CBSE Board
Class XII Physics
Sample Paper - 5

Time: Three Hours **Maximum Marks: 70**

General Instructions

(a) All questions are compulsory.

(b) There are 29 questions in total. Questions 1 to 8 carry one mark each, questions 9 to 16 carry two marks each, questions 17 to 25 carry three marks each and questions 27 to 29 carry five marks each.

(c) Question 26 is a value based question carrying four marks.

(d) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions of five marks each. You have to attempt only one of the given choices in such questions.

(e) Use of calculator is not permitted.

(f) You may use the following physical constants wherever necessary.

$e = 1.6\times10^{-19}$ C
$c = 3\times10^{8}$ m s^{-1}
$h = 6.6\times10^{-34}$ J s
$\mu_o = 4\pi\times10^{-7}$ T ma^{-1}
$K_B = 1.38\times10^{23}$ J K^{-1}
$N_A = 6.023\times10^{23}$ /mole
$m_n = 1.6\times10^{-27}$ kg

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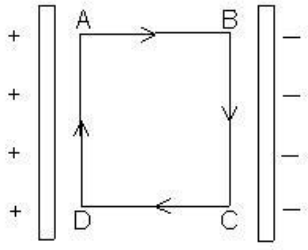
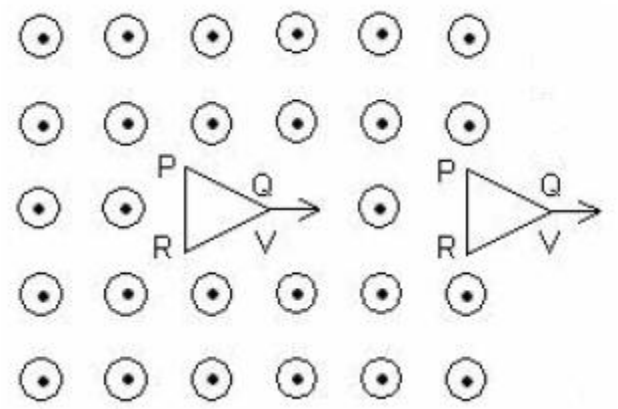
1. A uniform electric field $\vec{E}$ exists between two charged plates as shown in the figure. What would be the work done in moving a charge q along the closed rectangular path ABCDA? (1)



2. How does the (i) pole strength and (ii) magnetic moment of each part of a bar magnet change if it is cut into two equal pieces transverse to its length? (1)

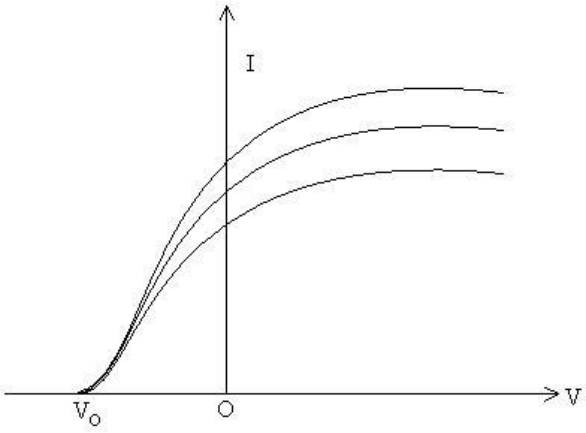
3. Figure given below shows two positions of a loop PQR in a perpendicular uniform magnetic field. In which position of the coil is there an induced emf? (1)



4. Why are microwaves used in RADAR? (1)

5. The image of a candle is formed by a convex lens on a screen. The lower half of the lens is painted black to make it completely opaque. Draw the ray diagram to show the image formation. How will this image be different from the one obtained when the lens is not painted black? (1)

6. 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. (1)

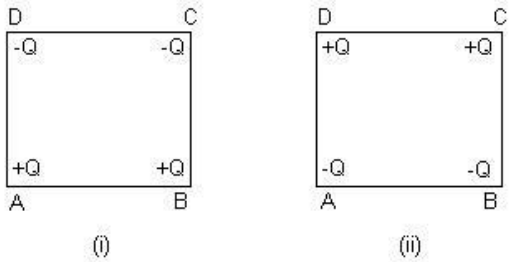


7. Name two factors on which electrical conductivity of a pure semiconductor at a given temperature depends. (1)

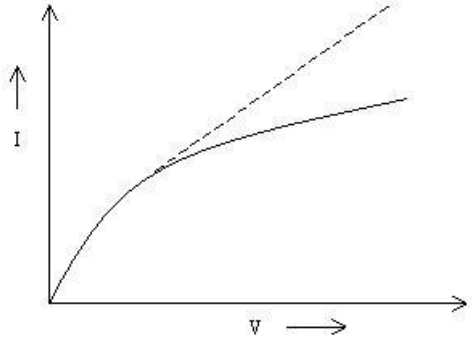
8. Give the conditions for inputs A and B for the following Boolean expressions.

(i) $\overline{A+B}=1$ (ii) $\overline{A}+\overline{B}=0$ (1)

9. Four point charges are placed at four corners of a square in the two ways (i) and (ii) shown below. Will the (a) Electric field (b) Electric potential, at the center of the square be the same or different in the two configurations and why? (2)



10. The I – V characteristics of a resistor are observed to deviate from the straight line for higher values of current as shown below. Why is this so? (2)

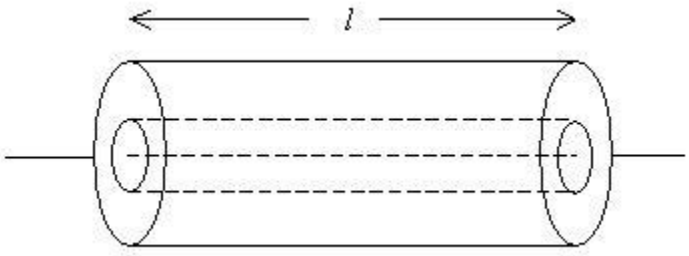


11. A charged particle moving with uniform velocity $\vec{v}$ enters a region where uniform electric and magnetic fields $\vec{E}$ and $\vec{B}$ are present. It passes through the region without any change in its velocity. What can we conclude about the

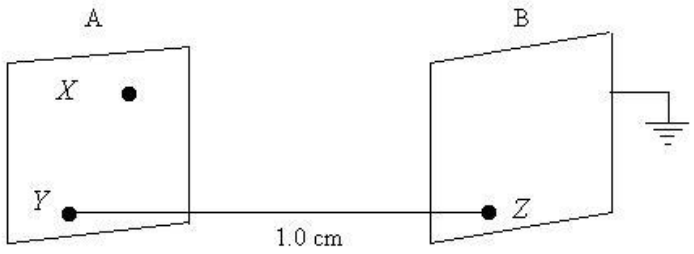
(i) Relative directions of $\vec{v}$, $\vec{E}$ and $\vec{B}$

(ii) Magnitude of $\vec{E}$ and $\vec{B}$ (2)

12. Figure shows two long coaxial solenoids, each of length L. The outer solenoid has an area of cross - section A_1 and number of turns n_1. The corresponding values for the inner solenoid are A_2 and n_2. Write the expression for self-inductance L_1, L_2 of the two coils and their mutual inductance M. Hence, show that $M < \sqrt{L_1 L_2}$. (2)



13. Two identical metallic surfaces A and B are kept parallel to each other in air, separated by a distance of 1.0 cm as shown in figure.

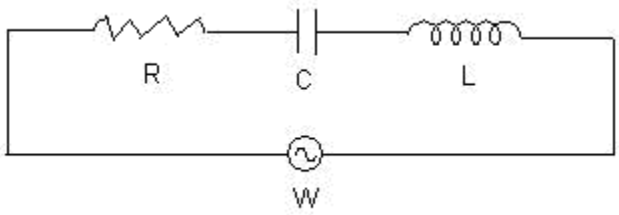


Surface A is given a positive potential of 10V and the other surface B is earthed.

(i) What is the magnitude and direction of the uniform electric field between points y and z?

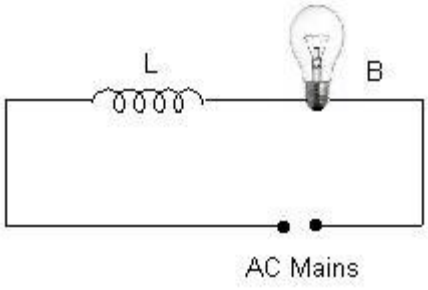
(ii) What is the work done in moving a charge of 20 μC from point x to point y? (2)

14. In the circuit shown below R represents a resistance. If the frequency ν of the supply is doubled, how should the value of C and L be changed so that the glow in the bulb remains unchanged?



OR

A coil L with air as core and a bulb B are connected in series to AC mains as shown in the given figure:



The bulb glows with some brightness. How would the glow of the bulb change if an iron rod were inserted in the coil? Give reason in support of your answer. (2)

15. Experimental observations have shown that X – rays

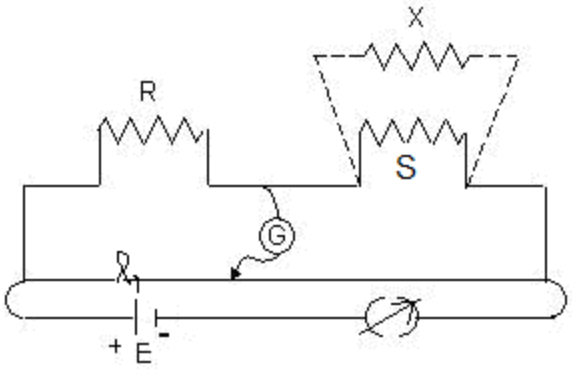
(i) travel in vacuum with a speed of $3\times10^{8} m/s$.

(j) exhibit the phenomenon of diffraction and can be polarized.

What conclusions can be drawn about the nature of X - rays from each of these observations? (2)

16. Write the relation between the angle of incidence (i), the angle of emergence) (e), the angle of prism (A) and the angle of deviation (δ) for rays undergoing refraction through a prism. What is the relation between refractive index of material of a prism in terms of A and δ. (2)

17. When two known resistances, R and S , are connected in the left and right gaps of a meter bridge, the balance point is found at a distance ' l ' from the zero end of the meter bridge wire. A unknown resistance X is now connected in parallel to the resistance s and the balance point is now found at a distance l_2 from the zero end of the meter bridge wire. Obtain a formula of X in terms of l_1, l_2 and S. (3)



18.

(a) Draw a labeled ray diagram to show the formation of an image by a compound microscope. Write expression for its magnifying power.

(b) How does the resolving power of a compound microscope change, when (i) refractive index of the medium between the object and the objective lens is increased and (ii) wavelength of the radiation used is increased? (3)

OR

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. (3)

19. Why is diffraction of sound waves more easily observed than diffraction of light waves? 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 is observed on a screen placed at 2m from the slit. (3)

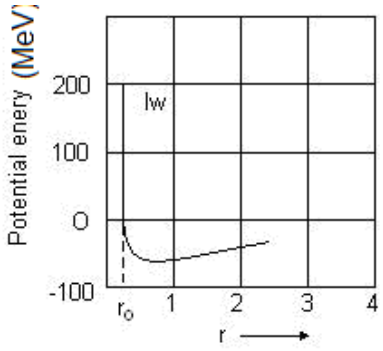
20. Obtain Einstein's photoelectric equation. Explain how it enables us to understand the:

(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 (3)

21.

(a) The potential energy (V), for a pair of nucleus varies with the separation (r) between them in the manner shown below.



Use this graph to explain why the force between the nucleon must be regarded as

(i) Strongly repulsive for separation values less than r_o

(ii) Attractive nuclear force $(r > r_o)$

(b) Write the two characteristic features of nuclear force. (3)

22. Define the term half life period and decay constant of a radioactive substance. Write their SI units and establish the relationship between the two. (3)

23. State the principle of working of p - n diode as a rectifier. Explain with the help of a circuit diagram the use of p - n diode as a full wave rectifier. Draw a sketch of the input output waveforms. (3)

24. In a AM demodulator, the output circuit consists of $R = 1k\Omega$ and $C = 10pF$. A carrier signal of 100 kHz is to be demodulated. Is the given set up good for this purpose? If not, suggest a value of C that would make the diode circuit good for demodulating this carrier signal. (3)

25. What is a Wheatstone bridge? Derive the balance condition of a Wheatstone bridge. (3)

26. A little boy while crossing the footpath saw an overhead street light transmitting current in the day time. Thinking it to be wastage of current and power loss, he switched off the switch of the street light over when it was at some height on the pole and it was not easy for him to switch off.

(a) What words would you frame for the little boy and his thinking?

(b) A small town with a demand of 800 kW and 200 V of electric power is situated 15 km away from the electric plant generating power of 400 kW. A wire (electric power line of 0.5 Ω per km) connects the town with the plant. The town receives the power from the line through a 4000 – 200 V step down transformer of a sub-station located in the town.

(c) Estimate the power loss in the form of heat. (4)

27. An electric dipole is held in a uniform electric field.

(i) Show the no translatory force acts on it.

(ii) Derive an expression for the torque acting on it.

(iii) The dipole is aligned parallel to the field. Calculate the work done in rotating it through 180^{o} (5)

OR

(a) Two extremely small charged copper spheres have their centers separated by a distance of 50 cm in vacuum. What is the mutual force of electrostatics repulsion if the charge on each is $6.5\times10^{-7}C$?

(b) What will be the force of repulsion if:

(i) The charge on each sphere is doubled and their separation is halved?

(ii) The two spheres are placed in water. (5)

28.

(a) With the help of a labeled diagram, explain the principle and working of a moving coil galvanometer.

(b) Two parallel coaxial circular coils of equal radius *R* and equal number of turns *N* carry equal currents I in the same direction and are separated by a distance 2R. Find the magnitude and direction of the net magnetic field produced at the mid-point of the line joining their centers. (5)

OR

How are materials classified according to their behaviour in a magnetic field? How will you judge as to which of the two given similar magnets is stronger without using a third magnet? (5)

29. Using the data given below, state which of the given lenses you will use as an eyepiece and as an objective to construct an astronomical telescope.

Lenses	Power (P)	Aperture (A)
L_1	3 D	8 cm
L_2	6 D	1 cm
L_3	10 D	1 cm

Draw a ray diagram to show the formation of the image of a distant object in the normal adjustment position for the astronomical telescope so formed. Write the expression for its (i) magnifying power and (ii) length of the telescope. (5)

OR

Draw a ray diagram to show the formation of the image of a small object due to compound microscope. Derive an expression for its magnifying power.

You are given two convex lenses of short aperture having lengths 4 cm and 8 cm respectively. Which one of these will you use as an objective and which one as an eyepiece for constructing a compound microscope? (5)