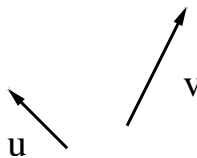


1. Write an inequality or a set of inequalities that describes the half space consisting of all the points to the left of the  $xz$ -plane.

5 pts

2. Copy the vectors below, and use them to sketch  $\mathbf{v} - 3\mathbf{u}$ .



8 pts

3. For each expression below, circle the appropriate choice to indicate that the expression yields a vector, yields a scalar, or is not meaningful.

8 pts

- (a)  $\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})$       scalar      vector      not meaningful
- (b)  $(\mathbf{a} \cdot \mathbf{b}) \times \mathbf{c}$       scalar      vector      not meaningful
- (c)  $\mathbf{a} \times (\mathbf{b} \times \mathbf{c})$       scalar      vector      not meaningful
- (d)  $(\mathbf{a} \cdot \mathbf{b}) \times (\mathbf{c} \cdot \mathbf{d})$       scalar      vector      not meaningful

4. Let  $\mathbf{a} = -\mathbf{i} + 4\mathbf{j}$  and  $\mathbf{b} = 2\mathbf{i} + 3\mathbf{j}$ .

- (a) Draw a sketch of  $\mathbf{a}$ ,  $\mathbf{b}$ , and the projection of  $\mathbf{b}$  onto  $\mathbf{a}$ , labeling each and labeling the tick marks on the axes.

8 pts

- (b) Compute the vector projection of  $\mathbf{b}$  onto  $\mathbf{a}$ .

8 pts

5. Find the value(s) of  $x$  that makes the two vectors  $\langle 3, 2, x \rangle$  and  $\langle 2x, 4, x \rangle$  orthogonal, or state that no such  $x$  exists.

8 pts

(OVER)

6. For  $\mathbf{u} = -\mathbf{i} + 2\mathbf{j} - 4\mathbf{k}$  and  $\mathbf{v} = 2\mathbf{i} - 4\mathbf{j} + 8\mathbf{k}$ , find  $5\mathbf{v} \times \left(\frac{1}{5}\mathbf{u} - \mathbf{v}\right)$ .

8 pts

7. Consider the plane  $2x - y + 5z = 12$ .

(a) State a vector normal to the plane.

7 pts

(b) Find parametric equations for the line through the point  $(-2, 2, 4)$  and perpendicular to the specified plane above.

8 pts

8. Consider the equation  $4(x - 1)^2 = 2(y + 1)^2 + (z - 1)^2$ .

- (a) Write the equation in standard form, classify the corresponding surface, and sketch the surface. Identify the vertex or center point and the axis of symmetry.

8 pts

- (b) Sketch the trace of the surface in the plane  $x = 2$ . (Your picture should be in 2D.) Label the axes, and give exact coordinates for the top-most, bottom-most, left-most, and right-most points.

8 pts

**(OVER)**

9. Find cylindrical coordinates for the point  $(x, y, z) = (1, \sqrt{3}, 2\sqrt{3})$ .

8 pts

10. Sketch and describe fully in words the solid region defined in spherical coordinates by the equations  $0 \leq \phi \leq \pi/3$ ,  $\rho \leq 2$ .

8 pts