7. (There is no partial credit for this problem. Make sure your answer is correct.) Let $\vec{a} = 2\vec{i} + 4\vec{j} + 6\vec{k}$ and $\vec{b} = 3\vec{i} + 4\vec{j} + \vec{k}$. Find vectors $\vec{u}$ and $\vec{v}$ with $\vec{b} = \vec{u} + \vec{v}$, $\vec{u}$ parallel to $\vec{a}$, and $\vec{v}$ perpendicular to $\vec{a}$.

$\vec{u} = \text{proj}_{\vec{a}}\vec{b} = \frac{\vec{a}\cdot\vec{b}}{\vec{a}\cdot\vec{a}}\vec{a} = \frac{6+16+6}{4+16+36}\vec{a} = \frac{28}{56}\vec{a} = \frac{1}{2}\vec{a} = \vec{i} + 2\vec{j} + 3\vec{k} = \vec{u}$

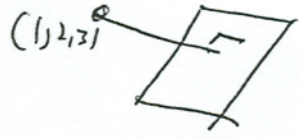
$\vec{v} = \vec{b} - \vec{u} = 2\vec{i} + 2\vec{j} - 2\vec{k} = \vec{v}$

$\vec{u} + \vec{v} = \vec{b}$ ✓

$\vec{u} \parallel \vec{a}$ ✓

$\vec{v} \cdot \vec{a} = 4 + 8 - 12 = 0$ ✓

8. Find the point on $5x + y + z + 17 = 0$ which is closest to $(1, 2, 3)$.



The line is $x = 1 + 5t$
$y = 2 + t$
$z = 3 + t$

The line hits the plane when

$5(1+5t) + (2+t) + (3+t) + 17 = 0$

$25t + t + t + 27 = 0$

$27t + 27 = 0$

$t = -1$

The point is $(-4, 1, 2)$.