

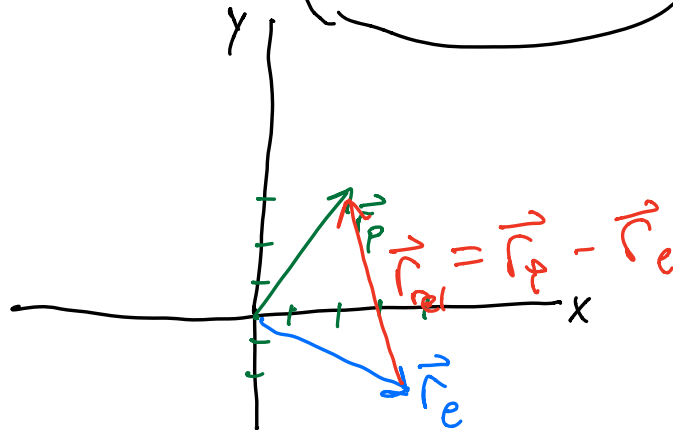
$$1. \vec{A} = \langle 3, 5, 1 \rangle$$

$$|\vec{A}| = \sqrt{3^2 + 5^2 + 1^2} = 5.92$$

$$2. \vec{r}_p = \langle 2, 3, 0 \rangle$$

$$\vec{r}_e = \langle 4, -2, 0 \rangle$$

$$\vec{r}_{el} = \vec{r}_p - \vec{r}_e = \langle -2, 5, 0 \rangle$$



$$3. \vec{A} = \langle 9, 5, 8 \rangle$$

$$\vec{B} = \langle -3, -5, 4 \rangle$$

$$\vec{A} \cdot \vec{B} = (9)(-3) + (5)(-5) + (8)(4)$$

$$= -27 - 25 + 32$$

$$= -20 \quad (1)$$

$$\vec{A} \cdot \vec{B} = |\vec{A}| |\vec{B}| \cos \theta$$

$$|\vec{A}| = 13.04 \quad |\vec{B}| = 7.07$$

$$\frac{\vec{A} \cdot \vec{B}}{(|\vec{A}|)(|\vec{B}|)} = \cos \theta$$

$$\frac{-20}{92.20} = \cos \theta$$

$$\theta = \arccos(-0.22) = 1.79 \text{ rad} \\ (102.5^\circ)$$



$$4. \vec{a} = \langle -3, 7, 1 \rangle$$

$$\hat{a} = \frac{\vec{a}}{|\vec{a}|} ; |\vec{a}| = 7.68$$

$$\hat{a} = \left\langle -\frac{3}{7.68}, \frac{7}{7.68}, \frac{1}{7.68} \right\rangle$$

$$\hat{a} = \langle -0.39, 0.91, 0.13 \rangle$$

$$\text{direction of } x\text{-axis} = \hat{x} = \langle 1, 0, 0 \rangle$$

$$\hat{a} \cdot \hat{x} = |\hat{a}| |\hat{x}| \cos \theta$$

$$\hat{a} \cdot \hat{x} = \cos \theta \rightarrow \theta = \arccos(-0.39 + 0 + 0)$$

$$\theta = 1.97 \text{ rad}$$

$$112.95^\circ$$

$$5. \quad \vec{B} = \langle 3, -9, 7 \rangle$$

$$\vec{v} = \langle 8, 4, 6 \rangle$$

$$\vec{A} = \langle a_x, a_y, a_z \rangle = a_x \hat{x} + a_y \hat{y} + a_z \hat{z}$$

$$\vec{B} = \langle b_x, b_y, b_z \rangle = b_x \hat{x} + b_y \hat{y} + b_z \hat{z}$$

$$\vec{A} \times \vec{B} = (a_x \hat{x} + a_y \hat{y} + a_z \hat{z}) \times (b_x \hat{x} + b_y \hat{y} + b_z \hat{z})$$

$$= a_x \hat{x} \times b_x \hat{x} + a_x \hat{x} \times b_y \hat{y} + a_x \hat{x} \times b_z \hat{z} \\ + a_y \hat{y} \times b_x \hat{x} + a_y \hat{y} \times b_y \hat{y} + a_y \hat{y} \times b_z \hat{z} \\ + a_z \hat{z} \times b_x \hat{x} + a_z \hat{z} \times b_y \hat{y} + a_z \hat{z} \times b_z \hat{z} ;$$

$$a_x \hat{x} \times b_y \hat{y} = a_x b_y (\hat{x} \times \hat{y})$$

$$\hat{x} \times \hat{x} = 0, \quad \hat{x} \times \hat{y} = \hat{z}, \quad \hat{x} \times \hat{z} = -\hat{y}$$

$$\hat{y} \times \hat{x} = -\hat{z}, \quad \hat{y} \times \hat{y} = 0, \quad \hat{y} \times \hat{z} = \hat{x}$$

$$\hat{z} \times \hat{x} = \hat{y}, \quad \hat{z} \times \hat{y} = -\hat{x}, \quad \hat{z} \times \hat{z} = 0$$

$$\vec{A} \times \vec{B} = a_x \hat{x} \times b_x \hat{x} + a_x \hat{x} \times b_y \hat{y} + a_x \hat{x} \times b_z \hat{z} \\ + a_y \hat{y} \times b_x \hat{x} + a_y \hat{y} \times b_y \hat{y} + a_y \hat{y} \times b_z \hat{z} \\ + a_z \hat{z} \times b_x \hat{x} + a_z \hat{z} \times b_y \hat{y} + a_z \hat{z} \times b_z \hat{z} ;$$

$$= a_x b_y \hat{z} + a_x b_z (-\hat{y})$$

$$+ a_y b_x (-\hat{z}) + a_y b_z \hat{x} +$$

$$+ a_z b_x \hat{y} + a_z b_y (-\hat{x})$$

$$\begin{aligned}\vec{A} \times \vec{B} &= (a_y b_z - a_z b_y) \hat{x} \\ &+ (a_z b_x - a_x b_z) \hat{y} \\ &+ (a_x b_y - a_y b_x) \hat{z}\end{aligned}$$

$$\vec{B} = \langle 3, -9, 7 \rangle$$

$$\vec{v} = \langle 8, 4, 6 \rangle$$

$$\begin{aligned}\vec{B} \times \vec{v} &= (-9 \cdot 6 - 7 \cdot 4) \hat{x} + (7 \cdot 8 - 3 \cdot 6) \hat{y} \\ &+ (3 \cdot 4 - (-9) \cdot 8) \hat{z}\end{aligned}$$

$$\vec{B} \times \vec{v} = -82 \hat{x} + 38 \hat{y} + 84 \hat{z}$$

6. $\vec{A} = \langle 4, 5, -7 \rangle$

$\vec{B} = \langle 6, -2, 2 \rangle$

if $\vec{A} \perp \vec{B}$, then $\vec{A} \cdot \vec{B} = 0$


$\vec{A} \cdot \vec{B} = 4 \cdot 6 - 5 \cdot 2 - 7 \cdot 2$

$= 24 - 10 - 14 = 0$

$\vec{A} \cdot \vec{B} = 0$

ORTHOGONAL ✓

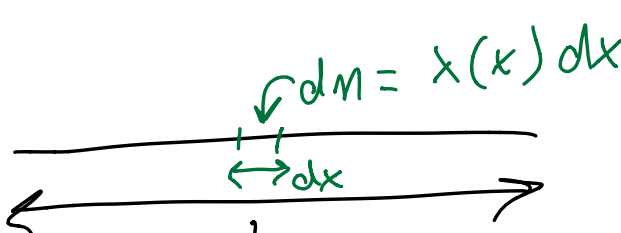
7.



A horizontal line representing a rod. Below it, a double-headed arrow indicates the length L .

$$\frac{M}{L} = \lambda_0 \Rightarrow M = \lambda_0 L$$

8.



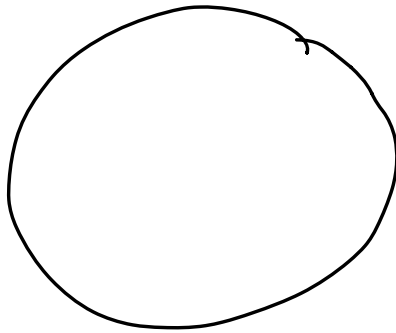
A horizontal line representing a rod of length L , indicated by a double-headed arrow below it. A small segment of the rod is highlighted with a double-headed arrow labeled dx . Above this segment, a curved arrow points to it with the label $dm = \lambda(x) dx$.

$$M = \int dm = \int_0^L \lambda(x) dx = \int_0^L \lambda_0 \left(\frac{x}{L}\right)^3 dx$$

$$= \frac{\lambda_0}{L^3} \int_0^L x^3 dx = \frac{\lambda_0}{L^3} \left(\frac{1}{4} x^4 \right) \Big|_0^L = \frac{\lambda_0}{4} L$$

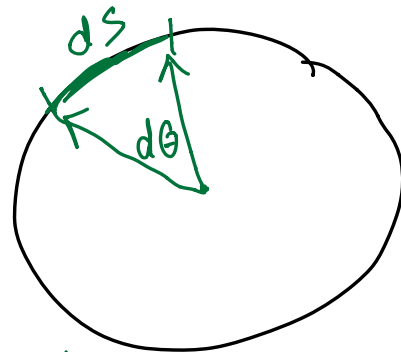
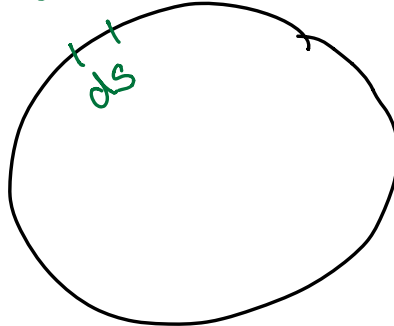
$$\boxed{M = \frac{1}{4} \lambda_0 L}$$

9.



$$\text{length } L = 2\pi R \Rightarrow R = \frac{L}{2\pi}$$

$$M = \int dm \quad dm = \lambda(\theta) ds$$



$$M = \int \lambda(\theta) ds$$

$$= \int \lambda(\theta) R d\theta$$

$$= \int \lambda_0 R d\theta$$

$$= \lambda_0 R \left. \frac{\theta^2}{2} \right|_0^{2\pi} = \frac{\lambda_0 R}{2} 4\pi^2$$

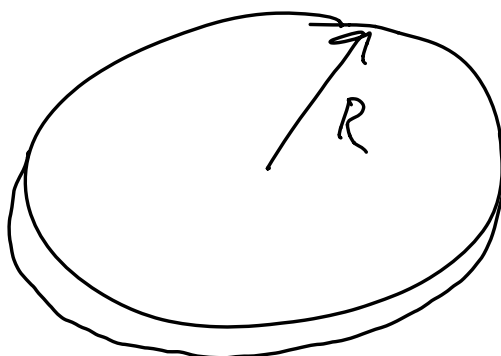
$$= 2\pi^2 \lambda_0 R$$

$$= 2\pi^2 \lambda_0 \frac{L}{2\pi} = \boxed{\pi \lambda_0 L = M}$$

$$ds = \frac{d\theta}{2\pi} \times 2\pi R$$

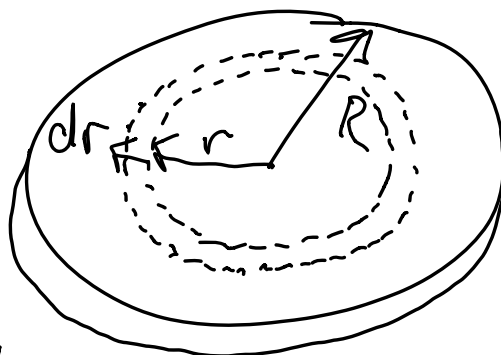
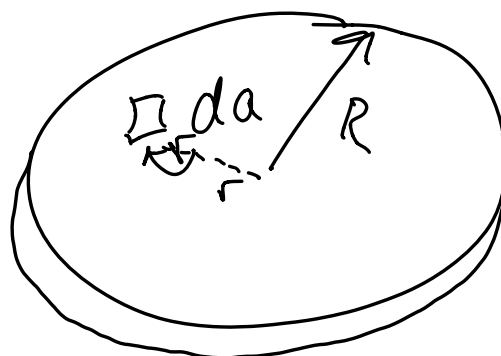
$$ds = d\theta R$$

10.



$$M = \int dm$$

$$dm = \sigma(r) da$$



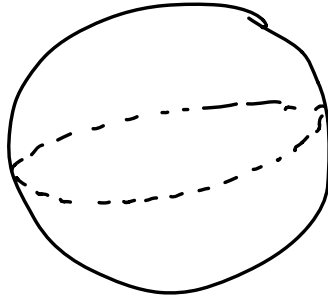
$$da = 2\pi r dr$$

$$dm = \sigma(r) 2\pi r dr$$

$$M = \int_0^R \sigma(r) 2\pi r dr = \int_0^R \sigma_0 \left(\frac{r}{R}\right)^2 2\pi r dr$$

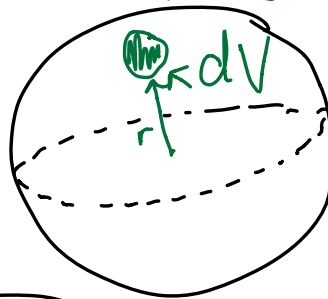
$$M = \frac{\sigma_0}{R^2} \frac{1}{4} R^4 2\pi = \frac{1}{2} \sigma_0 \pi R^2$$

11.



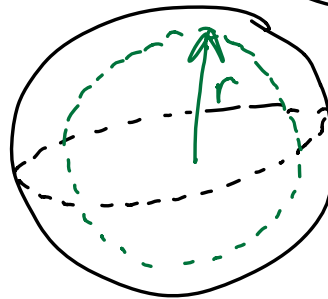
$$M = \int dm$$

$$dm = \rho(r) dV$$



$$M = \int dm$$

$$= \int_0^R \rho(r) 4\pi r^2 dr$$



$$dV = 4\pi r^2 dr$$

$$= \int_0^R \rho_0 \frac{r}{R} 4\pi r^2 dr = \frac{4\pi \rho_0}{R} \frac{1}{4} R^4$$

$$M = \pi \rho_0 R^3$$