

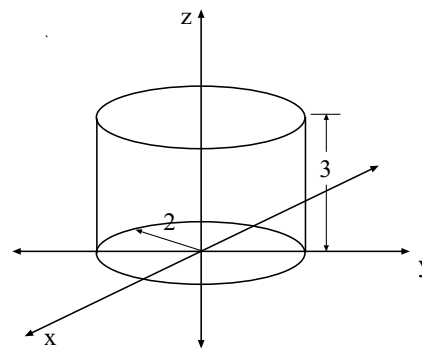
**Phys 2920, Spring 2010**  
**Problem Set #7**

1. (VA 5.28) If  $\mathbf{R}(t) = (3t^2 - t)\mathbf{i} + (2 - 6t)\mathbf{j} - 4t\mathbf{k}$ , find (a)  $\int \mathbf{R}(t) dt$ , and (b)  $\int_2^4 \mathbf{R}(t) dt$
2. (VA 5.34) Evaluate  $\int_2^3 \mathbf{A} \cdot \frac{d\mathbf{A}}{dt} dt$  if  $\mathbf{A}(2) = 2\mathbf{i} - \mathbf{j} + 2\mathbf{k}$  and  $\mathbf{A}(3) = 4\mathbf{i} - 2\mathbf{j} + 3\mathbf{k}$ .
3. (VA 5.38) If  $\mathbf{F} = (5xy - 6x^2)\mathbf{i} + (2y - 4x)\mathbf{j}$ , evaluate  $\int_C \mathbf{A} \cdot d\mathbf{r}$  along the curve  $C$  in the  $xy$  plane,  $y = x^3$  from the point  $(1, 1)$  to  $(2, 8)$ .
4. (VA 5.37) If  $\mathbf{A} = (2y + 3)\mathbf{i} + xz\mathbf{j} + (yz - x)\mathbf{k}$ , evaluate  $\int_C \mathbf{A} \cdot d\mathbf{r}$  along the following paths  $C$ :
  - (a)  $x = 2t^2$ ,  $y = t$ ,  $z = t^3$  from  $t = 0$  to  $t = 1$ .
  - (b) the straight lines from  $(0, 0, 0)$  to  $(0, 0, 1)$ , then to  $(0, 1, 1)$ , and then to  $(2, 1, 1)$ .
  - (c) the straight lines joining  $(0, 0, 0)$  and  $(2, 1, 1)$ .

5. Evaluate the surface integral  $\oint_S \mathbf{a} \cdot d\mathbf{S}$ , where the vector field is given (in cylindrical coordinates) by

$$\mathbf{a} = \rho^2 \cos^2 \phi \hat{\mathbf{e}}_\rho + \rho \sin \phi \hat{\mathbf{e}}_\phi + \rho z^3 \hat{\mathbf{e}}_z$$

and the closed surface is a circular cylinder of radius 2 whose axis is the  $z$  axis; it has height 3 and extends from  $z = 0$  to  $z = 3$ .



6. Find the moment of inertia (about the  $z$  axis) of the “ice cream cone” volume which was used in another example in class and which is shown here. (It is a sector of a solid sphere of radius  $R$ , out to an angle  $\theta = \pi/6$  out from the  $z$  axis)

Assume its mass density  $\rho_{\text{mass}}$  is uniform. Express the answer in terms of the total mass  $M$  of the object.

