Name: ____

1. (2 points) Write an equation for the line through the point $(1, 2, 3)$ which is parallel to the line

$$\vec{\ell}(t) = \langle 5t, 3 - 7t, 2 + 4t\rangle$$

Solution: The desired line will have an equation of the form

$$\vec{r}(t) = \langle 1, 2, 3\rangle + t\vec{v}$$

for some $\vec{v}$ which is parallel to the line $\vec{\ell}$. We can write $\vec{\ell}$ as

$$\vec{\ell}(t) = \langle 0, 3, 2\rangle + t\,\langle 5, -7, 4\rangle$$

So we can use $\vec{v} = \langle 5, -7, 4\rangle$, to get our desired line:

$$\vec{r}(t) = \langle 1, 2, 3\rangle + t\,\langle 5, -7, 4\rangle$$

2. (2 points) Write an equation for the plane which contains the points $P = (0, 0, 1)$ and $Q = (1, 1, 0)$, and $R = (-1, 2, 3)$.

Solution: We have three points in the plane, so we just need a normal vector. Notice that the vectors $\overrightarrow{PQ}$ and $\overrightarrow{PR}$ are in the plane, so the normal vector is orthogonal to both. So we can use the cross product:

$$\vec{n} = \overrightarrow{PQ} \times \overrightarrow{PR}$$

First let's find the two vectors:

$$\overrightarrow{PQ} = \langle 1, 1, -1\rangle$$
$$\overrightarrow{PR} = \langle -1, 2, 2\rangle$$

So the normal vector is the cross product of these:

$$\vec{n} = \langle 1, 1, -1\rangle \times \langle -1, 2, 2\rangle = \langle 4, -1, 3\rangle$$

We can use any of the three points to get an equation. Using $P = (0, 0, 1)$, we get

$$4x - y + 3(z - 1) = 0$$

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