Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE 2008

MARKING SCHEME

PHYSICS & CHEMISTRY

ORDINARY LEVEL

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Introduction

In considering this marking scheme the following points should be noted.

1. In many instances only key words are given, words must appear in the correct context in the candidate's answer in order to merit the assigned marks.

2. Marks shown in brackets represent marks awarded for partial answers as indicated in the scheme.

3. Words, expressions or statements separated by a solidus, /, are alternatives which are equally acceptable.

4. Answers that are separated by a double solidus, //, are answers which are mutually exclusive. A partial answer from one side of the // may not be taken in conjunction with a partial answer from the other side.

5. The descriptions, methods and definitions in the scheme are not exhaustive and alternative valid answers are acceptable.

6. The context and the manner in which the question is asked and the number of marks assigned to the answer in the examination paper determine the detail required in any question. Therefore, in any instance, it may vary from year to year.

7. Where indicated 1 mark is deducted for incorrect/ no units.

Question 1
Any eleven parts

***(a)* Figure 1 shows a football of mass 450 g. Calculate the weight of the football. [acceleration due to gravity, $g = 9.8$ m s^{-2}]**
$w = mg$ / $w = 0.45 \times 9.8$ 3
4.4 (N) 3

***(b)* What is meant by *potential energy*?**
stored // energy due to // ability // example 3
energy // position // to do work // 3
[*mgh* …6]

***(c)* Name two temperature scales.**
Centigrade / Celsius // Kelvin // Fahrenheit any two…2×3

(d)* What is meant by *Brownian motion.
movement of 3
particles / molecules 3

***(e)* Figure 2 shows a ray of light passing through a glass prism. Name the phenomenon that occurs at X.**
total internal 3
reflection 3

***(f)* Give one use for a concave mirror.**
shaving mirror / make-up mirror / optical instruments (example) / etc. any one…6
[use of a lens or convex mirror …3]

***(g)* Figure 3 shows a waveform. What name is given to the distance marked A?**
wavelength …6
[period / cycle …3]

***(h)* Copy and complete the following statement: "The leaves of a gold leaf ……. diverge when a …….rod is brought near to the cap."**
electroscope …3
positive / negative / charged …3

***(i)* What is the purpose of a transformer in a mobile phone charger?**
change / lower …3
(mains) voltage …3

***(j)* Figure 4 shows a 6 µF connected in parallel with an 8 µF capacitor. Calculate the effective capacitance of the combined capacitors.**
$C = C_1 + C_2$ / $C_1 = 6 + 8$ …3
14 (µF) …3
[$1/C = 1/C_1 + 1/C_2$ / $1/C = 1/6 + 1/8$ …3 only]

(k) **Calculate the number of units (kW h) used by a 3 kW electric kettle in 5 minutes.**

$3 \times 5 \div 60$ ...3

0.25 (kW h) ...3

[15 ...(−1)]

(l) **How would you detect a magnetic field?**

compass / iron filings / datalogging probe …6

(m) **State one of the laws of *electromagnetic induction*.**

voltage / emf / current …3

$\propto$ change in magnetic flux / opposes the change …3

(n) **Name one method of detecting nuclear radiation.**

cloud chamber / GM tube / solid state detector / photographic film etc. …6

(o) **Explain the term of *nuclear fusion*.**

nuclei / atoms / elements …3

joining …3

[example …3 only]

Question 2

***(a)* Define (i) velocity** **2×3**

rate of change // change of displacement // speed // $s \div$ …3
of displacement // w.r.t. time // in a given direction // t …3

(ii) acceleration **2×3**

rate of change // change of velocity // v-u ÷ …3
of velocity // w.r.t. time // t …3
[$F=ma$ …3]

State the unit of acceleration. **3**

$m\ s^{-2}$ …3
[$m\ s^{-1}$ …(–1)]

Figure 5 shows a greyhound starting to race. The greyhound starts from rest and reaches a velocity of 16 m s^{-1} in 3.6 s. Calculate: **6, 4×3**

(iii) the acceleration of the greyhound;

$a=(v-u) \div t$ / $a = (16 – 0) \div 3.6$ // $v^2 = u^2 + 2as$ / $16^2 = 0^2 + 2(4.4)s$ …6
4.4 ($m\ s^{-2}$) …3

(iv) the distance covered by the greyhound in the first 3.6 s.

$s = (0)(3.6) + ½(4.4)(3.6)^2$ / 28.5 (m) …3

Over the final 20 m of the track the greyhound runs at a constant velocity of 14 m s^{-1}. How long does it take the greyhound to run the final 20 m?

$14 = 20 \div t$ …3
1.4 s …3

(*b*) Copy and complete the following statement of *Newton's law of universal gravitation*: "The force between … masses is directly proportional to the product of the masses and inversely proportional to the … of the … between them." **6, 3**

two square distance 1st correct…6
remainder …3

Describe an experiment to measure the acceleration due to gravity, *g*. **6, 4×3**

App: pendulum /string / stand / cork / ruler/ timer
// electromagnet / ball / stand / ruler/ timer 1st correct …6
two additional parts …3

Method: correct arrangement of apparatus
measure length / height / distance (between the light gates)
set the pendulum swinging / release the ball(weight)
time the oscillations / time for the bal to fall / record t_1 and t_2
correct equation any three …3×3

Give one precaution to ensure an accurate result in the experiment. **6**

repeat experiment / small angle etc. any one…6

Question 3

A ray of light is refracted towards the normal as it enters a glass block. Explain, with the aid of a labeled diagram, the underlined terms. **9, 3**

refracted: bending towards denser medium
normal : perpendicular to surface
[no diagram …(−1)] 1st correct …9
2nd correct …3

State one of the laws of refraction. **2×3**

normal, incident ray, refracted ray // sin *i* …3
same plane // proportional to sin *r* …3

Figure 6 shows an object O placed 8 cm from a converging (convex) lens of focal length 4 cm. Copy and complete the diagram to show the formation of the image by the lens. **3×3**

one ray correct to the lens …3
correct refraction …3
second ray correct …3

How far is the image form the lens? **6**

8 cm // same as object distance (on the diagram) …6
[$1/f = 1/u + 1/v$ / $1/4 = 1/8 + 1/v$ …3]

Is the image real or virtual? **6**

real …6

Give a reason for your answer. **3**

image forms on screen / possible to draw rays / inverted / sign convention any one …3

Describe an experiment to measure the focal length of a converging lens. **5×3**

App: object, converging lens, screen / locating pin / plane mirror, ruler …3×3

Method: correct arrangement
focus image / move screen (pin)
correct measurements
calculate *f* / correct formula any two points …2×3

A converging lens can be used as a magnifying glass when the object is placed inside the focus of the lens. Give two properties of the image observed. **6, 3**

magnified / virtual / erect 1st correct point …6
2nd correct point …3

Question 4

***(a)* The following terms are used in stating *Boyle's law*: volume, mass, pressure temperature. Using these terms copy and complete the following statement of Boyle's law: " At constant … the … of a fixed … of gas is inversely proportional to its …"** **6,3**

temperature , pressure (volume), mass, volume (pressure) 1st correct …6
additional two correct …3

Describe an experiment to verify Boyle's law. **5×3**

App: pressure gauge // J tube
pump / plunger // mercury
sealed mass of gas any two …2×3

Method: measure volume
measure pressure
vary pressure
pV constant
any valid precaution any three.…3×3

In Figure 7, a sealed syringe contains 40 cm^3 of helium gas at a pressure of 100 kPa. The plunger on the syringe was then pressed until the volume of the helium gas was reduced to 20 cm^3. Calculate the pressure of the helium gas inside the syringe when its volume was reduced to 20 cm^3. **6, 3**

$p_1V_1 = p_2V_2$ / $p_1 \times 20 = 100 \times 40$ // volume halved …6
200 (kPa) // pressure doubles …3

***(b)* Temperature scales are based on a thermometric property. Explain the underlined term.** **6, 3**

changes …6
with temperature …3

Name the thermometric property on which a mercury thermometer is based. **2×3**

length (volume) …3
of a mercury column …3

Describe an experiment to calibrate an unmarked mercury thermometer. **6×3**

App: thermometer, beaker, heat source, ice, boiling water / steam any three … 3×3

Method: mark fixed point in ice …3
mark fixed point in steam …3
divide distance between points / draw a graph …3

Question 5

How would you show that an electric current has a heating effect? **2×3, 6**

battery / power supply / everyday appliance …3

heating element …3

measure increase in temperature / thermometer …6

Give two other effects of an electric current? **2×3**

magnetic, chemical …2×3

What is the unit used to measure electric current? **6**

ampère / amp / A …6

An electric kettle is protected by a fuse in its plug. How does a fuse limit the current in the kettle? **6**

fuse melts / blows …6

Figure 8 shows a circuit to verify *Ohm's law*. Name the part labeled X. **6**

rheostat / resistor / potentiometer / potential divider any one…6

What is its function? **3**

to change voltage / current …3

What measurements are made by the meters labeled Y and Z? **2×6**

Y-current / ammeter …6

Z-voltage / voltmeter …6

[reverse order …6]

State the relationship between the current through the resistor R and the voltage across it. **2×3**

$V \propto$ // V = …3

I // RI …3

Figure 9 shows two 10 Ω resistors connected together.

What term is used to describe this combination of resistors? **3**

series …3

Calculate the effective resistance of this combination. **2×3**

$R = R_1 + R_2$ / 10 Ω + 10 Ω …3

20 Ω …3

[parallel …(-1)]

Question 6
Answer any two parts

***(a)* Define (i) kinetic energy** **2×3**
energy due to // work // example …3
motion // done // …3
[$E = ½ mv^2$ …2×3]

(ii) momentum **2×3**
mass …3
× velocity (speed) …3

Figure 10 shows an arrow of mass 0.15 kg moving at 8 m s^{-1} towards a stationary apple of mass 0.25 kg. The arrow lodges in the apple and they move together. Calculate:
(i) the initial momentum of the arrow; **6, 3**
$p = m \times u$ / $p = 0.15 \times 8$ ...6
1.2 (kg m s^{-1}) …3

(ii) the initial kinetic energy of the arrow; **2×3**
$E = ½ mv^2$ / $E = ½ \times 0.15 \times 8^2$ …3
4.8 (J) …3

(iii) the velocity of the arrow and the apple as they move together. **2×3**
$1.2 = (0.15+0.25) \times v$ / $m_1u_1 + m_2u_2 = (m_1 + m_2)v$ …3
v = 3 (m s^{-1}) …3

***(b)* A sodium discharge lamp is a source of monochromatic light. Explain the underlined term.** **6**
one frequency / wavelength / colour …6

Figure 11 shows a narrow beam of monochromatic light approaching a pair of narrow slits and then striking a screen.
Name two wave phenomena which occur as light passes through the slits. **9, 3**
diffraction
interference 1st correct …9
2nd correct …3

Describe, with the aid of a diagram, the pattern observed on the screen. **6, 3**
bright and dark
lines / bands / fringes 1st correct …6
2nd correct …3

State two measurements which are recorded to find the wavelength of monochromatic light. **2×3**
number of fringes // order of image
measure distance // read angles
separation of slits // grating constant any two …2×3

Question 6

***(c)* What is an *electric field*?** **2×3**

region (where an electric) charge (experiences a) force — 1st correct …3; remainder …3

Figure 12 shows an isolated positive charge. Copy the diagram and sketch the electric field around the charge. **6, 3**

diagram showing field lines …6

arrow showing correct direction …3

Coulomb's law give the force between two charges. The force between two identical positive charges is 0.25 N. Is the force *attractive* or *repulsive*? **6**

repulsive …6

Give a reason for your answer. **3**

both positive charges …3

What will happen to the size of the force: **6, 3**

(i) if the size of the charges are increased?

increases

(ii) if the distance between the charges is increased?

decreases — 1st correct …6; 2nd correct …3

***(d)* What is meant by the *half-life* of a radioactive substance?** **2×3**

time taken for half // time for a sample …3

atoms / nuclei to decay // to decrease its activity (mass) to half …3

Alpha particles are one type of nuclear radiation. Name two other types of nuclear radiation. **2×6**

beta , gamma …2×6

Give one property of an alpha particle. **6**

low penetration / deflection by electric (magnetic) fields / charged particle / causes ionisation / expose photographic plates etc. — any one…6

Radon–222 emits alpha particles with a half-life of 4 days.
How much of a given sample of radon–222 is left after 8 days? **6, 3**

2 half lives …6

one quarter // 25% …3

Question 7
Any eleven parts

***(a)* What type of atomic orbital is shown in Figure 13?**
p-orbital …6

(*b*) Give two properties of an electron.
charged particle / negative charge / orbits the nucleus / very small mass etc
any two …2×3

(*c*) What is an ion?
charged / lost or gained electrons …3
atom / group of atoms …3

***(d)* Define electronegativity.**
attraction // EN difference …3
for electrons // greater than 1.7 …3
[less than 1.7 …(– 1)]

(*e*) Why is a catalyst used in a chemical reaction?
alters /changes ..3
rate of reaction …3

(*f*) Calculate the percentage of carbon by mass in water (C_2H_5OH).
$M_r = 2(12) + 5(1) + 16 + 1$ / $M_r = 46$ …3
% C = 52.2 …3

(*g*) Give one example of a transition metal.
one named (symbol) d-block element …6

(*h*) What term is used to describe a chemical reaction in which energy is released?
exothermic …6
[endothermic …3]

(*i*) Copy complete and balance the following reaction:
HCl + Mg → ___ + H_2.
$MgCl_2$ …3
$2HCl + Mg \rightarrow MgCl_2 + H_2$ …3

(*j*) What gas is produced when hydrogen peroxide (H_2O_2) decomposes?
oxygen / O_2 …6

(*k*) List the following elements in order of increasing activity:
copper, potassium, silver
silver, copper, potassium …6
[reverse order …(−1) ; any two correct…3]

(*l*) Give one use for *electrolysis*:
electroplating / extraction (purification) of metals / anodizing / *etc* …6

(*m*) The relative molecular mass of nitrogen gas (N_2) is 28. Calculate the number of molecules in 84 g of nitrogen gas. [Avogadro constant = 6.0×10^{23} mol^{-1}]
3 mol …3
$3 \times 6.0 \times 10^{23}$ / 1.8×10^{24} …3

(*n*) Name a *ketone*.
one named ketone *e.g.* propanone (acetone) …6

(*o*) Draw the structure of a benzene molecule.
structural formula for benzene …6
[C_6H_6 …3]

Question 8

(a) Define **4×3**

(i) atomic number

number of …3

protons …3

(ii) mass number

number of protons …3

and neutrons …3

[mass of an atom …3]

Copy the following table into your answerbook and complete it by filling in the missing numbers: (Refer to Mathematics Tables, p.44.) **6, 2×3**

Element	**Atomic number**	**Mass number**	**Number of neutrons**
sodium		23	12
fluorine	9	19	

1st correct …6

2nd correct …3

remainder …3

Give the electronic (*s*, *p*) configuration of **6, 3**

(iii) sodium $1s^2\ 2s^2\ 2p^6\ 3s^1$

(iv) fluorine $1s^2\ 2s^2\ 2p^5$

1st correct …6

2nd correct …3

[any two parts correct …2×3]

Elements combine to from compounds. Name two types of bond between elements in compounds **9, 3**

ionic / covalent / polar covalent

1st correct …9

2nd correct …3

Give one property of each of these types of bond. **2×3**

one property for each any two …2×3

[reverse order …3]

State the type of bond formed when an atom of sodium combines with an atom of fluorine. **6**

ionic …6

Explain, with the aid of a diagram, how this bond is formed. **3×3**

sodium atom with one outer electron …3

fluorine atom with seven outer electrons …3

diagram showing Na^+ and F^- ions / electron transfer …3

Question 9

(a) Vinegar is a <u>weak acid</u>. Explain the underlined term. **<u>6, 3</u>**

not fully dissociated // poor proton donor // pH close to 7

Name the scale used to compare the acidity of solutions

pH — 1st correct …6; 2nd correct …3

Define (i) an acid, (ii) a base, in terms of the Brønsted-Lowry theory. **<u>2×3</u>**

(i) proton donor …3

(ii) proton acceptor …3

Identify one acid and one base in the following reaction:

$CH_3COOH + H_2O \Leftrightarrow CH_3COO^- + H_3O^+$ **<u>2×3</u>**

acid: CH_3COOH / H_3O^+ — any one …3

base: H_2O / CH_3COO^- — any one …3

What is meant by a conjugate acid-base pair? **<u>2×3</u>**

two species / an acid and a base ..3

that differ by a H^+ …3

Give one example of a conjugate acid-base pair in the above reaction. **<u>2×3</u>**

CH_3COOH and CH_3COO^- / H_2O and H_3O^+ …2×3

[one correct part …3]

(b) Explain (i) *oxidation*, (ii) *reduction*, in terms of electron transfer. **<u>6, 2×3</u>**

(i) loss

(ii) gain — 1st correct...6; 2nd correct …3

of electrons ...3

[reverse order …9]

Identify the substance oxidised in the following reaction:

$CuO + H_2 \rightarrow Cu + H_2O$ **<u>6</u>**

H_2 …6

Name the oxidising agent in this reaction. **<u>6</u>**

CuO …6

What colour change is observed during this reaction? **<u>9</u>**

red / orange / brown …9

Question 10

To find the <u>concentration</u> of a potassium hydroxide (KOH) <u>solution</u>, a standard solution of hydrochloric acid (HCl) was used in a titration. Explain the underlined terms. **<u>9, 3</u>**

conc: amount / moles / grams present

soln: a mixture of a solute and solvent

1st correct …9
2nd correct …3

Figure 14 shows some glassware used in this titration.

(i) Name the pieces of glassware labelled A and B. **<u>9, 3</u>**

A-pipette

B-burette

1st correct …9
2nd correct …3

[reverse order …6]

(ii) Describe the procedure used in preparing B to hold the acid. **<u>6, 3</u>**

rinse with water / rinse with acid / close tap / place funnel on top /
fill with acid // fill part below the tap

1st correct…6
2nd correct ..3

(iii) Explain how 20 cm^3 portions of the potassium hydroxide solution can be accurately measured out. **<u>6, 3</u>**

Pipette filler / fill pipette with base /
fill to mark / meniscus on mark /
allow base to run into flask /
tap tip on edge of flask / don't blow out the last drop

1st correct …6
2nd correct …3

(iv) Give two safety precautions when carrying out this titration. **<u>6, 3</u>**

use of goggles / use of gloves / use of pipette filler

1st correct …6
2nd correct ...3

It was found that 20 cm^3 of potassium hydroxide (KOH) solution was neutralised by 18.7 cm^3 of 0.15 M hydrochloric acid (HCl) solution.
The equation for this reaction is: HCl + KOH → KCl +H_2O

(v) Calculate the molarity of the potassium hydroxide solution. **<u>3×3</u>**

$\frac{V_1 \times M_1}{n_1}$ / $\frac{18.7 \times 0.15}{1}$ …3

$\frac{V_2 \times M_2}{n_2}$ / $\frac{20 \times M_2}{1}$ …3

M_2 = 0.14 (M / moles per litre (dm^3)) …3

(vi) Give one way to improve the accuracy of this titration. **<u>6</u>**

repeat experiment / swirl the flask / white tile / wash the sides of the flask /
add the acid slowly / *etc*. any one …6

Question 11

What are hydrocarbons? **2×3**

carbon and …3

hydrogen compounds …3

Identify the main source of hydrocarbons. **6**

crude oil …6

The first member of each hydrocarbon homologous series is: methane (CH_4), ethene (C_2H_4), ethyne (C_2H_2). Name the homologous series to which methane belongs. **6**

alkanes …6

Sketch the structure of a methane molecule and state its shape. **2×3**

sketch showing 4 single bonds between carbon and hydrogen atoms …3

tetrahedral …3

Ethene and ethyne are unsaturated compounds. Explain the underlined term. **2×3**

double / triple …3

bonds …3

Describe a chemical test to show that ethyne is unsaturated. **9, 3**

decolourises

bromine / potassium permanganate solution 1st correct…9

2nd correct …3

Give one use for ethyne. **6**

welding …6

Methane is commonly used as a fuel and burns in air according to the following reaction: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O \ \Delta H = -895 \text{ kJ mol}^{-1}$

Calculate: **6×3**

(i) the quantity of energy released when 5 moles of methane are burned;

5 × (-)895 …3

(-)4475 (kJ mol^{-1}) …3

(ii) the number of moles of water released when 5 moles of methane are burned;

2 × 5 …3

10 …3

(iii) the number of moles of methane that should be burned to release 3580 kJ of energy.

3580 ÷ 895 …3

4 …3

Question 12
Answer any two parts

(*a*) Define a *mole* of a substance. **2×3**
Avogadro number // molecular mass // same number of particles …3
of particles // in grams // as 12 g of carbon …3

Calcium reacts with hydrochloric acid according to the following reaction: $Ca + 2HCl \rightarrow CaCl_2 + H_2$. Describe how you would identify the gas produced in this reaction. **6, 3**
burns …6
with 'pop' …3

If 60 g of calcium were used in this reaction, calculate:
(i) the number of moles of calcium used; **6, 3**
$n = m \div M_r$ / $n = 60 \div 40$ …6
1.5 …3

(ii) the number of moles of hydrochloric acid required to react completely with the calcium; **2×3**
1.5 × 2 …3
3 …3

(iii) the mass of calcium chloride produced. **3**
111 × 1.5 moles / 166.5 (g) …3

(*b*) Figure 15 shows carbon dioxide (CO_2) being prepared and collected.
Name the liquid A and the solid B. **2×6**
A – acid …6
B – marble chips / named carbonate / named hydrogencarbonate …6
[reverse order …9]

How would you know when the gas jar was full of carbon dioxide? **3**
extinguishes a burning splint …3

Limewater added to a gas jar full of carbon dioxide.
What colour change was observed in the limewater? **6**
turns milky / cloudy …6

Give two uses for carbon dioxide. **2×6**
stage effects / fire extinguisher / carbonated beverages / refrigerants etc. any two…2×6

Question 12

(*c*) The following elements react with oxygen to form an oxide. magnesium (Mg), sulfur (S). Give the name and chemical formula of each oxide formed. **6, 2×3**

magnesium oxide and sulfur dioxide / sulfur trioxide

MgO and SO_2 / SO_3

1st correct …6
2nd correct …3
remainder …3

From these oxides, identify: **6, 2×3**

(i) the acidic oxide;

SO_2 / SO_3

(ii) the basic oxide.

MgO

Name one other type of oxide.

neutral / amphoteric / correct example

1st correct…6
2nd correct …3
remainder …3

[reverse order ..6]

Describe a chemical test to show that an oxide is acidic. **3, 6**

dissolve oxide in water …3

use indicator / pH probe …6