AN ROINN OIDEACHAIS AGUS EOLAÍOCHTA | DEPARTMENT OF EDUCATION AND SCIENCE

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Ceimic — *Gnáthleibhéal*

Marking Scheme — *Leaving Certificate Examination, 2001*

Chemistry — *Ordinary Level*

AN ROINN OIDEACHAIS AGUS EOLAÍOCHTA

LEAVING CERTIFICATE EXAMINATION, 2001

CHEMISTRY – ORDINARY LEVEL

Marking Scheme

Question 1 11 x 6 + 4.
Question 2 (a) 4 x 3, (b) 3 x 3, (c) 6 + 2 x 3, (d) 3 x 3, (e) 1 x 6, (f) 3 + 3 x 3 +2 x 3.
Question 3 (a) 3 x 3, (b) 6, (c) 6, (d) 6, (e) 3 x 3, (f) 2 x 6, (g) 6 + 3, (h) 6 +3.
Question 4 (a) 6 + 3, (b) 6 + 2 x 3, (c) 2 x 6, (d) 3 + 3 x 3, (e) 4 x 3, (f) 6 + 3.
Question 5 (a) 4 x 3, (b) 2 x 3 + 2 x 6, (c) 3 x 6, (d) 6 (e) 2 x 6.
Question 6 (a) 6 + 3 + 6 + 6 x 3 + 6, (b) 2 x 3 + 5 x 3 + 2 x 3.
Question 7 (a) 3 + 3 + 6 + 2 x 3 + 6 + 3 x 3, (b) 4 x 6 + 3 + 2 x 3.
Question 8 (a) 4 x 3, (b) 6 + 3 + 3, (c) 2 x 6, (d) 6, (e) 2 x 6 + 6, (f) 2 x 3.
Question 9 (a) 2 x 3, (b) 3 x 6 + 2 x 3, (b) 2 x 6 + 3 x 3 (c) 2 x 3, (d) 3 x 3.
Question 10 (a) (i) 2 x 3, (ii) 2 x 3 + 6 + 2 x 6 + 3
Question 10 (b) (i) 3 x 6, (ii) 2 x 3 + 2 x 3, (iii) 3
Question 10 (c) (i) 6, (ii) 6, (iii) 3 + 6 (iv) 2 x 3 + 6
Question 10 (d) 11 x 3.

Question 1 **(11 x 6 + 4)**

Eleven highest scoring items to count.
One additional mark to be added to the first four items for which the highest marks are obtained.

(a) **Sulphur / S** (6)

(b) **Number of protons** (3) in the **nucleus** / of **an atom** (3) of an element // **Number of electrons** (3) in a **neutral atom** of an element (3)

(c) **Dobereiner** (6)

(d) **Equal volumes of different gases** at the same temperatures and pressure (3) **contain the same number of molecules** (3)

(e) **27.27 % / 27.3% / 27 %** (6) //

$\frac{12 \times 100\ (3)}{44\ (3)}$

(f) **van der Waal / London / Dispersion / Interaction of temporary dipoles** (6)

(g)

$$K_c = \frac{[CO].[H_2]^3}{[CH_4].[H_2O]} \quad (6)$$

[(3) for correct top and (3) for correct bottom {allow 3 marks for inverted expression}]

(h) **Calcium sulphate / Magnesium sulphate / Calcium chloride / Magnesium chloride / $CaSO_4$ / $MgSO_4$ / $CaCl_2$ / $MgCl_2$ / lime / gypsum /etc.** (6)

(i) **VII / +7 / 7** (6) [allow (3) where O.N. of K and O_4 are correct]

(j) **500** (6) ppm

$\frac{0.25 \times 1000}{500}$ (3) / 0.5 g/litre (3) // x 1000 (3)

(k) **Mg / Magnesium** (3) //

Na / Sodium (3)

(l) When a system at **equilibrium is disturbed / stressed** (3) the position of the equilibrium shifts so as to **minimise / oppose** the disturbance (3)

(m) **Aldehydes** (6)

(n) Addition of **silver nitrate** (3) results in **white precipitate** (3)

(o) 112 g (6)

$\frac{200}{100}$ / 2 (3) // x 56 (3)

(70)

Question 2

(a) **A** = **Volumetric flask / measuring flask** (3)

B = **Conical flask / titration flask** (3)

C = **Pipette** (3)

D = **Burette** (3)

(b) (i) **Volumetric flask** (3)

(ii) **Burette** (3)

(iii) **Pipette** (3)

(c) (i) **Pipette / Burette** (6)
(ii) **Conical flask / titration flask / volumetric flask** (3)//
Idea of **changing amount of reagent present** (3)

(d) **Methyl Orange / Methyl Red / etc.** (3) Not phenolphthalein or litmus
Colour in base (3) **Colour in acid** (3) Must be matched with indicator. [Allow 3 marks for reverse order, accept orange/yellow for colour of methyl orange in base]

(e) Any precaution *relevant to accuracy* re using the pipette:
Not blowing out the last drop / touching tip off side of flask / etc.
Any precaution *relevant to accuracy* re using the burette:
Reading bottom of meniscus / clamping vertically / reading at eye-level / making sure the area below the tap is full / etc.
Any precaution *relevant to accuracy* re the titration itself:
Washing down the walls of the flask with deionsed water /
swirling the flask to mix contents / use white tile / add drop-wise near end point / repeat to 0.1 cm^3 / remove funnel from top of burette / eye at meniscus level etc. (6)

(f) **20 / 20.0** (3) //

Concentration of sulphuric acid = **0.063 / 0.0625** mol dm^{-3} (9) //

Concentration of sulphuric acid = **6.17 / 6.125** g dm^{-3} (6) //

$\frac{V_1 \times M_1}{n_1} = \frac{V_2 \times M_2}{n_2}$ (3)

$\frac{25.0 \times 0.05}{1} = \frac{20.0 \times M}{1}$ (3)

M = 0.0625 (3) mol dm^3

98 (3) x 0.0625 = 6.125 (3)

98 (3) x 0.063 = 6.17 (3)

(66)

Question 3

(a) **X = ethanol / C_2H_5OH/ CH_3CH_2OH** (3) //

Y = Aluminium oxide / alumina / Al_2O_3 (3) //

White (3)

(b) (They contain) displaced **air / impure/ contain impurities** (6)

(c) To avoid a **suck-back** (6) [Allow (3) for "safety"]

(d) **Dehydration** (6)

(e) **Carbon dioxide / CO_2** (3) //

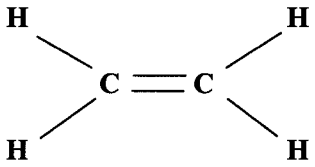
Water / H_2O (3) //

Carbon dioxide turns lime-water milky / water turns cobalt chloride paper pink / water turns anhydrous copper sulphate blue (3)

(f) **Decolourisation / colour becomes paler/ red-brown to colourless / red-brown disappeared** (6) //

(Evidence for) **unsaturation / double bond** (6)

(g)



(6) **Alkenes** (3)

(h) **$-CH_2CH_2CH_2CH_2-$** (6)

Plastic bags / plastic bottles / plastic sheeting / etc. (3)

(66)

Question 4

(a) **Sodium** (6) [accept symbol for 3 marks]//

Hydrogen / H_2 (3)

(b) **Chromium** (6) [accept symbol for 3 marks] //

Cr: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$ (3) // $4s^1\ 3d^5$ / $3d^5\ 4s^1$ (3) [accept [Ar] (3) / $3d^5\ 4s^1$ (3)]

(c) **Helium** (6) [accept symbol for 3 marks]//

Noble gases (6) [accept inert gases for 3 marks]

(d) **Nitrogen / N / N_2** (3) //

Diagram or words
N with 5 valence electrons (3)
Hydrogen with one electron (3)
Shared pairs formed / covalent bonding / NH_3 (3)

(e) **Hydrogen / H / H_2** (3)

Helium / He (3)

Nitrogen / N / N_2 (3)

Chlorine / Cl / Cl_2 (3)

(f) Any ionic example: **Name** (6) //

Formula (3)

[e.g. sodium chloride (6) //

NaCl (3)]

(66)

Question 5

(a) Diagram should have:
reaction flask containing magnesium and dilute hydrochloric acid /
with delivery tube to trough of water / and gas being collected over water /
in an inverted graduated cylinder or burette (4 x 3) //
reaction flask containing magnesium and dilute hydrochloric acid /
with delivery tube to gas syringe / sleeve / plunger (4 x 3)
Minimum of one label - no labels deduct 3 marks.

(b) **Labelled Axes** (3) //

Linear scales on axes (3) //

All points plotted correctly (6) [seven points plotted correctly allow (3)]//

Curve drawn (6) [points joined but not curve allow (3)]

(c) (i) **11 – 12 min** (6)

(ii) **2.1 – 2.5 min / 2 min 6 sec – 2 min 30 sec** (6)

(iii) **2.7 – 3.0 min / 2 min 42 sec – 3 min** (6)

(d) **Concentration of the acid decreased / acid used up / Magnesium ribbon got used up** (6)

(e) (i) **Reaction faster / increased rate/ shorter time** (6)

(ii) **Reaction faster / increased rate/ shorter time** (6)

(66)

Question 6

(a) (i) **Heat given out** (ii) **Heat taken in** (6 + 3)

Energy (Heat) change when **one mole** (3) of a substance is **formed from its elements** (3)

[Award 6 marks to all candidates attempting question 6 for Heat of Formation definition]

$2C + 2O_2$	$\rightarrow$	$2CO_2$	$\Delta H = -788$ kJ	(3 , 3)
$H_2 + \frac{1}{2}O_2$	$\rightarrow$	H_2O	$\Delta H = -286$ kJ	(3)
$2CO_2 + H_2O$	$\rightarrow$	$C_2H_2 + 2\frac{1}{2}O_2$	$\Delta H = 1299$ kJ	(3 , 3)
$2C + H_2$	$\rightarrow$	C_2H_2	$\Delta H = 225$ kJ mol^{-1}	(3)

50 MJ kg^{-1} / 49 962 kJ kg^{-1} (6) //

$\frac{1299}{26}$ (3) x 1000 (3) = 49962 kJ kg^{-1}

(b) Heat change when **one mole** (3) // of a substance is **burned in excess oxygen / burned to form the normal oxide of its elements** (3)

Using words or labelled diagram or a combination of both:
Calorimeter with water in it /known mass or volume of water/
known quantity of liquid being burned in a small container under calorimeter / ignite liquid/
draught shield / initial temperature being measured / final temperature being measured / stir /
heat produced from this amount of substance calculated / use of mcΔθ /
heat change for a mole of substance to be calculated from this (any 5 x 3) //
Bomb calorimeter with water in it /known mass or volume of water/
known quantity of liquid being burned / ignition source /
temperature being measured /
heat produced from this amount of substance calculated / use of mcΔθ /
heat change for a mole of substance to be calculated from this (any 5 x 3) //

Heat loss to surroundings / accurately measuring temperature rise / liquid does not burn completely (2 x 3)

(66)

Question 7

(a) (i) **Proton donor / source of H^+ ions / neutralised by a base/ pH < 7**(3)

(ii) **Proton acceptor / source of OH^- ions / neutralised by acid / pH > 7** (3)

(iii) **Two species related by the loss/gain of one H^+** (6) [accept valid example for (3)]

(iv) **pH = $-\log_{10}$** (3) **$[H^+]$** (3) {accept: pH = –log $[H^+]$}

(i) **0.05** (6) mol dm^{-3}

(ii) **12.7** (9) //

$[H^+][OH^-] = 10^{-14}$ (3) //

$\frac{1 \times 10^{-14}}{0.05} = [H^+] = 2 \times 10^{-13}$ (3) mol dm^{-3} //

$pH = -\log_{10} (2 \times 10^{-13})$

$= 12.7$ (3)

$pOH = -\log_{10} [OH^-] = -\log_{10} (0.05)$ /

$= 1.3$ (3)

$pH = 14 - pOH$ (3)

$pH = 14 - 1.3 = 12.7$ (3)

(b) (i) **CO_2 / Carbon dioxide** (6)

(ii) **MgO / Magnesium oxide** (6)

(iii) **H_2O / Water** (6)

(iv) CO / Carbon monoxide (6)

Rain which **has a low pH / with acidic oxides dissolved** (3)

Kills trees / kills fish / dissolved stonework / causes corrosion / etc. (2 x 3)

(66)

Question 8

(a) **A** = **Ethane** (3)

B = **Choroethane / ethyl chloride** (3)

C = **Ethanol / ethyl alcohol** (3)

D = **Ethanoic acid / acetic acid** (3)

(b) **Alkanes** (6) //

Named alkane (3) //

$\mathbf{C_nH_{2n+2}}$ (3) Matched formula

(c) **Chlorine** (6) //

ultra-violet light / hf / hν/ bright sunlight / free radical substitution (6)

(d) **Sodium hydroxide / hydroxide ion / named source of hydroxide** / alkaline **hydrolysis**(6)

(e) **Sodium dichromate / potassium dichromate / sodium chromate / potassium chromate / potassium manganate(VII) / potassium permanganate** / Name or formula (6) //

Sulphuric acid / $\mathbf{H_2SO_4}$ (6) // [Accept acidified dichromate or acidified sodium dichromate for 12 marks]

Oxidation (6)

(f) **Carboxylic** (3) **acids** (3)

(66)

Question 9

(a) A substance which **alters the rate of (speeds up) a chemical reaction** (3)
without being consumed in the process (3)

(i) **Activated iron oxide / Fe_2O_3 (6)**

(ii) **Rhodium-platinum gauze / Rh-Pt** (6)

(iii) **Vanadium pentoxide / vanadium(V) oxide / V_2O_5** (6)

$N_2 + 3H_2 \rightleftharpoons 2NH_3$ / $\frac{1}{2}N_2 + 1\frac{1}{2}H_2 \rightleftharpoons NH_3$ /

$SO_2 + \frac{1}{2}O_2 \rightleftharpoons SO_3$ / $2SO_2 + O_2 \rightleftharpoons 2SO_3$ /

$4NH_3 + 5O_2 \rightleftharpoons 4NO + 6H_2O$ (6) [Formulae 3, Balance 3]

(b) (i) **Air / atmosphere** (6)

(ii) **Natural gas / methane / CH_4 / naphtha** (6)

The conversion of molecular **nitrogen** (3) **into compounds / usable** by plants (3) //
Electric storms / lightning / legumes / N fixing bacteria / named legume (3)

(c) $NH_3 + HNO_3 \rightarrow NH_4NO_3$ (6) [3 for each side]

(d) Saturated **iron**(II) **sulphate** (3)

Concentrated **sulphuric acid** (3)

Brown ring at the junction of the two liquids (3)

(66)

Question 10 **(66)**

Two of the parts (a), (b), (c) and (d) to count.

(a) (i) Area in an atom **occupied by electrons** (3) **of similar energy** (3) // definite **fixed energy** (3) that an **electron in an atom** can have (3)

(ii) **Space around** the nucleus of **an atom / space around the nucleus** of an atom (3)
where there is a high probability (chance) of finding an electron / can hold two electrons(3)

Bohr (6)

Metal	Lithium	Sodium	Potassium	Magnesium	Calcium	Copper
Colour	Crimson / red	Orange / yellow	Lilac/ purple	White	Yellow/ orange	Green/ blue-green

(6, 6, 3)

(b) (i) **Iron ore / haematite / magnetite / Fe_2O_3 / Fe_3O_4 / iron oxide** (6) //
limestone / $CaCO_3$ (6) //
coke / C (6) (Names or formulae)

(ii) **Carbon monoxide** (3) //
CO (3) //

Fe_2O_3 + 3CO → 2Fe + $3CO_2$ (6) (formulae left 3, right 3)

(iii) **Carbon / C** (3)

(c) (i) **0.5** (6) //

$\frac{32.5}{65}$ (3) = 0.5 (3)

(ii) **1** (6) mole //

0.5 x 2 (3) = 1.0 (3)

(iii) **0.5** (3) moles //

11.2 (6) litres //

0.5 x 22.4 (3) = 11.2 (3)

(iv) **68** (12) grams //

136 (3) x 0.5 (3) = 68 (6)

(d) 1 = flocculation **2 = chlorination** **3 = fluoridation**

4 = filtration **5 = hard** **6 = soft**

7 = deionisation **8 = primary** **9 = tertiary**

10 = secondary **11 = eutrophication** (11 x 3)

(66)