



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.

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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
/	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.

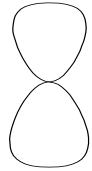
You should ensure that you have copies of these materials.

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

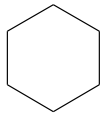
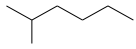
Q	Key
1	D
2	B
3	D
4	B
5	B
6	D
7	C
8	A
9	D
10	B
11	B
12	A
13	C
14	A
15	A
16	D
17	C
18	A
19	A
20	B

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 $(75.53 \times 35 + 24.47 \times 37)/100$ 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 1H 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 1H 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	

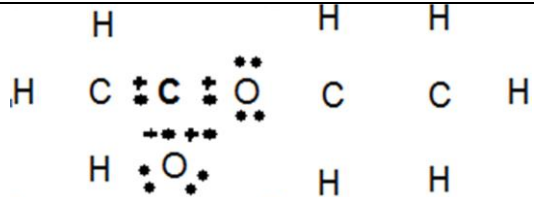
Question			Answer	Marks	Guidance
			OR 1000-1300 (cm^{-1}) AND CO		
			Total	10	

Question		Answer	Marks	Guidance
22	(a)	potassium sulfate ✓	1	ALLOW 'sulfate(VI)', 'sulphate' and 'K ₂ SO 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 4.91x10 ^{any other power} scores 1 2.96x10 ^{any other power} scores 2
	(c) (i)	Pb(NO ₃) ₂ + 2NaCl → PbCl ₂ + 2NaNO 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 ₂ CO 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 2 nd 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) → 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 ₂ O = 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 ₂ O or FeSO ₄ scores 1
		Total	17	

Question		Answer					Marks	Guidance	
23	(a)	fuel	name	skeletal formula	molecular formula	aliphatic or aromatic?	saturated or unsaturated?	3 For the name, IGNORE commas, dashes and spaces. ALLOW 'methly', 'metyl' and 'methy'	
		B	cyclohexane		C ₆ H ₁₂	aliphatic			saturated
		C	2-methylhexane		C ₇ H ₁₆	aliphatic			saturated
				✓	✓	✓			
	(b)	(i)	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)✓					2	+4131; (+)235; -9857 score 1
		(ii)	FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer = 1.6 x 10⁴/16000 cm³ award 3 marks $V = nRT/P$ 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 x 10 ⁶ expressed to 2sf (=16000 or 1.6x10 ⁴)✓					3	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)

Question		Answer	Marks	Guidance
	(c) (i)	<ul style="list-style-type: none"> • temperature rise (or temperature before and after) mass/volume of water in beaker ✓ • energy = $mc\Delta T$ (or descriptions substituted) ✓ 	2	<p>IGNORE mass of fuel burned (or mass before and after)</p> <p>ALLOW 'shc' and 'theta' for ΔT</p> <p>DO NOT ALLOW 'm=mass of fuel' in the formula</p> <p>'energy = mass of water x specific heat capacity x change in temperature of water' scores 2</p>
	(ii)	<p>Improvements with appropriate reasons ✓✓</p> <p><i>two from:</i></p> <ul style="list-style-type: none"> • 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 ΔT • stir – improve even heat distribution • oxygen enriched atmosphere – more complete combustion 	4	<p>One mark for each improvement then the second mark for a valid explanation</p> <p>e.g. 'Lid reduces evaporation (of water)' scores 1 mark (improvement but not a valid reason)</p>
	(d)	nitrogen and oxygen (from the air) combine/react/bond in the high temperature/heat (of the engine) ✓	1	<p>DO NOT ALLOW answers saying that reaction happens in catalyser/exhaust.</p> <p>DO NOT ALLOW answers which state that either gas comes from the fuel</p> <p>ALLOW 'N (atoms)'; 'O (atoms)'</p>
			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)	<p>120^(o) ✓</p> <p><u>three</u> groups/regions/areas of electron(s) (density) ✓</p> <p>(electrons) repel ✓ get as far away as possible ✓</p>	4	ALLOW ecf between 1 st and 2 nd marking points: i.e. 4 <i>pairs</i> /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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