Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION 2008

PHYSICS AND CHEMISTRY – ORDINARY LEVEL

MONDAY, 16 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*) **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}]

Figure 1

(*b*) What is meant by *potential energy*?

(*c*) Name **two** temperature scales.

(*d*) What is meant by *Brownian motion*?

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

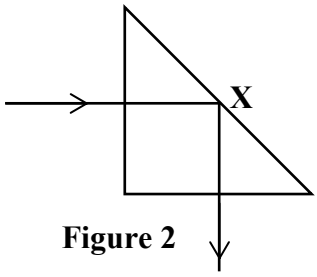

Figure 2

(*f*) Give **one** use of a concave mirror.

(*g*) **Figure 3** shows a waveform.
What name is given to the distance marked **A**?

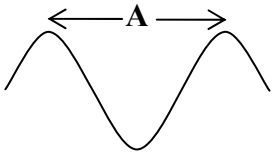

Figure 3

(*h*) Copy and complete the following statement:
"The leaves of a gold leaf . . . . . diverge when
a . . . . . rod is brought near to the cap."

(*i*) What is the purpose of a transformer in a mobile phone charger?

(*j*) **Figure 4** shows a 6 μF capacitor connected in parallel with a 8 μF capacitor. Calculate the effective capacitance of the combined capacitors.

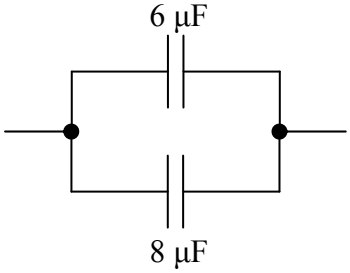

Figure 4

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

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

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

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

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

2. (*a*) Define (i) *velocity*, (ii) *acceleration*.
State the unit of acceleration. (15)

Figure 5

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:

(iii) the acceleration of the greyhound;

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

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? (18)

(*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." (9)

Describe an experiment to measure the acceleration due to gravity, *g*.
Give **one** precaution to ensure an accurate result in the experiment. (24)

3. A ray of light is refracted towards the normal as it enters a glass block.
Explain, with the aid of a labelled diagram, the underlined terms. (12)
State **one** of the *laws of refraction*. (6)

Figure 6 shows an object **O** placed 8 cm from a converging (convex) lens of focal length 4 cm.

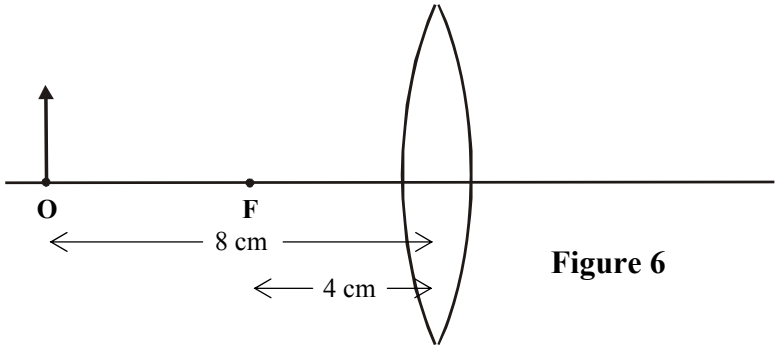

Figure 6

Copy and complete the diagram to show the formation of the image by the lens.
How far is the image from the lens?
Is the image *real* or *virtual*? Give a reason for your answer. (24)

Describe an experiment to measure the focal length of a converging lens. (15)

A converging lens can be used as a magnifying glass when an object is placed inside the focus of the lens.
Give **two** properties of the image observed. (9)

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 . . . . . ." (9)

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

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. (9)

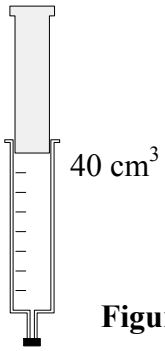

Figure 7

(*b*) Temperature scales are based on a thermometric property.
Explain the underlined term. (9)
Name the thermometric property on which a mercury thermometer is based. (6)
Describe an experiment to calibrate an unmarked mercury thermometer. (18)

5. How would you show that an electric current has a heating effect?
Give **two** other effects of an electric current. (18)
What is the unit used to measure electric current? (6)
An electric kettle is protected by a fuse in its plug. How does a fuse limit the current in a kettle? (6)

Figure 8 shows a circuit used to verify *Ohm's law*.
Name the part labelled **X**. What is its function?
What measurements are made by the meters labelled **Y** and **Z**? (21)
State the relationship between the current through the resistor **R** and the voltage across it. (6)

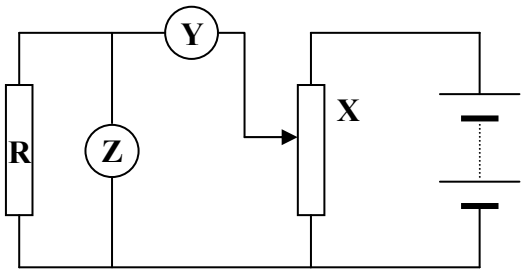

Figure 8

Figure 9 shows two 10 Ω resistors connected together.
What term is used to describe this combination of resistors?
Calculate the effective resistance of this combination. (9)

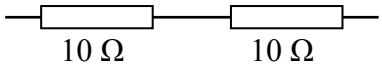

Figure 9

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)

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.

Figure 10

Calculate:

(i) the initial momentum of the arrow;

(ii) the initial kinetic energy of the arrow;

(iii) the velocity of the arrow and the apple as they move together. (21)

(*b*) A sodium discharge lamp is a source of <u>monochromatic light</u>.

Explain the underlined term. (6)

Figure 11 shows a narrow beam of monochromatic light approaching a pair of narrow slits and then striking a screen.

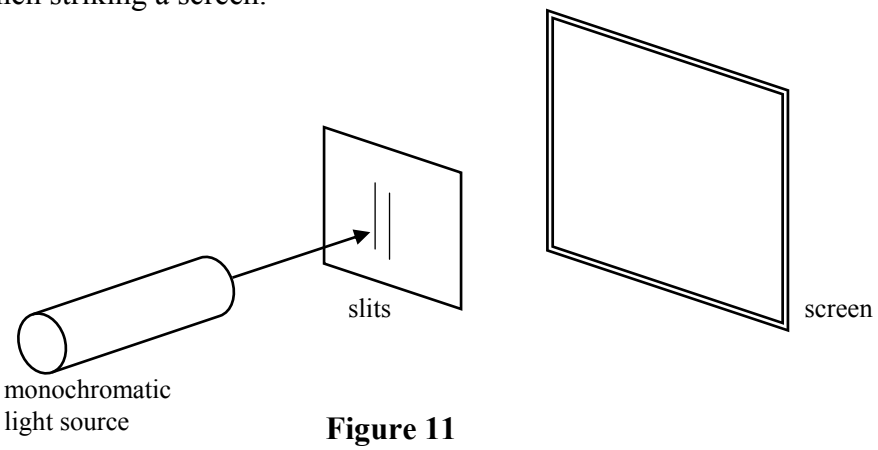

Figure 11

Name **two** wave phenomena which occur as the light passes through the slits. (12)

Describe, with the aid of a diagram, the pattern observed on the screen. (9)

State **two** measurements which are recorded to find the wavelength of monochromatic light. (6)

(*c*) What is an *electric field*? (6)

Figure 12 shows an isolated positive charge.

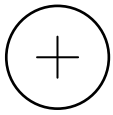

Figure 12

Copy the diagram and sketch the electric field around the charge. (9)

Coulomb's law gives the force between two charges.

The force between two identical positive charges is 0.25 N.

Is this force *attractive* or *repulsive*? Give a reason for your answer. (9)

What will happen to the size of the force:

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

(ii) if the distance between the charges is increased? (9)

(*d*) What is meant by the *half-life* of a radioactive substance? (6)

Alpha particles are one type of nuclear radiation.

Name **two** other types of nuclear radiation. (12)

Give **one** property of an alpha particle. (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? (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*) What type of atomic orbital is shown in **Figure 13**?

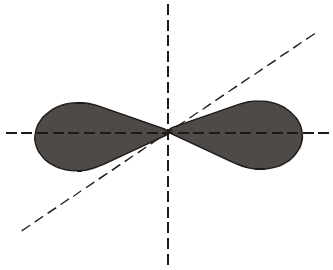

Figure 13

(*b*) Give **two** properties of an electron.

(*c*) What is an *ion*?

(*d*) Define *electronegativity*.

(*e*) Why is a catalyst used in a chemical reaction?

(*f*) Calculate the percentage of carbon by mass in ethanol ($\mathbf{C_2H_5OH}$).
[H=1; C=12; O=16]

(*g*) Give **one** example of a transition metal.

(*h*) What term is used to describe a chemical reaction in which energy is released?

(*i*) Copy, complete and balance the following reaction:

HCl + Mg → ____ + $\mathbf{H_2}$

(*j*) What gas is produced when hydrogen peroxide ($\mathbf{H_2O_2}$) decomposes?

(*k*) List the following elements in order of increasing activity:

copper potassium silver

(*l*) Give **one** use for *electrolysis*.

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

(*n*) Name a *ketone*.

(*o*) Draw the structure of a benzene molecule.

(11×6)

8. Define (i) *atomic number*, (ii) *mass number*. (12)

Copy the following table into your answerbook and complete it by filling in the missing numbers:

(Refer to Mathematics Tables, p.44.)

Element	Atomic number	Mass number	Number of neutrons
sodium	11		
fluorine			10

(12)

Give the electronic (*s, p*) configuration of (iii) sodium, (iv) fluorine. (9)

Elements combine to form compounds.

Name **two** types of bond between elements in compounds.

Give **one** property of each of these types of bond. (18)

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

Explain, with the aid of a diagram, how this bond is formed. (15)

9. (*a*) Vinegar is a weak acid.

Explain the underlined term.

Name the scale used to compare the acidity of solutions. (9)

Define (i) an acid, (ii) a base, in terms of the Brønsted-Lowry theory.

Identify **one** acid and **one** base in the following reaction: (12)

$$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$$

What is meant by a conjugate acid-base pair?

Give **one** example of a conjugate acid-base pair in the above reaction. (12)

(*b*) Explain (i) *oxidation*, (ii) *reduction*, in terms of electron transfer. (12)

Identify the substance oxidised in the following reaction: (6)

$$CuO + H_2 \rightarrow Cu + H_2O$$

Name the oxidising agent in this reaction. (6)

What colour change is observed during the reaction? (9)

10. To find the concentration of a potassium hydroxide (**KOH**) solution, a standard solution of hydrochloric acid (**HCl**) was used in a titration.

Explain the underlined terms. (12)

Figure 14 shows some glassware used in this titration.

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

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

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

(iv) Give **two** safety precautions when carrying out this titration. (9)

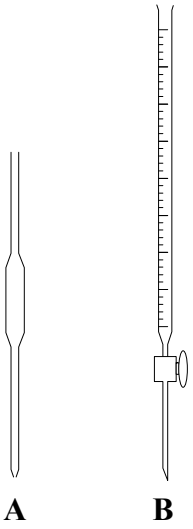

Figure 14

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:

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

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

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

11. What are *hydrocarbons*?

Identify the main source of hydrocarbons. (12)

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.

Sketch the structure of a methane molecule and state its shape. (12)

Ethene and ethyne are unsaturated compounds.

Explain the underlined term.

Describe a chemical test to show that ethyne is unsaturated.

Give **one** use for ethyne. (24)

Methane is commonly used as a fuel and burns in air according to the following reaction:

$$\mathbf{CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O} \qquad \mathbf{\Delta H = -895\ kJ\ mol^{-1}}$$

Calculate:

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

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

(iii) the number of moles of methane that should be burned to release 3580 kJ of energy. (18)

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

(*a*) Define a *mole* of a substance. (6)

Calcium reacts with hydrochloric acid according to the following reaction:

$$\mathbf{Ca + 2HCl \rightarrow CaCl_2 + H_2}$$

Describe how you would identify the gas produced in this reaction. (9)

If 60 g of calcium were used in this reaction, calculate:

(i) the number of moles of calcium used;

(ii) the number of moles of hydrochloric acid required to react completely with the calcium;

(iii) the mass of calcium chloride produced. (18)

[H=1; O=16; Ca=40; Cl=35.5]

(*b*) **Figure 15** shows carbon dioxide gas ($\mathbf{CO_2}$) being prepared and collected.

Name the liquid **A** and the solid **B**.

How would you know when the gas jar was full of carbon dioxide? (15)

Limewater was added to a gas jar full of carbon dioxide.

What colour change was observed in the limewater? (6)

Give **two** uses for carbon dioxide. (12)

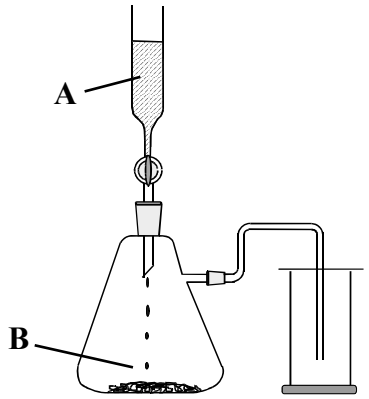

Figure 15

(*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. (12)

From these oxides, identify:

(i) the acidic oxide;

(ii) the basic oxide.

Name **one** other type of oxide. (12)

Describe a chemical test to show that an oxide is acidic. (9)

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