

1. (6 points) Find the equation of the plane in standard form that contains the points $P = (1, 1, -2)$, $Q = (2, 3, 1)$, and $R = (4, -1, 1)$.

2. Let $\vec{u} = 2\hat{i} - 3\hat{j} - \hat{k}$ and $\vec{p} = \langle 3, 0, 4 \rangle$. You may use work from one part in other parts.

(a) (4 points) Find the area of the rectangle spanned by \vec{p} and \vec{u} .

(b) (2 points) Find the flux of the constant vector field $\vec{F} = \langle -2, 1, 1 \rangle$ through the parallelogram spanned by \vec{u} and \vec{p} and oriented from \vec{u} to \vec{p} .

(c) (1 point) Find the volume of the box spanned by \vec{F} , \vec{p} , and \vec{u} .

3. Let $\vec{v} = \hat{i} - 2\hat{j} + 2\hat{k}$ and $\vec{w} = \langle 3, -1, 2 \rangle$. You may use work from one part in other parts.

(a) (3 points) Find the cosine of the angle between \vec{v} and \vec{w} .

(b) (4 points) Find $\vec{w}_{\parallel\vec{v}}$ and $\vec{w}_{\perp\vec{v}}$.

(c) (1 point) Find the work done by a force \vec{w} newtons applied to a particle with displacement \vec{v} meters.

(d) (4 points) Find a position function **and** the coordinate equations of a line that passes through the point $(0, 3, -1)$ that is parallel to \vec{w} . The position function should be written as a single vector.