UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

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

9701 CHEMISTRY

9701/22 Paper 2 (AS Structured Questions), maximum raw mark 60

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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) $C_xH_y + \left(x + \frac{y}{4}\right)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$

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) $C_XH_y + \left(x + \frac{y}{4}\right)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$

10 cm^3 20 cm^3 10 cm^3

1 mol of C_xH_y gives 1 mol of CO_2

whence $x = 1$ (1)

1 mol of C_xH_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]

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2 **(a)** $N_2 + 3H_2 \rightleftharpoons 2NH_3$ (1) [1]

(b) temperature between 300 and 550°C (1)

correct explanation of effect of temperature on rate of formation of 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 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 O_2 is used up/fish or aquatic life die (1) [2]

(e) **(i)** CO by incomplete combustion of the hydrocarbon fuel (1)

NO by reaction between N_2 and O_2 in the engine (1)

(ii) CO toxic/effect on haemoglobin (1)

NO toxic/formation of acid rain (1) [4]

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

(ii) $2CO + 2NO \rightarrow 2CO_2 + N_2$ (1) [2]

[Total: 14]

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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) $C_{11}H_{24} \rightarrow C_5H_{12} + C_6H_{12}$ **or**

$C_{11}H_{24} \rightarrow C_5H_{12} + 2C_3H_6$ **or**

$C_{11}H_{24} \rightarrow C_5H_{12} + 3C_2H_4$ (1) [3]

(c) (i)

$CH_3CH_2CH_2CH_2CH_3$	$CH_3CH_2CH(CH_3)$	$CH_3C(CH_3)_2$
isomer **B**	isomer **C**	isomer **D**
(1)	(1)	(1)

(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]

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(e) (i) heat released = m c δT = 200 x 4.18 x 27.5 (1)

= 22990 J = 23.0 kJ (1)

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

2059 kJ produced from $\frac{0.47 \times 2059}{23.0}$ g of **E** (1)

= 42.08 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]

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(d) (i) when a covalent bond breaks the two electrons in the bond are shared between the two atoms (1)

(ii) $CCl_2F_2 \rightarrow CClF_2 + Cl$ (as minimum)

allow $CCl_2F + F$ (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]

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