

Part 0: Core problems

These problems are from the book *Thomas' Calculus Early Transcendentals Custom Edition for the University of Pennsylvania*.

1. Express $\vec{P_1P_2}$ in the form $\vec{v} = v_1\vec{i} + v_2\vec{j} + v_3\vec{k}$, if P_1 is the point $(5, 7, -1)$ and P_2 is the point $(2, 9, -2)$.
2. Express \vec{AB} in the form $\vec{v} = v_1\vec{i} + v_2\vec{j} + v_3\vec{k}$, if A is the point $(-7, -8, 1)$ and B is the point $(-10, 8, 1)$.
3. Express the following vector as a product of its length and direction:

$$\vec{a} = 2\vec{i} + \vec{j} - 2\vec{k}.$$

4. Find the measures of the angles of the triangle whose vertices are $A = (-1, 0)$, $B = (2, 1)$ and $C = (1, -2)$.
5.
 - Cauchy-Schwartz inequality: Since $\vec{u} \cdot \vec{v} = |\vec{u}||\vec{v}| \cos \theta$, show that the inequality $|\vec{u} \cdot \vec{v}| \leq |\vec{u}||\vec{v}|$ holds for any vectors \vec{u} and \vec{v} .
 - Under what circumstances, if any, does $|\vec{u} \cdot \vec{v}|$ equals $|\vec{u}||\vec{v}|$? Give reasons for your answer.
6. Find the parametric equations for the line through the point $P(3, -4, -1)$ parallel to the vector $\vec{i} + \vec{j} + \vec{k}$.
7. Find the parametric equations for the line through the origin parallel to the vector $2\vec{j} + \vec{k}$.
8. Find the parametric equations for the line through $(2, 4, 5)$ perpendicular to the plane $3x + 7y - 5z = 21$.
9. Find the equation for the plane through $A(1, -2, 1)$ perpendicular to the vector from the origin to A .