Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2005

PHYSICS AND CHEMISTRY – ORDINARY LEVEL

MONDAY, 20 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 the unit of *work*?

(*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}?

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

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

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

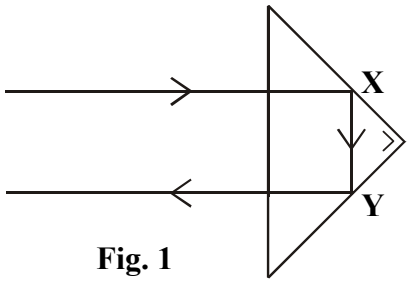

Fig. 1

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

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

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

(*j*) State the principle on which a moving coil galvanometer is based.

(*k*) How would you detect the magnetic effect of an electric current?

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

(*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.

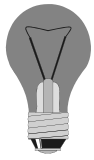
Fig. 2

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

(*o*) Give <u>one</u> difference between *nuclear fission* and *nuclear fusion*. (11 × 6)

2. What is *kinetic energy*?

State the *principle* of *conservation of energy*. (18)

Define (i) *velocity*, (ii) *force*. (12)

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." (6)

Fig. 3 shows a skateboarder of mass 70 kg being pulled along a smooth horizontal surface by a force of 14 N.

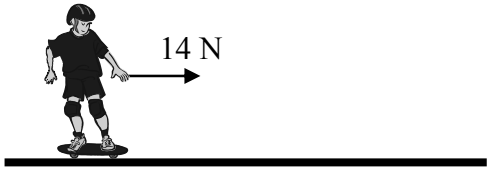

Fig. 3

If the skateboarder starts from rest, calculate:

(i) the acceleration of the skateboarder;

(ii) the velocity of the skateboarder after 10 seconds;

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

(iv) the distance travelled by the skateboarder during the 10 seconds. (24)

The force is then removed and the skateboarder passes over a smooth obstacle as shown in **Fig. 4**.

Fig. 4

Describe the changes in the kinetic energy as the skateboarder passes over the obstacle. (6)

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

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

Give <u>one</u> precaution you should take to ensure an accurate result. (18)

Give <u>one</u> difference between a *real image* and a *virtual image*. (6)

Draw ray diagrams to show how a concave mirror forms (i) a real image, (ii) a virtual image. (12)

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? (12)

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

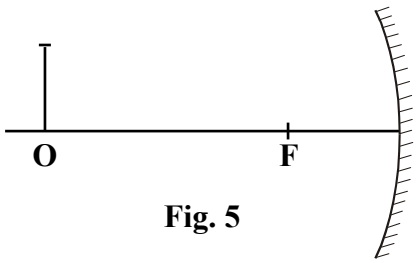

Fig. 5

4. (*a*) What is meant by (i) *diffraction*, (ii) *interference*, of waves? (12)

Give two differences between light waves and sound waves. (6)

Using a pair of narrow slits, describe how you would demonstrate interference of light waves. (15)

(*b*) 'Ultraviolet radiation is part of the electromagnetic spectrum with a frequency greater than blue light.'
Explain the underlined terms. (12)

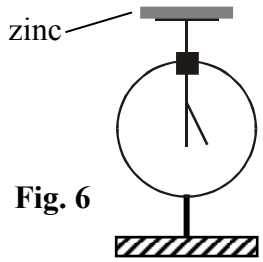

Fig. 6

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. (9)

When ultraviolet radiation shines on the zinc metal the electroscope loses its charge.
Name this phenomenon and explain why the electroscope loses its charge. (12)

5. (*a*) 'An electric current produces a heating effect in a resistor.'
List two factors on which the heating effect of an electric current depends.
Identify two household appliances that make use of this heating effect.
Household appliances contain a fuse. What is the purpose of a fuse? (18)

Fig. 7 shows a circuit with two resistors connected in series to a battery.
The current in the circuit is 1.5 A.
Calculate:

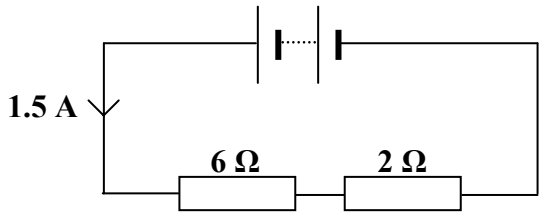

Fig. 7

(i) the effective resistance of the two resistors;

(ii) the potential difference (voltage) of the battery;

(iii) the potential difference (voltage) across the 2 Ω resistor. (15)

(*b*) State a *law of electromagnetic induction*.
Who discovered one of the laws of electromagnetic induction? (12)

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.

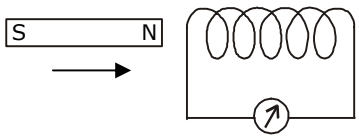

Fig. 8

In which *direction* will the needle in the galvanometer deflect when:

(i) the bar magnet moves out of the coil?

(ii) the bar magnet moves, south pole first, into the coil? (9)

Explain why the needle will not deflect when the magnet is stationary. (6)

Give one use of electromagnetic induction. (6)

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

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

Explain how this principle applies to the launching of a spacecraft. (9)

Fig. 9 shows two shopping trolleys each of mass 15 kg on a smooth horizontal floor.

Fig. 9

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**;

(ii) the velocity of the trolleys after the collision. (15)

(*b*) What is meant by a *thermometric property*? (9)

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

Describe an experiment to calibrate a mercury thermometer. (18)

(*c*) A capacitor consists of two parallel metal plates placed a small distance apart.

Copy **Fig. 10** to show the electric field pattern between the metal plates of a charged capacitor. (9)

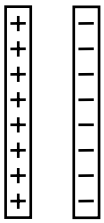

Fig. 10

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

Draw diagrams to show how two capacitors can be connected

(i) in series, (ii) in parallel. (18)

If two 6 μF capacitors are connected in parallel, what is their effective capacitance? (6)

(*d*) What is *radioactivity*? (6)

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

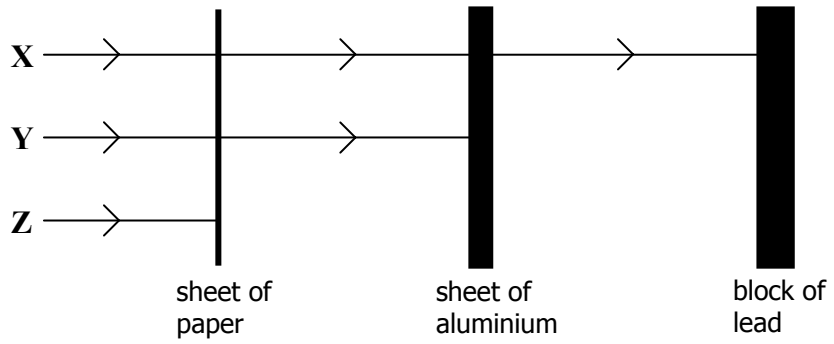

Fig. 11

Name each of the nuclear radiations labelled **X**, **Y** and **Z**. (15)

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

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

List <u>two</u> uses of 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*) Sketch the shape of the $\mathbf{BF_3}$ molecule, showing the position of the atoms.

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

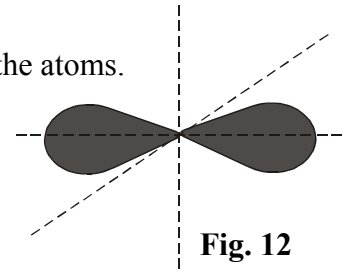

Fig. 12

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

(*e*) The relative molecular mass of nitrogen gas ($\mathbf{N_2}$) is 28.
Calculate the number of molecules in 7 g of nitrogen gas.
[Avogadro constant= 6.0×10^{23} mol^{-1}]

(*f*) Calculate the percentage of carbon by mass in ethyne ($\mathbf{C_2H_2}$).
[C=12; H=1]

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

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

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

(*j*) Name a chemical used to detect the presence of carbon dioxide ($\mathbf{CO_2}$).

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

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

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

$$\mathbf{CH_4 + O_2 \longrightarrow \_\_\_\_\_ + \_\_\_\_\_}$$

(*n*) Name a *ketone*.

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

Fig. 13

(11 × 6)

8. What is meant by the *atomic number* of an element? (6)

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

Copy and complete the following table in your answerbook:

subatomic particle	charge	location
Electron		
Proton	+1	
Neutron		nucleus

(15)

Give the electronic (s, p) configuration of (i) sodium, (ii) fluorine. (12)
(Refer to Mathematics Tables, p.44.)

What is an *ion*?
Show, using diagrams, how a bond is formed when an atom of sodium combines with an atom of fluorine.
Name the compound formed and give <u>two</u> properties of this type of bond. (24)

9. Define *oxidation* in terms of electron transfer. (6)

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

$$\mathbf{Cl_2 + 2Br^- \longrightarrow 2Cl^- + Br_2} \quad (12)$$

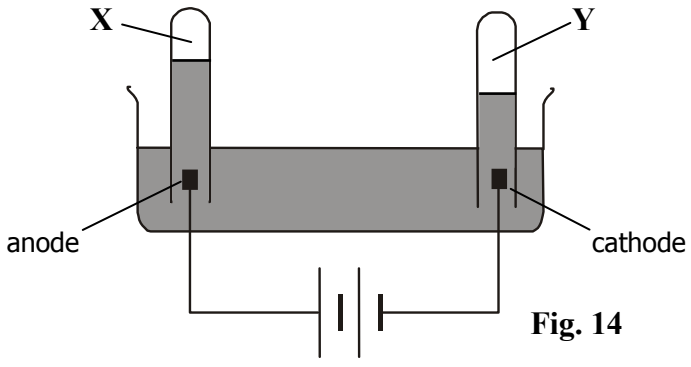

Fig. 14

The apparatus shown in **Fig. 14** can be used in the electrolysis of acidified water.
What substance is used to acidify the water? (6)
What material is usually used for the electrodes? (6)
Name the gas collected at (i) **X**, (ii) **Y**. (12)
Describe how you would identify the gas collected at **X**. (9)
Name the electrode at which oxidation occurs. (6)
Give <u>two</u> uses of electrolysis. (9)

10. What is meant by a *standard solution*? (6)

During a titration 25 cm^3 of a sodium hydroxide (**NaOH**) solution were transferred to a conical flask.

Describe how you would accurately measure and transfer 25 cm^3 of sodium hydroxide solution to a conical flask. (12)

Give <u>one</u> reason why a conical flask is used instead of a beaker during titrations. (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)

Give <u>two</u> precautions when taking readings from this piece of glassware. (12)

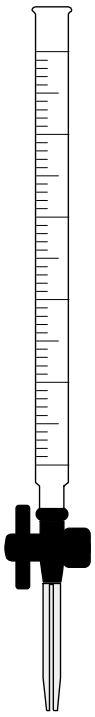

Fig. 15

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.
Describe how you would know when 'end-point was reached'. (12)

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

$$\mathbf{HCl + NaOH \longrightarrow \_\_\_\_ + H_2O}$$

Calculate the molarity of the sodium hydroxide solution. (12)

11. (*a*) Using the *Brønsted-Lowry* theory, define (i) an acid, (ii) a base, and (iii) a conjugate acid-base pair. (18)

Identify <u>two</u> acids and <u>one</u> acid-base pair in the following reaction:

$$\mathbf{CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+}$$ (15)

(*b*) <u>Ethanol</u> (**C_2H_5OH**) can be oxidised to <u>ethanoic acid</u> (**CH_3COOH**).

Draw the structure of each of the underlined compounds. (12)

Name the *homologous series* to which ethanol belongs.

What is the first member of this series? (12)

Give <u>one</u> use for (i) ethanol, (ii) ethanoic acid. (9)

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

(*a*) What is meant by a *mole* of a substance? (6)

Calcium reacts with sulfuric acid according to the following equation:

$$\mathbf{Ca + H_2SO_4 \longrightarrow CaSO_4 + H_2}$$

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

80 g of calcium were used in this reaction. Calculate:

(i) the number of moles of calcium used;
(ii) the number of moles of sulfuric acid required to react completely with the calcium;
(iii) the mass of calcium sulfate produced. (18)

[H=1; O=16; Ca=40; S=32]

(*b*) **Fig. 16** shows sulfur dioxide ($\mathbf{SO_2}$) being prepared and bubbled through a solution of litmus.

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

What is the purpose of liquid **C**? (6)

Explain why the litmus solution changes colour.

Why should we limit the release of $\mathbf{SO_2}$ gas into the environment? (9)

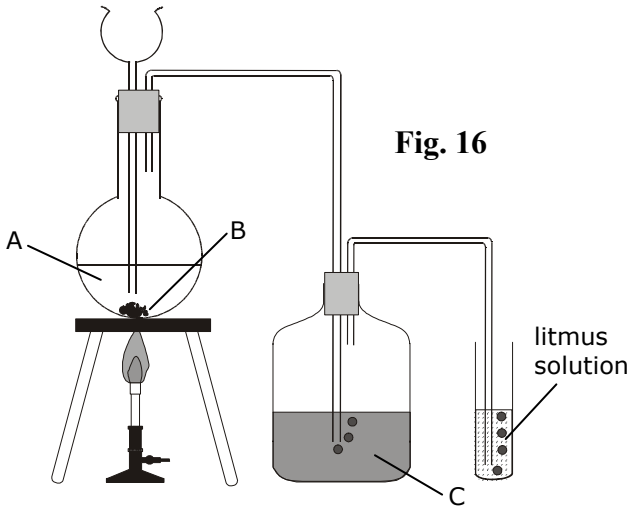

Fig. 16

Give <u>one</u> physical property and <u>one</u> use of $\mathbf{SO_2}$. (6)

(*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. (9)

Name (i) a metal above sodium, (ii) a metal below copper, in the electrochemical series. (12)

Describe what happens when a clean strip of magnesium is placed in a solution of copper sulfate as shown in **Fig. 17**. (6)

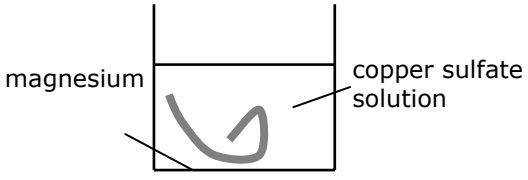

Fig. 17

Copy and complete the following equation for this reaction:

$$\mathbf{Mg + CuSO_4 \longrightarrow \_\_\_\_ + \_\_\_\_}$$ (6)

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