

# Quiz 1

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## Advanced Computer Graphics II

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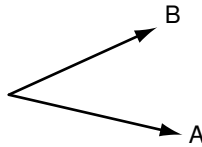
Date: January 21, 2009

1. (20 points) Suppose  $\vec{A}$  and  $\vec{B}$  are both non-zero vectors. Let  $\vec{A} = \{a_x, a_y, a_z\}$  and  $\vec{B} = \{b_x, b_y, b_z\}$ . Further, let  $\theta$  be the angle between them ( $0 \leq \theta \leq \pi$ ). Write an expression for each of the following in terms of  $a_x, a_y, a_z, b_x, b_y,$  and  $b_z$ :

(Note: To simplify the expressions, intermediate variables are allowed.)

- a.)  $\sin \theta$                       b.)  $\vec{A} \cdot \vec{B}$   
c.)  $\cos \theta$                       d.)  $\vec{A} \times \vec{B}$

2. (10 points) Let  $\vec{C} = \vec{A} \times \vec{B}$ . In the following diagram, is  $\vec{C}$  pointing into or out of the page (assuming a right-hand coordinate system)?



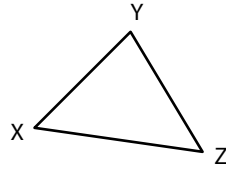
3. (10 points) Write the matrix corresponding to the following system of equations:

$$\begin{array}{rclcl} 7x & - & 10y & & = & -2 \\ 4x & & & + & 2z & = & 2 \\ & & 9y & + & 2z & = & 13 \end{array}$$

4. (30 points) Let  $\vec{X}$  and  $\vec{Y}$  be unit vectors, with  $\phi$  the acute angle between them ( $0 \leq \phi < \frac{\pi}{2}$ ). Which of the following are always true?

- a.)  $\vec{X} \cdot \vec{Y} = \cos \phi$                       b.)  $\vec{X} \cdot \vec{Y} < 0$                       c.)  $\|\vec{X} \times \vec{Y}\| < 1$   
d.)  $\|\vec{X} \times \vec{Y}\| < \cos \phi$                       e.)  $\vec{X} \cdot \vec{Y} > 0$                       f.)  $\vec{X} \cdot \vec{Y} \leq 1$

5. (10 points) Suppose  $X$ ,  $Y$ , and  $Z$  are the vertices of a triangle (as in the diagram below). Let  $\vec{e}_1 = Y - X$  and  $\vec{e}_2 = Y - Z$ . Give an expression for  $X$  using only  $\vec{e}_1$ ,  $\vec{e}_2$ , and  $Z$ .



6. (20 points) Let  $\vec{A} = \{2, -2, 3\}$  and  $\vec{B} = \{-3, 12, 4\}$ . Compute the following:

a.)  $\vec{A} \cdot \vec{B}$

c.)  $\|\vec{A} + \vec{B}\|$

b.)  $\vec{A} \times \vec{B}$

d.)  $\|\vec{B}\|$