

### IGME 309 Exercise 06: 3D Math

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1. (40 points) Given two vectors  $\vec{a} = (1, 2, 2)$  and  $\vec{b} = (3, 4, 0)$ , compute the following:
  - (1) The magnitude of  $\vec{a} =$  \_\_\_\_\_
  - (2) The magnitude of  $\vec{b} =$  \_\_\_\_\_
  - (3) The dot product  $\vec{a} \cdot \vec{b} =$  \_\_\_\_\_
  - (4) The cross product  $\vec{a} \times \vec{b} =$  \_\_\_\_\_
  
2. (30 points)  $\vec{a}$  and  $\vec{b}$  are two 3D vectors. Choose an answer from the provided choices for each of the following questions. “ $\times$ ” means cross product, and “ $\cdot$ ” means dot product.
  - (1)  $(\vec{a} \times \vec{b}) \cdot \vec{a} =$  \_\_\_\_\_
  - (2)  $\vec{a} \cdot \vec{a} =$  \_\_\_\_\_
  - (3)  $\|\vec{b} \times \vec{b}\| =$  \_\_\_\_\_

A. 0    B.  $\|\vec{a}\|$     C.  $\|\vec{b}\|$     D.  $\|\vec{a}\|^2$     E.  $\|\vec{b}\|^2$     F. 1    G. None of them
  
3. (30 points) Finding the intersection point of two lines is a fundamental operation to detect collisions. Given two lines in 2D defined using equations:  $g(t) = P_0 + td_0$ , where  $P_0 = (2, 3)$  and  $d_0 = (2, -1)$ , and  $h(s) = P_1 + sd_1$ , where  $P_1 = (0, 1)$  and  $d_1 = (-1, 1)$ , compute the intersection point of the two lines.