7. Consider the curve whose position vector is

$$\vec{r}(t) = 2t^2\,\vec{i} - t^3\,\vec{j} + \tfrac{4}{t}\,\vec{k}.$$

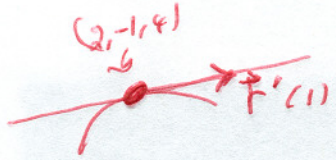
Find the equation of the line tangent to this curve at $t = 1$.

$\vec{r}(1) = 2\vec{i} - \vec{j} + 4\vec{k}$

at $t=1$ the point is $(2,-1,4)$

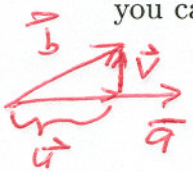
$\vec{r}\,'(t) = 4t\vec{i} - 3t^2\vec{j} - \frac{4}{t^2}\vec{k}$

$\vec{r}\,'(1) = 4\vec{i} - 3\vec{j} - 4\vec{k}$



$$\frac{x-2}{4} = \frac{y+1}{-3} = \frac{z-4}{-4}$$

8. **(There is no partial credit for this problem. Make sure your answer is correct.)** Let $\vec{a} = 1\,\vec{i} - 2\,\vec{j} + 2\,\vec{k}$ and $\vec{b} = 6\,\vec{i} - 7\,\vec{j} + 8\,\vec{k}$. 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 $\vec{a}$. (Every number in the answer is an integer. If you have fractions, either you can rid of them or you have made a mistake.)



$\vec{u} = \text{proj}_{\vec{a}}\vec{b} = \frac{\vec{a}\cdot\vec{b}}{\vec{a}\cdot\vec{a}}\vec{a} = \frac{6+14+16}{1+4+4}\vec{a} = \frac{36}{9}\vec{a}$

$= 4\vec{a} = 4\vec{i} - 8\vec{j} + 8\vec{k} = \vec{u}$

$\vec{v} = \vec{b} - \vec{u} = (6\vec{i} - 7\vec{j} + 8\vec{k}) - (4\vec{i} - 8\vec{j} + 8\vec{k})$

$\vec{v} = 2\vec{i} + \vec{j}$

$\vec{u} \parallel \vec{a}$ ✓

$\vec{u} + \vec{v} = \vec{b}$ ✓

$\vec{v}\cdot\vec{a} = 2 - 2 = 0$ ✓