FIRST PREBOARD EXAMINATION (2017-18)
CLASS: XII

Subject: PHYSICS **Date: 07.12.2017**
Time allowed: 3Hours Maximum Marks: 70

General Instructions:
1. **All** questions are **compulsory**.
2. Marks are indicated against each question.
3. This question paper contains 7 printed pages.
4. There are 26 questions in total.
5. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
6. Section A contains five questions of one mark each, Section B contains five questions of two marks each, Section C contains twelve questions of three marks each, Section D contains one value based question of four marks and Section E contains three questions of five marks each.
7. 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 the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
8. You may use the following values of physical constants wherever necessary:

$\mu_\circ = 4\pi x 10^{-7}$ TmA^{-1}
$1/4\pi\varepsilon_\circ = 9x10^{9}Nm^{2}C^{-2}$
$c=3x10^{8}$ m/s
$e=1.6x10^{-19}C$
$\varepsilon_\circ = 8.854x10^{-12}$ $C^{2}N^{-1}m^{-2}$
$m_e = 9.1x10^{-31}$ kg
$h = 6.63$ X 10^{-34} Js
$R = 1.03x10^{7}m^{-1}$

SECTION –A

1. Two point charges 'q_1' and 'q_2' are placed at a distance'd' apart as shown in the figure. The electric field intensity is zero at a point 'P' on the line joining them as shown. Conclude about the polarity and the magnitude of

charges q_1 and q_2

1

2. The horizontal component of earth's magnetic field at a place is B and angle of dip is 60°.What is the value of vertical component of earth's magnetic field at equator? 1

3. Plot a graph to show, the variation of current and alternating voltage, when applied to a purely capacitive circuit. 1

4. Define the term 'coherent sources' which are required to produce interference pattern in Young's double slit experiment. 1

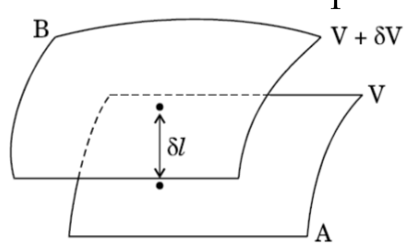
5. Draw a block diagram of a simple modulator for obtaining AM signal. 1

SECTION –B

6. In a parallel plate capacitor with air between the plates, each plate has an area of 6×10^{-3} m^2 and the distance between the plates is 3 mm. Calculate the capacitance of the capacitor. If this capacitor is connected to a 100 V supply, what is the charge on each plate of the capacitor? 2

OR

Two closely spaced equipotential surfaces A and B with potentials V and V+δV, (where δV is the change in V), are kept δl distance apart as shown in figure. Deduce the relation between the electric field and the potential gradient between them. Write the two important conclusions concerning the relation between the electric field and the potentials. 2



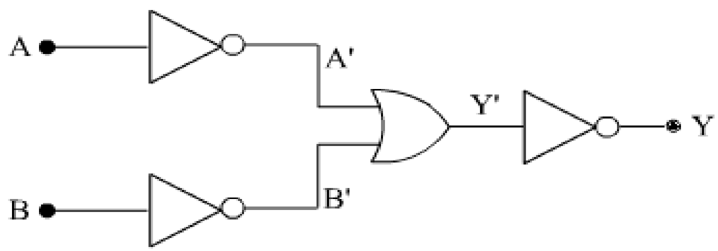
7. The refractive index of a material of a concave lens is n_1. It is immersed in a medium of refractive index n_2. A parallel beam of light is incident on the lens. Trace the path of emergent rays when (i) $n_2 > n_1$ (ii) $n_2 < n_1$. 2

8. X-rays fall on a photosensitive surface to cause photoelectric emission.

Assuming that the work function of the surface can be neglected, find the relation between the deBroglie wavelength (λ) of the electrons emitted to the energy (E_v) of the incident photons. Draw the nature of the graph for λ as a function of E_v. 2

9. Draw a graph between the frequency of incident radiation (υ) and the maximum kinetic energy of the electrons emitted from the surface of a photosensitive material. State clearly how this graph can be used to determine (i) Planck's constant and (ii) Work function of the material. 2

10. In the circuit shown in the figure, identify the equivalent gate of the circuit and make its truth table. 2



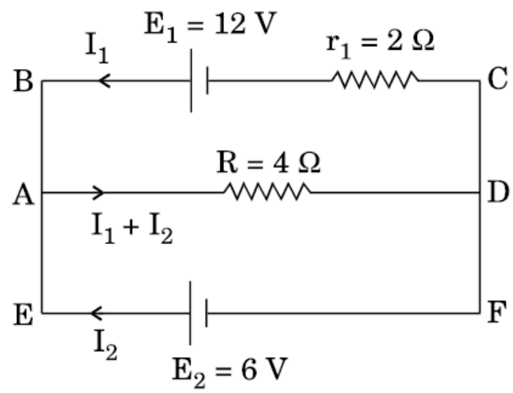
SECTION –C

11. Using Gauss's law obtain the expression for the electric field due to a uniformly charged thin spherical shell of radius R at a point outside the shell in terms of surface charge density σ. Draw a graph showing the variation of electric field with distance r from the centre of the shell for $r > R$ and $r < R$. 3

12. (i) Calculate the potential at a point P due to a charge of 4×10^{-7}C located 9 cm away.
(ii) Hence obtain the work done in bringing a charge of 2×10^{-9} C from infinity to the point P. Does the answer depend on the path along which the charge is brought? 3

13. (i) State the underlying principle of a potentiometer.
(ii) Draw a plot showing the variation of resistivity of a (a) conductor and (b) semiconductor, with the increase in temperature. How does one explain this behavior in terms of number density of charge carriers and the relaxation time? 3

14. In the electric network shown in the figure, use Kirchhoff's rules to calculate the power consumed by the resistance R = 4Ω. 3



15. Consider the motion of a charged particle of mass 'm' and charge 'q' moving with velocity $\vec{v}$ in a magnetic field $\vec{B}$.
(i) If $\vec{v}$ is perpendicular to $\vec{B}$, show that it describes a circular path having angular frequency ω = qB/m.
(ii) If the velocity $\vec{v}$ has a component parallel to the magnetic field $\vec{B}$, trace the path described by the particle. Justify your answer. 3

OR

(i) Draw a schematic sketch of a moving coil galvanometer and describe briefly its working.
(ii) 'Increasing the current sensitivity of a galvanometer does not necessarily increase the voltage sensitivity'. Justify this statement. 3

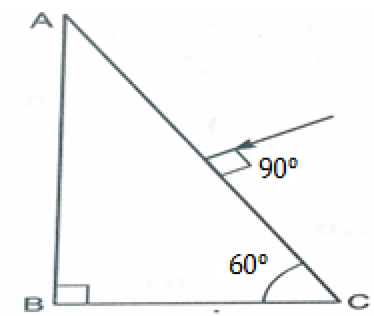
16. (i) Relative permeability of a material, μ_r =0.5. Identify the nature of the magnetic material and write its relation to magnetic susceptibility.
(ii) A short bar magnet placed with its axis at 30° with a uniform external magnetic field of 0.25 T experiences a torque of magnitude equal to 4.5×10^{-2} J. What is the magnitude of magnetic moment of the magnet?

17. (i) A metallic piece gets hot when surrounded by a coil carrying high frequency alternating current. Why?
(ii) A 1.0 m long metallic rod is rotated with an angular frequency of 400rad/s about an axis normal to the rod passing through its one end. The other end of the rod is in contact with a circular metallic ring. A constant

and uniform magnetic field of 0.5T parallel to the axis exists everywhere. Calculate the emf developed between the centre and the ring. 3

18. (i) Show, by giving a simple example, how electromagnetic waves carry energy and momentum.
(ii) How are microwaves produced? Why is it necessary in microwave ovens to select the frequency of microwaves to match the resonant frequency of water molecules?
(iii) Write two important uses of infrared waves. 3

19. Trace the path of a ray of light passing through a glass prism (ABC) as shown in the figure. If the refractive index of glass is $\sqrt{3}$, find out the value of the angle of emergence from the prism. 3



20. (i) A parallel beam of light of wavelength 500 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1m away. It is observed that the first minimum is at a distance of 2.5 mm from the centre of screen. Calculate the width of the slit.
(ii) How is the resolving power of a microscope affected when the diameter of the objective lens is decreased? Justify your answer. 3

21. Using Bohr's theory of hydrogen atom, calculate the energy of the photon emitted during a transition of the electron from the first excited state to the ground state. Write in which region of the electromagnetic spectrum, this transition lies. 3

22. (i) Write the relation for binding energy(BE) (in MeV) of a nucleus of mass ${}_{Z}^{A}M$, atomic number(Z) and the mass number (A) in terms of the masses of its neutrons and protons.

(ii) Draw a plot of the binding energy per nucleon as a function of mass number A, for $2 \leq A \leq 240$ Use this graph to explain the release of energy in the process of nuclear fusion of two light nuclei. 3

SECTION –D

23. Seetha was watching her favourite TV serial. Suddenly the picture started shaking on the TV screen. She asked her brother to check the dish antenna. Her brother found no problem in the antenna. Seetha noticed the same problem in TV picture again after some time. At the same time she heard the sound of a low flying aircraft passing over their house. She brought it to the notice of her brother. He explained the cause of shaking picture on TV screen when air craft passes over head.

(i) Which values are reflected in the approach of Seetha's brother?

(ii) How are these values helpful to an individual in daily life?

(iii) For an amplitude modulated wave, the maximum amplitude is found to be 10 V while the minimum amplitude is 2 V. Calculate the modulation index. Why is modulation index generally kept less than one? 4

SECTION –E

24. (i) A series LCR circuit is connected to an a.c. source of variable frequency. Draw a suitable phasor diagram to deduce the expressions for the amplitude of the current and phase angle.

(ii) Obtain the condition at resonance. Draw a plot showing the variation of current with the frequency of a.c. source for two resistances R_1 and R_2 ($R_1 > R_2$). Hence define the quality factor Q and write its role in the tuning of the circuit. 5

OR

(i) Draw a labelled diagram of a.c. generator and state its working principle.

(ii) Derive the expression for maximum value of induced emf.

(iii) Show the variation of the emf generated versus time as the armature is rotated with respect to the direction of the magnetic field.

(iv) Can the current produced by a.c. generator be measured with a moving coil galvanometer? Give reason. 5

25. (i) Draw a labelled ray diagram showing the image formation by a compound microscope. Derive an expression for its total magnification, when the final image is formed at the near point.
(ii) A compound microscope has an objective of focal length 1.25 cm and eyepiece of focal length 5 cm. A small object is kept at 2.5 cm from the objective. If the final image formed is at infinity, find the distance between the objective and the eyepiece. 5

OR

(i) Describe briefly by drawing diagram how unpolarised light can be polarised by reflection.
(ii) Light passes through two polaroids P_1 and P_2 with axis of P_2 making an angle θ with the pass axis of P_1. What is the value of θ, as the intensity of emergent light is zero? A third polaroid is placed between P_1 and P_2 with its pass axis making an angle β, with the pass axis of P_1. Find a value of β for which the intensity of light emerging from P_2 is $I_0/8$, where I_0 is the intensity of light incident on the polaroid P_1. 5

26. (i) Explain with the help of a diagram, how a depletion layer and barrier potential are formed in a p-n junction.
(ii) Draw a circuit diagram of a full wave rectifier. Explain its working and draw input and output waveforms. 5

OR

Draw the circuit diagram of a common-emitter amplifier using an npn transistor. Explain its working. Show that the voltage gain A_v of the amplifier is given by $A_v = -\beta_{ac}R_L/r_i$, where β_{ac} is the current gain, R_L is the load resistance and r_i is the input resistance of the transistor. What is the significance of the negative sign in the expression for voltage gain? 5