Alkanes: Fuels & Pollution

Mark Scheme

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	The Core Principles of Chemistry
Sub Topic	Alkanes: Fuels & Pollution
Booklet	Mark Scheme

Time Allowed: **47 minutes**

Score: **/39**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

Question Number	Correct Answer	Reject	Mark
1(a)	D		1
	Incorrect Answers: A – Atom economy of ethene, not all alkenes B - Ethene not doubled in numerator but doubled in denominator C- Atom economy where ethene not doubled		

Question Number	Correct Answer	Reject	Mark
1(b)	B		1
	Incorrect Answers: A – Incorrect reason for use of cracking C - Incorrect reason for use of cracking D- Incorrect reason for use of cracking		

Question Number	Correct Answer	Reject	Mark
2	C		1
	Incorrect Answers: A – Carbon dioxide does cause global warming B - Carbon dioxide does cause ice caps to melt D- Carbon dioxide does cause sea levels to rise		

Question Number	Correct Answer	Mark
3	A	**1**

Question Number	Correct Answer	Mark
4	D	**1**

Question Number	Correct Answer	Mark
5	D	**1**

Question Number	Correct Answer	Mark
6	C	**1**

Question Number	Acceptable Answers	Reject	Mark
7(a)(i)	Alkane(s) **IGNORE** Any references to 'branched' / 'aliphatic' / 'hydrocarbons'		**1**

Question Number	Acceptable Answers	Reject	Mark
7(a)(ii)	2,3-**di**methyloctane **IGNORE** Incorrect or missing punctuation		**1**

Question Number	Acceptable Answers	Reject	Mark
7(a)(iii)	**mark:** (Isomers) **A and C** **(1)** **NOTE** If no isomers or isomers other than A & C have been chosen, then award one mark max providing both 2nd and 3rd marking points are evident. **2nd mark:** (They/A and C) have the same **molecular formula** / $C_{10}H_{22}$ / same number of C and H (atoms) **(1)** **3rd mark:** (They/A and C) have different structural formulae/displayed formulae / skeletal formulae / different structures/different arrangement of atoms **IGNORE** Any references to 'in space' / 'spatial' Any references to names Any references to general formulae **(1)**	'Different chemical formulae'	**3**

Question Number	Acceptable Answers	Reject	Mark
7(a)(iv)	$C_{12}H_{24}$ **1st mark:** C_{12} **(1)** **2nd mark:** H_{24} **(1)**		**2**

Question Number	Acceptable Answers	Reject	Mark
7(b)(i)	OR **B** **ALLOW** lower case letters **IGNORE** any names or formulae		**1**

Question Number	Acceptable Answers	Reject	Mark
7(b)(ii)	OR **D** **ALLOW** lower case letters **IGNORE** any names or formulae		**1**

Question Number	Acceptable Answers	Reject	Mark
7(c)	Any **one** of: (It improves engine performance by) Promoting efficient combustion OR Allowing smoother burning OR Increasing octane number OR Reduces knocking / prevents knocking OR Pre-ignition being less likely OR Being (more) efficient (fuels) OR Better burning / fuels easier to burn OR Combusting more easily OR Improving combustion / complete combustion OR Burns more cleanly OR More miles per gallon **IGNORE** any references to energy density / boiling temperature / volatility		**1**

Question Number	Acceptable Answers	Reject	Mark
7(d)	[FIRST, check the answer on the answer line IF answer = 48000 (kJ kg^{-1}) award **(3)** marks] **1st two marks** $\frac{1000}{170}$ **(1)** x 8086 **(1)** **OR** $\frac{8086}{170}$ **(1)** x 1000 **(1)** NOTE: second mark in both cases dependent on first mark unless one minor transcription error in first mark e.g. use of 110 rather than 170 **3rd mark** = 47564.70588 = 48000 **(1)** Answer must be to 2 sf **Ignore signs and / or incorrect units at any stage** 48 scores **(2)** 47.56 scores **(1)** 1374.6 scores **(0)** even if rounded to 2SF		**3**

(Total for Question 7 = 13 marks)

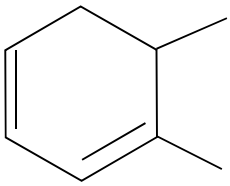
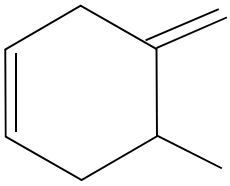
Question Number	Acceptable Answers	Reject	Mark
8(a)	Fractional distillation Both words needed		**1**

Question Number	Acceptable Answers	Reject	Mark
8(b)(i)	C_9H_{20}		**1**

Question Number	Acceptable Answers	Reject	Mark
8(b)(ii)	Correct skeletal formula **(1)** Correct name for the structure drawn providing that the structure is a branched-chain isomer of C_9H_{20} **NO TE for name if skeletal formula is incorrect** **ALLOW** Correct name, even if structural or displayed formula has been drawn **(1)** EXAMPLES of correct skeletal formulae and names  2-methyloctane  3-methyloctane  4-methyloctane	Structural or displayed formula	**2**

Question Number	Acceptable Answers	Reject	Mark
8(c)(i)	$C_{15}H_{32} \rightarrow C_{13}H_{28} + C_2H_4$ **IGNORE** State symbols, even if incorrect **ALLOW** Correct structural OR displayed OR skeletal OR mixture of these (as long as unambiguous)		**1**

Question Number	Acceptable Answers	Reject	Mark
8(c)(ii)	Any **carbon-carbon bond** (in the chain) can **break** OR The **carbon chain** can **break**/**split** in different places OR Carbon chain is cracked in many places / different places OR $C_{13}H_{28}$ / product will break down further **IGNORE** 'Molecule can break anywhere' / 'It breaks into smaller molecules' / 'large number of C atoms' / 'bonds break randomly' / 'hydrocarbon chain is long'		**1**

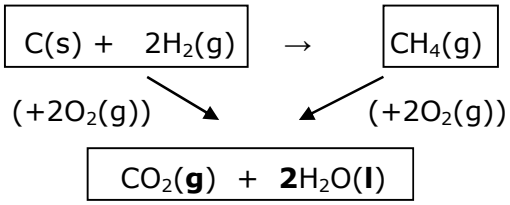
Question Number	Acceptable Answers	Reject	Mark
8(d)(i)	Two double bonds anywhere on the RING (allow them to be adjacent). e.g.  **ALLOW** One triple bond (instead of two double bonds) BUT not adjacent to a methyl group **ALLOW:** (ie double bond(s) on side-chain) 	If any other incorrect structure is included with the final answer Any 5-valent C atom in structure scores **(0)** If the methyl groups are joined by a bond **(0)** Benzene ring **(0)**	**1**

Question Number	Acceptable Answers	Reject	Mark
8(d)(ii)	**NOTE** The answer must relate to combustion or burning To promote efficient combustion OR To increase octane number OR To reduce knocking OR Pre-ignition less likely **ALLOW** To allow smoother burning OR More efficient fuels OR Better burning / fuels easier to burn OR Combust more easily OR Improves combustion **ALLOW** Reverse argument for straight-chain hydrocarbons **IGNORE** References to: 'less pollution' / 'burning more cleanly' / 'better fuels' / 'to form alkenes' / 'to form more useful products' /'branched chains form' / boiling point / volatility / 'to form H_2'	'Ignition less likely' **(0)**	**1**

(Total for Question 8 = 8 marks)

Question Number	Acceptable Answers	Reject	Mark
9(a)	(Enthalpy/energy change when) **one mole** of a compound / **one mole** of a substance IGNORE Statements such as "energy released" or "energy required" here **(1)** is formed from its elements (in their standard states, under standard conditions) **(1)** (Standard temperature is) 298 K / 25°C ALLOW '°K' IGNORE References to room temperature (Standard pressure is) 1 atm / 101 kPa / 100 kPa **(1)**	'is formed from its **gaseous** elements'	**3**

Question Number	Acceptable Answers	Reject	Mark
9(b)	$6C(s, graphite) + 7H_2(g) \rightarrow C_6H_{14}(l)$ **ALLOW** 6C(s) / 6C(graphite) Species **and** balancing correct **(1)** State symbols correct **(1)** State symbols mark is dependent on correct species but allow this mark if 14H used instead of $7H_2$ **NOTE** $C_6H_{14}(l) \rightarrow 6C(s, graphite) + 7H_2(g)$ scores **(1)**		**2**

Question Number	Acceptable Answers	Reject	Mark
9(c)	 **First mark:** Both arrows point downwards **(1)** **Second mark:** CO_2(**g**) + **2**H_2O(**l**) **(1)** **Third mark:** ((1 x −394) + (2 x −286) − (1 x −890) =) **−76** (kJ mol^{-1}) No TE from cycle arrows **(1)**	**2**H_2O(**g**) If incorrect units with a final answer, no 3rd mark	**3**

Question Number	Acceptable Answers	Reject	Mark
9(d)(i)	(+1652÷4 =) (+)**413** (kJ mol^{-1})	**−**413	**1**

Question Number	Acceptable Answers	Reject	Mark
9(d)(ii)	**st mark:** (+2825 − 6 x answer to (d)(i)) ALLOW TE only from a **positive** value given as answer to (d)(i) **(1)** **Second mark:** = (+)347 (kJ mol^{-1}) **(1)** Second mark is CQ on first mark Correct answer with or without working scores **(2)** **NOTE** **−**347 (kJ mol^{-1}) **scores (1)**		**2**

(Total for Question 9 = 11 marks)