# COMMON PRE-BOARD EXAMINATION 2022-23

## Subject: PHYSICS (042)

Class: XII — Time: 3 Hours

Date: — Max. Marks: 70

***General Instructions:***

1. *There are 35 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. All the sections are compulsory.*
3. *Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study-based questions of 4 marks each.*
4. *There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.*
5. *Use of calculators is not allowed.*

| | **SECTION A** | |
|---|---|---|
| 1. | If $\oint \vec{E}.d\vec{S} = 0$ over a surface, then<br>(a) the electric field inside the surface and on it is zero.<br>(b) the electric field inside the surface is necessarily uniform.<br>(c) the number of flux lines entering the surface must be equal to the number of flux lines leaving it.<br>(d) all charges must necessarily be inside | 1 |
| 2. | Two identical capacitors of 12 pF each are connected in series across a 50 V battery. Calculate the electrostatic energy stored in the combination.<br>(a) $7.5 \times 10^{-9}$J (b) $3.0 \times 10^{-8}$J (c) $5.6 \times 10^{-7}$J (d) $9.4 \times 10^{-6}$J | 1 |
| 3. | Some charge is being given to a conductor. Then, its potential<br>(a) is maximum at surface.<br>(b) is maximum at centre.<br>(c) is maximum somewhere between surface and centre.<br>(d) remains the same throughout the conductor. | 1 |
| 4. | Which one of the following characteristics of electrons determine the current in a conductor?<br>(a) Drift velocity<br>(b) Thermal velocity<br>(c) Both drift velocity and thermal velocity<br>(d) Neither drift nor thermal velocity | 1 |
| 5. | An electron is projected with uniform velocity along the axis of a current carrying long solenoid. Which of the following is true?<br>(a) The electron will be accelerated along the axis<br>(b) The electron path will be circular about the axis<br>(c) The electron will experience a force at 45° to the axis and hence execute a helical path<br>(d) The electron will continue to move with uniform velocity along the axis of the solenoid | 1 |

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| 6. | A voltmeter of range 2V and resistance 300 Ω cannot be converted to an ammeter of range:<br>(a) 5 mA (b) 8 mA (c) 1 A (d) 10 A | 1 |
| 7. | The self-inductance L of a solenoid of length *l* and area of cross-section A, with a fixed number of turns N increases as<br>(a) *l* and A increase. (b) *l* decreases and A increases.<br>(c) *l* increases and A decreases. (d) both *l* and A decrease. | 1 |
| 8. | A magnet is dropped with its north pole towards a closed circular coil placed on a table then<br>(a) looking from above, the induced current in the coil will be anti-clockwise.<br>(b) the magnet will fall with uniform acceleration.<br>(c) looking from above, the induced current in the coil will be clockwise.<br>(d) no current will be induced in the coil. | 1 |
| 9. | An inductor of reactance 1 Ω and a resistor of resistance 2 Ω are connected in series to the terminals of a 6 V ac source. The power dissipated in the circuit is<br>(a) 8 W (b) 12 W (c) 14.4 W (d) 18 W | 1 |
| 10. | To reduce the resonant frequency in an LCR series circuit with a generator<br>(a) the generator frequency should be reduced.<br>(b) another capacitor should be added in parallel to the first.<br>(c) the iron core of the inductor should be removed.<br>(d) dielectric in the capacitor should be removed. | 1 |
| 11. | The electric field intensity produced by the radiations coming from 100 W bulb at a 3 m distance is E. The electric field intensity produced by the radiations coming from 50 W bulb at the same distance is<br>(a) $\frac{E}{\sqrt{2}}$ (b) 2E (c) $\frac{E}{2}$ (d) $\sqrt{2}$E | 1 |
| 12. | In a Young's double-slit experiment the fringe width is found to be 0.4 mm. If the whole apparatus is dipped in water of refractive index 4/3, without disturbing the arrangement, the new fringe width will be<br>(a) 0.2 mm (b) 0.40 mm (c) 0.53 mm (d) 0.30 mm | 1 |
| 13. | A proton, a neutron, an electron and an α-particle have same energy. Then the relation between de-Broglie wavelengths of these particles is<br>(a) $\lambda_P = \lambda_n > \lambda_e > \lambda_\alpha$ (b) $\lambda_\alpha < \lambda_p = \lambda_n > \lambda_e$<br>(c) $\lambda_e < \lambda_p = \lambda_n > \lambda_\alpha$ (d) $\lambda_e = \lambda_p = \lambda_n = \lambda_\alpha$ | 1 |
| 14. | If an electron in a hydrogen atom jumps from the 3rd orbit to the 2nd orbit, it emits a photon of wavelength λ. When it jumps from the 4th orbit to the 3rd orbit, the corresponding wavelength of the photon will be<br>(a) $\frac{16}{25}\lambda$ (b) $\frac{9}{16}\lambda$ (c) $\frac{20}{7}\lambda$ (d) $\frac{20}{13}\lambda$ | 1 |
| 15. | The radius of a nucleus is<br>(a) inversely proportional to the cube root of its atomic weight<br>(b) inversely proportional to the cube root of its mass number<br>(c) directly proportional to the cube root of its mass number<br>(d) directly proportional to the cube root of its atomic weight | 1 |
| | | |

For question numbers 13 to 17, 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:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

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| 16. | **Assertion:** Diffraction takes place for all types of waves such as mechanical or non-mechanical, transverse or longitudinal.<br>**Reason:** Diffraction's effect are perceptible only if wavelength of wave is comparable to dimensions of diffracting device. | 1 |
| 17. | **Assertion:** Two photons of equal wavelength must have equal linear momentum.<br>**Reason:** Two photons of equal linear momentum will have equal wavelength | 1 |
| 18. | **Assertion:** Silicon is preferred over germanium for making semiconductor devices.<br>**Reason:** The energy gap in germanium is more than the energy gap in silicon. | 1 |
| | **SECTION B** | |
| 19. | Two identical charges, Q each kept at a distance r from each other. A third charge q is placed on the line joining the above two charges such that all the three charges are in equilibrium. What is the magnitude and the position of charge q | 2 |
| 20. | The susceptibility of a magnetic material is $-2.6 \times 10^{-5}$. Identify the type of magnetic material and write its three properties. | 2 |
| 21. | The oscillating electric field of an electromagnetic wave is given by:<br>$E_y = 30 \sin [2 \times 10^{11} t + 300 \pi x]$ V/m<br>a) Obtain the value of the wavelength of the electromagnetic wave.<br>b) Write down the expression for the oscillating magnetic field.<br>**OR**<br>How a microwave oven works to heat up a food item containing water molecules. | 2 |
| 22. | How does focal length of a lens change when red light incident on it is replaced by violet light? Give reason for your answer. | 2 |
| 23. | Find the ratio of intensities of two points P and Q on a screen of Young's double slit experiment, when waves from sources $S_1$ and $S_2$ have<br>a) phase difference of $\frac{\pi}{3}$ and $\frac{\pi}{2}$<br>b) path difference of 0 and $\lambda/4$ | 2 |
| 24. | $^3He_2$ and $^3He_1$ nuclei have the same mass number. Do they have the same binding energy? Why? | 2 |
| 25. | How can a diode act as a rectifier? | 2 |
| | **SECTION C** | |
| 26. | A Galvanometer of resistance G is converted into a voltmeter to measure upto V volts by connecting a resistance $R_1$ in series with the coil. If a resistance $R_2$ is connected in series with it, then it can measure upto V/2 volts. Find the resistance, in terms of $R_1$ and $R_2$, required to be connected to convert it into a voltmeter that can read upto 2V. Also find the resistance G of the galvanometer in terms of $R_1$ and $R_2$. | 3 |

| | | |
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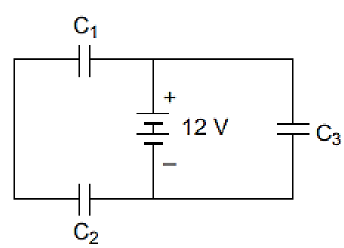
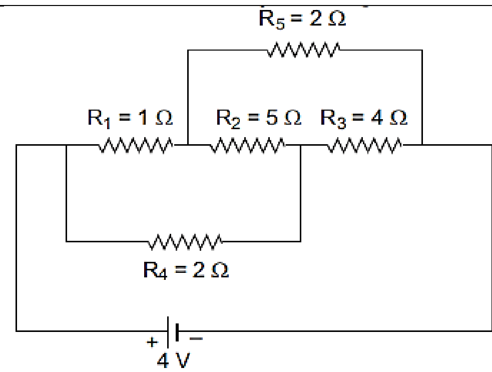
| 27. | Derive an expression for the mutual inductance of two long co-axial solenoids. Write any two factors on which mutual inductance of solenoids depend. | 3 |
| 28. | Define rms value of alternating voltage and find its expression in terms of current amplitude.<br>**OR**<br>In a series LCR circuit with an ac source of effective voltage 50 V, frequency $v = 50 / \pi$ Hz, $R = 300\Omega$, $C = 20\ \mu F$ and $L = 1.0$ H. Find the rms current in the circuit. | 3 |
| 29. | Light of wavelength 2000 Å falls on a metal surface of work functions 4.2 eV. What is the kinetic energy in eV of the fastest electrons emitted from the surface? What will be the change in the energy of the emitted electrons if the intensity of light with same wavelength is doubled? If the same light falls on another surface of work functions 6.5 eV, what will be the energy of emitted electrons?<br>**OR**<br>Draw a graph between the frequency of incident radiation and the maximum kinetic energy of the electrons emitted from the surface of a photosensitive material. State clearly how this graph can be used to determine (i) planks constant and (ii) work function of the material | 3 |
| 30. | When the maximum kinetic energy of photo electrons double while the wavelength of light changes from $\lambda_1$ to $\lambda_2$ then find the expression threshold wavelength and work function | 3 |
| | **SECTION D** | |
| 31. | a. Two isolated metal sphere A and B have radii R and 2R respectively and same charge q. Find which of the two spheres have greater energy density just outside the surface of the sphere.<br>b. Three identical capacitors $C_1$, $C_2$ and $C_3$ of capacitance 6 μF each one is connected to a 12 V battery as shown. Find: (i) charge on each capacitor (ii) equivalent capacitance of the network (iii) energy stored in the network of capacitors<br><br>**OR**<br>With the help of a diagram derive an expression for torque acting on a electric dipole when it is kept in the external electric field. What is the direction of this torque. Deduce the expression of the potential energy stored in the dipole. | 5 |
| 32. | a) Calculate the emf and internal resistance of the equivalent cell, if two cells of emfs 1.5 V and 2 V having internal resistances 0.2 Ω and 0.3 Ω respectively are connected in parallel.<br>b) Calculate the current drawn from the battery for the following circuit given below | 5 |




**OR**

Derive the expressions for the equivalent emf and resistance of cells when they are connected in parallel. Also find the expression for the current in the circuit for this case. How these expressions change, if the cells are identical?

33. A small telescope has an objective lens of focal length 140cm and an eyepiece of focal length 5cm. What is the: 5

a) Magnifying power of the telescope for viewing distant objects when the telescope is in normal adjustment.
b) Magnifying power of the telescope when the final image is formed at the least distance of distinct vision.
c) What is the separation between the objective and eyepiece when final image is formed at infinity?
d) If this telescope is used to view a 100m tall tower located 3km away, what is the height of the image of the tower formed by the objective lens?
e) What is the height of the image of the tower if it is formed at the least distance of distinct vision?

**OR**

a) With the help of a ray diagram explain the image formation at a least distance of distinct vision by using a compound microscope. Derive an expression for its magnifying power.
b) What are the characteristic properties of objective and eyepiece lenses, which are used in compound microscope?

## SECTION E

34. ***Read the following paragraph and answer the questions*** 4

The phenomena of total internal reflection takes place at the boundary between two transparent media when a light ray in a medium of higher refractive index of refraction approaches the other medium at an angle of incidence greater than the critical angle. Total Internal Reflection takes place in electromagnetic wave, sound wave as well as water wave

a) What are the two conditions for total internal reflection?
b) A ray of light, incident on an equilateral glass prism ($\mu_g = \sqrt{3}$) moves parallel to the base line of the prism inside it. Find the angle of incidence for this ray.
c) For which colour of light has minimum Critical angle when it passing from glass to air?

**OR**

How does the critical angle depend on the refractive index of rarer medium?

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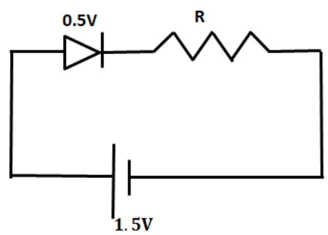
|---|---|---|
| 35. | ***Read the following paragraph and answer the questions*** | 4 |

Consider a thin p-type silicon semiconductor wafer. By adding precisely, a small quantity of pentavalent impurity, part of the p-Si wafer can be converted into n-Si. There are several processes by which a semiconductor can be formed. The wafer now contains p-region and n-region and a metallurgical junction between p and n- region. Two important processes occur during the formation of a p-n junction: diffusion and drift. We know that in an n-type semiconductor, the concentration of electrons is more compared to the concentration of holes. Similarly, in a p-type semiconductor, the concentration of holes is more than the concentration of electrons. During the formation of p-n junction, and due to the concentration gradient across p and n sides, holes diffuse from p-side to n-side and electrons diffuse from n-side to p-side. This motion of charge carriers gives rise to diffusion current across the junction.

a) What is the effect of doping on width of depletion layer?

b) A p-n junction diode when forward biased has a drop of 0.5 V which is assumed to be independent of current. The current in excess of 10 mA through the diode produces a large Joule heating which damages the diode. if we want to use a 1.5 V battery to forward bias the diode, what should be the value of resistor used in series with the diode so that the maximum current does not exceed 5mA?




c) Draw the energy band diagram for P type and N type semiconductor

**OR**

Draw the V-I graph in case of forward biasing and reverse biasing

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