Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE 2008

MARKING SCHEME

CHEMISTRY

ORDINARY LEVEL

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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.

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) INDICATE: (4)**,** (4); (b) EXPLAIN: (6); (c) WHAT: (6); (d) WHY: (6); (e) WHAT: (6); (f) WHY: (6); (g) WHY: (6); (h) WHAT: (6).

2. (a) WHAT: (5); (b) WHAT: (6); (c) OUTLINE: (4 × 3); (d) WHAT: (i): (6), (ii): (6); (e) NAME: (3); NAME: (3); COLOUR: (3); (f) CALC.: (9).

3. (a) MATCH: (2 × 5 + 4); (b) DESCIBE: (2 × 6 + 2 × 3); (c) WHERE: (6); (d) NAME: (6); (e) WHAT: (3), (3).

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

5. (a) (i) COMPLETE: (2 × 4 + 3 × 3); (ii) WHAT: (6); (b) (i) DEFINE: (2 × 3); (ii) HOW: (2 × 3); (c) (i) WHAT: (6); (ii) NAME: GIVE: (3 + 6).

6. (a) WHAT: (i) (4); (ii) (4); (b) (i) WHICH: (ii) WHICH: (iii) WHICH: (2 × 6 + 3); (c) WRITE: *ethyne*: (6) *butane*: (6); (d) NAME: STATE: USE: (2 × 6 + 3).

7. (a) (i) HOW: (5); (ii) GIVE: USE: (2 × 6); (b) (i) DEFINE: (6)**;** (ii) DESCRIBE: (3) (3) (3); (iii) WHAT: (9); (iv) CALC.: (9).

8. (a) STATE: HOW: (4 × (2 × 3)); (b) EXPLAIN: *primary*:(2 × 3); *secondary*: (2 × 3); *tertiary*: (2 × 3) (c) GIVE: (2 × 4).

9. (a) WHICH: (5); (b) GIVE: (3) (3) (3); (c) WHICH: (i): (6) (ii): (6); (d) (i) GIVE: (6); (ii): WHY (6); (iii) DESCRIBE: (6) (3) (3).

10. (a) (i) GRAPH: (3) (6) (3); (ii) FIND: (6); (iii) USE: (7);
(b) (i) STATE: (4 × 4); (ii) CHOOSE: (6 + 3);
(c) (i) STATE: (4 + 3); (ii) WHAT: (6); (iii) STATE: (2 × 3) GIVE: (2 × 3).

11. (a) (i) WHO: (5); (ii) WHO: (5); (iii) WHO: (5); (iv) WHO: (5); (v) WHO: (5);
(b) (i) EXPLAIN: WHAT: (4 + 3); (ii) IDENTIFY: (2 × 3); (iii) NAME: (6); NAME: (6):
(c) **A** (i) NAME: (2 × 5); (ii) NAME: GIVE: (6 + 3); IS: EXPLAIN: (2 × 3);
B (i) IDENTIFY: (4); (ii) WHAT: (6); (iii) WHO: (6); (iv) GIVE: (6 + 3).

SECTION A

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

QUESTION 1

(a) INDICATE: **water inlets and outlets identified //** (4)
correct flow direction (4)

(b) EXPLAIN: **to prevent bumping** (6)
[Allow 3 marks for mention of 'safety']

(c) WHAT: **orange** (6)
[Allow 'yellow' for 3 marks]

(d) WHY: **exothermic** reaction // **gives out heat** // **violent reaction** (6)
[Allow 3 marks for reference to 'safety']

(e) WHAT: **green** (6)

(f) WHY: **bring reaction to completion // increase yield // react fully** (6)

(g) WHY: **not hot enough** // **ethanoic acid boils above 100 °C** (6)

(h) WHAT: **vinegar** (6)

QUESTION 2

(a) WHAT: **volumetric** (5)

(b) WHAT: a solution of **known concentration** (6)

(c) OUTLINE: **weigh (get mass) of sodium carbonate //**
dissolve in small volume of **deionised water in a beaker** //
transfer to volumetric **flask** //
add deionised water until level of water near mark / **top up with deionised water** //
add **dropwise (by dropper / by pipette / by wash bottle) / bring meniscus level with mark** / **read at eye level //**
stopper and invert several times / **mix** thoroughly / solution **homogeneous (even concentration, same concentration throughout)** ANY FOUR: (4 × 3)

(d) WHAT: (i): pipette (6)
(ii): burette (6)
[Allow 6 marks if both are items are named but in wrong order]

(e) NAME: **indicator** (3)
colour at end-pint (3)
[indicator must be specified in order to get marks for colour]

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**]*

(f) CALC.: **0.125** M (9)

$$\frac{20.0 \times M}{2} \quad (3) \quad = \quad \frac{25.0 \times 0.05}{1} \quad (3) \qquad M = 0.125 \quad (3)$$

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

QUESTION 3

(a) MATCH:

FLAME COLOUR	Orange-yellow	Lilac	Green
SALT	**Sodium chloride / NaCl**	**Potassium nitrate / KNO_3**	**Copper(II) chloride / $CuCl_2$**

$(2 \times 5 + 4)$

(b) DESCIBE: **nichrome (platinum) wire / get lollipop stick (wood splint)** //
prepare (clean) probe (lollipop stick, wood splint) / steep lollipop stick overnight **in water** / **dip in HCl //**
dip in solution of **salt** / **dip (steep) lollipop stick in** solution of **salt //**
insert tip of probe / **place lollipop stick in** hottest part of **Bunsen flame** $(2 \times 6 + 2 \times 3)$

(c) WHERE: **street lights** (6)
[Accept 'fireworks']

(d) NAME: **strontium // lithium** (6)
[Accept correct elemental symbol]

(e) WHAT: **add silver nitrate / $AgNO_3$ //** (3)
white **precipitate** results (3)

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) **argon // Ar** (6)

(b) **absorbs heat / takes in energy** (6)

(c) atomic radii **increase (get bigger)** (6)

(d) **bomb calorimeter** (6)

(e) measure of **tendency (likelihood) to auto-ignite (knock, pink, pre-ignite, ignite early, ignite before spark) //**
number representing **ability (tendency, measure) to resist autoigniting (knocking, etc.) //**
number **based on a scale where 2,2,4-trimethyl pentane (*iso*-octane) is assigned a rating of 100 and heptane (*n*-heptane) a value of 0 //**
percentage by volume of 2,2,4-trimethylpentane (*iso*-octane) in a blend (mix) with heptane (*n*-heptane) that matches the behaviour of the fuel (6)

(f) JJ **Thomson** (6)

(g) **loss** of electrons (6)

(h) $$\frac{[SO_3]^2}{[SO_2]^2[O_2]}$$ (6)
[Allow 3 marks for top / 3 marks for bottom / 3 marks if inverted]

(i) **20** % (6)

$$\frac{24}{120} \times 100 \quad (3) \qquad (3)$$

(j) **clove oil (eugenol) / rose oil / oil of lavender / citrus (orange, etc.) oil / other correct plant material** (6)

(k) **A signage // posters // awareness campaigns // bonuses // penalties for unsafe behaviour**
ANY TWO: (2×3)

B lustre // malleable // conduct electricity // conduct heat // form salts ANY TWO: (2×3)

QUESTION 5

(a) (i) COMPLETE: $(2 \times 4 + 3 \times 3)$

	Relative mass	Relative charge	Location
Proton		**+1**	**nucleus**
Neutron	**1**	**0**	
Electron			**electron cloud**

(ii) WHAT: **number of protons** in nucleus // **nuclear charge** (6)

(b) (i) DEFINE: relative (measure of) **attraction / number expressing (giving) attraction //**
for a shared pair of **electrons / for electrons in a** covalent **bond** (2×3)

(ii) HOW: **low (no) difference ⇒ covalent //**
moderate difference ⇒ polar covalent //
high difference ⇒ ionic (electrovalent) ANY TWO: (2×3)

(c) (i) WHAT: pure **covalent** (6)

(ii) NAME: **ionic (electrovalent) //**
GIVE: **sodium fluoride / NaF / any ionic fluoride (name or structure)** (3 + 6)

QUESTION 6

(a) WHAT: (i) **compounds containing hydrogen and carbon only** (4)
(ii) **releases heat (energy) when burned** (4)

(b) (i) WHICH: **butane**
(ii) WHICH: **hydrogen**
(iii) WHICH: **ethyne** ($2 \times 6 + 3$)

(c) WRITE: *ethyne*: **H–C≡C–H / HCCH** (6)
butane: **$CH_3CH_2CH_2CH_3$** (6)
[Expanded structures must have all bonds indicated but need not have H-atoms indicated]
[Accept $(CH_3)_2CHCH_3$ or $(CH_3)_3CH$]

(d) NAME: **see below** (must be matched)
STATE: **see below** (must be matched)
USE: **see below** (must be matched) ($2 \times 6 + 3$)

Fraction	Where on column	Major use
refinery gas	**top /high**	**heating / cooking**
light gasoline (petroleum**)**	**high**	**petrol**
naptha	**high / mid**	**petrol / plastics**
kerosene (paraffin)	**mid**	**aviation fuel / heating**
gas oil / diesel	**mid**	**cars / trucks / heating**
lubricating oil /	**low**	**lubricant / engine oil**
fuel oil	**low**	**ship fuel / electricity generation**
bitumen	**bottom**	**road surfacing / roofing**

QUESTION 7

(a) (i) HOW: **produces H^+ ions in solution** (5)
[Allow 'proton donor' for 3 marks]

(ii) GIVE: **sodium hydroxide / NaOH / caustic soda** / any common example (i.e. base named) //
USE: **drain cleaning / oven cleaning /** matched use (2 × 6)

(b) (i) DEFINE: **$-\log_{10}[H^+]$** (6)
{**$-\log_{10}$** (3) **$[H^+]$**(3)}

(ii) DESCRIBE: **dip / spot / add / insert probe //** (3)
universal indicator paper **/ pH meter //** (3)
compare to chart to read pH / read meter (3)

(iii) WHAT: **0.1** M (9)

3.65 ÷ (3) 36.5 (3) = 0.1 (3)

(iv) CALC.: **0.1** M (9)

pH = $-\log_{10}[H^+]$
= $-\log_{10}$ [0.1] (6)
= – (– 1)
= 1 (3)

QUESTION 8

(a) STATE:

HOW: ANY FOUR × (2 × 3)

	purpose	how carried out
sedimentation	**remove** suspended **solids (small particles)**	**settling** in sedimentation tanks
flocculation	**coagulation (clumping together) of** fine suspended **solids (small particles)**	**addition of flocculating agent (alum, aluminium sulfate, aluminium chloride ferric chloride, polyelectrolytes etc.)**
filtration	**Removal of** suspended **solids / clearing of**	**passing water through sand (gravel) beds**
chlorination	**kill bacteria (microbes) / disinfection / sterilise**	**addition of chlorine (Cl_2) / chlorine releasing agent / example**
fluoridation	**to help prevent tooth decay / oral hygiene**	**addition of fluoride (F^-) / hexafluorosilicic (hydrofluorosilicic) acid (H_2SiF_6) / fluosilicate (fluorosilicate, silicofluoride, SiF_6^{2-})**
pH adjustment	**raise pH // lower pH**	**lime [calcium hydroxide, $Ca(OH)_2$] / sodium hydroxide [caustic soda, NaOH] / sodium carbonate (Na_2CO_3) / soda ash // sulfuric acid** (matched to lower pH)

(b) EXPLAIN: *primary*: **screening** // allow **settling** // **removal of suspended solids** (2 × 3)

secondary: **biological digestion // of sewage (organic nutrients)** (2 × 3)

tertiary: **removal of nitrates // removal of phosphates** (2 × 3)

(c) GIVE: **algal bloom // fish kills // eutrophication** (2 × 4)

QUESTION 9

(a) WHICH: **X** (5)

(b) GIVE: **X: ethene / ethylene** (3)
Y: ethanol / ethyl alcohol (3)
Z: ethanal / acetaldehyde (3)

(c) WHICH: (i): **Y / ethanol / ethyl alcohol** (6)
(ii): **X / ethene / ethylene** (6)

(d) (i): GIVE: **alumina / aluminium oxide / Al_2O_3** (6)

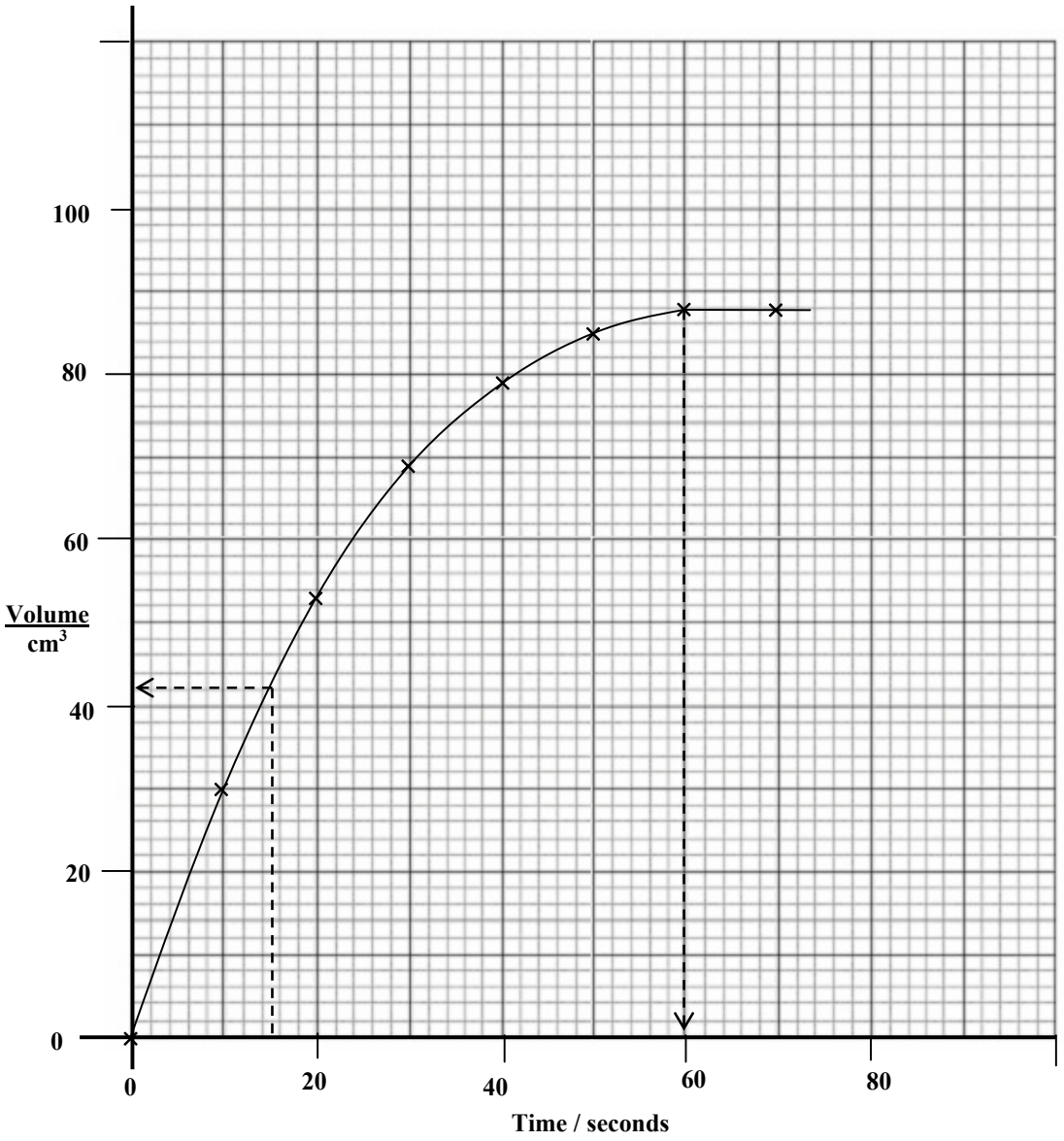
(ii): WHY: **prevent suck back / breaking of apparatus (test tube)** (6)
[Allow 3 marks for 'safety' without further clarification]

(iii): DESCRIBE: **test** (6)
observation (3)
conclusion (3)

test	observation	conclusion
bromine-water	**becomes colourless**	**unsaturated**
acidified **potassium manganate(VII)** / acidified **potassium permanganate**	**becomes colourless**	**unsaturated**
combustion	**burns with a luminous flame**	**flammable / short chain**

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

(a) (i) GRAPH: **labelled axes** (3)
points plotted correctly (6)
[Allow 3 marks if a minimum of 4 points are plotted correctly]
curve drawn (3)



(ii) FIND: **41 - 44** cm^3 (6)
[Allow 3 marks for figures up to 2 cm^3 on either side of this range]

(iii) USE: **57 - 60** seconds (7)
[Allow 3 marks for figures up to 2 cm^3 below this range]

(b) (i) STATE: **see table below** (4 × 4)

technique	use
Mass spectroscopy (MS)	**identify presence of isotopes //** **determination of isotopic abundances //** **determination of** relative **atomic masses //** **determination of** relative **molecular masses //** **identify compounds //** **elucidation of molecular structures**
Gas chromatography (GC)	**separation technique //** **testing for alcohol in blood //** **testing** athletes **for drugs (banned substances)** in blood
High-performance liquid chromatography (HPLC)	**separation technique //** **food analysis //** **testing for** presence of **growth promoters //** **testing for** presence of **vitamins //** **testing for** presence of **caffeine**
Thin-layer chromatography (TLC)	**separation technique /** **separation of dyes (pigments, paints)** in forensic science

(ii) CHOOSE: **see table below** (6 + 3)

technique	principle
Mass spectrometry (MS)	**charged particle moving in a magnetic field //** **undergo deflections which are related to their mass**
All chromatographies	**diff. affinity** for **(attraction** for**, interaction** with**,** **partitioning** between) **// mobile (or name) and (or)** **stationary (or name) phases**

(c) (i) STATE: reactions **at equilibrium //**
oppose (minimise, relieve) applied stress(es)*{disturbance(s)*} (4 + 3)
*[*If the word 'stress(es)' or 'disturbance(s)' is replaced by particular examples (e.g. temperature, pressure and concentration) allow the marks.]*

(ii) WHAT: **equilibrium process // forward and reverse reactions occurring simultaneously.** (6)
[Allow 'reversible reaction']

(iii) STATE: **low temperature // high pressure** (2 × 3)

GIVE: **reaction is exothermic // fewer molecules on the right** (2 × 3)

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

(a) (i) WHO: **Boyle** (5)
(ii) WHO: **Dalton** (5)
(iii) WHO: **Mendeleev** (5)
(iv) WHO: **Curie** (5)
(v) WHO: **Rutherford** (5)

(b) (i) EXPLAIN: **a substance which alters (changes, increases, decreases) the rate of a chemical** reaction but is not used up (chemically changes) in the process

WHAT: **heterogeneous // adsorption** (4 + 3)

(ii) IDENTIFY: **carbon dioxide / CO_2 //**
nitrogen / N_2 (2 × 3)

(iii) NAME: **platinum // palladium // rhodium** (6)
NAME: **sulfur // lead // arsenic** (6)

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

A

(i) NAME: **see table below**
NAME: **see table below** (2 × 5)

product	use
ammonia	**fertiliser manufacture // urea manufacture // nitric acid manufacture // explosives manufacture**
nitric acid	**fertiliser manufacture // explosives manufacture**
magnesium oxide	**refractory material // lining furnaces // fire brick manufacture**

[Accept correct formulae]

(ii) NAME: **see table below**
GIVE: **see table below** (6 + 3)

product	raw material	source
ammonia	**hydrogen // nitrogen // natural gas // methane // air**	**natural gas // air**
nitric acid	**ammonia // oxygen // air // water**	**NH_3 manuf. plant // air // river // ground water**
magnesium oxide	**seawater // limestone**	**sea // quarry**

[Accept correct formulae]

(iii) IS: **see table below**
EXPLAIN: **see table below** (2 × 3)

product	type	explain
ammonia	**batch**	**product produced in fixed runs or batches**
nitric acid	**batch**	**product produced in fixed runs or batches**
magnesium oxide	**continuous**	**Materials being fed into process and product removed (produced) continuously**

B

(i) IDENTIFY: **penicillin // vitamin B_{12}** (4)

(ii) WHAT: **x-ray // crystallography** (6)

(iii) WHO: **Bragg**s (6)

(iv) GIVE: **diamond / graphite / penicillin / vitamin B_{12}** (6 + 3)