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Mark Scheme (Results)
Summer 2007

GCE O

GCE O Level Chemistry (7081/02)

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At the standardisation meeting, the mark scheme will be discussed. It may be amended in the light of the discussion and of provisional marking experience. Examiners will take part in an agreement trial. The marks will be compared and discussed. Items used in the agreement trial may be taken away from the meeting for reference purposes; these must be destroyed (shredded/incinerated) at the conclusion of marking.

General Guidance on Marking

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge.

Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the Team Leader should be consulted through the review function.

Using the mark scheme

The mark scheme gives you:

- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

1 / means that the responses are alternatives and either answer should receive full credit.
2 ( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
3 Phrases/words in **bold** indicate that the <u>meaning</u> of the phrase or the actual word is **essential** to the answer.

7081/02

SECTION A

1 (a)

M1 concentrated sulphuric acid and ammonia react (to form a compound / ammonium sulphate) **(1)**

M2 use **anhydrous** calcium chloride / calcium oxide **(1)**

M3 ammonia is less dense than air / lighter than air **(1)**

M4 the gas must be collected by upward delivery / syringe **(1)**

OR use upward delivery

OR turn gas jar upside down

(b) $Ca(OH)_2 + 2NH_4Cl \rightarrow CaCl_2 + 2NH_3 + 2H_2O$
formulae correct **(1)**
equation balanced **(1)**

Ignore state symbols

(c) turns (damp) red litmus paper blue OR turns Universal indicator blue / purple **(1)**
smoke or white fumes / vapour with hydrogen chloride or put stopper of conc HCl bottle to gas

(d)

M1 (light) blue precipitate **(1)**

M2 precipitate dissolves to form **darker** blue solution **(1)**
Or gives dark blue solution with excess ammonia

M3 $[Cu(NH_3)_4(H_2O)_2]^{2+}$ or $[Cu(NH_3)_4(H_2O)_2]\ SO_4$ **(1)**

Total 10 marks

2 (a)

$Mg + 2H^+ \rightarrow Mg^{2+} + H_2$ accept Mg^{++} Mg^{+2} **(1)**

Must NOT include spectator ions

Ignore state symbols

(b) (i) 71 / 72 **(1)**

(ii) 160 cm^3 **(1)**

(iii) 160 cm^3 **(1)**

(iv) 57 s (± 2) **(1)**

(c) M1 moles H_2 / Mg = 160 / 24000 = (0.00667) **(1)**

M2 $\frac{24 \times 160}{24\,000}$ = 0.16g **(1)**

ecf from M1 if arithmetic error but must be based on use of 24000

M2 dependent on M1
Max (1) 150 used instead of 160 Answer only (0)

(d) ethanoic acid is a weaker acid / contains less H^+ / **(1)**
HCl is a stronger acid / contains more H^+ /
Ethanoic acid is a weak acid AND HCl is a strong acid
Ethanoic acid is partially ionised AND HCl is fully ionised

(e) steeper graph : must start at origin **(1)**
horizontal at 160 cm^3 **(1)**

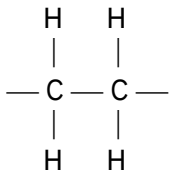
Total 10 marks

3 (a) (i) propane **(1)**

(ii) ethene **(1)**

(iii) methane **(1)**

(b) (i) addition **(1)**

(ii)  **(1)**

Or — CH_2 — CH_2 —

Ignore brackets, ignore n whether before or after formula

(c) (i) $C_2H_4 + H_2O \rightarrow C_2H_5OH$ **(1)**

Accept $CH_2=CH_2$ or $H_2C=CH_2$ or CH_2CH_2

Accept CH_3CH_2OH but NOT C_2H_6O NOT C_2H_5HO NOT CH_3CH_2HO

Ignore state symbols

(ii) acid catalyst / phosphoric acid (catalyst) (if acid specified it must be H_3PO_4) **(1)**

pressure 50 - 100 atm **(1)**

temperature 250 - 500 °C **(1)**
ALLOW (1) for BOTH high pressure and high temperature

(d) forces of attraction between ethanol molecules greater than between propane molecules **(1)**
Or stronger intermolecular forces in ethanol
Or weaker intermolecular forces in propane
Or hydrogen bonding in ethanol AND van der Waals forces / induced dipoles in propane.
Or hydrogen bonding in ethanol but not in propane.
Any reference to breaking covalent bonds (0)

Total 10 marks

4 (a) (i) **(1)**

M1 C = 40/12; H = 6.7/1; O = 53.3/16
= 3.33 6.7 = 3.33

M2 1:2:1 **(1)**

M3 CH_2O **(1)**

M1 is for dividing by A_r

Answer only scores (1)

(ii)

M1 $\frac{180}{30} = 6$ **(1)**

M2 $C_6H_{12}O_6$ **(1)**

M1 must be present to score both marks

ecf from part(a) for M1 only 180/empirical formula mass

(b) yeast or zymase **(1)**

temperature in range 25 – 40 °C **(1)**

absence of oxygen/air or anaerobic **(1)**

(c) (i) Condensation (polymer) ignore any reference to starch / carbohydrates **(1)**
Or condensational

NOT condensed

(ii) **(1)**

- O - ☐ - O - ☐ - O - (or longer)

Or - O - ☐ - O –

ALLOW - O - ☐ -

n does not have to be given, ignore its position, before or after formula

Total 10 marks

5 (a)

Experiment	Temperature	Volume of hydrochloric acid added
I	28.0	0
II	30.0	5
III	31.5	10
IV	33.0	15
V	34.0	20
VI	34.5	25
VII	35.5	30
VIII	35.5	35

table with columns for temperature and volume
(don't penalise if experiment column omitted) **(1)**

temperatures correctly read must be to 1dp eg 28.0 not 28 **(2)**
(allow 1 if between 4 and 7 correct)
Penalise temperature in I II IV V only once for absence of dp

(b) correct plots **(2)**
(allow 1 if between 4 + 7 correct)
line of best fit Must go slightly above 34.5 (exptVI) to score mark **(1)**

Plots consequential on readings in part (a)

(c) (i) 30 (cm^3)) BOTH ANSWERS FROM GRAPH **(1)**
(ii) 35.5 (ºC)) **(1)**

(d) M1 sodium hydroxide and hydrochloric acid ratio of 1:1 **(1)**

M2 $\frac{2 \times 25}{30} = 1.67$ ACCEPT 1.67 or 1.7 NOT 1.6 **(1)**

ecf from c(i) to denominator in M2

If c(i) is 35 , M2 = 1.43 ACCEPT 1.4

Total 10 marks

SECTION B

6 (a)

Reaction A

M1 heat **(1)**

M2 (colour change from green) to black or goes black **(1)**

M3 $CuCO_3 \rightarrow CuO + CO_2$ **(1)**

Reaction B

M4 add excess copper(II) oxide **(1)**

M5 to dilute sulphuric acid OR sulphuric acid : NOT concentrated sulphuric acid. **(1)**

M6 colourless solution turns blue or forms blue solution **(1)**

M7 filter off excess copper oxide **(1)**

M8 $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$ **(1)**
ACCEPT aq in equation for M5 and M6

Reaction C

M9 add sodium carbonate (solution) (if an insoluble carbonate is given allow M12 only) **(1)**

M10 blue/green precipitate **(1)**

M11 filter off precipitate **(1)**

M12 $CuSO_4 + Na_2CO_3 \rightarrow CuCO_3 + Na_2SO_4$ **(1)**

(b)

Copper oxide

M1 heat (in a combustion tube) **(1)**

M2 (stream of (dry)) hydrogen gas / CO / NH_3 / CH_4 **(1)**

M3 (black powder) becomes pink-brown or goes pink brown / red brown **(1)**

M4 $CuO + H_2 \rightarrow Cu + H_2O$ or with alternative reagent **(1)**
ACCEPT heating CuO with charcoal NOT coke
If coke or natural gas used allow m M1 M3 M4

Copper sulphate

M5 add zinc (powder) or Fe / Al / Mg **(1)**

M6 pink-brown precipitate / deposit or red brown ppt / deposit/blue colour fades **(1)**

M7 filter (precipitate) /decant **(1)**

M8 $Cu^{2+} + Zn \rightarrow Cu + Zn^{2+}$) accept a molecular equation **(1)**
) could be alternative reagent

(c)

M1 impure copper anode) if reversed (0) **(1)**

M2 (pure) copper cathode) **(1)**

M3 electrolyte of specified soluble copper salt solution **(1)**
(marks may be obtained from a suitably labeled diagram)

M4 anode $Cu \rightarrow Cu^{2+} + 2e^-$ **(1)**

M5 cathode $Cu^{2+} + 2e^- \rightarrow Cu$ **(1)**
ACCEPT e without charge for electron

M4/M5 electrodes do not have to be specified, but if given must be correct. If electrode equations reversed, allow (1) for two correct electrode equations.

Total 25 marks

7 if reaction specified not used must score (0)

(a)

M1 heat (in test tube / boiling tube) **(1)**

M2 (turns from blue) to off white or goes white **(1)**

M3 add water **(1)**

M4 (turns from white) to blue or goes blue **(1)**

M5 $CuSO_4.5H_2O \rightleftharpoons CuSO_4 + 5H_2O$ must have reversible arrows **(1)**
ACCEPT pair of equations ACCEPT $CuSO_4.xH_2O \leftrightarrow CuSO_4 + x\ H_2O$

(b)

M1 react $CaCO_3$ chips / lumps with HCl AND react powdered $CaCO_3$ with HCl **(1)**

M2 same mass of $CaCO_3$, same temperature, same volume of HCl, same concentration of HCL any 2 points score (1) mark **(1)**

M3 measure time to collect same volume or measure volume of gas at different times or measure time to lose mass **(1)**

M4 same volume in shorter time with powdered or results could be given on labelled vol-time graph showing powdered reacts faster **(1)**

M5 $CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$ **(1)**

(c)

M1 burn sulphur (in test tube) ALLOW heat **(1)**

M2 $S + O_2 \rightarrow SO_2$ **(1)**

M3 add named indicator solution OR damp named indicator paper **(1)**

M4 turns red **(1)**

M5 $SO_2 + H_2O \rightarrow H_2SO_3$ **(1)**

(d)

M1 take temperature of iron(II) sulphate solution Or use thermometer **(1)**

M2 add magnesium (ribbon) **(1)**

M3 grey deposit or green solution fades or goes colourless **(1)**

M4 temperature of reaction mixture higher or increase in temperature **(1)**

M5 $Mg + Fe^{2+} \rightarrow Mg^{2+} + Fe$ or $Mg + FeSO_4 \rightarrow MgSO_4 + Fe$ **(1)**

(e)

M1 soak separate wads of cotton wool in (concentrated) ammonia and (concentrated) hydrochloric acid **(1)**

M2 place at opposite ends of (long) glass tube **(1)**

M3 white 'smoke' / fumes / solid forms **(1)**

M4 nearer to hydrochloric acid end of the tube **(1)**

M5 $NH_3 + HCl \rightarrow NH_4Cl$ **(1)**

Total 25 marks

8 (a) (i)

M1 relative formula mass = 5 x 12 + 12 x 1 = 72 **(1)**

M2 $\frac{60 \times 100}{72}$ ecf on incorrect M_r in M1 **(1)**

M3 = 83.3% ALLOW 83 Answer only scores (1) **(1)**

(ii)

M1 $CH_3CH_2CH(CH_3)_2$ **(1)**

M2 (2)-methylbutane **(1)**

M3 $CH_3C(CH_3)_3$ **(1)**

M4 (2-2)-Dimethylpropane **(1)**

numbers used in names to indicate position of side chains must be correct to score.
Penalize sticks once only

(iii) alkanes **(1)**

C_nH_{2n+2} **(1)**

$C_{10}H_{22}$) NOT structural formula or molecular and **(1)**
) structural unless qualified

(b) bonds broken:

M1 C=C and H-H **(1)**

M2 energy taken in = 610 + 432 = 1042 kJ **(1)**

OR M1 OR 3(C–C) + 10(C–H) + 1(C=C) + 1(H–H) **(1)**

M2 = 1038 + 4130 + 610 + 432 = 6210 kJ **(1)**

bonds formed:

M3 C-C, 2 x C-H **(1)**

M4 energy given out = 346 + 2 x 413 = 1172 kJ **(1)**

OR M3 Or 4(C–C) + 12(C–H) **(1)**

M4 = 1384 + 4956 = 6340 **(1)**

If M2 and M4 correct score (2), if not check bonds broken and formed

M5 energy change = 1042 - 1172 Or 6210 – 6340 **(1)**

M6 = –130 kJ or kJ mol^{-1} Units must be given **(1)**

M5 ecf from M2 and M4
M6 ecf from M5) only allow if M5 is for
) bonds broken – bonds formed

M7 Exothermic / endothermic **(1)**
Stand alone mark based on sign of enthalpy change in M6.

continued

(c)

$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$

M1 symbols correct **(1)**

M2 balance **(1)**

$C_5H_{12} + {}^{11}/_2O_2 \rightarrow 5CO + 6H_2O$

M3 symbols correct **(1)**

M4 balance **(1)**

M5 less energy given out during incomplete combustion **(1)**

M6 less efficient / more expensive to use **(1)**

M7 carbon monoxide is poisonous / toxic **(1)**

M8 causes asphyxia explained in some way / forms carboxy haemaglobin **(1)**

NOT greenhouse gas

NOT bad for health

Total 25 marks

9 (a)

M1 bauxite **(1)**

M2 anode reaction: $2O^{2-} \rightarrow O_2 + 4e^-$) **(1)**
M3 cathode reaction: $Al^{3+} + 3e^- \rightarrow Al$) **(1)**

M2/M3 electrodes do not have to be specified, but if given must be correct. If electrode equations reversed, allow (1) for two correct electrode equations.

diagram to show:
M4 graphite / carbon anode)if reversed on diagram allow (1) for **(1)**
M5 graphite / carbon cathode)graphite / carbon electrodes **(1)**
M6 aluminium produced at cathode) could be scored from a **(1)**
)specified cathode equation
M7 electrolyte of aluminium oxide /alumina / Al_2O_3 **(1)**
M8 (dissolved in)molten **(1)**
M9 Cryolite / Na_3AlF_6 **(1)**

No (unlabelled) diagram, score max (3) for M4 to M9
If diagram not industrial, score max (3)

(b)

M1 e.g. iron / chromium / metal must be named **(1)**
M2 iron oxide (powder (mixed)) with aluminium **(1)**
M3 use of magnesium fuse or described **(1)**
M4 (Very) exothermic / (lot of) heat given out / yellow flame
molten iron formed / violent reaction **(1)**
M5 $Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$ **(1)**
Incorrect metal allow M2 M3 M4

(c)

M1 aluminium 2.8.3 **(1)**
M2 aluminium ion 2.8 **(1)**
M3 oxygen 2.6 **(1)**
M4 oxide ion 2.8 if oxygen 2.8.6 accept oxide ion as 2.8.8 **(1)**
M5 Al^{3+} and O^{2-} **(1)**
M6 2:3 ALLOW $2Al^{3+}$ and $3O^{2-}$ Accept formula Al_2O_3 dependent on M5 **(1)**
(If M5 scored, allow ratio of Al to O is 2 to 3 for M6)

(d)

diagram to show:
M1 Al^{3+} ions NOT + in circle without qualification eg Al^{3+} ions **(1)**
Not Al ions or metal ions or nuclei
M2 regular arrangement **(1)**
M3 (random) electrons **(1)**
M4 electrons described as delocalised / sea of electron **(1)**
M5 electrons move or are mobile (to carry current) **(1)**

Labelled diagram must show M1, M2 and M3

Total 25 marks