UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the November 2004 question paper

9701 CHEMISTRY

9701/06 **Paper 6 (Options), maximum raw mark 40**

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

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UNIVERSITY of CAMBRIDGE
International Examinations

Grade thresholds taken for Syllabus 9701 (Chemistry) in the November 2004 examination.

	maximum mark available	minimum mark required for grade:		
		A	B	E
Component 6	40	27	24	13

The thresholds (minimum marks) for Grades C and D are normally set by dividing the mark range between the B and the E thresholds into three. For example, if the difference between the B and the E threshold is 24 marks, the C threshold is set 8 marks below the B threshold and the D threshold is set another 8 marks down. If dividing the interval by three results in a fraction of a mark, then the threshold is normally rounded down.

November 2004

GCE A LEVEL

MARK SCHEME

MAXIMUM MARK: 40

SYLLABUS/COMPONENT: 9701/06

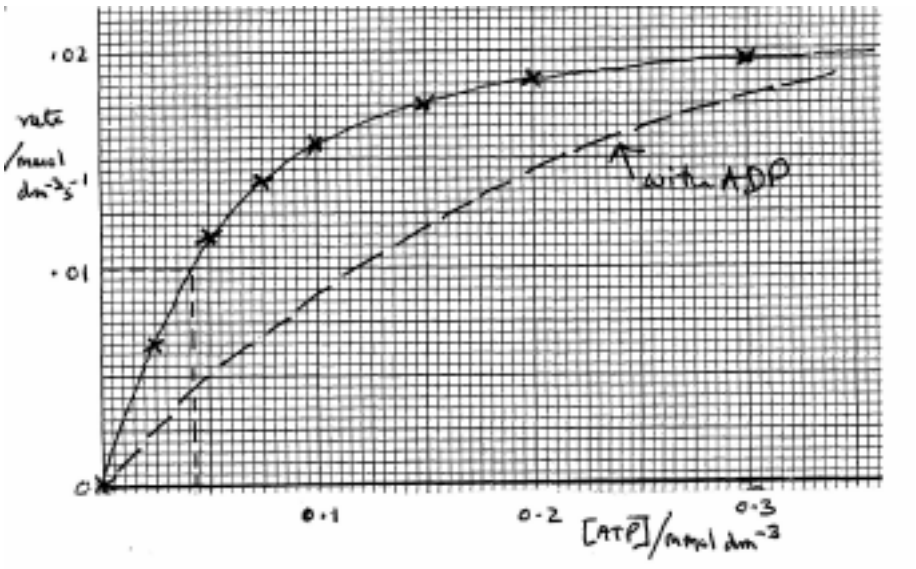
CHEMISTRY
Paper 6 (Options)

UNIVERSITY of CAMBRIDGE
International Examinations

Biochemistry

1. **(a)** ATP + H_2O → ADP + P **[1]**

(b) **(i)**



Axes labelled (1); points and plots (1); zero point (1)

(ii) K_m = 0.042 ± 0.003 (1)

(iii) mmol dm^{-3} (1) **[5]**

(c) Any three of:

ADP acts as an inhibitor/lowers rate (1)
Competes for active sites (1)
Chemically similar to ATP (1)
Feedback control/shifts equilibrium (1)

Line on graph must approach the same V_{max} (1)

[4]

2. **(a)** **(i)** $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ (1)

(ii) $C_{18}H_{36}O_2 + 16O_2 \rightarrow 18CO_2 + 18H_2O$ (1)

[2]

(b) **(i)** TWO valid points e.g.

Units of CHOH in glucose but CH_2 in stearic acid (1)
More O_2 required in stearic acid/more CO_2 produced (1)
More CH bonds to break (1)

[max 2]

(ii) Two M_r values (1)

Glucose 180 x 17 = 3,060 kJ mol^{-1} (1)
Stearic acid 284 x 39 = 11,076 kJ mol^{-1} (1)

[3]

(c) Converted into cellulose in plants for growth (1)
Makes starch in plants for storage (1)
Converted into glycogen in animals for storage (1)

[3]

Environmental Chemistry

3. **(a)** **(i)** <u>Stratosphere</u>

Ozone in the stratosphere absorbs/reduces uv radiation (1)
Formed by photochemical reaction of oxygen radicals with O_2 (1)
Removed in the presence of chlorine radicals from CFCs (1)

[3]

(ii) <u>Troposphere</u>

Formed by reaction of oxygen and nitrogen oxides (from vehicles) (1)
Irritates lungs/mucous membrane/destroys plant tissues (1)
Contributes to the 'greenhouse effect'/global warming (1)
Contributes to the formation of 'photochemical smog' (1)

[max 3]

(b) Lean burn engines reduce HC (1) CO emissions (1) 2 x (1)

Increase the formation of NO_x (1)

In catalytic converters the following occur:
(Allow any **two**)

$2CO + O_2 \rightarrow 2CO_2$ (1)
$C_8H_{18} + 12½O_2 \rightarrow 8CO_2 + 9H_2O$ (1)
$2NO + 2CO \rightarrow N_2 + 2CO_2$ (1)
$2NO_x + 2xCO \rightarrow N_2 + 2xCO_2$

[max 4]

4. **(a)** **(i)** Aluminium salts/sulphate NOT chloride (1)

(ii) Chlorine (allow ozone) (1)

(iii) Chlorinated organic materials/organic acids (1)

(iv) Nitrates - fertilisers (1)
Phosphates - detergents (1)

[5]

(b) <u>Landfill</u>

Large sites needed/these are unusable/not biodegradable (1)
Needs regular covering with soil (1)
Gases, such as CH_4, need to be vented (1)
Leachwater may contaminate groundwater (1)

[max 3]

<u>Incineration</u>

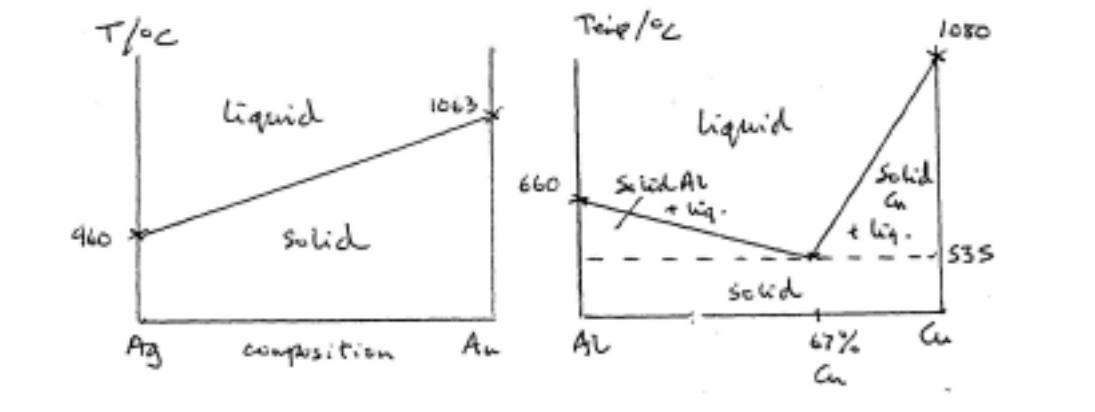
Produces CO_2 - greenhouse gas (1)
Other toxic gases (SO_2, NO_2, HCl) must be removed from exhaust gas (1)
Plastics can produce dioxins if the temperature is not controlled (1)

[any 2]

[5]

Phase Equilibria

5. **(a)** **(b)**



Sketch (1); areas (1) Sketch (1); areas (1); eutectic (1)

[5]

(c) Lower m.p. hence easier working (1)
Cost of materials (1)
Any Ag/Au solder with m.p. higher than Ag (1)
[allow speculations e.g. harder to join, expansion on solidification etc.]

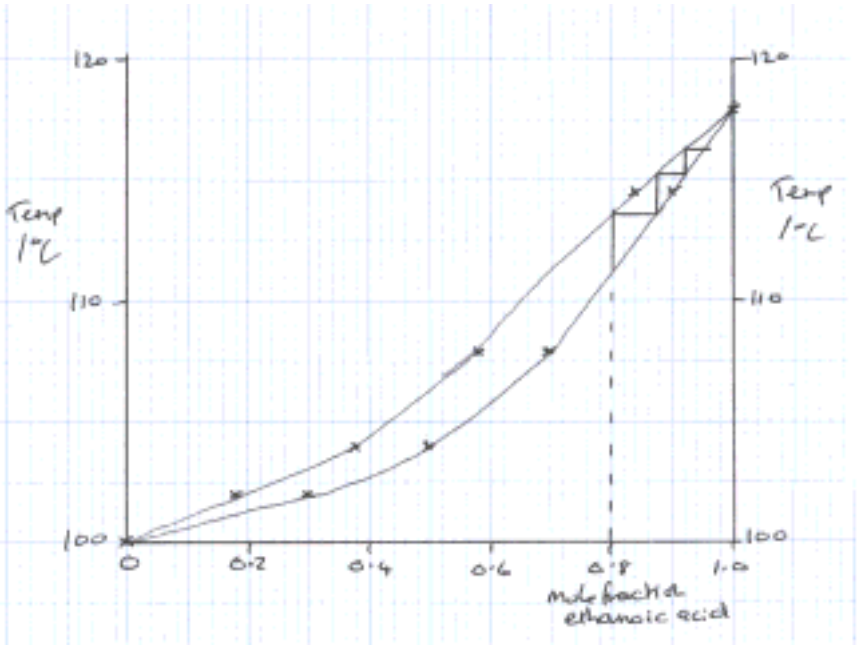
[max 2]

(d) **(i)** Ag and Au have similar atomic radii and form a solid solution (1)
Cu and Al (0.117 and 0.143) different atomic radii, do not form solution (1)
Cu and Al different types of metal (transition/p block) (1)

(ii) Ag and Au form homogenous mixture (1)
Cu and Al – contain domains of separate metals (1)

[max 3]

6. (a) (i) and (ii)

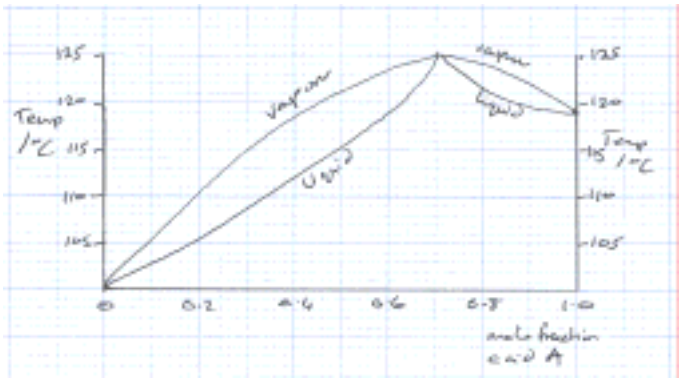


Axes (1); plot (1); liquid/vapour labels (1)

Construction lines (horizontal and vertical) (1)

Distillate is 0.94 - 0.98 mole fraction ethanoic acid (1)
(allow 0.42 - 0.46 if construction in -y direction) **[5]**

(b) (i)



Max at 0.7/125, vapour and liquid lines labelled (2 x 1)

(ii) Hydrogen bonding (1)

(iii) 0.90 → pure **A** }
0.70 → azeotrope } 3 correct scores (2), 2 correct scores (1)
0.50 → pure water }

[5]

Spectroscopy

7. **(a)** CH_3NO_2 $CH_2=CH_2$ (2 x 1) **[2]**
(contains π electrons or lone pairs scores (1))

(b) $\frac{0.48}{7.3} \times \frac{100}{1.1} = 5.97$ - hence 6 carbons (1)

E is C_6H_{12} (1)

[2]

(c) Pink form contains different chromophores/degree of delocalisation/ conjugation (1)
Greater delocalisation in alkaline/pink form (1)
Energy levels are closer together shifting absorption to visible range (1)

[3]

(d) -OH at ~3000 cm^{-1} (1)
C = O at ~ 1720 cm^{-1} (1)
(allow C-O at 1080 cm^{-1} or 1240 cm^{-1})
F is $CH_3CH_2CO_2H$ (1)

[3]

8. **(a)** Each proton's magnetic moment aligns with or against external field (1)
This gives two energy states (1)
For a given proton, it 'sees' adjacent protons energy states:
H_a protons see 2 H_b protons giving 1:2:1 triplet (1)
H_b protons see 3 H_a protons giving 1:3:3:1 quartet (1)
H_c proton has no adjacent protons (1)
Singlet (1)

[max 5]

(b) Low energy - does not damage tissues
Non-invasive - no tissue sample needed
Can be 'tuned' to particular protons/types of tissue **[any 2]**

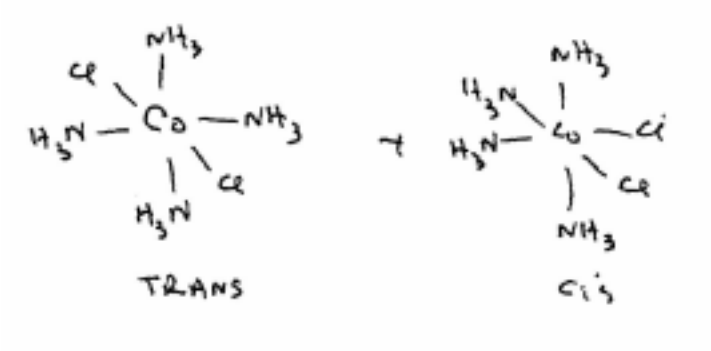
(c) **(i)** Cu^{2+} has a vacant d-orbital (1)
Allows promotion of electrons using energy in visible region (1)

(ii) Anhydrous Cu^{2+} has no ligands, hence d-orbitals are degenerate (1)
Hydrating the ion attaches water ligands splitting the orbitals (1)

[any 3]

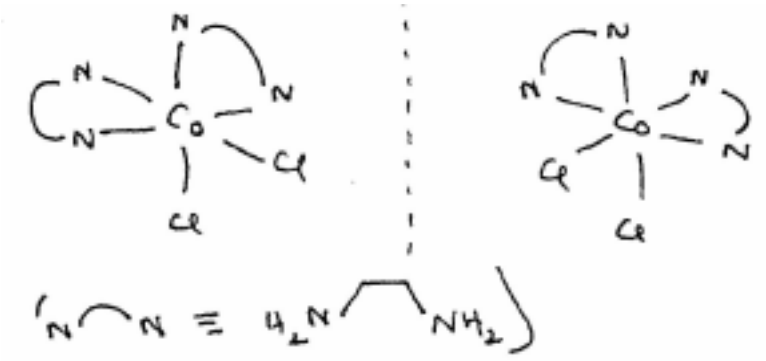
Transition Elements

9. **(a)** Cis-trans



2 x (1)

Optical



(1)
[3]

(b) **(i)** $[Co(H_2O)_6]^{2+}$ == $[Co(H_2O)_4]^{2+}$ + $2H_2O$ (1)
pink blue (1)

This reaction is endothermic (1)

(ii) $[Co(H_2O)_6]^{2+}$ + $4Cl^-$ == $[CoCl_4]^{2-}$ + $6H_2O$ (1)
blue (1)

(iii) $Co(OH)_2$ + $2OH^-$ == $[Co(OH)_4]^{2-}$ (1)
pink (1) blue (1)

Reversibility mention <u>anywhere</u> (1)

[max 7]

10. **(a)** **(i)** Cathodic areas : $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$ (1)

Anodic areas : $2Fe \rightarrow 2Fe^{2+} + 4e^-$ (1)

$Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2(s)$ or in words (1)

$2\ Fe(OH)_2(s) + ½O_2 + H_2O \rightarrow 2Fe(OH)_3$ [or $Fe_2O_3 \times H_2O$] rust (1)

Electrons pass from anodic to cathodic areas through the iron (1)

[max 4]

(ii) Galvanising (zinc) - electrochemical
Painting - excludes air/water
Plating - excludes air/water
Sacrificial anodes - electrochemical 2 x (1)

[2]

(b) **(i)** Ba = 0.3898 → 1
Fe = 0.3889 → 1
O = 1.556 → 4 hence formula is $BaFeO_4$ (1)

Oxidation state of iron is +6 (1)

(ii) $Fe_2O_3 + 3OCl^- + 4OH^- \rightarrow 2FeO_4^{2-} + 3Cl^- + 2H_2O$
(1) for species, (1) for balancing

[4]