Mark Scheme (Results)

January 2018

Pearson Edexcel International Advanced Level In Chemistry (WCH01) Paper 01 The Core Principles Of Chemistry

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Section A (multiple choice)

Question Number	Correct Answer	Mark
1	**The only correct answer is B** ***A*** *is not correct because this area is for ionisation* ***C*** *is not correct because this area is for deflection* ***D*** *is not correct because this area is for detection*	**(1)**

Question Number	Correct Answer	Mark
2	**The only correct answer is D** ***A*** *is not correct because this is for the +3 ion* ***B*** *is not correct because this is for the +2 ion* ***C*** *is not correct because this is for the atom*	**(1)**

Question Number	Correct Answer	Mark
3(a)	**The only correct answer is C** ***A*** *is not correct because this is an s block element* ***B*** *is not correct because this is a d block element* ***D*** *is not correct because this has 4 electrons in its p subshell*	**(1)**

Question Number	Correct Answer	Mark
3(b)	**The only correct answer is B** ***A*** *is not correct because W bonding type is incorrect* ***C*** *is not correct because WZ does not have covalent bonding* ***D*** *is not correct because Z is not ionic and WZ is not covalent*	**(1)**

Question Number	Correct Answer	Mark
4(a)	**The only correct answer is C** ***A*** *is not correct because this percentage is only for 3 oxygen atoms* ***B*** *is not correct because this percentage is only for 5 oxygen atoms* ***D*** *is not correct because this percentage uses 279.4 instead of 297.4*	**(1)**

Question Number	Correct Answer	Mark
4(b)	**The only correct answer is D** ***A*** *is not correct because this is only for one ion* ***B*** *is not correct because this is only for two ions* ***C*** *is not correct because this is only for three ions*	**(1)**

Question Number	Correct Answer	Mark
4(c)	**The only correct answer is D** ***A*** *is not correct because there are two moles of carbonate requiring neutralisation and not ½ mol* ***B*** *is not correct because there are two moles of carbonate requiring neutralisation and not one mol* ***C*** *is not correct because there are two moles of carbonate requiring neutralisation and not 1½ mol*	**(1)**

Question Number	Correct Answer	Mark
5	**The only correct answer is B** ***A*** *is not correct because the 4:6 ratio has been omitted* ***C*** *is not correct because the wrong ratio of 4:1 has been used* ***D*** *is not correct because the '4' of the 4:6 ratio has not been used*	**(1)**

Question Number	Correct Answer	Mark
6	**The only correct answer is C** ***A*** *is not correct because the number of moles 0.394 has been incorrectly divided by four and then used* ***B*** *is not correct because the wrong number of moles, 0.100, has been used* ***D*** *is not correct because 0.100 has been multiplied by four to give 0.400 and then used instead of the limiting 0.394 mol*	**(1)**

Question Number	Correct Answer	Mark
7	**The only correct answer is B** **A** is not correct because lithium has weaker bonding than boron **C** is not correct because nitrogen is a gas **D** is not correct because neon is a gas	**(1)**

Question Number	Correct Answer	Mark
8	**The only correct answer is A** ***B*** *is not correct because gloves do not lower the risk of a gas* ***C*** *is not correct because goggles do not lower the risk of a gas* ***D*** *is not correct because this is not the best way to reduce the risk but exposes more to it*	**(1)**

Question Number	Correct Answer	Mark
9	**The only correct answer is B** **A** is not correct because this is ionic bonding **C** is not correct because this is covalent bonding **D** is not correct because this is dative covalent bonding	**(1)**

Question Number	Correct Answer	Mark
10	**The only correct answer is A** ***B*** *is not correct because these are the spectator ions* ***C*** *is not correct because this equation includes the spectator ions* ***D*** *is not correct because this equation includes the spectator ions*	**(1)**

Question Number	Correct Answer	Mark
11(a)	**The only correct answer is C** ***A*** *is not correct because this is 50.5 as a percentage of all of the molar masses in the equation* ***B*** *is not correct because this is the atom economy for the production of hydrogen chloride instead of chloromethane* ***D*** *is not correct because this is 50.5 divided by the molar mass of chlorine*	**(1)**

Question Number	Correct Answer	Mark
11(b)	**The only correct answer is C** ***A*** *is not correct because this is the number of moles of the product times by one hundred* ***B*** *is not correct because this is the number of moles of the reactant times by one hundred* ***D*** *is not correct because this is the reactant mass as a percentage of the product mass*	**(1)**

Question Number	Correct Answer	Mark
11(c)	**The only correct answer is A** ***B*** *is not correct because there is no unpaired electron on the carbon* ***C*** *is not correct because this is the methane molecule* ***D*** *is not correct because this is the methyl anion*	**(1)**

Question Number	Correct Answer	Mark
12	**The only correct answer is A** ***B*** *is not correct because the* ΔH_3 *should be subtracted not added* ***C*** *is not correct because the enthalpy values should not be halved* ***D*** *is not correct because enthalpy values should not be halved nor added*	**(1)**

Question Number	Correct Answer	Mark
13	**The only correct answer is C** ***A*** *is not correct because this is the use of only 3x N-H instead of 6x* ***B*** *is not correct because this is the use of 2x N≡N instead of 1x* ***D*** *is not correct because this is the use of only 2x H-H instead of 3x*	**(1)**

Question Number	Correct Answer	Mark
14	**The only correct answer is C** ***A*** *is not correct because* there will be significant heat loss ***B*** *is not correct because* there will be significant heat loss ***D*** *is not correct because* there will be significant heat loss	**(1)**

Question Number	Correct Answer	Mark
15	**The only correct answer is D** ***A*** *is not correct because the blue copper ions move towards the cathode* ***B*** *is not correct because the blue copper ions move towards the cathode and there are no yellow ions* ***C*** *is not correct because the sulfate ions are colourless and not yellow*	**(1)**

(TOTAL FOR SECTION A = 20 MARKS)

Section B

Question Number	Acceptable Answers	Reject	Mark
16(a)(i)	(Different) boiling temperatures / boiling points IGNORE Chain length/intermolecular forces/ mass of alkane		**(1)**

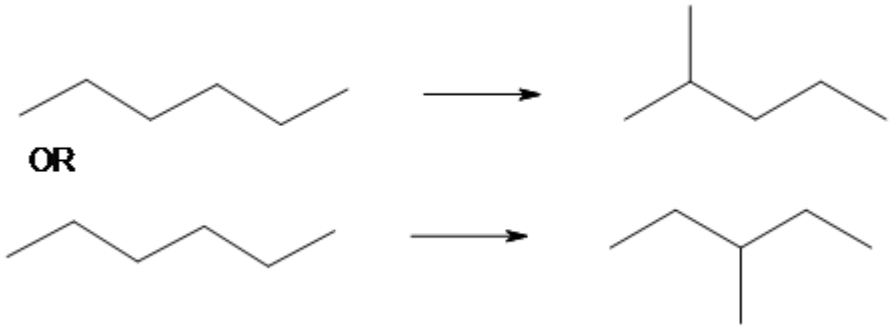
Question Number	Acceptable Answers	Reject	Mark
16(a)(ii)	Methane/ethane/propane/butane/methylpropane ALLOW Formulae CH_4/ C_2H_6/ C_3H_8 /C_4H_{10} If name and formula given then both must be correct IGNORE Refinery gas / natural gas / fuel gas / LPG		**(1)**

Question Number	Acceptable Answers	Reject	Mark
16(a)(iii)	Insufficient petrol obtained (from fractional distillation)/ Not enough petrol is obtained to meet demand / other fractions are surplus to requirements ALLOW There is a high demand for petrol / other fractions are less useful IGNORE Higher yield / references to cost		**(1)**

Question Number	Acceptable Answers	Reject	Mark
16(b)(i)	High temperature / Heat ALLOW Any value(s) ≥150°C IGNORE Pressure / steam / exclusion of oxygen / just 'temperature'	Warm UV light High Melting / boiling temp	**(1)**

Question Number	Acceptable Answers	Reject	Mark
16(b)(ii)	$C_{12}H_{26} \rightarrow C_8H_{18} + 2C_2H_4$ Correct formulae (1) Balancing of correct formulae (1) IGNORE State symbols even if incorrect / any conditions above arrow		**(2)**

Question Number	Acceptable Answers	Reject	Mark
16(c)(i)	Burns more 'smoothly'/ reduces/prevents 'knocking/pinking/pre-ignition' OR Has a higher octane rating ALLOW Burns more efficiently / burns more easily IGNORE references to incomplete combustion /less flammable / cleaner combustion / releases more energy		**(1)**

Question Number	Acceptable Answers	Reject	Mark
16(c)(ii)	 OR **MP1** Skeletal formula for hexane (1) **MP2** Skeletal formula for 2-methylpentane or 3-methylpentane (1) **MP3** Correct product name (1) ALLOW One mark for **MP1** and **MP2** if non-skeletal formulae used		**(3)**

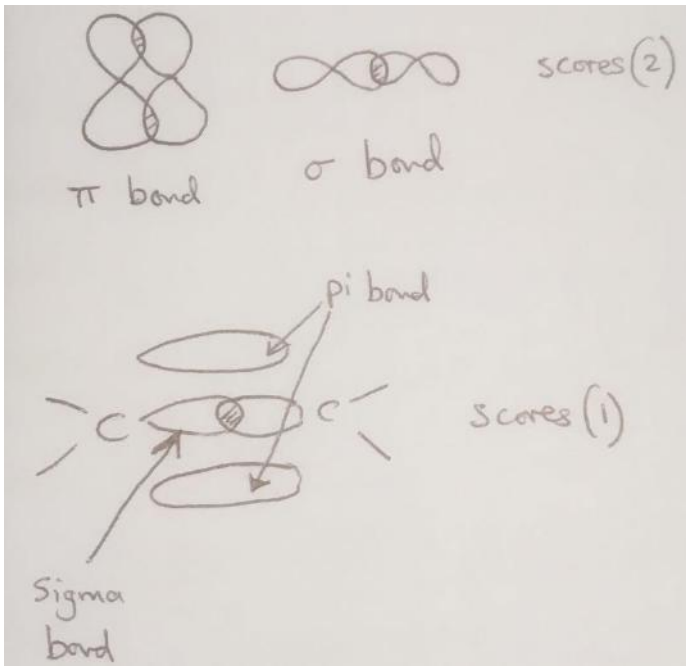
Question Number	Acceptable Answers	Reject	Mark
16(c)(iii)	(+) H_2/H−H IGNORE State symbols, even if incorrect	2H / $2H_2$ / $3H_2$ etc.	**(1)**

Question Number	Acceptable Answers	Reject	Mark
16(d)(i)	**MP 1** (multiplication by 10) $m(C_5H_{12})$ =0.626 x 10 = 6.26 (g) (1) **MP 2** (division by 72) $n(C_5H_{12})$ = 6.26 ÷ 72 = 0.08694…. (mol) (1) **MP 3** (multiplication by 5) $n(CO_2)$ = 5 x 0.08694….= 0.43472… (mol) (1) **MP 4** (multiplication by 24000 and to 3SF) $V(CO_2)$ = 0.43472… x 24000 = 10433.333 cm^3 = 10400 (cm^3) / 10.4 dm^3 Answer must be to 3SF (1) Correct answer without working scores (4) TE throughout		**(4)**

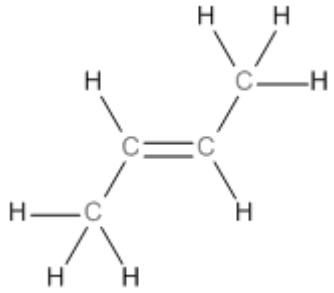
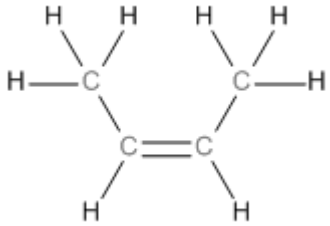
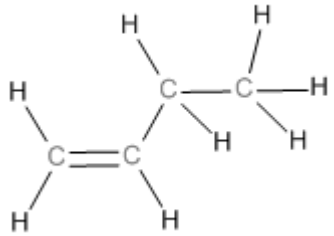
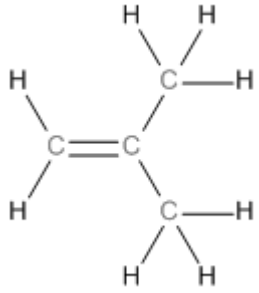
Question Number	Acceptable Answers	Reject	Mark
16(d)(ii)	$C_5H_{12} + 5½O_2 \rightarrow 5CO + 6H_2O$ Allow multiples IGNORE State symbols even if incorrect		**(1)**

Question Number	Acceptable Answers	Reject	Mark
***16(e)**	Non-renewable means that it is a finite resource/it takes millions of years to produce/ it will 'run out' / being used up faster than it is made ALLOW Not a sustainable resource (1) IGNORE Just 'it's not renewable' / 'can't be made again' Impact on climate change: (Increase in) global warming due to (increase in) CO_2 emissions OR (Increased) CO_2 causes stated effect of global warming, e.g. melting of polar ice caps/rise in sea levels/disrupted weather patterns OR (Increased) CO_2 absorbs infrared / traps heat (1) IGNORE Reference to acid rain / references to water Reference to methane production / greenhouse effect	Only be used once ozone layer UV light absorption CO / carbon monoxide	**(2)**

(Total for Question 16 = 18 marks)

Question Number	Acceptable Answers	Reject	Mark
17(a)(i)	A sigma bond has a single area of orbital overlap **and** a pi bond has two areas of orbital overlap (1) A sigma bond has axial/end-on/head-on /direct/horizontal overlap **and** a pi bond has lateral/sideways/parallel overlap (1) These points can be awarded for suitable labelled diagrams for example  ALLOW two correct statements from the list above about either sigma or pi bonds for (1) IGNORE Reference to the extent of overlap		**(2)**

Question Number	Acceptable Answers	Reject	Mark
17(a)(ii)	Lack of rotation (about the bond)/ restricted rotation (about the bond)/ barrier to rotation (about the bond) ALLOW No rotation (about the bond) IGNORE References to the groups attached to the double bond	Lack of molecular rotation	**(1)**

<table>
<tr><th>Question Number</th><th colspan="2">Acceptable Answers</th><th>Reject</th><th>Mark</th></tr>
<tr><td rowspan="3">17(a)(iii)</td><td>E isomer
 
(1)</td><td>Z isomer
 
(1)</td><td rowspan="3">(2-)methylprop-2-ene</td><td rowspan="3">(4)</td></tr>
<tr><td>Either
 
OR
 
(1)</td><td>But-1-ene

OR

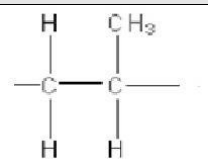
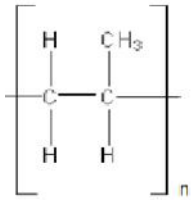
(2-)methylpropene

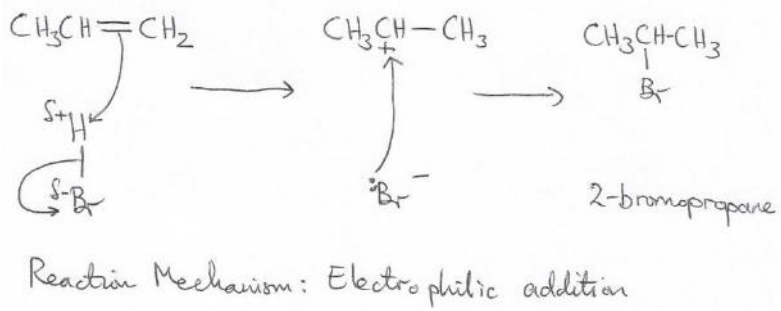
ALLOW
(2-)methylprop-1-ene (1)</td></tr>
<tr><td colspan="2">ALLOW
Skeletal formulae
Non-displayed CH_3/CH_3CH_2/C_2H_5

Award one mark out of two if E-Z isomers are drawn the wrong way round

ALLOW
MP4 can be awarded for the name of correct structure with minor error in MP3 e.g. missing H atom / extra H atom
MP4 can be awarded for the correct name if no structure has been drawn for MP3</td></tr>
</table>

Question Number	Acceptable Answers	Reject	Mark
17(b)(i)	Answers reading clockwise from top left: ALLOW Skeletal/displayed formulae $CH_3CHBrCH_2Br$ (1) H_2 **and** Ni/ Pt OR Hydrogen **and** Nickel/Platinum (1) $CH_3CH(OH)CH_2OH$ (1) IGNORE Names for organic species even if incorrect	$CH_2BrCH_2CH_2Br$ $CH_2OHCH_2CH_2OH$	**(3)**

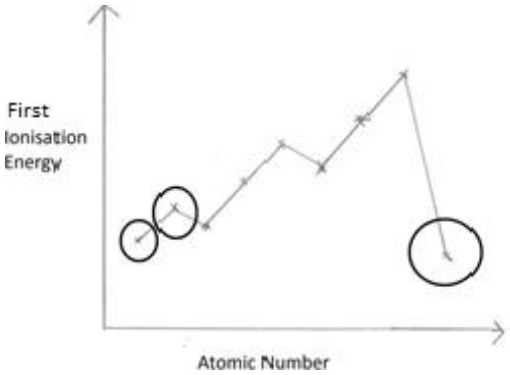
Question Number	Acceptable Answers	Reject	Mark
17(b)(ii)	 ALLOW  The methyl group can be displayed, given on either carbon of the repeat unit and drawn either on the top or the bottom Two or more correct repeat units		**(1)**

Question Number	Acceptable Answers	Reject	Mark
17(c)	Reaction mechanism, e.g.  **MP1** Curly arrow from C=C in correctly drawn propene to ($^{s+}$)H (1) **MP2** H−Br dipole **and** curly arrow from H−Br bond to Br or just beyond (1) **MP3** Structure of carbocation (1) **MP4** Curly arrow from lone pair on bromide **ion** to C+ **and** correct structure of product (1) **MP5** Reaction mechanism: Electrophilic addition (1) **MP6** Name of product: 2-bromopropane (1) Penalise formation of minor product 1-bromopropane in MP3 only	'Spare' bond on C+	**(6)**

(Total for Question 17 = 17 marks)

Question Number	Acceptable Answers	Reject	Mark
18(a)	In one mole (of atoms) / per mole (of atoms) (1) In the gaseous state ALLOW Reference to gaseous ions (1) IGNORE Any equations		**(2)**

Question Number	Acceptable Answers	Reject	Mark
18(b)	To overcome the (electrostatic) attraction/force of the nucleus/protons for the electron(s) IGNORE Just 'energy is needed' Just 'overcome the attraction'		**(1)**

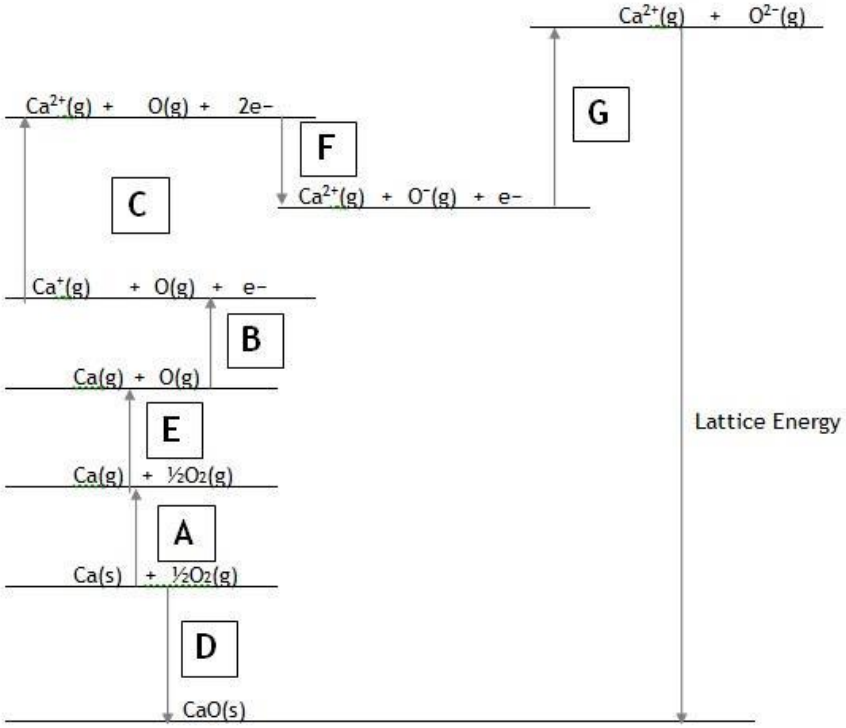
Question Number	Acceptable Answers	Reject	Mark
18(c)(i)	Sketch encircled, e.g.  Circle of the last cross to the right (1) Circles of the first two crosses on the left ALLOW One circle around both crosses on the left (1) Three correct circles and one incorrect scores one.		**(2)**

Question Number	Acceptable Answers	Reject	Mark
18(c)(ii)	Single figure of eight shape in any orientation, e.g.  IGNORE Any axes given	2 or 3 orbitals on the same diagram	**(1)**

Question Number	Acceptable Answers	Reject	Mark
***18(d)**	(Gradual) increase in first three ionisation energies (1) Big jump from third to fourth ionisation energy (so it is in Group 3) (1)		**(2)**

Question Number	Acceptable Answers	Reject	Mark
18(e)	Electrons (in the same orbital) repel each other/ repulsion is minimised ALLOW To avoid/prevent repulsion / so there is no repulsion (between electrons) OR (Electron) pairing causes repulsion IGNORE Just 'energetically more favourable' Just 'Hund's Rule'		**(1)**

(Total for Question 18 = 9 marks)

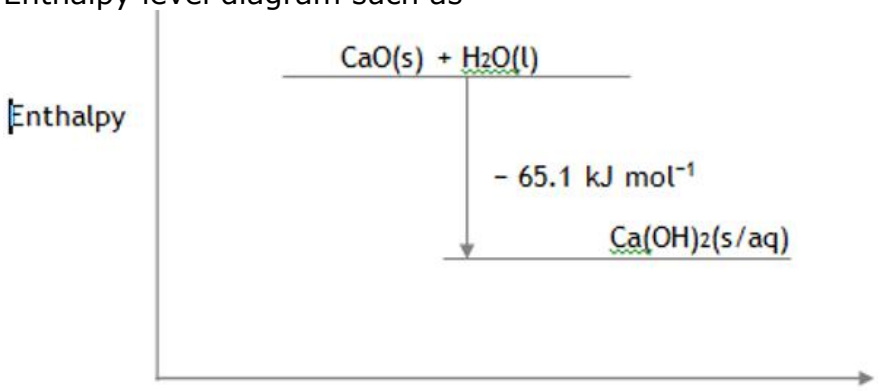
Question Number	Acceptable Answers	Reject	Mark
19(a)	Diagram similar to:  Arrows upwards for first and second ionization energies for calcium and correct labels B and C in boxes (1) Arrow downwards for first electron affinity of oxygen and arrow upwards for second electron affinity of oxygen **and** correct labels F and G in boxes (1) Correct entities and state symbols on horizontal lines ALLOW Omission of negative sign on electrons / inclusion of (g) for electrons (1)		**(1)**

Question Number	Acceptable Answers	Reject	Mark
19(b)	(U = −(635+178 +249+590+1145−141+798=) −3454 kJ mol^{-1} Correct answer scores (2) ALLOW one mark for −2184 kJ mol^{-1} OR −3736 kJ mol^{-1} OR (+)3454 kJ mol^{-1}		**(2)**

Question Number	Acceptable Answers	Reject	Mark
***19(c)**	(Theoretical lattice energies are calculated using an ionic model) The bonding in CaO is (almost purely/100%) ionic (1) The bonding in CaI_2 is partially covalent (1) The iodide (anion) is larger (than the oxide anion) (1) The iodide (anion) is (more) polarised (by the calcium ion) / the electron cloud is (more easily) distorted (by the calcium ion, resulting in a more negative lattice energy) ALLOW So the bonding is stronger than expected (in CaI_2) (1)	Just 'covalent' Atomic radius Weaker bond	**(4)**

Question Number	Acceptable Answers	Reject	Mark
19(d)(i)	**MP1** (calculation of Q) Q =(200 x 4.18 x 40=) 33440 (J) ALLOW 33.44 **kJ** (1) IGNORE Any sign given **MP2** (division by enthalpy change) n= (33440 ÷ 65100=) 0.51367 …… (mol) (1) **MP3** (multiplication by molar mass) m = (0.51367 … x 56.1=) 28.817 …/28.82/ 28.8 (g) (1) Correct answer with or without working scores (3) IGNORE SF except 1 SF but penalise once only ALLOW TE throughout		3

Question Number	Acceptable Answers	Reject	Mark
19(d)(ii)	To keep the drink at the required temperature/to minimise heat loss ALLOW To keep the drink hot/warm (1) To allow the can to be handled safely ALLOW To prevent hands from being burnt (1)		**(2)**

Question Number	Acceptable Answers	Reject	Mark
19(d)(iii)	Enthalpy level diagram such as  There are four requirements for the two marks: • Arrow downwards with −65.1 (kJ mol^{-1}) ALLOW Double-ended arrow/arrow that goes down but does not go exactly from the reactant line to the product line IGNORE Activation energy hump and labels even if incorrect • Y axis label ALLOW Energy for enthalpy • Reactant and product formulae • Reactant and product state symbol 4 correct scores 2 marks 2 or 3 correct scores 1 mark 1 correct scores 0 mark	Enthalpy change / ΔH / heat Additional compounds	**(2)**

(Total for Question 19 = 16 marks)

(TOTAL FOR SECTION B = 60 MARKS)

TOTAL FOR PAPER = 80 MARKS