

# Pre-Board Examination – 2019-2020

Class – XII

Subject – PHYSICS

Time : 3 Hours

Max. Marks : 70

## General Instructions:

1. All Questions are Compulsory.
2. There are 37 Questions in all.
3. This Question Paper has four sections Section A, Section B, Section C and Section D.
4. Section A contains 20 Questions 1 to 20 of 1 mark each. They are Very Short Answer type Questions.
5. Section B contains 7 Questions 21 to 27 of two marks each. They are Short Answer type Questions.
6. Section C contains 7 Questions 28 to 34 of three marks each. They are Short Answer type Questions.
7. Section D contains 3 Questions 35 to 37 of five marks each.
8. There is no overall choice. However, internal choice have been provided in two questions of one mark, two questions of two marks, one questions of three mark and three questions of five marks weightage. You have to attempt only one of the choices in such questions.

## SECTION A

**Q1 to 10 are Multiple Choice Questions. Select the most appropriate option from those given below each question:**

1. A current of 2 A flows through a  $2\ \Omega$  resistor when connected across a battery. The same battery supplies a current of 0.5 A when connected across a  $9\ \Omega$  resistor. The internal resistance of the battery is:
- A.  $1\ \Omega$                       B.  $2\ \Omega$                       C.  $1/3\ \Omega$                       D.  $1/4\ \Omega$
2. The magnetic field at a distance  $r$  from a long wire carrying current  $I$  is 0.4 T. The magnetic field at a distance  $2r$  is:
- A.  $0.2\text{ T}$                       B.  $0.8\text{ T}$                       C.  $0.1\text{ T}$                       D.  $1.6\text{ T}$

3. A voltmeter has a resistance of  $G$  ohms and range of  $V$  volts. The value of resistance to be used in series to convert it into voltmeter of range  $nV$  volt is:  
A.  $nG$                       B.  $(n-1)G$                       C.  $G/n$                       D.  $G/(n-1)$
4. Two slits in YDSE have width in the ratio 1: 25. The ratio of maximum to minimum Intensity is:  
A. 4/9                      B.  $9/4$                       C. 121/49                      D. 49/121

OR

In YDSE two slits are 5 mm apart and screen is placed 2 m away. What is the fringe separation when light of wavelength 500 nm is used?

- A. 0.002 mm                      B. 0.02 mm                      C.  $0.2 \text{ mm}$                       D. 2 mm
5. For an em wave propagating along x axis  $E_0 = 30 \text{ V/m}$ . Find the value of  $B_0$  ?  
A.  $10^{-7} \text{ T}$                       B.  $10^{-8} \text{ T}$                       C.  $10^{-9} \text{ T}$                       D.  $10^{-6} \text{ T}$
6. In a plano-convex lens, the radius of curvature of the convex surface is 10 cm and the focal length of the lens is 30 cm, then refractive index of material of lens is:  
A. 1.5                      B. 1.66                      C.  $1.33$                       D. 3

OR

The refractive index of glass with respect to air is  $3/2$  and that of water with respect to air is  $4/3$ . Then refractive index of water with respect to glass is:

- A. 2                      B.  $8/9$                       C.  $9/8$                       D. 1.66
7. To a fish in water with refractive index  $4/3$  a bird in the air appears to be 60 cm above the water surface. The real height of bird is:  
A. 40 cm                      B. 50 cm                      C.  $45 \text{ cm}$                       D. 30 cm
8. A lens produces real image and virtual image of an object when it is placed at distances  $x_1$  and  $x_2$  respectively from the lens. If the magnification produced in both cases is equal then the focal length of the lens is:  
A.  $x_1 + x_2/2$                       B.  $x_2 + x_1/2$                       C.  $(x_1 + x_2)/2$                       D.  $(x_1 + x_2)$
9. The magnification produced by the objective lens and the eye lens of a compound microscope are 25 cm and 6 cm respectively. The magnifying power of microscope is :  
A. 19                      B. 31                      C.  $150$                       D. 100

10. The total energy of an electron in the ground state of hydrogen atom is  $-13.6 \text{ eV}$ . Its potential energy in the second excited state is:

A.  $-3.4 \text{ eV}$       B.  $-1.7 \text{ eV}$       C.  $-1.51 \text{ eV}$       D.  $-3.02 \text{ eV}$

**Q11 to Q15 Fill in the Blank with appropriate answer:**

11. De Broglie wavelength of an electron accelerated by  $25 \text{ V}$  is .....  $12.27 \text{ \AA}$  .....
12. Two point charges placed at a distance  $r$  in air exert a force  $F$  on each other. The distance at which these charges experience the same force  $F$  in a medium of dielectric constant  $K$  is .....  $\frac{r}{\sqrt{K}}$  .....
13. The physical quantity with dimension  $Vm$  is ..... Electric flux .....
14. A solenoid with an iron core and a bulb is connected to a d.c. source. Iron core is removed from the bulb. The brightness of the bulb will ..... glow with same brightness .....
15. If De Broglie wavelength of a particle of kinetic energy  $K$  is  $\lambda$ , the wavelength if kinetic energy is made  $K/4$  is .....  $2\lambda$  .....

**Q16 to Q20 Answer the following Questions:**

16. An iron nail near a bar magnet experiences a force of attraction in addition to a torque. Why? The field  $B$  due to the bar magnet is non-uniform and the magnetised iron nail becomes a dipole in this field.
17. Draw the pattern of electric field lines, when a point charge  $-Q$  is kept near an uncharged conducting plate?
18. Will neutron to proton ratio increase/decrease in a nucleus when a positron is emitted? Increases
19. Work function of Sodium is  $2.75 \text{ eV}$ . What will be K.E. of emitted electron when photon of energy  $3.45 \text{ eV}$  is incident on the surface of sodium?  $0.7 \text{ eV}$
20. In a series LR circuit,  $X_L = 3R$ . Now a capacitor with  $X_C = 2R$  is added in series. Calculate the ratio of new to old power factor?

$$\text{Power factor} = \cos \phi = \frac{V_R}{V} = \frac{R}{Z}$$

$$\cos \phi_1 = \frac{R}{\sqrt{R^2 + 9R^2}} = \frac{1}{\sqrt{10}} \quad \cos \phi_2 = \frac{R}{\sqrt{R^2 + (3R - 2R)^2}} = \frac{1}{\sqrt{2}}$$

$$\frac{\cos \phi_1}{\cos \phi_2} = \frac{1}{\sqrt{5}}$$



# SECTION B

21. Two long and straight wires A and B carrying currents of 8A and 5 A in the same direction are separated by a distance of 4 cm. Estimate the force on a 10 cm of wire A?

$$F = \frac{\mu_0 I_1 I_2 l}{2 \pi d}$$

22. Two circular coils one of radius r and other of R are placed coaxially with their centres coinciding such that  $R \gg r$ , obtain an expression for the Mutual Inductance of the arrangement?

23. Electromagnetic radiations with wavelength:

- a) X is used to kill germs in water purifier. *UV*  
 b) Y is used in TV Communication System. *Radio waves*  
 c) Z is used to treat muscular strain. *IR*

Identify X, Y and Z and name part of spectrum to which they belong and arrange them in decreasing order of wavelength.

24. State and Prove Brewster law of Polarisation?

OR

Prove Snell's law of refraction on basis of Wave Theory?

25. In the Uranium radioactive series, the initial nucleus is Uranium with mass number 238 and atomic number 92 and final nucleus is Lead with mass number 206 and atomic number 82. Calculate the number of  $\alpha$  and  $\beta$  particles emitted?

$$\begin{aligned} U_{92}^{238} &\rightarrow Pb_{82}^{206} + x\alpha + y\beta \\ \therefore 238 &= 206 + 4x \\ 92 &= 82 + 2x - y \end{aligned}$$

OR

A radioactive substance decays to 1/32 of its initial activity in 25 days. Calculate its half-life?

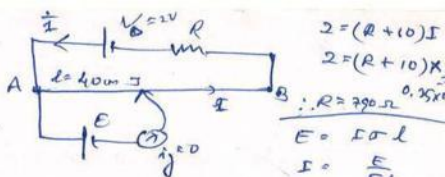
26. Draw circuit diagram for reverse biased p-n junction diode. Sketch the voltage-current graph for the same?

27. Give reasons for the following:

- a) A photodiode, when used as a detector of optical signals is operated under reverse biased.  
 b) Zener diode is fabricated by heavily doping both the p and n sides of junction.

Not  
Surf

### SECTION C



28. A potentiometer wire of length 100 cm has a resistance of  $10\Omega$ . It is connected in series with an external resistance and a battery of emf 2 V and of negligible internal resistance. A source of emf 10 mV is balanced against a length of 40 cm of potentiometer wire. Draw the circuit diagram and calculate the value of external resistance?
29. Twelve wires each of resistance  $r$  are connected to form a skeleton cube. Find the resistance of the cube using Kirchhoff's law between the two corners of the same edge?  
 $R_{AB} = \frac{7}{12} r$
30. Explain Principle and working of Cyclotron with help of a diagram?
31. A light beam of wavelength  $6500 \text{ \AA}$  is incident normally on a slit of width 0.5 mm. If the diffraction pattern is obtained on a screen kept 2m away from the slit find the:
- Width of central maximum.
  - Distance of second maximum from the central maximum
  - Angular spread of central maximum.
32. When a hydrogen atom is in its second excited state, find the ratio of the maximum and minimum wavelength of radiation emitted in the process. Also name the spectral series to which this radiation belongs?
33. Derive the expression for radioactive decay and obtain the relation between disintegration constant and half-life? Also define the disintegration constant?
34. With help of a circuit diagram explain principle and working of a p-n junction diode as a full wave rectifier?

OR

- With help of a circuit diagram explain principle and working of a Zener diode as a Voltage Regulator?

### SECTION D

35. a) - A free pith ball A of 8g carries a positive charge of  $5 \times 10^{-8} \text{ C}$ . What must be the nature and magnitude of the charge that should be given to a second pith ball B fixed 5 cm below the former ball so that the upper ball is stationary?

- b) Obtain an expression for electric field at a point on an axial line of electric dipole?

OR

- a) Using Gauss Theorem obtain an expression for electric field at a point due to a line charge?
- b) There is infinite number of capacitors each of capacitance  $1\mu\text{F}$ . They are connected in rows, such that the number of capacitor in first row, second row, third row, fourth row are respectively 1,2,4,8..... The rows of these capacitors are then connected in parallel between points A and B. Determine the equivalent Capacitance between A and B?
36. - Draw a ray diagram of a Compound Microscope and obtain an expression for its magnifying power when final image is formed at least distance of distinct vision? Also write the formulae for magnifying power when final image is formed at infinity?

OR

Draw a ray diagram to show formation of image by an Astronomical Telescope when final image is at infinity? Also obtain an expression for its magnifying power? Give any four advantages of Reflecting Telescope over Refracting Telescope?

37. - a) A capacitor of unknown capacitance  $C$ , a resistance of 100 ohm and an inductor of Self Inductance  $L = (4/\pi^2) \text{ H}$  are connected in series across a.c. source of 200 V and 50 Hz. Calculate the value of the Capacitance  $C$  and the current that flows in the circuit when the current is in phase with the voltage?
- b) Show that in an ac circuit containing pure Capacitor current leads the voltage by a phase difference of  $\pi/2$ ?

OR

- a) Calculate the current drawn by the primary of a transformer, which steps 200 V to 20 V to operate a device of resistance 20 ohm. Assume that efficiency of transformer is 80%
- b) Define Q factor of a series resonant circuit and obtain an expression for it?



Series RPH-DS1

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Candidates must write the code on the title page of the answer-book.

- Please check that this question paper contains 8 printed pages.
- Code number given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- Please check that this question paper contains 37 questions.
- Please write down the serial number of the question before attempting it.
- 15 minutes time has been allotted to read this question paper.

### PHYSICS (Theory)

Time allowed : 3 hours

Maximum Marks : 70

#### General Instructions :

- (i) All questions are compulsory. There are 37 questions in all.
- (ii) This question paper has four sections: Section A, Section B, Section C and Section D.
- (iii) Section A contains twenty questions of one mark each, Section B contains seven questions of two marks each, Section C contains seven questions of three marks each, and Section D contains three questions of five marks each.
- (iv) There is no overall choice. However, internal choices have been provided in two questions of one mark each, two questions of two marks, one question of three marks and three questions of five marks weightage. You have to attempt only one of the choices in such questions.

(v) You may use the following values of physical constants wherever necessary.

$$c = 3 \times 10^8 \text{ m/s}$$

$$h = 6.63 \times 10^{-34} \text{ Js}$$

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$$

$$\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{N}^{-1} \text{m}^{-2}$$

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2 \text{C}^{-2}$$

$$\text{Mass of electron} = 9.1 \times 10^{-31} \text{ kg}$$

$$\text{Mass of neutron} = 1.675 \times 10^{-27} \text{ kg}$$

$$\text{Mass of proton} = 1.673 \times 10^{-27} \text{ kg}$$

$$\text{Avogadro's number} = 6.023 \times 10^{23} \text{ per gram mole}$$

$$\text{Boltzmann constant} = 1.38 \times 10^{-23} \text{ JK}^{-1}$$

## SECTION - A

**Directions (Q1 to Q10):** Select the most appropriate option from those given below each question.

1. In an n-type silicon, which of the following statement is true? 1
  - (a) Electrons are the majority carriers and trivalent atoms are the dopants.
  - (b) Electrons are the minority carriers and pentavalent atoms are the dopants.
  - (c) Holes are the minority carriers and pentavalent atoms are the dopants.
  - (d) Holes are the majority carriers and trivalent atoms are the dopants.
2. Which of the following statements is incorrect. Equipotential surfaces: 1
  - (a) are closer in regions of large electric field compared to regions of lower electric field.
  - (b) will be more crowded near sharp edges of a conductor.
  - (c) will be more crowded near regions of large charge densities.
  - (d) will always be equally spaced.



3. Human body radiate:

- (a) Microwave (b) X-rays  
(c) Infrared rays (d) Gamma rays

4. For a cell, the terminal potential difference is 3.6 V, when the circuit is open. If the potential difference reduces to 3 V, when cell is connected to a resistance of  $5\ \Omega$ , the internal resistance of cell is

- (a)  $1\ \Omega$  (b)  $2\ \Omega$   
(c)  $4\ \Omega$  (d)  $8\ \Omega$

5. If the rms current in a 50 Hz ac circuit is 5 A, the value of the current  $1/300$  seconds after its value becomes zero is

- (a)  $5\sqrt{2}\text{ A}$  (b)  $5\sqrt{3/2}\text{ A}$   
(c)  $5/6\text{ A}$  (d)  $5/\sqrt{2}\text{ A}$

6. If distance between two current-carrying wires is doubled, then force between them is

- (a) halved. (b) doubled.  
(c) tripled. (d) quadrupled.

7. Two lenses of focal lengths 20 cm and  $-40\text{ cm}$  are held in contact. If an object lies at infinity, image formed by the lens combination will be at

- (a) infinity. (b) 20 cm.  
(c) 40 cm. (d) 60 cm.

8. Maximum kinetic energy of emitted electron depends on the frequency of incident photon when frequency of incident photons is

- (a) equal to the threshold frequency.  
(b) half of the threshold frequency.  
(c) greater than the threshold frequency.  
(d) one third of the threshold frequency.

9. How does the focal length of a convex lens changes if mono chromatic red light is used instead of violet light? 1
- (a) Focal length is increased when red light is used
- (b) Focal length is decreased when red light is used
- (c) Focal length remains same when red light is used
- (d) Focal length does not depend on the colour of light.
10. A small telescope has an objective lens of focal length 144 cm and an eyepiece of focal length 6.0 cm. The magnifying power of the telescope is 1
- (a) 24 (b) 6
- (c) 10.5 (d) 60

**Directions (Q11 to Q15): Fill in the blanks with appropriate answer.**

11. Two nuclei have mass numbers in the ratio 27 : 125. Then the ratio of their radii is 1
12. A pure semiconductor which is free of any impurity is called 1  
semiconductor.
13. The minimum energy required by a free electron to just escape from the metal surface is called as 1

**OR**

The expression of De-Broglie wavelength of an electron moving under a potential difference of V volts is \_\_\_\_\_.

14. For the same angle of incidence, the angles of refraction in three different medium A, B and C are  $15^\circ$ ,  $25^\circ$  and  $35^\circ$  respectively. The medium 1  
\_\_\_\_\_ will have minimum velocity of light.
15. In an ac circuit, the average power consumed by a pure capacitor during one complete cycle in a pure capacitor is 1

**Direction (Q16 to Q20): Answer the following.**

16. Two charges  $3 \times 10^{-5}$  C and  $5 \times 10^{-4}$  C are placed at a distance 10 cm from each other. Find the value of electrostatic force acting between them. 1



17. A vector needs three quantities for its specification. Name the three independent quantities conventionally used to specify the earth's magnetic field. 1

OR

Name the physical quantity which has its unit  $\text{JT}^{-1}$ .

18. The ground state energy of hydrogen atom is  $-13.6 \text{ eV}$ . What are the kinetic and potential energies of electron in this state? 1
19. An unpolarised light, of intensity  $I_0$ , is incident over a combination of two polaroid. Find the net intensity of light transmitted by the combination when the pass axes of the two polaroid are inclined to each other at an angle of  $60^\circ$ . 1
20. State Faraday's first law of electro magnetic induction. 1

### SECTION - B

21. What is displacement current? Prove that when a parallel plate capacitor is being charged by a time varying current then it produces the displacement current. 2
22. Describe briefly using the necessary circuit diagram the three basic processes which take place to generate the emf in a solar cell when light falls on it. 2

OR

Name the optoelectronic devices used for detecting optical signals and mention the biasing in which it is operated. Draw the V-I characteristics.

23. A charge particle  $q$  is moving in a straight line and accelerated at a potential difference of  $V$  volt. It enters in a uniform magnetic field  $B$  perpendicular to its path. Deduce an expression in terms of  $V$  for the radius of the circular path in which it travels. 2
24. State the principle of potentiometer. Give reason why a potentiometer is preferred over a voltmeter for the measurement of emf of the two cells. 2
25. A circular coil of radius  $10 \text{ cm}$ ,  $500$  turns and resistance  $2 \Omega$  is placed with its plane perpendicular to horizontal component of the earth's magnetic field. It is rotated about its vertical diameter through  $180^\circ$  in  $0.25 \text{ s}$ . Estimate the magnitude of the induced emf produced in the coil. Horizontal component of the earth's magnetic field at the place is  $3.0 \times 10^{-5} \text{ T}$ . 2



26. Draw the plot of variation of potential energy of pair of nucleons as a function of their separation. Write two important conclusion which you draw regarding the nuclear force. 2

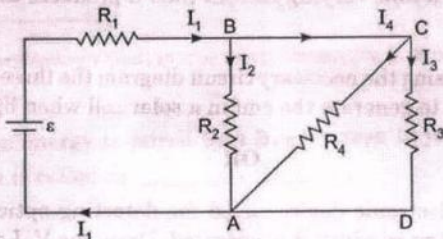
OR

State and deduce the radioactive decay law.

27. A ray of light passing through an equilateral prism from air undergoes minimum deviation when angle of incidence is  $3/4$ th of the angle of prism. Calculate the speed of light in the prism. 2

### SECTION - C

28. Write Einstein's photoelectric equation. State clearly the three salient features observed in photoelectric effect, which can be explained on the basis of photoelectric equation. 3
29. In the circuit  $R_1 = 4 \Omega$ ,  $R_2 = R_3 = 15 \Omega$ ,  $R_4 = 30 \Omega$  and  $\varepsilon = 10 \text{ V}$ . Find the equivalent resistance of the circuit and the current in each resistance. 3



30. State the principle of a moving coil galvanometer. Explain its working and obtain the expression for the deflection produced due to the current passed through the coil. 3

OR

State Biot-Savart law and using it derive the expression for the magnetic field due to a current carrying circular loop of radius  $R$  at a point distance  $x$  from its centre along its axis.

31. Using the postulates of Bohr's theory of hydrogen atom show that (i) radii of orbit increases as  $n^2$  and (ii) the total energy of electron increases as  $1/n^2$ , where  $n$  is the principal quantum number of the atom. 3

32. A student wants to use two p-n junction diodes to convert alternating current into direct current. Draw the labelled circuit diagram that he would use and explain how it works. 3
33. An electric dipole is held in a uniform electric field.  
 (a) Using suitable diagram show that it does not undergo any translatory motion.  
 (b) Derive an expression for torque acting on the dipole and specify its direction. 3
34. State Huygen's principle and using it prove Snell's law of refraction of a plane wave propagating from a rarer to a denser medium. 3

### SECTION - D

35. (a) State Gauss law in electrostatics and use it to deduce an expression for the electric field due to a uniformly charged spherical conducting shell of radius 'R' at a point (i) outside and (ii) inside the shell. Also draw the graph between 'E' and 'r'.  
 (b) A conducting sphere of radius 10 cm has an unknown charge. If the electric field at 20 cm from the centre of the sphere is  $1.5 \times 10^3$  N/C and points radially inward, what is the net charge on the sphere? 5

### OR

- (a) Derive an expression for energy stored in the parallel plate capacitor C charged to a potential V. Hence derive an expression for energy density of the capacitor.  
 (b) A slab of material of dielectric constant K has the same area as the plates of a parallel-plate capacitor but has a thickness  $(3/4)d$ , where d is the separation of the plates. How is the capacitance changed when the slab is inserted between the plates?
36. (a) Draw a ray diagram to show the formation of real image of a point due to a convex spherical surface, when a ray of light travelling from rarer to denser medium. Using the diagram derive a relation between object distance u, image distance v, radius of curvature R of convex spherical surface.



- (b) Double-convex lens is to be manufactured from a glass of refractive index 1.55, with both faces of the same radius of curvature. What is the radius of curvature required if the focal length is to be 20 cm?

5

OR

- (a) Describe Young's double slit experiment to produce interference pattern due to a monochromatic source of light and deduce the expression for the fringe width.
- (b) In single slit diffraction pattern, how does the linear width of central maxima change when
- slit width is decreased?
  - distance between slit and screen is increased?
  - light of smaller wavelength is used?

Justify your answer in each case.

37. (a) A series LCR circuit is connected to an a.c. source having applied voltage. Obtain an expression for the impedance, instantaneous current and its phase relation with its applied voltage. Also find the expression for the resonance frequency.
- (b) What is the phase difference between the voltages across the inductor and the capacitor at resonance in the LCR circuit?

5

OR

- (a) Draw the diagram of a device which is used to decrease high ac voltage into a low ac voltage and state its working principle. Write four sources of energy loss in this device.
- (b) In an ideal transformer, the number of turns in the primary and secondary are 200 and 1000 respectively. If the power input to the primary coil is 10 kW at 200 V. Calculate (i) output voltage and (ii) current in the primary coil.