1453

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LEAVING CERTIFICATE EXAMINATION, 1998

PHYSICS AND CHEMISTRY — ORDINARY LEVEL

THURSDAY, 18 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 *kinetic energy*?

(*b*) Calculate the work done when a force of 10 N moves a body 2 m in the direction of the force.

(*c*) Copy and complete the statement: "For a fixed mass of gas at constant ..... its volume varies directly with ....."

(*d*) State one of the *laws of reflection of light.*

(*e*) What is *Brownian motion*?

(*f*) How may infrared radiation be detected?

(*g*) Calculate the effective capacitance of the arrangement of capacitors shown in **Fig. 1**.

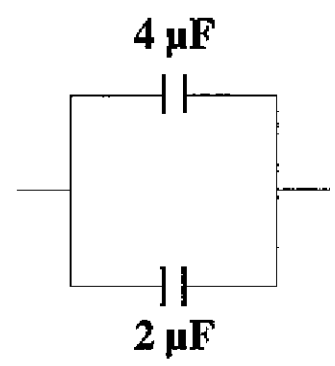

Fig. 1

(*h*) Name the unit of electric charge.

(*i*) Calculate the current used by a 200 watt electric bulb connected to a 100 V power supply.

(*j*) In **Fig. 2**, parallel rays of light are incident on a concave (diverging) lens. Copy the diagram and show the effect of the lens on the rays of light.

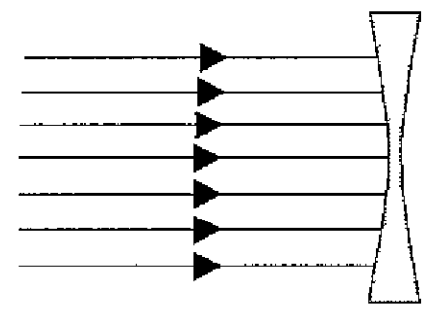

Fig. 2

(*k*) What reading on the Absolute scale of temperature is equivalent to 27 °C?

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

(*m*) What are *beta particles*?

(*n*) What is meant by *nuclear fission*? (11 x 6)

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

A motorcycle accelerates uniformly from 8 m s^{-1} to 20 m s^{-1} in a certain direction in a period of 6 seconds. Calculate:

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

(ii) the distance travelled by the motorcycle in the 6 second period. (12)

(*b*) State the *principle of conservation of momentum.* (12)

An object of mass 10 kg moving with a velocity of 6 m s^{-1} collides with another object of mass 5 kg which is at rest. The two objects stick together and move forward as a combined mass. Calculate the velocity of the combined mass. (18)

3. (*a*) What is meant by the *dispersion* of white light? (12)

Describe, with the aid of a labelled diagram, how a reasonably pure spectrum of white light may be produced in the laboratory. (24)

(*b*) What is meant by the *refraction of light*? (12)

A liquid which is 25 cm deep is viewed from above. If its refractive index is 1.25, calculate its *apparent depth.* (18)

4. Give an expression which defines temperature on the Celsius scale. (9)

Fig. 3 shows a constant volume gas thermometer.

(i) The pressure in the bulb A is 750 mm of mercury at 0° C, 1000 mm at 100 °C and 800 mm at room temperature. Calculate the room temperature. (12)

(ii) What is the principal use of the constant volume gas thermometer? (6)

(iii) Give *one* advantage and *one* disadvantage of a constant volume gas thermometer. (12)

(iv) When reading the constant volume gas thermometer, why is limb **B** adjusted until the mercury in the closed limb comes to the fixed mark **C**? (9)

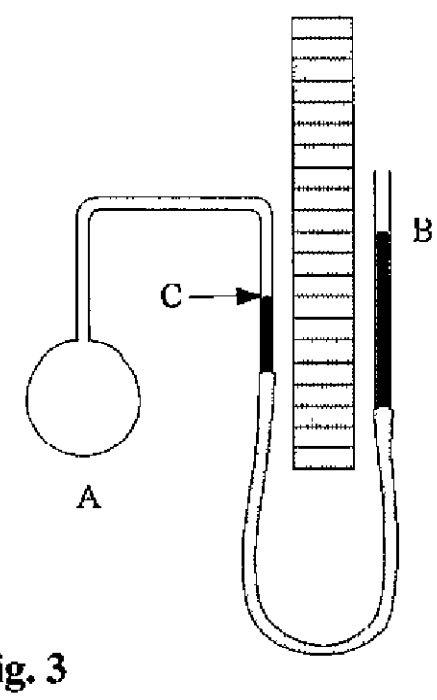

Fig. 3

(v) What is a *thermometric property*? (12)

(vi) State the thermometric property on which the constant volume gas thermometer is based. (6)

5. What is meant by *electromagnetic induction*? (12)

Fig. 4 shows a simple a.c. generator connected to a bulb.

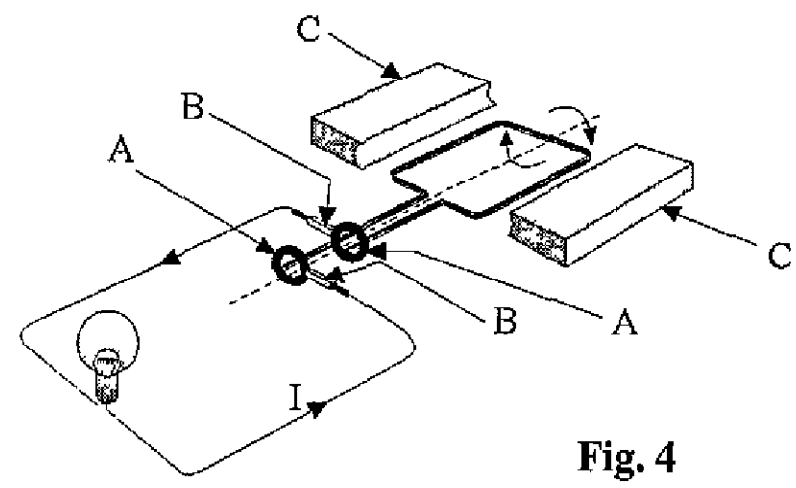

Fig. 4

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

Sketch a graph to show how the current (*I*) through the bulb varies during one complete rotation of the coil, starting with the coil in the vertical position. (18)

What would be the effect on the current through the bulb of:

(i) using a coil with a greater number of turns? (6)

(ii) winding the coil on a soft iron armature? (6)

(iii) rotating the coil at a slower speed? (6)

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

(*a*) Describe a laboratory experiment to measure the focal length of a concave mirror. (21)

Give two everyday uses of concave mirrors. (12)

(*b*) **Fig. 5** shows a waveform. What term is used to describe (i) **A**, (ii) **B**? (12)

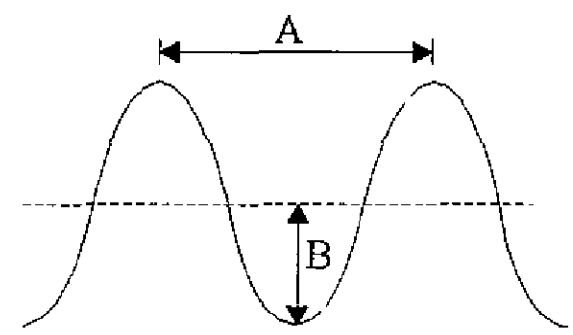

Fig. 5

Transverse and longitudinal are different types of wave. Give one example of each. (12)

Calculate the frequency of a wave of wavelength 20 m travelling at a speed of 340 m s^{-1}. (9)

(*c*) Describe a laboratory experiment to show the heating effect of an electric current. Your account should include a labelled circuit diagram. (21)

State *two* other effects of an electric current. (12)

(*d*) Compare the properties of alpha particles and gamma rays under the headings (i) nature, (ii) ionising ability and (iii) penetrating power. (18)

What is meant by the *half-life* of a radioactive isotope? (9)

Give one use of radioactive isotopes. (6)

SECTION II – CHEMISTRY (200 marks)

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

(*a*) What is meant by the *atomic number* of an element?

(*b*) Give an example of a *pyramidal molecule*.

(*c*) What element is represented by the following electronic configuration

$$\mathbf{1s^2 2s^2 2p^6 3s^2?}$$

(*d*) Give an example of a *covalent crystal.*

(*e*) What is the **pH** of a **0.1 M** solution of hydrochloric acid?

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

(*g*) Give an example of a transition element.

(*h*) Draw the structural formula for benzene.

(*i*) Give an example of an acidic oxide.

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

$$\mathbf{NaOH + HNO_3 =}$$

(*k*) Calculate the percentage of calcium by mass in calcium carbonate ($CaCO_3$).
[C = 12; O = 16; Ca = 40.]

(*l*) Calculate the number of molecules in 7.1 g of chlorine gas.
[C1 = 35.5; Avogadro constant = 6.0×10^{23} mol^{-1}].

(*m*) Name a ketone.

(*n*) Write down the chemical formula for sulphuric acid. (11x6)

8. (*a*) Explain the terms (i) mass number, (ii) isotope, (iii) relative atomic mass, of an element. (18)

$^{6}_{3}Li$ and $^{7}_{3}Li$ are two isotopes of lithium.

State the numbers of electrons, protons and neutrons in an atom of each isotope. (12)

(*b*) What is meant by (i) ionic bond, (ii) covalent bond, (iii) electronegativity? (18)

Explain how electronegativity values can be used to predict the type of bond formed between two elements. (12)

Give an example of (i) an ionic compound, (ii) a covalent compound. (6)

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

calcium iron copper.

Justify the order having regard to their reaction (if any) with water. (18)

Write down the chemical formula for an oxide of each metal. (18)

Name (i) a metal which is above calcium in the electrochemical series.

(ii) a metal which is below copper in the electrochemical series. (6)

Explain (i) oxidation, (ii) reduction, in terms of electron transfer. (12)

Copy and complete the following chemical equation:

$$Fe + CuSO_4 =$$ (6)

State the substance which is oxidised in the above reaction. (6)

10. **Fig. 6** shows an apparatus which is used in the preparation of hydrogen sulphide.

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

(ii) Hydrogen sulphide reacts with water as follows:

$$H_2S + H_2O \rightleftharpoons H_3O^+ + HS^-.$$

Indicate the Bronsted-Lowry acids, bases and conjugate pairs present. (18)

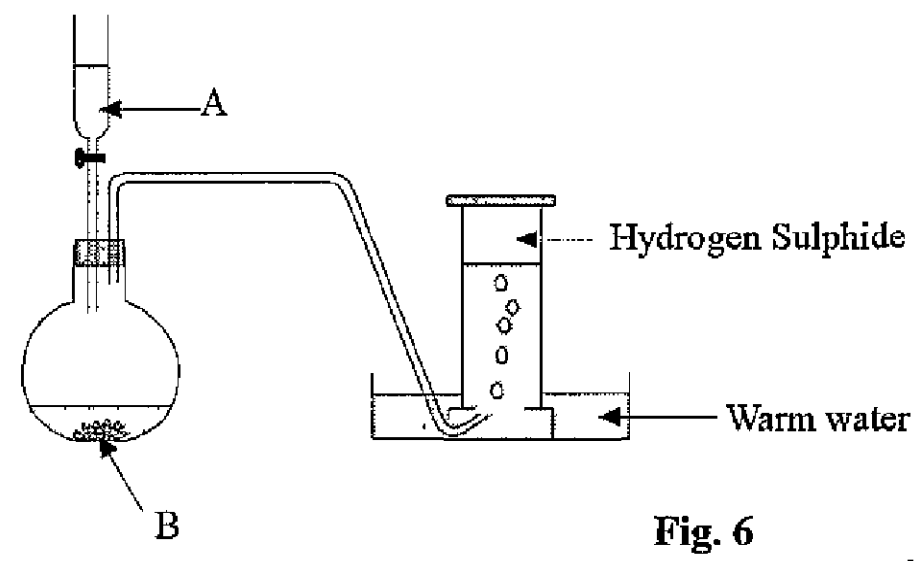

Fig. 6

(iii) State *Hess's law.* (9)

Define *heat of formation* of a substance. (9)

Calculate the heat of formation of hydrogen sulphide from the following data:

$$H_{2(g)} + \tfrac{1}{2}O_{2(g)} \longrightarrow H_2O_{(l)} \qquad \Delta H = -286 \text{ kJ mol}^{-1}$$
$$H_2S_{(g)} + 1\tfrac{1}{2}O_{2(g)} \longrightarrow H_2O_{(l)} + SO_{2(g)} \qquad \Delta H = -558 \text{ kJ mol}^{-1}$$
$$S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)} \qquad \Delta H = -293 \text{ kJ mol}^{-1}$$ (18)

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

ethane (C_2H_6) ethene (C_2H_4)

ethyne (C_2H_2) ethanal (CH_3CHO).

(i) Name the homologous series to which each of the above four compounds belongs. (12)

(ii) Two of the compounds listed above are unsaturated hydrocarbons. Name them and describe a chemical test to confirm that they are unsaturated. (15)

(iii) Write down the structural formula for ethanal. (6)

(iv) Indicate how ethanal may be prepared from ethyne. (9)

(v) Give the name of an organic acid formed when ethanal is oxidised. (6)

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

(*a*) Explain the term *electrolysis.* (9)

Fig. 7 shows an apparatus which may be used in the electrolysis of acidified water.

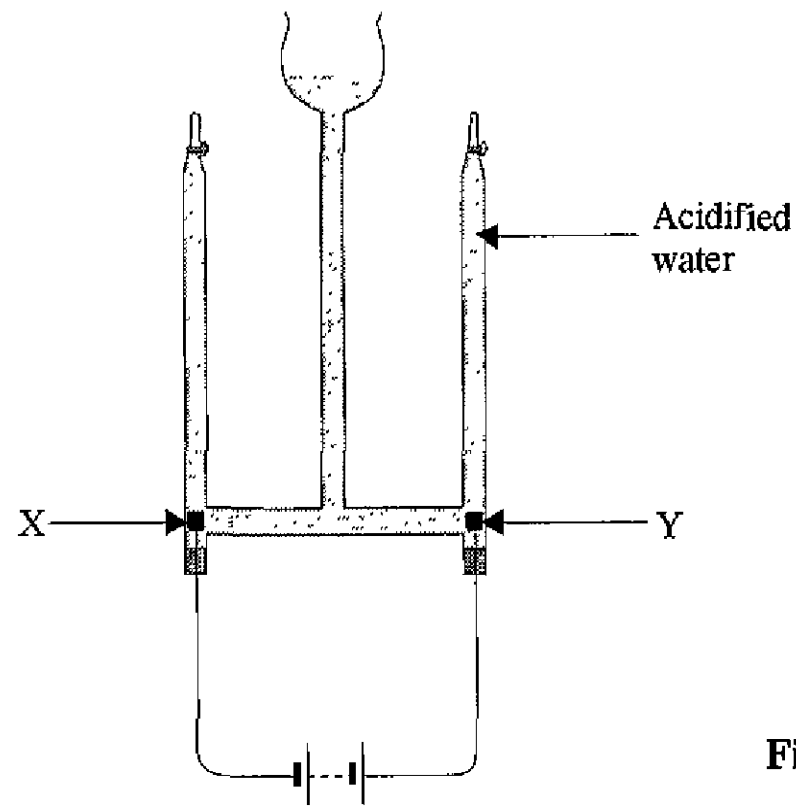

Fig. 7

Name the electrodes **X** and **Y**. (12)

Identify the gases liberated at **X** and **Y**. (6)

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

(*b*) State the function of an indicator in an acid-base titration. (6)

In a titration, 19.9 cm^3 of a **0.1 M** solution of hydrochloric acid neutralised 25.0 cm^3 of a sodium hydroxide solution.

(i) Name the piece of apparatus which was used to accurately measure 25.0 cm^3 of sodium hydroxide. (6)

(ii) Name a suitable indicator for the titration. (6)

(iii) Given that the equation for the reaction is:

$$\mathbf{HCl + NaOH = NaCl + H_2O,}$$

calculate the molarity of the sodium hydroxide solution. (15)

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

Sulphur burns in air forming sulphur dioxide according to the equation

$$\mathbf{S_{(s)} + O_{2(g)} = SO_{2(g)}}$$

If 8 g of sulphur are burned, calculate:

(i) the number of moles of sulphur dioxide produced. (6)

(ii) the mass of sulphur dioxide produced. (9)

(iii) the volume of sulphur dioxide produced at STP. (9)

[O = 16; S = 32; molar volume at STP = 22.4 litres (dm^3)]