



**Coimisiún na Scrúduithe Stáit**  
**State Examinations Commission**

**Leaving Certificate 2014**

**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.
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) EXPLAIN: contains **carbon (C) and hydrogen (H) // only** (2 × 3)
- SERIES: **alkynes (acetylenes)** (5)
- (b) IDENTIFY: (i) **water //**
- (ii) **calcium(II) dicarbide (calcium carbide, carbide, CaC<sub>2</sub>) //**
- (iii) **water //** (3 × 3)
- (c) EXPLAIN: **contain** mostly displaced **air / do not contain ethyne** (6)  
[impure (3) marks]
- (d) WHAT: **contain** at least one **triple (multiple) carbon-to-carbon bond** (3)  
[double bond not acceptable]
- DESCRIBE: shake with **identified reagent {bromine water (solution) / acidified KMnO<sub>4</sub>}** (3)
- colour before {Br<sub>2</sub> brown (red, orange, yellow) / KMnO<sub>4</sub> purple (pink, violet)} //**
- colour after (colourless, paler, lighter)** (2 × 3)  
[Reagent and colour must match – otherwise max 6 marks.][Accept ‘decolourises bromine’ for 6.]
- (e) DESCRIBE: **smoky (sooty) / luminous** (6)
- USE: **cutting metals / welding** (6)

## QUESTION 2

(a) TERM: solutions of **known concentration** (5)

(b) NAME: **A burette //**

**B pipette //**

**C wash (water, squeeze) bottle** (3 × 3)

(c) NAME: **titration (conical) flask / beaker / funnel //**

WHAT: **holds the reacting solutions / for waste / to fill burette** (2 × 3)  
[Name and give must match – otherwise max 3 marks.]

(d) RINSING: **rinse with deionised (distilled, pure) water //**

**rinse with solution (sodium hydroxide, NaOH)** (2 × 3)

(e) STATE: **washing down sides of titration (conical) flask / rinsing A (B) with deionized (distilled, pure) water** (3)

(f) NAME: **methyl orange / methyl red / phenolphthalein** (3)

CHANGE: **colour before // colour after** (2 × 3)

methyl orange:	yellow (orange) // red (pink, peach)
methyl red:	yellow // red
phenolphthalein:	purple (pink, violet) // colourless

(g) FIND: (i) **0.09048 (0.09 – 0.1) mol l<sup>-1</sup>** (9)

$$25 \times M = 17.4 \times 0.13 \quad (6)$$

$$M = 0.09048 (0.09 - 0.1) \quad (3)$$

(ii) **3.6192 (3.6 – 4) g l<sup>-1</sup>** (3)

$$0.09048 \times 40 = 3.6192 (3.6 - 4) \quad (3)$$

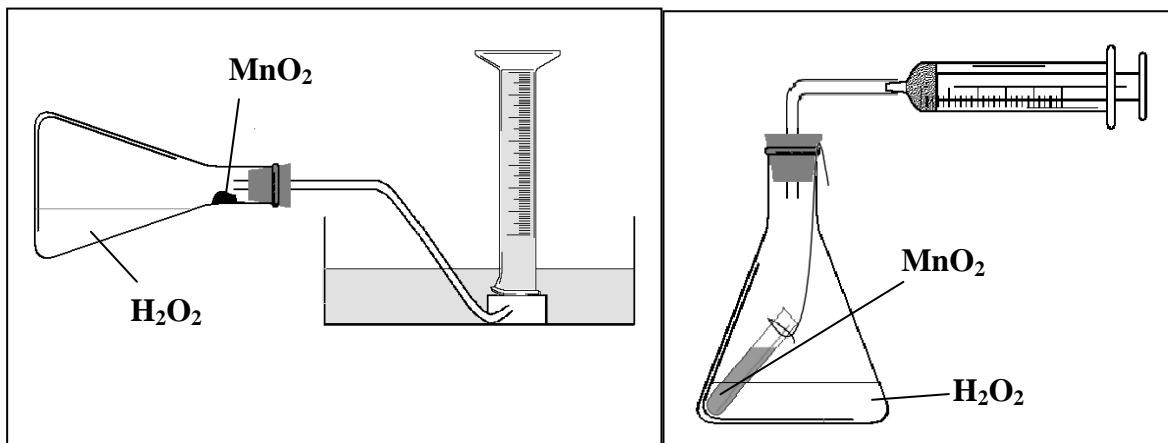
### QUESTION 3

(a) WHAT: substance that **alters (speeds up, slows down) rate** of reaction // **not consumed (not used up) / chemically unchanged** at the end (2 × 3)

SUGGEST: **manganese(IV) oxide / manganese dioxide / MnO<sub>2</sub> / KI / liver / minced-meat / celery / radish / yeast / catalase, etc** (5)

(b) GAS: **oxygen (O<sub>2</sub>)** (3)

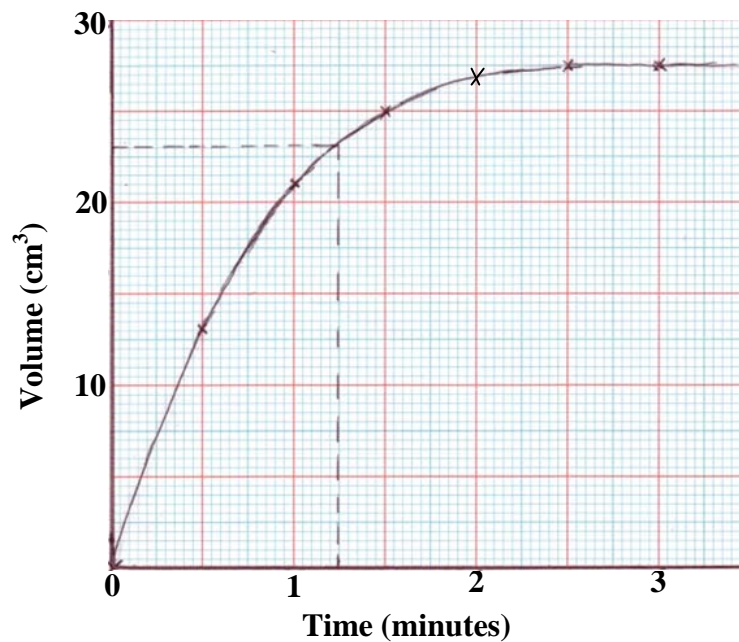
(c) DRAW:



**suitable diagram (mix and match collection system)** (6)  
[Graduation marks omitted or dropping funnel with liquid ...deduct 3 marks for each]

**any two correct labels (apparatus or chemicals)** (2 × 3)  
[Accept diagram of reaction in progress or before it commences.]

(d) PLOT:



**axes correctly labelled //**  
**axes correctly scaled //**  
**time axis correctly labelled and scaled //**  
**volume axis correctly labelled and scaled**

Any two: (2 × 3)

[Accept time or min(utes) & vol(ume) or cm<sup>3</sup>.]

**six points correctly plotted //**  
**smooth curve correctly drawn**

(2 × 3)

ESTIMATE: **23 cm<sup>3</sup>** [22 – 24 cm<sup>3</sup>]

(6)

(e) DOES:

**decreases //**  
**concentration of reactant decreases / graph gets less steep / H<sub>2</sub>O<sub>2</sub> used up** (2 × 3)  
[‘H<sub>2</sub>O<sub>2</sub> (and catalyst) used up’ acceptable but ‘catalyst used up’ on its own unacceptable.]



## 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) HOW: **4** (6)
- (b) DEFINE: **relative (measure of) attraction / number expressing (giving) attraction // for shared electrons / for electrons in a covalent bond** (2 × 3)
- (c) WHAT: state or draw **pyramidal** (6)  
[‘Tetrahedral’ allow 3; ‘tetrahedral’ does not cancel pyramidal drawing.]
- (d) IS: **endothermic //**  
EXPLAIN: **the heat change ( $\Delta H$ ) is positive (+) / heat is absorbed (taken in)** (2 × 3)  
[‘Is’ and ‘Explain’ are linked, i.e. ‘endothermic’ essential for the explanation to receive marks.]
- (e) WHAT: **polar** bonding (6)
- (f) WHY: to **sterilise** the water / **kills bacteria (micro-organisms, pathogens) / prevents disease** (6)  
[Accept ‘purify’.]
- (g) WHICH: **ions** (6)
- (h) TYPE: **alpha-particle ( $\alpha$ -particle)** (6)
- (i) CALC: **40 %** (6)

relative molecular mass	=	$1 \times 32 + 3 \times 16$	=	80	(3)
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percentage carbon	=	$\frac{32}{80} \times 100$	=	40	(3)
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- (j) WHY: **lower / wider range** (6)
- (k) A STATE: **safety training / first aid / fire drill / protective clothing / hazard monitoring / choice of location / alarm systems, etc** (6)  
*or*  
B NAME: **poly(chloroethene) / polyvinyl chloride / PVC** (6)

## QUESTION 5

- (a) DEFINE: **number of protons** in the nucleus (5)  
[Number of electrons not acceptable.]
- (b) WHAT: (i) **same number of electrons in outer (valence) shell (level) (levels) //**  
(ii) **same number of occupied shells** (6 + 6)
- WHY: **stable electron arrangement / stable (outer) octet of electrons** except for He with 2 outer electrons / **eight electrons in outer shell (level)** except for He with 2 electrons in outer shell (level) (6)  
[Accept 'full outer shell'.]
- (c) WHAT: (i) 2, 8, 2 // [Accept correct *s, p* configuration.]  
(ii) 2, 6 // [Accept correct *s, p* configuration.] (6 + 6)
- (d) NAME: **magnesium oxide //**
- FORMULA: **MgO** (2 × 3)
- BOND: **ionic (electrovalent)** (6)
- GIVE: **solid / high melting point / high boiling / soluble in water (polar solvents) / conduct electricity when molten / conduct electricity when dissolved in water (polar solvents) / do not exist as molecules / exist as crystal lattices of ions / react quickly in solution, etc** (3)

## QUESTION 6

- (a) NAME: **A methane //**  
**B butane / n-butane** (5 + 3)
- (b) GIVE: **decomposition of animal waste / decomposition of plants / slurry pits / bogs / coal mines / ruminants (cows, sheep, etc), etc** (6)  
COPY:  $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$  (2 × 3)
- (c) WHAT: **liquefied (liquid) petroleum gas //**  
NAME: **propane / 2-methylpropane (isobutane)** (6 + 6)
- (d) WHAT: **ability (tendency) of fuel to resist auto-ignition (knocking, pinking) / ability (tendency) of fuel to auto-ignite (knock, pink)** (6)  
WHICH: **D //**  
GIVE: **shorter chain / branched** (2 × 3)  
WHY: **to increase octane number / to prevent auto-ignition (knocking, pinking) //**  
WHY: **poisonous (toxic) / damage to catalytic converter / pollutant** (2 × 3)

## QUESTION 7

- (a) DEFINE: (i) **gives hydrogen (hydronium) ions ( $\text{H}^+$ ,  $\text{H}_3\text{O}^+$ ) in aqueous solution / proton (hydrogen ion,  $\text{H}^+$ ) donor / substance containing hydrogen that can be replaced by a metal //**
- (ii) **gives hydroxyl (hydroxide) ions ( $\text{OH}^-$ ) in aqueous solution / proton (hydrogen ion,  $\text{H}^+$ ) acceptor** (2 × 4)

WHAT: **acid and base reacting to form a salt and water only** (9)

- (b) DEFINE:  **$-\log_{10} //$   
 $[\text{H}^+] / [\text{H}_3\text{O}^+]$**  (2 × 3)

HOW: **pH paper /  
universal indicator solution (paper) /  
pH probe (meter)** (6)

- (c) CALC: (i) **2**
- (ii) **12** (6 + 6)

(i) $\text{pH} = -\log_{10}0.01$	(3)
$= 2$	(3)
(ii) $\text{pH} = 14 - \text{pOH} = 14 - \log_{10}0.01 = 14 - 2 = 12$	(6)

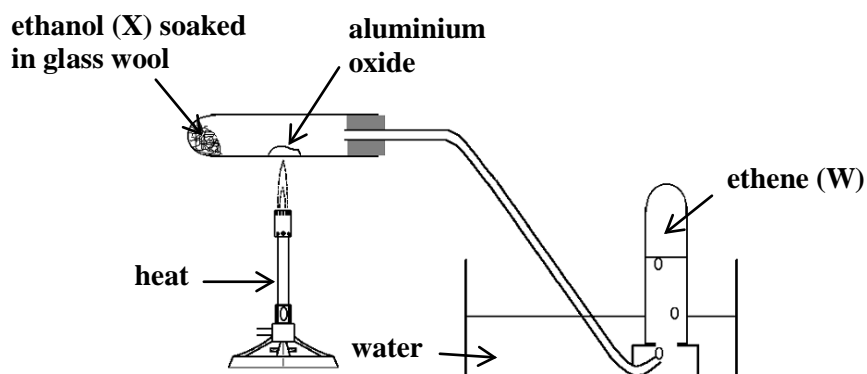
- (d) WHICH: (i) **pure water //**
- (ii) **saliva** (2 × 3)

IF: **higher** (3)

### QUESTION 8

- (a) NAMES:                    **W**                    **ethene //**  
                                      **X**                    **ethanol**                    (5 + 3)

(b) DESCRIBE:



**diagram (ethene generation part) without labels** (3)

**diagram (ethene collection part) without labels** (3)

**aluminium oxide ( $\text{Al}_2\text{O}_3$ ) / suitable catalyst / dehydrating agent //**

**state or show how ethanol and glass wool (cotton wool) is used //**

**valid safety step //**

**state or show heating of catalyst** (3 × 3)

- (c) WHICH:                    (i)    **Z //**  
                                      (ii)   **X //**  
                                      (iii)   **Y**                    (6 + 6 + 3)

(d) WHAT:                    **carbon dioxide ( $\text{CO}_2$ )**                    (3)

HOW:                    bubble through **limewater //**

limewater turns **milky**                    (2 × 3)

WHAT:                    **methanoic (formic) acid /  $\text{HCOOH}$**                     (3)

## QUESTION 9

- (a) WHAT: **does not easily form lather** with soap / **forms scum** with soap (6)
- WOULD: **yes** (6)
- GIVE: would **contain calcium (Ca) ions (compounds, Ca<sup>2+</sup>)** /  
**limestone would dissolve in rainwater (carbonic acid, H<sub>2</sub>CO<sub>3</sub>)** /  
**limestone is a calcium compound (calcium carbonate, CaCO<sub>3</sub>)** (6)  
[Allow 3 marks for 'contains calcium'.]
- DISTING: temporary: **removed by boiling / caused by calcium (magnesium) hydrogencarbonates //**
- permanent: **not removed by boiling / caused by soluble calcium (magnesium) salts (CaCl<sub>2</sub>, MgCl<sub>2</sub>, CaSO<sub>4</sub>, MgSO<sub>4</sub>, etc) / caused by soluble calcium (magnesium) salts other than hydrogencarbonates** (2 × 3)
- STATE: advantage: **good for teeth (bones) / contains calcium (Ca) / nice taste / better for brewing / better for tanning** leather, etc //
- disadvantage: **wastes soap / blocks pipes / scale (deposit) on kettles (boilers) / produces scum, etc** (2 × 3)
- (b) WRITE: **1 solid //**
- 2 sedimentation //**
- 3 micro-organisms //**
- 4 nitrates //**
- 5 eutrophication** (5 × 4)

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

- (a) (i) DESCRIBE: **platinum (nichrome) wire (spatula) / (soaked wooden splint) // dip in salt // hold in (over, against) flame // note colour of flame** (4 × 3)  
[All marks available for good labeled diagram.]

(ii) WHAT: **silver nitrate** (6)

(iii) COPY:

Solid	Flame Test Result	Chloride Test Observation
LiCl	<b>Crimson (Red)</b>	<b>White Precipitate</b>

**correct flame colour // correct anion test result** (4 + 3)

(b) WHICH: **gas** (6)

STATE: **for a definite (fixed) mass of gas / for a gas at constant temperature // pressure is inversely proportional to volume /  $pV = k / p \propto \frac{1}{V} / p_1V_1 = p_2V_2$**  (2 × 3)

HOW: (i) **0.5 mol** // (ii)  **$3 \times 10^{23}$  molecules** (2 × 3)

$\frac{11.2}{22.4} = 0.5 \quad (3) \quad \times 6 \times 10^{23} = 3 \times 10^{23} \quad (3)$
--

NAME: **diffusion** (7)

(c) EXPLAIN: (i) **rate of forward reaction = rate of backward (reverse) reaction** (7)

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

NAME: (iii) **Le Châtelier** (6)

USE: (iv) **increase in ammonia yield** (6)  
[‘Reaction goes to the right’, (3) marks.]

## QUESTION 11

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

- (a) MATCH:    **A**    **chromatography //**  
                  **B**    **distillation / fractionation //**  
                  **C**    **recrystallisation //**  
                  **D**    **fractionation / distillation //**  
                  **E**    **refluxing //**  
                  **F**    **steam distillation** ANY FIVE: (5 × 5)

- (b) DEFINE:    (i)    **loss of electrons //**  
                  (ii)    **gain of electrons** (2 × 3)

- IDENTIFY:    (iii) **Zn //**  
                  (iv)    **Cu<sup>2+</sup> //**  
                  (v)    **Cu<sup>2+</sup>** (6 + 2 × 3)

IS:            **above //**

GIVE:        **zinc loses electrons more easily / zinc is more readily oxidised / zinc displaces copper from solutions of copper salts / the standard electrode potential is negative for zinc and positive for copper / in an electrolytic cell, electrons flow from zinc to copper through the wire / zinc more reactive** (4 + 3)

(c) **A**

DISTING:    **reactants kept (placed) in container (vessel, batch reactor) //**  
                  **reactants in at one end, products out at the other continuously** (2 × 3)

SUGGEST:    **heat exchange / better catalysts / using most economic temperature / using most economic pressure / insulation, etc** (4)

(i) WHERE:    **location** (3)

SUGGEST:    **good transport facilities // skilled workforce available // possibility of expansion at site // safe location // close to raw materials, etc** ANY TWO: (2 × 3)

(ii) NAME:    **name of product //**

GIVE:        **use of product** (2 × 3)

**B**

(i) WHAT:    **carbon atoms //**

(ii) NAME:    **graphite / buckminsterfullerene / fullerene / lamp-black / soot / charcoal / graphene** (2 × 5)

(iii) WHAT:    **positive ions / Na<sup>+</sup> // and negative ions / Cl<sup>-</sup>** (2 × 3)  
                  [Accept 'ions' for 3 marks.]

(iv) WHAT:    **ionic (electrovalent) bonds** (6)

(v) WHAT:    **x-ray analysis** (3)







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