

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
GCE Ordinary Level

MARK SCHEME for the May/June 2007 question paper

5070 CHEMISTRY

5070/02

Paper 2 (Theory), maximum raw mark 75

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Section A

A1 (a) vanadium(V) (oxide) [1]
ALLOW: vanadium pentoxide/vanadium oxide/ V_2O_5

(b) carbon (monoxide) [1]
ALLOW: CO

(c) copper(II) (oxide) [1]
ALLOW: copper oxide/CuO

(d) sulphur dioxide [1]
ALLOW: SO_2
NOT: sulphur oxide

(e) calcium (oxide) [1]
ALLOW: CaO

[Total: 5]

A2 (a) M_r ammonium sulphate = 132, and $2N = 28$; [2]
 $\% = 100 \times 28/132 = 21$ or 21.2

(b) iron(II) – grey green/green solid or precipitate (both colour and precipitate needed for the mark) [1]
ALLOW: ppt

iron(III) – red-brown/brown/rust(y)-coloured (both colour and precipitate needed for the mark)
ALLOW: brick red [1]
NOT: red/pink/reddish/orange/other combinations with red or brown

ALLOW: 1 mark if both colours correct but no reference to precipitate

(c) (i) purple to colourless [1]
ALLOW: purple to (pale) yellow

(ii) (substances whose/atoms/ions/its) oxidation number increases/
oxidation number becomes more positive/
oxidation number becomes less negative/
decreases oxidation number of another substance etc. [1]

(d) (i) $\frac{22.5}{1000} \times 0.02 = 4.5 \times 10^{-4}$ (moles $KMnO_4$) [1]

(ii) $4.5 \times 10^{-4} \times 5 = 2.25 \times 10^{-3}$ (moles Fe^{2+})
 $2.25 \times 10^{-3} \times 56 = 0.126$ g
ALLOW: 0.13 g [2]

[Total: 9]

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A3	Ca^{2+}	20 (protons),	20 (neutrons),	18 (electrons)	[1]
	Cl^{-}	17 (protons),	20 (neutrons),	18 (electrons)	[1]

[Total: 2]

A4 (a) A and B [1]

(b) D [1]

(c) E [1]

(d) butene [1]
ALLOW: butylene/but-1-ene
REJECT: but-2-ene

[Total: 4]

A5 (a) (i) Na^{+} and Cl^{-} (both required) [1]

(ii) anode: chlorine [1]
ALLOW: Cl_2 or as product of an equation
cathode: hydrogen [1]
ALLOW: H_2 or as product of equation
IF: hydrogen at anode and chlorine at cathode = 1 mark

(b) complete circuit with electrodes dipping into electrolyte and cell(s)/(dc) power supply; [1]
impure copper anode/positive electrode and pure copper cathode/negative electrode [1]
ALLOW: + and – on diagram with impure and pure copper
ALLOW: impure copper anode and copper cathode;
(electrolyte) is aqueous copper(II) sulphate [1]
ALLOW: copper sulphate solution/aqueous CuSO_4 etc.

(c) (i) bauxite [1]
ALLOW: alumina/cryolite/diaspore/gibbsite/böhmite
NOT: aluminium oxide

(ii) carbon
ALLOW: graphite [1]

[Total: 8]

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A6 (a) (solution) turns brown/orange/yellow [1]
NOT: black/grey/purple solution/violet gas

(b) $\text{Cl}_2 + 2\text{KI} \rightarrow 2\text{KCl} + \text{I}_2$ [1]
ALLOW: $\text{Cl}_2 + 2\text{I}^- \rightarrow 2\text{Cl}^- + \text{I}_2$

(c) electrons lost/electron loss/electrons removed OWTTE [1]
ALLOW: oxidation number of iodine increases

(d) (i) No reaction because
astatine is less reactive than iodine ORA/
astatine is poorer oxidising agent than iodine ORA/
astatine releases electrons less well than iodine/
ALLOW: astatine lower in the group than iodine
ALLOW: reactivity decreases down the Group [1]
NOT: astatine less reactive (without reference to iodine/position in Group)

(ii) $2\text{Na} + \text{At}_2 \rightarrow 2\text{NaAt}$ [1]
ALLOW: multiples and $\text{Na} + \frac{1}{2} \text{At}_2 \rightarrow \text{NaAt}$

[Total: 5]

A7 (a) carbon dioxide/ CO_2 : [1]
limewater goes cloudy/white/milky/white precipitate [1]
(both limewater and result needed for one mark)
IF: another gas e.g. hydrogen then no marks

(b) $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ [1]
IGNORE: state symbols
REJECT: balanced equation with other species on left or right

(c) **U** – copper
V – magnesium
X – calcium
Y – sodium
Z – zinc correct order = 2 marks

U – sodium
V – magnesium
X – zinc
Y – copper
Z – calcium order reversed = 1 mark [2]

reason e.g.
the more reactive the metal, the longer the time taken to decompose ORA/
the more reactive the metal, the slower the rate (of decomposition) ORA/
ALLOW: more reactive metal (carbonates) take longer to decompose
ALLOW: the more reactive the metal (carbonate) the more stable it is to heat(ing) [1]
NOT: the metals are in order of the reactivity series

(d) $0.01 \times 5/2 = 0.025$ [1]

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[Total: 7]

Page 6	Mark Scheme	Syllabus	Paper
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- A8 (a)** displayed formula for ethanoic acid [1]
ALLOW: OH in place of O – H
NOT: CO₂H/COOH for carboxylic acid group
- (b)** $2\text{Cu} + \text{O}_2 + 4\text{H}^+ \rightarrow 2\text{Cu}^{2+} + 2\text{H}_2\text{O}$ [2]
correct formulae of reactants and products (1 mark)
correct balance (2nd mark)
- (c)** M_r of [Cu(CH₃CO₂)₂]₂·Cu(OH)₂ = 462 ;
x = 5 [2]

[Total: 5]

Section B

- B9 (a)** sodium: sodium hydroxide and hydrogen ; [1]
ALLOW: correct formulae/correct formulae in equation
NOT: sodium oxide/metallic hydroxide
magnesium: magnesium hydroxide and hydrogen; [1]
ALLOW: correct formulae/correct formulae in equation
NOT: magnesium oxide
(1 mark can be scored for hydrogen in both of the above OR sodium hydroxide and magnesium hydroxide in the above)
sodium reacts (much) faster than magnesium ORA [1]
ALLOW: any indication from observations e.g. lots of bubbles when sodium reacts with water and none/hardly any when magnesium reacts
- (b)** correct electronic structure of Na⁺ **and** O²⁻ drawn with charge on top right [1]
ALLOW: 2,8 and symbol Na⁺ **and** 2,8 and symbol O²⁻
REJECT: charges in middle of the atom
Formula: Na₂O [1]
- (c)** $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$ [1]
ALLOW: multiples and $2\text{Al} + 1\frac{1}{2} \text{O}_2 \rightarrow \text{Al}_2\text{O}_3$
- (d)** Any **two** from:
high melting point or high boiling point
insoluble in water
does not conduct electricity/poor electrical conductor/electrical insulator
does not conduct heat/poor conductor of heat
ALLOW: solid or hard [2]
- (e)** **one** physical property: low melting point/low boiling point/poor or non-conductor of electricity/poor or non-conductor of heat; [1]
NOT: gas/liquid
one chemical property: reacts with water to give acid/reacts with alkalis (or named alkali) to give salt [1]
ALLOW: acidic oxide/acidic in nature
ALLOW: (for acid) HClO₄/perchloric acid formed/(for alkali) NaClO₄

[Total: 10]

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B10(a) **X** = activation energy; [1]

ALLOW: E_a

Z = enthalpy change (of reaction); [1]

ALLOW: ΔH

NOT: energy change/heat given out

(b) (i) energy change is positive/enthalpy change is positive/
 energy of 2NO is above that of N_2 and O_2 /
 energy of N_2 and O_2 is below that of 2NO/
 energy of product(s) is above that of reactants/
 energy of reactants is below that of product(s) [1]
 NOT: it (unspecified) gains energy
 NOT: the product is above the reactants

(ii) bond breaking is endothermic/absorbs energy/takes in energy; [1]
 bond making is exothermic/releases energy/gives out energy; [1]
 more energy is absorbed than released [1]
[NOTE: 3rd mark can only be scored if first two marks have been gained]
REJECT: answers in terms of energy involved in bond making/breaking
 [more energy absorbed in bond breaking than release in bond making
 OWTTE = 3 marks]

(c) (i) activation energy lowered/provides surface for molecules to react/makes the
 reaction go by quicker alternative pathway [1]
 NOT: allows more frequent collisions

(ii) $2.4/2 = 1.2 \text{ dm}^3$ (unit required) [1]

(iii) either:
 $\frac{1.0}{1.2} \times 100$ (1 mark) = 83/83.3% (1 mark) [2]
 ALLOW: ecf from part **(ii)**
or:
 $1.0/24 = 0.04166$ (mol N_2)
 moles NO = $2 \times 0.04166 = 0.0833$ (moles) (1 mark)
 predicted moles NO = $2.4/24 = 0.1$ (moles)
 $100 \times 0.0833/0.1 = 83/83.3\%$ (2nd mark)

[Total: 10]

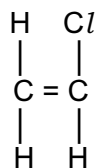
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- B11(a)** $C_nH_{2n+1}OH$ [1]
ALLOW: other letters e.g. x for n
NOT: $C_nH_{2n+2}O$
- (b)** carbon dioxide and water (both needed) [1]
ALLOW: correct formulae/steam for water
- (c) (i) for first mark**
 $C_2H_4 + H_2O \rightarrow C_2H_5OH$ [1]
[NOT: C_2H_6O for ethanol]
for second mark any two of:
high temperature/
ALLOW: 200°C to 400°C (usual = 300°C)
high pressure/
ALLOW: 50–100 atm (usual = 70 atm)
acid catalyst/phosphoric acid
REJECT: other named acids
IGNORE: silica/zeolite [1]
- (ii) either:**
 M_r for glucose 180 and ethanol 46 ; [1]
180 g glucose $\rightarrow$ 92 g ethanol; [1]
 $36 \times 92/180 = 18.4$ tonnes (unit needed) [1]
or:
moles glucose = $36 \times 10^6/180 = 0.2 \times 10^6$ moles (1 mark)
 0.2×10^6 moles glucose $\rightarrow$ 0.4×10^6 moles ethanol (1 mark)
 $0.4 \times 10^6 \times 46 = 18.4$ tonnes (1 mark)
- (iii)** ethene obtained from crude oil/petroleum/fossil fuels which is a finite resource/
non-renewable/will run out; [1]
glucose obtained from plants so continuous supply/renewable resource/won't run
out; [1]
ALLOW: reasonable named crop plants e.g. beet/wheat
ALLOW: glucose obtained by photosynthesis in place of plants
NOT: glucose made with the help of sunlight so renewable
NOT: because glucose is organic
(ethene from petroleum and glucose from plants = 1 mark)
- (d)** propanoic acid [1]
ALLOW: propionic acid/correct formula
ALLOW: propanal
NOT: propanic acid

[Total: 10]

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B12(a) correct structure of chloroethene showing all atoms and bonds



[1]

(b) (i) (bond formed) by sharing pair of electrons/two electrons (between the atoms) [1]
 NOT: electrons shared between two non metal atoms

(ii) electrons can't move/no mobile electrons/electrons not free to move [1]
 NOT: no free electrons/no sea of electrons
 REJECT: there are no ions or electrons to conduct

(c) (i) fills up landfill sites quickly/stays a long time in the ground/needs [1]
 a lot of landfill sites/takes up a lot of (valuable) land/blocks up drains
 ALLOW: can choke animals/fish/birds
 [NOT: harms animals/fish/birds]
 NOT: explanation of non-biodegradable e.g. does not rot
 NOT: not produces harmful fumes when burnt
 NOT: land pollution/fills up landfill sites (without qualification)

(ii) calcium chloride/ CaCl_2 [1]
 carbon dioxide/ CO_2 [1]
 water/ H_2O [1]

(d) (i) correct dot and cross diagram including inner shells of carbon [2]
 (paired electrons must be on the overlap areas of the orbits);
 inner shells of carbon missing/incorrect number of inner shells = 1 mark maximum

(ii) 28 tonnes (unit required) [1]

[Total: 10]