

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 [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]**

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- 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)**  $\text{COCl}_2 + 4\text{NH}_3 \rightarrow (\text{NH}_2)_2\text{CO} + 2\text{NH}_4\text{Cl}$   
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  $450^\circ\text{C}$  (1)  
ALLOW: from  $400\text{--}500^\circ\text{C}$   
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]

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- (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  $\times$  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]

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**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)**  $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$

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  $\text{CH}_2$  (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)**  $\text{C}_5\text{H}_{12}$  (1)

[1]

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

[1]

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(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  $\text{CH}_2$  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]**

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**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 =  $0.015 \times 34 = 0.51$  g (1)  
 ALLOW: ecf from wrong Mr values [2]

**(ii)**  $0.015 \times 24 = 0.36$  dm<sup>3</sup> (1)  
 ALLOW: ecf from wrong number of moles [1]

**(c)**  $2\text{PH}_3 \rightarrow 2\text{P} + 3\text{H}_2$   
 Correct formulae (1)  
 Balancing dependent on correct formulae (1)  
 ALLOW: equations with correct multiples or P<sub>4</sub> [2]

**(d) (i)**  $\text{PH}_4\text{I} + \text{NaOH} \rightarrow \text{PH}_3 + \text{NaI} + \text{H}_2\text{O}$  (1) [1]

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

**(e) (i)** P<sup>3-</sup> (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]**