GCE

Chemistry B (Salters)

Unit F331: Chemistry for Life

Advanced Subsidiary GCE

Mark Scheme for June 2015
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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.

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Annotations used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

<table>
<thead>
<tr>
<th>Annotation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>/</td>
<td>alternative and acceptable answers for the same marking point</td>
</tr>
<tr>
<td>✓</td>
<td>separates marking points</td>
</tr>
<tr>
<td>not</td>
<td>answers which are not worthy of credit and which will CON a correct answer</td>
</tr>
<tr>
<td>ignore</td>
<td>statements which are irrelevant and will NOT ‘CON’ a correct answer</td>
</tr>
<tr>
<td>allow</td>
<td>answers that can be accepted</td>
</tr>
<tr>
<td>( )</td>
<td>words which are not essential to gain credit</td>
</tr>
<tr>
<td>__</td>
<td>underlined words must be present in answer to score a mark</td>
</tr>
<tr>
<td>ecf</td>
<td>error carried forward</td>
</tr>
<tr>
<td>AW</td>
<td>alternative wording (replaces the old ‘or words to that effect’)</td>
</tr>
<tr>
<td>ora</td>
<td>or reverse argument</td>
</tr>
</tbody>
</table>

Annotations used in scoris:

<table>
<thead>
<tr>
<th>Annotation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>correct response</td>
</tr>
<tr>
<td>✗</td>
<td>incorrect response</td>
</tr>
<tr>
<td>bod</td>
<td>benefit of the doubt</td>
</tr>
<tr>
<td>nbod</td>
<td>benefit of the doubt not given</td>
</tr>
<tr>
<td>ECF</td>
<td>error carried forward</td>
</tr>
<tr>
<td>^</td>
<td>information omitted</td>
</tr>
<tr>
<td>I</td>
<td>Ignore</td>
</tr>
<tr>
<td>R</td>
<td>Reject</td>
</tr>
<tr>
<td>BP</td>
<td>blank page</td>
</tr>
</tbody>
</table>

Subject-specific Marking Instructions that apply across the whole question paper to be included here.

Use a ✓ for every correct answer where it is scored. Use BP for blank additional sheets. Don’t forget to use the chain(link) symbol where answers are on additional sheets.
## MARK SCHEME

<table>
<thead>
<tr>
<th>Question 1</th>
<th>Answer</th>
<th>Mark</th>
<th>Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td>Isotope</td>
<td>Number of protons</td>
<td>Number of neutrons</td>
</tr>
<tr>
<td>28Si</td>
<td>14</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>29Si</td>
<td>14</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>30Si</td>
<td>14</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b i | stage 2: ionisation
stage 3: acceleration
stage 4: drift(ing) (region) ✓ | 1 | MUST be in correct order
ALLOW ‘flight’ or ‘flight zone’ or ‘flight path’ for ‘drift’
IGNORE ‘time of flight’

b ii | positive ions OR cations ✓
accelerated to same Kinetic Energy ✓
therefore if mass small then velocity/speed large ora
OR ‘KE = 0.5mv²’ ✓ | 3 | ‘ions’ can be implied
QWC kinetic must be spelled correctly once
IGNORE reference to size
IGNORE wrong expressions for KE
ALLOW in terms of take less/more time to reach detector for 3rd m p.

b iii | (20.55x70)+(27.37x72)+(7.67x73)+(36.74x74)+(7.67x76) + 100 ✓
72.7 ✓ | 2 | Correct answer on answer line scores both marks;

b iv | Evidence of use of graph ✓
1.6 – 2(0) | 2 | First mark for working shown on graph. Could be best fit curve/construction lines or marks on the x axis
### Question 1

<table>
<thead>
<tr>
<th></th>
<th>Answer</th>
<th>Mark</th>
<th>Guidance</th>
</tr>
</thead>
</table>
| b | $^{76}_{32}Ge \rightarrow 2 -1\beta + ^{76}_{34}Se$ ✓ ✓ | 2 | ALLOW ecf on second mark if only 1 beta particle
ALLOW: – (minus) beta particles on left hand side of equation
ALLOW e symbol instead of β but DO NOT ALLOW e$^-$
Correct answer but with any superscripts / subscripts on right of symbols scores one mark
ALLOW just – instead of -1 for subscript on beta
Allow two stage process through As
IGNORE gamma decay
No beta decay, no mark |
<table>
<thead>
<tr>
<th>c i</th>
<th>Particle</th>
<th>Relative Mass</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>proton</td>
<td>1</td>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>neutron</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>electron</td>
<td>negligible OR zero OR 1/2000</td>
<td>-1</td>
<td></td>
</tr>
</tbody>
</table>
|   | ✓ | 1 | ALLOW other alternatives for relative mass of an electron
IGNORE + before relative mass but minus is con
Allow signs before or after the number
ALLOW between 1/1800-2000 (0.0005-0.0006)
IGNORE (very) small |
| c ii | 2, 8, 18, 4 ✓ | 1 | ALLOW 1s$^2$2s$^2$2p$^6$3s$^2$3p$^6$3d$^{10}$ 4s$^2$ 4p$^2$
NOT [Ar] 3d$^{10}$ 4s$^2$ 4p$^2$
ALLOW 4s and 3d reversed in full structure |
| d | Without gap properties of elements did not match ✓ | 1 | Answer should imply properties of known elements not fitting
Reference to atomic number is a CON because the question concerns what Mendeleev knew. |
| e | period: number of occupied shells/how many shells of electrons ✓
group: number of electrons in outer shell/valence electrons/outer electron structure ✓ | 2 | NOT number of highest filled shell
NOT number of outer shells
ALLOW energy level for shell |
<table>
<thead>
<tr>
<th>Question 2</th>
<th>Answer</th>
<th>Mark</th>
<th>Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 a i</td>
<td>(2x - 286) – (2x - 188) ✓</td>
<td>2</td>
<td>Answers of -196 score 2 without reference to working</td>
</tr>
<tr>
<td></td>
<td>-196 ✓</td>
<td></td>
<td>Answers of -98 (omitting 2s) score 1, no other ecf</td>
</tr>
<tr>
<td>a ii</td>
<td>H₂(g) + ½O₂(g) → H₂O(l)</td>
<td>2</td>
<td><strong>ALLOW</strong> state symbols mark for: 2H₂(g) + O₂(g) → 2H₂O(l) But zero for any other equation</td>
</tr>
<tr>
<td></td>
<td>Correct balanced equation ✓</td>
<td></td>
<td><strong>SECOND</strong> mark for correct state symbols on correct balanced equation ✓</td>
</tr>
<tr>
<td>a iii</td>
<td>On right (product side) there are more moles/molecules/particles ✓</td>
<td>2</td>
<td><strong>IGNORE</strong> ‘more products’</td>
</tr>
<tr>
<td></td>
<td>gas on right/gases have more entropy/gas product <strong>AW ✓</strong></td>
<td></td>
<td><strong>ALLOW</strong> state symbols mark for: 2H₂(g) + O₂(g) → 2H₂O(l) But zero for any other equation</td>
</tr>
<tr>
<td>b</td>
<td>moles H₂O₂ = 90/34 (= 2.65) ✓</td>
<td>3</td>
<td><strong>ALLOW</strong> ecf including ecf from rounding</td>
</tr>
<tr>
<td></td>
<td>3/2 x 2.65 (=3.97) moles of product ✓</td>
<td></td>
<td>Answers based on 2.779 x 10² score 3</td>
</tr>
<tr>
<td></td>
<td>70 x calculated number of moles and evaluated ✓</td>
<td></td>
<td>Answers based on 1.853 x 10² score 2</td>
</tr>
<tr>
<td></td>
<td><strong>ALLOW</strong> 2 or more sf</td>
<td></td>
<td>Answers based on 5.565 x 10² score 2</td>
</tr>
<tr>
<td></td>
<td>Answers based on 95.28 (use of 24 not 70) score 2</td>
<td></td>
<td><strong>ALLOW</strong> 2 or more sf</td>
</tr>
<tr>
<td>c i</td>
<td>aliphatic: no benzene ring(s) <strong>OR</strong></td>
<td>1</td>
<td>Reference to no rings in aliphatic is a <strong>CON</strong></td>
</tr>
<tr>
<td></td>
<td>aromatic: benzene/C₆H₆ rings/arenes ✓</td>
<td></td>
<td><strong>ALLOW</strong> multiples</td>
</tr>
<tr>
<td>c ii</td>
<td>C₁₀H₂₂ + 15½O₂ → 10CO₂ + 11H₂O</td>
<td>1</td>
<td><strong>ALLOW</strong> multiples</td>
</tr>
<tr>
<td>c iii</td>
<td>contains a double/triple bond <strong>OR</strong> C=C <strong>OR</strong> C≡C ✓</td>
<td>1</td>
<td><strong>ALLOW</strong> not all bonds are single</td>
</tr>
<tr>
<td>c iv</td>
<td>act as catalyst/speed up reaction/reduce activation energy <strong>OR</strong></td>
<td>1</td>
<td><strong>IGNORE</strong> act as molecular sieves/separate straight chains from branched chains</td>
</tr>
<tr>
<td></td>
<td>large surface area for reaction <strong>✓</strong></td>
<td></td>
<td><strong>ALLOW</strong> no carbon emissions/particulates/SOₓ</td>
</tr>
<tr>
<td></td>
<td><strong>NOT</strong> less CO etc</td>
<td></td>
<td><strong>IGNORE</strong> H₂O₂ only produces water/reference to greenhouse gases/global warming</td>
</tr>
<tr>
<td>d</td>
<td>Produces no CO₂/CO ✓</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Question 3</td>
<td>Answer</td>
<td>Mark</td>
<td>Guidance</td>
</tr>
<tr>
<td>-----------</td>
<td>--------</td>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td>3 a i</td>
<td>homologous series: ethers ✓</td>
<td>2</td>
<td>ALLOW alkoxyalkane for ether</td>
</tr>
</tbody>
</table>
| a ii     | butan-2-ol ✓  
C₄H₁₀O ✓ | 2 | Atoms in any order  
DO NOT ALLOW C₄H₉OH  
DO NOT ALLOW but-2-ol  
IGNORE dashes, brackets, commas |
| a iii    | Bond/atoms coming out of/above the plane of the paper/towards you ✓ | 1 | IGNORE vague statements of 3D  
NOT molecule coming out of the page |
| b        | NO/NO₂/N₂O₄ ✓  
reaction/combustion/bonding/combining of nitrogen and oxygen in air/atmosphere ✓  
at high temperatures/hot conditions/intense heat (in engine) ✓ | 3 | NOT NOₓ  
ALLOW correct formulae for second mark (N₂/O₂)  
ALLOW ONE of nitrogen and oxygen being stated as ‘from the air’ as long as there is not a CON e.g. ‘nitrogen from the fuel’.  
ALLOW ‘Oxidation of nitrogen in the air’  
NOT ‘in exhaust’  
NOT just ‘heat (in the engine)’  
IGNORE ‘extreme’ |
| c        | 2N₂O → 2N₂ + O₂ ✓ | 1 | ALLOW halved/multiples  
IGNORE state symbols |
| d i      | Reforming AND hydrogen ✓ | 1 | ALLOW reformation/reform  
ALLOW H₂ but IGNORE H |
<table>
<thead>
<tr>
<th>Question 3</th>
<th>Answer</th>
<th>Mark</th>
<th>Guidance</th>
</tr>
</thead>
</table>
| d ii      | carbons have four electron pairs/groups/sets OR carbons have four regions of electron density ✓  
repel to get as far apart as possible/minimise electronic energy ✓  
(predicted bond angles) of 109 (108-110) ✓  
CCC bond angle in cyclopropane less/smaller than 109 OR is 60 ✓ | 4    | 2<sup>nd</sup> marking point must be in terms of electrons (ignore bonds)  
NOT ‘as much as possible’ unless qualified with minimise  
Any angle quoted which is not 60 is con  
‘Smaller/less’ only scores if predicted angle has been stated as 108-110 |
| d iii     | energy required to break one mole of bond ✓  
differs (for same bond) in different compounds/molecular environments/types of molecule/AW ✓ | 2    | NOT ‘different molecules’                                                                                                                                                                                  |

16
<table>
<thead>
<tr>
<th>Question 4</th>
<th>Answer</th>
<th>Mark</th>
<th>Guidance</th>
</tr>
</thead>
</table>
| 4 a i | in the same group/forms 2+ ions/same charge ✓ | 1 | ALLOW similar size ions
ALLOW statement that they are (both) in group 2
IGNORE references to reactivity |
| a ii | ![Sr diagram](image) | 2 | One mark for each completely correct ion
ALLOW Sr surrounded by eight electrons
ALLOW any distribution of 6 + 2 electrons on oxygen as long as the 2 electrons match any shown on the Sr
ALLOW signs before numbers
Two correct ions with incorrect/no charges scores 1
Square brackets not essential if clearly ionic
Circle not required around O |
| a iii | (a) energy absorbed/ heating causes electrons go into / promoted/up/excited to higher energy levels ✓
(b) drop back emitting energy as light/photons/em (radiation) ✓
(c) energy levels/gaps are quantised/discrete
(d) energy is proportional to frequency/E= hf/E= hv ✓
(e) (spectra are unique) because (different) elements have different/ unique (gaps between) energy levels/AW ✓ | 5 | NOT by photon/light/em radiation unqualified
ALLOW ‘shells’ for energy levels
NOT simply ‘radiation’
Marking point (c) can be scored from a labelled diagram showing y axis as E/energy/energy levels as label, or labelled Bohr diagram.
“Shells” must be qualified by “energy levels” somewhere in the answer to score marking point (e) |
| b i | Any two from:
Fixed amount/moles of carbonate ✓
same temperature/heating conditions ✓
Same volume/amount/concentration of lime water ✓ | 2 | IGNORE mass of carbonate
IGNORE moles of ‘substance’ |
| b ii | lime water goes cloudy/milky ✓
observation seen sooner with calcium (carbonate) ora ✓ | 2 | ALLOW quicker bubbling/more cloudy/ more gas with calcium for second mark
IGNORE any reference to colour of residue |
| c | SiO$_3$$^{2-}$ ✓ ✓
One mark for any negative ion containing only Si and O; | 2 | ALLOW SiO$_4$$^{4-}$ |