Time : One hour;   No of Questions : 04;   No of Pages : 02 & Total marks : 100
Answer all questions

01.   **(a)**   Show that the resonance frequency f_p of the plasma oscillations of an ionized electrically neutral medium containing free charges of mass m is given by;

$$f_p^{\ 2} = \frac{e^2}{4\ \pi^2 \varepsilon_o\ m} \cdot N \ .$$

Where, N is density of free charges, $\varepsilon_o = 8.85 \times 10^{-12}\ Fm^{-1}$ and $e = 1.6 \times 10^{-19}\ C$.

(b)   Estimate the highest frequency that can be reflected from the ionosphere at normal incidence if the maximum electron density in the ionosphere is $2.0 \times 10^{12}\ m^{-3}$. (The mass of the electron is $9.1 \times 10^{-31}\ kg$)

(25 Marks)

02.   The magnetic field of the Earth can be represented to a good approximation by a dipole magnetic field with the intensity of *40 000 nT* at the equator.
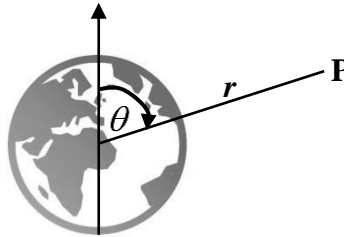
You are given the following mathematical equation for the Earth magnetic field intensity, $H(r,\theta)$ at any point P at a distance r from the center of the Earth and making an angle θ with the vertical, as shown in the figure above.

$$H(\ r,\ \theta\ ) = \frac{\mu_o}{4\ \pi} \cdot \frac{M}{r^3} \cdot \left(\ 1 + 3\ \cos^2\theta\ \right)^{\frac{1}{2}}$$

Where, M is the Dipole Moment of the Earth and the other symbols have their usual meanings.

(a)   Find the magnetic moment of the Earth's dipole.

(Take $\mu_o = 4\ \pi \times 10^{-7}\ Hm^{-1}$ and the radius of the Earth $= 6.4 \times 10^6\ m$)

(b)   Hence, find the intensity of the magnetic field at the poles of the Earth.

(25 Marks)

03. **(a)** Discuss how you would define the Earth's atmosphere in various regions based on the temperature distribution of the atmosphere.

(b) The temperature of the atmosphere of the Earth decreases with height at a constant rate of $6^{\circ}C/km$ in the lower atmosphere. The average temperature at the mean sea level is $27^{\circ}C$. Estimate the atmospheric average temperature at the summit of the Piduruthalagala at an altitude of 2.5 km.

(25 Marks)

04. **(a)** Define the term "**solar flare**", and describe how you would observe a solar flare occurring in the disc of the Sun from the surface of the Earth.

(b) Number of solar flares N_f occurring in the Sun per solar rotation relates to the mean sunspot number R as,

$$N_f = \alpha\,[R - 10\,].$$

(i) Determine the value of the proportional constant α, if 109 number of solar flares observed occurring per solar rotation, when the mean sunspot number is 82.

(ii) Estimate the number of flares occurring per solar rotation for a solar maximum having a mean sunspot number is 192.

(25 Marks)

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