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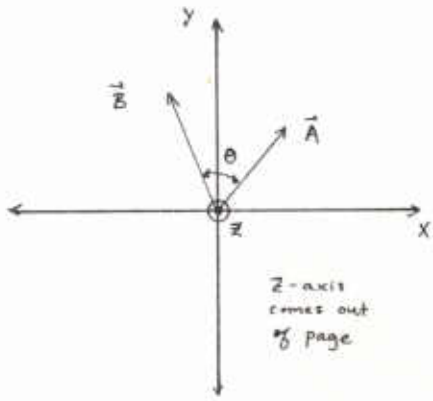
Phys 221 (Section 6)
Quiz #1

1. Express $3.7\frac{\text{ft}^3}{\text{hr}}$ in units of $\frac{\text{cm}^3}{\text{s}}$

$3.7\frac{\text{ft}^3}{\text{hr}} = \left(3.7\frac{\text{ft}^3}{\text{hr}}\right)\left(\frac{12\text{ in}}{\text{ft}}\right)^3\left(\frac{2.54\text{ cm}}{\text{in}}\right)^3\left(\frac{1\text{ hr}}{3600\text{ s}}\right) = 29.1\frac{\text{cm}^3}{\text{s}}$

2. For the vectors sketched in this figure, $|\mathbf{A}| = 7$ and $|\mathbf{B}| = 8$. Both vectors lie in the $x-y$ plane with an angle θ between their directions.



a) If $\mathbf{A}\cdot\mathbf{B} = 32$, what is θ ?

$\vec{A}\cdot\vec{B} = AB\cos\theta = 32 \qquad A = 7 \qquad B = 8$

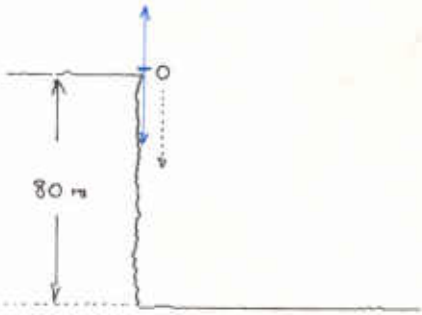
$\rightarrow \cos\theta = \frac{32}{AB} = \frac{32}{56} = 0.571 \rightarrow \theta = 55.2°$

b) What is the magnitude and direction of $\mathbf{A}\times\mathbf{B}$?

$|\vec{A}\times\vec{B}| = |AB\sin\theta| = (7)(8)\sin(55.2°) = 46.0$

By the right-hand rule the direction of $\vec{A}\times\vec{B}$ is along the positive z axis, or out of the page.

3. A rock is dropped off a cliff, 80 m from its base.



a) How long does it take to reach the bottom?

If rock starts at origin then $y = -\frac{1}{2}gt^2$

when does $y = -80$ m ? $\quad -80\text{ m} = -\frac{1}{2}gt^2$

$\rightarrow t = \sqrt{\frac{2(80\text{ m})}{(9.8\text{ m/s}^2)}} = 4.04\text{ s}$

b) What is its speed when it hits?

$v = v_0 + at = 0 - gt = -(9.8\frac{\text{m}}{\text{s}^2})(4.04\text{ s})$

$= -39.6\frac{\text{m}}{\text{s}}$

So the speed at impact is $s = |v| = 39.6\frac{\text{m}}{\text{s}}$

c) What is the speed of the rock when it has fallen 40 m?

When $x = -40$ m, find v :

$v^2 = v_0^2 + 2a(x - x_0) = 0 - 2g(x - x_0) = -2(9.8\frac{\text{m}}{\text{s}^2})(-40\text{ m}) = 784\frac{\text{m}^2}{\text{s}^2}$

$\rightarrow s = |v| = \sqrt{784\text{ m}^2/\text{s}^2} = 28\frac{\text{m}}{\text{s}}$

$1\text{ in} = 2.54\text{ cm} \qquad 1\text{ m} = 3.281\text{ ft} \qquad g = 9.8\frac{\text{m}}{\text{s}^2}$

$x = x_0 + v_0t + \frac{1}{2}at^2 \qquad v = v_0 + at \qquad v^2 = v_0^2 + 2a(x - x_0) \qquad x = x_0 + \frac{1}{2}(v_0 + v)t$