Determine if the points $(2, -1, -3)$, $(11, -4, 3)$ and $(-13, 4, -13)$ are collinear using techniques from chapter 11. **SCORE: ____ / 5 PTS**

P Q R

$\overrightarrow{PQ} = \langle 9, -3, 6 \rangle$ (1)

$\overrightarrow{PR} = \langle -15, 5, -10 \rangle$ (1)

$\langle 9, -3, 6 \rangle = k\langle -15, 5, -10 \rangle$

(1)
$9 = -15k \rightarrow k = -\frac{3}{5}$
$-3 = 5k \rightarrow k = -\frac{3}{5}$
$6 = -10k \rightarrow k = -\frac{3}{5}$

$\overrightarrow{PQ} = -\frac{3}{5}\overrightarrow{PR}$ (1)

SO P, Q, R ARE COLLINEAR (1)

Find the volume of the parallelepiped with adjacent edges $\langle -6, -1, 12 \rangle$, $\langle 3, 2, 4 \rangle$ and $\langle -3, -1, 4 \rangle$. **SCORE: ____ / 6 PTS**

(1)
$$\begin{vmatrix} -6 & -1 & 12 \\ 3 & 2 & 4 \\ -3 & -1 & 4 \end{vmatrix} \begin{matrix} -6 & -1 \\ 3 & 2 \\ -3 & -1 \end{matrix}$$

$= (-48 + 12 - 36) - (-12 + 24 - 72)$ (½ ½ ½ ½ ½ ½)

$= -72 - -60$

$= -12$ (1)

VOLUME $= 12$ (1)

Let P be the point $(-2,-1,4)$. Let Q be the point $(1,9,2)$. Let R be the point $(-5,-9,5)$. **SCORE: ____ / 16 PTS**

[a] Find the symmetric equations of the line passing through Q and parallel to the line with parametric equations $x = 2t - 3$, $y = 5 + 4t$, $z = 7 - t$.

$\vec{d} = \langle 2, 4, -1 \rangle$ (1)

$\frac{x-1}{2} = \frac{y-9}{4} = \frac{z-2}{-1}$ OR $2-z$ (1)

[b] Find a unit vector perpendicular to both $\overrightarrow{PQ}$ and $\overrightarrow{PR}$.

$\overrightarrow{PQ} = \langle 3, 10, -2 \rangle$ (½)

$\overrightarrow{PR} = \langle -3, -8, 1 \rangle$ (½)

$\overrightarrow{PQ} \times \overrightarrow{PR} = \langle -6, 3, 6 \rangle$ (2)

$\frac{1}{\sqrt{36+9+36}} \langle -6, 3, 6 \rangle = \frac{1}{\sqrt{81}} \langle -6, 3, 6 \rangle = \left|\frac{1}{9}\right| \langle -6, 3, 6 \rangle = \left\langle -\frac{2}{3}, \frac{1}{3}, \frac{2}{3} \right\rangle$ (1) (1)

[c] Find the parametric equations of the line passing through R and perpendicular to the plane $8x - 9z + 6 = 0$.

$\vec{d} = \langle 8, 0, -9 \rangle$

$x = -5 + 8t$ (1)

$y = -9$ (1)

$z = 5 - 9t$ (1)

[d] Find the area of the triangle with vertices P, Q and R.

$\frac{1}{2} \| \overrightarrow{PQ} \times \overrightarrow{PR} \| = \frac{1}{2}(9) = \left|\frac{9}{2}\right|$ (2)

[e] Find the equation of the plane passing through P, Q and R.

$\vec{n} = \langle -6, 3, 6 \rangle$ OR $\langle -2, 1, 2 \rangle$

$-2(x+2) + (y+1) + 2(z-4) = 0$ (1) (1) (1) (1)

$-2x + y + 2z - 11 = 0$

OK IF YOU USED $\langle -6, 3, 6 \rangle$ AS $\vec{n}$ OR Q OR R AS POINT