

# MULTIVARIABLE CALCULUS MATH 2D

---

## Midterm Exam I (with answers)

### Problem 1.

Determine whether the given vectors are orthogonal, parallel, or neither.

a)  $\langle 1, 2, 3 \rangle$  and  $\langle -3, 0, 1 \rangle$

b)  $\langle 3, \sqrt{3}, 1 \rangle$  and  $\langle -1, -\frac{1}{\sqrt{3}}, -\frac{1}{3} \rangle$

c)  $\langle 2, 4, 3 \rangle$  and  $\langle -3, 5, 1 \rangle$

**Answers:**

a) orthogonal;

b) parallel;

c) neither.

### Problem 2.

Calculate the given quantity if

$$\bar{v} = \langle 1, 2, 3 \rangle, \bar{u} = \langle 2, 0, 1 \rangle, \bar{w} = \langle -2, -1, 1 \rangle$$

a)  $2\bar{v} + 2\bar{u} - \bar{w}$

b)  $|\bar{v} \times \bar{u}|$

c)  $\bar{v} \cdot (\bar{u} \times \bar{w})$

**Answers:**

a)  $\langle 8, 5, 7 \rangle$

b)  $\sqrt{45}$

c) -13

### Problem 3.

Find the equation of the plane through  $(1, 2, 3)$  that contains the line

$$x = t + 2, y = 2t - 3, z = -t + 1$$

**Answer:**  $9x - y + 7z = 28$

#### Problem 4.

Find the distance from the origin to the line

$$x = 2t + 2, y = t - 3, z = t - 4$$

**Answer:**  $\sqrt{\frac{55}{2}}$

#### Problem 5.

Reduce the equation to one of the standard forms, classify the surface:

$$x^2 + 2y^2 + 3z^2 - 2x - 4y - 6z - 15 = 0$$

**Answer:**  $\frac{(x-1)^2}{a^2} + \frac{(y-1)^2}{b^2} + \frac{(z-1)^2}{c^2} = 1$ , where  $a^2 = 21, b^2 = 21/2, c^2 = 7$ . It is an ellipsoid.