

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

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| <b>5070 CHEMISTRY</b><br>5070/02      Paper 2 (Theory), maximum raw mark 75 |
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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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- 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]

Xe = 9.825/131; O = 1.2/16; F = 5.7/19

Xe = 0.075; O = 0.075 ; F = 0.3

correct ratio from this division;

Xe = 1; O = 1 ; 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  $\rightarrow$   $7500 \times 31 = 232.5 \text{ kg} / 232\,500 \text{ g}$ ;

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

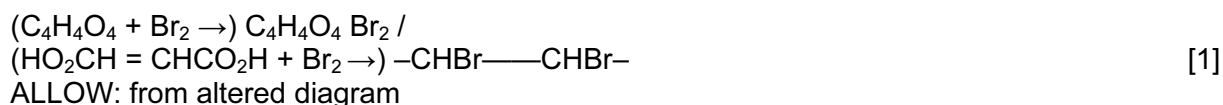
- (c) (i) 1 mark for each catalyst with its correct product:  
e.g. iron for making ammonia / ALLOW: iron oxide  
nickel for making margarine / hydrogenation of alkenes / making alkanes  
vanadium(V) oxide for making sulfur trioxide / sulfuric acid [2]  
ALLOW: vanadium oxide NOT: wrong oxidation state  
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]  
 decolorised / 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**

$$\frac{C_1V_1}{C_2V_2} = \frac{0.2 \times 18}{C_2 \times 60} \text{ (1 mark for working as shown)}$$

$$\frac{C_1V_1}{C_2V_2} = \frac{n_1}{n_2} \quad \frac{0.2 \times 18}{C_2 \times 60} = \frac{2}{1} \text{ (2 marks for working as shown)}$$

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
- ALLOW: information from word equation or symbol equation with correct formulae [2]
- (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]**