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 $\vec{a}$ = 3.0
   (2) The magnitude of $\vec{b}$ = 5.0
   (3) The dot product $\vec{a} \cdot \vec{b}$ = 11.0
   (4) The cross product $\vec{a} \times \vec{b}$ = (-8.0, 6.0, -2.0)

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) $(\vec{a} \times \vec{b}) \cdot \vec{a}$ = A
   (2) $\vec{a} \cdot \vec{a}$ = D
   (3) $||\vec{b} \times \vec{b}||$ = A

   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.

   Intersection = [-6.0, 7.0]

   t = -4.0, s = 6.0