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

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A1 (a) (i) D

(ii) A

(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)

(b) 3 / III (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)

(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)

(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 × 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]