Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2006

PHYSICS AND CHEMISTRY – ORDINARY LEVEL

MONDAY, 19 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*) What is meant by *potential energy*?

(*b*) A car has a mass of 950 kg. What force is needed to give it an acceleration of 6 m s^{-2}?

(*c*) Calculate the work done when a force of 5 N moves an object a distance of 3 m.

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

(*e*) Give <u>one</u> use of a concave mirror.

(*f*) How would you show that white light is a mixture of colours?

(*g*) **Fig. 1** shows waves passing through a narrow opening. Name the phenomenon that takes place.

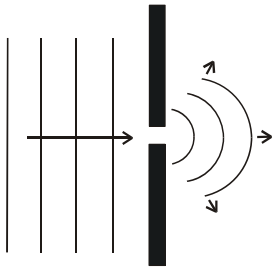

Fig. 1

(*h*) Copy and complete the following statement:
"In the photoelectric effect . . . . . are released from the surface of a metal when . . . . . .falls on it."

(*i*) **Fig. 2** shows a 2 μF capacitor connected in parallel with a 6 μF capacitor. Calculate the effective capacitance of the combined capacitors.

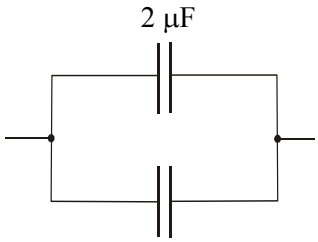

Fig. 2

(*j*) State *Ohm's law*.

(*k*) Calculate the number of units (kW h) used by a 2 kW electric fire left on for 3 hours.

(*l*) Draw a diagram showing the magnetic field pattern due to a current flowing in a straight conductor.

(*m*) State <u>one</u> of the *laws of electromagnetic induction*.

(*n*) Who discovered the equation $E = mc^2$?

(*o*) Explain the term *nuclear fission*. (11 × 6)

2. (*a*) Define (i) *velocity*, (ii) *acceleration*. (12)

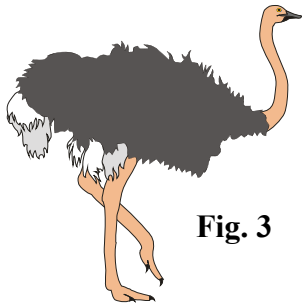

Fig. 3

Fig. 3 shows an ostrich, which is an African flightless bird.
An ostrich starting from rest reaches a speed of 18 m s^{-1} in 3 seconds.
Calculate:

(i) the acceleration of the ostrich;
(ii) the distance covered by the ostrich in 3 seconds;
(iii) the time taken for the ostrich to cover 20 m. (21)

(*b*) State the *principle of the conservation of momentum*. (12)

Fig. 4 shows two spheres on a smooth horizontal surface. Sphere **B** is at rest and sphere **A** is approaching it with a velocity of 5 m s^{-1}. The mass of each sphere is 2 kg. After the collision both spheres move in the same direction and the velocity of sphere **A** is 1.5 m s^{-1}.

Calculate:

(i) the momentum of sphere **A** before the collision;
(ii) the velocity of sphere **B** after the collision;
(iii) the momentum of sphere **B** after the collision. (15)

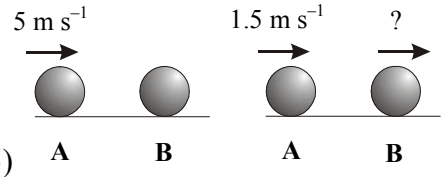

Fig. 4

What type of energy is lost by sphere **A** in the collision? (6)

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

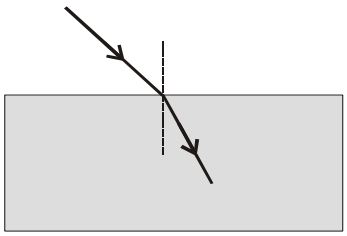

Fig. 5

Fig. 5 shows a ray of light entering a block of glass.

Copy the diagram and label (i) the angle of incidence *i*, (ii) the angle of refraction *r*. (9)

Describe an experiment to show how a ray of light passes through a glass block. (12)

In an experiment to measure the refractive index of the glass block the following data was recorded:

angle of incidence *i*	30°
angle of refraction *r*	19°

Using this data, calculate the refractive index of the glass. (9)

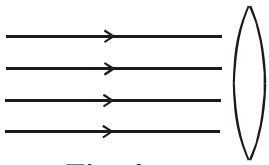

Fig. 6

Fig. 6 shows parallel rays of light approaching a lens.

Name the type of lens shown.

Copy and complete the diagram showing the paths of the rays after they pass through the lens.

Give <u>one</u> use of this type of lens. (15)

Draw a ray diagram showing how a lens can form a magnified image. (9)

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

Describe an experiment to verify Boyle's law. (15)

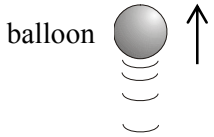

Fig. 7

Fig. 7 shows a balloon rising through the atmosphere while the temperature remains constant.

The balloon contains 2 m^3 of helium gas when the pressure is 100 kPa.

The balloon reaches a height where the pressure is 50 kPa.

Calculate the volume of the balloon at this height. (6)

What happens to the volume of the balloon as it continues to rise? (3)

(*b*) "Two fixed points and a thermometric property are needed to set up a temperature scale."

Explain the underlined terms. (9)

What are the values of the fixed points on the Celsius scale? (6)

Give one example of a thermometric property. (6)

Describe an experiment to mark the position of the lower fixed point on a mercury thermometer. (12)

5. (*a*) Copy and complete the following statement of *Coulomb's law*:

"The force between two point charges is directly proportional to the . . . . . of the charges and inversely proportional to the . . . . . of the . . . . . between them." (9)

Draw a labelled diagram of a gold leaf electroscope.

Give one use for a gold leaf electroscope. (15)

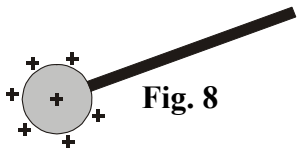
Fig. 8

Fig. 8 shows a positively charged metal disc on the end of an insulated handle.

Name a suitable material for the handle.

What will be observed as the charged disc is brought close to an uncharged electroscope? (9)

(*b*) "An electric current is a flow of charge in a circuit."

Give two ways of increasing the current in a circuit.

Name a device used to measure electric current. (12)

Fig. 9 shows how two resistors can be combined together.

In diagram **A** the resistors are arranged *in series*.

How are the resistors arranged in diagram **B**? (9)

Calculate the effective resistance of the combined resistors in (i) **A**, (ii) **B**. (12)

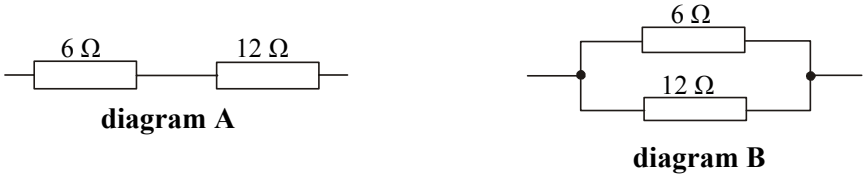

Fig. 9

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

(*a*) Describe an experiment to measure the acceleration due to gravity, *g*. (21)

The acceleration due to gravity on the surface of a planet is given by:

$$g = \frac{GM}{r^2}$$

What do the symbols *G*, *M* and *r* stand for? (12)

(*b*) **Fig. 10** shows part of the electromagnetic spectrum in order of increasing wavelength.

Explain the underlined term. (6)

Give two properties common to all regions of the electromagnetic spectrum. (12)

Name the regions labelled (i) **A**, (ii) **B**. (9)

How would you detect the radiation found at **A**? (6)

X-rays	**A**	**light**	**B**	**microwaves**

Fig. 10

(*c*) A transformer will only work with an a.c. supply.

What is meant by a.c.? (6)

Fig. 11 shows a transformer which converts a 230 V a.c. supply into 4600 V a.c.

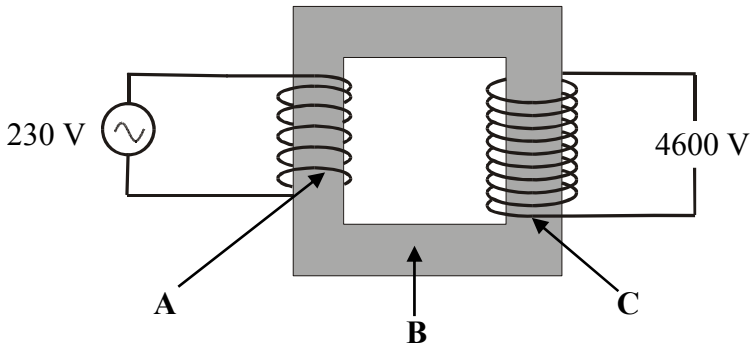

Fig. 11

Name the parts labelled (i) **A**, (ii) **B**, (iii) **C**. (9)

If part **A** has 1500 turns calculate the number of turns on part **C**. (9)

Name one device that uses a transformer. (6)

Why does a transformer become warm during use? (3)

(*d*) "Ionisation can be caused by the radiations emitted from radioactive substances."

Explain the underlined terms. (12)

Name the radiation emitted from radioactive substances which causes the greatest amount of ionisation?

Give one other property of this radiation. (9)

Give two uses for radioactive substances. (12)

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*) What is an *isotope*?

(*b*) Name the <u>two</u> elements found in a molecule of methane.

(*c*) In the equation $E = hf$, what does f represent?

(*d*) **Fig. 12** shows a salt crystal. Name the type of bonding which exists between the particles in a salt crystal.

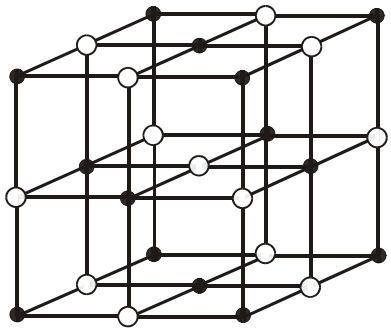

Fig. 12

(*e*) Define *electronegativity*.

(*f*) Calculate the percentage of carbon by mass in methanol (**CH_3OH**).
[H=1; C=12; O=16]

(*g*) What is meant by an *endothermic reaction*?

(*h*) State *Hess's law*.

(*i*) Give <u>one</u> example of a *weak acid*.

(*j*) Calculate the **pH** of a **0.01 M** solution of hydrochloric acid (**HCl**).

(*k*) List the following elements in their order in the electrochemical series.
zinc **copper** **potassium**

(*l*) Give <u>two</u> uses of *electrolysis*.

(*m*) The relative molecular mass of oxygen gas (**O_2**) is 32.
Calculate the number of molecules in 64 g of oxygen gas.
[Avogadro constant = 6.0×10^{23} mol^{-1}]

(*n*) Give <u>one</u> example of a neutral oxide.

(*o*) Give <u>one</u> example of an *aromatic* compound.

(11×6)

8. Electrons are subatomic particles found in atomic orbitals.

Sketch the shape of (i) an s-orbital, (ii) a p-orbital. (12)

Name two other subatomic particles. (12)

Give the electronic (s, p) configuration of (i) neon, (ii) chlorine. (9)

(Refer to Mathematics Tables, p.44.)

Will the element neon form a bond with other elements?

Give one reason for your answer. (6)

Name the type of bond in a molecule of chlorine.

Give two properties of this type of bond.

Draw a diagram showing how this bond is formed in a molecule of chlorine. (18)

Give

(i) the formula for the chloride of carbon;

(ii) the shape of a molecule of the chloride of carbon. (9)

9. Define (i) a base, (ii) a conjugate acid-base pair, using the Brønsted-Lowry theory. (12)

Identify two bases and one acid-base pair in the following reaction: (18)

$$H_2SO_4 + H_2O \rightleftharpoons H_3O^+ + HSO_4^-$$

Water is an amphoteric substance.

Explain the underlined term. (6)

The following elements react with oxygen to form oxides:

sodium **magnesium** **sulfur**

Give the chemical formula for an oxide of each of these elements. (9)

From these oxides, name (i) an acidic oxide, (ii) a basic oxide. (12)

Describe a test to find out if an oxide is acidic or basic. (9)

10. In a titration, a student used a standard solution of hydrochloric acid (**HCl**) to find the concentration of a potassium hydroxide (**KOH**) solution.
Explain the underlined terms. (12)

Fig. 13 shows some glassware used for this experiment.

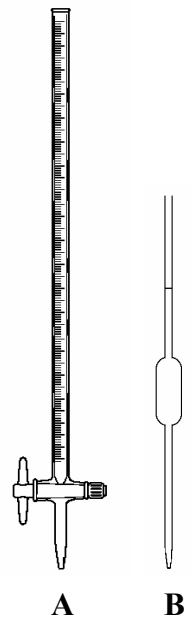

Fig. 13

Name the pieces of glassware labelled (i) **A**, (ii) **B**. (12)

Describe the procedure used in preparing **A** to hold the acid. (9)

Explain how 20 cm^3 portions of the potassium hydroxide solution can be accurately measured out. (9)

Why is an indicator used in a titration?
Name a suitable indicator for this titration.
Give one precaution taken to improve the accuracy of the titration. (15)

The student noted that 20 cm^3 of potassium hydroxide (**KOH**) solution was neutralised by 17.5 cm^3 of **0.15 M** hydrochloric acid (**HCl**) solution.
The equation for this reaction is:

$$\mathbf{HCl + KOH \rightarrow KCl + H_2O}$$

Calculate the molarity of the potassium hydroxide solution. (9)

11. The gas ethyne (acetylene) ($\mathbf{C_2H_2}$) is an unsaturated hydrocarbon.
Explain the underlined terms. (12)

Describe a chemical test to show that ethyne is unsaturated. (12)
Draw the structural formula of ethyne ($\mathbf{C_2H_2}$). (9)
Name the homologous series to which ethyne belongs. (6)
Name another homologous series of 'unsaturated hydrocarbons'. (6)

Carbon dioxide is produced when ethyne reacts with oxygen.
Name the other substance produced during this reaction. (6)
Write an equation to show this reaction. (6)
Describe a test for the presence of carbon dioxide gas. (9)

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

(*a*) Define (i) *oxidation*, (ii) *reduction*, in terms of electron transfer. (12)
State the substance oxidised in <u>each</u> the following reactions: (9)

$$CuO + H_2 \rightarrow Cu + H_2O$$
$$2KI + Cl_2 \rightarrow 2KCl + I_2$$

Copy, complete and balance the following reaction of calcium with hydrochloric acid:

$$Ca + HCl \rightarrow \_\_\_\_\_ + \_\_\_\_\_$$

Identify the *oxidising agent* in this reaction. (12)

(*b*) **Fig. 14**. shows the decomposition of a solution of hydrogen peroxide using a catalyst.

What is the purpose of a catalyst? (6)
Name a suitable catalyst for this reaction. (6)
Write a balanced equation for the reaction. (9)
How would you identify the gas produced? (9)
Give <u>one</u> use for the gas produced. (3)

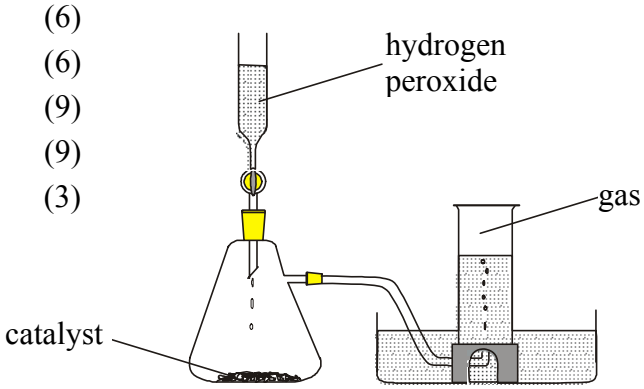

Fig. 14

(*c*) Define *heat of combustion*. (9)

Propane (C_3H_8) is a gas used as a camping fuel.
Propane burns in air and the equation for the reaction is:

$$C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)} \qquad \Delta H = -2220 \text{ kJ mol}^{-1}$$

Calculate:

(i) the quantity of heat released in the combustion of *two* moles of propane;
(ii) the number of moles of oxygen needed for the combustion of *two* moles of propane;
(iii) the quantity of heat released in the combustion of 22 g of propane. (24)
[H=1; C=12]

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