PRE BOARD -1 EXAM, 2019-20
Physics (Code No. 042)
Class – XII

Max. Marks: 70
Date: 23 /1/2020 Max. Time: 3 Hrs.

General Instructions:

1. All questions are compulsory. There are 37 questions in all.

2. This question paper has four sections: Section A, Section B, Section C and Section D.

3. 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.

4. 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.

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

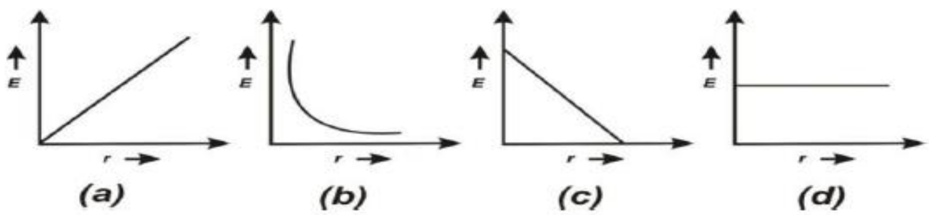
$c = 3 \times 10^{8} ms^{-1}$ $h = 6.6 \times 10^{-34} Js$ $e = 1.6 \times 10^{-19}$ C

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

SECTION-A

Question numbers 1 to 10 are multiple choice questions carry one mark each.

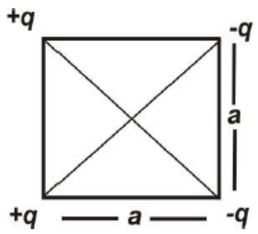
1. For a point charge, the graph between electric field versus distance is given by : - [1]



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

(a) $\frac{N}{C} \times m^2$ (b) $N \times m^2$ (c) $\frac{N}{m^2} \times C$ (d) $\frac{N^2}{m^2} \times C^2$

3. The potential at the centre of the square is- [1]



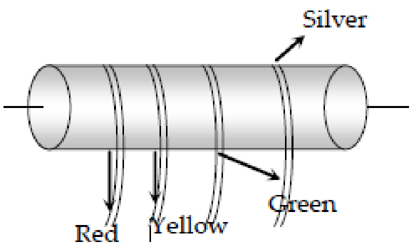
(a) Zero

(b) $\frac{kq}{a\sqrt{2}}$

(c) $\frac{kq}{a^2}$

(d) $\frac{kq}{2a^2}$

4. In the figure, a carbon resistor has bands of different colours on its body as mentioned in the figure. The value of the resistance is [1]



(a) $24\times10^6\Omega\pm5\%$

(b) $35\times10^6\Omega\pm10\%$

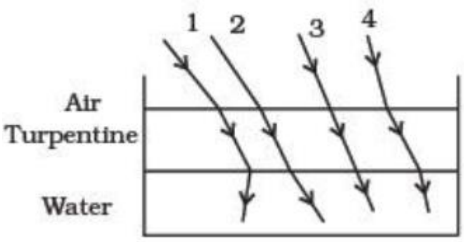
(c) $5.6\,k\,\Omega$

(d) $24\times10^6\Omega\pm10\%$

5. A wire in the form of a circular loop, of one turn carrying a current, produces magnetic induction B at the centre. If the same wire is looped into a coil of two turns and carries the same current, the new value of magnetic induction at the centre is [1]

(a) B (b) 2 B (c) 4 B (d) 8 B

6. The optical density of turpentine is higher than that of water while its mass density is lower shows a layer of turpentine floating over water in a container. For which one of the four rays incident on turpentine in the path shown is correct? [1]



(a) 1 (b) 2 (c) 3 (d) 4

7. Which of the following is correct for "Malus Law" [1]

(a) $I = I_0^2 \cos^2\theta$

(b) $I = I_0 \cos^2\theta$

(c) $I = I_0^2 \sin^2\theta$

(d) $I = I_0 \tan^{-1}\theta$

8. The value of refractive index of medium of polarising angle 60^0 is [1]

(a) $\sqrt{3}$ (b) $\frac{1}{\sqrt{3}}$

(c) $\sqrt{2}$ (d) $\frac{1}{\sqrt{2}}$

9. The slope of frequency of incident ray and stopping potential for a given surface will be [1]

(a) h (b) h/e

(c) eh (d) e

10. What is the angular momentum of an electron revolving in the 3^{rd} orbit of an atom? [1]

(a) $31.5\times10^{-34} J.sec$ (b) $.315\times10^{-34} J.sec$

(c) $3.15\times10^{-34} J.sec$ (d) $315\times10^{-34} J.sec$

SECTION-B

Question numbers 11 to 20 are very short answer questions carry one mark each.

11. Horizontal and vertical components of earth's magnetic field at a place are equal. The angle of dip at that place is ________ [1]

OR

A free-floating magnetic needle at north pole is ___________to the surface of earth.

12. Two coils have mutual inductance of 1.5 Henry. If the current in the primary Circuit is raised by 5A in one millisecond after closing the circuit, then the Induced emf in secondary coil is _____________ volt. [1]

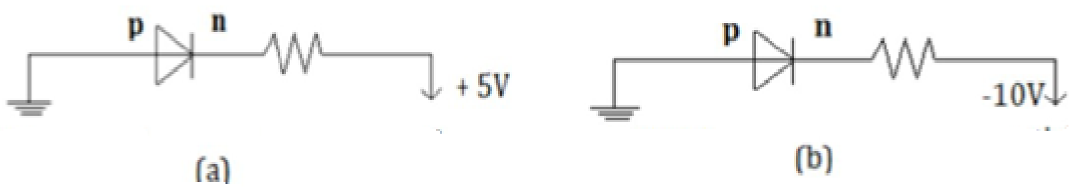
13. EM waves are produced by _________________________ charges. [1]

14. The de Broglie wavelength of a particle with mass 1kg and velocity 100m/s is _____________________. [1]

15. A convex lens of refractive index 1.5 is immersed in a medium of refractive index 1.65. The nature of the lens in the medium is ___________________. [1]

16. A radioactive isotope of silver has half-life of 20 minutes. What is the fraction of the original activity that remain after one hour? [1]

17. Identify the p-n junction biasing in following diagram. [1]



18. The radioactive isotope D decays according to the sequence [1]

$$D \xrightarrow{\beta-particle} D_1 \xrightarrow{\alpha-particle} D_2$$

If the mass number and atomic number of D_2 are 176 and 71 respectively, what is:
(a) The mass number
(b) Atomic number of D?

19. Work function of Sodium is 2.75eV. What will be KE of emitted electron when photon of energy 3.54eV is incident on the surface of sodium. [1]

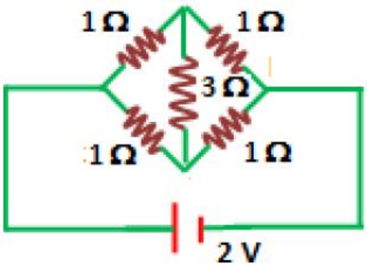
20. From the information of energy band gaps of diodes, how do you decide which can be light emitting diodes? [1]

OR

Give any two advantages of LEDs over conventional incandescent low power lamps

<u>Question numbers 21to 27 are short answer questions carry two marks each.</u>

21. Calculate the current drawn from the battery shown in the figure. Also, determine the current in each resistance. [2]

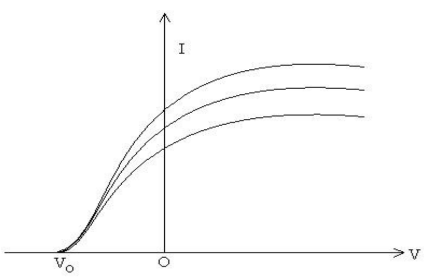


22. A conducting slab of thickness’ is introduced without touching between the plates of a parallel plate capacitor, separated by a distance‘d’ (t < d). Derive an expression for the capacitance of the capacitor. [2]

23. Deduce an expression for the frequency of revolution of a charged particle in a magnetic field and show that it is independent of velocity or energy of the particle. [2]

24. Two polaroid P_1 and P_2 are placed with their pass axes perpendicular to each other. Unpolarised light of intensity Io is incident on P_1. A third Polaroid P_3 is kept in between P_1 and P_2 such that its pass axis makes an angle of 60º with that of P_1. Determine the intensity of light transmitted through P_1, P_2 and P_3. [2]

25. a. In an experiment on photoelectric effect, the following graphs were obtained between the photoelectric current (I) and the anode potential (V). Name the characteristic of the incident radiation that was kept constant in this experiment. [2]

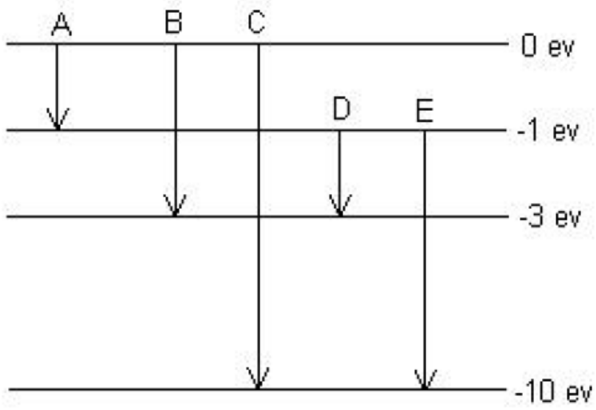


b) Obtain Einstein’s photoelectric equation. Explain how it enables us to understand the:

i) linear dependence of the maximum kinetic energy of the emitted electrons on the frequency of the incident radiation

ii) existence of threshold frequency for a given photo emitter.

26. The energy levels diagram of an atom is given below. Which one of the level transitions will result in the emission of photons of wavelength 620 nm? [2]



OR

A monochromatic radiation of wavelength 975 Å excites the hydrogen atom from its ground state to a higher state. How many different spectral lines are possible in the resulting spectrum? Which transition corresponds to the longest wavelength amongst them?

27. Draw energy band diagram of p & n type semiconductors. Also, write two differences between p and n type semiconductors. [2]

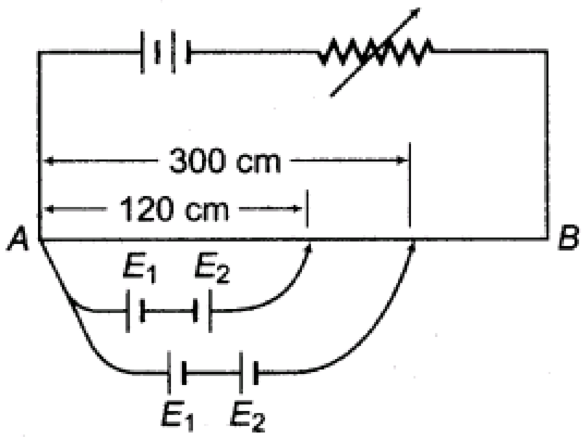
OR

Energy gap in a p – n photodiode is 2.8 eV. Can it detect a wavelength of 6000 nm? Justify your answer.

<u>Question numbers 28to 34 are long answer questions carry three marks each</u>

28. a. State the underlying principle of a potentiometer. [3]

b. In the figure, a long uniform potentiometer wire AB is having a constant potential gradient along its length. The null points for the two primary cells of emf E_1 and E_2 connected in the manner shown, are obtained at a distance of 120 cm and 300 cm from the end A. Find

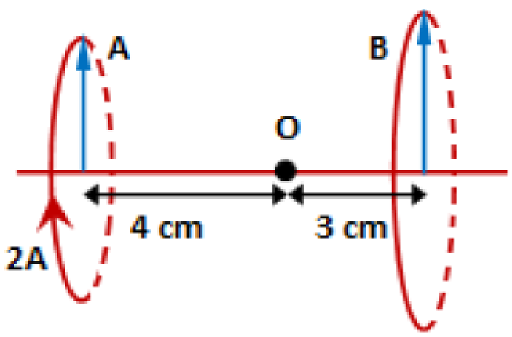


i) E_1 / E_2 and

ii) position of null point for the cell E_1

c. How is the sensitivity of a potentiometer increased?

29. Two circular co-axial current carrying loops A and B of radii 3 cm and 4 cm are placed as shown in the figure What should be the magnitude and direction of the current in the loop B so that the net magnetic field at the point O be zero? [3]



30. a. An inductor 200 mH, capacitor 500 µF, resistor 10 Ω are connected in series with a 100 V, variable frequency ac source. Calculate (i) the frequency at which the power factor of the circuit is unity (ii) current amplitude at this frequency (iii) Q-factor [3]
b. Explain why a capacitor blocks direct current?

31. a. Deduce the expression for the refractive index of glass prism in terms of the angle of minimum deviation and angle of prism. [3]

b. What change will occur to the minimum deviation of a prism if it is immersed in water?

32. Define resolving power of an astronomical refracting telescope and write expression for it in normal adjustment. Assume that light of wavelength 6000Å is coming from a star, what is the limit of resolution of a telescope whose objective has a diameter of 2.54m? [3]

OR

Define wave front. Using Huygen's geometrical construction of wave front, verify laws of refraction.

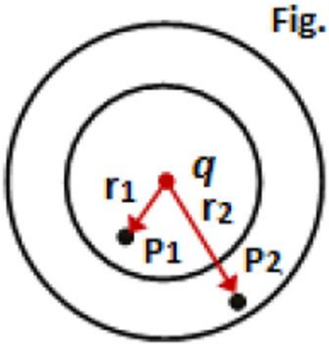
33. a. Draw a plot of potential energy of a pair of nucleons as a function of their separation. Write two important conclusions which you can draw regarding the nature of nuclear forces. [3]
b. From the relation $R = R_0A^{1/3}$, where R_0 is a constant and A is the mass number of a nucleus, show that the nuclear matter density is nearly constant (i.e. independent of A).

34. a. Draw the circuit diagram of a full wave rectifier. Explain its working principle. Plot the graph of the input and output waveform. [3]
b. Name the Biasing in:
(i) Zener diode
(ii)Photodiode

<u>Question numbers 35 to 37 are very long answer questions carry five marks each</u>

35. a. State Gauss theorem in electrostatics. Using Gauss's law, derive expression for intensity of electric field at any point near the infinitely long straight uniformly charged wire. [5]
b. A small sphere carrying charge +q is located at the centre of a spherical cavity located in large uncharged metal sphere as shown in the figure. Use Gauss' theorem to find electric field at points P_1 and P_2.

Fig. I



36. a. With the help of a labelled diagram, explain the principle and working of a moving coil galvanometer. [5]

b. A galvanometer has a resistance of 15 mΩ and the meter shows full-scale deflection for a current of 4mA. How will you convert the meter in to an ammeter of range 0 to 6A?

OR

a. A long solenoid with air core has n turns per unit length and carries a current I. Using Ampere's circuital law; derive an expression for the magnetic field B at an interior point on its axis. Write an expression for magnetic intensity **H** in the interior of the solenoid.

b. A (small) bar of material, having magnetic susceptibility χ, is now put along the axis and near the centre, of the solenoid, which is carrying a d.c. current through its coils. After some time, the bar is taken out and suspended freely with an unspun thread. Will the bar orient itself in magnetic meridian if (i) $\chi < 0$ (ii) $\chi > 1000$? Justify your answer in each case.

37. a. Write the basic assumptions used in the derivation of lens – maker's formula and hence derive this expression. [5]

b. A concave lens has the same radius of curvature for both sides and has a refractive index 1.5 in air. In the second case, it is immersed in a liquid of refractive index 1. 4. Calculate the ratio of the focal length of the lens in the two cases.

OR

a. There are two sets of apparatus of Young's double slit experiment. In set A, the phase difference between the two waves emanating from the slits does not change with time, whereas in set B, the phase difference between the two waves from the slits changes rapidly with time. Deduce the expression for the resultant intensity in both the above-mentioned set ups (A and B), assuming that the waves emanating from the two slits have the same amplitude A and same wavelength λ.

b. Light of wavelength 600 nm is incident normally on a single slit of width 0.5 mm. Calculate the separation between two dark bands on the sides of the central maximum. The diffraction pattern observed on a screen placed at 2m from the slit.

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