

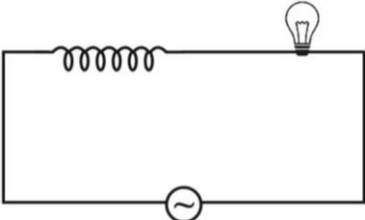


GRADE: XII Date: 11/12/23	FIRST MODEL EXAMINATION 2023-24 PHYSICS	Marks: 70 Time: 3h
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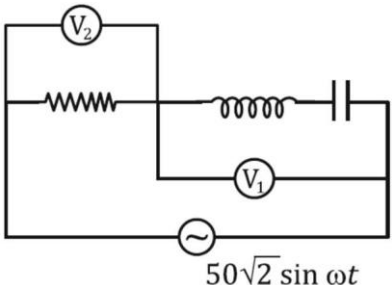
- (1) There are 33 questions in all. All questions are compulsory.
- (2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
- (3) All the sections are compulsory.
- (4) **Section A** contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, **Section B** contains five questions of two marks each, **Section C** contains seven questions of three marks each, **Section D** contains two case study based questions of four marks each and **Section E** contains three long answer questions of five marks each.
- (5) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.
- (6) Use of calculators is not allowed.
- (7) You may use the following values of physical constants where ever necessary
 - i. $c = 3 \times 10^8$ m/s
 - ii. $m_e = 9.1 \times 10^{-31}$ kg
 - iii. $e = 1.6 \times 10^{-19}$ C
 - iv. $\mu_0 = 4\pi \times 10^{-7}$ TmA⁻¹
 - v. $h = 6.63 \times 10^{-34}$ Js
 - vi. $\epsilon_0 = 8.854 \times 10^{-12}$ C²N⁻¹m⁻²
 - vii. Avogadro's number = 6.023×10^{23} per gram mole

Q. NO.		MAR KS
1	In the equation $AB = C$, A is the current density, C is the electric field, Then B is (a)resistivity (b)conductivity (c)potential difference (d)resistance	1

2	<p>The electric potential on the axis of an electric dipole at a distance 'r' from its centre is V. Then the potential at a point at the same distance on its equatorial line will be</p> <p>(i) 2V (ii) -V (iii) V/2 (iv) Zero</p>	1
3	<p>A positively charged particle is released from rest in a uniform electric field. The electric potential energy of the charge</p> <p>(a)remains constant because the electric field is uniform. (b)increases because charge moves along the electric field. (c)decreases because charge moves along the electric field. (d)decreases because charge moves opposite to the electric field.</p>	1
4	<p>Two concentric and coplanar circular loops P and Q have their radii in the ratio 2:3. Loop Q carries a current 9 A in the anticlockwise direction. For the magnetic field to be zero at the common centre, loop P must carry</p> <p>(a)3A in clockwise direction (b)9A in clockwise direction (c)6 A in anti-clockwise direction (d)6 A in the clockwise direction.</p>	1
5	<p>A long straight wire of circular cross section of radius a carries a steady current I. The current is uniformly distributed across its cross section. The ratio of the magnitudes of magnetic field at a point distant a/2 above the surface of wire to that at a point distant a/2 below its surface is</p> <p>(a) 4 :1 (b)1:1 (c)4: 3 (d)3 :4</p>	1
6	<p>If the magnetizing field on a ferromagnetic material is increased, its permeability</p> <p>(a)decreases (b)increases (c)remains unchanged (d)first decreases and then increases</p>	1

7	<p>An iron cored coil is connected in series with an electric bulb with an AC source as shown in figure. When iron piece is taken out of the coil, the brightness of the bulb will</p>  <p>(a) decrease (b) increase (c) remain unaffected (d) fluctuate</p>	1
8	<p>Which of the following statement is NOT true about the properties of electromagnetic waves?</p> <p>(a) These waves do not require any material medium for their propagation (b) Both electric and magnetic field vectors attain the maxima and minima at the same time (c) The energy in electromagnetic wave is divided equally between electric and magnetic fields (d) Both electric and magnetic field vectors are parallel to each other</p>	1
9	<p>The polarity of induced emf is given by</p> <p>(a) Ampere's circuital law (b) Biot -Savart law (c) Lenz's law (d) Fleming's right-hand rule</p>	1

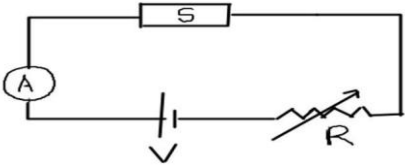
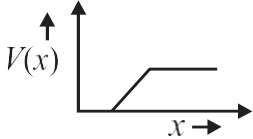
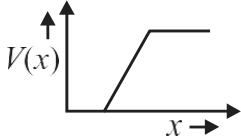
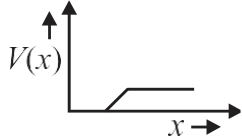
10	<p>A magnetic needle is kept in a non-uniform magnetic field. It experiences</p> <p>(a) a torque but not a force. (b) neither a force nor a torque. (c) a force and a torque. (d) a force but not a torque</p>	1
11	<p>The work function for a metal surface is 4.14 eV. The threshold wavelength for this metal surface is:</p> <p>(a) 4125 Å (b) 2062.5 Å (c) 3000 Å (d) 6000 Å</p>	1
12	<p>The radius of the innermost electron orbit of a hydrogen atom is 5.3×10^{-11} m. The radius of the $n = 3$ orbit is</p> <p>(a) 1.0×10^{-10} (b) 1.59×10^{-10} (c) 2.2×10^{-10} (d) 4.77×10^{-10}</p>	1
13	<p>Which of the following statements about nuclear forces is not true?</p> <p>(a) The nuclear force between two nucleons falls rapidly to zero as their distance is more than a few fermi meters (10^{-15} m). (b) The nuclear force is much weaker than the Coulomb force. (c) The force is attractive for distances larger than 0.8 fm and repulsive if they are separated by distances less than 0.8 fm. (d) The nuclear force between neutron-neutron, proton-neutron and proton-proton is approximately the same.</p>	1
14	<p>If the reading of the voltmeter V1 is 40 V, then the reading of voltmeter V2 is</p>	1

	 <p>(a) 30 V (b) 58 V (c) 29 V (d) 15 V</p>	
15	<p>Name the physical quantity having unit $A\ m^2$</p> <p>(a)Magnetic flux (b)Magnetic dipole moment (c)Intensity of magnetic field (d) Pole strength</p>	1
16	<p>Two statements are given-one labelled Assertion (A) and the otherlabelled Reason (R). Select the correct answer to these questionsfrom the codes (a), (b), (c) and (d) as given below.</p> <p>a) Both A and R are true and R is the correct explanation of A</p> <p>b) Both A and R are true and R is NOT the correct explanation of A</p>	1
	<p>c) A is true but R is false</p> <p>d) A is false and R is also false</p> <p>ASSERTION(A): The electrical conductivity of a semiconductor increases on doping.</p> <p>REASON: Doping always increases the number of electrons in the semiconductor.</p>	

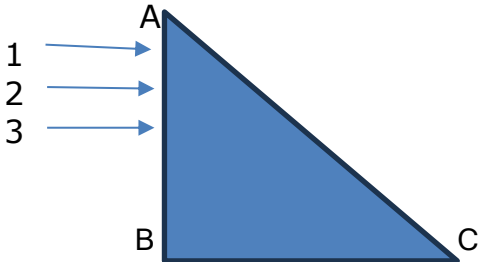
17	<p>Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.</p> <p>a) Both A and R are true and R is the correct explanation of A b) Both A and R are true and R is NOT the correct explanation of A c) A is true but R is false d) A is false and R is also false</p> <p>ASSERTION: In an interference pattern observed in Young's double slit experiment, if the separation (d) between coherent sources as well as the distance (D) of the screen from the coherent sources both are reduced to $1/3^{\text{rd}}$, then new fringe width remains the same.</p> <p>REASON: Fringe width is proportional to (d/D).</p>	1
18	<p>Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.</p> <p>a) Both A and R are true and R is the correct explanation of A b) Both A and R are true and R is NOT the correct explanation of A c) A is true but R is false d) A is false and R is also false</p> <p>Assertion(A) : The photoelectrons produced by a monochromatic light beam incident on a metal surface have a spread in their kinetic energies.</p> <p>Reason(R) :</p>	1
	<p>The energy of electrons emitted from inside the metal surface, is lost in collision with the other atoms in the metal.</p>	

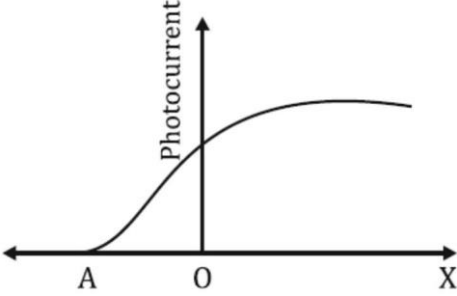
SECTION B

19	<p>(a) An Electromagnetic wave is travelling in a medium with a velocity v. Draw a sketch showing the propagation of the em wave, indicating the direction of the oscillating electric and magnetic fields.</p> <p>(b) How are the magnitude of the electric and magnetic fields related to the velocity of the em wave?</p>	2
20	<p>A uniform magnetic field gets modified as shown in figure when two specimens A and B are placed in it.</p> <div style="text-align: center;"> <p>(a) (b)</p> </div> <p>(i) Identify the specimen A and B. (ii) How is the magnetic susceptibility of specimen A different from that of specimen B?</p>	2
21	<p>What is the nuclear radius of ^{125}Fe, if that of ^{27}Al is 3.6 fermi?.</p> <p style="text-align: center;">OR</p> <p>The short wavelength limit for the Lyman series of the hydrogen spectrum is 913.4 \AA. Calculate the short wavelength limit for the Balmer series of the hydrogen spectrum.</p>	2
22	<p>A biconvex lens made of a transparent material of refractive index 1.25 is immersed in water of refractive index 1.33. Will the lens behave as a converging or a diverging lens? Justify your answer.</p>	2

23	<p>The figure shows a piece of pure semiconductor S in series with a variable resistor R and a source of constant voltage V. Should the value of R be increased or decreased to keep the reading of the ammeter constant, when semiconductor S is heated? Justify your answer</p>  <p style="text-align: center;">OR</p> <p>The graph of potential barrier versus width of depletion region for an unbiased diode is shown in graph A. In comparison to A ,graphs B and C are obtained after biasing the diode in different ways .Identify the type of biasing in B and C and justify your answer.</p> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;"> <p>'A'</p>  </div> <div style="text-align: center;"> <p>'B'</p>  </div> <div style="text-align: center;"> <p>'C'</p>  </div> </div>	2
24	<p>What is the shape of the wavefront in each of the following cases</p> <p>(a) light diverging from a point source</p> <p>(b) light emerging out of a line source</p>	2
25	<p>(a) In a series LCR circuit with an ac source of effective voltage 50 v ,frequency $50/\pi$ Hz,$R=300\Omega$,$c=20$ uF and $L=1$ H .Find the rms current in the circuit.</p>	

SECTION C

26	Two long straight parallel conductors carrying currents I_1 and I_2 are separated by a distance d . If the currents are flowing in the same direction, show how the magnetic field produced by one exerts an attractive force on the other. Obtain the expression for this force and hence define 1 ampere.	3
27.	(a) Draw the graph showing the variation binding energy per nucleon with the mass number. (b) Explain with the help of this graph the release of energy in the process of nuclear fission and fusion reaction	3
28	<p>Three rays 1.2.3 of different colors falls normally on one of the sides of an right angled prism as shown in figure. Refractive indices of prism these rays is 1.39,1.47 and 1.52 respectively. Trace the path and find which of these rays get internally reflected and which get refracted from face Ac</p> 	3
29	<p>Radiation of frequency 10^{15} Hz is incident on three photosensitive surfaces A, B and C. Following observations are recorded:</p> <p>—</p> <p>Surface A: no photoemission occurs</p> <p>Surface B: photoemission occurs but the photoelectrons have zero kinetic energy.</p>	3

	<p>Surface C: photo emission occurs and photoelectrons have some kinetic energy. Using Einstein's photo-electric equation, explain the three observations.</p> <p style="text-align: center;">OR</p> <p>The graph shows the variation of photocurrent for a photosensitive metal</p> <div style="text-align: center;">  </div> <p>(a) What does X and A on the horizontal axis represent? (b) Draw this graph for three different values of frequencies of incident radiation ν_1, ν_2 and ν_3 ($\nu_3 > \nu_2 > \nu_1$) for the same intensity. (c) Draw this graph for three different values of intensities of incident radiation I_1, I_2 and I_3 ($I_3 > I_2 > I_1$) having the same frequency.</p>	
30	<p>The ground state energy of hydrogen atom is -13.6 eV. The photon emitted during the transition of electron from $n=3$ to $n=1$ state, is incident on a photosensitive material of unknown work function. The photoelectrons are emitted from the material with the maximum kinetic energy of 9 eV. Calculate the threshold wavelength of the material used.</p>	3

SECTION D

31	<p>(a) Define electric flux. write its SI unit (b) Using gauss law obtain the expression for electric field at a point due to an infinitely long, thin uniformly charged straight wire of linear charge density $\lambda \text{ Cm}^{-1}$</p>	5
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	<p style="text-align: center;">OR</p> <p>(a) Three charges $-q$, Q and $+q$ are placed at equal distances on a straight line. If the potential energy of the system of these charges is zero, then what is the ratio $Q:q$?</p> <p>(b)(i) Obtain the expression for the electric field intensity due to a uniformly charged spherical shell of radius R at a point distant r from the centre of the shell outside it.</p> <p>(ii) Draw a graph showing the variation of electric field intensity E with r, for $r > R$ and $r < R$.</p>	
32	<p>(a) State Biot Savart law. Using this law find an expression for the magnetic field at the centre of a circular coil of N turns, radius r carrying a current I</p> <p>(b) Sketch the magnetic field for a circular current loop, clearly indicating the direction of the field</p> <p style="text-align: center;">OR</p> <p>(a) State the two Kirchhoff's rules used in the analysis of electric circuits and explain them.</p> <p>(b) Derive the equation of the balanced state in a Wheatstone bridge using Kirchhoff's laws.</p>	5
33	<p>a) Draw a ray diagram for formation of image of a point object by a thin double convex lens having radii of curvature R_1 and R_2, hence derive lens maker's formula for a double convex lens. state the assumption made and sign convention used</p> <p style="text-align: center;">OR</p>	5

	<p>(a) Explain with the help of a ray diagram, how is image formed in a compound microscope</p> <p>(b) Define and obtain the expression for magnifying power</p> <p>(c) power of three lens are 10 D, 5 D, 2 D respectively, which one you prefer for an objective and eyepiece of a microscope</p>	
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SECTION E

34	<p>Case Study:</p> <p><i>Read the following paragraph and answer the questions.</i></p> <p>A number of optical devices and instruments have been designed and developed such as periscope, binoculars, microscopes and telescopes utilizing the reflecting and refracting properties of mirrors, lenses and prisms. Most of them are in common use. Our knowledge about the formation of images by the mirrors and lenses is the basic requirement for understanding the working of these devices.</p> <p>(i) Why the image formed at infinity is often considered most suitable for viewing. Explain</p> <p>(ii) In modern microscopes multicomponent lenses are used for both the objective and the eyepiece. Why?</p> <p>(iii) Write two points of difference between a compound microscope and an astronomical telescope</p> <p>(iv) Write two distinct advantages of a reflecting type telescope over a refracting type telescope.</p>	4
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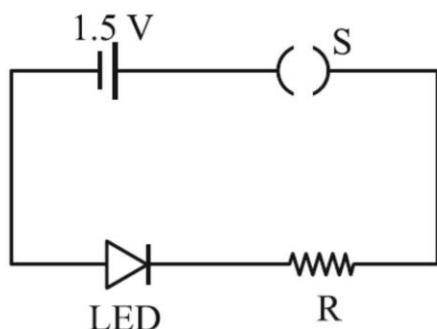
Read the following paragraph and answer the questions

LED is a heavily doped P-N junction which under forward bias emits spontaneous radiation. When it is forward biased, due to recombination of holes and electrons at the junction, energy is released in the form of photons. In the case of Si and Ge diode, the energy released in recombination lies in the infrared region. LEDs that can emit red, yellow, orange, green and blue light are commercially available. The semiconductor used for fabrication of visible LEDs must at least have a band gap of 1.8 eV. The compound semiconductor Gallium Arsenide – Phosphide is used for making LEDs of different colors.



LEDs of different kinds

- (i). Why are LEDs made of compound semiconductor and not of elemental semiconductors?
- (ii) What should be the order of bandgap of an LED, if it is required to emit light in the visible range?
- (iii) A student connects the blue colored LED as shown in the figure. The LED did not glow when switch S is closed. Explain why?



- (iv) Draw V-I characteristic of a p-n junction diode in
 (i) forward bias and (ii) reverse bias

