MARK SCHEME for the October/November 2010 question paper
for the guidance of teachers

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1  (a) the actual number of atoms of each element present (1)

   in one molecule of a compound (1) [2]

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

   \[ xCO_2 \quad (1) \]

   \[ \frac{y}{2}H_2O \quad (1) \] [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\(_x\)H\(_y\) gives 1 mol of CO\(_2\)

   whence \( x = 1 \) (1)

   1 mol of C\(_x\)H\(_y\) reacts with 2 mol of O\(_2\)

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

   and \( y = 4 \) (1)

   molecular formula is CH\(_4\) (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) [4]

(c) manufacture of \( \text{HNO}_3 \)

   or explosives

   or nylon

   or as a cleaning agent

   or as a refrigerant (1) [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) [2]

(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) [4]

(f) (i) platinum/Pt – allow palladium/Pd or rhodium/Rh (1)

   (ii) \( 2\text{CO} + 2\text{NO} \rightarrow 2\text{CO}_2 + \text{N}_2 \) (1) [2]

[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) \( \text{C}_{11}\text{H}_{24} \rightarrow \text{C}_5\text{H}_{12} + \text{C}_6\text{H}_{12} \) or

\( \text{C}_{11}\text{H}_{24} \rightarrow \text{C}_5\text{H}_{12} + 2\text{C}_3\text{H}_6 \) or

\( \text{C}_{11}\text{H}_{24} \rightarrow \text{C}_5\text{H}_{12} + 3\text{C}_2\text{H}_4 \) (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) \( \text{heat released} = mc \delta T = 200 \times 4.18 \times 27.5 \) (1)

\[ = 22990 \text{ J} = 23.0 \text{ kJ} \] (1)

(ii) 23.0 kJ produced from 0.47 g of \( E \)

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

\[ = 42.08 \text{ g of} \ E \] (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/\( \text{C}_2\text{H}_5\text{OH/alcohol} \) (1)

reaction 3 
reagent NaOH/KOH (1)
solvent ethanol/\( \text{C}_2\text{H}_5\text{OH/alcohol} \) (1) [6]

(b) with \( \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{I} \) 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) $\text{CCl}_2\text{F}_2 \rightarrow \text{CClF}_2 + \text{Cl}$ (as minimum)

allow $\text{CCl}_2\text{F} + \text{F}$ (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]