PEARSON EDEXCEL IGCSE CHEMISTRY · 4CH1

CHEMISTRY



MARK SCHEME

SECTION 4: ORGANIC CHEMISTRY (PACK 3)

SCORE	PERCENTAGE
/121	%

STEMUP

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Mark Scheme

Q1.

Question number	Answer	Notes	Marks
(a)	136		1
(b)	M1 simplest (whole number) ratio of atoms present (in a compound) M2 empirical formula (of ocimene/$C_{10}H_{16}$) is C_5H_8	**ALLOW** elements for atoms **ALLOW** C : H ratio 5:8	2

Question number	Answer	Notes	Marks
(c)	unsaturated hydrocarbon because M1 contains (carbon to carbon) double bond(s) M2 contains carbon and hydrogen (atoms) M3 only	 **REJECT** molecules M3 DEP on mention of carbon and hydrogen	3
(d) (i)	**A** addition B is incorrect because the type of reaction between an alkene and bromine is addition not polymerisation C is incorrect because the type of reaction between an alkene and bromine is addition not precipitation D is incorrect because the type of reaction between an alkene and bromine is addition not substitution		1

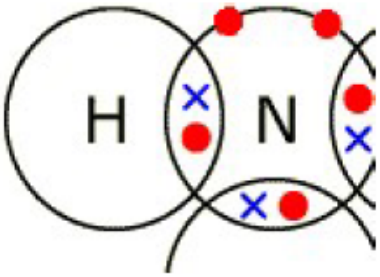
Question number	Answer	Notes	Marks
(d) (ii)	ocimene contains more than one double bond /three double bonds		1

Question number	Answer	Notes	Marks
(e)	$C_{10}H_{16} + 14\,O_2 \rightarrow 10\,CO_2 + 8\,H_2O$ M1 $CO_2 + H_2O$ M2 correctly balanced	 **ACCEPT** in either order **M2 DEP M1** **ACCEPT** multiples or fractions	2
(f) (i)	M1 carbon/C/soot M2 carbon monoxide/CO	**ACCEPT M1 M2** in either order	2
(ii)	(carbon monoxide/CO) reduces capacity of blood to carry oxygen OWTTE	**ACCEPT** correct references to haemoglobin / carboxyhaemoglobin	1

Q2.

Question number	Answer	Notes	Marks
(a) (i)	$N_2 + O_2 \rightarrow 2NO$	**ALLOW** fractions and multiples **IGNORE** state symbols, even if incorrect	1
(ii)	the reaction has a high activation energy / E_a	**ACCEPT** to give the reactants enough energy to react **ACCEPT** a lot of energy is required to break the bonds in the reactants **ALLOW** nitrogen is unreactive	1
(iii)	acid rain	**ACCEPT** references to respiratory problems **ALLOW** a specific harmful effect of acid rain **ALLOW** references to smog **ALLOW** references to greenhouse gases / global warming / climate change **ALLOW** toxic	1

(b)	(i)	M1 catalyst provides an alternative reaction route/ pathway M2 with lower activation energy		2
	(ii)	M1 particles / molecules are closer together M2 therefore more collisions M3 per unit time	**ACCEPT** more particles in a smaller volume /space more frequent collisions scores M2 and M3 any reference to increasing energy max = 1	3

(c)	(i)	M1 one pair of electrons between the nitrogen and each hydrogen M2 two non-bonding electrons on the nitrogen  	 M2 dep on M1	2 2
	(ii)	M1 (electrostatic) attraction between nuclei M2 and shared pair(s) of electrons OR M1 (electrostatic) attraction between shared pair(s) of electrons M2 and nuclei (of both atoms)	nuclei must be plural **ALLOW** bonding pair(s) of electrons **ALLOW** bonding pair(s) of electrons nuclei must be plural	2
	(iii)	M1 forces between molecules/intermolecular forces (of attraction) are weak M2 and therefore require little energy to overcome	**ALLOW** intermolecular bonds are weak **IGNORE** less energy Mention of breaking covalent bonds = 0	
				14

Q3.

Question number	Answer	Notes	Marks
(a)	shared pair(s) of electrons (between two atoms)	**REJECT** if between molecules	1
(b) (i)	$N_2 + 2O_2 \rightarrow 2NO_2$	**ALLOW** multiples and fractions	1
(ii)	acid rain	**ACCEPT** breathing problems/ asthma **ALLOW** an effect of acid rain e.g. kills fish	1
(c)	An explanation that links the following six points **M1** nitrogen dioxide has a simple molecular structure **M2** silicon dioxide has a giant (covalent) structure **M3** many/strong (covalent) bonds in silicon dioxide (need to be broken) **M4** intermolecular forces in nitrogen dioxide **M5** are weak **M6** more energy needed to break the bonds in silicon dioxide than to overcome the (intermolecular) forces in nitrogen dioxide	 **REJECT** ionic or metallic structure/ bonds for **M2** and **M3** **REJECT** mention of intermolecular forces for **M3** **REJECT** covalent bonds are weak for **M4** and **M5** **REJECT** reference to breaking of covalent bonds in nitrogen dioxide	6 Total 9

Q4.

Question number	Answer	Notes	Marks
(a) (i)	Y		1
(ii)	V		1
(iii)	W		1
(iv)	X		1
(v)	displayed formula of but-1-ene or methylpropene		1
(vi)	Any two from		2
	M1 same general formula	**ALLOW** same empirical formula	
	M2 similar chemical properties	**ALLOW** they react in a similar way/same chemical properties	
	M3 trend in physical properties	**ACCEPT** named physical property e.g. trend in boiling points	
	M4 each consecutive member differs by a CH_2 group		

(b)	(i)	M1 $\frac{38.7}{12}$ $\frac{9.7}{1}$ $\frac{51.6}{16}$ **OR** 3.225 9.7 3.225 M2 (divide by smallest) 1 3 1	0 marks if upside down calculation or use of atomic numbers	2
	(ii)	M1 Mr of CH_3O = 31 M2 (62 ÷ 31 = 2 so molecular formula is) $C_2H_6O_2$	$C_2H_6O_2$ without working scores 2	2
				11

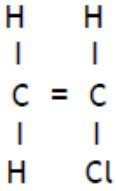
Q5.

Question number	Answer	Notes	Marks
(a)	M1 (propane/it) contains hydrogen and carbon (atoms) M2 only	REJECT carbon and hydrogen molecules M2 is dependent on mention of just carbon and hydrogen in M1	2
(b) (i)	carbon monoxide	ALLOW CO	1
(ii)	it decreases the capacity of the blood to transport oxygen OWTTE	ALLOW carbon monoxide binds to haemoglobin	1
(c)	M1 (strong electrostatic) attraction between (bonding) pair of electrons M2 (and) nuclei (of both atoms) OR M1 (bonding) pair of electrons M2 attracted to nuclei	 REJECT nucleus REJECT nucleus 0 marks if reference to intermolecular forces between atoms	2
(d)	An explanation that links the following three points M1 (crude oil) produces more long chain hydrocarbons than can be used directly OWTTE M2 shorter chain alkanes are more flammable /more useful as fuels M3 alkenes are used to make polymers / plastics	 ALLOW less demand for long chain hydrocarbons ALLOW shorter chain alkanes/hydrocarbons are more useful	3
(e) (i)	M1 C_3H_7Br M2 HBr	 ALLOW polysubstituted product if correct balancing number in front of Br_2 and HBr	2
(ii)	substitution		1

12 marks

Q6.

Question number	Answer	Notes	Marks
(a) (i)	C_nH_{2n}	**ALLOW** upper case N or different letter e.g. x	1
(ii)	An explanation that links the following three points **M1** (a compound) with a (C=C) double bond **M2** (which contains) hydrogen and carbon (atoms) **M3** only	 **ACCEPT** molecule or substance for compound **REJECT** element for compound and/or molecules for atoms once only **M3** dep on mention of just C and H in **M2**	3

(b)	(i)			1
	(ii)	An explanation that links one of the following pairs		2
		M1 inert	**ALLOW** do not react /unreactive	
		M2 (so) do not biodegrade OWTTE	**ALLOW** other relevant alternatives eg landfill sites fill up	
		OR		
		M1 burning polymers releases gases/fumes		
		M2 (which) are toxic/poisonous	**ALLOW** (which) contribute to global warming /greenhouse effect	
				Total 7

Q7.

Question number	Answer	Notes	Marks
(a) (i)	M1 (molecules / compounds containing) hydrogen and carbon (atoms)		2 grad
	M2 only	M2 dep on M1 or near miss	
(ii)	propane		1 Clerical
(iii)	C_2H_6		1 Grad
(iv)	M1 add bromine water	**REJECT** bromine or bromide or bromide water	2 Exp
	M2 decolourised	**ALLOW** turns (from orange / yellow to) colourless **M2** dependent on **M1** unless **M1** is bromine, bromide or bromide water	
(b) (i)	M1 structure is simple molecular / simple covalent		3 Exp
	M2 intermolecular forces (of attraction) are weak	**ALLOW** intermolecular bonds, if clearly not covalent bonds	
	M3 and require little energy to overcome / break	**ALLOW** low / less energy Any reference to breaking covalent bonds do not award **M2** and **M3**.	
(ii)	The intermolecular forces in R are stronger (than the intermolecular forces in S) OR reverse argument	**ALLOW** R has a higher Mr / surface area than S / has more Cs and Hs **ALLOW** R has stronger bonds / more bonds than S if breaking bonds is mentioned in (b)(i)	clip

(c)	(i)	Any one from: **M1** heat lost to the atmosphere **M2** heat absorbed by the beaker / calorimeter / thermometer **M3** some hydrocarbon evaporates (rather than burning)		1 Grad
	(ii)	$C_6H_{14} + \mathbf{5}\ O_2 \rightarrow 3\ C + \mathbf{3}\ CO + \mathbf{7}\ H_2O$	**ALLOW** multiples or fractions	1 Grad
	(iii)	**M1** (carbon monoxide is) toxic / poisonous **M2** (because it) reduces the capacity of the blood to transport oxygen	**ALLOW** correct references to haemoglobin	2 Exp

(iv)	**M1** calculates temperature increase **M2** substitution of values into $Q=mc\Delta T$ **M3** calculation of heat energy released Example calculation ΔT = 37.5(°C) Q = 100 x 4.2 x 37.5 Q = 15 750 J	ALLOW ecf from **M1** **IGNORE** sign of answer **IGNORE** units, unless answer is divided by 1000 to give 15.75 **kJ** Correct answer with or without working scores 3 marks.	3 Exp
		Total for question	17

Q8.

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>(a)</td><td>
<table>
<tr><th>Information</th><th>Substance</th></tr>
<tr><td>a good conductor of electricity</td><td>copper</td></tr>
<tr><td>an element that has a basic oxide</td><td>copper</td></tr>
<tr><td>a substance used as a fuel</td><td>methane</td></tr>
<tr><td>a major cause of acid rain</td><td>sulfur dioxide</td></tr>
<tr><td>a non-metallic element that is a solid at room temperature</td><td>iodine</td></tr>
</table>
</td><td>ALLOW correct formulae</td><td>5</td></tr>
<tr><td>(b)</td><td>A description which refers to the following points

M1 bubble/add (the gas/carbon dioxide) into limewater

M2 (limewater) turns cloudy/milky</td><td>ACCEPT calcium hydroxide

ACCEPT white precipitate

M2 dep on use of limewater/calcium hydroxide in M1</td><td>2

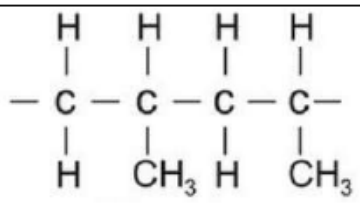
Total 7</td></tr>
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Q9.

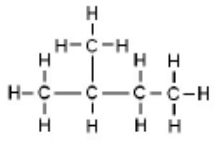
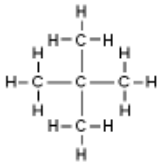
Question number	Answer	Additional guidance	Marks
(a) (i)	**M1** (a compound) containing hydrogen/H and carbon/C (atoms) (1) **M2** only (1)	**ACCEPT** molecule/substance for compound **REJECT** element/mixture/atom for compound in **M1** only **ACCEPT** alternatives for only, eg just **M2** dep on mention of just H and C in **M1**	2
(ii)	C_nH_{2n+2}	**ALLOW** upper case N or x in place of n	1
(b)	fractional distillation	**ALLOW** fractionation /fractionating **REJECT** simple distillation **IGNORE** distillation on its own	1
(c)	An explanation that links together the following two points: **M1** carbon monoxide / CO **M2** reduces the capacity of the blood/haemoglobin to carry oxygen **/** is poisonous /is toxic	If both name and formula given, both must be correct **IGNORE** carbon oxide **ACCEPT** combines with haemoglobin in preference to oxygen	2

(d) (i)	An explanation that links together any two of the following points: **M1** (petrol) <u>vapour/gas/fumes</u> (produced) **M2** diffuses (through the air) **M3** (petrol) will ignite/catch fire/explode/ is flammable	 **ALLOW** travels/moves/spreads for diffuses	2
(ii)	petrol is more volatile	**ACCEPT** petrol evaporates more easily/more readily **ACCEPT** petrol turns into a vapour/gas more easily/ more readily **ALLOW** petrol is more flammable/catches fire more easily **ACCEPT** reverse argument	1
		Total	**9**

Q10.

Question number	Answer	Notes	Marks
(a) (i)	A		1
(ii)	C		1
(iii)	propene		1
(iv)	M1 same molecular formula M2 different structural / displayed formulae		2
(b) (i)	$CH_3Br + HBr$	ALLOW balanced equations for multiple substitutions	1
(ii)	substitution		1
(c) (i)	M1 37.8÷12, 6.3÷1, 55.9÷35.5 M2 3.15, 6.3, 1.57 M3 divide by smallest to get 2:4:1 **OR** M1 M_r of C_2H_4Cl = 63.5 M2 24/63.5 x 100 and 4/63.5 x 100 and 35.5/63.5 x100 M3 37.8% and 6.3% and 55.9%	M2 subsumes M1 M3 must be calculated	3
(ii)	M1 127÷63.5=2 M2 Molecular formula = $C_4H_8Cl_2$	Answer of $C_4H_8Cl_2$ without working scores 2	2
(d) (i)	 M1 two carbon atoms both with 2 H atoms M2 two carbon atoms both with 1 H atom and 1 CH_3 group and nothing attached to the joining bonds	Marks are independent	2
(ii)	Any one from: landfill sites are getting full toxic / greenhouse gases are produced when burned		1
			Total for question = 15 marks

Q11.

Question number	Answer	Notes	Marks
ai	**M1** (compounds/molecules) with the same molecular formula **M2** but with different structural/displayed formula	**ACCEPT** same number **and** same type of atoms **REJECT** elements for compounds/molecules once only **ACCEPT** different structures **ACCEPT** atoms arranged differently **REJECT** contradicting statements, e.g. same displayed formula but different structures scores 0 out of 2	**2**
ii	 **OR**  **M1** correct carbon skeleton **M2** all hydrogen atoms and all bonds shown	**M2** dep on **M1**	**2**

bi	$(C_5H_{12} + Br_2) \rightarrow \mathbf{C_5H_{11}Br + HBr}$ **M1** correct formula of organic product **M2** HBr as a product **and** correctly balanced	deduct 1 mark if cases or subscripts incorrect **ACCEPT** multiple substitutions of bromine $C_5H_{10}Br_2 + H_2$ scores **M1**	**2**
ii	substitution		**1**