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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UNIVERSITY of CAMBRIDGE International Examinations

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]

(c) (i) $TiCl_4 + 4Na \rightarrow Ti + 4NaCl$ [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 $XeOF_4$ (any order) [1]

[Total: 8]

A4 (a) (reacts with water to) produce hydroxide ions / proton acceptor
hydrogen ion acceptor [1]
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 × 24 = 4.8 dm^3 [1]
ALLOW: ecf
ACCEPT: 4.8 alone
NOT: 4.8 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 → 31 (g) methylamine; [1]
240 kg methanol → 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 mol;
7500 mol methanol → 7500 × 31 = 232.5 kg / 232 500 g;
ALLOW: 232.5
NOT: 232.5 g
NOT: 240 (kg)
ALLOW: ecf from wrong molar masses

[Total: 7]

A5 **(a)** $2KBr + Cl_2 \rightarrow 2KCl + Br_2$ [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) $2O_3 \rightarrow 3O_2$ [1]
IGNORE: state symbols
IGNORE: word equation

(c) **(i)** rose from early 1980's to 1988 / just before 1990; [1]
ALLOW: rose to 1987 OR1989 / 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]

(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: $Cu^{2+} + 2e^- \rightarrow Cu$;
  ALLOW: e for electron / –2e on right
- anode reaction: $Cu \rightarrow Cu^{2+} + 2e^-$ [4]
  ALLOW: e for electron / –2e on left

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

(b) (i) $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$ [1]
ALLOW: $4OH^- - 4e^- \rightarrow 2H_2O + O_2$
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 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]

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

$(C_4H_4O_4 + Br_2 \rightarrow)\ C_4H_4O_4\ Br_2$ /
$(HO_2CH = CHCO_2H + Br_2 \rightarrow)$ –CHBr——CHBr– [1]
ALLOW: from altered diagram

(b) moles sodium hydroxide = $0.018 \times 0.2 = 3.6 \times 10^{-3}$; [1]
moles fumaric acid = ½ answer to first mark; [1]
ALLOW: ecf

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

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

$$\frac{C_1V_1}{C_2V_2} = \frac{n_1}{n_2} \quad \frac{0.2 \times 18}{C_2 \times 60} = \frac{2}{1}$$ (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.

- <u>burning</u> 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 [2]

[Total: 10]

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)** $C_8H_{18} + 12½\ O_2 \rightarrow 8CO_2 + 9H_2O$ (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]

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_2 / bond forming is exothermic; [1]
more energy involved in bond making than bond breaking / more energy released than absorbed [1]

(d) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ [1]
$Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$ [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]