PH102 Tutorial Sheet 1 (Jan 02, 2015)
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Welcome to PH102 Tutorials
Wish you all a Very Happy New Year
This is a warm up tutorial

1. Express the following vectors in Cartesian Coordinate system: $\vec{A} = \rho z sin\varphi\hat{\rho} + 3\rho cos\varphi\hat{\varphi} + \rho cos\varphi sin\varphi\hat{k}$ and
$$\vec{B} = r^2\hat{r} + sin\theta\hat{\varphi}$$

2. Given a vector field: $\vec{D} = rsin\varphi\hat{r} - \frac{1}{r}sin\theta cos\varphi\hat{\theta} + r^2\hat{\varphi}$
Determine:
(a) $\vec{D}$ at P (10, 150°, 330°)
(b) The component of $\vec{D}$ tangential to the spherical surface r= 10 at P
(c) A unit vector at P perpendicular to $\vec{D}$ and tangential to the cone Θ = 150°

3. Let $\vec{H}$ =$5\rho sin\varphi\hat{\rho} - \rho z cos\varphi\hat{\varphi} + 2\rho\hat{k}$

At point P(2, 30°, -1), find:
(a) a unit vector along $\vec{H}$
(b) the component of $\vec{H}$ parallel to $\hat{\imath}$
(c) the component of $\vec{H}$ normal to ρ = 2
(d) the component of $\vec{H}$ tangential to φ = 30°

4. A vector field in "mixed" coordinate variables is given by
$\vec{G}$ =$\frac{xcos\varphi}{\rho}\hat{\imath} + \frac{2yz}{\rho^2}\hat{\jmath} + \left(1 - \frac{x^2}{\rho^2}\right)\hat{k}$
Express $\vec{G}$ completely in spherical system.
5. Consider the object shown in Figure 1. Calculate
(a) The distance BC, (b) the distance CD, (c) the surface area ABCD
(d) the surface area ABO, (e) the surface area AOFD

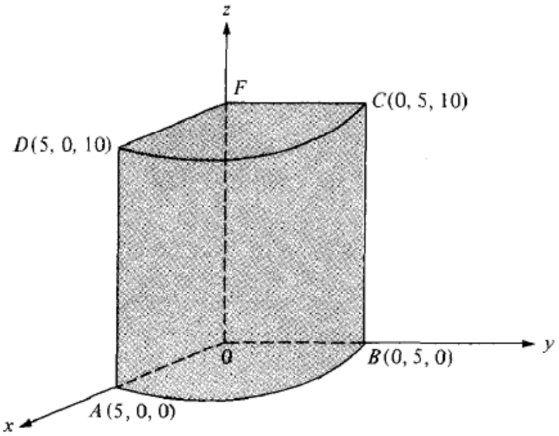

Fig 1

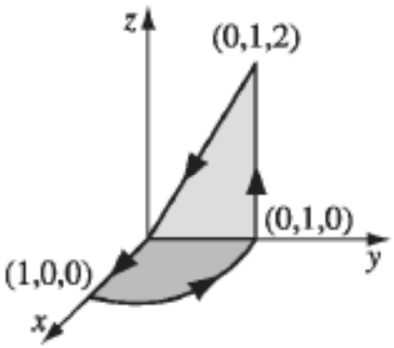

Fig 2

6. Write down the area elements (vector) for the curved and plane surfaces for an inverted Cone.

7. Compute the line integral of $\boldsymbol{V} = rcos^2\theta\hat{r} - rcos\theta sin\theta\hat{\theta} + 3r\hat{\varphi}$ around the path shown in Fig 2.
8. A Vector $\vec{\boldsymbol{G}}$(r) is given as $\vec{\boldsymbol{G}}$(r) = $10e^{-2z}\left(\rho\hat{\rho} + \hat{k}\right)$, determine $\oint \vec{G}.\overrightarrow{da}$ over the entire surface of the cylinder of unit radius and unit height.
9. A vector is given as $\vec{\boldsymbol{A}} = 5r\hat{\varphi}$ obtain the surface integration over a surface defined by 0<r<1 and -3<z<3, φ being constant.
10. A body is moved along the path as shown in figure 3, under the force $\vec{\boldsymbol{A}} = 2\hat{\imath} - 5\hat{\jmath}$. The path between point a and b is a parabola given by $y = 2x^2$. (a) calculate the work done to move the body from point a and b along the parabolic path. (b) Calculate the work done to move the body from a to c and then to point b. (c) compare the results of above two parts.

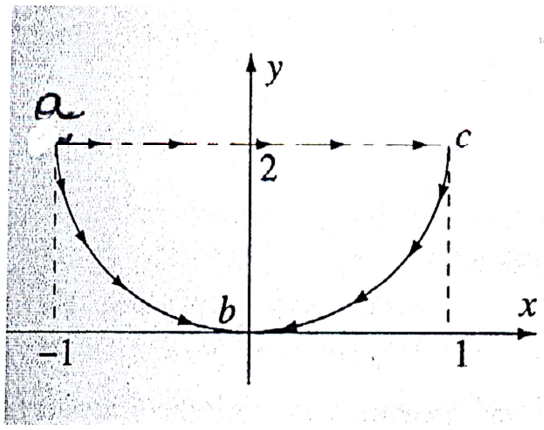

Fig 3