UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

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

0620 CHEMISTRY

0620/31 Paper 31 (Extended Theory), maximum raw mark 80

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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the October/November 2009 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

GENERAL INSTRUCTIONS FOR MARKING

- Error carried forward may be allowed in calculations. This will be discussed in the mark scheme. This is not applied when the candidate has inserted incorrect integers or when the answer is physically impossible.

- **COND** the award of this/these mark(s) is conditional upon a **previous** mark being awarded.
  Example – Is the reaction exothermic **or** endothermic? Give a reason for your choice.
  Mark scheme
  exothermic [1]
  COND a correct reason given [1]. This mark can only be awarded if the candidate has recognised that the reaction is exothermic.

- When the name of a chemical is demanded by the question, a **correct** formula is usually acceptable. When the formula is asked for, the name is not acceptable.

- When a word equation is required a **correct** symbol equation is usually acceptable. If an equation is requested then a word equation is not usually acceptable.

- An incorrectly written symbol, e.g. NA **or** CL, should be penalised once in a question.

- In the mark scheme if a word **or** phrase is underlined it (**or** an equivalent) is required for the award of the mark.
  (.....) is used to denote material that is not specifically required.

- **OR** designates alternative and independent ways of gaining the marks for the question.
  or indicates different ways of gaining the same mark.

- Unusual responses which include correct Chemistry which answer the question should always be rewarded – even if they are not mentioned in the marking scheme.

1 (a) (i) argon **or** krypton **or** helium [1]
Accept xenon and radon even though percentages are very small
NOT hydrogen

(ii) water and carbon dioxide [2]

(b) (i) sulfur dioxide **or** lead compounds **or** CFCs **or** methane **or** particulates **or** unburnt hydrocarbons **or** ozone etc. [1]

(ii) incomplete combustion [1]
of a fossil fuel **or** a named fuel **or** a fuel that contains carbon [1]

(iii) at high temperature **or** inside engine [1]
nitrogen and oxygen (from the air) react [1]

(iv) it changes carbon monoxide to carbon dioxide [1]
oxides of nitrogen to nitrogen [1]

OR symbol **or** word equation of the type:
$2NO + 2CO \rightarrow CO_2 + N_2$ [2]

OR a redox explanation – the oxides of nitrogen oxidise carbon monoxide to carbon dioxide, [1]
they are reduced to nitrogen [1]

OR $2NO \rightarrow N_2 + O_2$ [1]
$2CO + O_2 \rightarrow 2CO_2$ [1]

[Total: 10]

2 (a) pH < 7 [1]
example [1]

pH > 7 [1]
example [1]
NOT amphoteric oxides Be, A*l*, Zn, Pb, Sn etc

pH = 7 [1]
example H_2O, CO, NO [1]
the two marks are not linked, mark each independently
NOT amphoteric oxides Be, A*l*, Zn, Pb, Sn etc.

(b) (i) shows both basic and acidic properties [1]

(ii) a named strong acid [1]
a named alkali [1]

[Total: 9]

3 **(a)** **(i)** heat **or** roast **or** burn <u>in air</u> [1]
need both points for mark

(ii) $ZnO + C \rightarrow Zn + CO$ [2]
or $2ZnO + C \rightarrow 2Zn + CO_2$
unbalanced **ONLY** [1]

(b) zinc is more reactive [1]
it loses electrons and forms ions in preference to iron [1]
zinc corrodes not iron [1]
NOT zinc rusts

OR zinc loses electrons and forms ions [1]
the electrons move on to the iron [1]
the iron cannot be oxidised **or** it cannot rust **or** it cannot lose electrons [1]
CREDIT correct Chemistry that includes the above ideas

(c) **(i)** zinc atoms change into ions, (the zinc dissolves) [1]
copper(II) ions change into atoms, (becomes plated with copper) [1]

(ii) ions [1]
electrons [1]

[Total: 10]

4 **(a)** diffusion [1]
different M_r **or** ozone molecules heavier than oxygen molecules
or different densities or oxygen molecules move faster than ozone molecules [1]
NOT oxygen is lighter **or** ozone heavier

OR fractional distillation [1]
they have different boiling points [1]

(b) **(i)** from colourless (solution) [1]
to brown (solution) [1]

(ii) I^- loses electrons (to form iodine molecules) [1]
must be in terms of electron transfer **NOT** oxidation number

(iii) they (electrons) are accepted by ozone
or it is an electron acceptor [1]

(c) (i) correct structural skeleton [1]
COND 4bp around both carbon atoms [1]
2bp and 2nbp around sulfur atom [1]
NOTE marks 2 and 3 can only be awarded if mark 1 has been scored

(ii) water
carbon dioxide
sulfur dioxide
all **three** [2]
any **two** [1]
Accept correct formulae

[Total: 11]

5 (a) (i) strong
hard
light **or** low density
high melting point **or** high fixed points
Accept high strength to weight ratio for [2]
it includes marks 1 and 3
any **THREE** [3]

(ii) silicon [1]
four [1]

(b) diagram to include:
each germanium atom bonded 4 oxygen atoms [1]
each oxygen to 2 germanium atoms [1]
looks **or** stated to be tetrahedral [1]
"tetrahedral" scores mark even if diagram does not look tetrahedral
independent marking of three points

(c) (i) structural formula of Ge_4H_{10} all bonds shown [1]

(ii) germanium(IV) oxide [1]
water [1]

[Total: 11]

6 (a) (i) burn sulfur in air **or** oxygen [1]
or heat a metal sulfide in air

(ii) bleach for wood pulp/cloth/straw **or** preserve food **or** sterilising
or making wine **or** fumigant **or** refrigerant [1]
Accept making paper

(iii) vanadium(V) oxide **accept** vanadium oxide **or** V_2O_5
or vanadium pentoxide [1]
oxidation state not essential but if given it has to be (V)

(iv) rate too slow **or** rate not economic [1]

(v) reaction too violent **or** forms a mist [1]

(b) (i) add water to yellow powder **or** to anhydrous salt [1]
it would go green [1]

(ii) change from purple **or** pink [1]
to colourless **NOT** clear [1]

(iii) reacts with <u>oxygen</u> in air [1]

(c) number of moles of $FeSO_4$ used = 9.12/152 = 0.06 [1]
number of moles of Fe_2O_3 formed = 0.03* [1]
mass of one mole of Fe_2O_3 = 160 g [1]
mass of iron(III) oxide formed = 0.03 × 160 = 4.8 g [1]
number of moles of SO_3 formed = 0.03 [1]
volume of sulfur trioxide formed = 0.03 × 24 = 0.72 dm^3 [1]
If mass of iron(III) oxide greater than 9.12 g, then only marks 1 and 2 available

Apply **ecf** to number of moles of Fe_2O_3* when calculating volume of sulfur trioxide.
Do not apply **ecf** to integers

[Total: 16]

7 (a) (i) heat [1]
catalyst [1]

(ii) an equation that gives:
alkene + alkane
or alkene + alkene + hydrogen [1]

a correct and balanced equation for the cracking of decane, $C_{10}H_{22}$ but not but-1-ene [1]

(iii) water **or** steam [1]

(b) (i) $C_4H_9OH + 6O_2 \rightarrow 4CO_2 + 5H_2O$ [2]
If only error is balancing the oxygen atoms [1]

(ii) butanol + methanoic acid → butyl methanoate + water [2]
correct products **or** reactants ONLY [1]

(c) (i) correct structural formulae [1] each [2]
accept either propanol and –OH in alcohol and acid
penalise once for CH_3 type diagrams
For either C_3H_8O **or** $C_3H_6O_2$ [0]

(ii) to conserve petroleum **or** reduce greenhouse effect [1]

(d) have same boiling point [1]

[Total: 13]