ST-XII 11/2014

SUBJECT : PHYSICS (SET-II)

Time : 3 Hrs. M.M.: 70

General Instructions :

(i) All the questions are compulsory.

(ii) Question nos. 1 to 5 are very short answer questions, carrying 1 mark each.

(iii) Question nos. 6 to 10 are short answer questions, carrying 2 marks each.

(iv) Question nos. 11 to 22 are also short answer questions, carrying 3 marks each.

(v) Question nos. 23 is a value based questions, carrying 4 marks each.

(vi) Question nos. 24 to 26 are long answer questions, carrying 5 marks each.

(vii) You may use the following values of physical constants

$c = 3 \times 10^8$ *m/s* $h = 6.6 \times 10^{-34}$ *Js*

$e = 1.6 \times 10^{-19}$ *C* $\mu_0 = 4\Pi \times 10^{-7}$ *TmA*$^{-1}$

Q1. A light ray incident on an equilateral glass prism of R.I. $\sqrt{3}$ moves parallel to the base of the prism inside it. Find the angle of incidence for this ray.

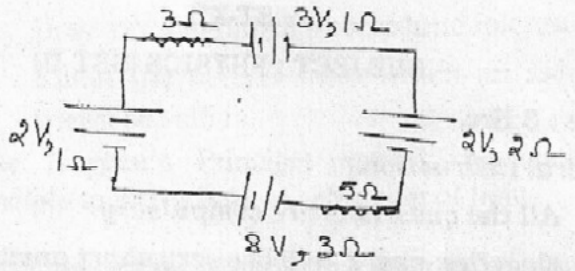
Q2. Name the characteristic of EM waves that remains same for red light of wavelength 7000A°, UV rays of wavelength 400 nm and microwaves of frequency 10^9 Hz.

Q3. What is the angle of dip at a place where the horizontal component of the magnetic field is zero?

Q4. A capacitor has been charged by a d.c. source. What are the magnitudes of conduction and displacement current when it is fully charged.

Q5. How does the angular separation between the fringes in a single slit diffraction pattern changes when the distance between the slit and screen is reduced to half?

Q6. Find current flowing in the given circuit.



Q7. A boat is moving towards east with a speed of 1.5 m/s at a place where earth's magnetic field is 5×10^{-5} T and angle of dip is 30°. The boat carries a vertical antenna 2m long. Find the emf induced in the antenna.

Q8. (a) Two charges $-2Q$ and Q are located along X-axis at point (a, o, o) and (4a, o, o) respectively. What is the electric flux of these charges through a sphere of radius 3a, centred at the origin?

(b) Calculate the electric flux through a surface of area $20m^2$ lying in XY plane due to an electric field given by $\vec{E} = 6\hat{i} + 3\hat{j} + 2\hat{k}$ N/C.

OR

Obtain an expression for the energy stored in a parallel plate capacitor. Hence, show that half of the total energy supplied by battery in charging the capacitor is lost.

Q9. The oscillating electric field of EM wave is given by $E_y = 2 \times 10^7 \sin [wt + 300\ \bar{\lambda} x]$ N/C.

(i) Find the value of w, if this wave is travelling in vacuum.

(ii) Find the frequency of this wave in a transparent medium of R.I. 1.5 wrt air.

Q10. Describe the path of a charged particle moving in a uniform magnetic field with initial velocity (i) parallel to the field (ii) perpendicular to the field (iii) at an arbitrary angle θ ($0° < \theta < 90°$)

Q11. State the principle of working of a moving coil galvanometer. Also outline the necessary steps to convert a galvanometer of resistance Rg into an ammeter of range 0 to 1 Ampere.

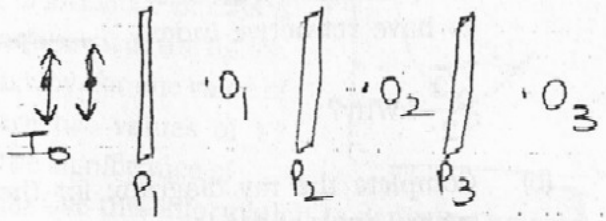
Q12. Write the nature of path of free electrons in a conductor in the (i) presence of electric field (ii) absence of electric field. What is the average velocity of an electron in the presence of electric field? Do all electrons have the same average velocity? How does this average velocity of free electrons vary with temperature?

Q13. A series LCR circuit is connected to an ac source of voltage 'V' and frequency 'ω'. When the capacitor is removed from the circuit, then the current lags behind the voltage by an angle Ø. When inductor is removed, then the current leads the voltage by same angle Ø. Find the current flowing and the average power dissipated in the LCR circuit.

OR

The primary of a transformer has 200 turns and secondary has 1000 turns. If the output power from the secondary at 1000V is 9 kW, then calculate (i) primary voltage (ii) heat loss in the primary coil if its resistance is 0.2Ω.

Q14. Three identical polaroid sheets P_1, P_2 and P_3 are placed such that the pass axis of P_2 and P_3 make 60° and 90° angle with P_1 respectively. An unpolarised light of intensity I_o falls on P_1. Find the intensity of light as observed by observers O_1, O_2 and O_3 positioned as shown beow.



Q15. Find the total potential energy of a system of two point charges 7μc and –2μc located at (2, 0, 0) and (–2, 0, 0) in the presence of an external electric field, $E = \frac{9 \times 10^5}{r^2}$ N/C

Q16. Using Biot-savart law, find the magnetic field of a current carrying circular loop on its axis. What is the magnetic field at the centre of this loop?

Q17. Why is (a) soft iron preferred for making electromagnets and steel for making permanent magnets? (b) The relative magnetic permeability of a magnetic material is 800. Identify the nature of the material and give its one example.

Q18. What is the effect on the interference pattern in Young's double slit experiment in the following cases :

(a) White light is used instead of monochromatic light.

(b) The apparatus is immersed in water

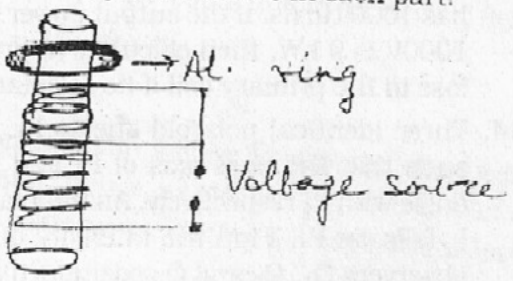
(c) One of the slit is closed.

Q19. Predict your observations regarding the metal ring in the given circuit :

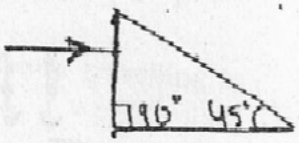
(a) If the voltage source is dc and is just switched on.

(b) If the voltage source is ac.

Give reason for your answers in each part.



Q20. (a) Is it possible for a medium to have refractive index $\frac{\sqrt{3}}{2}$? Why?



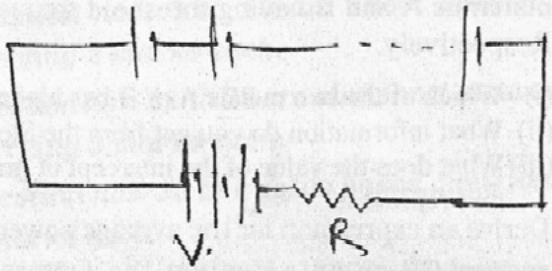
(b) Complete the ray diagram; for the prism having critical angle of 41°.

Q21. A capacitor C_1 is charged by a battery of potential 'V'. The battery remains connected and the gap between capacitor plates is filled by a dielectric. Explain with reason, what will happen to the charge, energy and capacitance of the capacitor C_1.

Q22. N identical cells, each of emf 'E' and internal resistance 'r' are connected in series as shown.

(a) Find the net emf and net internal resistance of this combination.

(b) If this combination is connected in series with a battery of voltage 'V' and resistor 'R', then find the current flowing the circuit.

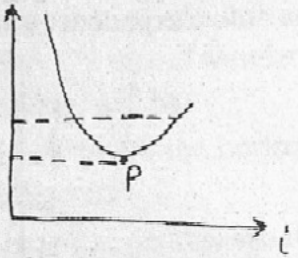


Q23. Garima went on a ride in the Delhi Metro with her parents. At the Metro station, they were made to pass through a gateway for security check. Garima observed that when some people passed through the gate, a long 'beep' is heard. She was confused and so she asked the duty staff, who explained her about the working of metal detector.

(i) What values are displayed by Garima?

(ii) Explain the principle on which metal detector works.

Q24. A plot between angle of deviation and angle of incidence for a glass prism is as shown in the figure. (i) Explain why, for one value of δ there are two values of 'i'? (ii) State the significance of point P. (iii) Use this information to derive an expression for the refractive index of the material of the prism.



OR

(i) A concave lens of refractive index 1.4 is immersed in a medium of refractive index 1.75. How would the nature of lens be affected?