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LEAVING CERTIFICATE EXAMINATION, 2000

PHYSICS AND CHEMISTRY — ORDINARY LEVEL

MONDAY, 19 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*), (*d*) etc. All items carry equal marks. *Keep your answers short.*

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

(*b*) For a given mass of gas at constant pressure, write down the relationship between temperature and volume.

(*c*) Calculate the momentum of a body which has a mass of 8 kg and is moving with a velocity of 4 m s^{-1}.

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

(*e*) What is the main use of a constant volume gas thermometer?

(*f*) **Fig. 1** illustrates what happens when a beam of white light falls upon a prism. Name the effect.

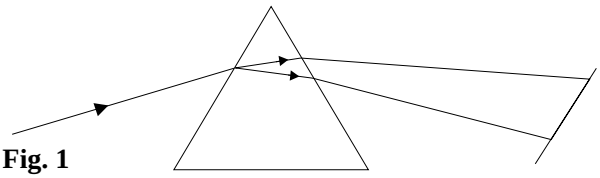

Fig. 1

(*g*) State one method for the detection of infrared radiation.

(*h*) Copy and complete the following statement: "The .....lens of an astronomical telescope has a shorter focal length than the ..... lens of the astronomical telescope."

(*i*) A current of 2 A flows in the circuit shown in **Fig. 2.** What is the voltage of the battery in the circuit?

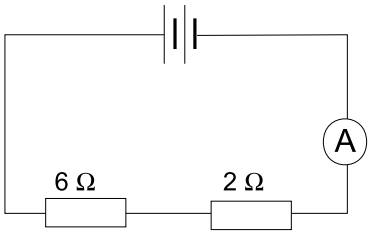

Fig. 2

(*j*) What is the basic principle on which the operation of a moving-coil galvanometer depends?

(*k*) Calculate the effective capacitance of the arrangement of capacitors shown in **Fig. 3.**

Fig. 3 5 μF 5 μF

(*l*) What are *Q* and *r* in Coulomb's law of forces, $F = k\dfrac{Q_1Q_2}{r^2}$?

(*m*) State two properties of gamma radiation.

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

(*o*) State an application of the *photoelectric effect.* (11×6)

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

A body of mass 5 kg is at rest. A force of 20 N acts on the body for 6 seconds.

Calculate: (i) the acceleration of the body,

(ii) the velocity after the 6 seconds,

(iii) the distance travelled in the 6 seconds,

(iv) the kinetic energy after the 6 seconds. (4×12)

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

Show, using ray diagrams, how a concave mirror forms

(i) a real image, (ii) a virtual image. (18)

Describe a laboratory experiment to measure the focal length of a concave mirror. (18)

An object is placed 30 cm in front of a concave mirror of focal length 12 cm.

Find the position of the image and state whether the image is real or virtual. (18)

4. (*a*) Explain the difference between *heat* and *temperature.* (12)

State the unit of heat and the unit of temperature. (6)

Describe a mercury thermometer and indicate the principle on which its operation depends. (15)

(*b*) Radioactivity is defined as *"the **spontaneous** disintegration of **unstable nuclei** with the emission of **radiation**".*

Explain the underlined terms. (18)

State two precautions that should be taken when handling radioactive substances in the laboratory. (12)

State a use for radioactivity. (3)

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

Fig. 4 shows a transformer.

Answer the following questions.

(i) For what is a transformer used? (6)

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

(iii) Explain how the transformer works. (18)

(iv) The input coil is connected to a 240 V supply and has 100 turns. How many turns are required in the output coil to give an output of 12 V ? (9)

(v) State one source of energy loss in a transformer and indicate how this energy loss may be reduced. (12)

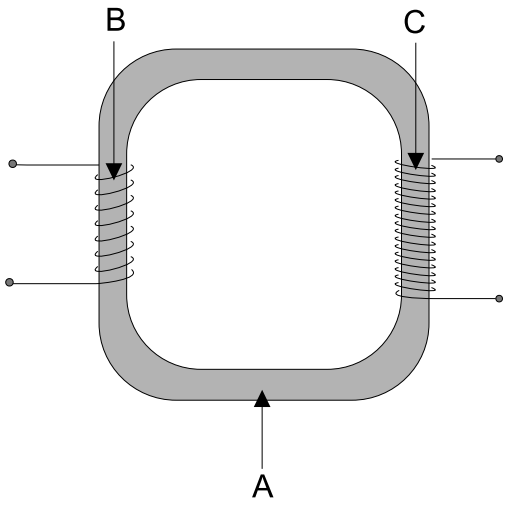

Fig. 4

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 *g*, the acceleration due to gravity.

State two precautions you would take to ensure an accurate result.

(*b*) Explain the terms (i) interference, (ii) diffraction.

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

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

Outline, with the aid of a clearly labelled diagram, a laboratory experiment to verify Ohm's law.

(*d*) Name two kinds of wave motion and explain the difference between them.

Give an example of each kind.

With reference to wave motion, what do you understand by (i) frequency, (ii) wavelength?

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

(*b*) Sketch the shape of the $\mathbf{CO_2}$ molecule.

(*c*) What is meant by *a transition element*?

(*d*) What is the **pH** of a **0.2 M** (mol dm^{-3}) solution of hydrochloric acid?

(*e*) Define the *ionisation energy* of an element.

(*f*) Complete and balance the equation:

$$\mathbf{FeCl_2 + Cl_2 \rightarrow}$$

(*g*) Calculate the percentage mass of carbon in ethanol ($\mathbf{C_2H_5OH}$).

[**H = 1; C = 12; O = 16**.]

(*h*) How may benzene be converted to nitrobenzene?

(*i*) What is meant by *oxidation* in terms of electron transfer?

(*j*) Name an element with *variable valency.*

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

(*l*) Name <u>two</u> chemicals used to prepare sulphur dioxide.

(*m*) What is meant by the *ground state* of an electron?

(*n*) Give <u>two</u> applications of electrolysis.

(*o*) State *Hess's law.* (11×6)

8. (*a*) What is meant by (i) energy level, (ii) atomic orbital? (12)

Identify the atoms that are represented by the following electronic structures.

(i) $1s^2 2s^2 2p^6 3s^2$, (ii) $1s^2 2s^2 2p^6 3s^2 3p^6$. (12)

Sketch the shape of an s-orbital. (9)

(*b*) What is meant by the *electronegativity* of an element? (9)

Explain the terms (i) covalent bond, (ii) ionic bond. (12)

Given that the electronegativity values of hydrogen, sodium and chlorine are 2.1, 0.9 and 3.0 respectively, indicate the type of bonding which you would expect in the following substances:

NaCl NaH HCl $\mathbf{H_2}$. (12)

9. What is meant by the *molarity* of a solution? (6)

In a titration experiment it was found that it took 20.0 cm^3 of sulphuric acid ($\mathbf{H_2SO_4}$) to neutralise 25.0 cm^3 of 0.1 M sodium hydroxide (**NaOH**) solution.

(i) Draw a labelled diagram of the apparatus used in the experiment. (12)

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

(iii) Outline how the experiment was performed. (12)

(iv) State <u>two</u> precautions you would take to ensure accuracy. (12)

(v) Calculate the molarity of the sulphuric acid solution. (9)

(vi) Write a balanced equation for the chemical reaction. (9)

10. (*a*) Give an example of (i) an exothermic, (ii) an endothermic, reaction. (12)

Define the *heat of formation* of a compound. (6)

Using the equation $\mathbf{Ca_{(s)} + H_{2(g)} + O_{2(g)} = Ca(OH)_{2(s)}}$, calculate the heat of formation of calcium hydroxide $\mathbf{Ca(OH)_2}$ from the following data:

$\mathbf{CaO_{(s)}}$	+	$\mathbf{H_2O_{(l)}}$	→	$\mathbf{Ca(OH)_{2(s)}}$	$\mathbf{\Delta H = -\ 66\ kJ\ mol^{-1}}$
		$\mathbf{CaO_{(s)}}$	→	$\mathbf{Ca_{(s)} + ½\ O_{2(g)}}$	$\mathbf{\Delta H = +635\ kJ\ mol^{-1}}$
$\mathbf{H_{2(g)}}$	+	$\mathbf{½\ O_{2\ (g)}}$	→	$\mathbf{H_2O_{(l)}}$	$\mathbf{\Delta H = -286\ kJ\ mol^{-1}}$

(15)

(*b*) **Fig. 5** shows an apparatus that is used in the preparation of carbon dioxide.

(i) Name the liquid **A** and the solids **B** and **C**. (18)

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

(iii) State one physical property, one chemical property and one use of carbon dioxide. (9)

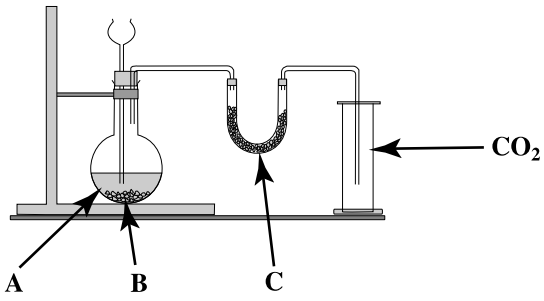

Fig. 5

11. Explain the terms (i) *homologous series*, (ii) *functional group.* (12)

ethanol **(C_2H_5OH)** ethene **(C_2H_4)**
ethanoic acid **(CH_3COOH)** ethanal **(CH_3CHO)**

(i) Name the homologous series to which <u>two</u> of the above compounds belong. (12)

(ii) Give structural formulae for both ethanol and ethene. (12)

(iii) What are the functional groups in ethanoic acid and ethanal? (12)

(iv) How is ethene made from ethanol? (18)

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

(*a*) (i) What is meant by each of the following types of oxides: acidic, basic?

(ii) Give an example of each type.

(iii) With respect to <u>one</u> oxide named give its general appearance and describe <u>one</u> of its chemical reactions.

(*b*) Define (i) Bronsted–Lowry acid, (ii) conjugate base, (iii) conjugate acid–base pair.

Name the acids and bases and identify the acid–base pairs in the following reaction:

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

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

Zinc reacts with dilute sulphuric acid according to the equation

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2.$$

If 13 g of zinc were used in this reaction, calculate

(i) the number of moles of sulphuric acid required to react completely with the zinc.

(ii) the mass of zinc sulphate produced.

(iii) the volume of hydrogen produced at STP.

[Molar volume at STP = 22.4 litres (dm^3); H = 1; O = 16; S = 32; Zn = 65 .]