UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

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

5070 CHEMISTRY

5070/21 Paper 2 (Theory), maximum raw mark 75

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 2010 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

UNIVERSITY of CAMBRIDGE International Examinations

A1 **(a)** **(i)** D [1]

(ii) A [1]

(iii) E [1]

(iv) B [1]

(v) F [1]

(vi) C [1]

(b) Propanol / propan-2-ol (1) [1]

[Total: 7]

A2 **(a)** Ga (1)
IGNORE: lack of atomic and nucleon number [1]

(b) Ni and Mn (1)
IGNORE: lack of charge [1]

(c) 23 (1) [1]

(d) 2,8,8 (1)
ALLOW: $1s^2 2s^2 2p^6 3s^2 3p^6$
IGNORE: any charge shown [1]

(e) **(i)** regular arrangement of particles in rows (minimum 2 rows of 4 atoms) (1)
at least 2 different sized particles arranged in the structure (1)
Mark independently
ALLOW: either atoms or ions [2]

(ii) any suitable use e.g. catalyst for margarine manufacture (1)
manufacture of margarine or hydrogenation of alkenes NOT sufficient [1]

(iii) Layers cannot slide (as easily as with pure iron) (1)
because Ni atoms cause irregularities in lattice / ions of different size (1) [2]

[Total: 9]

A3 (a) (i) More carbonyl chloride formed / (reaction) shifts to right (1)
ALLOW: favours the forward reaction
Idea of moving in direction so that concentration of chlorine is lowered (1)
IGNORE: references to rate [2]

(ii) More carbonyl chloride formed / (reaction) shifts to right (1)
ALLOW: favours the forward reaction
Idea of moving in the direction of the fewer number of molecules or moles / idea of moving to the side with the smaller volume (1)
IGNORE: references to rate [2]

(iii) less carbonyl chloride formed / (reaction) shifts to left (1)
ALLOW: favours the backward reaction
because the (forward reaction) is exothermic / in the direction of the endothermic reaction (1)
IGNORE: references to right [2]

(b) $COCl_2 + 4NH_3 \rightarrow (NH_2)_2CO + 2NH_4Cl$
Correct formulae (1)
Balancing dependent on formulae (1) [2]

(c) (i) replace nitrogen lost from soil (when plants harvested) / replace essential elements lost from soil (when plants harvested) / OWTTE / nitrogen converted to protein (for growth) (1)
increase nutrients is NOT sufficient [1]

(ii) iron catalyst (1)
temperature 450°C (1)
ALLOW: from 400–500°C
pressure 200 atm (1)
ALLOW: from 150–400 atmospheres [3]

[Total: 12]

A4 (a) (i) any **two** differences
e.g.
- potassium soft + iron hard (1)
  ALLOW: iron is harder
- potassium low melting point + iron high melting point (1)
  ALLOW: iron has a higher melting point
- potassium not very dense + iron (very) dense (1)
  ALLOW: iron is more dense [2]

(ii) any **one** difference
e.g.
- variable oxidation states (1)
- potassium is more reactive than iron (1)
- potassium reacts with cold water + iron does not (1)
- potassium tarnishes iron does not (1)
- potassium reacts with air at room temperature iron does not (1) [1]

(b) divide by M_r
C = 10.5/12 O = 10/16 H = 0.75/1
C = 0.875 O = 0.625 H = 0.75 (1)
OR
divide by lowest
C = 1.4 O = 1.0 H = 1.2 (1)
statement or indication relating above ratios to empirical formula $C_7O_5H_6$ (1)
e.g. multiply each by 5 or divide each by 0.2 or 2 (and × by 10) [3]

(c) **(i)** $Ag^+ + e^- \rightarrow Ag$ (1) [1]

(ii) reduction is addition of electrons / silver ion(s) gains electrons (1)
ALLOW: oxidation state of silver changes from 1 to 0
ALLOW: it gains electrons but NOT silver gains electrons [1]

(d) (add aqueous) sodium hydroxide / (add aqueous) ammonia (1)

red brown precipitate (both red brown **and** ppt needed) (1) **dependent** on the use of the correct reagent [2]

[Total: 10]

A5 **(a)** Two electrodes dipping into aqueous potassium bromide in beaker and at least one label (1)
NOT: copper electrodes or incorrect electrolyte

external circuit and power source (1) [2]

(b) **(i)** liquid (around anode) goes brown (1)
ALLOW: brown fumes (around anode) [1]

(ii) test: lighted splint (1)
result: pops / explodes / squeaks (1)
result is **dependent** on correct test [2]

(iii) $2H^+ + 2e^- \rightarrow H_2$ (1) [1]

(iv) potassium is higher in the discharge series / potassium is higher in the reactivity series (than hydrogen) / potassium is higher (than hydrogen) in the electrochemical series (1)
ALLOW: potassium is more reactive than hydrogen [1]

[Total: 7]

B6 **(a)** atomic number / number of protons (1) [1]

(b) 3 / III (1) [1]

(c) any **two** differences
e.g.
- groups are horizontal in old table (1)
- noble gases not present in old table (1)
- hydrogen and lithium in same period (or column) (1)
- groups don't start with Group I (1)
- zinc appears in same group as magnesium (1)
- magnesium and calcium in same period (in old table) (1)
- old table does not include actinides / does not include lanthanides / transition elements / old table has more elements (1) [2]

(d) **(i)** transition elements (1)
ALLOW: d-block [1]

(ii) increasing temperature increases speed of reaction (1)

particles collide with greater frequency / particles collide more often / more successful collisions / more energetic collisions (1) [2]

(e) **(i)** more reactive in order Li, Na, K / more reactive down the Group (1) [1]

(ii) $2Na + 2H_2O \rightarrow 2NaOH + H_2$
ALLOW: any correct multiples including fractions [1]

(iii) any value between 20–55°C (actual = 39°C) (1) [1]

[Total: 10]

B7 **(a)** any **two** from:
- has a general (molecular) formula (1)
- consecutive members differ by CH_2 (1)
- have similar or the same chemical properties (1)
ALLOW: can be prepared by same or similar methods
- have same functional group (1)
- physical properties change in predictable way (1)
ALLOW: example of change in physical property [2]

(b) **(i)** C_5H_{12} (1) [1]

(ii) Any value between 23–47 (actual = 36°C) (1) [1]

(c) (i) enthalpy change is negative (1) [1]

(ii) Bond breaking is endothermic and bond making exothermic / heat needed to break bonds and heat given out when bonds form (1)
but
Energy given out when new bonds formed greater than energy absorbed in breaking bonds (2) [2]

(iii) Any **two** from:
- difference in CH_2 in successive members (1)
- extra bonds broken are the same each time (1)
- extra ones made are the same (1) [2]

(d) Marshes / flatulence in animals or as result of bacteria or digestion in animals / paddy fields / decomposition in landfill sites (1)
ALLOW: melting of permafrost / decay of organic material
IGNORE: natural gas [1]

[Total: 10]

B8 (a) (i) Giant covalent structures (of atoms) / very long chained molecules (1) [1]

(ii) any suitable named or generically named macromolecule (1)
e.g. polysaccharides / starch / cellulose / DNA / RNA
ALLOW: fats / (large) carbohydrates [1]

(b) (concentrated) hydrochloric acid (1)
NOT: sulfuric / nitric acid
ALLOW: enzyme protease

Heat / reflux (1) **dependent** on the correct reagent
ALLOW: any value between 20–40°C for an enzyme [2]

(c) any **two** from:
- base of chromatography paper in solvent (1)
- spot of amino acids on base line (1)
- let the solvent run up paper (1)

AND
spray with locating agent (1)
Measure R_f values (1) [4]

(d) (i) Both have amide linkage / CONH link or group (1) [1]

(ii) Has many different side groups / only one carbon between each amide linkage / has more than two monomers (1)
Different monomers is NOT sufficient [1]

[Total: 10]

B9 **(a)** correct electronic structure of three bonding pairs and a lone pair (1) [1]

(b) **(i)** moles phosphorus = 1.86/31 = 0.06 mol
use of 4:1 ratio so moles phosphine = 0.06/4 = 0.015 mol (1)
mass phosphine = 0.015 × 34 = 0.51 g (1)
ALLOW: ecf from wrong Mr values [2]

(ii) $0.015 \times 24 = 0.36\ dm^3$ (1)
ALLOW: ecf from wrong number of moles [1]

(c) $2PH_3 \rightarrow 2P + 3H_2$
Correct formulae (1)
Balancing dependent on correct formulae (1)
ALLOW: equations with correct multiples or P_4 [2]

(d) **(i)** $PH_4I + NaOH \rightarrow PH_3 + NaI + H_2O$ (1) [1]

(ii) fumes of phosphine / smell of garlic / gas given off / effervescence [1]

(e) **(i)** P^{3-} (1) [1]

(ii) high melting point / high boiling point / conducts electricity when it dissolves (or reacts) with water / soluble in water / conducts electricity when molten (1) [1]

[Total: 10]