OCR
RECOGNISING ACHIEVEMENT

GCE

Chemistry

Mark Scheme

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

<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Marks</th><th>Additional guidance</th></tr>
<tr><td>2</td><td>a</td><td>i</td><td><table><tr><td>Isotope</td><td>Number of protons</td><td>Number of neutrons</td><td>Number of electrons</td></tr><tr><td>207</td><td>82</td><td>125</td><td>82</td></tr></table>✓</td><td>1</td><td></td></tr>
<tr><td></td><td>b</td><td>i</td><td>a stream of electrons (idea of moving electrons) or laser pulse ✓</td><td>1</td><td>ALLOW bombarded / hit by other electrons
NOT exposed to an electric charge</td></tr>
<tr><td></td><td></td><td>ii</td><td><u>negative</u> plates or electric field or electrostatic attraction ✓</td><td>1</td><td>Attraction to a negative charge scores but not ‘negative charge’ on its own.
Magnetic field is CON</td></tr>
<tr><td></td><td></td><td>iii</td><td>(atomic / isotopic) Mass ✓</td><td>1</td><td>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</td></tr>
<tr><td></td><td>c</td><td>i</td><td>Height / intensity / abundance / peak / %
at 208 (in spectrum)
bigger/larger/higher (in 1950) ✓</td><td>1</td><td>

Reverse argument: smaller in <u>1930</u> (spectrum)</td></tr>
<tr><td></td><td></td><td>ii</td><td>pre- / auto-ignition (of fuel) ✓

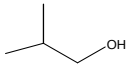
damages cylinder / pistons / valves / engine OR reduces power / engine performance / efficiency ✓</td><td>2</td><td>ALLOW implication that ignition/explosion occurs at wrong time in ‘cycle’
Mark separately

IGNORE answers in terms same of octane no.</td></tr>
<tr><td></td><td>d</td><td>i</td><td>Radioactive/radioisotopes ✓</td><td>1</td><td></td></tr>
</table>

Question			Expected Answers	Marks	Additional guidance
		ii	$^{235}_{92}U \rightarrow {}^{4}_{2}\alpha + {}^{231}_{90}Th$ $^{4}_{2}\alpha$ ✓ $^{231}_{90}$ ✓ Th or ecf from atomic number above ✓	3	
		iii	time taken for half / halving / 50%✓ of (radioactive) isotope / atom**s** 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^{0} ✓	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	$BaCO_3(s) + 2HCl(aq) \rightarrow BaCl_2(aq) + CO_2(g) + H_2O(l)$ formulae ✓ balancing of correct formulae ✓ (s) + (aq) → (aq) + (g) + (l); (brackets essential) ✓	3	Co_2 BOD Allow the state symbols for incorrect formulae of barium compounds only eg BaCl (aq)
		ii	Marks are in three sections: <u>First section for method as below (1 mark)</u> Heating <u>carbonate</u> (even if only Ba carbonate) in a tube / flask and passing (AW) gas through limewater ✓ <u>Second section for ideas of fair testing (2 marks)</u> Any two from the three below: Same amount / moles of <u>carbonate</u> ✓ Same volume / amount / quantity of lime water ✓ Same heating conditions ✓	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
			Third section for expected observations (2 marks) lime water goes 'cloudy' / AW ✓ takes longer to go cloudy / gets less cloudy down group (ora) ✓		**ALLOW** white / chalky / milky / faint white precipitate 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.
	b		M_r of $BaSO_4$ = 233.4 or 233 ✓ No. of moles = $\frac{2.20 \times 10^{-4}}{M_r}$ **AND** evaluation to any sf ✓ A calculated or the correct answer to 3 sig figs ✓	3	Second marking point for working **allow ecf** Second mark **lost** if evaluation correct but **wrongly transferred** to answer line (can score sig figs however) **Sig fig** independent providing 'followable' working present Correct answer on its own scores all three (9.43 or 9.44 x 10^{-7}) Correct answer to the wrong number of sig figs scores 2 **ALLOW** answer in non-standard form
	c		two outermost / valence / outer shell electrons therefore Gp 2 ✓ sixth 'shell' / six shells therefore Period 6 ✓	2	**NOT** loses two electrons
			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**) Initial 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 x 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**	