LEAVING CERTIFICATE 2008

MARKING SCHEME

CHEMISTRY

ORDINARY LEVEL
LEAVING CERTIFICATE 2008

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.

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 two 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) DESCRIBE: (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); (d) 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 // 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]

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Color in Basic Solution</th>
<th>Color in Acid Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>methyl orange</td>
<td>orange (yellow) to red</td>
<td>accept peach</td>
</tr>
<tr>
<td>Methyl red</td>
<td>yellow to red</td>
<td></td>
</tr>
<tr>
<td>phenolphthalein</td>
<td>pink (purple, violet, red) to colourless</td>
<td></td>
</tr>
<tr>
<td>thymolphthalein</td>
<td>blue to colourless</td>
<td></td>
</tr>
<tr>
<td>thymol blue</td>
<td>blue to yellow</td>
<td></td>
</tr>
<tr>
<td>cresol purple</td>
<td>purple (pink, violet)</td>
<td>to yellow</td>
</tr>
<tr>
<td>neutral red</td>
<td>yellow-brown (yellow, brown) to red</td>
<td></td>
</tr>
<tr>
<td>phenol red</td>
<td>red to yellow</td>
<td></td>
</tr>
<tr>
<td>thymol blue</td>
<td>blue to yellow</td>
<td></td>
</tr>
</tbody>
</table>

[Colour must be matched with chosen indicator
Colour in acid (i.e. final colour) is indicated in bold]

(f) CALC.: 0.125 M (9)

\[
\frac{20.0 \times M}{2} = \frac{25.0 \times 0.05}{1} \quad M = 0.125
\]

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

(a) MATCH:

<table>
<thead>
<tr>
<th>FLAME COLOUR</th>
<th>Orange-yellow</th>
<th>Lilac</th>
<th>Green</th>
</tr>
</thead>
<tbody>
<tr>
<td>SALT</td>
<td>Sodium chloride / NaCl</td>
<td>Potassium nitrate / KNO₃</td>
<td>Copper(II) chloride / CuCl₂</td>
</tr>
</tbody>
</table>

(2 × 5 + 4)

(b) DESCRIBE: 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 × 6 + 2 × 3)

(c) WHERE: street lights
[Accept ‘fireworks’] (6)

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

(e) WHAT: add silver nitrate / AgNO₃ // 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) \[
\frac{[SO_4]^2}{[SO_2]^3[O_2]} \quad \text{[Allow 3 marks for top / 3 marks for bottom / 3 marks if inverted]} (6)
\]

(i) 20% \[
\frac{24}{120} \times 100 \quad \text{(3)}
\]

(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:  

<table>
<thead>
<tr>
<th></th>
<th>Relative mass</th>
<th>Relative charge</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proton</td>
<td></td>
<td>+1</td>
<td>nucleus</td>
</tr>
<tr>
<td>Neutron</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Electron</td>
<td></td>
<td></td>
<td>electron cloud</td>
</tr>
</tbody>
</table>

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

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

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

(c) (i) WHAT: pure covalent  

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

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

(b) (i) WHICH: butane (2 × 6 + 3)
     (ii) WHICH: hydrogen
     (iii) WHICH: ethyne

(c) WRITE: ethyne: H–C≡C–H / HCCH (6)
       butane: CH₃CH₂CH₂CH₃ (6)
       [Expanded structures must have all bonds indicated but need not have H-atoms indicated]
       [Accept (CH₃)₂CHCH₃ or (CH₃)₃CH]

(d) NAME: see below (must be matched)
     STATE: see below (must be matched)
     USE: see below (must be matched) (2 × 6 + 3)

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Where on column</th>
<th>Major use</th>
</tr>
</thead>
<tbody>
<tr>
<td>refinery gas</td>
<td>top / high</td>
<td>heating / cooking</td>
</tr>
<tr>
<td>light gasoline (petroleum)</td>
<td>high</td>
<td>petrol</td>
</tr>
<tr>
<td>naptha</td>
<td>high / mid</td>
<td>petrol / plastics</td>
</tr>
<tr>
<td>kerosene (paraffin)</td>
<td>mid</td>
<td>aviation fuel / heating</td>
</tr>
<tr>
<td>gas oil / diesel</td>
<td>mid</td>
<td>cars / trucks / heating</td>
</tr>
<tr>
<td>lubricating oil /</td>
<td>low</td>
<td>lubricant / engine oil</td>
</tr>
<tr>
<td>fuel oil</td>
<td>low</td>
<td>ship fuel / electricity generation</td>
</tr>
<tr>
<td>bitumen</td>
<td>bottom</td>
<td>road surfacing / roofing</td>
</tr>
</tbody>
</table>
QUESTION 7

(a) (i) HOW: produces H\(^+\) ions in solution  
[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  

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

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

(iii) WHAT: 0.1 M  

\[
3.65 \div (3) \ 36.5 \ (3) \ = 0.1 \ (3)
\]

(iv) CALC.: 0.1 M  

\[
pH = - \log_{10} [H^+] \\
= - \log_{10} [0.1] \ (6) \\
= -(-1) \\
= 1 \ (3)
\]
QUESTION 8

(a) STATE:

HOW: ANY FOUR \times (2 \times 3)

<table>
<thead>
<tr>
<th>purpose</th>
<th>how carried out</th>
</tr>
</thead>
<tbody>
<tr>
<td>sedimentation</td>
<td>remove suspended solids (small particles)</td>
</tr>
<tr>
<td>flocculation</td>
<td>coagulation (clumping together) of fine suspended solids (small particles)</td>
</tr>
<tr>
<td>filtration</td>
<td>Removal of suspended solids / clearing of</td>
</tr>
<tr>
<td>chlorination</td>
<td>kill bacteria (microbes) / disinfection / sterilise</td>
</tr>
<tr>
<td>fluoridation</td>
<td>to help prevent tooth decay / oral hygiene</td>
</tr>
<tr>
<td>pH adjustment</td>
<td>raise pH // lower pH</td>
</tr>
</tbody>
</table>

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

secondary: biological digestion // of sewage (organic nutrients) (2 \times 3)

tertiary: removal of nitrates // removal of phosphates (2 \times 3)

(c) GIVE: algal bloom // fish kills // eutrophication (2 \times 4)
QUESTION 9

(a) WHICH: X

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

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

(d) (i): GIVE: alumina / aluminium oxide / Al₂O₃
(ii): WHY: prevent suck back / breaking of apparatus (test tube)
[Allow 3 marks for ‘safety’ without further clarification]
(iii): DESCRIBE: 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: \(41 - 44 \text{ cm}^3\) (6)
[Allow 3 marks for figures up to 2 cm\(^3\) on either side of this range]

(iii) USE: \(57 - 60 \text{ seconds}\) (7)
[Allow 3 marks for figures up to 2 cm\(^3\) below this range]
(b) (i) STATE: see table below

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

(ii) CHOOSE: see table below

<table>
<thead>
<tr>
<th>technique (MS)</th>
<th>principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>charged particle moving in a magnetic field // undergo deflections which are related to their mass</td>
<td></td>
</tr>
<tr>
<td>All chromatographies</td>
<td>diff. affinity for (attraction for, interaction with, partitioning between) mobile (or name) and (or) stationary (or name) phases</td>
</tr>
</tbody>
</table>

(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 // CO₂ // nitrogen // N₂ (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)

<table>
<thead>
<tr>
<th>product</th>
<th>use</th>
</tr>
</thead>
<tbody>
<tr>
<td>ammonia</td>
<td>fertiliser manufacture // urea manufacture // nitric acid manufacture // explosives manufacture</td>
</tr>
<tr>
<td>nitric acid</td>
<td>fertiliser manufacture // explosives manufacture</td>
</tr>
<tr>
<td>magnesium oxide</td>
<td>refractory material // lining furnaces // fire brick manufacture</td>
</tr>
</tbody>
</table>

[Accept correct formulae]

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

<table>
<thead>
<tr>
<th>product</th>
<th>raw material</th>
<th>source</th>
</tr>
</thead>
<tbody>
<tr>
<td>ammonia</td>
<td>hydrogen // nitrogen // natural gas // methane // air</td>
<td>natural gas // air</td>
</tr>
<tr>
<td>nitric acid</td>
<td>ammonia // oxygen // air // water</td>
<td>NH₃ manuf. plant // air // river // ground water</td>
</tr>
<tr>
<td>magnesium oxide</td>
<td>seawater // limestone</td>
<td>sea // quarry</td>
</tr>
</tbody>
</table>

[Accept correct formulae]

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

<table>
<thead>
<tr>
<th>product</th>
<th>type</th>
<th>explain</th>
</tr>
</thead>
<tbody>
<tr>
<td>ammonia</td>
<td>batch</td>
<td>product produced in fixed runs or batches</td>
</tr>
<tr>
<td>nitric acid</td>
<td>batch</td>
<td>product produced in fixed runs or batches</td>
</tr>
<tr>
<td>magnesium oxide</td>
<td>continuous</td>
<td>Materials being fed into process and product removed (produced) continuously</td>
</tr>
</tbody>
</table>
B

(i) IDENTIFY: penicillin // vitamin B\textsubscript{12} (4)

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

(iii) WHO: Braggs (6)

(iv) GIVE: diamond / graphite / penicillin / vitamin B\textsubscript{12} (6 + 3)