This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners’ meeting before marking began, which would have considered the acceptability of alternative answers.

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CIE is publishing the mark schemes for the October/November 2010 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.
1 (a) the actual number of atoms of each element present (1) in one molecule of a compound (1) [2]

(b) \[ C_xH_y + \left( x + \frac{y}{4} \right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O \]

\[ xCO_2 (1) \]

\[ \frac{y}{2}H_2O (1) \] [2]

(c) (i) oxygen/O_2 (1)

(ii) carbon dioxide/CO_2 (1)

(iii) 10 cm^3 (1)

(iv) 20 cm^3 (1) [4]

(d) \[ C_xH_y + \left( x + \frac{y}{4} \right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O \]

\[ 10 \text{ cm}^3 \quad 20 \text{ cm}^3 \quad 10 \text{ cm}^3 \]

1 mol of C\textsubscript{x}H\textsubscript{y} gives 1 mol of CO\textsubscript{2}

whence \( x = 1 \) (1)

1 mol of C\textsubscript{x}H\textsubscript{y} reacts with 2 mol of O\textsubscript{2}

whence \( x + \frac{y}{4} = 2 \)

and \( y = 4 \) (1)

molecular formula is CH\textsubscript{4} (1) [3]

[Total: 11]
2 (a) \( \text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3 \)(1)

(b) temperature between 300 and 550°C (1)
   - correct explanation of effect of temperature on rate of formation of \( \text{NH}_3 \) or on position of equilibrium (1)
   - catalyst of iron or iron oxide (1)
   - to speed up reaction or to reduce \( E_a \) (1)

(c) manufacture of \( \text{HNO}_3 \)
   - or explosives
   - or nylon
   - or as a cleaning agent
   - or as a refrigerant (1)

(d) fertiliser in rivers causes excessive growth of aquatic plants/algae (1)
   - when plants and algae die \( \text{O}_2 \) is used up/fish or aquatic life die (1)

(e) (i) \( \text{CO} \) by incomplete combustion of the hydrocarbon fuel (1)
   - \( \text{NO} \) by reaction between \( \text{N}_2 \) and \( \text{O}_2 \) in the engine (1)
(ii) \( \text{CO} \) toxic/effect on haemoglobin (1)
   - \( \text{NO} \) toxic/formation of acid rain (1)

(f) (i) platinum/Pt – allow palladium/Pd or rhodium/Rh (1)
   - 2\( \text{CO} + 2\text{NO} \rightarrow 2\text{CO}_2 + \text{N}_2 \) (1)

[Total: 14]
3 (a) (i) a compound which contains only carbon and hydrogen (1)

(ii) separation of compounds by their boiling points (1) [2]

(b) (i) high temperature and high pressure (1)

high temperature and catalyst (1)

(ii) \[ C_{11}H_{24} \rightarrow C_5H_{12} + C_6H_{12} \text{ or } \]
\[ C_{11}H_{24} \rightarrow C_5H_{12} + 2C_3H_6 \text{ or } \]
\[ C_{11}H_{24} \rightarrow C_5H_{12} + 3C_2H_4 \] (1) [3]

(c) (i)

\[
\begin{array}{ccc}
\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3 & \text{CH}_3\text{CH}_2\text{CHCH}_3 & \text{CH}_3 \\
\text{CH}_3 & \text{CH}_3 & \text{CH}_3 \\
\text{isomer B} & \text{isomer C} & \text{isomer D} \\
(1) & (1) & (1)
\end{array}
\]

(ii) the straight chain isomer (isomer B above) (1)

it has the greatest van der Waals’ forces (1)

because unbranched molecules have greater area of contact/can pack more closely together (1) [6]

(d) 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]
(e) (i) heat released = \( m \cdot c \cdot \delta T = 200 \times 4.18 \times 27.5 \)
\[ = 22990 \text{ J} = 23.0 \text{ kJ} \] (1)

(ii) 23.0 kJ produced from 0.47 g of E

\[ \frac{2059 \text{ kJ}}{23.0} \times \frac{0.47 \text{ g}}{} = 42.08 \text{ g of E} \] (1)

allow ecf in (i) or (ii) on candidate’s expressions [4]

(f) \( C_3H_6 = 42 \)

E is \( C_3H_6 \)

for ecf, E must be unsaturated and be no larger than \( C_5 \) (1) [1]

[Total: 18]

4 (a) reaction 1

reagent NaOH/KOH (1)
solvent \( H_2O/water/aqueous \) (1)

reaction 2

reagent \( NH_3/ammonia \) (1)
solvent ethanol\( /C_2H_5OH/alcohol \) (1)

reaction 3

reagent NaOH/KOH (1)
solvent ethanol\( /C_2H_5OH/alcohol \) (1) [6]

(b) with \( CH_3CH_2CH_2CH_2I \) rate would be faster (1)

C-I bond is weaker than C-Br bond (1)

C-I bond energy is 240 kJ mol\(^{-1}\), C-Br bond energy is 280 kJ mol\(^{-1}\)
data must be quoted for this mark (1) [3]

(c) non-toxic

non-flammable

volatile/low bp

unreactive (any 2) [2]
(d) (i) when a covalent bond breaks the two electrons in the bond are shared between the two atoms (1)

(ii) $\text{CCl}_2F_2 \rightarrow \text{CClF}_2 + \text{Cl}$ (as minimum)

allow $\text{CCl}_2F + \text{F}$ (1) [2]

(e) they are flammable (1) [1]

[Total: 14]

5 (a) NaBr/sodium bromide [1]

(b) Br$_2$/bromine or SO$_2$/sulfur dioxide [1]

(c) concentrated sulfuric acid is an oxidising agent or phosphoric(V) acid is not an oxidising agent [1]

[Total: 3]