States of Matter

Mark Scheme 4

Level	International A Level
Subject	Chemistry
Exam Board	CIE
Topic	States of Matter
Sub-Topic	
Paper Type	Theory
Booklet	Mark Scheme 4

Time Allowed: **51 minutes**

Score: **/42**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	777.5%	70%	62.5%	57.5%	45%	<45%

1 **(a (i)** alkanes **or** paraffins **not** hydrocarbons (1)

(ii) C_4H_{10} + **13**O_2 → **8**CO_2 + **10**H_2O (1 [2]

(b) (**carbon** allow graphite (1)

(ii) C_4H_{10} + **5**O_2 → **8**C + **10**H_2O
allow balanced equations which include CO and/or CO_2 (1) [2]

(c) enthalpy change when 1 mol of a substance (1)
is burnt in an excess of oxygen/air under standard conditions
or is completely combusted under standard conditions (1) [2]

(d) $m = \frac{pVM_r}{RT} = \frac{1.01\times10^5\times125\times10^{-6}\times44}{8.31\times293}$ g (1

= 0.228147345 g
= 0.23 g (1)

(ii) heat released = m c δ T = 200 × 4.18 × 13.8 J (1)
= 11536.8 J = 11.5 kJ (1)

(iii) 0.23 g of propane produce 11.5 kJ
44 g of propane produce $\frac{11.5\times44}{0.23}$ kJ
= 2200 kJ mol^{-1} (1) [5]

(e) (from methane to butane
there are more electrons in the molecule (1)
therefore greater/stronger van der Waals' forces (1)

(ii) straight chain molecules can pack more closely (1)
therefore stronger van der Waals' forces (1)
or reverse argument [4]

[Total: 15]

2 **(a** $C(s) + O_2(g) \rightarrow CO_2(g)$ (1)
the enthalpy change/energy change/heat change when
one mole of a compound/CO_2 (1)
is formed from its elements in their standard states (1) [3]

(b) (i)

	$CO_2(g)$	+	$3H_2(g)$	$\rightleftharpoons$	$CH_3OH(g)$	+	$H_2O(g)$
$\Delta H^{\ominus}_f$/kJ mol^{-1}	–39		0		–20		–24

$\Delta H^{\ominus}_{reaction}$ = –201 + (–242) – (–394) (1)
–49 kJ mol^{-1} (1)
correct sign (1)

(ii) removal of CO_2 from the atmosphere (1)
CO_2 is a greenhouse gas/causes global warming (1) [5]

(c) In this part, in each case, the 'effect' must be correctly stated in order to gain the explanation mark.

higher temperature
yield is reduced/equilibrium goes to LHS (1)
because forward reaction is exothermic/reverse reaction is endothermic (1)

higher pressure
yield is increased **or** equilibrium goes to RHS (1)
fewer moles/molecules on RHS **or** more moles/molecules on LHS (1)

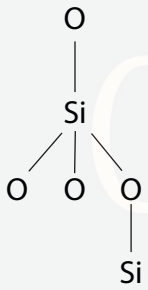
use of catalyst
yield does not change (1)
forward and backward rates speeded up by same amount (1) [6]

[Total: 14]

3 **(a** CO_2 is simple molecular/simple covalent/has discrete molecules (1)
CO_2 has induced dipole – induced dipole interactions/
van der Waals' forces/weak intermolecular forces (1)
SiO_2 is giant molecular/giant covalent/macromolecular (1)
SiO_2 has strong covalent bonds (1)
[any 3]

(b) minimum is 4-valent Si (1)
and at least one Si-O-Si (1)

i.



[2]

(c) (i) for an ideal gas, **any four** from the following
the molecules behave as rigid spheres (1)
there are no/negligible intermolecular forces
between the molecules (1)
collisions between the molecules are perfectly elastic (1)
the molecules have no/negligible volume (1)
the molecules move in random motion (1)
the molecules move in straight lines (1)
the kinetic energy of the molecules is
directly proportional to the temperature (1)
the pressure exerted by the gas is due to the collisions
between the gas molecules and the walls of the container (1)
not an ideal gas obeys $pV = nRT$
(max 4)

(ii) there are intermolecular forces between CO_2 molecules/
CO_2 molecules have volume (1) [5]

(d) graphite has delocalised electrons (1) [1]

(e) ($SiO_2 + 2C \rightarrow SiC + CO_2$ **or**
$SiO_2 + 3C \rightarrow SiC + 2CO$ (1)

(ii) diamond **because** SiC is hard (1) [2]

[Total: 13]