AN ROINN OIDEACHAIS

LEAVING CERTIFICATE EXAMINATION, 1996

PHYSICS AND CHEMISTRY — ORDINARY LEVEL   **1511**

THURSDAY, 13 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)   What is meant by *potential energy*?

    (b)   Calculate the momentum of a body of mass 12 kg which has a velocity of 5 m s^{-1}.

    (c)   Give an expression for *Newton's law of gravitation.*

    (d)   Complete the statement: "For a fixed mass of gas at constant...

          its volume varies inversely with its ...."

    (e)   State a disadvantage of the constant volume gas thermometer.

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

    (g)   **Fig. 1** shows a ray of light **AB** incident upon a concave mirror. Copy the diagram and show the path of the reflected ray.
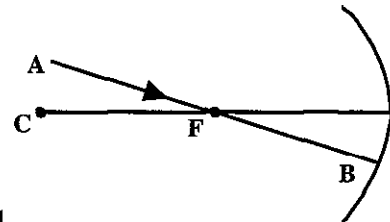

Fig. 1

    (h)   Why is a convex mirror used as a rear-view mirror in a car?

    (i)   State *Coulomb's law.*

    (j)   Calculate the effective resistance of the arrangement of resistors shown in **Fig. 2**.
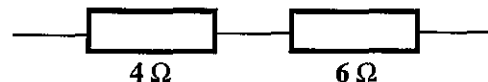

Fig. 2

    (k)   Give an everyday example of static charge.

    (l)   What is an electric current?

    (m)   State an application of the photoelectric effect.

    (n)   What is an alpha particle?

                                                                                        (11 x 6)

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2. Define (i) force, (ii) acceleration. (15)

State *Newton's second law of motion*. (9)

A car of mass 2 000 kg accelerates uniformly from rest to a velocity of 30 m s^{-1} in a certain direction in a period of 5 seconds. Calculate

(i) the acceleration of the car. (12)

(ii) the force require to produce this acceleration. (9)

(iii) the distance travelled by the car in the first 3 seconds. (12)

(iv) the kinetic energy of the car after 5 seconds. (9)

3. (a) Temperature is defined on the Celsius scale according to the equation

$$\frac{t}{100} = \frac{X_t - X_0}{X_{100} - X_0}$$

What does X represent in the above equation? Give an example. (9)

When a mercury thermometer is placed in melting ice the length of the column of mercury is 40 mm. When it is placed in steam the length of the column of mercury is 200 mm. The length of the column of mercury is 120 mm when the thermometer is placed in a warm liquid.

Calculate the temperature of the warm liquid on the Celsius scale. (24)

(b) State *three* of the basic assumptions of the kinetic theory of gases. (18)

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

4. State the laws of refraction of light. (18)

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

Fig. 3 shows a ray of light travelling from air through water.

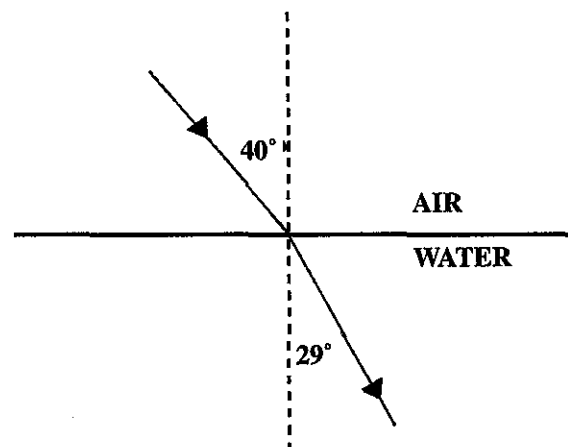Calculate the refractive index of the water from the information given in the diagram. (24)

Fig. 3

5. (a) State *one* of the laws of electromagnetic induction. (9)

A galvanometer is connected across the terminals of a solenoid as shown in **Fig. 4.**

What is observed as:

   (i) the bar magnet is moving into the solenoid. (9)

   (ii) the bar magnet is held stationary in the solenoid. (9)

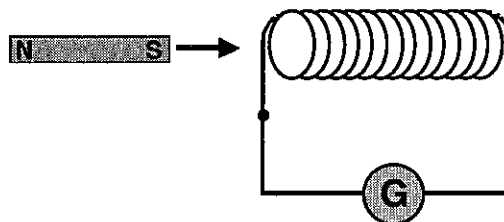   (iii) the bar magnet is being withdrawn from the solenoid. (6)

Fig. 4

(b) **Fig. 5** shows a simple AC generator.

Name the parts labelled **A, B** and **C.** (18)

What is the function of the magnet **D.** (9)

Name *one* other device which is based on electromagnetic induction. (6)
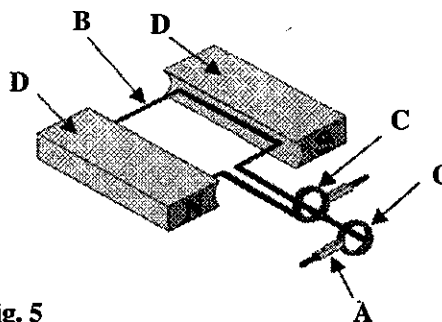
Fig. 5

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

(a) Describe an experiment to measure, **g**, the acceleration due to gravity. Your account should include:

   (i) a labelled diagram of the apparatus used, (12)

   (ii) the measurements made and how they were used to calculate a value for **g**, (15)

   (iii) one precaution which should be taken to improve the accuracy of this experiment. (6)

(b) Give an example of (i) a transverse wave, (ii) a longitudinal wave? (12)

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

Give a list of the apparatus you would use to show the interference of light and use a diagram to show the arrangement. (12)

(c) Define *capacitance*. (9)

State *two* of the factors on which capacitance of a parallel plate capacitor depends. (12)

What is the effective capacitance of the arrangement of capacitors shown in **Fig. 6.** (6)

Give *one* use of capacitors. (6)
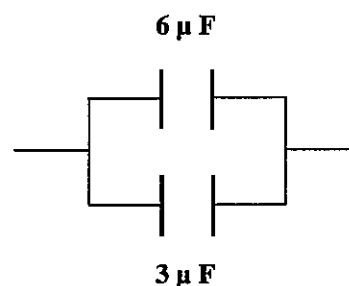
6 μ F

3 μ F

Fig. 6

(d) Explain the term *half-life*. (9)

A radioactive substance has a half-life of 15 minutes. What fraction of the original sample remains after 1 hour? (18)

Give *one* use of radioactive isotopes. (6)

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

(a)   Give an example of a molecular crystal.

(b)   What is meant by the *mass number* of an element?

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

(d)   The relative molecular mass of oxygen is 32. How many molecules are there in 8 g?
(**Avogradro constant = 6×10^{23} mol^{-1}; O = 16**).

(e)   Calculate the pH of a 0.01 M **HNO$_3$** solution.

(f)   Give *one* characteristic property of transition elements.

(g)   Complete the following equation:

$$CaCO_3 \quad + \quad 2HCl \quad \longrightarrow$$
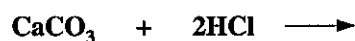
(h)   Write down the functional group in ketones.

(i)   Give the structural formula of ethanoic acid.

(j)   In the equation $E_1 - E_2 = h\nu$, what does h represent?

(k)   Indicate *one* acid and its conjugate base from the following:

$$HCl \quad + \quad NH_3 \quad \longrightarrow \quad NH_4^+ \quad + \quad Cl^-$$

(l)   Name an ester.

(m)   Write down the formula for hydrogen peroxide.

(n)   Name a polar solvent.

                                                                                            (11 x 6)

8. (a) $^{12}_{6}C$ is an <u>isotope</u> of carbon. Explain the underlined term.   (6)

Give the electronic (s, p) configuration of $^{12}_{6}C$ and state the number of electrons, protons and neutrons in an atom of the isotope.   (18)

Carbon combines with hydrogen to form methane (**CH$_4$**). Sketch the shape of the methane molecule.   (9)

(b)   What is meant by (i) an ionic bond, (ii) a covalent bond.   (12)

State the type of bond formed when (i) two chlorine atoms combine together, (ii) chlorine combines with sodium.   (12)

Show by means of a diagram the electronic arrangement in (i) a free chlorine atom, (ii) a chlorine molecule. (9)

9. What is (i) an acid (ii) a base in terms of the Bronsted-Lowry theory? (12)

Fig. 7 shows part of the apparatus used in the titration of hydrochloric acid and sodium hydroxide.

(i) Name the items of glassware labelled **A, B** and **C**. (9)

(ii) State which liquid is placed in **A** and which liquid is placed in **B**. (12)

(iii) Name a suitable indicator that may be added to the contents of flask **B**. (6)

(iv) State *one* precaution that should be taken in this experiment to ensure a more accurate end-point. (9)
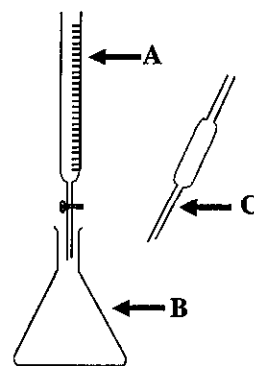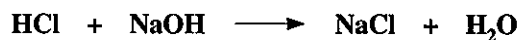

Fig. 7

In the titration, 25 cm^3 of sodium hydroxide required 22.5 cm^3 of 0.1 M **HCl** for neutralisation. Given that the equation for the titration is:

$$\text{HCl} + \text{NaOH} \longrightarrow \text{NaCl} + \text{H}_2\text{O}$$

calculate the molarity of the sodium hydroxide acid solution. (18)

10. Explain the terms (i) homologous series, (ii) functional group. (18)

Ethyne is an <u>unsaturated</u> <u>hydrocarbon</u>. Explain each of the underlined terms. (12)

Fig. 8 shows an apparatus which may be used in the preparation of ethyne in the laboratory.

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

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

(iii) State what would be observed when a solution of acidified potassium manganate(VII) (permanganate) is added to a jar of ethyne. (6)

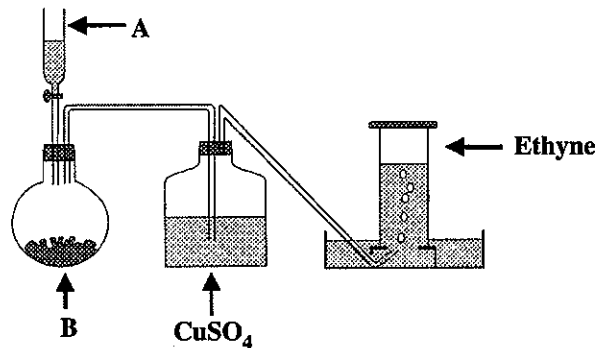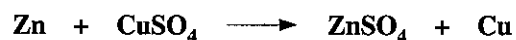(iv) Write down the chemical equation for one reaction of ethyne with bromine. Name the product. (12)

Fig. 8

11. (a) State Faraday's first law of electrolysis. (9)

Define oxidation in terms of electron transfer. (6)

Zinc reacts with copper(II) sulphate according to the equation

$$Zn \ + \ CuSO_4 \ \longrightarrow \ ZnSO_4 \ + \ Cu$$

What does this reaction indicate about the relative positions of copper and zinc in the electrochemical series? (6)

State the substances which were (i) oxidised, (ii) reduced in the reaction. (12)

(b) State Hess's law. (9)

Define heat of formation. (9)

Given that

$$2H_2 \ + \ O_2 \ \longrightarrow \ 2H_2O \qquad \Delta H \ = \ -572 \ kJ \ mol^{-1}$$

calculate the energy change when *one* mole of water is formed. (9)

State whether the reaction is exothermic or endothermic. (6)

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

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

Explain why the first ionisation energy of lithium is lower than that of neon. (6)

In what way are atoms of elements in (i) a period, (ii) a group, of the periodic table similar in terms of electron arrangement and properties. (18)

(b) Oxides of five elements are listed below:

$$Na_2O \qquad CO \qquad SO_2 \qquad Al_2O_3 \qquad NO_2.$$
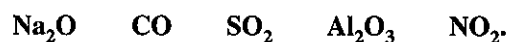
In the case of each compound.

(i) state whether it is a solid, a liquid *or* a gas at room temperature. (12)

(ii) state whether it is an acidic, basic, neutral *or* amphoteric oxide. (12)

Give the equation for the reaction of sulphur dioxide with water. (9)

(c) What is a *mole of a substance*? (9)

Copper reacts with concentrated sulphuric acid according to the equation

$$Cu \ + \ H_2SO_4 \ \longrightarrow \ CuSO_4 \ + \ SO_2 + H_2O$$

If in this reaction 0.1 moles of copper were reacted, calculate:

(i) the number of moles of sulphuric acid used up. (6)

(ii) the volume of sulphur dioxide liberated at STP. (9)

(iii) the mass of water formed (9)
[H = 1; O = 16; Cu = 63.5; molar volume at STP = 22.4 ℓ (dm^3)].