Name: Solutions

1. Find a vector perpendicular to the vectors $\mathbf{v} = \langle 2, 2, 1\rangle$ and $\mathbf{w} = \langle 3, 1, 1\rangle$.

$$\vec{v} \times \vec{w} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 2 & 1 \\ 3 & 1 & 1 \end{vmatrix} = \hat{i}(2-1) - \hat{j}(2-3) + \hat{k}(2-6)$$

$$= \hat{i} + \hat{j} - 4\hat{k}$$

$$= \langle 1, 1, -4 \rangle$$

2. Find the equation of a plane that passes through the points $0(0, 0, 0)$, $P(2, 2, 1)$ and $Q(3, 1, 1)$.

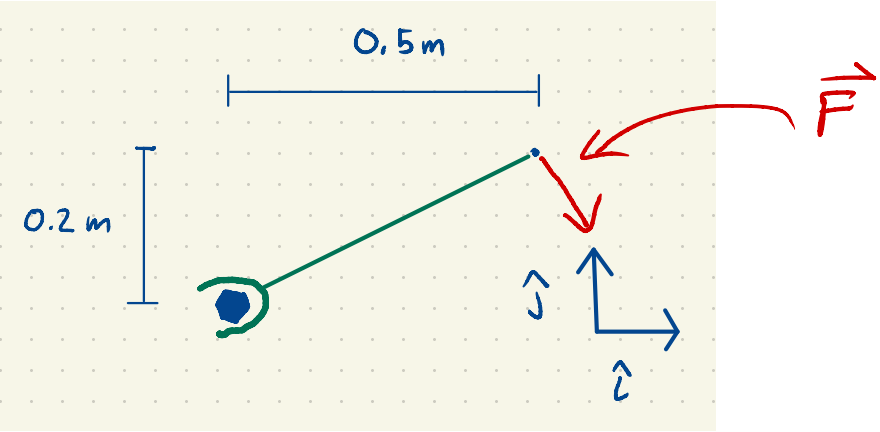
From above: $\vec{OP} \times \vec{OQ} = \langle 1, 1, -4 \rangle$

$$1 \cdot (x-0) + 1 \cdot (x-0) - 4(y-0) = 0$$

3. Find the equation of a plane that is parallel to the plane you found in problem 2 but that passes through the point $R(5, 1, 4)$.

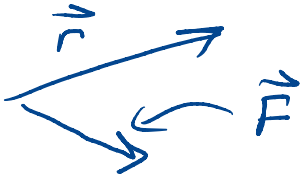
$$(x-5) + (x-1) - 4(y-4) = 0$$

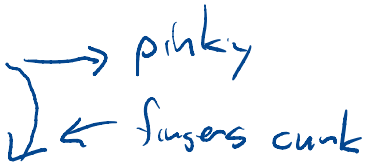
A wrench is tightening a nut as in the diagram below. The nut is located at the origin and the far end of the wrench is located at the point $\mathbf{r} = \langle 0.5, 0.2, 0 \rangle$ with distance measured in meters. A force vector $\mathbf{F}$ is applied: $\mathbf{F}$ points in the direction $\langle 1, -1, 0 \rangle$ and has total length of 100 N.



4. Add a force vector in the diagram. It should point roughly in the right direction. Then determine if the applied torque is pointing into or out of the page.

Into page:





thumb points into page.

5. Compute the torque vector. Please remember to include units!

Direction of force: $\langle 1, -1, 0 \rangle$

Unit vector: $\frac{1}{\sqrt{2}}\langle 1, -1, 0 \rangle$

$$\vec{F} = \frac{100}{\sqrt{2}}\langle 1, -1, 0 \rangle \text{ N}$$

$$\vec{\tau} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0.2 & 0.5 & 0 \\ \frac{100}{\sqrt{2}} & \frac{100}{\sqrt{2}} & 0 \end{vmatrix} = \hat{k}\left(\frac{20}{\sqrt{2}} - \frac{50}{\sqrt{2}}\right) = -\frac{30}{\sqrt{2}}\hat{k} \text{ Nm}$$