# LEAVING CERTIFICATE EXAMINATION, 1990

# PHYSICS—HIGHER LEVEL

# FRIDAY, 15 JUNE-MORNING, 9.30 to 12.30

Answer all questions in Section A.

Answer two questions from Section B and three questions from Section C.

# SECTION A (120 marks)

Answer	each	question	in	this	section

Each question carries the same number of marks.

Ans	corr	five of the following items, (i), (ii), (iii), etc. In the case of each item write the ect answer in the box provided.	letter correspondin	g to
(i)	A. B. C.	unit of pressure, the pascal, is equivalent to the kg m <sup>-2</sup> kg m <sup>2</sup> N m N m <sup>2</sup> N m <sup>-2</sup>	Answer E	(6)
(ii)	A. B. C. D.	triple point of water, on the Kelvin scale, is assigned the value 0 K 270 K 273 K 273·16 K 373 K.	Answer D	(6)
(iii)		en the intensity of a sound increases from 10 mW m <sup>-2</sup> to 20 mW m <sup>-2</sup> the relations, is	ive increase in inten	sity,
	A. B. C. D. E.	10 salar cut green manufathous all the engineers after a few are a long at the contract of the	The second secon	
(iv)	200	energy stored in a parallel plate capacitor is	Answer A	(6)
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	-		Answer D	(6)
(v)	The d.c.	circuit shown in Fig. 1 consists of two diodes and a resistor of large resistant power supply. The voltage at X is	ce connected to a 6	V
V	D.	approximately 6 V because diode A is reverse biased approximately 6 V because diode B is forward biased approximately 0 V because diode B is reverse biased approximately 0 V because diode B is forward biased approximately 0 V because diode A is reverse biased.	Answer	(6)
		6 V		

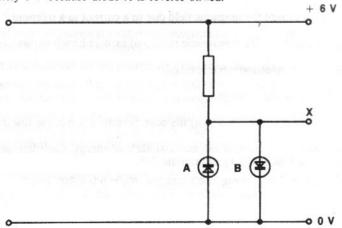


Fig. 1

	i) When $\frac{238}{92}$ U decays to $\frac{226}{88}$ Ra the numbers of $\alpha$ -particles and $\beta$ -particles given out are	
	21	
	A. 3 α-particles and 2 β-particles 2.38 86	
	<ul> <li>B. 4 α-particles and 3 β-particles</li> <li>C. 3 α-particles and 4 β-particles</li> </ul>	
	D. 2 α-particles and 3 β-particles	
	E. 4 α-particles and 2 β-particles.	
	92 Answer (6)	Par
	SQ 6	1
An	nswer five of the following.	
(i	Give the equation which defines simple harmonic motion (6)	
(ii)	··· tui	
(**)		. /
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(iii)	posterior and the current nowing through it was	
	established by This relationship may be expressed as P (6)	
iv)	In order to convert a galvanometer to an ammeter a resistor of	
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	(0)	
(v)	An oil drop, falling between two parallel metal plates, may be used in an experiment to determine	
	the	
	The (0)	
VI)	The nature of alpha particles was established by	
	working at Cambridge in the early years of thecentury. (6)	
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	swer five of the following.	
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7. The electrochemical equivalent of copper was determined by passing a current, I, through a copper voltameter for a time, t, and measuring the mass of copper liberated from the solution. This was done for three different values of I and the following results were obtained.

I/A	0.5	1.0	1.5
m/g	0.20	0.42	0.59

Given that the value of t in each case was 20 minutes calculate a value for the electrochemical equivalent of copper.

Draw a circuit diagram for this experiment, labelling the anode and the cathode.

(9)

Explain how the mass of the copper deposited might have been determined in each case.

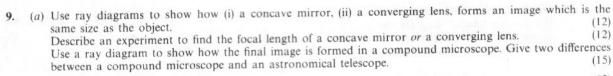
Give two precautions which should be taken to ensure a more accurate result.

(6)

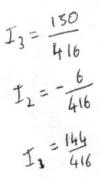
### SECTION C (200 marks)

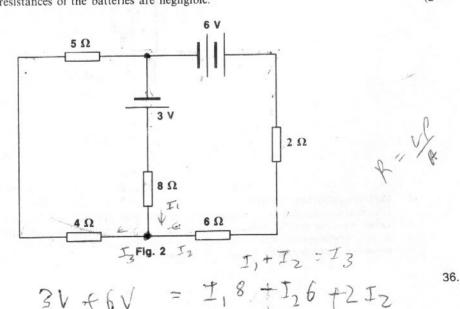
Answer three questions from this section. Each question carries the same number of marks.

(i) State Newton's law of gravitation. (ii) What is meant by centripetal force? Describe a laboratory experiment to determine the value of g, the acceleration due to gravity. (18)Using Newton's law of gravitation, derive an expression for g. Calculate the value of g at the equator, given that the radius of the earth at the equator is  $6.378 \times 10^6$  m. Calculate the angular velocity of a point on the equator, in rad s<sup>-1</sup>, given that the period of rotation of the (6) earth about its axis is 24 hours. A body of mass 5.000 kg is suspended from a spring balance at the equator in order to measure its weight. (15)Calculate (i) the force of gravity on the body, (ii) the reading on the balance.  $(G = 6.673 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}; \text{ mass of earth} = 5.977 \times 10^{24} \text{ kg.})$ 



- (12)(b) Explain briefly how it may be shown experimentally that sound is a wave motion. What is the Doppler effect? Explain, with the aid of labelled diagrams, how this phenomenon occurs. (15)
- (12)10. Define (i) resistance, (ii) resistivity. Describe an experiment to measure the resistivity of the material of a wire. Two resistors, each of resistance R, are connected in series in a circuit. Show that the effective resistance of the (12)two resistors is 2R. Use Kirchhoff's laws to calculate the current flowing through the 6  $\Omega$  resistor in the circuit shown in Fig. 2. (24) Assume that the internal resistances of the batteries are negligible.





2 f2 fb F3 + 4 Is + 5 Iz

#### 11. State the laws of electromagnetic induction.

(12)

Describe an experiment to illustrate one of these laws.

(12)

Explain the term self-induction.

(9)

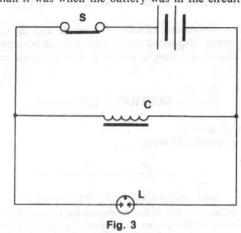
Fig. 3 shows a circuit containing a coil with an iron core, C, a switch, S, a neon lamp, L and a low voltage (e.g. 6 V) battery. When the switch is opened the lamp lights briefly. Given that the neon lamp lights only when there is a high voltage (of the order of 90 V) between its terminals, explain

(a) why the lamp lights when the switch is opened;

(12)

(b) why the lamp would be unlikely to light if the coil did not have an iron core.

If the battery in Fig. 3 were replaced with an a.c. supply of the same voltage would the current flowing through the coil be larger or smaller than it was when the battery was in the circuit? Explain.



## 12. (a) What is the photoelectric effect?

(6)

Give an expression for Einstein's photoelectric law.

When radiation of wavelength  $2.4 \times 10^{-7}$  m falls on a metal surface the maximum kinetic energy of the emitted electrons is found to be 4.2 eV. What is the value of (i) the work function of the metal in joules, (ii) the threshold frequency for the metal?

(Speed of light in vacuum,  $c = 3.0 \times 10^8 \text{ m s}^{-1}$ ; charge on electron,  $e = 1.6 \times 10^{-19} \text{ C}$ ; Planck's constant,  $h = 6.6 \times 10^{-34} \,\text{J s.}$ )

"In a unipolar (field effect) transistor the drain current is controlled by the gate voltage". Explain, with the aid of a labelled diagram, the meaning of the underlined terms.

Explain how the drain current is controlled by the gate voltage.

(9)

Give two applications of transistors. (6)

### 13. Answer any two of the following.

(a) State the principle of conservation of energy. A body of mass m is released from rest at A, a height h above the ground (Fig. 4). Assuming that the body falls freely, derive an expression, in terms of x, for the kinetic energy of the body at B. Hence show that the total energy of the body at B is equal to its energy at A and explain how it may be deduced that the sum of the potential and kinetic energies of a freely falling body is constant. (15)



(b) Define specific heat capacity.

(6)

Describe an experiment to measure the specific heat capacity of a liquid or a solid. (18)Given that the specific heat capacity of water is eleven times that of copper calculate the mass of copper at a temperature of 100 °C required to raise the temperature of 200 g of water from 20 °C to 24 °C, assuming that no energy is lost to the surroundings.

(c) State Coulomb's law of force between electric charges.

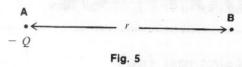
What is meant by saying that Coulomb's law is an example of the inverse square law?

(6)

Define electric field intensity and give its unit.

Use Coulomb's law to derive an expression for the electric field intensity at a distance r from a point charge Q.

Fig. 5 shows a negative charge at a point A. Copy the diagram and show on it the direction of the electric field intensity at B.



(d) What is meant by the term radioactivity?

Describe, with the aid of a diagram, one type of radiation detector and explain how it works.

(6)

(18)

"Nuclear radiation has many important applications. However, it may also be dangerous and a number of precautions must be observed when it is being used."

Discuss this statement by giving three examples of applications of nuclear radiation and three precautions which should be observed in its use.

