OCR
Oxford Cambridge and RSA

GCE

Chemistry B

Unit **H033/01:** Foundations of chemistry

Advanced Subsidiary GCE

Mark Scheme for June 2017

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Benefit of doubt not given
	Noted but no credit given
	Ignore
	Blank page

Annotations

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument
I	Alternative and acceptable answers for the same marking point
✓	Separates marking points

Subject-specific Marking Instructions

a) Where a candidate overwrites an answer (particularly in questions 1 to 20) the assessor should attempt to mark the more prominent response.

b) The first 20 multiple choice questions require either 1 mark, 0 marks or NR – there is no need to tick or otherwise annotate these responses. All other questions require ticks which match the number of marks awarded or NR.

c) Always check the pages which are linked to question 21a (and additional objects if present). All such pages should be marked with BP (Blank Page) unless they contain material relevant to a question. In which case, they should be linked to the appropriate question and marked as required (tick or SEEN).

d) If an answer appears to continue outside the marking zone the assessor should link the additional material to the appropriate question and mark as required (tick or SEEN).

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

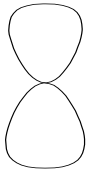
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

SECTION A

5

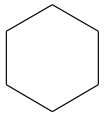
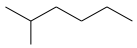
Q	Key
1	D
2	B
3	D
4	B
5	B
6	D
7	C
8	A
9	D
10	B
11	B
12	A
13	C
14	A
15	A
16	D
17	C
18	A
19	A
20	B

Question			Answer	Marks	Guidance
21	(a)	(i)	protons 17; neutrons 18; electrons 17	1	
		(ii)	$1s^2 2s^2 2p^6 3s^2 3p^5$	1	**ALLOW** capital letters and non-superscripted numbers
		(iii)	dumb-bell **AND** 2 electrons 	1	**IGNORE** shading of dumb-bell **IGNORE** attempt to show 3D nature **IGNORE** orientation of dumb-bell If more than one dumbbell is shown the answer must make clear that it is two electrons per dumb-bell
	(b)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **If answer = 35.49 award 2 marks** (75.53 x 35 + 24.47 x 37)/100 **OR** 35.4894 ✓ 35.49 (2 dp) ✓	2	35.5 scores 1 mark Any calculated answer to 2dp scores 1 mark
	(c)	(i)	$C_2H_5{}^{35}Cl^+$ / $CH_3CH_2{}^{35}Cl^+$	1	**ALLOW** isotope number on either side of the Cl throughout part (c) **ALLOW** formula without isotope superscript if relevant isotope is mentioned separately **ALLOW** ^{12}C and ^{1}H in formula **ALLOW** omission of either + sign or '35' but not both **DO NOT ALLOW** minus sign **IGNORE** dot to recognise radical nature of cation
		(ii)	m/z 66 is $C_2H_5{}^{37}Cl^{(+)}$ ✓ Ratio (of peak heights) is 3:1/75.53:24.47/75:25/the same as the ratio of the isotopes ✓	2	**IGNORE** absence of plus sign '(The two peaks) due to the two isotopes of Cl' scores first mark **DO NOT ALLOW** 'ratio is 4:1'
		(iii)	$^{13}CCH_5{}^{(35)}Cl^{(+)}$ / $^{13}CH_3CH_2{}^{(35)}Cl^{(+)}$ / $CH_3{}^{13}CH_2{}^{(35)}Cl^{(+)}$/$C_2H_4{}^{37}Cl^{(+)}$	1	**ALLOW** ^{12}C and ^{1}H in formula **IGNORE** sign **NOTE** superscript 35 and + not necessary for this mark
	(d)		**EITHER** 3200-3600 (cm^{-1}) **AND** OH	1	**DO NOT ALLOW** other absorptions

Question			Answer	Marks	Guidance
			OR 1000-1300 (cm^{-1}) **AND** CO		
			Total	**10**	

Question			Answer	Marks	Guidance
22	(a)		potassium sulfate ✓	1	**ALLOW** 'sulfate(VI)', 'sulphate' and 'K_2SO_4'
	(b)	(i)	coloured lines on dark/black (background) ✓	1	**ALLOW** 'bright lines on dark/black (background)'
		(ii)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **If answer = 296/295.6.../300 (kJ mol^{-1}) award 3 marks** E= hc/λ **OR** 6.63 x 10^{-34} x 3.00 x 10^{8}/ 4.05 x 10^{-7} ✓ Evaluation of a given expression for E (= 4.91(11..) x 10^{-19} (J per atom)) ✓ = 4.91 x 10^{-19} x 6.02 x 10^{23} /1000 = 296 (kJ mol^{-1}) ✓	3	**ALLOW** ecf **ALLOW** 2 or more sf 4.91x10^{-22} scores 2 4.91x10^{-19} scores 2 4.91x$10^{\text{any other power}}$ scores 1 2.96x$10^{\text{any other power}}$ scores 2
	(c)	(i)	$Pb(NO_3)_2$ + 2NaCl → $PbCl_2$ + 2$NaNO_3$	1	State symbols need not be present but **DO NOT ALLOW** incorrect symbols **IGNORE** ionic equations
		(ii)	Wash (the residue/solid with water) ✓ Remove soluble material/salts/impurities/etc✓	2	**DO NOT ALLOW** washing with anything other than water
	(d)	(i)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **If answer = 0.318 (mol dm^{-3}) award 2 marks** n (Na_2CO_3) = (25.0 / 1000 x 0.150) = 0.00375 mol n (HCl) = (2 x 0.00375) = 0.0075 mol [HCl] = (0.0075 x 1000 / 23.6) = 0.318 (mol dm^{-3}) correct use of ratio 2 ✓ rest correct ✓	2	**ALLOW** 2 or more sf 0.1588... or 0.079... score 1 mark
		(ii)	'The student is incorrect' ✓ **EITHER** 0.150 means between 0.1495 and 0.1504 AW **OR** 0.150 means 0.150 ±0.0005 AW **OR** 0.15 means between 0.145 and 0.154 AW **OR** 0.15±0.005 AW ✓	2	**IGNORE** reference to significant figures **ALLOW** '… 0.1495 and 0.1505' **ALLOW** '…. 0.145 and 0.155' **ALLOW** '0.150 is more <u>precise</u> (than 0.15)' for 2nd marking point.

Question			Answer	Marks	Guidance
	(e)	(i)	green (ppt) with NaOH/(sodium) hydroxide (solution)/OH^- ✓	1	**IGNORE** reference to green ppt turning brown on standing **ALLOW** 'green-blue (ppt.)'
		(ii)	$Fe^{2+}(aq) + 2OH^-(aq) \rightarrow Fe(OH)_2(s)$ ✓	1	**ALLOW** correct equation for test for sulfate if given as answer to 22(e)(i)
	(f)	(i)	heat to constant mass AW	1	**ALLOW** '....weight'
		(ii)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **If answer = 7 award 2 marks** amount of H_2O = 4.29/18 **or** 0.238 **AND** amount $FeSO_4$ = 5.16/151.8 **or** 0.034 ✓ Ratio 0.238/0.034 = 7 so x= 7 ✓	2	Ratio correctly based on incorrect calculations of moles of H_2O or $FeSO_4$ scores 1
			Total	17	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>23</td><td>(a)</td><td></td><td>
<table>
<tr><th>fuel</th><th>name</th><th>skeletal formula</th><th>molecular formula</th><th>aliphatic or aromatic?</th><th>saturated or unsaturated?</th></tr>
<tr><td>B</td><td>cyclohexane</td><td>  </td><td>C_6H_{12}</td><td>aliphatic</td><td>saturated</td></tr>
<tr><td>C</td><td>2-methylhexane</td><td>  </td><td>C_7H_{16}</td><td>aliphatic</td><td>saturated</td></tr>
<tr><td></td><td colspan="2">✓</td><td>✓</td><td colspan="2">✓</td></tr>
</table>
</td><td>3</td><td>For the name, IGNORE commas, dashes and spaces.
ALLOW ‘methly’, ‘metyl’ and ‘methy’</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>FIRST CHECK THE ANSWER ON THE ANSWER LINE
If answer = -235 (kJ mol^{-1}) award 2 marks

$\Delta_f H(C_7H_{16})$ = $8\Delta_f H(H_2O)$ + $7\Delta_f H(CO_2)$ + 4811
OR (8 x -286) + (7 x -394) + 4811
OR - 2288 - 2758 + 4811 ✓
= -235 (kJ mol $^{-1}$)✓</td><td>2</td><td>+4131; (+)235; -9857 score 1</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>FIRST CHECK THE ANSWER ON THE ANSWER LINE
If answer = 1.6 x 10^4/16000 cm^3 award 3 marks

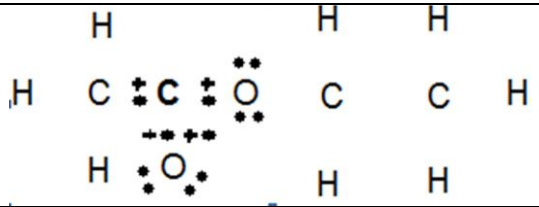
V = mRT/M_r P OR calculation of n followed by V = nRT/P OR expression with correctly inserted numbers✓

Evaluation of a given expression which has a maximum of 1 error/omission (= 0.01581.....)✓

answer to step 2 x10^6 expressed to 2sf (=16000 or 1.6x10^4)✓</td><td>3</td><td>e.g. 150000V = 1.045 x 8.314 x 273 scores first mark.

ALLOW calculation based on VT/P is constant and using value of 24.0 for molar volume at RTP (2sf)</td></tr>
</table>

Question			Answer	Marks	Guidance
	(c)	(i)	• temperature rise (or temperature before and after) mass/volume of water in beaker ✓ • energy = mc∆T (or descriptions substituted) ✓	2	**IGNORE** mass of fuel burned (or mass before and after) **ALLOW** 'shc' and 'theta' for ∆T **DO NOT ALLOW** 'm=mass of fuel' in the formula 'energy = mass of water x specific heat capacity x change in temperature of water' scores 2
		(ii)	Improvements with appropriate reasons ✓✓ *two from:* • install (draft) screens AW – reduce heat loss • lag (sides of) calorimeter – reduce heat loss • lid on calorimeter – reduce heat loss • use bomb calorimeter – avoid heat losses/(more) complete combustion • move burner closer to beaker – improve heat transfer • use copper calorimeter – improve heat transfer • move thermometer off bottom of beaker – more accurate ∆T • stir – improve even heat distribution • oxygen enriched atmosphere – more complete combustion	4	One mark for each improvement then the second mark for a valid explanation e.g. 'Lid reduces evaporation (of water)' scores 1 mark (improvement but not a valid reason)
	(d)		nitrogen and oxygen (from the air) combine/react/bond in the high temperature/heat (of the engine) ✓	1	**DO NOT ALLOW** answers saying that reaction happens in catalyser/exhaust. **DO NOT ALLOW** answers which state that either gas comes from the fuel **ALLOW** 'N (atoms)'; 'O (atoms)'
				15	

Question			Answer	Marks	Guidance
24	(a)	(i)	equal rates/speed	1	
	(b)	(i)	the ability/tendency of an <u>atom</u> (in a molecule) to attract electrons in a (chemical/covalent) bond	1	**ALLOW** 'how strongly...'; 'how easily...' AW **DO NOT ALLOW** 'ability of a nucleus.....' **DO NOT ALLOW** references to ionic bonding
		(ii)		1	Each lone pair should be two identical symbols; Bonding pairs between C and O must be two different symbols; The bonding pair between the two C's can be either identical or different.
		(iii)	120$^{(o)}$ ✓ <u>three</u> groups/regions/areas of electron(s) (density) ✓ (electrons) repel ✓ get as far away as possible ✓	4	**ALLOW** ecf between 1st and 2nd marking points: i.e. 4 *pairs*/groups etc and 104-110 **OR** 2 groups etc and 180 scores 1 of first 2 marking points **ALLOW** 'three regions of <u>negative</u> charge' Last two marks can be scored for any reference to electrons repelling as far as possible. **IGNORE** 'maximum repulsion' or 'repel as much as possible' 'minimise repulsion' scores last two marks
		(iv)	permanent (dipole) – permanent dipole	1	**ALLOW** minor spelling errors; 'pd-pd'
				8	

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