

Name:(Last, First)_____

Signature _____

Quiz Section (or Time and TA's Name) _____

Answers on exam. No books or notes. You may remove the scratch paper at the end of your exam. (n) means the problem is worth n points.

1 (20)

2 (20)

3 (20)

4 (15)

5 (25)

Total

(20) 1. Let

$$\vec{a} = \vec{i} + \vec{j}$$

and

$$\vec{b} = 3\vec{i} + 2\vec{j} + \vec{k}.$$

Find a vector \vec{u} such that

(i) $\vec{u} = c\vec{b}$ for some scalar c , and

(ii) $\vec{a} - \vec{u} \perp \vec{b}$,

where \perp means orthogonal or perpendicular.

Draw a picture illustrating the relations between \vec{a} , \vec{b} and \vec{u} .

(20) 2. Suppose a quadrilateral has all four sides of equal length and both pairs of opposite sides parallel. Draw a picture of the quadrilateral, label two adjacent sides as vectors and describe the two diagonals as vector combinations of those two vectors. Then prove that the two diagonals are orthogonal.

(20) 3. Let $\vec{a} = \langle a_1, a_2, a_3 \rangle$ and $\vec{b} = \langle b_1, b_2, b_3 \rangle$.

(a) Give the definition of the cross product $\vec{a} \times \vec{b}$ by writing out its three coordinates.

(b) Prove that $\vec{a} \times \vec{b}$ is orthogonal to \vec{b} , by using your answer to (a) and the coordinate definition of dot product.

(15) 4. Find the volume of the parallelepiped having three adjacent edges

$$\vec{a} = \vec{i} + \vec{k}$$

$$\vec{b} = \vec{i} - \vec{j}$$

$$\vec{c} = \vec{i} + 2\vec{j} - 4\vec{k}.$$

(25) 5. Find the equation of the plane that passes through the point $(1, 2, 3)$ and contains the line

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

Draw a picture to illustrate your answer.