Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION 2007

PHYSICS AND CHEMISTRY – ORDINARY LEVEL

MONDAY 18 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*) A horse gallops at a constant speed of 10 m s^{-1}.
Calculate the distance travelled by the horse in 2 minutes.

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

(*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 . . . . . ."

(*d*) Give **one** advantage of the *constant volume gas thermometer*.

(*e*) What type of lens is used in a magnifying glass shown in **Figure 1**?

Figure 1

(*f*) Infrared radiation is part of the electromagnetic spectrum.
Name **one** other part of the electromagnetic spectrum.

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

(*h*) Give **one** example of a longitudinal wave.

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

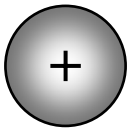

Figure 2

(*j*) Calculate the number of units (kW h) used by an 8 kW electric shower in 6 minutes.

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

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

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

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

(*o*) Name the type of nuclear reaction that occurs in the sun. (11 × 6)

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

State the *principle of conservation of momentum*. (9)

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**.

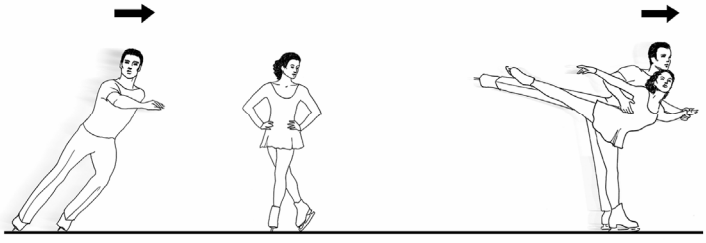

Figure 3

Calculate:

(iii) the initial momentum of each skater;

(iv) the velocity of the skaters as they move together. (12)

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

What is meant by *potential energy*? (15)

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. (9)

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

How far will the rock have fallen when its potential energy is half its original value? (9)

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

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

When you look at a plane mirror you see a virtual image.

Explain the underlined terms.

Give **one** other property of the image in a plane mirror. (15)

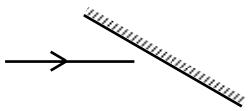

Figure 4

Figure 4 shows a ray of light approaching a plane mirror.

Copy the diagram and show the path of the reflected ray. (9)

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

Describe an experiment to measure the focal length of a concave mirror. (12)

Figure 5 shows a pin placed 6 cm in front of a concave mirror of focal length 4 cm.

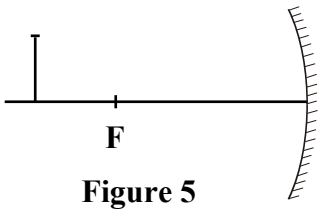

Figure 5

Find the distance of its image from the concave mirror. (9)

Give **two** properties of the image of the pin. (6)

4. (*a*) Explain the terms (i) *heat*, (ii) *temperature*. (12)

Describe, with the aid of a diagram, a mercury thermometer. (9)

State the thermometric property on which the mercury thermometer is based. (6)

Name **two** temperature scales. (6)

(*b*) State **two** assumptions of the *kinetic theory of gases*. (12)

What is meant by Brownian motion? (9)

Describe an experiment to show Brownian motion. (12)

5. (*a*) The following terms are used in stating *Ohm's law*:

conductor	voltage	temperature	current

Using these terms, copy and complete *Ohm's law*:

"The . . . . . through a . . . . . is proportional to the . . . . . between its ends at constant . . . . . ." (9)

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)

Calculate the total resistance of the circuit. (6)

Using Ohm's law, calculate the current in the circuit. (9)

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

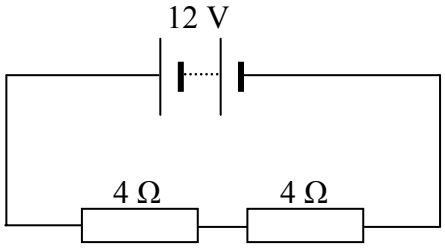

Figure 6

(*b*) How would you show that there is a magnetic field around a conductor which is carrying a current? (12)

Figure 7 shows a coil of wire carrying a current.

Copy the diagram and draw the magnetic field pattern around the coil. (9)

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

Give **one** use of a magnetic field around a coil. (12)

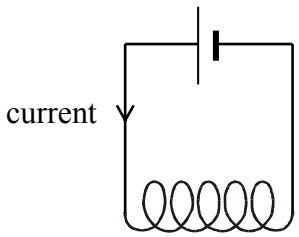

Figure 7

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

(*a*) What is meant by *acceleration*? (6)

State **one** of Newton's laws of motion. (9)

A car of mass 1200 kg increases its velocity from 2 m s^{-1} to 20 m s^{-1} in 6 seconds.

Calculate:

(i) the acceleration of the car;

(ii) the force accelerating the car;

(iii) the distance travelled by the car in the 6 seconds. (18)

(*b*) Diffraction occurs when monochromatic light passes through narrow slits.

Explain the underlined terms. (12)

An experiment was carried out to measure the wavelength of monochromatic light.

Draw a labelled diagram of the apparatus used.

What measurements should be recorded during the experiment? (21)

(*c*) Define *capacitance*. (6)

Figure 8 shows a parallel plate capacitor connected to a battery.

Copy the diagram and show the distribution of charges on the plates of the capacitor. (6)

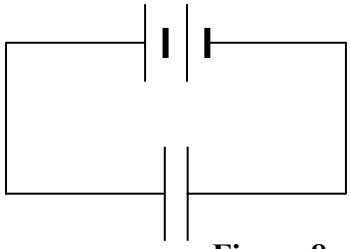

Figure 8

Give **one** way in which the capacitance of the capacitor can be changed. (6)

Calculate the effective capacitance of two 4 μF capacitors when connected in (i) series, (ii) parallel. (9)

Give **one** use of a capacitor. (6)

(*d*) Alpha, beta and gamma radiations are emitted from radioactive substances.

(i) Which radiation consists of electrons?

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

(iii) Which radiation will pass through a thick sheet of aluminium? (15)

List **two** uses of radioactive substances. (9)

Give **two** precautions when using radioactive substances. (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*) Sketch a *p-orbital*.

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

(*c*) Give **one** property of a compound with *ionic bonding*.

(*d*) What type of bonding exists *between* water molecules?

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

(*f*) Calculate the percentage of oxygen by mass in water ($\mathbf{H_2O}$).
[O=16; H=1]

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

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

(*i*) What is the **pH** of a **0.05 M** solution of nitric acid ($\mathbf{HNO_3}$)?

(*j*) Which **one** of the following oxides is amphoteric?
$\mathbf{Na_2O}$ $\mathbf{CO_2}$ $\mathbf{Al_2O_3}$

(*k*) Give **one** characteristic property common to transition elements.

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

$$\mathbf{CaCO_3 + HCl \longrightarrow CaCl_2 + \_\_\_\_\_ + \_\_\_\_\_}$$

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

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

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

Figure 9

(11×6)

8. (*a*) Each element in the periodic table has a unique period number and group number.

Explain the underlined terms. (12)

What is meant by the *first ionisation energy* of an element? (9)

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

Identify the group with the largest first ionisation energy values. (12)

(Refer to Mathematics Tables, p.45.)

(*b*) Define (i) *mass number*, (ii) *isotope*. (12)

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

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

(iv) Calculate the relative atomic mass of this sample of chlorine. (21)

9. (*a*) Each of the following elements reacts with hydrogen:

nitrogen **sulfur** **chlorine**

Give the name and chemical formula of **each** product formed. (15)

From these products, identify (i) an acidic product, (ii) a basic product. (6)

Sketch and state the shape of **one** of the products, showing the positions of the atoms. (12)

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

What is a meant by a *strong acid*? (15)

Identify **two** acids and **two** bases in the following reaction:

$$\mathbf{HNO_3 + H_2O \rightleftharpoons NO_3^- + H_3O^+}$$

Give **one** example of an acid-base pair in the above reaction. (18)

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

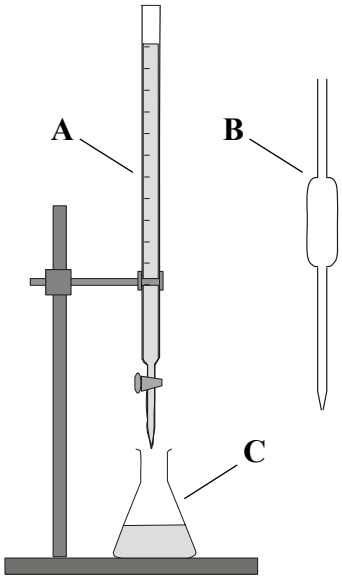

Figure 10

(i) Identify the pieces of glassware labelled **A**, **B** and **C**. (9)

(ii) Outline the procedure for preparing and filling **A**. (9)

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

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

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

(vii) Copy and complete the equation for the reaction that takes place in this titration:

$$\mathbf{HCl} + \mathbf{NaOH} \longrightarrow \underline{\quad} + \underline{\quad}$$ (9)

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

(ix) Give **one** safety precaution when carrying out a titration. (6)

11. Ethene (ethylene) ($\mathbf{C_2H_4}$) is a member of a homologous series of hydrocarbons.
Explain the underlined terms. (12)

Name the homologous series to which ethene belongs.
Name **one** other homologous series of hydrocarbons.
Sketch the structural formula of ethene. (18)

Figure 11 shows apparatus used to prepare ethene where a liquid **X,** soaked in glass wool, passes over a heated catalyst **Y**.

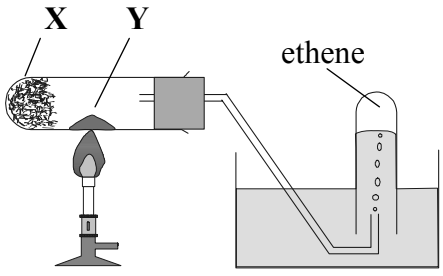

Figure 11

Identify liquid **X** and catalyst **Y**.
What is the purpose of a catalyst? (18)

Samples of ethene gas were collected.
What is observed when a sample was tested with:
(i) a burning splint?
(ii) bromine water solution?
What do these tests tell you about ethene? (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)

Describe the appearance of sodium and bromine at room temperature. (9)

Sodium and bromine react together to form sodium bromide as follows:

$$\mathbf{2Na + Br_2 \longrightarrow 2NaBr}$$

46 g of sodium were used in this reaction.

Calculate:

(i) the number of moles of sodium used;

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

(iii) the mass of sodium bromide produced. (18)

[Na=23; Br= 80]

(*b*) **Figure 12** shows sulfur dioxide ($\mathbf{SO_2}$) being prepared.

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

Identify liquid **C** and give its use. (9)

Give

(i) **one** physical property of $\mathbf{SO_2}$

(ii) **one** chemical property of $\mathbf{SO_2}$.

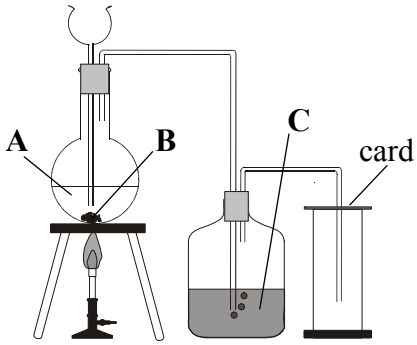

Figure 12

$\mathbf{SO_2}$ is considered an environmental pollutant.

Name **one** major source of $\mathbf{SO_2}$ released into the atmosphere. (12)

(*c*) What is *electrolysis*?

Name the scientist who discovered the laws of electrolysis. (12)

Figure 13 shows a solution of copper sulfate ($CuSO_4$) undergoing electrolysis using copper electrodes.

List **two** ions present in the solution.

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

What change will happen to the mass of electrode **B** during the electrolysis? (15)

Give **one** use of electrolysis. (6)

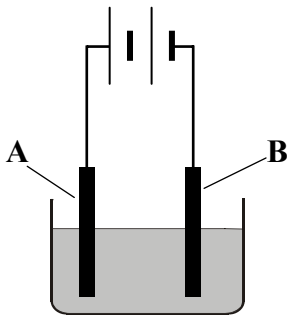

Figure 13

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