AN ROINN OIDEACHAIS 1829

LEAVING CERTIFICATE EXAMINATION, 1997

PHYSICS AND CHEMISTRY — ORDINARY LEVEL

THURSDAY, 19 JUNE — AFTERNOON, 2.00 to 5.00

Six questions to be answered. Answer any **three** questions from Section I and any **three** from Section II. All the questions carry equal marks.

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*) State *Newton's third law of motion.*

(*b*) State <u>one</u> difference between the *objective lens* of a telescope and that of a microscope.

(*c*) Calculate the effective capacity of the arrangement of capacitors in **Fig. 1**.

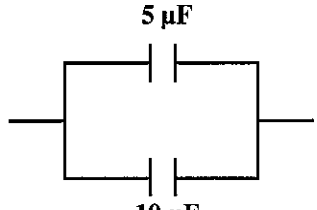

Fig. 1

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

(*e*) Calculate the momentum of a body of mass 0.4 kg which has a velocity of 15 m s^{-1}.

(*f*) Define the unit of work, i.e. the joule.

(*g*) Give an example of a longitudinal wave.

(*h*) A wave of wavelength 20 m travels at 300 m s^{-1}. What is its frequency?

(*i*) State *Charles' law.*

(*j*) What is meant by *nuclear fusion*?

(*k*) Give an application of the *photoelectric effect.*

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

(*m*) Complete the statement: "Infrared radiation has a ..... wavelength than visible light and may be detected by its ..... effect."

(*n*) **Fig. 2** shows a simple cell. What metal is used for the part labelled **A**?

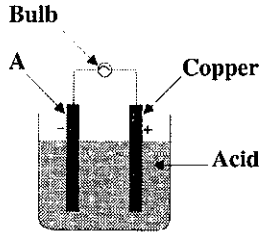

Fig. 2

(*o*) Calculate the quantity of heat produced when a current of 3A flows through a resistance of 10 Ω for 30 seconds.

(11 x 6)

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2. Define (i) mass, (ii) acceleration, (iii) force. (21)

Describe an experiment to measure the acceleration due to gravity, g. (24)

A body of mass 2 kg is dropped from a height of 180 m and accelerates towards the ground with a constant acceleration of 10 m s^{-2}. Calculate:

(i) the velocity with which the body strikes the ground; (12)

(ii) the kinetic energy of the body on striking the ground. (9)

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

Describe a laboratory experiment to measure the focal length of a convex lens. (24)

When an object is placed 15 cm from a convex lens of focal length 10 cm a real image is formed.
What is the position and magnification of the image? (24)

Why is a convex mirror used as a wing mirror on a car? (6)

4. (*a*) Give four basic assumptions of the kinetic theory of gases. (18)

Outline a laboratory experiment to demonstrate Brownian Motion. (15)

(*b*) Give an equation, or expression, which defines the Celsius temperature scale. (12)

A thermometer has a resistance of 70 ohms when placed in ice water; 55 ohms when placed in boiling water; and 60 ohms in water. Calculate the temperature of the water. (15)

What is the temperature of the water on the Absolute scale? (6)

5. (*a*) A conductor, which is carrying current, experiences a force in a magnetic field. Describe an experiment to demonstrate the above effect. (24)

Name an instrument which is based on this principle. (6)

(*b*) What is meant by *electromagnetic induction*? (12)

Name the apparatus shown in **Fig. 3** and state its function. (12)

Identify the parts labelled **A** and **B**. (6)

Give an example of the use of this apparatus outside the laboratory. (6)

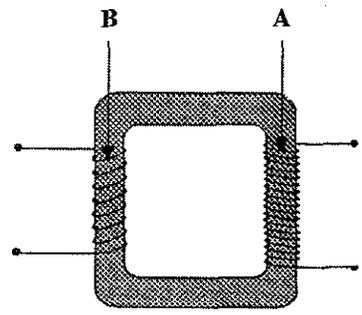

Fig. 3

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

(*a*) What is meant by the *interference of light waves*? (9)

Outline an experiment to demonstrate the interference of light waves. (18)

Calculate the frequency of light of wavelength 5.9×10^{-7} m. [$c = 3 \times 10^8$ m s^{-1}] (6)

(*b*) Compare the properties of alpha-particles, beta-particles and gamma rays under the headings:

(i) penetrating power; (9)

(ii) ionising ability. (9)

Describe an experiment to show the effect of an electric *or* magnetic field on alpha, beta and gamma radiations. (15)

(*c*) State Ohm's law. (9)

Outline, using an appropriate circuit diagram, an experiment to verify Ohm's law. (15)

If the current flowing in the circuit in **Fig. 4** is 3 amperes, when the switch is closed, calculate the value X of the resistor. (9)

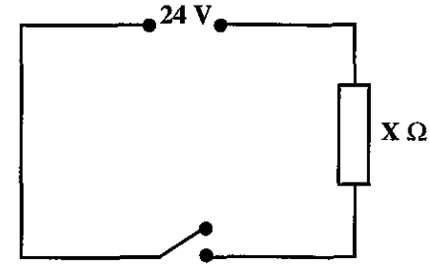

Fig. 4

(*d*) State <u>three</u> effects of an electric current. (15)

Outline a laboratory experiment to demonstrate <u>one</u> of the effects. (12)

Give an everyday application of <u>one</u> of the effects of an electric current. (6)

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 is an *endothermic* reaction?

(*b*) How many (i) electrons (ii) neutrons are in the ion $^{27}_{13}Al^{3+}$?

(*c*) What are *isotopes*?

(*d*) Name the carboxylic acid present in vinegar.

(*e*) Calculate the percentage by mass of sulphur in sulphur dioxide **[S = 32; O = 16]**.

(*f*) What is meant by the *pH of a solution*?

(*g*) Which of the following oxides is amphoteric:

Na_2O, CO_2, Al_2O_3 ?

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

(*i*) Sketch the shape of a p-orbital.

(*j*) Calculate the number of molecules in 9 g of water.
[H = 1; O = 15; Avogadro constant = 6 x 10^{23} mol^{-1}]

(*k*) Give the chemical formula for ethanol.

(*l*) Name two chemicals which may be used in the preparation of hydrogen peroxide.

(*m*) What is meant by the term *catalyst*?

(*n*) Name an ester.

(*o*) Which one of the following occurs as a molecular crystal:

diamond, iodine, iron ?

(11 x 6)

8. (*a*) Explain the terms (i) mass number, (ii) valency of an atom. (12)

Write down the electronic configuration (s,p) of (i) sodium and (ii) chlorine. (12)

In what ways are the electronic arrangements of the elements of a group in the Periodic Table similar? (6)

Name the groups to which (i) sodium and (ii) chlorine belong. (6)

(*b*) What is meant by (i) an ionic bond, (ii) a covalent bond, (iii) the electronegativity of an element? (18)

How may electronegativity values be used to predict the type of bonds formed when sodium combines with chlorine? (12)
[Refer to Mathematics Tables, page 46]

9. (*a*) Define (i) oxidation, (ii) reduction, in terms of electron transfer. (12)

Fig. 5 shows an apparatus in which direct current is being passed through molten sodium chloride.

(i) Which electrode is the cathode and which is the anode? (12)

(ii) Name the products formed at **A** and **B**. (12)

(iii) At which electrode does reduction take place? (6)

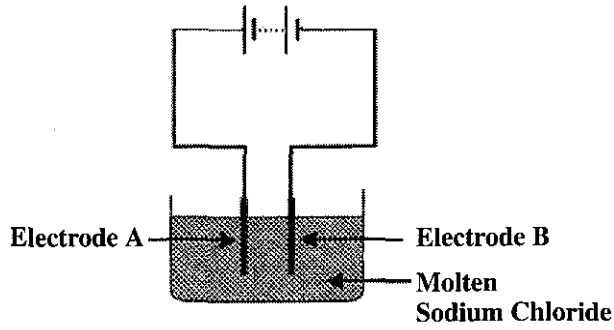

Fig. 5

(*b*) (i) Arrange the metals iron, magnesium, copper and calcium, in order of decreasing activity in the electrochemical series. (6)

(ii) Two of these metals are transition elements. Name them. (6)

(iii) Give two characteristic properties of transition elements. (6)

(iv) Complete and balance the equation $Mg + FeSO_4 =$ (6)

10. Define (i) an acid, (ii) a base, in Bronsted-Lowry terms. (12)

In a titration to determine the concentration of potassium hydroxide in a solution, 22.5 cm^3 of a 0.1 M sulphuric acid solution were required to neutralise 25.0 cm^3 of potassium hydroxide solution in the reaction:

$$2KOH + H_2SO_4 = K_2SO_4 + 2H_2O$$

(i) Draw a labelled diagram of the apparatus used in this experiment. (9)

(ii) Name a suitable indicator for the titration and state its colour in a solution containing (*a*) an acid, (*b*) a base. (12)

(iii) Calculate the molarity of the potassium hydroxide solution. (18)

(iv) How would you ensure that the endpoint of the titration was determined precisely? (15)

11. The gas ethyne (C_2H_2) is the first member of a homologous series of unsaturated hydrocarbons.

(i) Explain the terms which are underlined. (12)

(ii) Name the homologous series to which ethyne belongs. (6)

(iii) Describe, with the aid of a labelled diagram, how you would prepare ethyne in the laboratory. (18)

(iv) Outline a chemical test which can be carried out, to show that ethyne is unsaturated. (9)

(v) Name the compounds in **Fig. 6**.

Give a characteristic reaction of one of these compounds, naming the main reaction product. (21)

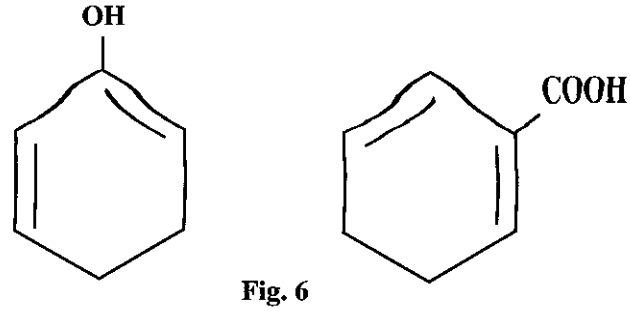

Fig. 6

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

(*a*) **Fig. 7** shows an apparatus used to prepare carbon dioxide gas in the laboratory.

Name the substances **A** and **B** used in the preparation of carbon dioxide. (12)

How would you test for the presence of carbon dioxide gas? (6)

Write a chemical equation for the reaction of carbon dioxide with water and name the product. (9)

Give an everyday use of carbon dioxide. (6)

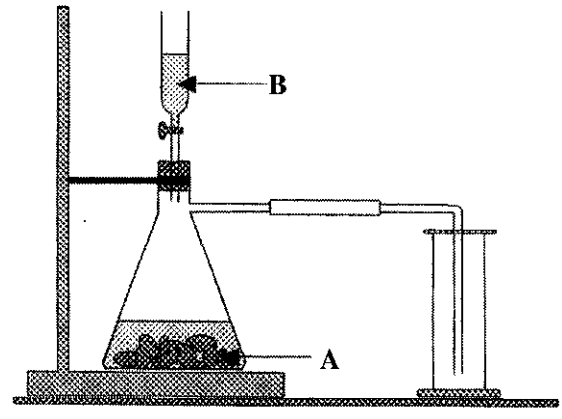

Fig. 7

(*b*) Define the *heat of combustion* of a compound. (6)

Methane burns in air to form carbon dioxide and water according to the equation:

$$CH_4 + 2O_2 = CO_2 + 2H_2O \qquad \Delta H = -880 \text{ kJ mol}^{-1}$$

Calculate:

(i) the quantity of heat released in the combustion of 3 moles of methane. (9)

(ii) the number of moles of water formed in the combustion of 3 moles of methane. (9)

(iii) the quantity of heat released in the combustion of 4 g of methane. **[C = 12; H = 1]**. (9)

(*c*) Use electron pair repulsion theory to explain the shapes of three of the following molecules:

H_2O CH_4 BeH_2 NH_3. (33)