1D. Cross Product

2)

$$\vec{PQ} = \langle 1, 1, -1 \rangle$$

$$\vec{PR} = \langle -3, 1, -2 \rangle$$

$$\vec{PQ} \times \vec{PR} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{n} \\ 1 & 1 & -1 \\ -3 & 1 & -2 \end{vmatrix} = -\hat{i} + 5\hat{j} + 4\hat{n}$$

$$A = \frac{1}{2}\left|\vec{PQ} \times \vec{PR}\right| = \frac{1}{2}\sqrt{(-1)^2 + 5^2 + 4^2} = \boxed{\frac{1}{2}\sqrt{42}}$$

5a)

$$|A \times B| = |A||B|\sin\theta$$

$$|A \times B| = |A||B| \;\Rightarrow\; \boxed{\theta = \frac{\pi}{2}}$$

5b)

$$|A \times B| = |A||B|\sin\theta$$

$$A \cdot B = |A||B|\cos\theta$$

$$|A \times B| = A \cdot B \;\Rightarrow\; \sin\theta = \cos\theta \;\Rightarrow\; \boxed{\theta = \cdots, \frac{-7\pi}{4}, \frac{-3\pi}{4}, \frac{\pi}{4}, \frac{5\pi}{4}, \cdots}$$

7)

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

$$\vec{PR} = \langle -1, 0, 1 \rangle$$

$$\vec{PS} = \langle 2, 1, -2 \rangle$$

$$V = \frac{1}{6}\det\left(\vec{PQ}, \vec{PR}, \vec{PS}\right) = \boxed{\frac{1}{6}}$$