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LEAVING CERTIFICATE EXAMINATION, 2002

PHYSICS AND CHEMISTRY - ORDINARY LEVEL

MONDAY, 17 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 1 - 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*) State *the principle of conservation of energy.*

(*c*) The mass of an astronaut is 100 kg. What is his weight on the moon where the acceleration due to gravity, *g*, is 1.6 m s^{-2}?

(*d*) The temperature of a beaker of water is 27 °C. What is the temperature of the water on the absolute (Kelvin) temperature scale?

(*e*) State <u>two</u> assumptions of the kinetic theory of gases.

(*f*) Copy and complete the statement: "When light is reflected the angle of . . . . . equals the angle of . . . . . ."

(*g*) **Fig. 1** shows a beam of white light being dispersed by a prism. Ray **X** is the least deviated and ray **Y** is the most deviated. What colour does (i) ray **X**, (ii) ray **Y**, form on the screen?

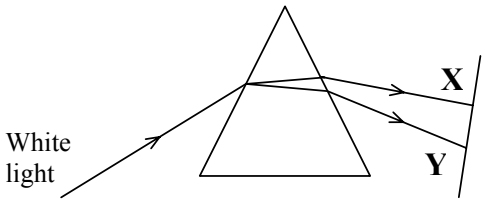

Fig. 1

(*h*) A wave has a wavelength of 10 m and travels with a speed of 200 m s^{-1}. What is the frequency of the wave?

(*i*) **Fig. 2** shows two charged spheres at a fixed distance apart. Copy the diagram and draw on it field lines to show the electric field between the two spheres.

Fig. 2

(*j*) What is *the photoelectric effect*?

(*k*) State <u>one</u> factor on which the heating effect of an electric current depends.

(*l*) Name the unit of potential difference.

(*m*) **Fig. 3** shows two capacitors connected in parallel with each other. Calculate the effective capacitance of the two capacitors.

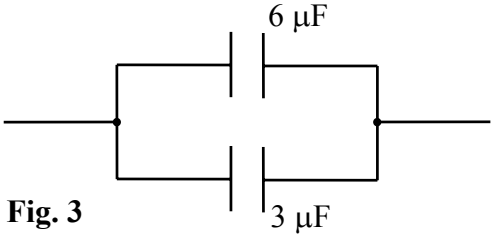

Fig. 3

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

(*o*) Explain the term *nuclear fusion*.

(11 × 6)

2. Define (i) *acceleration*, (ii) *force*, (iii) *kinetic energy*. (18)

State *Newton's second law of motion*. (6)

A truck accelerates steadily from rest to a speed of 20 m s^{-1} in 10 seconds.

(i) What is its acceleration? (9)

(ii) Calculate the force causing this acceleration if the mass of the truck is 3000 kg. (9)

(iii) What distance does the truck travel in the 10 seconds? (12)

(iv) What is the kinetic energy of the truck after the 10 seconds? (12)

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

The diagram, **Fig. 4**, shows a ray of light being refracted as it enters and leaves a glass block. Copy the diagram into your answerbook. Show clearly on the diagram the angle of incidence, *i*, and the angle of refraction, *r*, where the light ray enters the glass block. (6)

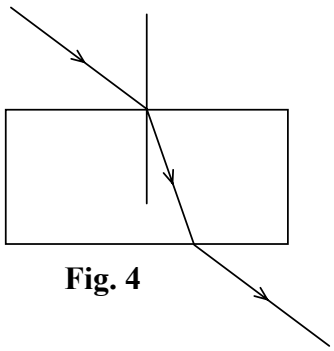

Fig. 4

Describe, with the aid of the diagram in **Fig. 4**, or otherwise, how you would measure the refractive index of glass. (15)

(*b*) A converging (convex) lens is used as a magnifying glass to examine a small pin. The lens is held at a distance of 5 cm from the pin. The focal length of the lens is 10 cm.

(i) Draw a ray diagram to show how the lens forms an image of the pin. (12)

(ii) Describe the image of the pin formed by the lens. (6)

(iii) Find the distance of the image from the lens. (9)

(iv) Give <u>one</u> use of a converging (convex) lens other than as a magnifying glass. (6)

4. (*a*) Explain the terms (i) *heat*, (ii) *temperature*. (12)

Describe a mercury thermometer and give the thermometric property on which it is based. (15)

Name <u>one</u> other type of thermometer. (6)

(*b*) State *Boyle's law*. (6)

Describe a laboratory experiment to verify Boyle's law. (12)

Draw a labelled diagram of the apparatus used. (6)

A student's account of this experiment finished like this:

"A number of readings were taken and the results were plotted on a graph which verified Boyle's law."

The graph drawn by the student is shown in **Fig. 5**. Identify the axes labelled **A** and **B** in **Fig. 5**. (9)

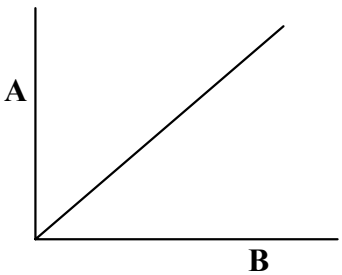

Fig. 5

5. (*a*) State the principle on which the moving-coil galvanometer is based. (9)

Fig. 6 shows a moving-coil galvanometer.
Name the parts of the galvanometer labelled **A**, **B** and **C**. (18)

What is the function of part **B**? (6)

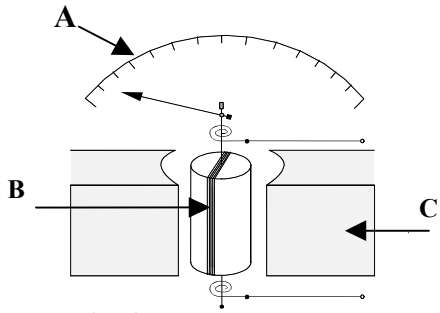

Fig. 6

(*b*) What is meant by the term *electromagnetic induction*? (9)

Fig. 7 shows a simple transformer.

(i) What is a transformer used for? (6)

(ii) Name the parts labelled **A** and **B**. (9)

(iii) What is connected to part **B**? (6)

(iv) Name <u>one</u> device in your home that uses a transformer. (3)

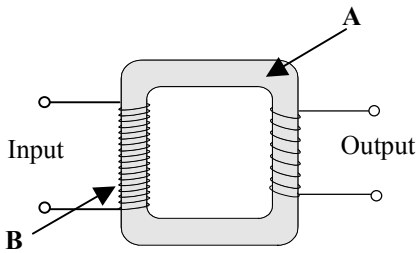

Fig. 7

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

(*a*) State *Newton's law of gravitation*. (9)

You are asked to measure the acceleration due to gravity, *g*.

List the apparatus you need. (6)

Draw a diagram to show how the apparatus is arranged. (6)

What measurements do you take? (6)

Give <u>two</u> precautions you would take to get a more accurate result. (6)

(*b*) What is meant by (i) *diffraction,* (ii) *interference,* of light waves? (12)

An experiment was carried out to measure the wavelength of monochromatic light.

List the apparatus used. (9)

What measurements were taken? (6)

Give the equation used to find the wavelength of the light. (6)

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

What is meant by the *resistance* of a conductor? (6)

Fig. 8 shows a circuit with two resistors connected in series to a 24 V battery. Calculate:

(i) the effective resistance of the two resistors;

(ii) the current flowing in the circuit;

(iii) the potential difference across the 4 Ω resistor. (18)

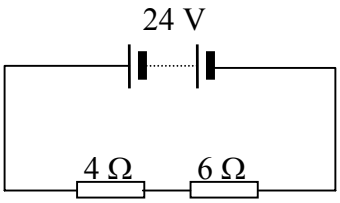

Fig. 8

(*d*) "<u>Radioactive</u> substances emit various types of <u>radiation</u>, each of which can cause <u>ionisation</u>."

Explain the three underlined terms. (18)

State which type of radiation causes the most ionisation and name <u>one</u> other type of radiation emitted by radioactive substances. (9)

Give <u>two</u> uses of radioactive substances. (6)

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*) How many (i) protons, (ii) electrons, are there in the $\mathbf{F^-}$ ion?

(*b*) What is meant by *the first ionisation energy* of an element?

(*c*) Which element is represented by the electronic configuration $\mathbf{1s^2\ 2s^2\ 2p^6\ 3s^2}$?

(*d*) Sketch the shape of the water molecule, showing the position of the atoms.

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

(*f*) In the equation $\boldsymbol{E_2 - E_1 = hf}$, what does $\boldsymbol{h}$ represent?

(*g*) What is meant by *an amphoteric oxide*?

(*h*) Calculate the percentage of carbon by mass in methane ($\mathbf{CH_4}$).
[**C = 12; H = 1.**]

(*i*) Give <u>one</u> example of *a covalent crystal*.

(*j*) Name the compound shown in **Fig. 9**.

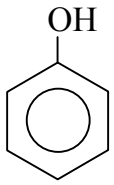

Fig. 9

(*k*) Calculate the **pH** of a **0.1 M** solution of hydrochloric acid.

(*l*) What is the functional group in ethanoic acid ($\mathbf{CH_3COOH}$)?

(*m*) Copy, complete and balance the equation: $\mathbf{H_2SO_4 + NaOH \rightarrow}$

(*n*) Name a *ketone*.

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

(11 × 6)

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

Give the name of the group of elements in the periodic table to which
(i) sodium belongs, (ii) chlorine belongs. (6)

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

Explain how electronegativity values may be used to predict the type of bond formed when (i) sodium combines with chlorine, (ii) two chlorine atoms combine with each other. (18)
(Refer to Mathematics Tables, p. 46.)

Show, by means of diagrams, how the bond is formed when (i) sodium combines with chlorine, (ii) two chlorine atoms combine with each other. (12)

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

magnesium iron copper

Justify this order by referring to the reaction (if any) of each metal with dilute acid, e.g. HCl. (18)

Write down the chemical formula for an oxide of <u>one</u> of these elements. (6)

Name (i) a metal above magnesium, (ii) a metal below copper, in the electrochemical series. (6)

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

An iron nail is placed in a copper sulphate solution as shown in **Fig. 10**.

What element is deposited on the surface of the nail? (6)

Copy and complete the following equation.

$$\mathbf{Fe + CuSO_4 \rightarrow} \quad (6)$$

Name (i) the substance oxidised, (ii) the substance reduced, in this reaction. (12)

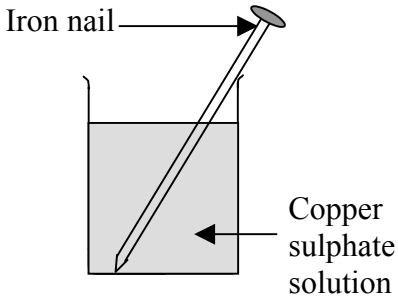

Fig. 10

10. The concentration of a potassium hydroxide solution was determined by titrating 25.0 cm^3 portions of the potassium hydroxide solution with a standard **0.1 M** solution of hydrochloric acid.

The pieces of glassware used in this titration experiment are shown in **Fig. 11**.

(i) Name the pieces of glassware **B** and **C**. Which of these is used to measure the volume of the potassium hydroxide solution? (15)

(ii) Describe the procedure for washing and filling **B** and the procedure for washing and filling **C**. (18)

(iii) Name the piece of glassware labelled **A**. How do you make sure that the contents of **A** are mixed during the titration? (12)

(iv) Name a suitable indicator for this titration. What is the colour change at the end point? (12)

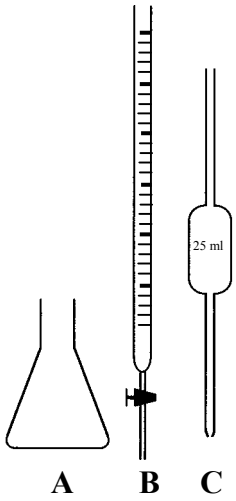

Fig. 11

In this titration experiment 25.0 cm^3 of the potassium hydroxide solution were neutralised by 27.5 cm^3 of the **0.1 M** hydrochloric acid solution. The equation for this reaction is

$$\mathbf{HCl + KOH \rightarrow KCl + H_2O}$$

Calculate the molarity of the potassium hydroxide solution. (9)

11. The gas ethene (C_2H_4) is the first member of a homologous series of unsaturated hydrocarbons.

Explain the two underlined terms and name the homologous series to which ethene belongs. (18)

(i) Describe, with the aid of a diagram, the experimental procedure by which ethanol may be converted to ethene. (18)

(ii) State one precaution that should be taken in this experiment. (6)

(iii) Describe the chemical test that can be carried out to show that ethene is unsaturated. (12)

Carbon dioxide and water are produced when ethene is burned in oxygen.

Write an equation for this reaction.
Describe a test for the presence of one of the products of this reaction. (12)

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

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

What is meant by *a weak acid*? (6)

Name (i) the acid, (ii) the base, (iii) a conjugate acid-base pair, in the reaction:

$$H_2SO_4 + HF \rightarrow HSO_4^- + H_2F^+$$ (9)

(*b*) **Fig. 12** shows an apparatus used in the preparation of sulphur dioxide (SO_2).

(i) Name the liquids **A** and **C** and the solid **B**. (18)

(ii) What is the function of **C**? (6)

(iii) Give one chemical property, one physical property and one use of SO_2. (9)

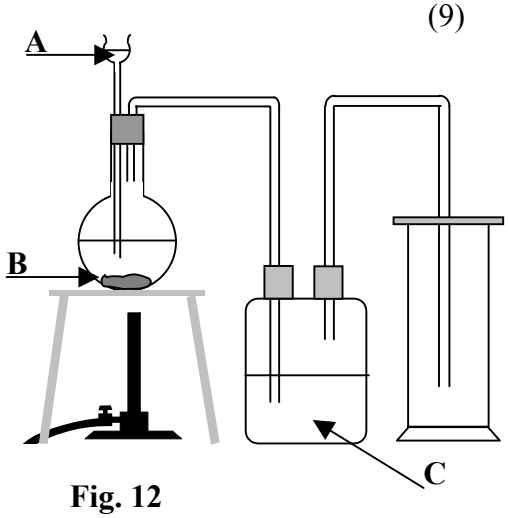

Fig. 12

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

Define (i) *heat of reaction,* (ii) *heat of formation,* of a substance. (12)

Calculate the heat change for the reaction $2Fe_2O_{3(s)} + 3C_{(s)} \rightarrow 4Fe_{(s)} + 3CO_{2(g)}$, given the following heat of reaction information.

$$4Fe_{(s)} + 3O_{2(g)} \rightarrow 2Fe_2O_{3(s)} \qquad \Delta H = -822 \text{ kJ}$$

$$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)} \qquad \Delta H = -393 \text{ kJ}$$ (12)