

# Math 173 - Quiz 1

January 27, 2011

Name key Score \_\_\_\_\_

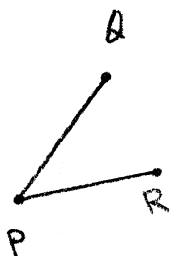
Show each step to receive full credit. Supply explanations when necessary.

1. (3 points) Let  $\vec{u} = 3\hat{i} - 4\hat{j} + 7\hat{k}$  and let  $\vec{v} = -5\hat{i} - \hat{j} + 3\hat{k}$ . Find  $\vec{v} \times \vec{u}$ .

$$\vec{v} \times \vec{u} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -5 & -1 & 3 \\ 3 & -4 & 7 \end{vmatrix} = \hat{i}(-7+12) - \hat{j}(-35-9) + \hat{k}(20+3)$$

$$= \boxed{5\hat{i} + 44\hat{j} + 23\hat{k}}$$

2. (3 points) The points  $P$ ,  $Q$ , and  $R$  are given below. Find the angle between the line segments  $\overline{PQ}$  and  $\overline{PR}$ .



$P(1, 2, 3)$      $Q(-2, 0, 5)$      $R(3, -2, 8)$

$$\vec{PQ} = -3\hat{i} - 2\hat{j} + 2\hat{k}$$

$$\vec{PR} = 2\hat{i} - 4\hat{j} + 5\hat{k}$$

$$\cos \theta = \frac{\vec{PQ} \cdot \vec{PR}}{|\vec{PQ}| |\vec{PR}|} = \frac{-6 + 8 + 10}{\sqrt{17} \sqrt{45}} = \frac{12}{\sqrt{765}}$$

$$\theta = \cos^{-1} \left( \frac{12}{\sqrt{765}} \right)$$

$$\approx 1.122$$

$$\approx 64.29^\circ$$

3. (3 points) Find the projection of  $\vec{w} = 2\hat{i} + \hat{j} + \hat{k}$  onto  $\vec{u} = -3\hat{i} + 2\hat{j} - 2\hat{k}$ .

$$\text{proj}_{\vec{u}} \vec{w} = \frac{\vec{u} \cdot \vec{w}}{\vec{u} \cdot \vec{u}} \vec{u} = \frac{-6 + 2 - 2}{9 + 4 + 4} \vec{u} = \boxed{\frac{-6}{17} (-3\hat{i} + 2\hat{j} - 2\hat{k})}$$

4. (1 point) If  $\vec{u}$  and  $\vec{v}$  are orthogonal to  $\vec{w}$ , is  $\vec{u} + \vec{v}$  orthogonal to  $\vec{w}$ ? Explain your reasoning.

Yes,

$$\vec{w} \cdot (\vec{u} + \vec{v}) = \vec{w} \cdot \vec{u} + \vec{w} \cdot \vec{v}$$

$$= 0 + 0 = 0$$