

Questions No. 3: (12 Marks)

3-a) Define with illustrating sketch the phenomena of total internal reflection. (2 Degrees)

3-b) Sketch the Michelson's interferometer. (2 Degrees)

3-c) Consider the double-slit arrangement, where the separation of the slits is 0.2 mm and the distance to the screen is 2 m. A transparent thin sheet of thickness 30 μm and refractive index 1.5 is placed over only the upper slit. Calculate the distance by which the central maximum of the interference pattern moves upward. (4 Degrees)

3-d) Monochromatic light of wavelength 632.8 nm is incident normally on a diffraction grating containing 7000 lines/cm. Find the angle of the first-order maximum. (4 Degrees)

Questions No. 4: (13 Marks)

4-a) Draw the refractive index profile for both step-index and graded-index optical fibre. (2 Degrees)

4-b) In using a polarizer and analyzer in the polarization experiment, the intensity of the final light beam is 12.5% of that of the initial beam (before transmission through the polarizer). Calculate the angle between the transmission axes of the analyzer and polarizer. (4 Degrees)

4-c) Concerning the interaction of radiation with matter, explain with illustrating sketch, the followings; (i) absorption, (ii) spontaneous emission and (iii) stimulated emission. (3 Degrees)

4-d) An electron moves with a speed of $0.95c$. Find its total energy and kinetic energy in MeV. Take, for the electron, $m = 9.1 \times 10^{-31}$ Kg and $e = 1.6 \times 10^{-19}$ C and the speed of light is 3×10^8 m/s.

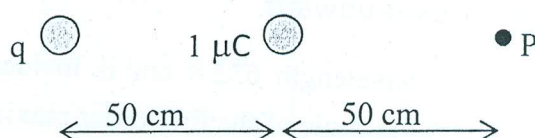
(4 Degrees)



Answer All Questions

Questions No. 1: (12 Marks)

1-a) According to the Fig. shown, consider the electric field at point P is zero. (i) What is sign and magnitude of the charge q? (ii) What is potential at the point P? (4 Degrees)



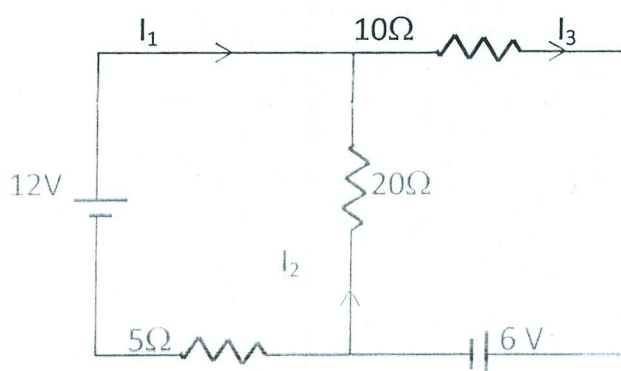
1-b) For a thin spherical shell of radius R and charge Q , plot both of the electric field, E , and electric potential, V , versus the distance, r , from the sphere's center. (4 Degrees)

1-c) A charged thin sphere of 10 nC charge. The maximum value of the potential due to this charge is found to be 450 V (i) What is the electric field at 15 cm and at 30 cm from the center? (ii) What is the potential at the center of the sphere? Take $K=9 \times 10^9 \text{ Nm}^2/\text{C}^2$. (4 Degrees)

Questions No. 2: (13 Marks)

2-a) A parallel-plate capacitor of capacitance $2 \times 10^{-11} \text{ F}$ is connected with 12 V battery, (i) calculate the charge and the energy stored on the capacitor. (ii) If the battery is then disconnected and a slab of dielectric material of $k = 5$ is inserted between the plates, calculate the energy stored on the capacitor after inserting the dielectric. (5 Degrees)

2-b) Consider the circuit in the figure shown. Find the currents I_1 , I_2 and I_3 . (4 Degrees)



2-c) An electron of kinetic energy 400 eV moves perpendicular to a uniform magnetic field of intensity 0.02 T. Calculate the radius and the period of its orbit. For electron, take $m = 9.1 \times 10^{-31} \text{ kg}$ and $e = 1.6 \times 10^{-19} \text{ C}$. (4 Degrees)