Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2004

PHYSICS AND CHEMISTRY – ORDINARY LEVEL

MONDAY, 21 JUNE – MORNING 9.30 TO 12.30

Six questions to be answered.
Answer any **three** questions from **Section I** and any **three** questions from **Section II**.
All the 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.

SECTION I – PHYSICS (200 marks)

1. Answer **eleven** of the following items, *(a)*, *(b)*, *(c)*, etc. All the items carry equal marks. *Keep your answers short.*

(a) State the *principle of conservation of energy*.

(b) A cyclist increases her velocity from 5 m s^{-1} to 8 m s^{-1} in 6 seconds.
What is her acceleration?

(c) Absolute zero is the lowest temperature on the absolute (Kelvin) temperature scale.
What is the value of absolute zero on the Celsius scale?

(d) What is meant by a *thermometric property*?

(e) Give <u>one</u> use of total internal reflection.

(f) What is meant by the *diffraction* of a wave?

(g) Give <u>one</u> example of a longitudinal wave.

(h) **Fig. 1** shows a waveform.
What name is given to (i) height **X**, (ii) length **Y**?

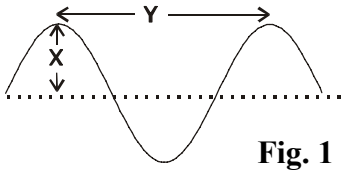

Fig. 1

(i) What is the purpose of a fuse in an electric circuit?

(j) Copy and complete the statement: "Two positive charges will . . . . . but a positive charge and a . . . . . charge will attract."

(k) State a *law of electromagnetic induction*.

(l) **Fig. 2** shows two capacitors connected in parallel. Calculate the effective capacitance of the two capacitors.

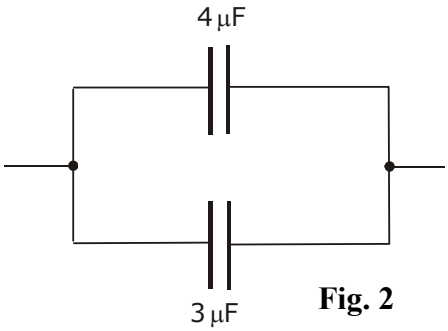

Fig. 2

(m) Give <u>one</u> use of a gold leaf electroscope.

(*n*) In the equation $E = mc^2$, what does *c* represent?

(o) What is *nuclear fusion*? (11 × 6)

2. Define (i) *acceleration*, (ii) *weight*. (12)

Describe an experiment to measure the acceleration due to gravity, *g*.
Give <u>one</u> precaution you should take to get an accurate result. (24)

Copy and complete the following statement of *Newton's law of gravitation*: (9)

"The force of attraction between two bodies is proportional to the . . . . . of their masses and inversely proportional to the . . . . . of the . . . . . .between them."

Fig. 3 shows a helicopter hovering at a height of 200 m above the ground. A package of mass 5 kg is thrown downwards from the helicopter with an initial velocity of 3 m s^{-1}.

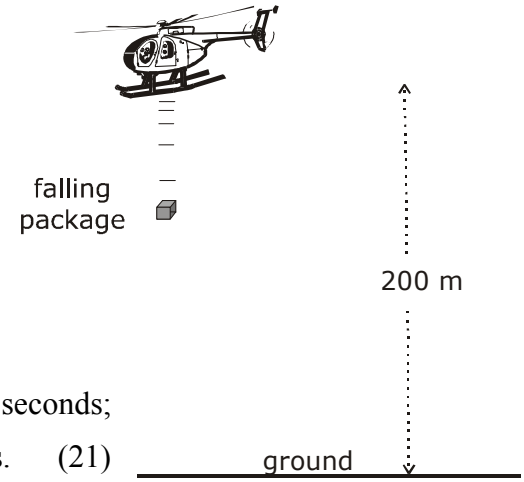

Fig. 3

Calculate:

(i) the weight of the package;

(ii) the velocity of the package after 5 seconds;

(iii) the distance that the package falls from the helicopter in 5 seconds;

(iv) the height of the package *above* the ground after 5 seconds. (21)

[acceleration due to gravity, g = 9.8 m s^{-2}]

3. *(a)* What is meant by (i) *a real image*, (ii) *a magnified image*? (12)

State <u>two</u> properties of the image formed by a plane mirror. (6)

A law of reflection states that the angle of incidence is equal to the angle of reflection.

Describe an experiment to verify this law using a plane mirror. (15)

(b) State the *laws of refraction of light.* (12)

Fig. 4 shows an object, **O**, placed 6 cm from a converging (convex) lens of focal length 3 cm.

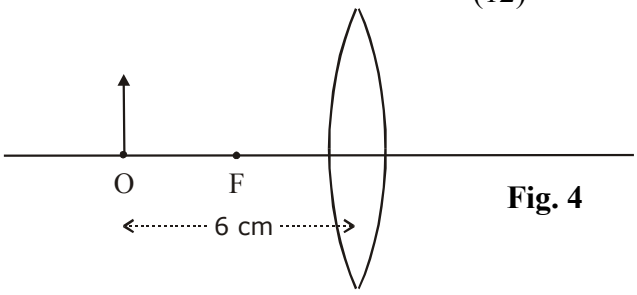

Fig. 4

Copy and complete the diagram to show the formation of the image by the lens. (9)

Is the image real or virtual? Give a reason for you answer. (9)

Give <u>one</u> use of a converging lens. (3)

4. *(a)* State *Boyle's law.* (9)

Describe, with the aid of a labelled diagram, an experiment to verify Boyle's law. (18)

What is meant by an *ideal gas*? (6)

(b) Give <u>two</u> assumptions of the *kinetic theory of gases*. (9)

What is *Brownian motion*? (6)

Describe an experiment to demonstrate Brownian motion. (15)

What does Brownian motion tell you about the nature of gases? (3)

5. State the principle on which a moving coil galvanometer is based. (9)

Describe an experiment to demonstrate this principle. (15)

Name <u>three</u> parts of a moving-coil galvanometer. (9)

A transformer is connected to an a.c. supply. What does a.c. stand for? (6)

Fig. 5 shows a transformer.

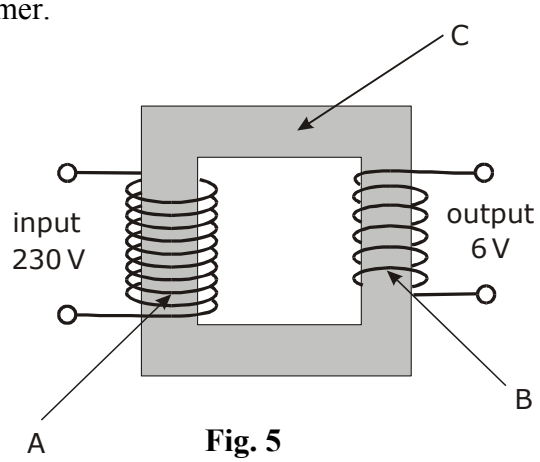

Fig. 5

(i) Name the parts of the transformer labelled **A**, **B** and **C**. (9)

(ii) Part **A** is connected to a 230 V supply and has 460 turns. How many turns are required on part **B** to give an output of 6 V? (9)

Name <u>one</u> device that uses a transformer. (3)

What is the advantage to the ESB in transmitting electricity at high voltages? (6)

6. Answer any **two** of the following parts, *(a), (b)*, *(c)* and *(d)*. Each part carries 33 marks.

(a) Define (i) *kinetic energy*, (ii) *momentum*. (12)

Fig. 6 shows <u>two</u> metal spheres each of mass 2 kg on a smooth horizontal surface. Sphere **A** moving at a velocity of 4 m s^{-1} collides with sphere **B** which is at rest. After they collide both spheres move in the same direction and sphere **A** then moves with a velocity of 1 m s^{-1}.

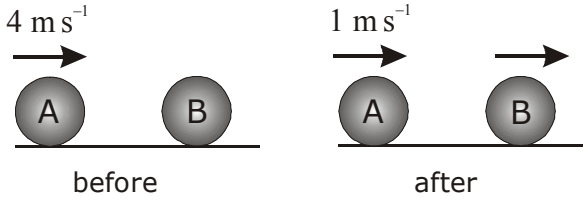

Fig. 6

Calculate:

(i) the initial kinetic energy of sphere **A**;

(ii) the momentum of sphere **A** before the collision;

(iii) the momentum of sphere **B** after the collision. (21)

(b) **Fig. 7** shows a beam of white light passing through a prism forming a <u>spectrum</u> on a screen.

Explain the underlined term. (6)

What happens to the light as it enters the prism at **W**? (6)

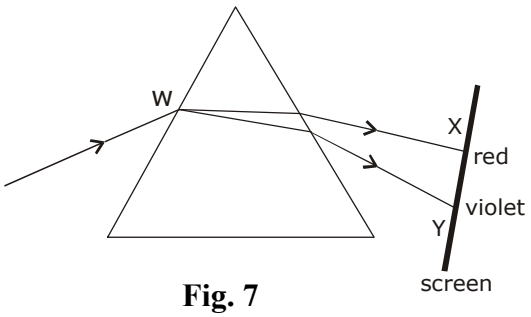

Fig. 7

Name the invisible radiation on the screen at (i) region **X**, (ii) region **Y**. (12)

Describe how you could detect <u>one</u> of these invisible radiations. (9)

(c) State *Ohm's law*. (9)

What is the unit of electric current? (6)

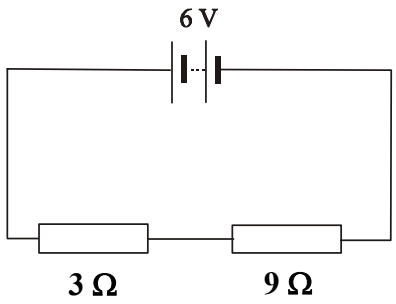

Fig. 8

Fig. 8 shows a circuit with two resistors connected in series to a 6 V battery.

Calculate:

(i) the total resistance of the circuit;

(ii) the current in the circuit;

(iii) the potential difference (voltage) across the 9 Ω resistor. (18)

(d) Gamma radiation may be emitted by a radioactive substance.

Give two properties of the underlined term. (12)

Name two other types of nuclear radiation. (6)

Give two uses of radioactive substances. (6)

Radon is a radioactive gas with a half-life of 4 days.

What fraction of a sample of radon gas is left after 12 days? (9)

SECTION II – CHEMISTRY (200 marks)

7. Answer **eleven** of the following items, *(a)*, *(b)*, *(c)*, etc. All the items carry equal marks. *Keep your answers short*.

(a) How many (i) protons, (ii) electrons, are there in the $\mathbf{Li^+}$ ion?

(b) Which element is represented by the electronic configuration: $\mathbf{1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6}$?

(c) Sketch an *s-orbital*.

(d) Give <u>one</u> example of a molecular crystal.

(e) Arrange the following metals in order of <u>increasing</u> activity:

aluminium sodium zinc

(f) Name <u>one</u> oxide which is a major cause of atmospheric pollution.

(g) What is meant by an *amphoteric oxide*?

(h) Copy, complete and balance the equation: $\mathbf{Ca + HCl \rightarrow}$

(i) Give an example of a *weak acid*.

(j) Calculate the percentage of nitrogen by mass in ammonia ($\mathbf{NH_3}$).

[N=14; H=1]

(k) State *Hess's law*.

(l) Name <u>two</u> gases produced when acidified water undergoes electrolysis.

(m) The relative molecular mass of ethanal ($\mathbf{CH_3CHO}$) is 44. Calculate the number of molecules in 22 g of ethanal.

[Avogadro constant = 6.0×10^{23} mol^{-1}]

(n) Name the compound shown in **Fig. 9.**

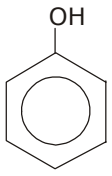

Fig. 9

(o) Give the molecular formula for benzene.

(11×6)

8. *(a)* Explain the terms (i) *mass number,* (ii) *isotope*. (12)

The element gallium (**Ga**) consists of **60%** $^{69}_{31}\mathbf{Ga}$ and **40%** $^{71}_{31}\mathbf{Ga}$.

(iii) State the number of neutrons in <u>each</u> of these isotopes.

(iv) Calculate the relative atomic mass of gallium. (21)

(b) What is meant by (i) *covalent bond*, (ii) *ionic bond*? (12)

Give <u>one</u> property of ionic compounds. (3)

The table shows the electronegativity values of some elements:

Element	hydrogen	sodium	chlorine
Electronegativity value	2.1	0.9	3.0

Using this data, explain why

(iii) sodium chloride is an ionic compound;

(iv) hydrogen chloride is a polar covalent molecule. (12)

State the type <u>and</u> size of charge of the chloride ion in sodium chloride. (6)

9. What is meant by the *molarity* of a solution? (6)

Explain why an *indicator* is used during a titration. (6)

In a titration experiment to find the concentration of a solution of sodium hydroxide (**NaOH**) it was found that 25 cm^3 of the sodium hydroxide (**NaOH**) solution was neutralised by 18.5 cm^3 of **0.1 M** sulfuric acid ($\mathbf{H_2SO_4}$).

(i) Draw a labelled diagram of the apparatus used in this experiment. (12)

(ii) Name a suitable indicator for this experiment. (6)

(iii) Describe how the volume of sulfuric acid required for neutralisation was found. (9)

(iv) State <u>two</u> precautions taken to ensure an accurate result. (12)

(v) Copy, complete and balance the equation for the reaction:

$$\mathbf{H_2SO_4 + 2NaOH \rightarrow \_\_\_\_\_ + \_\_\_\_\_}$$ (6)

(vi) Calculate the molarity of the sodium hydroxide solution. (9)

10. *(a)* Define *heat of formation*. (6)

Hydrogen burns in air forming water vapour. The equation for the reaction is:

$$H_{2(g)} + \tfrac{1}{2}O_{2(g)} \rightarrow H_2O_{(g)} \qquad \Delta H = -286 \text{ kJ mol}^{-1}$$

Explain why this reaction is exothermic. (6)

Calculate:

(i) the quantity of heat released in the combustion of 6 moles of hydrogen;

(ii) the number of moles of oxygen used in the combustion of 6 moles of hydrogen;

(iii) the number of moles of hydrogen required to release 1430 kJ of energy. (21)

(b) Oxidation and reduction reactions always occur together.

Explain the underlined words in terms of electron transfer. (12)

Identify (i) the substance oxidised, (ii) the oxidising agent, in the following reaction:

$$Ca + F_2 \rightarrow CaF_2$$ (9)

Copy and complete the following reaction of copper oxide with hydrogen gas:

$$CuO + H_2 \rightarrow$$

Name (iii) the substance oxidised, (iv) the substance reduced, in the reaction of copper oxide with hydrogen gas. (12)

11. Methane (CH_4) is a hydrocarbon compound.

Identify the homologous series to which methane belongs. (6)

Name two other members of this homologous series. (12)

Give one use for methane gas. (6)

Give the structural formula of (i) ethene (C_2H_4), (ii) ethanol (C_2H_5OH). (12)

Describe, with the aid of a labelled diagram, an experiment to produce ethene from ethanol. (18)

Fig. 10 shows a sample of ethene gas being bubbled through a test tube containing a solution of bromine.

What happens to the solution in the test tube? (6)

What does this tell you about the structure of ethene? (6)

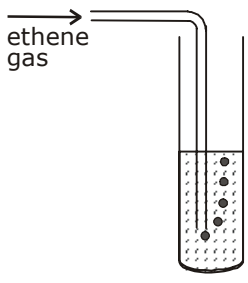

Fig. 10

12. Answer any **two** of the following parts *(a)*, *(b)* and *(c)*. Each part carries 33 marks.

(a) **Fig. 11** shows a gas being prepared and bubbled through limewater in a test tube. The limewater turns 'milky'.

Name the gas being produced. (6)

Name liquid **A** and solid **B**. (12)

Give <u>two</u> uses of the gas produced. (6)

Describe a test to find out if the gas is acidic or basic. (9)

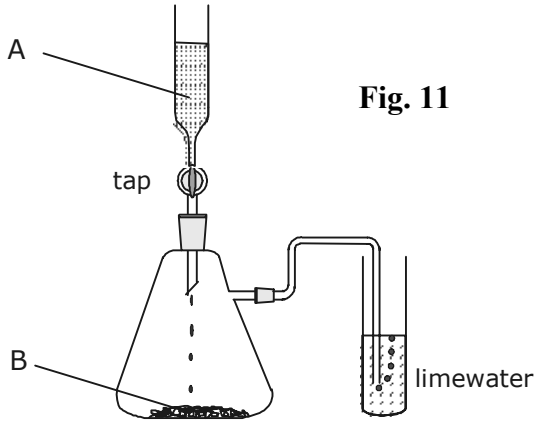

Fig. 11

(b) Define (i) an *acid*, (ii) a *base*, in terms of the *Brønsted-Lowry* theory? (12)

Identify (iii) <u>two</u> acids, (iv) <u>two</u> bases and (v) <u>one</u> acid-base pair in the reaction: (15)

$$\mathbf{NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-}$$

Name the scale used to compare the acidity of substances. (6)

(c) The numbers of bond pairs and lone pairs are used to determine the shape of a molecule.

Draw a diagram to show the arrangement of electrons in ammonia ($\mathbf{NH_3}$). (6)

Copy and complete the following table in your answerbook:

Molecule	**Number of bond pairs**	**Number of lone pairs**	**Shape**
$\mathbf{NH_3}$			pyramidal
$\mathbf{BF_3}$		0	(trigonal) planar
$\mathbf{H_2O}$	2		

(15)

Sketch the shape of any <u>two</u> of the molecules in the table, showing the positions of the atoms in each case. (12)

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