AN ROINN OIDEACHAIS

LEAVING CERTIFICATE EXAMINATION, 1973

PHYSICS—HIGHER LEVEL

FRIDAY, 22 JUNE—MORNING, 9.30 to 12.15

Any **six** questions to be answered.

All the questions carry the same marks.

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

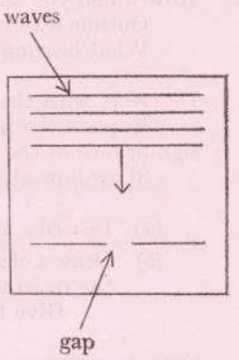
(*a*) Define the unit of force i.e. the newton.

(*b*) Write down, in terms of the kinetic theory, an expression for the pressure exerted by a gas.

(*c*) An astronaut can throw a ball 2 m vertically upwards on earth. How far could he throw the ball vertically upwards on the moon giving the ball the same initial vertical velocity? Take the acceleration due to gravity on the moon to be one-sixth that on the earth.

(*d*) An object is placed 20 cm from a convex lens of focal length 15 cm. Where is the image located?

(*e*) Waves of wavelength 1 cm approach a gap as shown in the diagram (not drawn to scale). Copy the diagram and indicate the shape of the waves emerging from the gap if it is 1 cm wide.



(*f*) What is the origin of line spectra in terms of atomic structure?

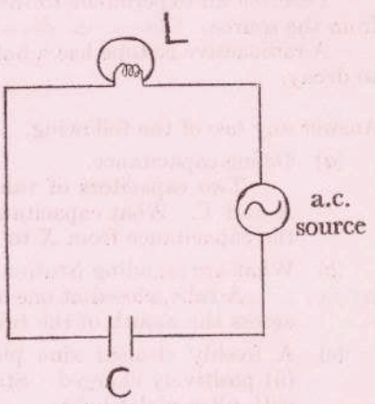
(*g*) Give an example of an oscillating system executing simple harmonic motion.

(*h*) Define the ampere.

(*i*) The primary coil of a transformer has 2000 turns and the secondary coil 100 turns. If the primary is connected to the 240 volt a.c. supply what voltage is developed in the secondary coil?

(*j*) Show how a galvanometer may be converted into a voltmeter.

(*k*) The diagram shows a lamp L which is lighting, an a.c. source and a capacitor C. What would be observd if the a.c. supply were changed to a d.c. supply, and why?



(*l*) Sketch the characteristic curve for a thermionic diode, i.e. the relation between the current through a diode and the potential difference between its electrodes.

(*m*) Complete the nuclear reaction

$$^{9}_{4}\mathrm{Be} + ^{4}_{2}\mathrm{He} \rightarrow ^{12}_{6}\mathrm{C} +$$

(*n*) On what does the intensity of the X-radiation depend in an X-ray tube?

(*o*) Why is energy released in nuclear fission?

(*p*) Write down an expression for the energy of a photon of light in terms of the wavelength of the light.

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

A tennis player strikes a 0·04kg tennis ball travelling towards him at 25 m s^{-1} and returns it at 20 m s^{-1}. Find (i) the change of momentum of the ball, (ii) the change in the kinetic energy of the ball.

(*b*) State Newton's law of gravitation.

If the acceleration due to gravity at the moon's surface is 1·62 m s^{-2} and its radius is $1{\cdot}74 \times 10^{6}$ m calculate the mass of the moon (Take $G = 6{\cdot}67 \times 10^{-11}$ N m^2 kg^{-2}).

What would be the acceleration due to the moon's gravity at a distance of 260 km above the moon's surface?

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3. (*a*) What is meant by specific heat capacity? Describe how you would measure the specific heat capacity of a metal.

A car of mass 1600 kg moving at 20 m s^{-1} is brought to rest by the application of disc brakes. What will be the average rise in temperature of the brakes if each of the four brakes has a mass of 4 kg and the metal from which they are made has a specific heat capacity of 500 J kg^{-1} K^{-1}? (Assume that all the kinetic energy is changed into heat energy in the brakes).

(*b*) What is a thermocouple? Describe how a thermocouple is used to measure temperature and mention its merits.

4. Establish the formula

$$\mu = \frac{\sin \frac{1}{2}(A + D)}{\sin \frac{1}{2} A}$$

where μ is the index of refraction of the glass of a glass prism, A is the refracting angle of the prism and D the angle of minimum deviation.

Indicate how a spectrometer may be used to measure the angles A and D.

What is meant by chromatic aberration? Mention how it may be corrected.

5. How would you show by experiment (i) that light consists of waves, (ii) the transverse nature of light waves?

Outline a terrestrial method by which the velocity of light has been measured.

What bearing had the measurements of the velocity of light in air and in water on the theories of light?

6. Describe, with the aid of a diagram, the structure of a moving-coil ammeter and explain how it operates.

Explain the principles underlying the operation of an a.c. electric motor and refer, in particular, to the significance of the back e.m.f.

Show how alternating current may be converted into direct current.

7. (*a*) Describe an experiment to measure the horizontal component of the earth's magnetic field strength.

(*b*) Draw a clearly labelled diagram of a Wheatstone bridge circuit and describe how you would measure the resistance of a piece of wire using this circuit.

Give the theory associated with (*a*) **or** (*b*).

8. Give an account of cathode rays and X-rays under the following headings: (i) production, (ii) nature, (iii) effect of magnetic field, (iv) diffraction.

Electrons with a velocity of 10^7 m s^{-1} enter a uniform magnetic field at right angles to the field lines (lines of force). If the magnetic flux density is 2×10^{-3} tesla (Wb m^{-2}) find the radius of the circular path of the electrons (Take $e/m = 1{\cdot}76 \times 10^{11}$ C kg^{-1}).

9. What is meant by (i) radioactivity, (ii) the half-life of a radioactive isotope?

Outline two methods of detecting radiations from a radioactive source.

Describe an experiment to investigate how the intensity of gamma radiation varies with the distance from the source.

A radioactive isotope has a half-life of 5 days. Calculate the time taken for seven-eights of the isotope to decay.

10. Answer any *two* of the following.

(*a*) Define capacitance.

Two capacitors of values $4\mu F$ and $6\mu F$, respectively, are joined in series between two points X and Y. What capacitance must be placed in parallel with the $4\mu F$ capacitor in order to increase the capacitance from X to Y by $0{\cdot}6$ μF?

(*b*) What are standing (stationary) waves? Give an example of standing waves.

A tube, closed at one end, 0·15 m long emits a note of 570 hertz when a current of air is blown across the mouth of the tube. Find the velocity of the sound.

(*c*) A freshly cleaned zinc plate is connected to an electroscope which is (i) negatively charged, (ii) positively charged. State and explain what happens in each case when the plate is irradiated with ultra-violet light.

Explain what would happen if a radioactive substance were brought close to the electroscope in (ii).

(*d*) Describe an experiment to measure the specific charge (ratio of the charge to mass) of the hydrogen ion.