Pearson

Mark Scheme (Results)

Summer 2017

Pearson Edexcel GCE
in Chemistry (6CH01) Paper 01
The Core Principles of Chemistry

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Summer 2017
Publications Code 6CH0_01_1706_MS

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.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate

Using the mark scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication
Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Section A (multiple choice)

Question Number	Answer	Mark
1	**1.The only correct answer is D** ***A*** *is not correct because this is parts per 1000* ***B*** *is not correct because this is parts per 10000* ***C*** *is not correct because this is parts per 100000*	**(1)**

Question Number	Answer	Mark
2	**2.The only correct answer is C** ***A*** *is not correct because ionization involves impact with a high energy electron* ***B*** *is not correct because positive ions are formed* ***D*** *is not correct because ionization involves impact with a high energy electron & positive ions are formed*	**(1)**

Question Number	Answer	Mark
3	**3. The only correct answer is B** ***A*** *is not correct because this is the mass of one isotope* ***C*** *is not correct because this is a mean without weighting* ***D*** *is not correct because this is the mass of one isotope*	**(1)**

Question Number	Answer	Mark
4	**4. The only correct answer is D** ***A*** *is not correct because* isoelectronic does not relate to mass ***B*** *is not correct because* isoelectronic does not relate to Z ***C*** *is not correct because* this is true for a negative ion	**(1)**

Question Number	Answer	Mark
5	**5. The only correct answer is D** ***A*** *is not correct because this has two unpaired electrons* ***B*** *is not correct because this has three unpaired electrons* ***C*** *is not correct because this has two unpaired electrons*	**(1)**

Question Number	Answer	Mark
6	**6. The only correct answer is A** ***B*** *is not correct because this uses 4 atoms per molecule* ***C*** *is not correct because this counts types of atoms only* ***D*** *is not correct because this is the number of molecules*	**(1)**

Question Number	Answer	Mark
7	**7. The only correct answer is C** **A** is not correct because it could be covalent **B** is not correct because it could be ionic **D** is not correct because it must be a compound	**(1)**

Question Number	Answer	Mark
8	**8. The only correct answer is A** ***B*** *is not correct because there must be electron density between the atoms* ***C*** *is not correct because these are antibonding orbitals* ***D*** *is not correct because it shows no overlap of orbitals*	**(1)**

Question Number	Answer	Mark
9	**9. The only correct answer is A** ***B*** *is not correct because this uses AuO not* Au_2O_3 ***C*** *is not correct because this uses* Au_3O_2 *not* Au_2O_3 ***D*** *is not correct because this uses* Au_3O *not* Au_2O_3	**(1)**

Question Number	Answer	Mark
10	**10. The only correct answer is B** ***A*** *is not correct because this omits the residual CO* ***C*** *is not correct because this uses 800 cm^3 of CO_2 and 500 cm^3 of N_2 only* ***D*** *is not correct because T & P are the same for all measurements*	**(1)**

Question Number	Answer	Mark
11(a)	**11(a). The only correct answer is C** ***A*** *is not correct because the reaction does not involve redox so not a displacement* ***B*** *is not correct because the reaction is not a neutralization* ***D*** *is not correct because the reaction does not involve redox*	**(1)**

Question Number	Answer	Mark
11(b)	**11(b). The only correct answer is B** ***A*** *is not correct because this the ratio of molar masses expressed as a percentage* ***C*** *is not correct because this the ratio of masses expressed as a percentage* ***D*** *is not correct because the molar masses have been used the wrong way round*	**(1)**

Question Number	Answer	Mark
12	**12. The only correct answer is C** ***A*** *is not correct because IE1 is endothermic and EA1 is exothermic* ***B*** *is not correct because IE1 is exothermic and EA1 is exothermic* ***D*** *is not correct because IE1 is endothermic and EA1 is endothermic*	**(1)**

Question Number	Answer	Mark
13	**13. The only correct answer is B** ***A*** *is not correct because the ΔH values have been added and the sign reversed* ***C*** *is not correct because C because the ΔH values have been subtracted but the sign reversed* ***D*** *is not correct because the ΔH values have been added*	**(1)**

Question Number	Answer	Mark
14	**14. The only correct answer is A** ***B*** *is not correct because F−F bond is weak and H−F bond is strong* ***C*** *is not correct because the H−H bond being strong would make the reaction less exothermic* ***D*** *is not correct because the H−H bond is strong*	**(1)**

Question Number	Answer	Mark
15	**15. The only correct answer is D** ***A*** *is not correct because the yellow chromate(VI) ions would be attracted to the anode and the green mixed colour would be in the middle* ***B*** *is not correct because the blue copper(II) ions would be attracted to the cathode and the green mixed colour would be in the middle* ***C*** *is not correct because the yellow chromate(VI) ions would be attracted to the anode and blue copper(II) ions would be attracted to the cathode*	**(1)**

Question Number	Answer	Mark
16	**16. The only correct answer is D** ***A*** *is not correct because the longest chain has 8 carbons* ***B*** *is not correct because the longest chain has 8 carbons* ***C*** *is not correct because the longest chain has 8 carbons*	**(1)**

Question Number	Answer	Mark
17	**17. The only correct answer is C** ***A*** *is not correct because it is trans* ***B*** *is not correct because it is trans and E* ***D*** *is not correct because it is E*	**(1)**

Question Number	Answer	Mark
18	**18. The only correct answer is C** ***A*** *is not correct because it has a σ bond and a π bond* ***B*** *is not correct because it has a σ bond and a π bond* ***D*** *is not correct because it has a σ bond and a π bond*	**(1)**

Question Number	Answer	Mark
19	**19. The only correct answer is A** ***B*** *is not correct because* hazard is fixed but risk varies ***C*** *is not correct because* risk varies ***D*** *is not correct because* hazard is fixed	**(1)**

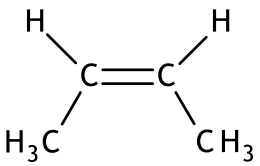
TOTAL FOR SECTION A = 20 MARKS

Section B

Question Number	Acceptable Answer	Reject	Mark
20(a)(i)	2-methylpropene ALLOW 2-methylprop-1-ene / methylpropene IGNORE Omission of hyphens	2-methylpropan-2-ene *E*-2-methylpropene *Z*-2-methylpropene	**(1)**

Question Number	Acceptable Answer	Reject	Mark
20(a)(ii)	C_4H_8	$CH_2CHCH_2CH_3$	**(1)**

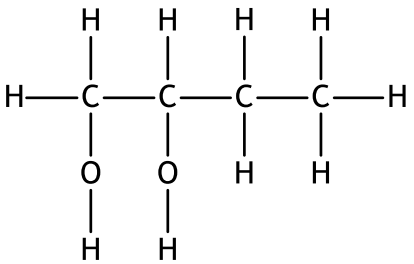
Question Number	Acceptable Answer	Reject	Mark
20(a)(iii)	**A** and **B** have the same molecular formula ALLOW Same number of C and H atoms **(1)** but different structural formulae / structures **(1)** IGNORE Reference to the carbon-carbon double bond spatial arrangement	Just 'formula' M_r	**(2)**

Question Number	Acceptable Answer	Reject	Mark
20(a)(iv)	 ALLOW Skeletal formula		**(1)**

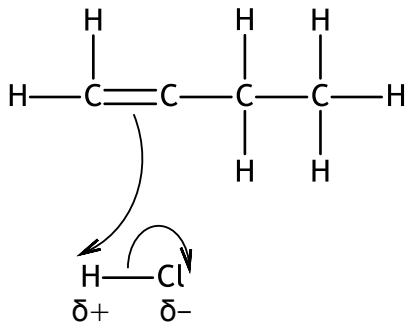
Question Number	Acceptable Answer	Reject	Mark
20(a)(v)	ALLOW Reverse argument for **A**: A has two methyl groups / H atoms attached to one C IGNORE References to energetic barriers to free rotation about the double bond		**(1)**

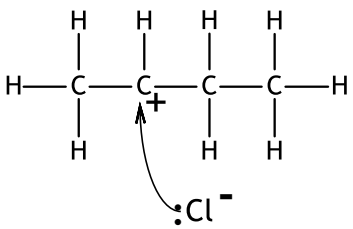
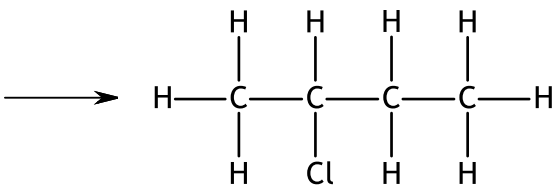
Question Number	Acceptable Answer	Reject	Mark
20(b)(i)	(Liquid) bromine OR bromine in a non-polar solvent / suitable named solvent ALLOW $Br_2(l)$ / Br_2 in an organic solvent / bromine gas / $Br_2(g)$ IGNORE Br_2	$Br_2(aq)$ / bromine water/ aqueous bromine / bromide	**(1)**

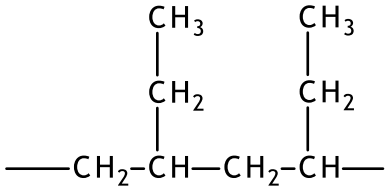
Question Number	Acceptable Answer	Reject	Mark
20(b)(ii)	Bromine water / aqueous bromine ALLOW $Br_2(aq)$ / 'bromine and water' IGNORE Concentrated/dilute	$Br_2(l)$ (Liquid) bromine Additional reagents Bromic(I) acid	**(1)**

Question Number	Acceptable Answer	Reject	Mark
20(b)(iii)	 ALLOW OH for O—H IGNORE Attachment to OH unless the bond is clearly C—H—O	Skeletal and structural formulae	**(1)**

Question Number	Acceptable Answer	Reject	Mark
20(c)(i)	Electrophilic **(1)** Addition **(1)**		**(2)**

Question Number	Acceptable Answer	Reject	Mark
20(c)(ii)	Penalise incorrect halogen once in c(ii) and c(iii)  **MP1** Arrows Arrow from π bond to H or close to H **and** Arrow from bond to Cl or just beyond Cl **(1)** **MP2** Dipole **(1)**		**(2)**

Question Number	Acceptable Answer	Reject	Mark
20(c)(iii)	  Intermediate with correctly placed (secondary) positive charge Penalise primary intermediate here **(1)** Cl^- with correctly placed curly arrow close to C atom **(1)** lone pair at start of curly arrow **(1)** Final product **(1)** TE for MP 2, 3 and 4	Bromoalkane	**(4)**

Question Number	Acceptable Answer	Reject	Mark
20(c)(iii)	 ALLOW Branch chains in any direction C_2H_5 for CH_3CH_2 Ethyl groups on carbon atoms 2 and 3 IGNORE brackets and 'n'	One repeat unit	**(1)**

(Total for Question 20 = 18 marks)

Question Number	Acceptable Answer	Reject	Mark
21(a)(i)	(^{24}Mg and ^{26}Mg atoms) have 12 protons **(1)** IGNORE (^{24}Mg and ^{26}Mg atoms) have the same number of protons / proton number ^{24}Mg has 12 neutrons but ^{26}Mg has 14 neutrons ALLOW ^{26}Mg has two more neutrons than ^{24}Mg **(1)** ALLOW for 1 mark Just '^{24}Mg and ^{26}Mg atoms have the same number of protons/proton number **and** different numbers of neutrons /neutron number' IGNORE '^{24}Mg and ^{26}Mg atoms have the same atomic number but different mass numbers' References to electrons unless incorrect		**(2)**

Question Number	Acceptable Answer	Reject	Mark
21(a)(ii)	Percentage ^{24}Mg = x $(24x + 26(100 - x) \div 100 = 24.433$ **(1)** $2x = 2600 - 2443.3 = 156.7$ % ^{24}Mg = x = 78.35; % ^{26}Mg = 100 – x = 21.65 ALLOW 78.4 and 21.6 OR 78.3 and 21.7 **(1)** Correct answers with no working scores 2 marks. Ignore SF except 1		**(2)**

Question Number	Acceptable Answer	Reject	Mark
21(b)(i)	$1s^2\ 2s^2\ 2p^6\ 3s^2$ OR $1s^2\ 2s^2\ 2p_x^2\ 2p_y^2\ 2p_z^2\ 3s^2$		**(1)**

Question Number	Acceptable Answer	Reject	Mark
21(b)(ii)	$Mg(g) \rightarrow Mg^{+}(g) + e^{(-)}((g))$ OR $Mg(g) - e^{(-)}((g) \rightarrow Mg^{+}(g)$		**(1)**

Question Number	Acceptable Answer	Reject	Mark
***21(b)(iii)**	Ionized / outer electrons are in the 3s / same orbital/subshell (for each atom) ALLOW Same shell (for subshell) Atoms have the same inner shell shielding **(1)** Mg has one more proton (in the nucleus) (so attractive force is greater) ALLOW Higher proton number Greater effective nuclear charge Reverse argument **(1)** IGNORE References to atomic radius Outer electrons in the same quantum shell /shell Atomic number	Filled / half-filled orbital has greater stability Magnesium is Mg^{2+} but sodium is Na^{+} Mg has higher charge density (than Na)	**(2)**

Question Number	Acceptable Answer	Reject	Mark
21(b)(iv)	(The nuclear charge is greater but ....) Ionized / outer electron of aluminium is in a (3)**p** orbital / the (3)p subshell **(1)** which is further from the nucleus than the (3)s orbital OR is at a higher energy than the (3)s orbital OR is shielded by the (inner) 3s orbital ALLOW Use of 3s subshell for 3s orbital Reverse argument **(1)** IGNORE Use of 2s and 2p for 3s and 3p if consistent	Filled 3s orbital is stable	**(2)**

Question Number	Acceptable Answer	Reject	Mark
21(c)(i)	When heat is supplied to a system, it is very difficult / impossible to measure the heat absorbed by the reaction OR When heat is supplied to a system, it is very difficult / impossible to measure the temperature change due to the reaction ALLOW When heat is supplied to a system, it is very difficult / impossible to measure the temperature change OR Difficult to measure the temperature of a solid IGNORE Reference to thermicity of the reaction	Just 'difficult / impossible to measure the temperature change'	**(1)**

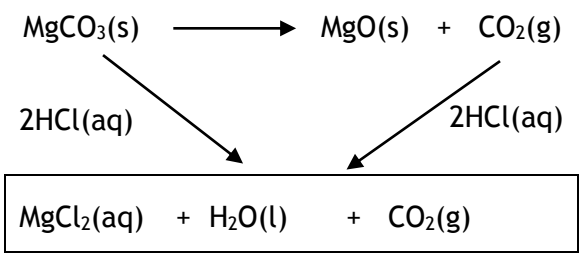
Question Number	Acceptable Answer	Reject	Mark
21(c)(ii)	Enthalpy / heat change of a reaction is independent of the route. ALLOW Enthalpy / heat change is independent of the route.		**(1)**

Question Number	Acceptable Answer	Reject	Mark
21(d)(i)	So that all the $MgCO_3$ reacts. ALLOW So that all the solid reacts So that all the solid reacts IGNORE Reference to limiting factors	Just 'to ensure complete reaction'	**(1)**

Question Number	Acceptable Answer	Reject	Mark
21(d)(ii)	(Good thermal insulation) reduces heat transfer with the surroundings ALLOW Reduces heat loss to the surroundings **(1)** (Low heat capacity) less / little heat is used to heat / cool the container **(1)**	No heat loss	**(2)**

Question Number	Acceptable Answer	Reject	Mark
21(d)(iii)	(ΔE) = 50.0 x 4.18 x 18.5 = 3866.5 (J) OR 3.8665 = 3.87 **kJ** IGNORE SF except 1 SF +/− signs		**(1)**

Question Number	Acceptable Answer	Reject	Mark
21(d)(iv)	Molar mass $MgCO_3$ = 84.3 **(1)** ΔH = (−)answer 21(d)(iii) ÷ mol $MgCO_3$ = (−)3866.5 ÷ (2.50/84.3) OR = (−)3866.5 ÷ 0.029656 OR = (−)3866.5 x 33.72 **(1)** = (−)130378 = −130 000 / −1.30 x 10^5 J mol^{-1} OR = −130 kJ mol^{-1} **(1)** TE at each stage Correct answer with no working scores 3 Correct answer with no working and no or incorrect units and / or sign scores 2	Answer not to 3 SF 130 kJ mol^{-1}	**(3)**

Question Number	Acceptable Answer	Reject	Mark
21(e)(i)	 IGNORE Omission of 2HCl(aq) (on lhs)		**(1)**

Question Number	Acceptable Answer	Reject	Mark
21(e)(ii)	$\Delta H_1 = \Delta H_2 - \Delta H_3$ **(1)** = −126 – (−231) = +105 kJ mol^{-1} **(1)** Correct answer including sign, with no working scores 2 105 kJ mol^{-1} / −105 kJ mol^{-1} / +105 all score 1 mark No TE on incorrect cycle equation		**(2)**

Question Number	Acceptable Answer	Reject	Mark
21(f)	The student values were much smaller / smaller magnitude / less negative than the Data Book values which indicates a systematic error **(1)** Uncertainties will give values scattered about the true value (so cannot explain the discrepancy) OR The results obtained by the students are precise but inaccurate **(1)** If no other mark is scored allow uncertainties are too small to account for the discrepancy scores 1 IGNORE References to likely sources of error such as heat loss		**(2)**

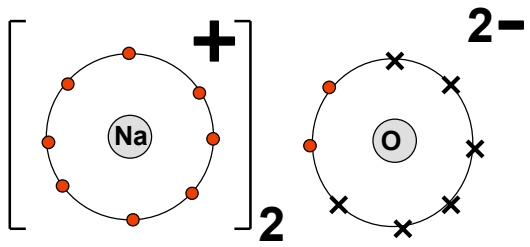
(Total for Question 21 = 24 marks)

Question Number	Acceptable Answer	Reject	Mark
22(a)(i)	$Na^+(g) + Cl^-(g) \rightarrow NaCl(s)$	$NaCl(s) \rightarrow Na^+(g) + Cl^-(g)$	**(1)**

Question Number	Acceptable Answer	Reject	Mark
22(a)(ii)	Born-Haber (cycle)		**(1)**

Question Number	Acceptable Answer	Reject	Mark
***22(a)(iii)**	Sodium chloride is purely ionic **(1)** Silver chloride is partly / significantly covalent **(1)** because silver ion / Ag^+ is polarising / has a high(er) charge density OR chloride ion / Cl^- is polarised (by Ag^+) OR There is orbital overlap between silver and chloride ions OR Large electronegativity difference between Na and Cl **and** Small(er) electronegativity difference between Ag and Cl **(1)**	silver ion has a higher charge Reference to electronegativity differences between **ions**	**(3)**

Question Number	Acceptable Answer	Reject	Mark
22(b)	<table><tr><td></td><td>Na</td><td>S</td><td>O</td></tr><tr><td>%</td><td>29.1</td><td>40.6</td><td>30.3</td></tr><tr><td>% ÷ A_r</td><td>29.1 /23</td><td>40.6 /32.1</td><td>30.3 /16</td></tr><tr><td></td><td>= 1.265</td><td>= 1.265</td><td>= 1.894</td></tr><tr><td>(÷ 1.265)</td><td>1</td><td>1</td><td>1.5</td></tr><tr><td>Ratio</td><td>2</td><td>2</td><td>3</td></tr></table> **(1)** **(1)** Formula = $Na_2S_2O_3$ **(1)** Correct answer with no working scores **(1)** ALLOW other correct methods		**(3)**

Question Number	Acceptable Answer	Reject	Mark
22(c)	 Two sodium **ions** (indicated in any way) ALLOW No electrons **(1)** Oxide ion **(1)** Penalise omission of / incorrect charges once only Charges reversed scores max 1 (for electron configurations and 2:1 ratio)	Covalent bonding	**(2)**

(Total for Question 22 = 10 marks)

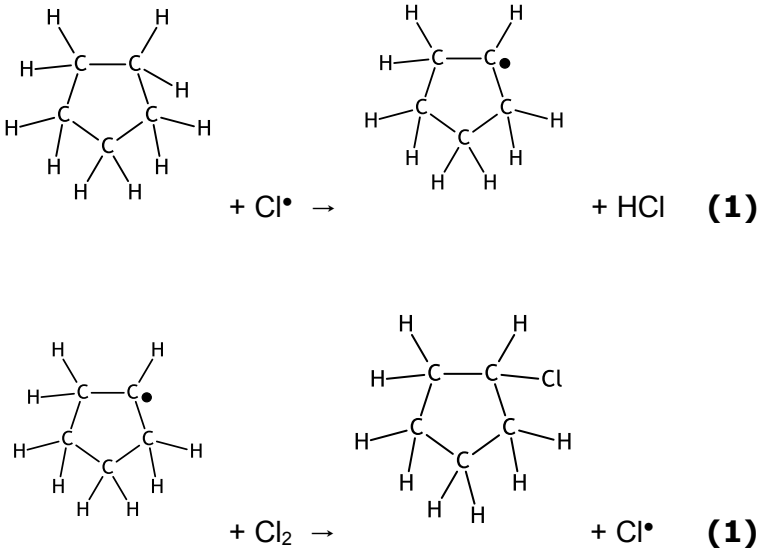
Question Number	Acceptable Answer	Reject	Mark
23(a)(i)	CH_2 ALLOW C_1H_2 H_2C		**(1)**

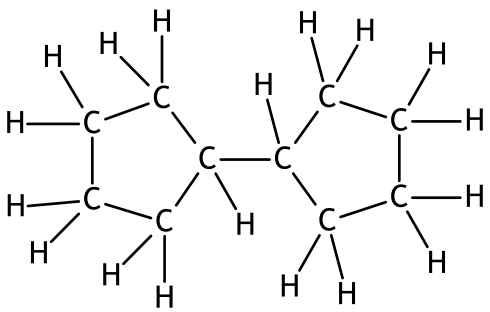
Question Number	Acceptable Answer	Reject	Mark
23(a)(ii)	C_nH_{2n} ALLOW Any general representation of n		**(1)**

Question Number	Acceptable Answer	Reject	Mark
23(b)(i)	Fractional distillation OR Fractionation	Just 'distillation' Cracking followed by fractional distillation	**(1)**

Question Number	Acceptable Answer	Reject	Mark
23(b)(ii)	$C_5H_{12} \rightarrow C_5H_{10} + H_2$ OR Displayed / skeletal /structural formulae IGNORE State symbols even if incorrect Conditions even if incorrect		**(1)**

Question Number	Acceptable Answer	Reject	Mark
23(c)(i)	Ultraviolet / UV (radiation / light) ALLOW Sunlight IGNORE heat		**(1)**

Question Number	Acceptable Answer	Reject	Mark
23(c)(ii)	See below OR $C_5H_{10} + Cl^{\bullet} \rightarrow C_5H_9^{\bullet} + HCl$ **(1)** $C_5H_9^{\bullet} + Cl_2 \rightarrow C_5H_9Cl + Cl^{\bullet}$ **(1)** Penalise omission of unpaired electron once only Penalise incorrect location of unpaired electron on displayed formulae once only  **(1)**	charged species	**(2)**

Question Number	Acceptable Answer	Reject	Mark
23(c)(iii)		Structural or skeletal or molecular formulae	**(1)**

(Total for Question 23 = 8 marks)

TOTAL FOR SECTION B = 60 MARKS

TOTAL FOR PAPER = 80 MARKS

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