



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2015

Marking Scheme

Chemistry

Ordinary Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

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 formulae 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.
7. Bonus marks at the rate of 10% of the marks obtained will be given to a candidate who answers entirely through Irish and who obtains less than 75% of the total marks.

Candidates are required to attempt 8 questions in total. All questions carry equal marks (50).

Section A

At least two questions must be answered from this section.

Section B

At least five questions must be answered from this section.

Eight items to be answered in **Question 4**. Six marks 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.

Note that candidates who attempt **Question 10** are required to answer two of the parts (a), (b) and (c) and candidates who attempt **Question 11** are required to answer two of the parts (a), (b) and (c) where candidates who answer part (c) may choose **A** or **B**.

Section A

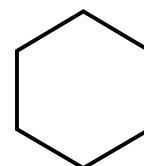
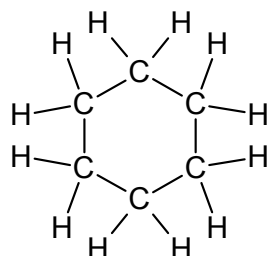
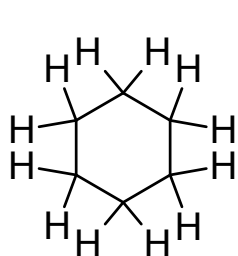
At least two questions must be answered from this section.

QUESTION 1

- (a) (i) WHAT: **steam distillation**
- (ii) NAME: **Liebig condenser**
- (iii) WHAT: **cool (condense) distillate (vapours) / change vapours into liquids**
- (iv) SHOULD: **Y**
- (v) DESCRIBE: **milky (white, cloudy) liquid**

(8 + (4 × 3))

- (b) (i) DRAW:



(6)

[Allow (3) for benzene or for a correct cyclohexane structure with aromaticity incorrectly indicated.]

- (ii) CAN: **organic** (6)

- (iii) DESCRIBE: **stopper //**
shake (invert, mix) layers //
release vapours (pressure) by opening tap or stopper //
repeat washing (rewash) aqueous layer twice with more solvent //
allow to stand / allow layers separate //
open tap to drain (collect layers)

(2 × 6)

- (iv) HOW: **evaporate solvent / heat / use steambath (waterbath, hotplate) / distillation**

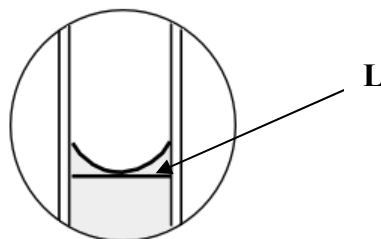
(6)

QUESTION 2

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

(b) STATE: **add rinsings** of beaker to flask (F) / **use wash bottle** /
pour down glass rod (funnel) placed in neck of volumetric flask (F) / **use funnel** (3)

(c) SKETCH: **curved meniscus //**
bottom of meniscus touching L (2 × 3)
[in a sketch]



(d) EXPLAIN: to ensure thorough **mixing** / to get an **even concentration** / to achieve a **homogeneous (uniform)** mixture / **otherwise** solution **dilute near calibration mark and more concentrated at the bottom** (3)

(e) CALCULATE: **2.65 g** (9)

$M_r = 106$ (3)	$M_r = 106$ (3)
$106 \times 0.05 = 5.3 \text{ g/l}$ (3)	$106 \div 2 = 53 \text{ g}$ (3)
$5.3 \div 2 = 2.65 \text{ g} / 500 \text{ cm}^3$ (3)	$53 \times 0.05 = 2.65 \text{ g} / 500 \text{ cm}^3$ (3)

(f) NAME: (i) **pipette** (3)

(ii) **burette** (3)
[Allow (3) for pipette and burette in reverse order.]

(g) NAME: **methyl orange // phenolphthalein** (3)

STATE: **yellow (orange) // pink (accept purple, violet)**
red (pink, peach) // colourless (2 × 3)

[Marks may be given for correct colours of an incorrect indicator.
Allow (3) for correct colours reversed (and matching a named indicator).
(9) marks only available for correct indicator and correct colours in correct order.]

(h) FIND: **0.1(1) mol l⁻¹** (9)

$\frac{25 \times 0.05}{1} =$ (3)
$\frac{22.7 \times M}{2}$ (3)
$M = 0.1(1) \text{ mol l}^{-1}$ (3)

QUESTION 3

(a) WHAT: **purple (lilac, violet)** (5)
[Allow 'pink' for (3).]

(b) (i) WHAT: **brown**

(ii) WHAT: **sulfuric acid (H₂SO₄)**

(iii) WHAT: **iron(II) sulfate / FeSO₄**

(iv) WHAT: **algal bloom / eutrophication / scum / smelly water / fish kill /
water unsuitable for drinking / water unsuitable for recreation /
water contaminated (polluted) / toxic**

(6 + (3 × 3))

(c) DESCRIBE: **filter //
known volume //
through filter paper //
previously weighed / of known mass //
wash filter paper with distilled water //
dry / place in oven, etc //
reweigh //
find difference in masses**

(6 + 3)

(d) DESCRIBE: **known volume //
previously filtered water //
in a dry //
beaker (container) //
previously weighed / of known mass //
evaporate (heat) to dryness //
cool //
reweigh beaker (container) //
find difference in masses**
[No diagram maximum (6) marks.]

(6 + 3)

(e) FIND: (i) **0.06 g / l** (6)

0.03×2	(3)
$= 0.06 \text{ g / l}$	(3)

(ii) **0.65 g / l and 650 mg / l (ppm)** (6)

$0.13 \times 5 = 0.65 \text{ g / l}$	(3)
$0.65 \times 1000 = 650 \text{ mg / l (ppm)}$	(3)

Section B

QUESTION 4

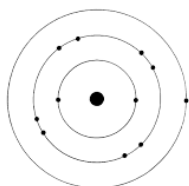
Eight items to be answered. Six marks to be allocated to each item and one additional mark to be added to each of the first two items for which the highest marks are awarded.

- (a) WHAT: **periodic table / arranged elements in a table / arranged elements in order of increasing atomic mass / arranged elements in order of periodically repeating properties / arranged elements according to atomic weight (mass) / predicted properties of elements that had not been discovered** (6)
- (b) WHAT: **it falls back to a lower energy level / it releases energy / it emits electromagnetic radiation (light, a photon) / causes line in spectrum** (6)
- (c) WHAT: **V-shaped / bent / tetrahedral with two lone pairs** (6)
[Diagram acceptable.]
- (d) WRITE: **$2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ / $\text{Mg} + \frac{1}{2}\text{O}_2 \rightarrow \text{MgO}$**
FORMULAE: (3) BALANCING: (3)
[BALANCING marks may only be awarded if FORMULAE marks have been awarded.]
[Allow (3) for MgO if no other marks awarded.]
- (e) HOW MANY: (i) **2** (3)
(ii) **6** (3)
[Allow (3) for (i) 1 and (ii) 3.]
- (f) STATE: **pressure is inversely proportional to volume / $pV = \text{constant (k)}$ / $p_1V_1 = p_2V_2$ // for a fixed mass of gas / at constant temperature** (2 × 3)
- (g) NAME: **platinum / Pt / palladium / Pd / rhodium / Rh** (6)
- (h) GIVE: **ethanoic (acetic) acid / CH_3COOH** (6)
- (i) AT WHICH: **tertiary / third / last** (6)
- (j) NAME: **chromatography** (6)
- (k) A IDENTIFY: **carbon dioxide // methane** (2 × 3)
or
B IDENTIFY: **calcium // sodium** (2 × 3)

QUESTION 5

(a) WHAT: **a charged atom / charged group of atoms / species with unequal number of protons and electrons / an atom (group of atoms) with a positive or negative charge / an atom (group of atoms) that has lost or gained electrons** (5)
[Allow (3) for 'charged particle'.]

(b) DRAW:

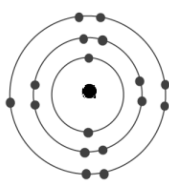


(6)

[Allow (3) for two correctly filled inner shells.] [Allow (3) marks for 2, 8, 1.]

EXPLAIN: **loses an electron** (3)

(c) DRAW:



[Allow (3) marks for 2, 8, 7.] (6)

EXPLAIN: **gains an electron** (3)

(d) WHY: **fewer protons in sodium / more protons in chlorine / smaller nuclear charge in sodium / bigger nuclear charge in chlorine / electrons held more tightly by nucleus in chlorine / electrons held less tightly by nucleus in sodium** (6)
[Allow (3) marks for 'atomic radius decreases across the periodic table'.]

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

USE: H = **2.20**, O = **3.44** / electronegativity difference is **1.24** / **polar** // **polar / covalent** (2 × 3)
[Award marks once for 'polar'.]

EXPLAIN: (i) **attraction between the ions** of the crystal // **ionic compounds / and polar (partially charged) water molecules // dissolve in water** (2 × 3)
[Allow (3) marks for 'like dissolves like'.]

(ii) **ions are free** from lattice in solution / **ions move** (3)

QUESTION 6

- (a) WHY: **contain carbon and hydrogen** only (5)
- (b) GIVE: **methane // ethyne // propene // propane // methylbenzene** (3 × 3)
[Allow toluene for methylbenzene.][Note order in answer unimportant.]
- (c) WHICH: (i) **B / ethyne / C₂H₂**
(ii) **A / methane / CH₄**
(iii) **C / propene / C₃H₆**
(iv) **D / propane / C₃H₈**
(2 × 6) + (2 × 3)
- (d) GIVE: **water / H₂O // carbon dioxide / CO₂** (2 × 3)
- (e) EXPLAIN: contains a **benzene ring**
WOULD: **yes**
EXPLAIN: **it is cyclic / benzene ring / has a high degree of unsaturation**
[Allow 'resists knocking'.] ['Aromatic' not acceptable.]
(6 + 3 + 3)

QUESTION 7

- (a) DEFINE: (i) **gives hydrogen (hydronium) ions (H^+ , H_3O^+) in aqueous solution / proton (hydrogen ion, H^+) donor //**
- (ii) **gives hydroxyl (hydroxide) ions (OH^-) in aqueous solution / proton (hydrogen ion, H^+) acceptor** (2 × 4)

(b) (i) DEFINE: $-\log //$
 $[\text{H}^+] / [\text{H}_3\text{O}^+]$ (2 × 3)

(ii) ARRANGE: **B, C, A / 6, 4, 1** (6)

(iii) CALCULATE: **1.2(2)** (6)

$[\text{H}^+] = 0.03 \times 2 = \mathbf{0.06}$	(3)
$\text{pH} = -\log 0.06 = \mathbf{1.2(2)}$	(3)

[Allow (3) marks (consequentially) for 1.5(2).]

- (c) (i) WHAT: **clumping** small suspended particles together / **removing suspended particles** / **forming heavy (large) particles that sink** / **adding polyelectrolyte (named flocculating agent)** (6)

(ii) WHY: **to kill microorganisms (bacteria) / to disinfect / to purify**

GIVE: **unpleasant taste / unpleasant smell / causes nausea / bleaches / toxic (poisonous, harmful to health) / irritating** (6 + 3)

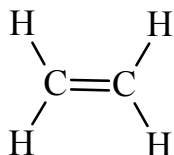
(iii) STATE: pipe **corrosion** / **tooth decay**

WHAT: **base / named base** (6 + 3)

QUESTION 8

(a) GIVE: **ethene**

DRAW:



(5 + 3)

(b) (i) GIVE: **aluminium oxide (alumina) / Al₂O₃**

(ii) CLASSIFY: **elimination**

(9 + 3)

(c) (i) EXPLAIN: at least one **double** or triple **bond** between carbon atoms (6)

(ii) DESCRIBE: **add bromine** solution (water) / **add acidified permanganate (KMnO₄/H⁺) // brown to colourless / pink to colourless / decolourises (colour fading)** is a positive test (6 + 3)

(d) (i) NAME: **ethanal**

(ii) IS: **oxidation**

(iii) WHICH: **ethanol**

WHY: **ethanol polar / ethene is non-polar / H-bonding occurs** between ethanol and water molecules

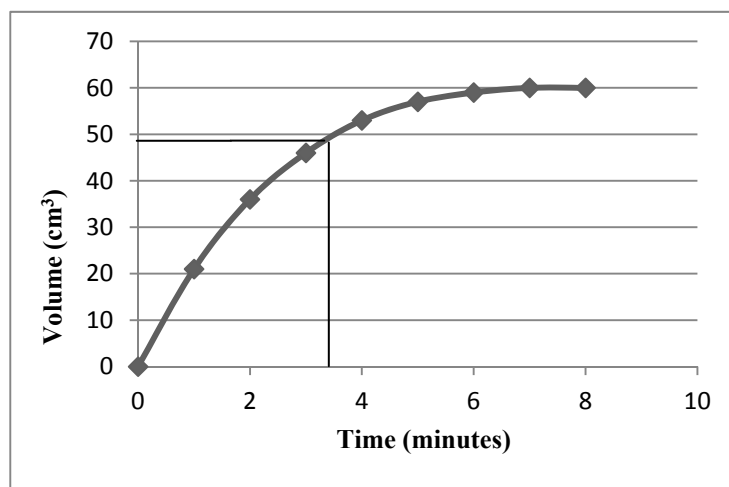
(Four responses: (6) + (3 × 3))

QUESTION 9

- (a) DEFINE: **measure of amount (mass, concentration) of a reactant used up / measure of amount (mass, concentration) of a product formed // in a given (unit) time**

(3 + 2)

- (b) PLOT:



axes correctly labelled (3)

axes correctly scaled (3)

at least seven points correctly plotted (6)

smooth curve correctly drawn through points and (0, 0) (3)

[Allow (3) for 5 points correctly plotted.]

- (c) EXPLAIN: **reactants (seashells, acid) get used up / less to react as time goes by / concentration of reactants decreases / rate proportional to concentration** (6)

- (d) HOW: **bubbles stop / volume gas in syringe stays constant / plunger (syringe) stops moving / no seashells remain** (6)

- (e) (i) USE: **48 - 52 cm³** (6)

- (ii) CALCULATE: **answer to (e) (i) ÷ 3.5 cm³ per minute** (3)

answer to (e) (i) ÷ 3.5 cm³ per minute (3)

- (f) HOW: (i) **increased (faster)**
(ii) **increased (faster)**
(iii) **decreased (slower)**

(3 × 3)

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

(a) COPY: (3 × 4) + (3 × 1)

Atoms	Atomic Number	Mass Number	Number of Neutrons
$^{10}_5\text{B}$	5	10	5
$^{11}_5\text{B}$	5	11	6

(i) DEFINE: **unstable / decay / emits radiation (rays, alpha rays, beta rays, gamma rays)** (6)

(ii) OF WHAT: **gold** (4)

(b) WHAT: **releases heat / gives out energy** (6)

NAME: **bomb // calorimeter** (2 × 2)

DEFINE: **heat (change, involved, released) when 1 mole of a substance // is completely burned / burned in excess oxygen** (2 × 3)

CALCULATE: **- 4163 kJ mol⁻¹** (3)

$$- 8326 \div 2 = - 4163 \text{ kJ mol}^{-1} \quad (3)$$

IS: **yes** (3)

GIVE: **ΔH negative / all combustion reactions are exothermic / hexane is a fuel** (3)

(c) (i) WHAT: **20 g** (7)

(ii) HOW: **0.25 moles** (6)

$$\frac{5}{20} = \quad (3)$$

$$0.25 \text{ mol} / \frac{1}{4} \text{ mol} \quad (3)$$

(iii) HOW: **1.5×10^{23}** (6)

$$6 \times 10^{23} \quad (3)$$

$$0.25 \times 6 \times 10^{23} = 1.5 \times 10^{23} \quad (3)$$

(iv) WHAT: **5.6 litres / 5600 cm³** (6)

$$22.4 \text{ litres} / 22400 \text{ cm}^3 \quad (3)$$
$$0.25 \times 22.4 = 5.6 \text{ litres} / 0.25 \times 22400 = 5600 \text{ cm}^3 \quad (3)$$

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

- (a) WRITE: **1 redox //**
 2 lost //
 3 gained //
 4 reduced //
 5 zinc //
 6 oxidised (2 × 4) + (4 × 3)

STATE: **blue colour fades / zinc begins to dissolve (disappear) / copper precipitates (forms) / zinc becomes coated with copper / zinc becomes brown (black, tarnished) / solution becomes warm / fizzing (bubbles)** (5)

- (b) EXPLAIN: **forward and reverse reactions //**
 have equal rates (4 + 3)

WRITE: $K_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$ (6)

WHAT: **increases yield of ammonia**

EXPLAIN: **Le Châtelier's principle / pressure stress opposed by reaction moving right (forward, to side with fewer moles of gas) / increased pressure favours forward reaction (side with fewest moles of gas / reaction tries to reduce pressure (stress) by making more ammonia**

GIVE: **cost / safety** (6 + (2 × 3))

(c) Answer part A or part B.

A

(i) WHAT: **nitrogen / N₂** (4)
[Allow noble gases.]

WHAT: **78%** (3)
[Allow 76 – 80%.]
[Allow 1% if noble gases given as answer above.]

GIVE: **packaging / making ammonia / medical use to freeze tissue / flushing tanks** (3)
[Allow use of noble gases consequentially.]

(ii) NAME: **ozone**

WHAT: **blocks uv rays from sun / removes chlorine atoms (radicals, Cl[•]) from atmosphere / prevents cataracts (skin cancer)**

IDENTIFY: **CFCs / chlorofluorocarbons** (6 + 6 + 3)

B

(i) GIVE: **iron oxide, magnetite, haemetite (FeO, Fe₂O₃, Fe₃O₄) / iron sulfide (FeS) / pyrites, etc**

NAME: **coke / limestone**

WHAT: **slag** (6 + 6 + 3)

(ii) NAME: **steel (cast iron, pig iron)**

WHAT: **carbon (silicon)** (6 + 4)

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