APEEJAY COMMON PRE BOARD EXAMINATION
SESSION 23-24
Class: XII
Subject: PHYSICS

Time: 3 hours **MM: 70**

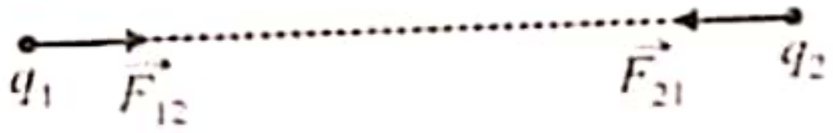
General Instructions:

1. All questions are compulsory. There are 33 questions in total.
2. Section A contains **sixteen** questions which are of objective type carrying **one** mark each (twelve MCQ and four Assertion Reasoning based), Section B contains **five** questions of **two** marks each, Section C contains **seven** questions of **three** marks each, Section D contains **two** questions of **four** marks each which are case based questions and Section E contains **three** questions of **five** marks each.
3. There is no overall choice. However, an internal choice has been provided in **one** question of **two** marks, **one** question of **three** marks, one question in each CBQ in Section D and and all the **three** questions of **five** marks weightage. You have to attempt only one of the choices in such questions.
4. You may use the following values of the 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
$\mu_0 = 4\pi \times 10^{-7}$ Tm A^{-1}
$\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}
$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ Nm^2 C^{-2}
Mass of electron $= 9.1 \times 10^{-31}$ Kg

SECTION A

1. According to Coulomb's law, which is the correct relation for the following figure?



(a) $q_1 q_2 > 0$
(b) $q_1 q_2 < 0$
(c) $q_1 q_2 = 0$
(d) $1 > q_1 q_2 > 0$

2. An electric dipole of moment p is placed parallel to the uniform electric field. The amount of work done in rotating the dipole by 90° is-

(a) 2pE
(b) pE
(c) pE/2
(d) Zero

3. A light wave of wave length 6210 Å falls on a metal having a work function of 1eV. The maximum kinetic energy of the emitted photo electrons will be

(a) 1 eV
(b) 2 eV
(c) 3 eV
(d) 10 eV

4. The ratio of the kinetic energy to the potential energy of an electron in Bohr orbit is:
   (a) 1: -1
   (b) 1: -2
   (c) 2:1
   (d) 2: -1

5. An electron is moving along positive x-axis in a magnetic field which is parallel to the positive y-axis. In what direction will the magnetic force be acting on the electron?
   (a) Along -x axis
   (b) Along -z axis
   (c) Along +z axis
   (d) Along -y axis

6. If the magnetizing field on a ferromagnetic material is increased, its permeability
   (a) decreases
   (b) increases
   (c) remains unchanged
   (d) first decreases and then increases

7. The temperature (T) dependence of resistivity of materials A and material B is represented by fig (i) and fig (ii) respectively. Identify material A and material B.

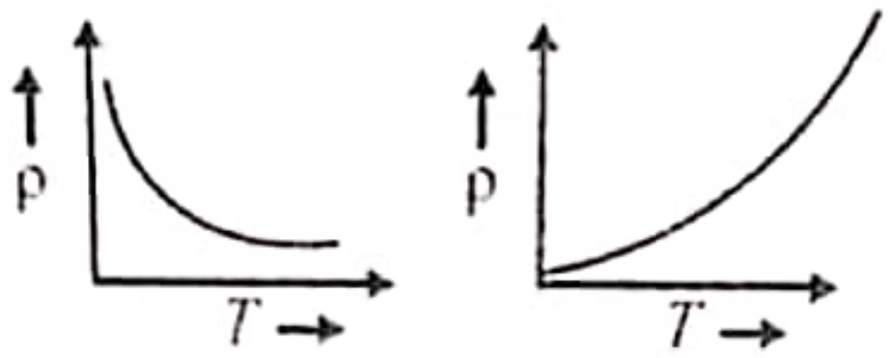


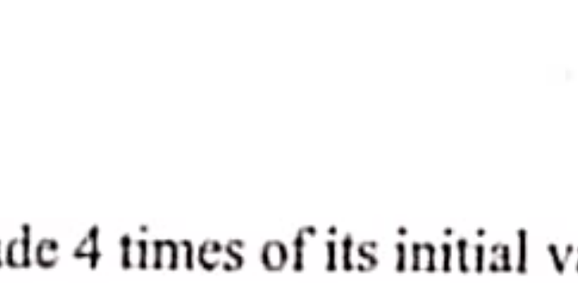
fig. (i) fig. (ii)

(a) material A is copper and material B is germanium
(b) material A is germanium and material B is copper
(c) material A is nichrome and material B is germanium
(d) material A is copper and material B is nichrome

8. The magnetic materials having negative magnetic susceptibility are
   (a) Non-magnetic
   (b) paramagnetic
   (c) diamagnetic
   (d) ferromagnetic

9. If the frequency of an A.C. is made 4 times of its initial value, the inductive reactance will be
   (a) 4 times
   (b) 2 times
   (c) Half
   (d) remain the same

10. The diagram below shows the electric field (E) and magnetic field (B) components of an electromagnetic wave at a certain time and location.



The direction of the propagation of the electromagnetic wave is
(a) perpendicular to E and B and out of plane of the paper

(b) perpendicular to E and B and into the plane of the paper
(c) parallel and in the same direction as E
(d) parallel and in the same direction as B

11) The magnetic flux linked with the coil (in Weber) is given by the equation

$\Phi = 5t^2 + 3t + 16$

The induced EMF in the coil at time, t=4 will be-

(a) -27 V
(b) -43 V
(c) -108 V
(d) 210 V

12. In the Bohr model, an electron jumps from the n =1 orbit to the n = 4 orbit. What is its energy in terms of E_1? Where E_1 is the energy of the electron in the first orbit.

(a) $E_1/9$
(b) $E_1/16$
(c) $4E_1$
(d) $16E_1$

Assertion-Reasoning Questions

DIRECTIONS: Read the two statements Assertion (A) and Reason (R) carefully to mark the correct option out of the options given below:

(a) Assertion (A) and Reason (R) both are correct statements and Reason is correct explanation for Assertion.

(b) Assertion (A) and Reason (R) both are correct statements but Reason is not correct explanation for Assertion.

(c) Assertion (A) is correct statement but Reason (R) is wrong statement.

(d) Assertion (A) is wrong statement but Reason (R) is correct statement.

13. Assertion (A): Assertion: Two equipotential surfaces can be orthogonal.
Reason: Electric field lines are normal to the equipotential surface.

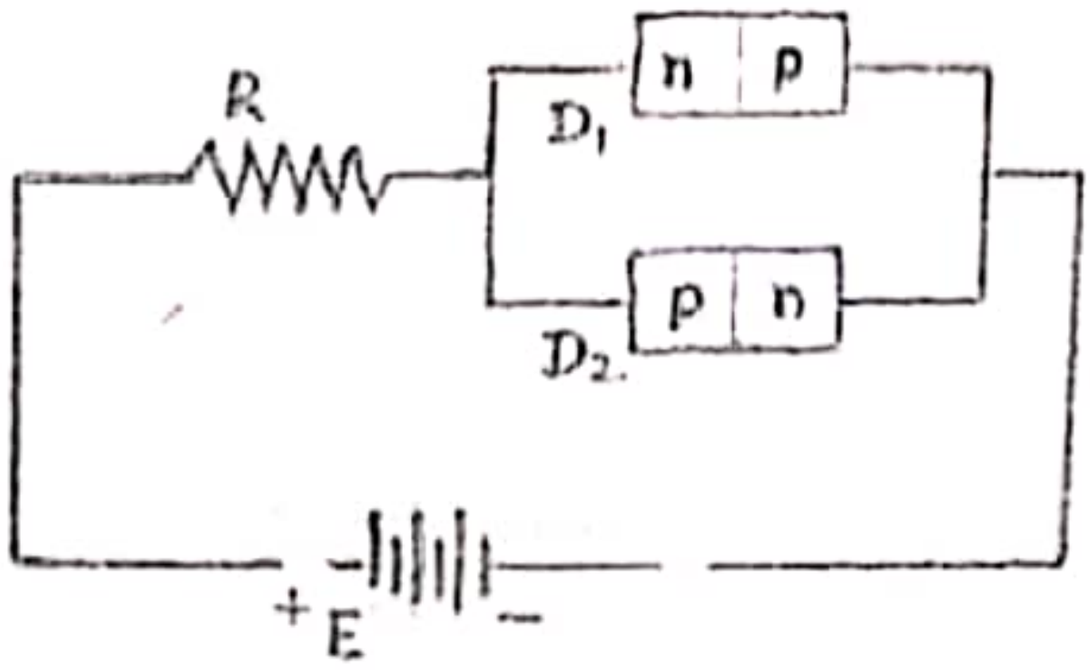
14. ASSERTION (A): If there is some gap between the conduction band and the valence band the electrons in the valence band remain bound and no free electrons are available in the conduction band. Then the material is an insulator.
REASON (R) : Resistance of insulators is very low.

15. ASSERTION(A): As work function of a material increases by some mechanism, it requires greater energy to excite the electrons from its surface.
REASON (R) : A plot of stopping potential (Vo) versus frequency (v) for different materials, has greater slope for metals with greater work function.

16. ASSERTION(A): Wave fronts obtained from light emitted by a point source in an isotropic medium are always spherical.
REASON(R) : Speed of light in isotropic medium is not constant.

SECTION B

17. Figure shows two p-n junction diodes along with a resistance and a battery. Which of the two diodes will conduct? Give reason.



18. The work function of Cs is 2.14 eV. Find
    (a) Threshold frequency for Cs
    (b) Wavelength of incident light if the photo current is brought to zero by stopping potential of 0.60 V?

19. Show diagrammatically the behaviour of magnetic field lines in the presence of (i) paramagnetic and (ii) diamagnetic substances. How does one explain this distinguishing feature?

20. Draw a ray diagram of Astronomical Telescope for the final image formed at infinity. A small telescope has an objective lens of focal length 140 cm and an eyepiece of focal length 5.0 cm. Find the magnifying power of the telescope for viewing distant objects when the telescope is in normal adjustment.

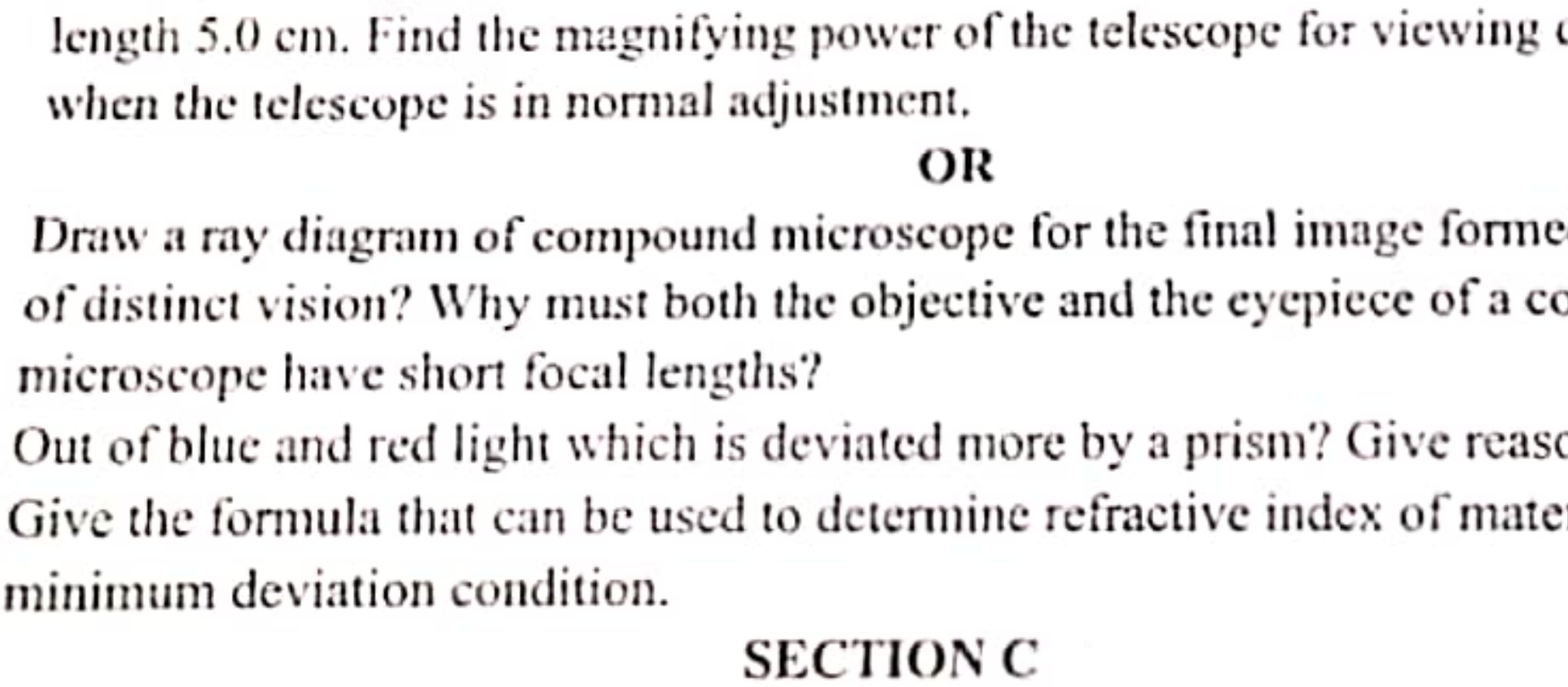
OR

Draw a ray diagram of compound microscope for the final image formed at least distance of distinct vision? Why must both the objective and the eyepiece of a compound microscope have short focal lengths?

21. Out of blue and red light which is deviated more by a prism? Give reason. Give the formula that can be used to determine refractive index of material of a prism in minimum deviation condition.

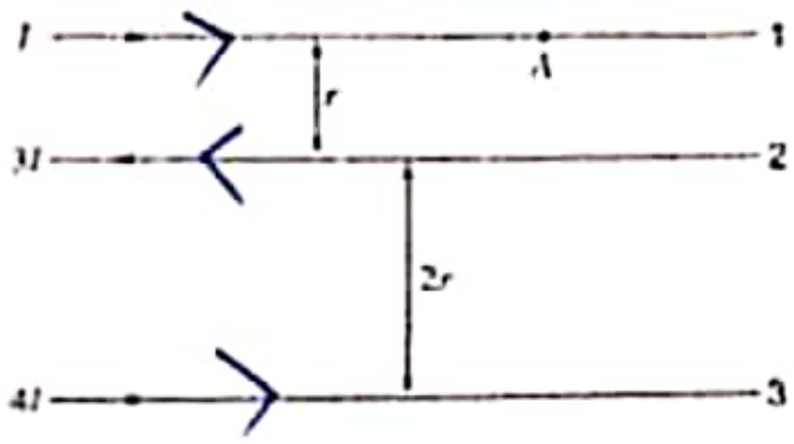
SECTION C

22. Obtain the equivalent capacitance of the network across AB shown in the following figure. How much charge is drawn from the source?



25. Two cells of emf E_1 and E_2 and internal resistance r_1, and r_2 are connected in parallel such that they send current in same direction. Derive an expression for equivalent resistance and equivalent emf of the combination.

26. Figure shows three infinitely long straight parallel current carrying conductors.



Find the

(i) Magnitude and direction of the net magnetic field at point A lying on conductor 1,

(ii) Magnetic force on conductor 2.

27. (a) Name the following constituent radiations of electromagnetic spectrum which

(i) are used in satellite communication/in radar and geostationary satellite

(ii) are used for studying crystal structure of solids

(iii) are similar to the radiations emitted during decay of radioactive nuclei

(iv) are used for water purification/ are absorbed from sunlight by ozone layer

(b) A radio wave and an infrasonic wave have the same wavelength when travelling through air. Are their frequencies the same or different? Give a reason for your answer.

28. How does the mutual inductance of a pair of coils affected when:

(a) the separation between the coils is increased?

(b) the number of turns of each coil is increased?

(c) a thin iron sheet is placed between the two coils, other factors remaining the same.

Explain your answer in each case.

29. Draw a plot of potential energy of a pair of nucleons as a function of their separation. Mark the region where nuclear force is (i) attractive and (ii) repulsive. Write two important conclusions which you can draw regarding the nature of nuclear forces.

OR

The total energy of an electron in the first excited state of the hydrogen atom is about –3.4 eV. What is the kinetic energy of the electron in this state? What is the potential energy of the electron in this state? Which of the answers above would change if the choice of the zero of potential energy is changed?

30. Write the relation between mass number and radius of a nucleus. Show that nuclear density in a given nucleus is independent of mass number.

What is the longest wavelength of photon that can ionize a hydrogen atom in its ground state? Specify the type of radiation.

SECTION D

29. **PN Junction Diode**

A PN-junction diode is formed when a p-type semiconductor is fused to an n-type semiconductor creating a potential barrier voltage across the diode junction A PN Junction Diode allows current in one direction only. However, unlike a resistor, a diode does not behave linearly with respect to the applied voltage. Instead it has an exponential current-voltage relationship and therefore we can not describe its operation by simply using an equation such as Ohm's law. If a suitable positive voltage (forward bias) is applied between the two ends of the PN junction, it can supply free electrons and holes with the extra energy they require to cross the junction as the width of the depletion layer around the PN junction is decreased. By applying a negative voltage (reverse bias) results in the free charges being pulled away from the junction resulting in the depletion layer width being increased. Then the depletion layer widens with an increase in the application of a reverse voltage and narrows with an increase in the application of a forward voltage.

(i) A PN junction is said to be forward-biased when

(a) The positive terminal of the battery is connected to P-side and the negative side to the N-side

(b) Junction is earthed

(c) N-side is connected directly to the p-side

(d) The positive terminal of the battery is connected to N-side and the negative side to the P-side.

(ii) For a PN junction diode, the current in reverse bias may be

(a) Few milliamperes

(b) Between 0.2A and 15A

(c) Few amperes

(d) Few micro or nano amperes

(iii) A PN junction

(a) Has low resistance in forward as well as reverse directions

(b) Has high resistance in forward as well as reverse directions

(c) Conducts in the forward direction only

(d) Conducts in the reverse direction only

(iv) When a PN junction is reverse biased

(a) Holes and electrons tend to concentrate towards the junction

(b) The barrier tends to break down

(c) Holes and electrons tend to move away from the junction

(d) None of these

OR

In a PN junction the potential barrier is due to the charges on either side of the junction, these charges are

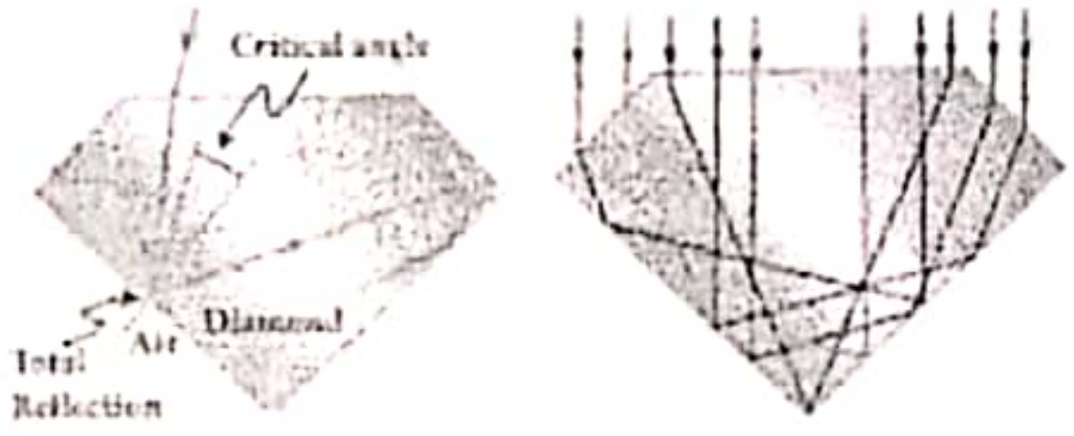
(a) Majority carriers

(b) Minority carriers

(c) Both (a) and (b)

(d) Fixed donor and acceptor ions

30. BRILLIANCE OF DIAMOND



The total internal reflection of the light is used in polishing diamonds to create a sparking brilliance. By polishing the diamond with specific cuts, it is adjusted the most of the light rays approaching the surface are incident with an angle of incidence more than critical angle. Hence, they suffer multiple reflections and ultimately come out of diamondfrom the top. This gives the diamond a sparking brilliance.

(i) Light cannot easily escape a diamond without multiple internal reflections. This is because:

(a) its critical angle with reference to air is too large.
(b) its critical angle with reference to air is too small.
(c) the diamond is transparent.
(d) rays always enter at an angle greater than critical angle.

(ii) The critical angle for a diamond is 24.4°. Then its refractive index is:

(a) 2.42
(b) 0.413
(c) 1
(d) 1.413

(iii) The basic reason for the extraordinary sparkle of suitably cut diamond is that:

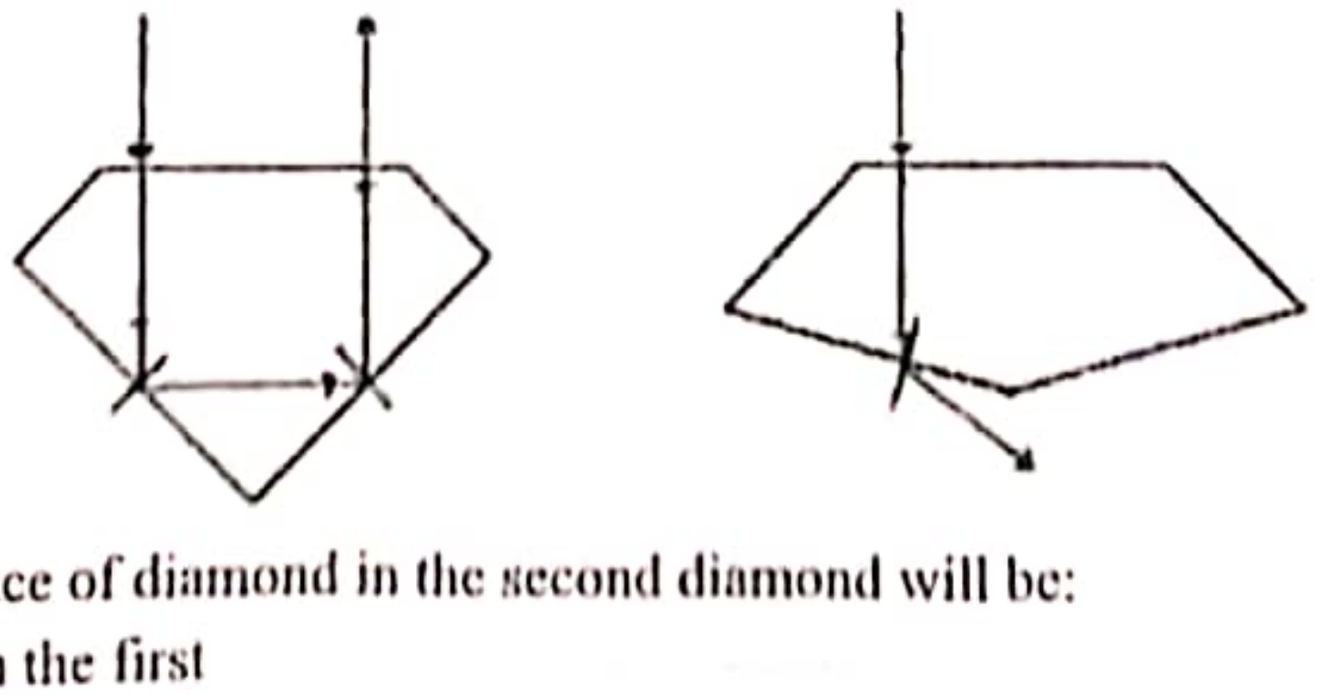
(a) it has a low refractive index.
(b) it has high transparency.
(c) it has a high refractive index.
(d) it is very hard.

(iv) A diamond is immersed in a liquid with a refractive index greater than water. Then the critical angle for total internal reflection will:

(a) depend on the nature of the liquid.
(b) decrease.
(c) remains the same.
(d) increase.

OR

The following diagram shows the same diamond cut in two different shapes.



The brilliance of diamond in the second diamond will be:

(a) less than the first
(b) greater than first

(c) same as first

(d) will depend on the intensity of light

SECTION E

31. (a) Derive an expression for the electric field on the equatorial line of a dipole. Express the result in vector form also.

(b) Three-point electric charges +q each are kept at the vertices of an equilateral triangle of side a. Determine the magnitude and sign of the charge to be kept at the centroid of the triangle so that the charges at the vertices remain in equilibrium.

OR

Which theorem relates the electric flux and charge enclosed inside a body. State and prove this theorem. Apply this theorem to obtain the expression for the electric field at a point due to an infinitely long, thin, uniformly charged straight wire of linear charge density λ C/m.

32. State the underlying principle and working of a transformer.

How is the large scale transmission of electric energy over long distances done with the use of transformers?

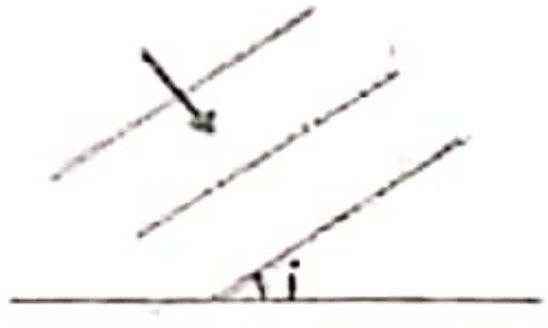
OR

(a) When an a.c. source is connected to an ideal capacitor show that the average power supplied by the source over a complete cycle is zero.

(b) A lamp is connected in series with a capacitor. Predict your observations when the system is connected first across a d.c. and then an a.c. source. What happens in each case if the capacitance of the capacitor is reduced?

33. *(a) How is a wavefront defined?*

(b) State Huygen's principle. A plane wavefront propagating in a medium of refractive index 'n_1' is incident on a plane surface making the angle of incidence 'i' as shown in the figure. It enters into a medium of refractive index 'n_2' ($n_2 > n_1$). Use Huygens' construction of secondary wavelets to trace the propagation of the refracted wavefront. Hence verify Snell's law of refraction.



OR

(a) In Young's double slit experiment, deduce the conditions for (i) constructive and (ii) destructive interference at a point on the screen. Draw a graph showing variation of the resultant intensity in the interference pattern against position 'X' on the screen.

(b) Compare this with the intensity distribution of fringes due to diffraction at a single slit. What important difference do you observe?

All The Best