Fill in the blanks. The correct answer in each case is either "***a scalar***", "***a vector***" or "***not valid***".

SCORE: _____ / 4 PTS

[a] $(\vec{u} \cdot \vec{v})\vec{w}$ is VECTOR 1

[b] $(\vec{u} \cdot \vec{v}) \times (\vec{u} \cdot \vec{w})$ is NOT VALID 1

[c] $(\vec{u} \times \vec{v})\vec{w}$ is NOT VALID 1

[d] $(\vec{u} \times \vec{v}) \cdot (\vec{u} \times \vec{w})$ is SCALAR 1

Fill in the blanks. GRADED BY ME **SCORE: _____ / 6 PTS**

NOTE: For each part (ie. [a], [b], [c]), you must fill in at least 2 blanks correctly to receive any credit.

[a] If plane $\wp$ is parallel to line ℓ, then the NORMAL vector of plane $\wp$ is PERPENDICULAR to the DIRECTION vector of line ℓ.

[b] If line ℓ is perpendicular to plane $\wp$, then the DIRECTION vector of line ℓ is PARALLEL to the NORMAL vector of plane $\wp$.

[c] If plane $\wp_1$ is parallel to plane $\wp_2$, then the NORMAL vector of plane $\wp_1$ is PARALLEL to the NORMAL vector of plane $\wp_2$.

Fill in the blanks. **SCORE: _____ / 3 PTS**

[a] If $\vec{t} \times \vec{b} = <-3, 2, 6>$, then $\vec{b} \times \vec{t} =$ $\boxed{<3, -2, -6>}$ 1. $-(\vec{t} \times \vec{b})$

[b] $\vec{w} \times \vec{w} =$ $\boxed{\vec{0}}$ 1 ← NO POINTS IF YOU WROTE THE NUMBER 0 INSTEAD OF THE VECTOR $\vec{0}$.

[c] If $\vec{m}$ is a vector of magnitude 8, and $\vec{c}$ is a vector of magnitude 9, and the angle between $\vec{m}$ and $\vec{c}$ is $\frac{5\pi}{6}$ radians,

then the magnitude of $\vec{c} \times \vec{m} =$ $\boxed{36}$ 1. $\|\vec{c}\|\|\vec{m}\| \sin\theta = (9)(8)\sin\frac{5\pi}{6}$

SCORE: _____ / 17 PTS

Let P be the point $(3, -2, -4)$.
Let Q be the point $(1, 1, -2)$.
Let R be the point such that $\overrightarrow{PR} = 3\vec{j} - \vec{k}$.

[a] Find parametric equations for the line which is parallel to $3 + y = \frac{2-z}{5}$, $x = -4$, and also contains Q.

$\vec{d}_1 \parallel \vec{d}_2 \longrightarrow$ USE $\vec{d}_1 = \vec{d}_2 = \langle 0, 1, -5 \rangle$

$$\boxed{\begin{aligned} x &= 1 \\ y &= 1 + t \\ z &= -2 - 5t \end{aligned}}$$

2 IF ALL 3 EQUATIONS CORRECT,
1 POINT IF EXACTLY 2 CORRECT,
0 POINTS IF 0 OR 1 CORRECT

[b] Find the standard (point-normal) equation of the plane which contains P, Q and R.

$\vec{n} \perp \overrightarrow{PQ}$ AND $\overrightarrow{PR} \longrightarrow$ USE $\vec{n} = \overrightarrow{PQ} \times \overrightarrow{PR}$

$\overrightarrow{PQ} = \boxed{\langle -2, 3, 2 \rangle}$ 1

$$\overrightarrow{PQ} \times \overrightarrow{PR} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ -2 & 3 & 2 \\ 0 & 3 & -1 \end{vmatrix} = \boxed{\langle -9, -2, -6 \rangle} \longrightarrow \text{USE } \vec{n} = \langle 9, 2, 6 \rangle$$

3

SANITY CHECK: $\langle 9,2,6 \rangle \cdot \langle -2, 3, 2 \rangle = -18 + 6 + 12 = 0$
$\langle 9,2,6 \rangle \cdot \langle 0, 3, -1 \rangle = \boxed{0 + 6 - 6} = 0$ 1

2 $\boxed{9(x-3) + 2(y+2) + 6(z+4)} = 0$
OR
$\boxed{9(x-1) + 2(y-1) + 6(z+2)} = 0$ 1

[c] Find the area of triangle PQR.

$\frac{1}{2} \| \overrightarrow{PQ} \times \overrightarrow{PR} \| = \frac{1}{2}\sqrt{81 + 4 + 36} = \boxed{\frac{11}{2}}$ 1 1

[d] Find a vector of magnitude 22 perpendicular to both $\overrightarrow{PQ}$ and $\overrightarrow{PR}$.

2

$$22\left(\frac{1}{\|\overrightarrow{PQ} \times \overrightarrow{PR}\|} \overrightarrow{PQ} \times \overrightarrow{PR}\right) = 22\left(\frac{1}{11}\langle -9, -2, -6 \rangle\right) = \boxed{\langle -18, -4, -12 \rangle \text{ OR } \langle 18, 4, 12 \rangle}$$

[e] Find symmetric equations for the line which is perpendicular to $3x - 2z = 6$, and also contains Q.

$\vec{d} \parallel \vec{n} \longrightarrow$ USE $\vec{d} = \vec{n} = \langle 3, 0, -2 \rangle$

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

2 $\boxed{\frac{x-1}{3} = \frac{-z-2}{2}}, \boxed{y = 1}$ 1