

Mathematical Physics I, 2008

Assignment 1

1. Consider a right handed coordinate system with the origin fixed on the center of the earth, the z -axis in the direction from the origin the north pole and x -axis in the direction from the origin to Greenwich. If all coordinates are in kilometers, write down the cartesian coordinates of the position vectors of Chennai, Amsterdam and the South Pole, accurate to about 100 KM. Use the internet for any information that you require.

2. If,

$$\vec{A} + \vec{B} = \vec{C}$$

then prove that,

$$|\vec{A}| + |\vec{B}| \geq |\vec{C}|$$

3. Consider a coordinate system with its origin on one of the vertices of a unit cube and its axes parallel to the edges.
 - (a) Compute the cartesian coordinates of the unit vector normal to the plane formed by the origin, the vertex on the $x - y$ plane diagonally opposite the origin and the vertex furtherest away from the origin.
 - (b) What is the area of the above triangle ?
4. Compute the cosine of the angle between any two body diagonals of a cube.
5. Write down the coordinates of the position vectors of the 4 vertices of a perfect tetrahedron (all edges equal in length) in any convenient coordinate system. Prove your answer by computing the lengths of all the edges.
6. The direction of the vector from the center of the earth to the center of the sun is given to be \hat{n}_s . A flat plate is held fixed with its normal vector (the vector perpendicular to all the lines in the plate) in the direction \hat{n}_p . When $\hat{n}_p = \hat{n}_s$, it is found that the rate at which energy is incident on the plate is 500 watts/m^2 . If $\hat{n}_p \neq \hat{n}_s$, what is the incident power per unit area ? Prove your answer.