> <p>a carbon (atom) with four different groups / atoms / substituents attached</p>	1
4(d)(i)	H C=O (group / bond) AND O–H (group / bond)	1
	I C=O (group / bond) AND C–H (group / bond)	1

Question	Answer	Marks
4(d)(ii)	H = ethanoic acid	1
	I = methyl methanoate	1
	Total:	23