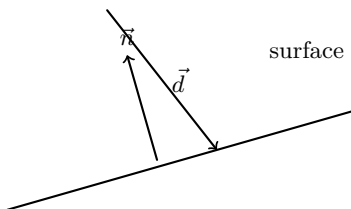


Question 10

A spotlight beam points along $\vec{d} = \langle 2, -1, 2 \rangle$. A surface has unit normal $\vec{n} = \frac{1}{3}\langle 1, 2, 2 \rangle$. Find the magnitude of the component of $\vec{d}$ normal to the surface.

Question 10 – Solution

Strategy Compute the dot product carefully, then choose the formula that matches the question. A zero, positive, or negative dot product also gives immediate geometric information.



Step 1 Because $\vec{n}$ is a unit vector, the normal component magnitude is $|\vec{d} \cdot \vec{n}|$.

Step 2 Compute $\vec{d} \cdot \vec{n} = (2 - 2 + 4)/3 = 4/3$.

Step 3 Therefore the requested magnitude is $\boxed{4/3}$. The absolute value makes the result independent of the chosen normal orientation.

Verification The result follows from the defining vector formulas used above, and each component, magnitude, or scalar condition has been checked against the information in the question.

Key idea The dot product converts two vectors into a scalar measuring directional agreement: positive means generally aligned, zero means perpendicular, and negative means generally opposed.