Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE 2011

MARKING SCHEME

CHEMISTRY

ORDINARY LEVEL

Introduction

In considering the marking scheme the following should be noted.

1. In many cases only key phrases are given which contain the information and ideas that must appear in the candidate's answer in order to merit the assigned marks.

2. The descriptions, methods and definitions in the scheme are not exhaustive and alternative valid answers are acceptable.

3. The detail required in any answer is determined by the context and the manner in which the question is asked, and by the number of marks assigned to the answer in the examination paper, and in any instance, therefore, may vary from year to year.

4. The bold text indicates the essential points required in the candidate's answer. A double solidus (//) separates points for which separate marks are allocated in a part of the question. Words, expressions or statements separated by a solidus (/) are alternatives which are equally acceptable for a particular point. A word or phrase in bold, given in brackets, is an acceptable alternative to the preceding word or phrase. Note, however, that words, expressions or phrases must be correctly used in context and not contradicted, and where there is evidence of incorrect use or contradiction, the marks may not be awarded. Cancellation may apply when a candidate gives a list of correct and incorrect answers.

5. In general names and formulas of elements and compounds are equally acceptable except in cases where either the name or the formula is specifically asked for in the question. However, in some cases where the name is asked for, the formula may be accepted as an alternative.

6. There is a deduction of one mark for each arithmetical slip made by a candidate in a calculation.

Outline Marking Scheme

Section A [At least <u>two</u> questions must be answered from this section]

1. (a) (i) NAME; (ii) IDENTIFY; WHAT: (8 + 3 + 3); (b) (i) NAME; (ii) IDENTIFY; (iii) WHAT: (6 + 6 + 3); EXPLAIN: (2 × 3); (c) NAME: (3); MAKE: (3); HOW: (3); (d): EXPLAIN: (6).

2. (a) NAME: (5); (b) WHAT: (3); WHY: (3); (c) CALC.: (6); (d) NAME: (2 × 3); (e) WHAT: (6); (f) NAME: (3); STATE: (2 × 3); (g) WHY: (3); (h) CALC.: (9).

3. (a) NAME; FORM.: (5 + 3); (b) DRAW: (4 × 3); (c) (i) PLOT: (3) (3) (6) (3); (ii) FROM: (6); USE: (3) (d) WHY: (6).

4. (a) (2 × 3); (b) (2 × 3) ; (c) (2 × 3); (d) (6); (e) (6); (f) (6); (g) (6); (h) (6); (i) (6); (j) (2 × 3); (k) **A:** (6); **B:** (6).

5. (a) (i) DEFINE: (6); (ii) DEFINE: (5); (b) NAME: (6); (c) WHAT: (3); (d) DRAW: (2 × 3); (e) DEFINE: (2 × 3); (f) USE: (2 × 3); (g) DRAW: (3 × 3); STATE: (3).

6. (a) WHICH: (2 × 4 + 3); (b) (i) WHY: (3); (c) GIVE: (2 × 3); (d) (i) IDENTIFY: (2 × 6); (ii) DESCRIBE: (6); EQUATION: (6); (e): GIVE: (6).

7. (a) (i) DEFINE; (ii) DEFINE: (5 + 3); (b) GIVE: (2 × 3); (c) EXPLAIN: (2 × 3); EXAMPLE: (6); (d) DEFINE: (6); CALC. (i): (9); (ii): (3); (e) GIVE: (6).

8. (a) WHICH: (5); (b) GIVE: (4 × 3); (c) WHAT (i); (ii): (9 + 3); (d) DESCRIBE: (2 × 3); (e) USE: (6); (f) WHICH; GIVE: (6 + 3).

9. (a) WRITE: [(3 × 9) + (3 × 3)]; (b) DESCRIBE: 2 × (4 + 3).

10. (a) DESCRIBE: 4 + (4 × 3); WHAT (i); (ii): (6 + 3);
(b) (i) GIVE: (4); (ii) DESCRIBE: (5 × 3); (iii) STATE: (2 × 3);
(c) DEFINE (i); (ii): (4 + 3); (iii) INDICATE; JUSTIFY: (3 × 3); (iv) DESCRIBE: (3 × 3).

11. (a) WHAT: (4 + 3); (i) NAME: (3 × 3); WHICH: (3); (ii) NAME: (2 × 3);
(b) (i) HOW: (9); (ii) HOW: (4); (iii) WHAT: (12);
(c) **A** (i) EXPLAIN: (2 × 2); STATE: (2 × 3); (ii) STATE: (6 + 3); (iii) GIVE: (2 × 3);
B WHO: (3); (i) WHAT: (7); (ii) EXPLAIN: (6); (iii) HOW: (6); HOW: (6).
[Q 11 (c) B can receive a maximum of 25 marks]

SECTION A

At least *two* questions must be answered from this section.

QUESTION 1

(a) (i) NAME: **distillation / fractionation //**

(ii) IDENTIFY: preparation of **ethanoic acid /** preparation of **soap //**

WHAT: **ethanoic acid / ethanol** (8 + 3 + 3)

(b) (i) NAME: **reflux //**

(ii) IDENTIFY: **preparation of ethanoic acid / preparation of soap //**

(iii) WHAT: **to bring reaction to completion / maximise yield / to speed up a reaction / to heat a liquid without loss of vapours** (6 + 6 + 3)

EXPLAIN: **liquid is heated (boils) // vapour cooled (condensed) in condenser // liquid falls back into flask** Any (2 × 3)

(c) NAME: (Liebig) **condenser** (3)

MAKE: **correct connection** (3)

HOW: **cold water flows between two glass surfaces / provides a cold jacket / hot vapour hits the cold surface and condenses** (3)

(d) EXPLAIN: **to prevent bumping /** act as **anti-bumping agent** (6)

QUESTION 2

(a) NAME: **volumetric flask** (5)

(b) WHAT: **invert** several times (3)

WHY: to ensure **mixing (homogeneous solution)** (3)

(c) CALC.: **5.3** (6)

x ÷ 106 (3) = 0.05 (3) / 0.05 × 106 (3) = x (3)

(d) NAME: **B: pipette** (3)

C: burette (3)

[Allow 3 marks if both items are named but in wrong order]

(e) WHAT: **Wash down sides of titration flask** (6)

(f) NAME: **indicator** (3)

initial colour // final colour (2×3)

[colours must be matched]

methyl orange	**orange** (**yellow**) to **red (accept peach)**
Methyl red	**yellow** to **red**
phenolphthalein	**pink** (**purple**, **violet**, **red**) to **colourless**
thymolphthalein	**blue** to **colourless**
thymol blue	**blue** to **yellow**
cresol purple	**purple** (**pink**, **violet**) to **yellow**
neutral red	**yellow-brown** (**yellow**, **brown**) to **red**
phenol red	**red** to **yellow**
bromothymol blue	**blue** to **yellow**

[Colour must be matched with chosen indicator
*Colour in **acid** (i.e. final colour) is indicated in **bold**]*
[Correct colours but reversed – award 3 marks]

(g) WHY: **contrast / to see colour change** (3)

(h) CALC.: **0.11** M (9)

$\frac{22.7 \times M}{2}$ (3) = $\frac{25.0 \times 0.05}{1}$ (3) M = 0.11 (3)

[Allow 3 marks for calculation formula if no other marks are awarded]

QUESTION 3

(a) GIVE: NAME: **manganese dioxide**

FORM.: **MnO_2** (5 + 3)

(b) DRAW: **reaction vessel where peroxide decomposes //**
delivery tube to means of collection of oxygen //
means collecting evolved oxygen //
means of measuring (calibration) //
minimum of one appropriate label Any (4 × 3)
[no diagram – deduct 3 marks]

(c) (i) PLOT: **volume axis correctly labelled** (3)
time axis correctly labelled (3)
minimum of 7 points plotted correctly (6)
curve drawn (3)
[allow 3 marks if a minimum of 4 points plotted correctly]

(ii) FROM: **52 ± 2** cm^3 (6)
[Allow 3 marks in ±4 range]

USE: **11 – 12** minutes [consistent with graph] (3)

(d) WHY: **concentration** of peroxide **decreases** with time / **rate proportional to concentration** (6)

SECTION B

QUESTION 4

Eight items to be answered. Six marks to be allocated to each item and one additional mark to be added to each of the first two items for which the highest marks are awarded.

(a) **small // identical // indivisible** Any (2×3)

(b) **bomb // calorimeter** (2×3)

(c) **evolves (gives out) // heat** (2×3)

(d) **cracking / reforming / isomerisation / dehydrocyclisation / addition of MTBE / addition of lead compounds** (6)

(e) **carcinogenic** (6)
[Allow 3 marks for health hazard or harmful]

(f) Robert **Boyle** (6)

(g) $\dfrac{[NH_3]^2}{[N_2].[H_2]^3}$ (6)
[Allow 3 marks for top / 3 marks for bottom / 3 marks if inverted]

(h) **decrease** (6)

(i) **35** % (6)

$$\frac{28}{80} \quad (3) \times 100 \quad (3)$$

(j) **platinum // rhodium // palladium // cerium** Any (2×3)

(k) **A** propellant in **aerosols / refrigerants / to expand plastics / fire retardants / air-conditioning / dry cleaning / solvents / expanded polymers** / burger **cartons** (6)

B **carbon** (6)

QUESTION 5

(a) DEFINE: (i) **number of protons** in the nucleus of an atom of an element (6)

(ii) **number of protons and neutrons** in the nucleus of an atom (5)

(b) NAME: JJ **Thomson** (6)

(c) WHAT: **8** (3)

(d) DRAW: **2 electrons in first shell // 6 electrons in second shell** (2×3)

(e) DEFINE: **measure of the** relative **attraction an atom has //**
for a shared pair of electrons in a covalent bond / for the **electrons in a covalent bond** (2×3)

(f) USE: **electronegativity difference / electronegativity values //**
polar covalent (2×3)

(g) DRAW: **electronic configurations of hydrogen and oxygen //**
two shared pairs of electrons //
two non-bonding (lone) pairs of electrons (3×3)

STATE: **angular / v-shaped / bent** (3)

QUESTION 6

(a) WHICH: (i) **methane //**

(ii) **butane //**

(iii) **ethyne //** $(2 \times 4 + 3)$

(b) WHY: **smell / safety** (3)

(c) GIVE: *kerosene*: **aviation fuel / heating** (3)

bitumen: **road surfacing / roofing / water proofing** (3)

(d) (i) IDENTIFY: **X: calcium carbide / calcium dicarbide / CaC_2** (6)

Y: water / H_2O (6)

(ii) DESCRIBE: **sooty / smoky / luminous** flame (6)

EQUATION: **$C_2H_2 + 2½O_2 \rightarrow 2CO_2 + H_2O$** (6)
[all formulas correct (3), balancing (3)]

(e) GIVE: **clean / burns more efficiently than petrol /** produces **drinking water in spacecraft / available** (6)

QUESTION 7

(a) DEFINE: (i) **produces H^+ ions** in solution
[Allow 'proton donor' for 3 marks]

(ii) **produces OH^- ions** in solution (5 + 3)

(b) GIVE: **valid acid** (3)

valid base (3)

(c) EXPLAIN: **reaction of an acid and a base // to give a salt and water** (2 × 3)

EXAMPLE: **stomach acid** treatment / **sting** treatment / adding **lime to acidic soil** (6)

(d) DEFINE: **– log $_{10}$ [H^+]** (6)
{**– log $_{10}$** (3) [H^+] (3)}

CALC.: (i) **1** (9)

{**– log $_{10}$ [0.1]** (6)}= 1 (3)

(ii) **0.7** (3)

{**– log $_{10}$ [0.2]**}= 0.7 (3)

(e) GIVE: **not good for concentrated solutions / not accurate outside 0 – 14 range** (6)

QUESTION 8

(a) WHICH: **X / CH_3CH_2OH / ethanol** (5)

(b) GIVE:

W: ethene //

X: ethanol //

Y: ethanal //

Z: ethanoic acid / acetic acid (4×3)

(c) WHAT:

(i) **hydration / addition //**

(ii) **oxidation** (9 + 3)

(d) DESCRIBE: add **bromine water / potassium manganate**(VII) **(potassium permanganate) // decolorises** (2×3)

(e) USE: **vinegar** / food **preservative / stain remover** (6)

(f) WHICH: **W / C_2H_4 / ethene**

GIVE: **polyethene / polythene** (6 + 3)

QUESTION 9

(a) WRITE:

1: chlorination
2: filtration
3: pH adjustment
4: fluoridation
5: sedimentation / flocculation
6: sedimentation / flocculation $[(3 \times 9) + (3 \times 3)]$

(b) DESCRIBE:

primary: **screening** / **passing through a grid** / **use of grit channels** / **settling** //

removal of solid material

secondary: **biological** digester / **trickling tank** / **trickling filter** / **bio-tower** / **activated sludge unit** / **settling*** //

biological **destruction of waste material / oxidation by micro-organisms**

tertiary: **addition of polyelectrolyte** / **precipitation** agents / **biological denitrification** (for nitrates) / **settling*** //

removal of nitrates (phosphates) Any two $2 \times (4 + 3)$

[* settling can only be used once]

QUESTION 10: Answer any *two* of the parts (a), (b) and (c).

(a) DESCRIBE: **platinum probe (wire) / nichrome probe (wire) / wood splint //**
prepare (clean) probe / soak wood splint //
dip in salt //
place **in hottest part //**
of Bunsen flame //
observe colour [(4 + 4 × 3)]

WHAT (i) **yellow / orange //**

(ii) **lilac / purple** (6 + 3)

(b) (i) GIVE: **drug identification / separation of dyes** (4)

(ii) DESCRIBE: **see table below** Any (5 × 3)

[some points can be got from a diagram]

Chromatography	
Saturate tank	Prepare column (flush with solvent or water)
Application of sample to plate	Application of sample to column
Where/how application is made (i.e. spot)	Where/how application is made (i.e. at top)
Arrangement with eluent – in tank	Arrangement with eluent – addition to column
Elution	Elution
Separation observed	Separation observed

(iii) STATE: **partitioning / differing attraction //**
between stationary (solid, static) and moving phase (solvent) (2 × 3)

(c) DEFINE: (i) **loss //**
(ii) **gain** (4 + 3)

(iii) INDICATE: **Mg / magnesium //**
Cl / Cl_2 / chlorine //
JUSTIFY: **Mg loses electrons / chlorine gains electrons** (3 × 3)

(iv) DESCRIBE: **add silver nitrate** solution //
white / cream //
precipitate //
soluble in ammonia
Any (3 × 3)

QUESTION 11: Answer any *two* of the parts (a), (b) and (c)

(a) WHAT: **spontaneous** random // **decomposition (disintegration or decay) of the nucleus** of an atom (4 + 3)

(i) NAME: **alpha (α) // beta (β) // gamma (γ)** (3 × 3)
WHICH: **gamma (γ)** (3)

(ii) NAME: **radium (Ra) // polonium (Po)** (2 × 3)

(b) (i) HOW: **0.1** (9)
$2.7 \div 27 = 0.1$ (3 × 3)

(ii) HOW: **0.3** (4)
0.1×3 (4)

(iii) WHAT: **13.35** (12)
$[27 + 3(35.5)] \times 0.1$ (4 × 3)

(c) Answer part **A** *or* part **B**.

A

(i) EXPLAIN: **prevention of the radiation of // heat** absorbed **from the sun** (2 × 2)
STATE: **increased temperatures / melting of ice caps / climate change/ rising sea level** (2 × 3)

(ii) STATE: Methane: **gas leaks / cattle population / paddy fields / dumps//**
Water: **combustion of fossil fuels /respiration/ evaporation** (6 + 3)

(iii) GIVE: **nitrogen monoxide [nitrogen(II) oxide, nitric oxide] / nitrogen dioxide [nitrogen(IV) oxide] / sulfur dioxide / sulphur trioxide//**
NO / NO_2 / SO_2 / SO_3 (2 × 3)
Correct name and formula matched for full marks

B

WHO: Humphry **Davy** (3)

(i) WHAT: **electrolysis** (7)

(ii) EXPLAIN: **sodium** too **reactive/ stable salts** (6)

(iii) HOW: **coated with zinc / dipped in molten zinc** (6)
HOW: **excludes air (water) / zinc preferentially oxidised / cathodic protection / zinc serves as sacrificial metal** (6)
[Q 11 (c) B can receive a maximum of 25 marks]