

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
GCE Ordinary Level

**MARK SCHEME for the October/November 2009 question paper  
for the guidance of teachers**

**5070 CHEMISTRY**

**5070/02**

Paper 2 (Theory), maximum raw mark 75

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- A1 (a) (i)** ethene [1]
- (ii) sodium iodide [1]
- (iii) ammonium sulfate [1]
- (iv) nitrogen(IV) oxide [1]
- (v) calcium oxide [1]
- (vi) calcium oxide [1]

**(b)** substance containing two (or more) elements / different atoms combined/ bonded / joined [1]  
REJECT: references to a mixture

**(c)** ions cannot move / in fixed position in solid / in lattice; [1]  
IGNORE: charged particles  
NOT: strong electrostatic forces between ions  
REJECT: reference to electrons  
ions can move in solution / are mobile in solution [1]  
NOT: ions free  
REJECT: reference to electrons

**[Total: 9]**

**A2 (a)**  $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$  [1]  
ALLOW:  $C_2H_6O$  for ethanol  
IGNORE: word equation  
IGNORE: state symbols

**(b)** fermentation [1]  
REJECT: fermentation + respiration

**(c)** speed increases from 20°C / (at lower temperatures) speed increases as temperature increases then decreases / at high(er) temperatures speed decreases (as temperatures increase) / slower OR stops at high(er) temperatures [2]

**(d)** initial gradient greater and starts at 0,0; [1]  
finishes at same final volume [1]

**[Total: 6]**

**A3 (a)** nitrogen 79% and oxygen 20% [1]

**(b) (i)** atoms of same element / same proton number / same atomic number with different numbers of neutrons / nucleons / mass number [1]  
NOT: atoms with different numbers of neutrons

(ii) 18 electrons and 22 neutrons [1]

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(c) (i)  $\text{TiCl}_4 + 4\text{Na} \rightarrow \text{Ti} + 4\text{NaCl}$  [1]  
 IGNORE: word equation  
 IGNORE: state symbols

(ii) to prevent the sodium oxidising/ to prevent oxygen reacting with the sodium [1]  
 ALLOW: air in place of oxygen  
 NOT: argon is unreactive

(d) divide by correct relative atomic mass; [1]  
 $\text{Xe} = 9.825/131$ ;  $\text{O} = 1.2/16$ ;  $\text{F} = 5.7/19$   
 $\text{Xe} = 0.075$ ;  $\text{O} = 0.075$ ;  $\text{F} = 0.3$   
 correct ratio from this division;  
 $\text{Xe} = 1$ ;  $\text{O} = 1$ ;  $\text{F} = 4$  [1]  
 ALLOW: ecf from step 1  
 correct formula  $\text{XeOF}_4$  (any order) [1]

[Total: 8]

A4 (a) (reacts with water to) produce hydroxide ions / proton acceptor [1]  
 hydrogen ion acceptor  
 ALLOW: hydroxide ions produced  
 NOT: reacts with water unqualified / it is an alkali / pH more than 7

(b) (grey)-green precipitate [1]  
 NOT: grey precipitate / blue-green precipitate / yellow green ppt

(c) moles methylamine =  $6.2/31 = 0.2$ ; [1]  
 IGNORE: units  
  
 volume of methylamine =  $0.2 \times 24 = 4.8 \text{ dm}^3$  [1]  
 ALLOW: ecf  
 ACCEPT: 4.8 alone  
 NOT:  $4.8 \text{ cm}^3$

(d) (i) substance which speeds up a reaction [1]  
 ALLOW: substance which changes the speed / rate of reaction

(ii) 32 (g) of methanol  $\rightarrow$  31 (g) methylamine; [1]  
 240 kg methanol  $\rightarrow$  232.5 kg / 232 500 g methylamine; [1]  
 ALLOW: 232.5 / 233  
 NOT: 232.5 g  
 ALLOW: ecf from wrong molar masses  
**or using moles**  
 240 kg methanol =  $240\,000 / 32 = 7500 \text{ mol}$ ;  
 7500 mol methanol  $\rightarrow$   $7500 \times 31 = 232.5 \text{ kg}$  / 232 500 g;  
 ALLOW: 232.5  
 NOT: 232.5 g  
 NOT: 240 (kg)  
 ALLOW: ecf from wrong molar masses

[Total: 7]

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- A5 (a)**  $2\text{KBr} + \text{Cl}_2 \rightarrow 2\text{KCl} + \text{Br}_2$  [1]  
 ALLOW: ionic equation / multiples  
 IGNORE: word equation  
 IGNORE: state symbols
- (b)** (acidified) potassium dichromate; [1]  
 ALLOW: (acidified) potassium manganate(VII) / potassium permanganate  
 turns green; [1]  
 ALLOW: (for permanganate) turns colourless / decolourises  
 IGNORE: starting colour
- (c)** density: ALLOW 2 to 4 (actual is 3.12); [1]  
 boiling point: ALLOW 20 –120 (actual is 59) [1]
- (d)** explanation of evaporation e.g. particles (or molecules) with a lot of energy leave the liquid /  
 bromine particles break free from each other / forces or bonds between bromine molecules  
 broken; [1]  
 ALLOW: particles (or molecules) of bromine escape from liquid  
 NOT: particles evaporate  
 diffusion / diffuse; [1]  
 REJECT: Brownian motion  
 explanation of diffusion involving qualified movement of molecules / particles  
 e.g. random movement of molecules / molecules move anywhere / molecules in (constant)  
 collisions / particles disperse / particles travel throughout the room / constant motion of the  
 bromine particles; [1]  
 IGNORE: molecules move from area of high concentration to low concentration / particles  
 move to the other side of the room

[Total: 8]

- A6 (a)** it / ozone absorbs OR traps ultra violet radiation / it absorbs ultraviolet light; [1]  
 ALLOW: uv for ultraviolet  
 ALLOW: protects against uv rays / prevents uv rays getting to (Earth's) surface / blocks uv  
 rays  
 (too much) ultra violet radiation can cause skin cancer / cataracts; [1]  
 ALLOW: uv is harmful to skin / causes skin burns
- (b)**  $2\text{O}_3 \rightarrow 3\text{O}_2$  [1]  
 IGNORE: state symbols  
 IGNORE: word equation
- (c) (i)** rose from early 1980's to 1988 / just before 1990; [1]  
 ALLOW: rose to 1987 OR 1989 / rose to just before 1990  
 ALLOW: there was an increase in CFCs in the 1980's  
 ALLOW: rose to a peak in 1988  
 NOT: increased until 1990  
 then declined / lowers OR decreases after 1987 or 1988 or 1989 / from the end of the  
 1980's [1]

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- (ii) Any 2 sensible suggestions which include relevant dates e.g:
- relates drop in amount of ozone between 1980 and 1988 to increase in CFC production;
  - level of ozone from 1998 to 2002 has slightly increased when CFC production had remained low or decreased
  - CFC production dropped significantly from 1988 to 1998 but so did the amount of ozone;
  - level of ozone from 1998 to 2006 has been very variable and no definite correlation with decrease CFC production [2]

[Total: 7]

B7 (a) ANY 4 of:

- power source / battery connected to electrodes dipping in electrolyte;  
ALLOW: from diagram  
REJECT: wrong electrolyte / carbon electrodes
- anode impure copper and cathode pure copper;
- cathode increases in size / mass and anode decreases in size / mass;  
ALLOW: copper deposits on cathode and removed from anode
- cathode reaction:  $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ ;  
ALLOW: e for electron /  $-2\text{e}$  on right
- anode reaction:  $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$  [4]  
ALLOW: e for electron /  $-2\text{e}$  on left

NOTE: both equations correct but anode reaction and cathode reaction the wrong way round gains 1 mark only

- (b) (i)  $4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$  [1]  
ALLOW:  $4\text{OH}^- - 4\text{e}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2$   
ALLOW: multiples

- (ii) copper ions in solution not replaced / reduction in amount of copper ions available; [1]  
NOT: anode is not copper  
NOT: because the copper is being used up  
NOT: because copper ions are reduced to copper at the cathode

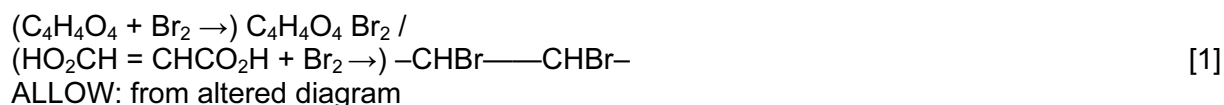
- (c) (i) 1 mark for each catalyst with its correct product:  
e.g. iron for making ammonia / ALLOW: iron oxide  
nickel for making margarine / hydrogenation of alkenes / making alkanes  
vanadium(V) oxide for making sulfur trioxide / sulfuric acid [2]  
ALLOW: vanadium oxide NOT: wrong oxidation state  
ALLOW: platinum for  $\text{SO}_3$  / sulfuric acid / nitric acid  
NOT: for Haber process / for Contact process

- (ii) any two properties of transition metals other than catalyst e.g.  
variable oxidation number OR variable oxidation state OR form more than one sort of ion / variable valency  
form coloured compounds or coloured ions  
form complex ions  
ALLOW: high density  
ALLOW: high melting or high boiling points [2]

[Total: 10]

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- B8 (a)** orange / red / brown colour of bromine; [1]  
 decolourised / goes colourless (when fumaric acid added); [1]  
 REJECT: becomes discoloured



- (b)** moles sodium hydroxide =  $0.018 \times 0.2 = 3.6 \times 10^{-3}$ ; [1]  
 moles fumaric acid =  $\frac{1}{2}$  answer to first mark; [1]  
 ALLOW: ecf

concentration of fumaric acid =  $(1000/60 \times \text{answer to second mark})$   
 $[(1000/60) \times 1.8 \times 10^{-3}] = 0.03 \text{ mol/ dm}^3$  [1]  
 ALLOW: ecf

**OR**

$$\frac{C_1 V_1}{C_2 V_2} = \frac{0.2 \times 18}{C_2 \times 60} \quad (1 \text{ mark for working as shown})$$

$$\frac{C_1 V_1}{C_2 V_2} = \frac{n_1}{n_2} \quad \frac{0.2 \times 18}{C_2 \times 60} = \frac{2}{1} \quad (2 \text{ marks for working as shown})$$

Correct answer = 3rd mark

- (c)** polyester [1]

- (d)** clothing / ropes / fishing lines / fishing nets / stockings / parachutes / toothbrush (bristles) / balloons / guitar strings / racquet strings / petrol tanks [1]  
 ALLOW: fabrics  
 IGNORE: fibres without qualification

- (e)** Any two environmental problems e.g. [2]
- burning causes poisonous or harmful fumes / acidic fumes  
 NOT: references to carbon dioxide / soot / pollution
  - fills up landfill sites / not enough landfill sites / difficulty to store waste
  - litter / just thrown away / eyesore
  - trap animals or birds / harms organisms in sea ALLOW: harms or kills wildlife
  - blocks drains OR streams

**[Total: 10]**

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**B9 (a)** Any two of:

- carbon dioxide + water (combine);
- to form glucose + oxygen;
- in presence of chlorophyll / sunlight

[2]

ALLOW: information from word equation or symbol equation with correct formulae

**(b)** correct dot and cross diagram for carbon dioxide

i.e. 4 bonding electrons between carbon and each oxygen and 4 non bonded electrons on each oxygen [1]

IGNORE: inner shell electrons

**(c) (i)**  $C_8H_{18} + 12\frac{1}{2} O_2 \rightarrow 8CO_2 + 9H_2O$  (or multiple of this) [1]

**(ii)** carbon dioxide (produced) is a greenhouse gas / carbon dioxide is responsible for global warming

ALLOW: increased carbon dioxide levels lead to stated effect of climate change e.g. melting of polar ice / glaciers / desertification / rise in sea levels etc [1]

REJECT: statements about linking global warming / carbon dioxide to ozone layer

**(d) (i)** amount of bicarbonate decreases / more carbonate forms; [1]

ALLOW: more water forms / more carbon dioxide forms

ALLOW: concentration of bicarbonate decreases / concentration of carbonate / water / carbon dioxide increases

position of equilibrium moves to the left / reaction moves in the in direction of decreasing concentration / when conditions in equilibrium changed the equilibrium shifts to oppose the change OWTTE ; [1]

**(ii)** any Group I carbonate / ammonium carbonate [1]

ACCEPT: hydrogencarbonates / correct formulae

**(e)** Any 2 of:

- sulfur dioxide in flue gases from burning of fossil fuels / named fossil fuel; NOT: removes sulfur dioxide from atmosphere
  - sulphur dioxide reacts with calcium carbonate
  - to form calcium sulfite (+ carbon dioxide);
  - calcium sulfite reacts (with oxygen and water) to form calcium sulfate;
  - removal of sulfur dioxide fuels reduces acid rain / reduces sulfur dioxide in atmosphere / sulfur dioxide causes acid rain
  - removal of sulfur dioxide reduces named effect of acid rain / sulfur dioxide causes e.g. respiratory difficulties / acidification of lakes / erodes buildings or bridges / kills trees / kills animals or plant in rivers or ponds [2]
- NOT: kills plants or animals in seas / kills marine life

**[Total: 10]**

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**B10(a)** haematite / limonite / magnetite / siderite [1]

**(b)** Any 3 of:

- calcium carbonate / limestone decomposes to calcium oxide;
- calcium oxide reacts with silica / silicon dioxide / sand (in the ore);
- calcium oxide is basic so reacts with acidic impurities;
- to form a slag / calcium silicate (this mark consequential on either of the two above);
- silicates / impurities would clog up the blast furnace if not removed [3]

**(c)** energy needed to break the bonds (in carbon and oxygen) / bond breaking is endothermic; [1]  
 energy released on forming bonds in CO<sub>2</sub> / bond forming is exothermic; [1]  
 more energy involved in bond making than bond breaking / more energy released than absorbed [1]

**(d)** Fe<sub>2</sub>O<sub>3</sub> + 3CO → 2Fe + 3CO<sub>2</sub> [1]  
 Fe<sub>2</sub>O<sub>3</sub> + 3C → 2Fe + 3CO [1]  
 IGNORE: state symbols  
 IGNORE: word equation

**(e)** remove (some) carbon / blow oxygen through (the molten iron) / react it with oxygen / use a basic oxygen converter [1]  
 NOT: use a furnace / use a converter  
 NOT: adding other metals to form stainless steel / alloys

**[Total: 10]**