Coimisiún na Scrúduithe Stáit
State Examinations Commission

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Gnáthleibhéal

Marking Scheme

Physics and Chemistry

Leaving Certificate Examination, 2005

Ordinary Level

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Marking Scheme

Six questions to be answered

- Answer any **three** questions from **Section I** and any **three** questions from **Section II.**
- All questions carry equal marks.
- However, in each section, one additional mark will be given to each of the first two questions for which the highest marks are obtained by the candidate.

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.

SECTION I – PHYSICS (200 marks)

Three questions to be answered

Question 1 **Answer any eleven parts**

(*a*) *What is the unit of work?*

Joule (J) / Newton metre (Nm) …6

(b) The mass of an astronaut is 80 kg. What is the astronaut's weight on the moon, where the acceleration due to gravity, g, is 1.6 m s^{-2}?

$W = m \times g$ / $W = 80 \times 1.6$ …3

128 (N) …3

(c) Copy and complete the following statement of Boyle's law: "At constant temperature the

pressure / P // volume / V …3

of a fixed mass of gas is inversely proportional to its

volume / V // pressure / P …3

(d) State two assumptions of the kinetic theory of gases.

elastic collisions / rapid motion / random motion / negligible volume / straight line notion / negligible duration of collisions / large number of particles / temperature depends on kinetic energy (speed) **any two** …2×3

(e) A liquid boils at 120 °C. What is the value of its boiling point on the absolute (Kelvin) temperature scale?

$T = \theta + 273$ / $T = 120 + 273$ …3

393 …3

[273 only … 3]

(f) Fig. 1 shows a ray of light passing through a glass prism. Name the phenomenon that occurs at X and at Y.

total internal reflection …2×3

[one correct term … 3]

(g) Give <u>one</u> use of a convex (converging) lens.

magnifying glass / binoculars / microscope etc. **any one** …6

[use of curved mirror …3]

(h) What is meant by the dispersion of white light?

splitting / separation / breaking up …3

into colours / spectrum / rainbow …3
[white light passes through a prism … 3]

(i) What are F and r in Coulomb's law, $F = k\frac{Q_1 Q_2}{r^2}$ ***?***

(F =) force …3
(r =) distance / radius …3

(j) State the principle on which a moving coil galvanometer is based.
conductor / coil / current, in a magnetic field, experiences a force / moves …6
[any one term …3; one expression omitted −1]

(k) How would you detect the magnetic effect of an electric current?
compass / card and iron filings …6

(l) Name a device that can increase the voltage of an a.c. supply.
transformer …6

(m) Fig. 2 shows a torch bulb which draws a current of 0.5 A when connected to a 6 V battery. Calculate the power rating of the bulb.
$P = V \times I$ / $P = 6 \times 0.5$ …3
3 (W) …3

(n) What is meant by the half-life of a radioactive substance?
time for half // time for a sample …3
(atoms / nuclei) to decay // to decrease its activity / mass to half …3

(o) Give <u>one</u> difference between nuclear fission and nuclear fusion.
nuclei / atoms / elements …3
split up // join (fuse) …3
[correct examples / reverse …3]

Question 2.

What is kinetic energy? ***2 × 3***

energy due to / example …3

motion …3

[work done …2×3]

State the principle of conservation of energy. ***4×3***

energy cannot be created // total energy …2 × 3

or destroyed / it can only be changed from one form to another // is constant …2 × 3

[energy before = energy after …2×3]

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) force ***2 × 3***

that which causes acceleration / ma …2 × 3

[causes motion / changes shape / a push or a pull / example … 3]

Copy and complete the following statement of Newton's first law of motion: "A body remains at . . . or moves with a constant . . . unless an external force acts on it." ***2 × 3***

rest …3

velocity / speed / motion …3

Fig. 3 shows a skateboarder of mass 70 kg being pulled along a smooth horizontal surface by a force of 14 N. If the skateboarder starts from rest, calculate: ***8 × 3***

(i) the acceleration of the skateboarder

$F = ma$ / $14 = 70 \times a$ …3

0.2 (m s^{-2}) …3

(ii) the velocity of the skateboarder after 10 seconds

$v = u + at$ …3

$v = 0 + (0.2)(10)$ …3

2 (m s^{-1}) …3

(iii) the kinetic energy of the skateboarder after 10 seconds; ($E_k = ½mv^2$)

$E_k = ½ (70) (2)^2$ …3

140 (J) …3

(iv) the distance travelled by the skateboarder during the 10 seconds.

$s = ut + ½at^2$ / $s = (0)(10) + ½ (0.2) (10)^2$ / 10 (m) … 3

The force is then removed and the skateboarder passes over a smooth obstacle as shown in Fig. 4. Describe the changes in the kinetic energy as the skateboarder passes over the obstacle. ***2 × 3***

kinetic energy decreases / $E_k \rightarrow E_p$ … 3

kinetic energy increases / $E_p \rightarrow E_k$ … 3

[slows down and then speeds up …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

= angle of reflection …3

Describe an experiment to measure the focal length of a concave mirror. ***5×3***

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

Method correct arrangement shown / stated
focus / clear image
move screen / pin
correct measurements
correct formula **any two** …2×3

Give one precaution you should take to ensure an accurate result. ***3***

narrow beam of light / repeat for other values of u / repeat and take an average /
no parallax (stated / implied) / steady apparatus / approximate value for f / $u > f$

any one …3

Give one difference between a real image and a virtual image. ***6***

formed on a screen // not formed on a screen
inverted // erect
rays meet // rays appear to meet
two correct examples **any one** …6
[partial answer / reverse …3]

Draw ray diagrams to show how a concave mirror forms (i) a real image,

(ii) a virtual image. ***4×3***

concave mirror and object

1st correct ray

2nd correct ray and image **1st correct ray diagram** …3 × 3

2nd correct ray diagram …3

Fig. 5 shows a pin placed at O, 15 cm in front of a concave mirror of focal length 5 cm.

What is the distance of its image from the mirror? ***4×3***

$1/f = 1/u + 1/v$ …2×3

$1/5 = 1/15 + 1/v$ …3

7.5 (cm) …3

Give <u>one</u> use of a concave mirror. ***6***

Shaving mirror / make-up mirror / searchlights / floodlights torch / headlights /

dentist / microscope etc. **any one** …6

[use of convex mirror or lens … 3]

Question 4

(a)What is meant by (i) diffraction ***9, 3***

bending / spreading (stated / implied)
obstacle / narrow opening

(ii) interference, of waves

two waves
meeting / adding together **1st correct** …9
2nd correct …3

[reverse …6]

Give two differences between light waves and sound waves. ***2×3***

transverse wave // longitudinal wave

travel through a vacuum // require a medium

light waves travel fast // sound wave travels slower

can be polarised // cannot be polarised **any two** …2×3

[see light and hear sound … 3]

Using a pair of narrow slits, describe how you would demonstrate interference of light waves. ***2×6, 3***

Apparatus (monochromatic) light source / laser …6
screen / spectrometer / telescope …6

Method correct arrangement / pattern shown …3

(b) 'Ultraviolet radiation is part of the electromagnetic spectrum with a frequency greater than blue light.' Explain the underlined terms. ***9, 3***

range / spread
waves / colours

no. of vibrations
per second **1st correct …9**
2nd correct …3

Fig. 6 shows a piece of zinc on the metal cap of a negatively charged electroscope.
Describe how the electroscope was given a negative charge. ***3×3***

Van de Graaff generator, high voltage source, negatively charged rod etc. //
positively charged rod …6
transfer the charge // charge by induction …3

When ultraviolet radiation shines on the zinc metal the electroscope loses its charge.
Name this phenomenon and explain why the electroscope loses its charge. ***6, 2×3***

photoelectric effect …6
electrons …3
released / escape / gain energy …3

Question 5

(a) 'An electric current produces a heating effect in a resistor.' List <u>two</u> factors on which the heating effect of an electric current depends. ***<u>2×3</u>***

resistance, current, time, power, voltage **any two** …2×3

Identify <u>two</u> household appliances that make use of this heating effect. ***<u>2×3</u>***

cooker, toaster, electric kettle etc. **any two** …2×3

Household appliances contain a fuse. What is the purpose of a fuse? ***<u>2×3</u>***

protects // prevents // melts / blows …3

an appliance // a fire // if the current is too large …3

[safety device … 6]

Fig. 7 shows a circuit with two resistors connected in series to a battery. The current in the circuit is 1.5 A. Calculate (i) the effective resistance of the two resistors ***<u>2×3</u>***

$R = R_1 + R_2$ / $R = 6 + 2$ …3

8 (ohms) …3

(ii) the potential difference (voltage) of the battery ***<u>2×3</u>***

$V = RI$ / $V =$ (8) (1.5) …3

12 (V) …3

(iii) the potential difference (voltage) across the 2 Ω resistor ***<u>3</u>***

$V = 2 \times 1.5 / 3$ (V) …3

(***b) State a law of electromagnetic induction.*** ***<u>2×3</u>***

emf / current …3

∝ (rate of) change of magnetic flux / opposes the change …3

Who discovered one of the laws of electromagnetic induction? ***<u>6</u>***

Faraday / Lenz / Henry …6

Fig. 8 shows a galvanometer connected across the ends of a coil of wire. When the bar magnet moves, north pole first, into the coil the needle in the galvanometer deflects to the right, as shown in the diagram. In which direction will the needle in the galvanometer deflect when:

(i) the bar magnet moves out of the coil? ***6, 3***

left

(ii) the bar magnet moves, south pole first into the coil?

left **1st correct** …6

2nd correct …3

Explain why the needle will not deflect when the magnet is stationary. ***2×3***

no change // no induced // no movement …3

in magnetic field // emf /current // in / of the coil …3

Give <u>one</u> use of electromagnetic induction. ***6***

transformer, generator, dynamo etc **any one** …6

Question 6 **Answer any two parts**

(a) State the principle of 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

Explain how this principle applies to the launching of a spacecraft. ***3×3***

gas expelled in one direction …3

spacecraft moves …3

opposite direction …3

Fig. 9 shows two shopping trolleys each of mass 15 kg on a smooth horizontal floor. Trolley A moving at 2.5 m s^{-1} strikes trolley B which is at rest. After the collision both trolleys move together in the same direction. Calculate:

(i) the initial momentum of trolley A ***5×3***

$p = mv$ / $p = 15 \times 2.5$ …3

37.5 (kg m s^{-1}) …3

(ii) the velocity of the trolleys after the collision.

$m_1u_1 + m_2u_2 = (m_1 + m_2)\, v_2$ …3

$37.5 + 0 = 30\, v_2$ …3

1.25 (m s^{-1}) …3

(b) What is meant by a thermometric property? ***6, 3***

changes …6

with temperature / heat …3

Name the thermometric property on which a mercury thermometer is based. ***6***

length / volume …3

of mercury / liquid …3

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

Apparatus (mercury) thermometer / beaker / heat source / ice / steam / boiling water

any three … 3×3

Method mark in ice / freezing point …3

mark in steam / boiling point …3

measure distance between the two points / divide (up equally) / draw a graph …3

(c) A capacitor consists of two parallel metal plates placed a small distance apart. Copy Fig. 10 and show the electric field pattern between the metal plates of a charged capacitor. ***3×3***

horizontal parallel lines …3

arrow …3

correct direction …3

Give <u>one</u> way in which the capacitance of the capacitor can be increased. ***2×3***

area // distance // permittivity …3

increase // decrease // increase …3

Draw diagrams to show how two capacitors can be connected (i) in series, (ii) in parallel ***6, 2×3***

correct symbol for capacitor …3

series

parallel **1st correct** …6

2nd correct …3

If two 6 μF capacitors are connected in parallel, what is their effective capacitance? ***2×3***

$C = C_1 + C_2$ / $C = 6 + 6$ …3

12 (μF) …3

(d) What is radioactivity? ***2×3***

decay of / disintegration of / nuclei / atoms …3

with the emission of radiation / energy / particles / alpha / beta / gamma …3

Fig. 11 shows three types of nuclear radiation being absorbed by different materials.

Name each of the nuclear radiations labelled X, Y and Z. **9, 2× 3**

(X) gamma

(Y) beta

(Z) alpha **1st correct** …9

remainder … 2×3

Give <u>one</u> danger associated with radioactive substances. ***3***

skin burns / cataracts / leukaemia / cause cancer / genetic defects etc …3

State <u>one</u> precaution that should be taken when handling radioactive substances. ***3***

don't handle directly / store in a safe place / wear protective clothing /

reduce duration of exposure / do not eat (drink) near the source etc. …3

List <u>two</u> uses of radioactive substances. ***2×3***

Medical/cancer treatment/carbon dating /detecting leaks /energy source etc. **any two** … 2×3

SECTION II – CHEMISTRY (200 marks)

Question 7 Answer any **eleven** parts.

(a) What is an isotope?

same number of protons / same atomic number / atoms of the same element …3

different number of neutrons / different mass number …3

(b) Sketch the shape of the BF_3 molecule, showing the position of the atoms.

correct position of atoms …3

correct 2D shape / correct angles / name correct shape …3

(c) What type of orbital is shown in Fig. 12?

p-orbital …6

[dumbbell / s or d orbital … 3]

(d) Give <u>one</u> example of a substance that has hydrogen bonding.

water / ammonia / HF / alcohols / carboxylic acids etc. …6

[HCl …3]

(e) The relative molecular mass of nitrogen gas (N_2) is 28. Calculate the number of molecules in 7 g of nitrogen gas.

1 mole (28 g) $\rightarrow$ 6.0×10^{23} …3

¼ mole (7 g) $\rightarrow$ 1.5×10^{23} …3

(f) Calculate the percentage of carbon by mass in ethyne (C_2H_2).

$M_r = 26$ …3

% C = 92 …3

(g) What is meant by an exothermic reaction?

heat / energy // ΔH …3

given out // negative …3

(h) Define the heat of formation of a compound.

heat change …3

when one mole is formed (from its elements) …3

(i) Calculate the pH of a 0.05 M solution of hydrochloric acid (HCl).

$pH = -\log [H^+]$ / $pH = -\log [0.05]$ …3

1.3 …3

(j) Name a chemical used to detect the presence of carbon dioxide (CO_2).

limewater (calcium hydroxide) …6

[turns milky / extinguishes a lighted taper …3]

(k) Give <u>one</u> characteristic property of transition elements.

variable valency / coloured compounds / catalysts / incomplete inner shell / metals / property of a metal etc. …6

[example 3]

(*l*) State *Faraday's first law of electrolysis*.

mass …3

$\propto$ quantity of electricity / charge / It …3

(m) Copy, complete and balance the following reaction:

CO_2 / H_2O …3

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ …3

(n) Name a ketone.

Propanone / acetone / butanone / correct formula etc. …6

[example …3]

(o) Name the compound shown in Fig.13.

benzene / phenyl / C_6H_6 …6

[aromatic … 3]

Question 8

What is meant by the atomic number of an element? ***2×3***

number of …*3*

protons …3

[in an atom / position in the periodic table …3]

Give the number of (i) protons, (ii) neutrons, (iii) electrons, in $^{19}_{9}\mathbf{F}$***.*** ***3×3***

(i) 9 …3

(ii) 10 …3

(iii) 9 …3

Copy and complete the following table in your answer book: ***2×6, 3***

subatomic particle	**charge**	**location**
Electron	−1	electron cloud
Proton		nucleus
Neutron	0	

1st two correct … 2×6

remainder …3

Give the electronic (s, p) configuration of (i) sodium ***9, 3***

$1s^2\ 2s^2\ 2p^6\ 3s^1$

(ii) fluorine.

$1s^2\ 2s^2\ 2p^5$ **1st correct** …9

2nd correct …3

What is an ion? ***2×3***

charged …3

atom / group of atoms …3

Show, using diagrams, how a bond is formed when an atom of sodium combines with an atom of fluorine. ***2×3***

sodium with one electron / flourine with seven electrons / show electron transfer **any two** …3

Name the compound formed ***2×3***

sodium …3

fluoride …3

Give <u>two</u> properties of this type of bond. ***2×3***

crystalline / solid / high m.p. / high b. p. / soluble in water / conduct electricity etc **any two** … 2×3

Question 9

Define oxidation in terms of electron transfer. ***2×3***

loss …3

of electrons …3

Identify (i) the substance oxidised **9, 3**

Br^- / $2Br^-$

(ii) the substance reduced

Cl_2 **1st correct** …9

[reverse …3] **2nd correct** …3

The apparatus shown in Fig. 14 can be used in the electrolysis of acidified water. What substance is used to acidify the water? ***6***

any named acid …6

[acid …3]

What material is usually used for the electrodes? ***6***

platinum / graphite …6

[metal …3]

Name the gases collected at (i) X ***6***

oxygen …6

(ii) Y ***6***

hydrogen …6

[reverse …6]

Describe how you would identify the gas collected at X ***6, 3***

relights …6

glowing splint …3

Name the electrode at which oxidation occurs. ***6***

anode …6

Give two uses of electrolysis. ***6, 3***

electroplating / extraction of metals / purification of metals / anodising Al /

manufacture of NaOH or chlorine etc. **1st correct** …6

2nd correct …3

Question **10**

What is meant by a standard solution? ***2×3***

molarity / concentration …3

known …3

Describe how you would accurately measure and transfer 25 cm^3 of sodium hydroxide solution to a conical flask. ***6,2×3***

pipette / pipette filler / draw base into pipette / fill until meniscus / is level with mark / allow base to run into flask / do not blow out last drop **1st correct** ...6

next two …2×3

Give one reason why a conical flask is used instead of a beaker during titrations. ***6***

swirl flask / no loss of liquid etc. **any one** …6

The piece of glassware shown in Fig. 15 was then filled with a 0.2 M hydrochloric acid (HCl) solution. Name the piece of glassware. ***6***

burette …6

[pipette …3]

Give two precautions when taking readings from this piece of glassware. ***9, 3***

read at eye level / read bottom of the meniscus / hold burette vertical / place white card behind the scale / make sure the tap is closed etc. **1st correct** …9

2nd correct …3

End-point was reached when 22.5 cm^3 of 0.2 M hydrochloric acid (HCl) solution reacted with 25 cm^3 of the sodium hydroxide (NaOH) solution. Name a suitable indicator for this titration. ***6***

any named indicator …6

Describe how you would know when 'end-point was reached'. ***2×3***

colour …3

change …3

Copy and complete the equation for the reaction that takes place in this titration ***9***

NaCl …9

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

$\frac{M_1 \times V_1}{n_1} = \frac{M_2 \times V_2}{n_2}$ / $\frac{0.2 \times 22.5}{1} = \frac{M_2 \times 25}{1}$ / 0.18 (M) …3

Question 11

(a) Using the Brønsted-Lowry theory, define (i) an acid ***6, 3***

proton // pH between 0 - 7 // low pH …6

donor …3

[example …3]

(ii) a base ***2×3***

proton // pH between 7- 14 // high pH …3

acceptor …3

[example …3]

(iii) a conjugate acid-base pair. ***3***

acid and a base / two species which differ by a proton …3

[example …3]

Identify two acids and one acid-base pair in the following reaction ***2×6, 3***

CH_3COOH and H_3O^+

CH_3COOH and CH_3COO^- / H_2O and H_3O^+ **1st two correct** …2×6

remainder …3

(*b*) ***Ethanol (C_2H_5OH) can be oxidised to ethanoic acid (CH_3COOH). Draw the structure of each of the underlined compounds.*** ***4×3***

C − C −

H's attached

− OH / − COOH **1st correct** …3×3

2nd correct …3

Name the homologous series to which ethanol belongs ***6***

alcohols …6

What is the first member of this series? ***6***

methanol …6

[another named member …3]

Give one use for (i) ethanol ***6, 3***

alcoholic drinks / paints / varnishes / perfumes / dyes / drugs etc.

(ii) ethanoic acid

vinegar / cellulose acetate / solvent etc. **1st correct** …6

2nd correct …3

12. <u>Answer any two parts</u>

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

Avogadro number // molecular mass // same number of particles …3

of particles // in grams // as 12 g of carbon …3

Calcium reacts with sulfuric acid according to the following equation:

$$Ca + H_2SO_4 \longrightarrow CaSO_4 + H_2$$

Describe how you would identify the gas produced in the above reaction. ***<u>3, 6</u>***

lighted taper / H_2 …3

burns with a 'pop' …6

80 g of calcium were used in this reaction. Calculate (i) the number of moles of calcium used ***<u>6, 3</u>***

40 g → 1 mole …6

80 g → 2 (moles) …3

(ii) the number of moles of sulfuric acid required to react completely with the calcium ***<u>2×3</u>***

1 mole H_2SO_4 reacts with 1mole Ca …3

2 (moles) …3

(iii) the mass of calcium sulfate produced. ***<u>3</u>***

M_r of $CaSO_4$ = 136 / 272 (g) …3

(b) ***Fig. 16 shows sulfur dioxide (SO_2) being prepared and bubbled through a solution of litmus. Name the liquid A and solid B.*** ***<u>2×6</u>***

(A) acid …6

(B) sulphite e.g. sodium sulphite / copper …6

What is the purpose of liquid C? ***<u>6</u>***

removes water / dehydrates / purify **any one** …6

Explain why the litmus solution changes colour ***<u>3</u>***

acid …3

Why should we limit the release of SO_2 gas into the environment? ***<u>6</u>***

acid rain / pollution etc …6

Give <u>one</u> physical property and <u>one</u> use of SO_2. ***<u>2×3</u>***

gas / colourless / choking smell / poisonous / soluble in water etc. …3

bleach / manufacture of sulphuric acid etc. …3

(*c*) *The following list shows the order of three elements in the electrochemical series:*

sodium magnesium copper

Explain why these elements are in this order, considering their reaction (if any) with water. ***3×3***

(Na) reacts quickly (with cold water) / Na more reactive than Mg …3

(Mg) reacts slowly (with steam) / Mg more reactive than Cu …3

(Cu) no reaction …3

[order of reactivity …2×3 / react less vigorously …3]

(i) ***Name (i) a metal above sodium (ii) a metal below copper, in the electrochemical series*** ***9, 3***

potassium

mercury / silver / gold **1st correct** …9

2nd correct …3

Describe what happens when a clean strip of magnesium is placed in a solution of copper sulfate as shown in Fig. 17. ***2×3***

coated …3

with copper …3

[changes colour …3]

Copy and complete the following equation ***2×3***

$MgSO_4$ …3

Cu …3