Coimisiún na Scrúduithe Stáit
State Examinations Commission

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Fisic agus Ceimic	**Gnáthleibhéal**

Marking Scheme	Leaving Certificate Examination, 2007
Physics and 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 deduct 1 mark for incorrect/ no units.

Question 1
Answer any eleven parts

(a) **A horse gallops at a constant speed of 10 m s^{-1}. Calculate the distance travelled by the horse in 2 minutes.**
$v = s \div t$ / 10 = $s \div (2 \times 60)$ …3
1200 (m) …3
[20 m … (−1)]

(b) **What is the unit of *work*?**
joule / J / kilojoule / kJ / Nm any one …6
[$W = F \times s$ …3]

(c) **Copy and complete the following statement of *Boyle's law*: "At constant temperature, the … of a fixed mass of gas is inversely proportional to its …"**
volume // pressure …3
pressure // volume …3

(d) **Give one advantage of the *constant volume gas thermometer.***
accurate / sensitive / wide range / one fixed point / defines absolute temperature scale / thermometric property independent of gas used / used as a standard thermometer etc.any one …6

(e) **What type of lens is used in a magnifying glass shown in Figure 1?**
converging / convex …6

(f) **Infrared radiation is part of the electromagnetic spectrum. Name one other part of the electromagnetic spectrum.**
radio / microwave / visible / ultraviolet / x-ray / gamma any one …6

(g) **What is meant by the dispersion of white light?**
splitting / breaking up …3
into (component) colours …3
[example …6; passing light through a prism … 3]

(h) **Give one example of a longitudinal wave.**
sound / ultrasound / earthquakes / compression waves on a spring etc. any one …6

(i) **Figure 2 shows a sphere which has a positive charge. Copy the diagram and show the electric field around the sphere.**
field lines around sphere …3
arrow on field lines …3

(j) **Calculate the number of units (kW h) used by an 8 kW electric shower in 6 minutes.**
8 × 0.1 …3
0.8 (kW h) …3
[48 (kWh) … (−1)]

(k) **What is the purpose of a fuse in an electric circuit?**
melts / breaks / blows // protects // prevents …3
if current is too large // an appliance // a fire …3
[safety device … 6]

(l) **Name one device that uses a transformer.**

mobile phone charger / television / radio / computer etc any one …6

(m) **In the photoelectric effect, what is released from the surface of a metal?**

electrons / negative charges …6

(n) **What is meant by the half life of a radioactive substance?**

time taken // time for half …3

activity to decrease by ½ // (atoms / nuclei) to decay …3

(o) **Name the type of nuclear reaction that occurs in the sun.**

nuclear fusion …6

Question 2

***(a)* Define (i) velocity** **2×3**

rate of change // change of displacement // speed // s ÷ …3

of displacement // w.r.t. time // in a given direction // t …3

(ii) momentum **2×3**

mass / m …3

× velocity / × v ...*3*

State the principle of the conservation of momentum. **3×3**

momentum before / $m_1u_1 + m_2u_2$ // total …3

equals / = // momentum …3

momentum after / $= m_1v_1 + m_2v_2$ // remains constant …3

[in a closed system …3]

During an ice skating competition a skater of mass 75 kg moves with a velocity of 4 m s^{-1}. He collides with his stationary partner, whose mass is 55 kg. Both skaters then move together in a straight line as shown in Figure 3. Calculate

(iii) the initial momentum of each skater; **3×3**

$p_1 = 75 \times 4$ …3

*300 (*kg m s^{-1}) …3

$p_2 = 0$ *(*kg m s^{-1}) …3

(iv) the velocity of the skaters as they move together. **3**

300 = *130* × v / 2.3 (m s^{-1}) …3

(b)* State the *principle of the conservation of energy. **3×3**

energy cannot // total …3

be created // energy …3

or destroyed / it can only be changed from one form to another // is constant …3

What is meant by *potential energy*? **2×3**

energy due to // stored // example …3

position // energy // …3

[$E_p = mgh$ …6]

A rock of mass 25 kg falls from the top of a cliff which is 60 m high. Calculate the potential energy of the rock before it falls. **6, 3**

$E_p = m \times g \times h$ / $E_p = 25 \times 9.8 \times 60$ …6

14700 (J) / 14.7 (kJ) …3

The potential energy of the rock changes as it falls. Explain why the potential energy of the rock changes. **3**

changes to kinetic energy // principle of conservation of energy // height decreases any one …3

How far will the rock have fallen when its potential energy is half its original value? **2×3**

14700 ÷ 2 = 7350 / 7350 = 25 × 9.8 × *h* …3

30 m …3

Question 3

State the laws of reflection of light. **4×3**

incident ray, normal, reflected ray …3
on the same plane …3

angle of incidence …3
equals the angle of reflection …3
[incidence ray = reflected ray …3]

When you look at a plane mirror you see a virtual image.
Explain the underlined terms. **2×6**

flat / not curved / 2 d …6
cannot be formed on a screen / rays appear to meet / erect / formed behind the mirror etc.
any one …6

Give one other property of the image in a plane mirror. **3**

same size / laterally inverted / erect / $u = v$ etc. any one …3

Figure 4 shows a ray of light approaching a plane mirror. Copy the diagram and show the path of the reflected ray. **6, 3**

redrawn diagram showing ray striking the mirror …6
reflected ray shown …3

Give one use of a plane mirror. **3**

a fitting room / periscope / increase light in a room / mirror ball etc any one …3

Describe an experiment to measure the focal length of a concave mirror. **4×3**

concave mirror, locating pin/screen, object, ruler any three … 3×3

correct arrangement shown /stated
focus / clear image // move screen / pin
correct measurements
correct formula any one …3

Figure 5 shows a pin placed 6 cm in front of a concave mirror of focal length 4 cm. Find the distance of its image from the concave mirror. **6, 3**

$1/u + 1/v = 1/f$ / $1/6 + 1/v = 1/4$ …6
12 (cm) …3

Give two properties of the image of the pin. **2×3**

magnified / real / inverted / in front of the mirror any two …2×3

Question 4

***(a)* Explain the terms (i) heat, (ii) temperature.** **6, 2×3**

(i) form of energy …6

(ii) measure / degree …3
of hotness / coldness …3
[reading on the Celsius scale …3]

Describe, with the aid of a diagram, a mercury thermometer. **3×3**

scale
thread / column of mercury
glass bulb
glass surround any three …3x3

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

length / volume …3
of mercury …3
[definition of thermometric property …3]

Name two temperature scales **2×3**

Centigrade / Celsius / Kelvin / Fahrenheit any two …2×3

***(b)* State two assumptions of the kinetic theory of gases.** **9, 3**

elastic collisions / rapid motion / random motion / negligible volume /
straight line motion / negligible duration of collisions / large number of molecules/
temperature depends on kinetic energy

1st correct …9
2nd correct …3

What is meant by Brownian motion? **6, 3**

motion
of particles / molecules

1st correct …6
2nd correct …3

Describe an experiment to show Brownian motion. **4×3**

microscope, smoke cell, lamp / microscope, pollen grains, water any two …2×3
fill cell with smoke / shine light from side / focus microscope any one …3
describe observation …3

Question 5

(*a*) Copy and complete Ohm's law "The … through a … is proportional to the … between its ends at constant …" **3×3**

current conductor voltage temperature any three correct …3×3

Figure 6 shows a circuit with two 4 Ω resistors connected in series to a 12 V d.c. supply. What does d.c. stand for? **3**

direct current …3

Calculate the total resistance of the circuit. **2×3**

$R = R_1 + R_2$ / $R = 4 + 4$ …3

8 (Ω). …3

[2 (Ω) …(−1)]

Using Ohm's law, calculate the current in the circuit. **6, 3**

$V = R\,I$ / $12 = 8 \times I$ …6

1.5 (A) …3

Name one device used to measure voltage (potential difference). **6**

voltmeter / multimeter etc …6

(*b*) How would you show that there is a magnetic field around a conductor that is carrying a current? **6, 2×3**

card and iron filings // compass …6

around conductor // beside conductor …3

forms a pattern //needle moves ...3

Figure 7 shows a coil of wire carrying a current. Copy the diagram and draw the magnetic field pattern around the coil. **6, 3**

sketch of lines around the coil …6

arrows indicating direction of field lines …3

Give one way to increase the strength of the magnetic field around the coil. **6**

increase current / increase pd across coil / more turns on coil etc. any one …6

Give one use of a magnetic field around a coil. **6**

electromagnets / relays / starter motor in a car etc any one …6

Question 6 Any <u>two</u> parts

***(a)* What is meant by acceleration?** **<u>2×3</u>**

rate of change // change in velocity /speed // $\underline{v - u}$ …3
of velocity / speed // w.r.t. time // t …3

State one of Newton's laws of motion. **<u>6, 3</u>**

a body remains at rest/moves with const velocity//rate of change of momentum //action and reaction
unless an (external) force acts // proportional to the force // are equal and opposite

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

[$F = ma$ …6]

A car of mass 1200 kg increases its velocity from 2 m s^{-1} to 20 m s^{-1} in 6 seconds.
Calculate: **<u>6, 4×3</u>**

(i) the acceleration of the car

$a = v - u / t$ / $a = (20 - 2) / 6$ ...6
3 (m s^{-2}) …3

(ii) the force accelerating the car

$F = m \times a$ / $F = 1200 \times 3$ …3
3600 (N) …3

(iii) the distance travelled by the car in 6 seconds

$s = ut + ½ at^2$ / $s = 2(6) + ½ (3)(6)^2$ / 66 (m) …3

***(b)* <u>Diffraction</u> occurs when <u>monochromatic</u> light pass through narrow slits.**
Explain the underlined terms. **<u>2×3, 6</u>**

bending / spreading of (light)waves …3
around an obstacle / through an opening …3
[diagram …6]

one wavelength / frequency / colour …6
[example …3]

An experiment was carried out to measure the wavelength of monochromatic light.
Draw a labelled diagram of the apparatus used. **<u>6, 2×3</u>**

light (sodium) source / laser
diffraction grating / Young's slits
spectrometer / screen

1st correct …6
remainder …2×3

What measurements should be recorded during this experiment? **<u>6, 3</u>**

grating constant // separation of slits
order of image // number of fringes
read angles // measure distance

1st correct …6
remainder …3

***(c)* Define *capacitance*.** **2×3**
ratio of charge / Q ÷ …3
to potential (pd) / V …3

Copy the diagram and show the distribution of charges on the plates of the capacitor. **2×3**
different charge on each plate …3
positive LHS / negative RHS …3

Give one way in which the capacitance of the capacitor can be changed. **2×3**
change distance // change area of …3
between plates // overlap …3
[change dielectric …6]

Calculate the effective capacitance of two 4 μF capacitors when connected in (i) series, (ii) parallel. **3×3**

(i) $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$ / $\frac{1}{C} = \frac{1}{4} + \frac{1}{4}$
2 (μF)

(ii) $C = C_1 + C_2$ / C = 4 + 4 /
8 (μF)

1st correct…2×3
2nd correct…3

Give one use of a capacitor **6**
stores energy / smoothing ac / rectifier / camera flash gun / radios etc any one …6

***(d)* Alpha, beta and gamma radiations are emitted from radioactive substances** **9, 2×3**

(i) Which radiation consists of electrons?
beta // β

(ii) Which radiation has the shortest range in air?
alpha // α

(iii) Which radiation will pass through a thick sheet of aluminium?
gamma // ϒ
1st correct …9
remainder …2×3

List two uses of radioactive substances. **6, 3**
industry e.g. thickness monitoring, leak detection // agricultural e.g. take up of agrichemicals // food e.g. preservation // medical e.g. sterilisation of equipment etc.
1st correct…6
2nd correct…3

Give two precautions when using radioactive substances. **6, 3**
minimise time / protective clothing / use of tongs etc 1st correct …6

2nd correct …3

Question 7
Answer any eleven parts

***(a)* Sketch a p-orbital.**
dumb-bell shape shown / stated …6
[sketch of an s-orbital …3]

(*b*) Which element is represented by the electronic configuration $1s^2$?
helium / He. …6

(*c*) Give one property of a compound with ionic bonding.
solid / crystal / high mp / high b.p. /conducts electricity /soluble in water etc. any one…6

***(d)* What type of bonding exists between water molecules?**
hydrogen …6
[covalent / polar bond …3]

(*e*) The relative molecular mass of nitrogen gas (N_2) is 28. Calculate the number of molecules in 56 g of nitrogen gas. [Avogadro constant = $6.0 \times 10^{23} mol^{-1}$.]
2 moles …3
1.2×10^{24} (molecules) …3

(*f*) Calculate the percentage of oxygen by mass in water (H_2O).
$M_r = 2(1) + 16$ / $M_r = 18$ …3
% O = 88.8 …3

(*g*) What is meant by an *exothermic reaction*?
heat / energy // ΔH …3
given out / released // positive …3

(*h*) Define the *heat of formation* of a compound.
heat change / produced / required …3
when one mole is formed (from its elements) …3

(*i*) What is the pH of a 0.05 M solution of nitric acid (HNO_3)
$pH = -\log_{10}[H^+]$ / $pH = -\log_{10}[0.05]$ …3
1.3 …3

(*j*) Which one of the following oxides is amphoteric? Na_2O, CO_2, Al_2O_3
Al_2O_3 …6
[explains amphoteric …3]

(*k*) Give one characteristic property common to transition elements.
variable valency / form coloured compounds / metallic in nature etc any one …6

(*l*) Copy complete and balance the following reaction:

$CaCO_3$ + HCl → $CaCl_2$ + ___ + ___

CO_2 / H_2O / 2HCl …3

$CaCO_3$ + 2HCl → $CaCl_2$ + CO_2 + H_2O …3

(*m*) Define *oxidation* in terms of electron transfer.

loss …3

of electrons …3

[gain of oxygen …3]

(*n*) Give one use for ethanoic (acetic) acid.

vinegar / flavour / preservative / food industry / chemical industry etc any one …6

(*o*) Name the compound shown in Figure 9.

benzene / phenyl / C_6H_6 …6

[aromatic …3]

Question 8

(*a*) Each element in the periodic table has a unique period number and group number. Explain the underlined terms. **4×3**

substance that cannot be broken down // atoms …3
into a simpler substance by chemical means//of one type /with the same atomic no …3
[example …3]

vertical //similar …3
column //electronic configurations / number of outer electrons / properties …3
[example // family of elements …3]

What is meant by the *first ionisation energy* of an element? **3×3**

energy …3
to remove …3
most loosely bound / outer electron …3

Explain why the first ionisation energy values decrease down the first group. **6, 3**

increase // greater distance // screening // less attraction …6
atomic radius // from the nucleus // inner electrons // between electron and nucleus …3
[easier to remove an electron / less energy required …3]

Identify the group with the largest first ionisation energy values. **3**

group 8 / group 0 / group 18 / noble gases / inert gases …3

(*b*) Define (i) *mass number* , (ii) *isotope*. **4×3**

(i) number of protons …3
and neutrons …3

(ii) same atomic number / same number of protons / atoms of same element …3
different number of neutrons / different mass number …3
[example …3]

A sample of chlorine consists of 75% $^{35}_{17}$Cl and 25% $^{37}_{17}$Cl.

(iii) State the number of neutrons in each of the two types of chlorine. **2×6**

18 …6
20 …6

(iv) Calculate the relative atomic mass of the sample of chlorine. **3×3**

75 × 35 / 2625 …3
25 × 37 / 925 …3
35.5 …3

Question 9

(*a*) Each of the following elements reacts with hydrogen: nitrogen, sulfur, chlorine.
Give the name and chemical formula of each product formed. **9, 2×3**

ammonia // hydrogen sulfide // hydrogen chloride / hydrochloric acid
NH_3 // H_2S // HCl

1st correct …9
2nd correct … 3
remainder…3

From these products, identify (i) an acidic product, (ii) a basic product. **2×3**

(i) H_2S / HCl …3
(ii) NH_3 …3

Sketch and state the shape of one of the products, showing the position of the atoms. **2×6**

H_2S V-shaped / NH_3 pyramidal / HCl linear

sketch one correct shape …6
state one correct shape …6

(*b*) Using the Brønsted-Lowry theory, define (i) an acid, (ii) a base. **4×3**

(i) proton / H^+ …3
donor …3
[in terms of pH …3]

(ii) proton / H^+ ...3
acceptor ...3
[in terms of pH …3]

What is meant by a *strong acid*? **3**

fully dissociates / good proton donor …3

Identify two acids and two bases in the following reaction:
$HNO_3 + H_2O \leftrightarrow NO_3^- + H_3O^+$ **6, 2×3**

acids: HNO_3 and H_3O^+
bases: H_2O and NO_3^-

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

Give one example of an acid-base pair in the above reaction. **6**

HNO_3 and NO_3^- / H_3O^+ and H_2O …6

Question 10

Figure 10 shows apparatus used in a titration to find the concentration of a sodium hydroxide (NaOH) solution using 1.8 M hydrochoric acid (HCl) solution.

(i) Identify the pieces of glassware labelled A, B and C. **3×3**

A-burette …3
B-pipette …3
C- (conical) flask …3

(ii) Outline the procedure for preparing and filling A. **6, 3**

place in (retort) stand / wash with water / wash with acid /
close the tap / fill (using a funnel) etc

1st correct …6
2nd correct …3

(iii) State one precaution when taking readings from A. **6**

avoid parallax error / clamp burette vertically / no air bubbles / repeat /
read at eye level / read lower meniscus / white card behind the scale any one …6

(iv) Explain why deionised water is added to C during the titration. **6**

washing any acid droplets into flask …6

End-point was reached when 20.8 cm^3 of 1.8 M hydrochloric acid (HCl) solution reacted with 25 cm^3 of the sodium hydroxide (NaOH) solution.

(v) At the 'end-point'what happens to an indicator? **2×3**

changes …3
colour …3

(vi) Name one suitable indicator. **6**

a named indicator …6

(vii) Copy and complete the equation for the reaction that takes place in this titration:
HCl + NaOH → **6, 3**

HCl + NaOH → NaCl + H_2O

1st product…6
2nd product…3

Calculate the molarity of the sodium hydroxide solution. **3×3**

$\frac{V_1 \times M}{n_1}$ / $\frac{20.8 \times 1.8}{1}$ …3

$\frac{V2 \times M2}{n_2}$ / $\frac{25 \times M2}{1}$ …3

M_2 = 1.5 (M / moles per litre (dm^3)) …3

Give <u>one</u> safety precaution when carrying out a titration. **6**

goggles / gloves / pipette filler any one …6
[non-safety precaution …3]

Question 11

Ethene (ethylene) (C_2H_4) is a member of a <u>homologous series</u> of <u>hydrocarbons</u>.

Explain the underlined terms **<u>6, 2×3</u>**

successive members differ by CH_2 / same general formula /
gradual change in physical properties — any one …6
[example / same functional group …3]

compound of hydrogen …3
and carbon …3
[named example …2×3]

Name the homologous series to which ethene belongs. **<u>6</u>**

alkenes …6

Name one other homologous series of hydrocarbons. **<u>6</u>**

alkanes / alkynes …6

Sketch the structural formula of ethane. **<u>2×3</u>**

C = C …3
H's attached / implied …3

Identify liquid X and catalyst Y. **<u>9, 3</u>**

X- ethanol / C_2H_5OH
Y- aluminium oxide / Al_2O_3 — 1sr correct …9
[X = alcohol / glass wool …3] — 2nd correct …3

What is the purpose of a catalyst? **<u>2×3</u>**

changes …3
the rate of the reaction …3

What is observed when a sample was tested with: **<u>6</u>**
(i) a burning splint?

gas burns …6

(ii) bromine water solution? **<u>6</u>**

decolourises …6

What do these tests tell you about ethene? **<u>6</u>**

it is a fuel / unsaturated …6

Question 12

(*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

Describe the appearance of sodium and bromine at room temperature. **6, 3**

metal / solid // liquid // correct colour

1st correct…6
2nd correct…3

Sodium and bromine react together to form sodium bromide as follows:
$2Na + Br_2 \rightarrow 2NaBr$
46 g of sodium were used in this reaction. Calculate:

(i) the number of moles of sodium used; **6, 3**

23 g → 1 mole …6
2 moles …3

(ii) the number of moles of bromine required to react completely with the sodium; **6**

1 mole …6

(iii) the mass of sodium bromide produced. **3**

M_r of NaBr = 103 / 206 (g) …3
[126 …(−1)]

(*b*) Figure 12 shows sulfur dioxide (SO_2) being prepared. Name the liquid A and the solid B. **9, 3**

A – (sulfuric) acid
B – (sodium) sulfite / copper

1st correct …9
2nd correct …3

Identify liquid C and give its use. **6, 3**

(concentrated) sulfuric acid
remove water / dehydrating agent

1st correct …6
2nd correct …3

Give (i) one physical property of SO_2. **3**

gas / pungent / colourless / poisonous etc. any one…3

(ii) one chemical property of SO_2 . **3**

acidic / soluble in water / reducing agent / reacts with alkalis etc. any one…3

Name one major source of SO_2 released into the atmosphere. **6**

burning fossil fuels /volcanoes etc. …6

(*c*) What is electrolysis? **2×3**

decomposition …3

of an electrolyte …3

[example …3]

Name the scientist who discovered the laws of electrolysis. **6**

Faraday …6

Figure 13 shows a solution of copper sulfate ($CuSO_4$) undergoing electrolysis using copper electrodes. List two ions present in the solution. **2×3**

Cu^{2+} / SO_4^{2-} / H^+ / OH^- any two…2×3

Name the electrodes labelled (i) A, (ii) B. **2×3**

(i) A-anode …3

(ii) B-cathode …3

What change will happen to the mass of electrode B during the electrolysis? **3**

increases in mass …3

Give one use of electrolysis. **6**

electroplating / extraction of metals / purification of metals / anodising / manufacture of chemicals etc. any one …6

[coating a metal …3]

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