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LEAVING CERTIFICATE EXAMINATION, 2001

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** 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 the same marks. *Keep your answers short.*

(*a*) What is meant by the *momentum* of a body?

(*b*) What is the acceleration of a body when its velocity changes from 3 m s^{-1} to 9 m s^{-1} in 2 seconds?

(*c*) State *Newton's law of gravitation.*

(*d*) State *Boyle's law.*

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

(*f*) **Fig. 1** shows an object **O** in front of a concave mirror. Copy the diagram into your answer book and complete the ray diagram to show the image.

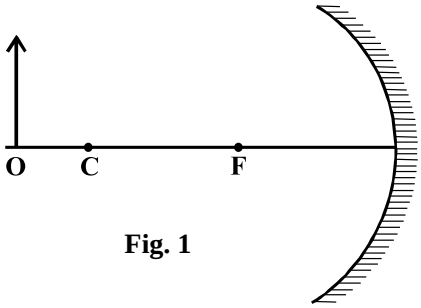

Fig. 1

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

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

(*i*) When ultraviolet radiation falls on a clean zinc plate electrons are released from it. What is the name for this effect?

(*j*) What is meant by *diffraction* of waves?

(*k*) In the equation $\boldsymbol{E = hf}$, what does $\boldsymbol{f}$ represent?

(*l*) Copy and complete the statement: "In the atom the.....have a positive charge while the electrons have a.....charge."

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

(*n*) What is the advantage of transmitting electricity at high voltages?

(*o*) **Fig. 2** shows an electric current varying with time. What is this type of current called?

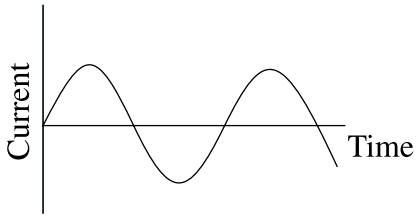

Fig. 2

(11×6)

2. (*a*) State any <u>two</u> of *Newton's laws of motion*. (12)

Fig. 3 shows a block of wood being pulled along a smooth table by a force *F*.

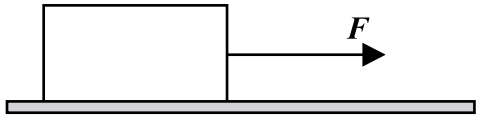

Fig. 3

The mass of the block is 8 kg.
The acceleration of the block is 2.5 m s^{-2}.
Calculate the force *F*. (9)

If the block starts from rest what distance does it travel in 5 seconds? (12)

(*b*) Define *kinetic energy.*
State the *principle of conservation of energy.* (12)

The mass of a car is 1000 kg and it is travelling with a velocity of 20 m s^{-1}.
Calculate the kinetic energy of the car. (12)

The driver brakes and the car stops. What happens to the kinetic energy of the car? (9)

3. (*a*) Define (i) temperature, (ii) thermometric property. (12)

On which thermometric property is a mercury thermometer based? (3)

Outline an experiment to calibrate a mercury thermometer in the laboratory. (18)

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

What is meant by Brownian motion? (6)

Outline a laboratory experiment to demonstrate Brownian motion. (18)

4. Explain the terms (i) refractive index, (ii) total internal reflection. (15)

Describe an experiment to measure the refractive index of a liquid. (24)

Fig. 4 shows a ray of light entering a block of glass. The refractive index of the glass is 1.5. What is the angle of refraction of the light in the glass? (15)

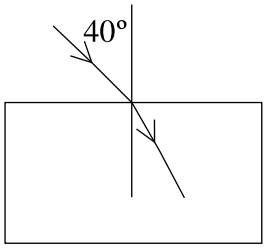

Fig. 4

Give <u>two</u> uses of total internal reflection. (12)

5. (*a*) What is an electric current? (6)

Describe simple laboratory experiments, one in each case, to show:

(i) the heating effect of an electric current;
(ii) that a current-carrying conductor in a magnetic field experiences a force. (24)

Name <u>one</u> device that works on the principle that a current-carrying conductor in a magnetic field experiences a force. (6)

(*b*) State the *laws of electromagnetic induction.* (12)

Fig. 5 shows a galvanometer connected across the terminals of a solenoid. When a bar magnet is moved, north pole first, into the solenoid the galvanometer needle is deflected to the right as shown in the diagram.

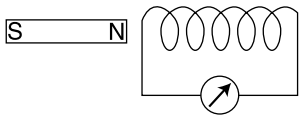

Fig. 5

When the bar magnet is moved out of the solenoid again what deflection occurs in the galvanometer? (6)

What deflection occurs in the galvanometer when the bar magnet is moved south pole first into the solenoid? (6)

Give <u>one</u> practical application of electromagnetic induction. (6)

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

(*a*) Define *capacitance*. (6)

Give <u>two</u> factors on which the capacitance of a parallel plate capacitor depends. (6)

Describe an experiment to show how the capacitance depends on one of these factors. (15)

Give <u>one</u> use of capacitors. (6)

(*b*) What is meant by monochromatic light? (9)

Describe a laboratory experiment to measure the wavelength of monochromatic light. (24)

(*c*) State *Ohm's law*. (6)

Define *potential difference*. (6)

Fig. 6 shows a circuit containing two resistors connected in parallel with each other. Calculate:

(i) the effective resistance of the two resistors;
(ii) the current flowing in the circuit. (21)

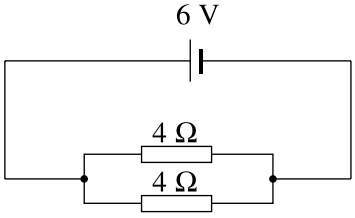

Fig. 6

(*d*) What is meant by the terms (i) radioactivity, (ii) half-life? (12)

A radioactive isotope has a half-life of 3 hours. How much of a sample is left after 9 hours? (9)

State <u>two</u> dangers associated with radioactive materials and give <u>two</u> precautions you would take when handling such materials in the laboratory. (12)

SECTION II – CHEMISTRY (200 marks)

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

(*a*) What element is represented by the electronic configuration $\mathbf{1s^2 2s^2 2p^6}$?

(*b*) What is meant by an *atomic orbital*?

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

(*d*) Sketch the shape of the $\mathbf{NH_3}$ molecule.

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

(*f*) What is an *endothermic* reaction?

(*g*) Which one of the following oxides is amphoteric?

$$\mathbf{Na_2O} \qquad \mathbf{CO_2} \qquad \mathbf{Al_2O_3}$$

(*h*) Calculate the percentage by mass of **Ca** in calcium carbonate, $\mathbf{CaCO_3}$.

[C = 12; O = 16; Ca = 40.]

(*i*) Write down the functional group in alcohols.

(*j*) Copy, complete and balance the following equation:

$$\mathbf{H_2SO_4 + NaOH \longrightarrow \quad + 2H_2O}$$

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

(*l*) Name <u>two</u> chemicals which may be used to prepare carbon dioxide in the laboratory.

(*m*) Give <u>one</u> everyday use for ethanoic (acetic) acid.

(*n*) What is the chemical formula of benzene?

(*o*) The relative molecular mass of oxygen ($\mathbf{O_2}$) is 32. Calculate the number of molecules in 8 g of oxygen.

[Avogadro constant = $\mathbf{6.0 \times 10^{23}\ mol^{-1}}$.] (11×6)

8. (*a*) What is meant by (i) ionic bond, (ii) electronegativity? (12)

Using electronegativity values, show that magnesium oxide (**MgO**) is an ionic compound. (12)
(See Mathematics Tables, p. 44.)

Give the name and formula of another ionic compound. (6)

Give <u>one</u> property of ionic compounds. (6)

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

$^{12}_{6}\mathbf{C}$ and $^{14}_{6}\mathbf{C}$ are both isotopes of carbon. State the number of electrons, protons and neutrons in an atom of each of these isotopes. (18)

9. (*a*) State *Hess's law*. Define the *heat of combustion* of a substance. (12)

Using the equation $\mathbf{C_2H_{2(g)} + 2½O_{2(g)} \longrightarrow 2CO_{2(g)} + H_2O_{(l)}}$, calculate the heat of combustion of ethyne (acetylene), $\mathbf{C_2H_2}$, from the following data:

$$\mathbf{C_2H_{2(g)} \longrightarrow 2C_{(s)} + H_{2(g)}} \qquad \Delta H = \mathbf{-225\ kJ\ mol^{-1}}$$

$$\mathbf{C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}} \qquad \Delta H = \mathbf{-393\ kJ\ mol^{-1}}$$

$$\mathbf{H_{2(g)} + ½O_{2(g)} \longrightarrow H_2O_{(l)}} \qquad \Delta H = \mathbf{-286\ kJ\ mol^{-1}}$$ (21)

(*b*) Explain each of the following in terms of electron transfer:

(i) oxidation;
(ii) reduction. (18)

Identify the substance oxidised and the substance reduced in the following equation:

$$\mathbf{CuO + H_2 \longrightarrow Cu + H_2O}$$ (12)

What is the oxidising agent in this reaction? (3)

10. What is meant by (i) *standard solution,* (ii) *neutralisation*? (18)

(i) Describe how you would carry out a titration of hydrochloric acid with sodium hydroxide. Give <u>two</u> precautions you would take to ensure an accurate result. (21)

(ii) Name a suitable indicator you would use in this titration and state the colour change at the end-point. (12)

(iii) The equation for the chemical reaction that takes place in this titration is:

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

In a titration, 22.5 cm^3 of **0.1 M** sodium hydroxide (**NaOH**) were required to neutralise 25.0 cm^3 of hydrochloric acid (**HCl**).

Calculate the molarity of the hydrochloric acid solution. (15)

11. (*a*) What is meant by (i) a *saturated* hydrocarbon, (ii) a *homologous* series? (12)

Give the names and the structural formulas for $\mathbf{CH_4}$ and $\mathbf{C_3H_8}$. (12)

Name the homologous series to which these compounds belong. (6)

(*b*) Define (i) acid, (ii) base, (iii) conjugate acid-base pair, in terms of the Bronsted-Lowry theory. (18)

Identify an acid, a base and a conjugate acid-base pair in the following reaction:

$$\mathbf{CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+}$$ (18)

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)

Carbon burns in air, forming carbon dioxide according to the equation:

$$\mathbf{C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}}$$

If 3.0 g of carbon are burned in an excess of oxygen, calculate:

(i) the number of moles of $\mathbf{CO_2}$ produced; (9)

(ii) the mass of $\mathbf{CO_2}$ produced; (9)

(iii) the volume of $\mathbf{CO_2}$ produced at STP. (9)

[C = 12; O = 16; molar volume at STP = 22.4 litres (dm^3).]

(*b*) The apparatus shown in **Fig. 7** may be used in the electrolysis of acidified water.

(i) Why is the water acidified? (6)

(ii) Name a material which may be used for the electrodes **X** and **Y**. (6)

(iii) Name the gas liberated at the negative electrode, **X**, and the gas liberated at the positive electrode, **Y**, when an electric current flows through the acidified water. (12)

(iv) How would you identify <u>one</u> of the gases produced? (9)

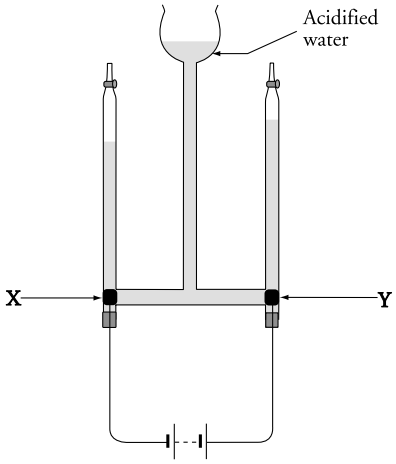

Fig. 7

(*c*) What is the *electrochemical series*? (6)

The following list shows three elements in their order in the electrochemical series:

potassium magnesium copper

(i) Explain why these elements are in this order, taking into account their reaction (if any) with water. (12)

(ii) Describe what happens when a piece of magnesium metal is dipped into a solution of copper(II) ions. (6)

(iii) Copy and complete the following equation:

$$\mathbf{Mg + CuSO_4 \longrightarrow}$$ (9)

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