Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2013

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 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.

SECTION A

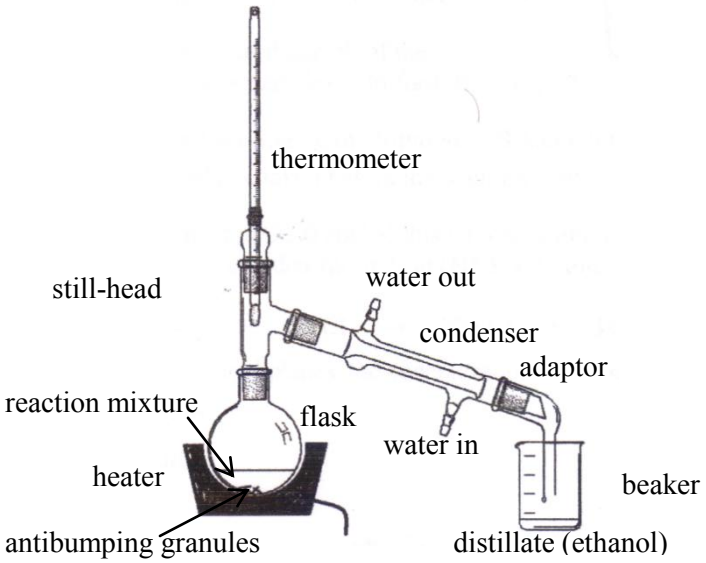
QUESTION 1

(*a*) WHAT: cooking **fat / lard / vegetable (olive, sunflower, rape** seed**) oil //**

sodium (potassium) hydroxide (caustic soda, NaOH, caustic potash, KOH)

(7 + 1)

(*b*) COPY: diagram with two correct labels:



ANY TWO: (9 + 3)

(*c*) WHAT: **antibumping granules / glass beads (bits, pieces) / boiling chips porcelain chips (bits, pieces) / pumice** / **any named inert material** (6)

(*d*) WHAT: the **ethanol / C_2H_5OH / alcohol** (6)
[Accept **water**]

(*e*) BRINE: **salt / NaCl //**
water / solution / dissolved / in water //

HOW: **filtration / decanting / pour off water**

(5 + 3 + 1)

(*f*) WHY: to avoid **burns** to skin from /
to remove sodium **hydroxide (name or formula:** see (a) above**) /** to remove **impurities**
[Allow **safety**]

WARM: to **avoid dissolving (wasting)** much **soap /** more **soluble** in warm water

(7 + 2)

QUESTION 2

(*a*) EXPL: solution of **known** //
concentration (3 + 2)

(*b*) GIVE: **pure / not deliquescent (or not hygroscopic, doesn't absorb moisture) /**
reasonably **high** relative **formula (molar,** accept **molecular) mass (M_r) /**
stable / not efflorescent (doesn't lose moisture) / solid / soluble (6)

(*c*) NAME: **volumetric** flask (6)

(*d*) HOW: add **rinsings** of beaker //
use of **funnel** // use of **glass rod** //
rinse funnel into flask and remove / **rinse** glass rod into flask ANY ONE: (9)

(*e*) OUTL: **flask** on **level** surface // [Accept "flat" for "level."]
mark at eye-level //
using wash bottle //
add dropwise (with dropper, with pipette) //
until bottom of **meniscus on (level with) mark** (ANY ONE)

WHAT: **invert (shake)** several times / ensure **thorough mixing (uniform concentration)**
(9 + 3)

FIND: (*i*) **0.14** moles per litre (9)

$$\frac{17.85 \times M}{2} = \frac{25.0 \times 0.05}{1} \quad (6)$$

$$M = 0.14 \quad (3)$$

[Formula alone 3 marks]
[3 marks for each correct side of the expression. If both sides are incorrect then allow 3 marks for correct formula.]

(*ii*) **5.11** grams per litre (3)

$$0.14 \times 36.5 = 5.11 \quad (3)$$

[If answers are not given to two decimal places, deduct one mark. Make this deduction once only.]
[3 marks for writing answer (i) × 36.5 or for correctly multiplying it out. Where M_r is given as 36 treat as slip.]

QUESTION 3

(*a*) DESC: using **clean / description of cleaning //**
platinum (nichrome) / soaked (dipped) //
wire (probe) / splint (lollipop **stick**) //
dip wire (splint) into salt //
place **salt in (into, on, at edge of, at top of) flame //**
note (observe) colour ANY TWO: (8 + 3)

STATE: sodium: **yellow / orange //**
potassium: **lilac / violet / purple //**
copper: **blue-green / green** (6 + 2 + 1)

(*b*) (*i*) WHAT: **copper deposited / brown (red-brown, red, black)** deposit on rod (zinc) /
bubbles / **lighter blue / lighter colour / paler / colourless** solution / **zinc corroding**
[Accept zinc wearing away or acquiring 'rusty' appearance; Cu precipitate; plating]

(*ii*) EXPL: electron transfer **from zinc (Zn) / zinc (Zn) lost** electrons /
to copper ions / **copper** ions **gained** electrons (9 + 3)
[Accept **zinc oxidised** OR **copper reduced**]

(*c*) (*i*) HOW: add solution of **silver nitrate //**
white / precipitate formed (9 + 3)
[Allow 3 marks for mention of NH_3]

(*ii*) HOW: add freshly prepared **iron**(II) **sulfate (ferrous sulfate, $FeSO_4$)** solution //
concentrated (conc) **sulfuric acid / H_2SO_4 //**
poured carefully **down** in**side of** slanting **test tube //**
two layers formed //
brown ring at junction of liquids
ANY TWO (2 × 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*) WHICH: **solid** (6)
[Accept **liquid** or **gas** for 3 marks]

(*b*) TERM: **atomic radius / covalent radius** (6)
[Accept **radius** for 3 marks]

(*c*) WHAT: reaction in which **heat (energy) //**
is gained (taken in) (2 × 3)

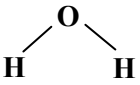
(*d*) WRITE: **CH_2O** (6)

(*e*) TYPE: **substitution / free radical / halogenation (chlorination)** (6)

(*f*) IDENTIFY: liquid A: **water (H_2O) //**

solid B: **calcium(II) dicarbide / calcium dicarbide /**
calcium carbide / CaC_2 [Accept "carbide."] (5 + 1)
[Allow 5 marks for reversed correct answers]

(*g*) STATE: (*i*) **linear / straight / H – Cl //**

(*ii*) **v-shaped / bent / angular**  (5 + 1)

(*h*) DIST: *temporary*: **removed by boiling** / *permanent*: **not removed by boiling** (6)

(*i*) WRITE: $\dfrac{[NH_3]^2}{[N_2][H_2]^3}$ (6)
[3 for numerator correct, 3 for denominator correct, 3 if both correct but inverted]

(*j*) NAME: **diffusion** (6)

(*k*) **A** STATE: **lightning / bacteria (micro-organisms) /volcano** (6)
[Accept **legumes** or **clover**, etc]

or

B NAME: **sodium / aluminium / lithium / magnesium / calcium / other correct answer** (6)
[Accept **potassium**][Accept **copper** for 3 marks]

QUESTION 5

(*a*) DIST: *mass no*: **number of protons and neutrons / number of nucleons / mass of nucleus / mass of** particular **isotope**

rel at mass: average **mass of atom(s)** of an element / average of **isotopes** taking **abundance** into account //

based on (relative to, compared with) $^{1}/_{12}$ mass of

carbon-12 atom (5 + 3 + 3)

GIVE: they are mixtures of **isotopes / average masses** of isotopes (6)

(*b*) (*i*) WHO: **Mendeleev //**

(*ii*) WHAT: order of increasing **atomic number (Z)** (8 + 1)

(*c*) (*i*) EXPL: **spontaneous //**

[Allow **random**]

decay (disintegration, decomposition, breakdown) // of **unstable / nuclei** (atoms) //

with emission of **radiation (particles, rays)**

ANY TWO: (5 + 1)

(*ii*) WHAT: a high-speed **electron (e^{-1})** [Accept "***e***"] (3)
[Allow any valid property as a way of identifying a beta particle: negatively charged or charge of –1; high speed particles; moderately (medium) penetrating; moderately (medium) ionising; deflected in an electric field; negligible or very small mass (1/1840 amu); speeds of 30 – 70 % of light)]

(*iii*) EXPL: **time** taken //

for half the radioactive **atoms to decay /**

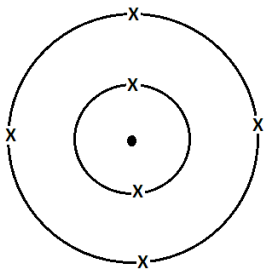
for half the mass (amount) (sample) of the element **to decay**

for activity to decrease by a half

(5 + 1)

(*iv*) GIVE: radiocarbon **dating** of ancient artefacts **/ tracer** in studying reactions (3)
[Accept mention of **archaeology**]

(*d*) DRAW: (2 × 3)



[Allow 3 marks for showing 2 electrons in inner shell. Allow 3 marks for showing 4 electrons in the outer shell. Where 14 e correctly arranged 2, 8, 4 allow 5.]

QUESTION 6

(*a*) NAME: crude **oil (petroleum) // coal // natural gas // biogas**
[Accept fossil fuel(s) for 5 marks if it is the only answer; otherwise allow 3 marks]

ANY TWO: (5 + 3)

(*b*) (*i*) WHAT: **liquefied (liquid) petroleum gas**
[Not "bottled gas". Award max 3 for 'gas' if '(liquefied) liquid' and 'petroleum' are incorrect]

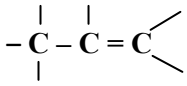
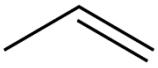
(*ii*) NAME: **propane**

(*iii*) WHAT: **mercaptans / sulfur** compounds //
HOW: give the gas a noticeable **odour (smell)**

(*iv*) GIVE: **cooking / heating / camping stoves / lighter / tarring roofs**

(6 + 6 + 3 × 3)

(*c*) NAME: **propene / propylene**

DRAW:  / **$CH_3CH{=}CH_2$** /  (6 + 3)

(*d*) NAME: **methylbenzene / toluene**

WOULD: **high //**
GIVE: presence of **aromatic / ring / cyclic**

(6 + 3 + 3)

QUESTION 7

(*a*) DEFINE: (i) *acid*: dissociates to give **hydrogen ions (H^+)** in aqueous solution (water) //

(ii) *base*: dissociates to give **hydroxyl (hydroxide) ions (OH^-)** in aqueous solution (water)

(5 + 3)

[Accept BL definitions for full marks]

EXPLAIN: **reaction between acid and base //**

giving salt and water only (5 + 1)

GIVE: *name*: **hydrochloric acid //**

formula: **HCl** (5 + 1)

(*b*) DESCRIBE: (*i*) **find mass of (weigh) filter paper //**

filter // known volume of water through weighed filter paper //

dry and // **reweigh** filter paper // **subtract** weighings

(*ii*) **find mass of (weigh) evaporating dish (beaker, other) //**

evaporate to dryness // **known volume //** of **filtered water //**

cool and reweigh dish // **subtract** weighings

ANY THREE from (*i*) or (*ii*): (3 × 6)

(*c*) EXPRESS: (*i*) **0.15** g/l // **1.7** g/l (2 × 3)

$\frac{0.015\times1000}{100} = 0.15$ g/l	(3)
$\frac{0.17\times1000}{100} = 1.7$ g/l	(3)

[Treat as a –1 slip a correct expression with incorrect answer or no answer]

(*ii*) **150** parts per million // **1700** parts per million (2 × 3)

0.15	× 1000	=	150 ppm	(3)
1.7	× 1000	=	1700 ppm	(3)

[Accept answer to (*i*) × 1000 for 3 marks, but –1 slip if incorrect answer or no answer given]

QUESTION 8

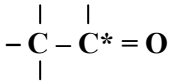
(*a*) NAME: **X** **ethanol / ethyl alcohol //** [Accept **alcohol**]

Y **ethanal / acetaldehyde //**

Z **ethene / ethylene** (6 + 4 + 1)

(*b*) WHICH: **Y / CH_3CHO / ethanal / acetaldehyde / the aldehyde**

DRAW:



[Allow correct structure of X, Y or Z]

PLANAR: **planar carbon correctly identified e.g. with asterisk** (6 + 2 × 3)

(*c*) WHAT: **oxidation (dehydrogenation)** (3)

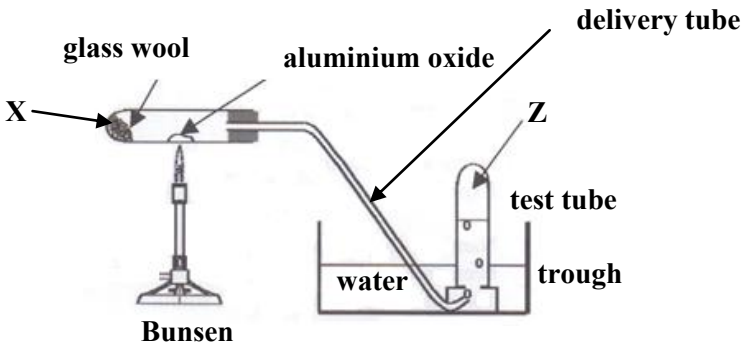
DESCRIBE: **add** a little **Y** to Fehling's solution in a test tube //

heat (warm) gently //

red precipitate {ppt **of copper(I) oxide (cuprous oxide, Cu_2O)}** formed

ANY TWO: (6 + 3)

(*d*) DRAW:



ANY TWO CORRECT LABELS: (6 + 3)

Give (2 × 3) for left assembly and right assembly

QUESTION 9

(*a*) DEFINE: (*i*) **change in concentration //**

per (in) unit time (3 + 2)
[Accept **speed of reaction** for 3 marks]

(ii) **alters (speeds up, increases) rate** of reaction //

but chemically **unchanged** at the end (5 + 1)

(*b*) GIVE: **manganese(IV) oxide / manganese dioxide / MnO_2 / liver / celery** (6)

(*c*) WHAT: **enzyme(s) //**

EXAMPLE: **amylase (ptyalin) / lipase / pepsin / catalase / other correct example** (6 + 3)

(*d*) (i) DIFF: rate **slower in A** / rate **faster in B**

WHAT: different **surface area(s) // particle size** (6 + 3)

(ii) HOW: **increase** in rate (6)

(*e*) NAME: **platinum // palladium // rhodium**

ANY TWO: (5 + 1)

[Accept symbols]

GIVE: **harmful gases converted to harmless gases / nitrogen oxide(s) converted to nitrogen / carbon monoxide converted to carbon dioxide /** unburned **hydrocarbons converted to carbon dioxide and water** (3)

QUESTION 10

(*a*) DEFINE: relative **attraction (affinity)** / measure of **attraction / number expressing attraction //**

for shared electrons / for electrons in a covalent bond / shared pair (4 + 3)

EXPLAIN: (*i*) **increase in nuclear charge /**

decrease in atomic radius

[Allow increase in atomic number or increasing number of protons]

(*ii*) **increase in atomic radius / increase in size of atom / increase in number of shells / shielding (screening)** effect increased (6 + 3)

USE: HCl: **polar //** [Accept **covalent**]

NaCl: **ionic //**

H_2: **covalent** (5 + 2 + 2)

(*b*) (*i*) HOW MANY: **0.1** moles (7)

$M_r = 84$	(3)
$8.4 \div 84 = 0.1$	(4)

[Treat $M_r = 83$ as slip]

(*ii*) WHAT: **0.9** grams (6)

0.1 mol $NaHCO_3 \equiv 0.05$ mol H_2O	(3)
$0.05 \times 18 = 0.9$ g	(3)

[Award 3 marks if 18 used in calculation attempt]

(*iii*) VOLUME: **1.12** litres (6)

0.1 mol $NaHCO_3 \equiv 0.05$ mol CO_2	(3)
$0.05 \times 22.4 = 1.12$ l	(3)

[Award 3 marks if 22.4 used in calculation attempt]

MOLECULES: **3×10^{22}** (6)

1.12 litres CO_2	= 0.05 mol	(3)
$0.05 \times 6 \times 10^{23}$	= 3×10^{22}	(3)

[Award 3 marks if 6×10^{23} used in calculation attempt]

(*c*) (*i*) STATE: **separation //**

mixture of components (parts) //

as a mobile phase (named solvent) //

passes through a stationary phases (named stationary phase) (4 + 3)

(*ii*) WHICH: **gas chromatography / GC** (6)
[Accept HPLC or high performance liquid chromatography or TLC or thin layer chromatography for 6 marks]

(*iii*) DESC: Paper chromatography

apply mixture using dropper (capillary tube) / spotting on paper //

about 2 cm (slightly, just) above (below*) eluent** //

place in tank (beaker, other suitable container) //

the **indicators separate as they move up (down)** with eluent**

ANY THREE: (6 + 3 + 3)

* The eluent** can be at the top of the tank and move down the paper.

or

Thin layer chromatography

apply mixture using dropper (capillary tube) / spotting on plate //

about 2 cm (slightly, just) above eluent //**

place plate **in tank (beaker, other suitable container) //**

the **indicators separate as they move up** with eluent**

ANY THREE: (6 + 3 + 3)

or

Column chromatography

dissolve mixture in eluent // add to column /**

add mixture to column // add eluent**

continue to add eluent so that it flows through column //**

separation occurs into bands

ANY THREE: (6 + 3 + 3)

** For **eluent** accept **mobile phase** or **solvent** or named solvent, e.g. **water**.

[Marks can be awarded for labelled diagram, and least one label being present.]

QUESTION 11

(*a*) WRITE: 1: **Dalton //**
2: **Thomson //**
3: **Rutherford //**
4: **Bohr //**
5: **Moseley** (12 + 6 + (2 × 3) +1)

(*b*) STATE: (*i*) **clumping (removing)** suspended **particles //**
(*ii*) **raising the pH //** [Accept **making less acid** or **neutralising** or **prevention of damage to pipes (teeth)**]
(*iii*) **lowering the pH //** [Accept **making less basic (alkaline)** or **neutralising** or **improving taste**]
(*iv*) **killing harmful bacteria / sterilizing //**
(*v*) **preventing tooth decay** (5 + 5 + 2 + 2 + 1)

NAME: **sand / gravel / aggregate** (3)

SUGGEST: **sewage / fertilisers / silage** ANY TWO: (6 + 1)
[Accept **run off** for either **fertilisers** or **silage** but not for both; accept **flooding** or **heavy rain**]

(*c*) **A** (*i*) GIVE: **purify / remove carbon dioxide / remove water vapour //**
liquefy //
by lowering temperature / increasing pressure (compressing) //
separate oxygen by fractional **distillation** ANY TWO: (7 + 3)

(*ii*) WHAT: CFCs: **chlorofluorocarbon(s) //**
HCFCs: **hydrochlorofluorocarbons(s)** (5 + 1)

GIVE: **refrigerants / air-conditioning** gases / **aerosol** propellants / **fire extinguishers** (3)

(*iii*) WHAT: **ultra-violet (uv) barrier / prevents** skin **cancer** (6)

or

B (*i*) EXPL: **list of elements (metals)** arranged in **order** //
of tendency to lose electrons (order of tendency to be oxidised) / of their standard **electrode potentials** / of **decreasing reactivity** (4 + 3)

(*ii*) GIVE: **variable valency (valence) // coloured ions (compounds) //** ability to **act as catalysts** ANY TWO: (2 × 3)

(*iii*) WHICH: **iron** (3)

GIVE: **higher in electrochemical series / loses electrons more easily / more easily oxidised** (3)

(*iv*) METH: **painting // electroplating // galvanising (coating with zinc) //** **tin coating //** use of **sacrificial** metal // **greasing** ANY TWO: (2 × 3)

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