PRE BOARD EXAM, 2020-21

Physics (Code No. 042)

Class – XII

Max. Marks: 70
Max. Time: 3 Hrs.

General Instructions:

1. All questions are compulsory. There are 33 questions in all.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
3. Section A contains ten very short answer questions and four assertion reasoning MCQs of 1 mark each, Section B has two case based questions of 4 marks each, Section C contains nine short answer questions of 2 marks each, Section D contains five short answer questions of 3 marks each and Section E contains three long answer questions of 5 marks each.
4. There is no overall choice. However internal choice is provided. You have to attempt only one of the choices in such questions.

5. You may use the following values of physical constants wherever necessary.

$c = 3 \times 10^8 ms^{-1}$ $\qquad$ $h = 6.6 \times 10^{-34} Js$ $\qquad$ $e = 1.6 \times 10^{-19} C$

$\mu_o = 4\pi \times 10^{-7} T\, m\, A^{-1}$ $\qquad$ $1/4\pi\varepsilon_o = 9 \times 10^9 \, N\, m^2/C^2$ $\qquad$ $m_e = 9.1 \times 10^{-31} kg$

Section – A

All questions are compulsory.
In case of internal choices, attempt any one of them.

1. What is the S. I. unit of electric flux? [1]

2. If λx , λm , λv represents wavelength of X-Rays, microwaves & visible rays then arrange wave length in decreasing order. [1]

OR

Sketch schematic diagram depicting electric and magnetic fields for an electromagnetic wave propagating along x-direction.

3. A 100 turns coil shown in the figure carries a current of 2 A in a magnetic field of 0.2 Wb m^{-2}. Calculate the torque acting on the coil. [1]
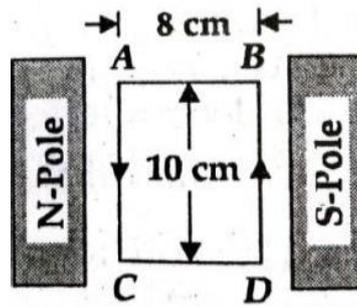

4. What will be the self-inductance if the number of turns per unit length of the coil of a solenoid is doubled keeping other dimensions same? [1]

OR

A wheel with ten metallic spokes each 0.50 *m* long is rotated with a speed of 120 *rev/min* in a plane normal to the earth's magnetic field at the place. If the magnitude of the field is 0.4 Gauss, Calculate the induced e.m.f. between the axle and the rim of the wheel.

5. The critical angle for total internal reflection from a medium to vacuum is 30^0. What is the velocity of light in the medium? [1]

6. The graph shows the variation of stopping potential with frequency of incident radiation for two photosensitive metals A and B. Which one of the two has higher value of work function? Justify your answer. [1]
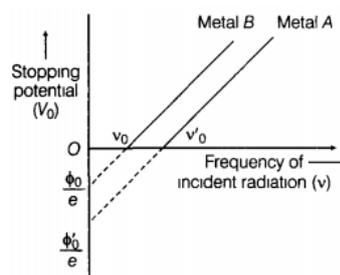
7. What is the ratio of nuclear radii if the mass numbers of two nuclei are 4 and 32? [1]
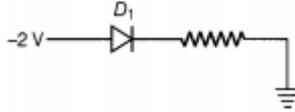
OR

A nucleus with A = 235 splits into two new nuclei whose mass number are in the ratio of 2 :1. Find the radii of the new nuclei.

8. Draw energy band diagram of n-type and p-type semiconductor at temperature T > 0 K. Mark the donor and acceptor energy level with their energies. [1]
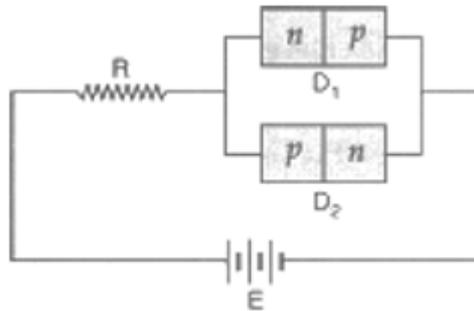
OR

a. Which type of biasing is there in the following diode?

b. Write the name the minority charge carriers in a p-type semi-conductor?

9.   In figure shows two p-n junctions diodes along-with a resistance R and a d.c. battery E.   [1]

Indicate the path and direction of flow of appreciable current in the circuit.

10.   What is a Light Emitting Diode (LED)? Mention one important advantage of LEDs over conventional lamps.   [1]

For question numbers 11, 12, 13 and 14, 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 and R is also false

11.   **Assertion (A):** Positive charge always moves from a higher potential point to a lower potential point.
      Reason (R): Electric potential is a vector quantity.   [1]

12.   **Assertion (A):** A current flows in a conductor only when there is an electric field within the conductor.
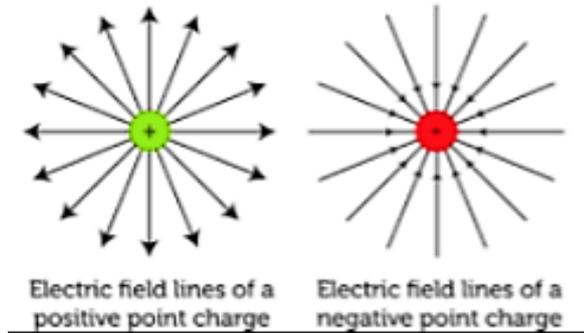   **Reason (R):** The drift velocity of electrons in the presence of electric field decreases.   [1]

13.   **Assertion (A):** In an electromagnetic wave, the magnitude of the magnetic field vector is much smaller than the magnitude of the electric field vector.
      Reason (R): The energy of electromagnetic waves is shared equally by the electric and magnetic fields.   [1]

14   **Assertion (A):** When a capacitor is charged by a battery, both the plates receive charge equal in magnitude, no matter the sizes of plates are identical or not.
      Reason (R): The charge distribution on the plates of a capacitor is in accordance with the charge conservation principle.   [1]

15.

A charge is a property associated with the matter due to which it experiences and produces an electric and magnetic field. Charges are scalar in nature and they add up like real numbers. Also, the total charge of an isolated system is always conserved. When the objects rub against each other charges acquired by them must be equal and opposite.


Electric field lines of a   Electric field lines of a
positive point charge   negative point charge

i.   The cause of charging is:
   a.   the actual transfer of protons
   b.   the actual transfer of electrons
   c.   the actual transfer of neutrons
   d.   none of the above

ii.   Pick the correct statement.

   a.   The glass rod gives protons to silk when they are rubbed against each other.
   b.   The glass rod gives electrons to silk when they are rubbed against each other.
   c.   The glass rod gains protons from silk when they are rubbed against each other.
   d.   The glass rod gains electrons when they are rubbed against each other.

iii.   If two electrons are each 1.5×10^{-10}m from a proton, as shown in Figure, magnitude of the net electric force they will exert on the proton is
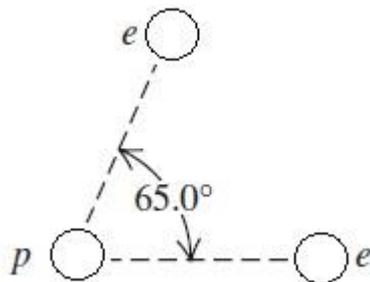
   a. 1.97×10^{-8}N
   b. 2.73×10^{-8}N
   c. 3.83×10^{-8}N
   d. 4.63×10^{-8}N
   e.

iv.   A charge is a property associated with the matter due to which it produces and experiences:

   a.   electric effects only
   b.   magnetic effects only
   c.   both electric and magnetic effects
   d.   none of these

v.   The cause of quantization of electric charges is:

   a.   transfer of an integral number of neutrons
   b.   transfer of an integral number of protons
   c.   transfer of an integral number of electrons
   d.   none of the above

16.   Electrons in an atom or a molecule absorb energy and get excited, they jump from a lower   4
energy level to a higher energy level, and they emit radiation when they come back to their
original states. This phenomenon accounts for the emission spectrum through hydrogen too,
better known as the hydrogen emission spectra.
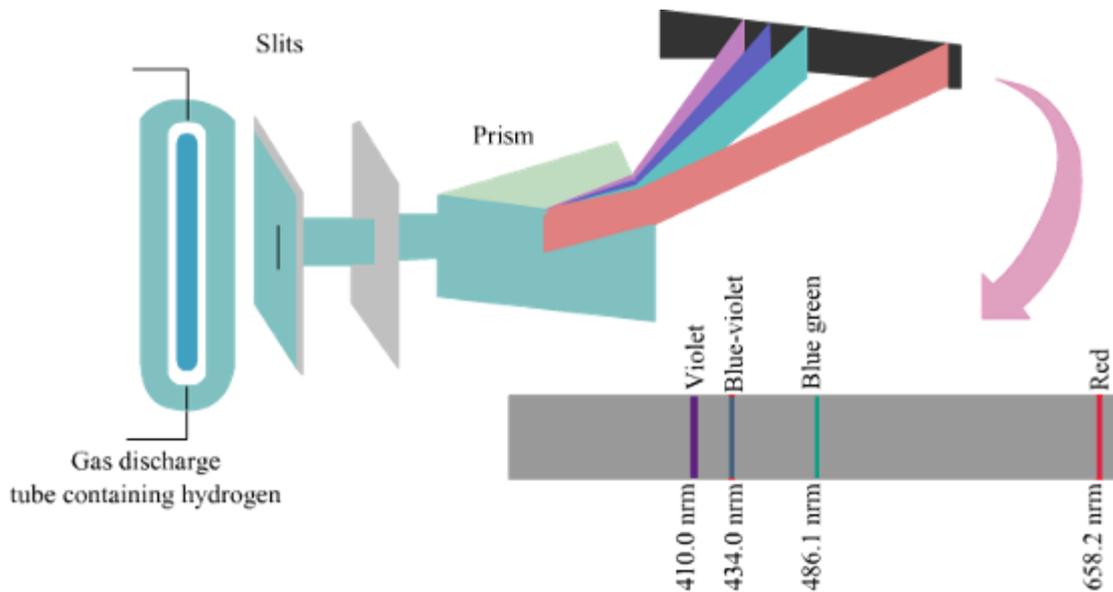
   i.   If 13.6 eV energy is required to ionize the hydrogen atom, then energy required to
remove an electron from n = 2 is:-
      a.   10.2 eV
      b.   0 eV
      c.   3.4 eV
      d.   6.8 eV
   ii.   In Bohr's model of an atom which of the following is an integral multiple of $h/2\pi$?

      a.   Kinetic energy
      b.   The radius of an atom
      c.   Angular momentum
      d.   None of these
   iii.   The ratio between Bohr radii is: -

      a.   1 : 2 : 3
      b.   2 : 4 : 6
      c.   1 : 4 : 9
      d.   none of these
   iv.   On moving up in the energy states of an H-like atom, the energy difference between
two consecutive energy states:-

      a.   increase
      b.   decrease
      c.   unchanged
      d.   none of these

v.   The Bohr model of atoms:

a.   Assumes that the angular momentum of electrons is quantized
b.   Uses Einstein's photoelectric equation
c.   Predicts continuous emission spectra for atoms
d.   None of these

Section – C
All questions are compulsory. In case of internal choices, attempt anyone.

17.   a. State the underlying principle of working of a moving coil galvanometer.   [2]

b. Write two reasons why a galvanometer cannot be used as such to measure current in a given circuit. Name any two factors on which the current sensitivity of a galvanometer depends.

18.   a. An equi convex lens of focal length f is cut into two identical plane convex lenses. How will the power of each part be related to the focal length of the original lens?   [2]

b. A double convex lens of +5D is made of glass of refractive index 1.55 with both faces of equal radii of curvature. Find the value of its radius of curvature.

OR

Find the radius of curvature of the convex surface of a plano-convex lens, whose focal length is 0.3 m and the refractive index of the material of the lens is 1.5.

19.   A point charge Q is fixed at point Z at a distance R from point Y on a circle of radius R as shown in the figure. Another point charge q is moved along the circle from point X to a diametrically opposite point Y. Point Z also lie on the extended diameter XY. How much work has to be done for the movement of the charge q?   [2]
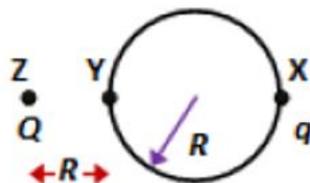
OR

Three charges -q, Q and -q are placed at equal distances on a straight line. If the electric potential energy of the system of charges is zero, what is the ratio of q and Q?

20. Why are photodiodes used preferably in reverse bias condition? A photodiode is fabricated from a semiconductor with band gap of 2.8 eV. Can it detect a wavelength of 6000 nm? Justify. [2]

21. A bar magnet M is dropped so that it falls vertically through the coil C as shown in the figure (a). The graph obtained for voltage produced across the coil vs time is shown in figure (b). (i) Explain the shape of the graph. (ii) Why is the negative peak longer than the positive peak? [2]

(a)   (b)
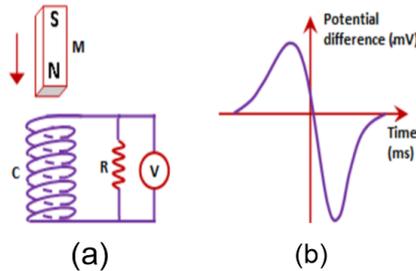
22. Identify the following electromagnetic radiations as per the wavelengths given below. Write one application of each. [2]
(a) 1 mm
(b) 10^{-8} m

23. State the principle of working of p-n diode as a rectifier. Explain, with help of a circuit diagram, the use of p-n diode as a full wave rectifier. [2]

24. Define the terms magnetic inclination and horizontal component of earth's magnetic field at a place. Establish the relationship between the two with help of a diagram. [2]

OR

Horizontal component of earth's magnetic field at a place is √3 times the vertical component. What is the value of inclination at that place?

25. What type of wave front will emerge from a distant light source? Use Huygens' principle to verify the laws of refraction. [2]

Section -D
All questions are compulsory. In case of internal choices, attempt any one.

26. a. State Biot Savart law. Give its mathematical formulation. [3]

b. Two small identical circular coils (radius = R) marked 1, 2 carry equal current and are placed with their geometric axes perpendicular to each other as shown in the figure. Derive an expression for the resultant magnetic field at point 0.
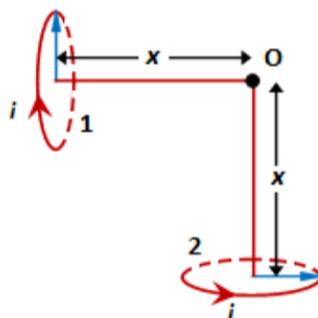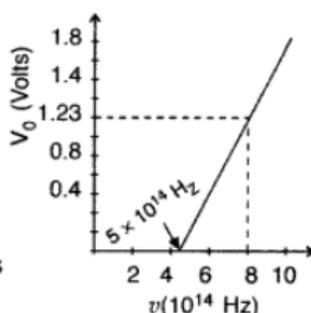
OR

a. State Ampere's circuital law. Give its mathematical formulation.

b. What is the net magnetic field at point P? Also determine the distance of the point from the conductor X at which the net magnetic field is zero.
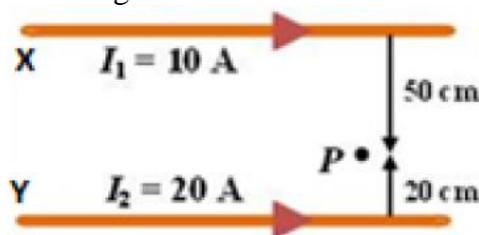

27. a. Using the graph shown in the figure for stopping potential v/s the incident frequency of photons, calculate Planck's constant. [3]

b. A proton and a deuteron are accelerated through the same accelerating potential. Which one of the two has
(i) greater value of de-Broglie wavelength associated with it, and
(ii) less momentum?

28. a. Write the mathematical relation between mobility and drift velocity of charge carriers in a conductor. Name the mobile charge carriers responsible for conduction of electric current in (i) an electrolyte (ii) an ionized gas. [3]

b. Using Kirchhoff's laws, determine the currents I_1, I_2 and I_3 in the circuit shown in figure.
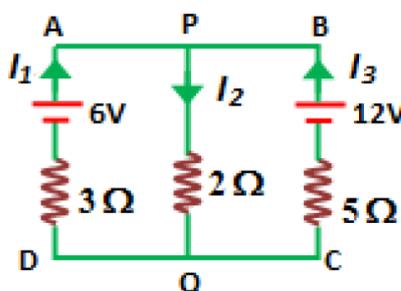
29. a. Out of blue and red light which is deviated more by a prism? Give reason. [3]
b. Derive the formula that can be used to determine refractive index of material of a prism in minimum deviation condition.

OR

a. Write the relationship between angle of incidence 'i', angle of prism 'A' and angle of minimum deviation for a triangular prism.

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.

30.   (i) Draw a labelled ray diagram showing the formation of a final image by a compound microscope at least distance of distinct vision.   [3]

(ii) The total magnification produced by a compound microscope is 20. The magnification produced by the eyepiece is 5. The microscope is focussed on a certain object. The distance between the objective and eyepiece is observed to be 14 cm. If least distance of distinct vision is 20 cm. Calculate the focal length of the objective and the eyepiece.

(iii) What is the length of a telescope in a normal adjustment?

Section – E
All questions are compulsory. In case of internal choices, attempt any one.

31.   a. State Gauss theorem in electrostatics. Using Gauss's law, derive expression for intensity of   [5]
electric field of infinitely long wire.

b.   Two infinitely long parallel wires having linear charge densities λ_1 and λ_2 respectively are placed at a distance of R. What is the force per unit length on either wire?

OR

a. What is the work done in rotating an electric dipole of dipole moment p from its position of stable equilibrium to its position of unstable equilibrium in a uniform electric field E?

b. Derive an expression for the torque experienced by an electric dipole in a uniform electric field. What is net force acting on this dipole?

c. An electric dipole of length 2cm is placed with its axis making an angle of 60^0 with respect to uniform electric field of 10^5 N/C. If it experiences a torque of $8\sqrt{3}$ Nm, calculate the magnitude of charge on the dipole, and its potential energy.

32.   a. What is quality factor Q? Express it in terms of L, C and R. What does it signify?   [5]

b. Why should the quality factor have high value in receiving circuits? Name the factors on which it depends.

c. A series LCR circuit is connected to an a.c. source of 220V, 50Hz. If the readings of voltmeters across resistor, capacitor and inductor are 65 V, 415 V and 204 V and R = 100Ω. Calculate (i) current in the circuit (ii) value of L, and (iii) capacitance required to produce resonance with the given inductor L.

OR

a. Derive an expression for the impedance of a series L-C-R circuit connected to an AC supply of variable frequency.

b. In the circuit shown in figure, neglecting source resistance, what are reading of the voltmeter and ammeter?
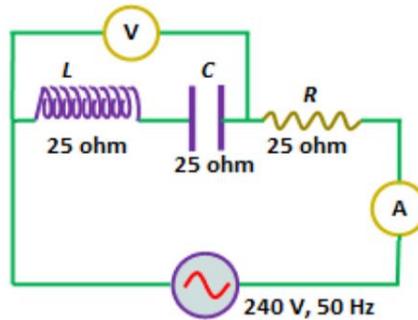
33.   a. What is the effect on the interference fringes to a Young's double slit experiment when   [5]

    (i)   the separation between the two slits is decreased?
    (ii)   the width of the source slit is increased?
    (iii)   the monochromatic source is replaced by a source of white light? Justify your answer in each case.

b. The intensity at the central maxima in Young's double slit experimental set up is I_0. Show that the intensity at a point is $I_0 / 4$ where the path difference is $\lambda /3$.

OR

a. Describe briefly how a diffraction pattern is obtained on a screen due to a single narrow slit illuminated by a monochromatic source of light. Hence, obtain the conditions for the angular width of secondary maxima and secondary minima.

b. Two wavelengths of sodium light of 590 nm and 596 nm are used in turn to study the diffraction taking place at a single slit of aperture $2 \times 10^{-6} m^2$. The distance between the slit and the screen is 1.5m. Calculate the separation between the positions of first maxima of the diffraction pattern obtained in the two cases.

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