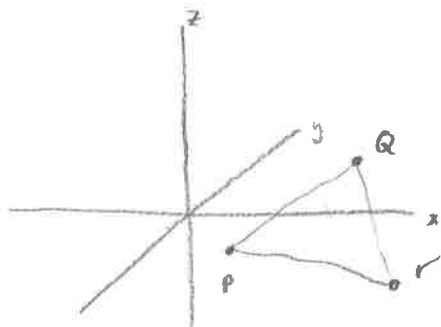


Show your work fully for all questions. Quiz has front and back sides.

Problem 1: Find  $\mathbf{a} \cdot \mathbf{b}$ .  $\mathbf{a} = (4, -2, 3)$ ,  $\mathbf{b} = 2\mathbf{i} + 5\mathbf{k}$ .

$$\begin{aligned}\mathbf{a} \cdot \mathbf{b} &= (4, -2, 3) \cdot (2, 0, 5) \\ &= 4 \cdot 2 + -2 \cdot 0 + 3 \cdot 5 \\ &= 8 + 15 \\ &= 23\end{aligned}$$

Problem 2: Find the lengths of the sides of the triangle with points  $PQR$ . Is it a right triangle? Is it isosceles?  $P = (2, -1, 0)$ ,  $Q = (4, 1, 1)$ ,  $R = (4, -5, 4)$



$$\begin{aligned}\vec{PQ} &= (4-2, 1-(-1), 1-0) = (2, 2, 1) \\ \vec{QR} &= (4-4, -5-1, 4-1) = (0, -6, 3) \\ \vec{RP} &= (2-4, -1-(-5), 0-4) = (-2, 4, -4)\end{aligned}$$

$$|PQ| = \sqrt{2^2 + 2^2 + 1} = \sqrt{9} = 3$$

$$|QR| = \sqrt{0^2 + (-6)^2 + 3^2} = \sqrt{45}$$

$$|RP| = \sqrt{(-2)^2 + 4^2 + (-4)^2} = \sqrt{36} = 6$$

Not isosceles.

$$RP \cdot PQ = -2 \cdot 2 + 2 \cdot 4 + -4 \cdot 1 = 0 \Rightarrow RP \text{ is perpendicular to } PQ$$

$\Rightarrow PQR$  is a right triangle.

**Problem 3:** Find a (non-zero) vector perpendicular to both  $\mathbf{a}$  and  $\mathbf{b}$ .  $\mathbf{a} = (1, -3, 1)$ ,  $\mathbf{b} = (2, 1, 0)$ .

The cross product gives such a vector.

$$\begin{aligned} \mathbf{a} \times \mathbf{b} &= (-3 \cdot 0 - 1 \cdot 1, 1 \cdot 2 - 1 \cdot 0, 1 \cdot 1 - (-3) \cdot 2) \\ &= \boxed{(-1, 2, 7)} \end{aligned}$$

**Problem 4:** Find the equation for the plane through the point  $(1, 2, 5)$  with normal vector  $2\mathbf{i} - \mathbf{j} + \mathbf{k}$ .

The normal vector tells us that the plane has an equation of the form:

$$2x - y + z = C \quad \text{for some } C$$

Plug in the known point:

$$2 \cdot 1 - 1 \cdot 2 + 1 \cdot 5 = 5$$

So our plane is  $\boxed{2x - y + z = 5}$