CBSE
Class XII Physics
Sample Paper - 5

Time: 3 Hours **Maximum Marks: 70**

General Instructions:

1. All questions are compulsory. There are 27 questions in all.
2. This question paper has four sections: Section A, Section B, Section C and Section D.
3. Section A contains five questions of one mark each, Section B contains seven questions of two marks each, Section C contains twelve questions of three marks each, and Section D contains three questions of five marks each.
4. There is no overall choice. However, internal choice has been provided in two questions of one mark, two questions of two marks, four questions 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 :

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

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

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

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

$\varepsilon_0 = 8.854 \times 10^{-12}\ C^2\ N^{-1}\ m^{-2}$

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^{9}\ N\ m^2\ C^{-2}$

$m_e = 9.1 \times 10^{-31}\ kg$

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

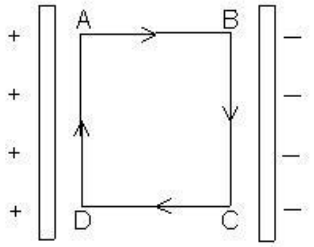
mass of proton $= 1.673 \times 10^{-27}\ kg$

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

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

Section A

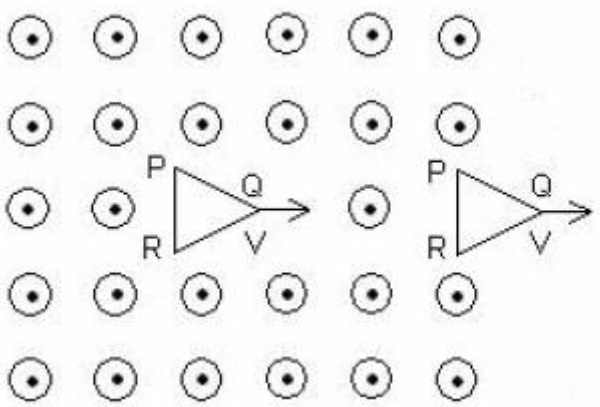
1. A uniform electric field E exists between two charged plates as shown in the figure. What would be the work done in moving a charge q along the closed rectangular path ABCDA? (1)



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)

OR

The 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)



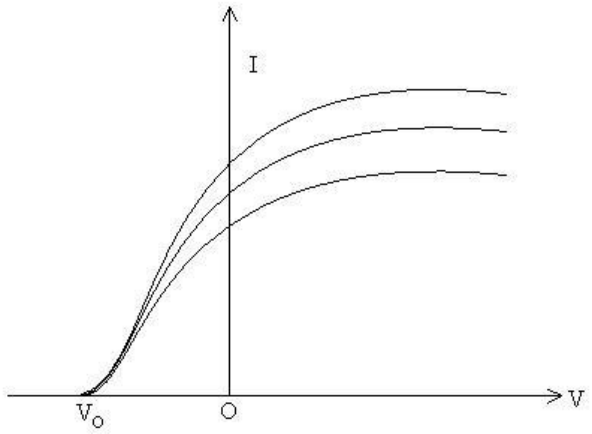
3. Why are microwaves used in RADAR? (1)

OR

Arrange these in the decreasing order of frequency: microwaves, infra red waves, x-rays, visible rays (1)

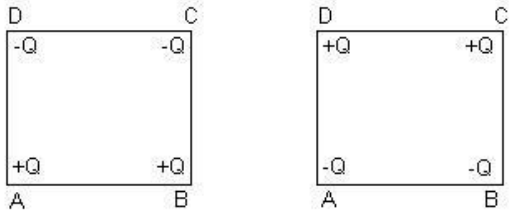
4. The image of a candle is formed by a convex lens on a screen. The lower half of the lens is painted black to make it completely opaque. Draw the ray diagram to show the image formation. How will this image be different from the one obtained when the lens is not painted black? (1)

5. In an experiment on the photoelectric effect, the following graphs were obtained between the photoelectric current (I) and the anode potential (V). Name the characteristic of the incident radiation which was kept constant in this experiment. (1)



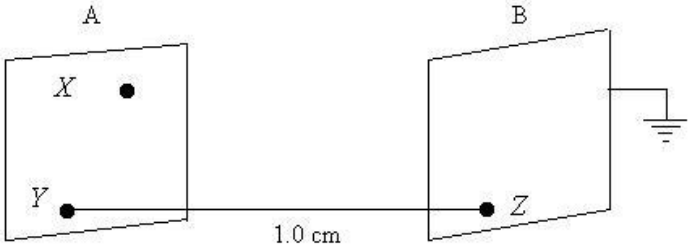
Section B

6. 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 and (b) electric potential at the centre of the square be the same or different in the two configurations and why? (2)



OR

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 the figure.

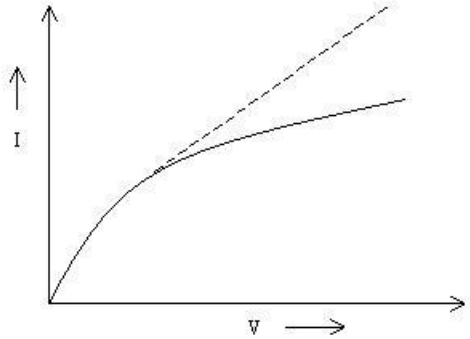


Surface A is given a positive potential of 10 V and the other surface B is earthed.

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

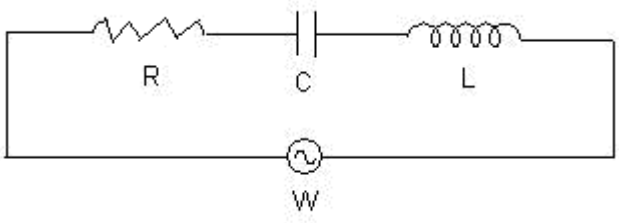
(ii) What is the work done in moving a charge of 20 μC from point x to point y? (2)

7. 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)



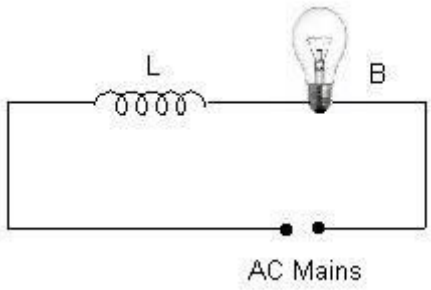
8.

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 the core and a bulb B are connected in series to the 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 was inserted in the coil? Give reason in support of your answer. (2)

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

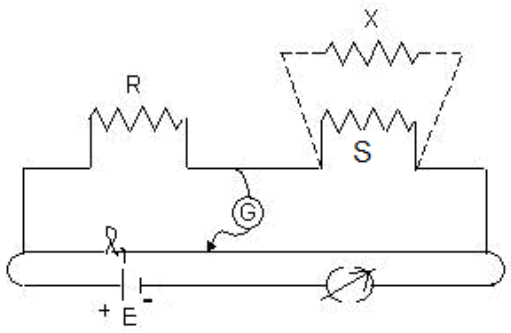
10. Why is a semiconductor damaged by a strong current? (2)

11. A message signal of frequency 10 kHz is used to modulate a carrier of frequency 1 MHz. Find the side bands produced. (2)

12. 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 the material of a prism in terms of A and δ. (2)

Section C

13. 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. An unknown resistance X is connected in parallel to the resistances, 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.



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

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

15. 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 2 m from the slit. (3)

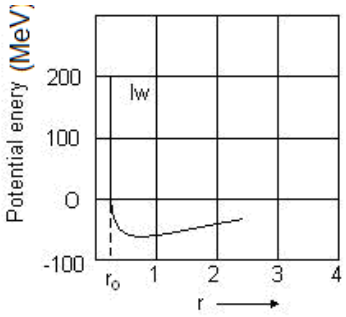
16. Obtain Einstein's photoelectric equation. Explain how it enables us to understand the

(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)

17. What is mutual induction? What is the SI unit of coefficient of mutual induction? On which two factors do mutual inductance of two coils depend?

18. (a) The potential energy (V) for a pair of nucleons 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 $\left(r > r_o\right)$

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

OR

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)

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

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

21. Two large metal plates each of area 1 m^2 are placed facing each other at a distance of 5 cm and carry equal and opposite charges on their faces. If the electric field between the plates is 1000 NC^{-1}, then find the charge on each plate.
(3)

OR

Define electron volt. Express it in joule. (3)

22. A magnet 2 cm long has pole strength of 60 Am. Find the magnitude of magnetic field B at a point on its axis at a distance of 20 cm from it. What would be the value of B if the point was to lie at the same distance on the equatorial line of the magnet?
(3)

23. What emf will be induced in a 10 H inductor in which current changes from 10 A to 7 A in 9×10^{-2} s?

24. Give any six characteristics of alpha rays.

Section D

25. An electric dipole is held in a uniform electric field.
(i) Show that 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 centres separated by a distance of 50 cm in vacuum. What is the mutual force of electrostatic repulsion if the charge on each is $6.5 \times 10^{-7} C$?

(b) What will be the force of repulsion if the
(i) charge on each sphere is doubled and their separation is halved
(ii) two spheres are placed in water (5)

26.

(a) With the help of a labelled 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 midpoint of the line joining their centres. (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)

27. Using the data below, state which of the given lenses you will use as an eye-piece 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 a compound microscope. Derive an expression for its magnifying power.
You are given two convex lenses of a 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 eye-piece for constructing a compound microscope? (5)