

Chemistry

Advanced GCE F331

Chemistry for Life

Mark Scheme for June 2010

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Question			Expected Answer	Mark	Rationale/Additional Guidance
1	a	i	Nitrogen from air ✓ combine with oxygen OR reacts with oxygen OR nitrogen oxidised ✓ (Allow combusts / combustion OR burns with oxygen) high temp (in engine) ✓	3	Mark separately. ALLOW 'nitrogen and oxygen from air' ACCEPT 'atmosphere' for air IGNORE refs. to incomplete combustion NOT exhaust/around the engine (CON)
		ii	(causes) acid rain ✓ kills / damages plants / aquatic life / buildings / acidifies lakes or rivers ✓ OR ozone formation ✓ damages / harmful to animals / plants / people or attacks organic matter / plastics / rubber / textiles / paints ✓ OR <u>photochemical</u> smog or <u>photochemical</u> fog ✓ breathing difficulties / eye or nose irritation / produces ozone with problems above ✓	2	IGNORE greenhouse gas and references to ozone depletion 2 nd mark depends on first scoring within each pair DO NOT ACCEPT NO is toxic / harmful for first marking point but could score second e.g. causes breathing difficulties
		iii	Nitrogen / N ₂ ✓	1	Formula if used MUST be correct ALLOW dinitrogen IGNORE CO ₂

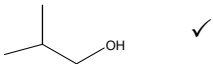
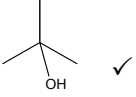
Question		Expected Answer	Mark	Rationale/Additional Guidance
	iv	<p>Reactants / Molecules are adsorbed / adsorption on (surface of) catalyst ✓ QWC – Adsorption/adsorb/adsorbed</p> <p>Bonds break <u>within / in</u> reactant / molecules OR intramolecular bonds break OR bonds break between atoms in reactants / molecules ✓</p> <p>Bonds form in products or new bonds form ✓</p> <p>Products / molecules leave surface AW ✓</p>	4	<p>QWC – Adsorption / adsorb / adsorbed NOT adsorped / adsorbtion</p> <p>NB If QWC ‘word’ not there or spelt incorrectly the first mark is not scored</p> <p>NB It must be clear that it is the bonds within the molecules that are breaking</p> <p>‘Bonds form’ on its own does not score this marking point. IGNORE references to ‘between’ reactants or molecules</p> <p>NOT ‘are removed’ from surface AW such as ‘diffuse’ ‘desorb’ ‘released’</p> <p>If order wrong max 3 Labelled diagrams could score all marks</p>
	b	<p>answer = - 164</p> <p>minus ✓</p> <p>164 ✓</p>	2	Any number with minus sign scores first marking point
		Total	12	

Question			Expected Answers				Marks	Additional guidance
2	a	i	Isotope	Number of protons	Number of neutrons	Number of electrons	1	
			207	82	125	82		
			✓					
	b	i	a stream of electrons (idea of moving electrons) or laser pulse ✓				1	ALLOW bombarded / hit by other electrons NOT exposed to an electric charge
		ii	<u>negative</u> plates or electric field or electrostatic attraction ✓				1	Attraction to a negative charge scores but not 'negative charge' on its own. Magnetic field is CON
		iii	(atomic / isotopic) Mass ✓				1	Molecular mass or molecules mass is CON ALLOW: weight; heavier slower or lighter faster different numbers of neutrons IGNORE density/size or 'relative' atomic or isotopic mass
	c	i	Height / intensity / abundance / peak / % at 208 (in spectrum) bigger/larger/higher (in 1950) ✓				1	Reverse argument: smaller in <u>1930</u> (spectrum)
		ii	pre- / auto-ignition (of fuel) ✓ damages cylinder / pistons / valves / engine OR reduces power / engine performance / efficiency ✓				2	ALLOW implication that ignition/explosion occurs at wrong time in 'cycle' Mark separately IGNORE answers in terms same of octane no.
	d	i	Radioactive/radioisotopes ✓				1	

Question		Expected Answers	Marks	Additional guidance
	ii	${}^{235}_{92}\text{U} \rightarrow 4\alpha + {}^{231}_{90}\text{Th}$ 4α ✓ ${}^{231}_{90}$ ✓ Th or ecf from atomic number above ✓	3	
	iii	time taken for half / halving / 50% ✓ of (radioactive) isotope / atoms to decay OR of count rate OR of mass / amount AW ✓	2	DO NOT ALLOW 'atom' or 'matter' ALLOW 'substance' (to decay by half etc)
e	i	lone pairs ✓ bonding pairs ✓	2	BOTH same symbol for electrons IGNORE position of pairs MUST have at least two different symbols for electrons
	ii	4 pairs of electron / two bonding + two lone / non-bonding pairs ✓ repel as far apart as possible / minimize electronic energy / minimise repulsion ✓ V-shaped / bent / boomerang or diagram ✓ 104 -110° ✓	4	ALLOW sets / groups / areas of electrons Repel must refer to electrons (not atoms / bonds) NOT repel as <u>much</u> as possible NB <u>not</u> requiring reference to central atom in this straightforward molecule
Total			19	

Question	Expected answers	Marks	Additional guidance
3 a i	$\text{BaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{BaCl}_2(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$ <p>formulae ✓</p> <p>balancing of correct formulae ✓</p> <p>(s) + (aq) → (aq) + (g) + (l); (brackets essential) ✓</p>	3	Co ₂ BOD Allow the state symbols for incorrect formulae of barium compounds only eg BaCl (aq)
	<p>ii</p> <p>Marks are in three sections:</p> <p><u>First section for method as below (1 mark)</u></p> <p>Heating <u>carbonate</u> (even if only Ba carbonate) in a tube / flask and passing (AW) gas through limewater ✓</p> <p><u>Second section for ideas of fair testing (2 marks)</u></p> <p>Any two from the three below:</p> <p>Same amount / moles of <u>carbonate</u> ✓</p> <p>Same volume / amount / quantity of lime water ✓</p> <p>Same heating conditions ✓</p>	5	Mark separately. DO NOT ALLOW heating carbonate in with water for this marking point ALLOW 'passing into tube containing lime water' Some marks can come from labelled / annotated diagram NOT 'burn' ALLOW 'constant' instead of 'same' ALLOW same bunsen flame or tube same height above bunsen or heat to same temperature IGNORE time of heating

Question	Expected answers	Marks	Additional guidance
	<p><u>Third section for expected observations (2 marks)</u></p> <p>lime water goes 'cloudy' / AW ✓</p> <p>takes longer to go cloudy / gets less cloudy down group (ora) ✓</p>		<p>ALLOW white / chalky / milky / faint white precipitate</p> <p>Needs a clear indication of trend down group linked to observations of lime water (e.g. Mg carbonate gets cloudier than Barium carbonate). Just stating trend on own does not score this mark.</p>
b	<p>M_r of $\text{BaSO}_4 = 233.4$ or 233 ✓</p> <p>No. of moles = $\frac{2.20 \times 10^{-4}}{M_r}$ AND evaluation to any sf ✓</p> <p>A calculated or the correct answer to 3 sig figs ✓</p>	3	<p>Second marking point for working allow ecf</p> <p>Second mark lost if evaluation correct but wrongly transferred to answer line (can score sig figs however)</p> <p>Sig fig independent providing 'followable' working present</p> <p>Correct answer on its own scores all three (9.43 or 9.44×10^{-7})</p> <p>Correct answer to the wrong number of sig figs scores 2</p> <p>ALLOW answer in non-standard form</p>
c	<p>two outermost / valence / outer shell electrons therefore Gp 2 ✓</p> <p>sixth 'shell' / six shells therefore Period 6 ✓</p>	2	<p>NOT loses two electrons</p>
	Total	13	

Question		Expected Answers	Marks	Additional guidance
4	a	Alcohol(s) ✓	1	Hydroxyl is CON
	b	 ✓ (2)-methylpropan-1-ol ✓ OR  ✓ (2)-methylpropan-2-ol ✓	2	(1 + 1) i.e. mark separately but must be a consistent 'set' Must be skeletal IGNORE wrong dashes, commas IGNORE ambiguous attachments unless clearly through H atom e.g. -HO (is a CON) <u>Initial</u> numbers non-essential, but any other initial no. used CON's mark
	c	i moles per kg = $1000/74 = 13.51$ ✓ kJ per kg = $13.51 \times 2676 = 36,153$ or $36,162$ ✓ ALLOW rounded values (13.5 or 14) giving 36,126 or 37,464 respectively	2	2nd mark depends on first being correct unless 1 used instead of 1000 (gives 36 as answer) ALLOW 2 or more sig figs Any 'correct' answer scores two Ignore any sign
		ii energy in / needed / endothermic to break bonds ✓ energy released / given out / exothermic when bonds form ✓ more energy given out than taken in ✓	3	refs to number of bonds broken or formed is a CON only on last marking point (i.e. max 2)

Question		Expected Answers	Marks	Additional guidance
	iii	greater (total) / increase in entropy when mixed ✓ more disorder / ways of <u>arranging</u> when mixed ✓	2	ALLOW entropy <u>change</u> increases NOT just 'ways' More ways of arranging atoms/elements is CON Watch out for the (wrong) statement 'more molecules when mixed' therefore..... CON 's second mark
d	i	$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ formulae all correct ✓ balancing of correct formulae ✓	2	ALLOW multiples Zero if 'spurious species' used to balance IGNORE ss
	ii	greater volume of air / oxygen or greater number of oxygens needed per <u>mole / molecule</u> of biobutanol (ora) ✓	1	ALLOW greater chain length of biobutanol means more air/oxygen needed for complete combustion (ora)
e	i	Any two from: Less CO / unburnt HC / particulate / SO _x / carcinogens ✓ (IGNORE NO_x) Sustainable replaceable / renewable ✓ No net CO ₂ / carbon neutral ✓ Fossil fuels have other uses ✓ Biodegradable ✓	2	Pollutants must be specified Ignore simply 'replacement for fossil fuels' (in stem) If more than two benefits given incorrect answers (e.g. ozone depletion) CON correct answers eg 1 correct 1 wrong scores 1; 1 correct 2 wrong scores 0 2 correct 1 wrong scores 1; 2 correct 2 wrong scores 0

Question	Expected Answers	Marks	Additional guidance
ii	Any one from: Uses up land which could be used for food / agriculture ✓ More energy to make than is released / fossil fuels used in production of biofuels ✓ CO ₂ emissions in manufacture ✓ Reduces biodiversity AW ✓ Lower energy density ✓	1	IGNORE NO_x Land usage must be linked to food / agriculture DO NOT ALLOW references to energy per mole ALLOW engine has to be modified An incorrect answer CONs any correct answer
	Total	16	

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