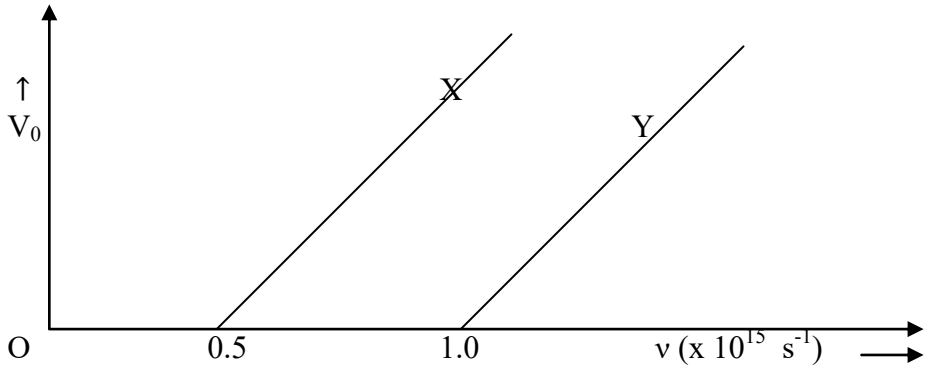
Sample Paper – 2009
Class – XII
Subject – Physics

General Instructions:

(a) All questions are compulsory
(b) There are 30 questions in total. Qns. 1 to 8 carry 1 mark each. Qns. 9 to 18 carry 2 marks each, Qns. 19 to 27 carry 3 mark each and Qns. 28 to 30 carry 5 marks each.
(c) There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and all three questions of 5 marks each. You have to attempt only one of the given choices in such questions.
(d) Use of calculators is not permitted.
(e) You may use the following physical constants wherever necessary.

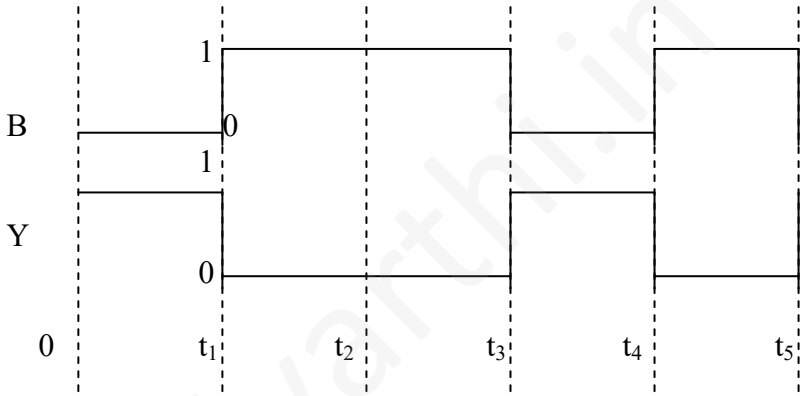
$c = 3 \times 10^{8}$ ms^{-1}
$h = 6.6 \times 10^{-34}$ Js
$e = 1.6 \times 10^{-19}$C
$\mu_o = 4\pi \times 10^{-7}$ TmA^{-1}
$1/4\pi\varepsilon_o = 9 \times 10^{9}$ N m^{2}C^{-2}
Avogadro number $N_A = 6.023 \times 10^{23}$ mol^{-1}
Mass of the neutron $= 1.675 \times 10^{-27}$ kg
Boltzmann constant, $k = 1.38 \times 10^{23}$ J K^{-1}

1 Two point charges q_1 and q_2 are placed close to each other in air. What is the nature of the force between them when (i) $q_1 q_2 > 0$ and (ii) $q_1 q_2 < 0$
2 An electron and a proton moving parallel to each other in the same direction with equal momenta, enter into a uniform magnetic field which is at right angles to their velocities. Trace their trajectories in the magnetic field.
3 In a series L C R circuit the voltage across an inductor, capacitor and the resistor are 30 V, 30 V and 60 V respectively. What is the phase difference between the applied voltage and current in the circuit?
4 What physical quantity is the same for X – rays of wavelength 10^{-10} m, red light of wavelength 6800Å and radio waves of wavelength 500 m?
5 The refractive index of a medium is $\sqrt{3}$. What is the angle of refraction, if the unpolarised light is incident on it at the polarizing of the medium?
6 The following graph shows the variation of stopping potential V_o with the frequency ν of the incident radiation for two photosensitive metals X and Y.



Which of the metals has larger threshold wavelength? Give reason.

7. How is the band gap, Eg, of a photo diode related to the maximum wavelength, λ_m , that can be detected by it?
8. An unknown input (A) and the input (B) shown below, are used as the two inputs in a NAND gate. The output Y, has the form shown below. Identify the intervals over which the input 'A' must be 'low'.



9 Two point electric charges of values q and 2q are kept at a distance 'd' apart from each other in air. A third charge Q is kept along the same line such a way that the net force acting on q and 2q is zero. Calculate the position of the charge 'Q' in terms of 'q' and 'd'.

OR

Two point charges 4μC and – 2 μC are separated by a distance of 1 m in air. At what point on the line joining the charges is the electric potential zero?

10 Two cells of e m f E_1 and E_2 are connected together in two ways as shown.

The balance points in a given potentiometer experiment for these two combinations of cells are found to be at 351 cm and 70.2 cm respectively. Calculate the ratio of the e m fs of the two cells.

11 A set of 'n' identical resistors, each of resistance R Ω, when connected in series have an effective resistance X Ω, and when the resistors are connected in parallel their effective resistance is Y Ω. Find the relation between R, X and Y.

12 A stream of electrons travelling with a speed 'v' m s^{-1} at right angles to a uniform magnetic field B is deflected in a circular path of radius 'r'. Prove that (e/m) = (v/rB)

13 A rectangular coil of 'N' turns and area of cross section 'A' is held in a time – varying magnetic field given by $B = B_o$ Sin ωt, with the plane of the coil normal to the magnetic field. Deduce an expression for the e m f induced in the coil.

14 An electric lamp, which runs at 80 V d c and consumes 10 A is connected to a 100 V, 50 Hz a c mains. Calculate the inductance of the choke required.

15 Which constituent radiation of the electromagnetic spectrum is used:
(i) in radar
(ii) to photograph internal parts of human body
(iii) for taking photographs of the sky during the night and foggy conditions
(iv) emitted during a nuclear decay.

16 Two nearby narrow slits are illuminated by a single monochromatic source. Name the pattern obtained on the screen. One of the slits is now completely covered. What is the name of the pattern now obtained on the screen. Write any one difference between the patterns obtained in the two cases.

17 What do the terms 'depletion region' and 'barrier potential' mean for a p-n junction?

18 Show that the range of transmission `d' of a T.V. tower of height `h' is given by the relation $d = \sqrt{(2Rh)}$, where `R' is the radius of the Earth.

19 Define the term resistivity and write its S I unit. Derive the expression for resistivity of a conductor in terms of number density of electrons and relaxation time.

20 An a c voltage $E = E_o \text{ Sin } \omega t$ is applied across a pure capacitor of capacitance C. Show mathematically that the current flowing through it leads the applied voltage by a phase angle of $\pi/2$.

OR

Show that the average value of the alternating voltage $E = E_o \text{ Sin } \omega t$, over the first half cycle is $2I_O/\pi$

21 You are given three lenses having powers P and aperture A as follows;

$P_1 = 6$ D	$A_1 = 3$ cm
$P_2 = 3$D	$A_2 = 15$ cm
$P_3 = 12$ D	$A_3 = 1.5$ cm

Which two of these will you select to construct (i) telescope (ii) microscope? State the basis for your answer in each case.

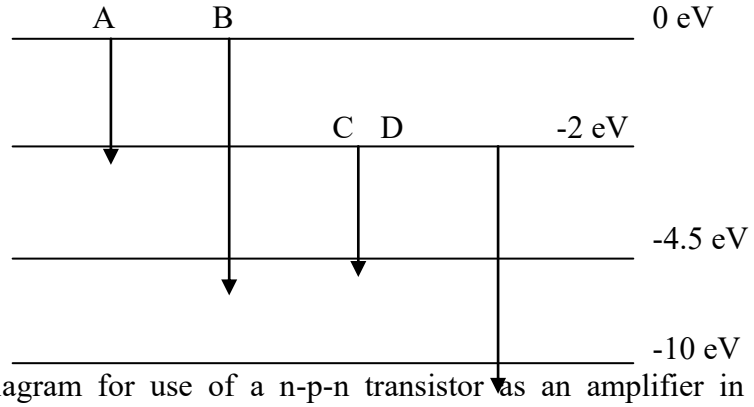
22 What is the effect on the interference fringes in a Young's double-slit experiment due to each of the following operations:
(a) the screen is moved away from the plane of the slits;
(b) the (monochromatic) source is replaced by another (monochromatic) source of shorter wavelength;
(c) the separation between the two slits is increased.
Give reason for all.

23 Draw the graph showing the variation of binding energy per nucleon with mass number of different atomic nuclei.
Calculate binding energy/nucleon of $_{26}Fe^{56}$ nucleus.
[Given: Mass of $_{26}Fe^{56} = 55.934939$ u, mass of proton = 1.007825 u, mass of neutron = 1.008665 u, 1 u = 931 MeV/c^2]

24 Define the term modulation. Name three different types of modulation used for a message signal using a sinusoidal continuous carrier wave. Explain the meaning of any one of these

25 Red light, however bright it is, can not produce the emission of electrons from a clean zinc surface. But even weak ultra violet radiation can do so. Why?
X – rays of wavelength `λ' fall on a photosensitive surface, emitting electrons. Assuming that the work function of the surface is negligible, prove that the de – Broglie wavelength of electrons emitted will be $[h\lambda/2mc]^{1/2}$

26 The energy levels of an atom are shown below. Which of the transitions will result in the emission of a photon of wavelength 275 nm?



27 Draw a circuit diagram for use of a n-p-n transistor as an amplifier in common emitter configuration.
The input resistance of a transistor is 1000 Ω . On changing its base current by 10μA the collector current increases by 2mA. If a load resistance of 5kΩ is used in the circuit, calculate; (i) current gain and (ii) voltage gain of the amplifier. I

28 Derive an expression for the capacity of a parallel plate capacitor with a dielectric slab of thickness, less than the plate separation, placed between the plates.
A parallel plate capacitor is to be designed with a voltage rating of 1 kV using a material of dielectric constant 3 and dielectric strength about 10^7 Vm^{-1}. For safety we would like the field never to exceed say 10 % of dipole strength. What minimum area of the plates is required to have a capacitance of 50 pF?

OR

What is an electric dipole? Deduce an expression for the torque acting on an electric dipole placed in a uniform magnetic field. Hence define dipole moment.An electric dipole of length 2 cm is placed with its axis making an angle of 60^o to a uniform electric field of 10^5 NC^{-1}. If it experiences a torque of $8\sqrt{3}$ Nm, calculate the; (i) magnitude of charge on the dipole. (ii) potential energy of the dipole.

29 Explain the principle and working of a cyclotron, with the help of a labelled diagram.
A cyclotron's oscillator frequency is 10 MHz. What should be the operating magnetic field for accelerating protons? If the radius of its dees is 60 cm, what is the kinetic energy of the proton beam produced by the accelerator? Express your answer in MeV. (Charge of proton = 1.6 x 10^{-19} C, mass of proton = 1.67x10^{-27} kg, 1 MeV = 1.6 x 10^{-13} J)

OR

With the help of a neat labelled diagram, explain the principle and construction of a moving coil galvanometer. Define the terms current sensitivity and voltage sensitivity of a galvanometer.
In a galvanometer there is a deflection of 10 div per mA. The coil resistance of the galvanometer is 78 Ω. If a shunt of 2Ω is connected to the galvanometer and there are 75 divisions in all on the scale of the galvanometer, calculate the maximum current which the galvanometer can read.

30 Draw a ray diagram to show the formation of the image of a point object placed in a medium of refractive index n_1 on the principal axis of a convex spherical surface of radius of curvature R and refractive index n_2. Using the diagram derive the relation; n_2 n_1 n_2 - n_1

$$\frac{}{v} - \frac{}{u} = \frac{}{R}$$

A converging lens of focal length 50 cm is placed co axially in contact with another lens of unknown focal length. If the combination behaves like a diverging lens of focal length 50 cm, find the power and nature of the second lens.

OR

Derive the lens maker's formula in case of a double convex lens. State the assumptions made and conventions of signs used.

A converging lens has a focal length of 20 cm in air. It is made of a material of refractive index 1.6. If it is immersed in a liquid of refractive index 1.3, what will be its new focal length?

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