

Name: \_\_\_\_\_

Student Number: \_\_\_\_\_

Answer all questions and show all your work. No calculators allowed. (Total Marks: 38).  
You have 20 minutes to complete the quiz.

1. Let  $\mathbf{v} = (1, 2, 4)$ ,  $\mathbf{e} = (3, 2, 1)$ ,  $\mathbf{u} = (3, 2, 4)$ . Calculate each of the following:

[5] (a)  $\text{proj}_{\mathbf{e}} \mathbf{v}$

[5] (b)  $\mathbf{v} \times \mathbf{u}$

[5] (c) The area of the parallelogram determined by  $\mathbf{u}$  and  $\mathbf{v}$

[5] 2. Find all  $k \in \mathbb{R}$  such that  $(-1, -2, k, -4)$  is orthogonal to  $(-2, 5, k, 2)$ .

3. Let  $\mathbf{u}, \mathbf{v}, \mathbf{w}$  be vectors in  $\mathbb{R}^3$ . Which of the following expressions make sense? If they don't, explain why.

[2] (a)  $\mathbf{u} \bullet (\mathbf{v} + \mathbf{w})$

[2] (b)  $\|\mathbf{v} \bullet \mathbf{u}\|$

[2] (c)  $(\mathbf{u} \bullet \mathbf{v}) + \mathbf{u}$

[2] (d)  $(\mathbf{u} \bullet \mathbf{v}) \times \mathbf{w}$

[2] (e)  $(\mathbf{u} \times \mathbf{v}) \times \mathbf{w}$

[8] 4. Let  $\mathbf{u} = (a, b, c)$ ,  $\mathbf{v} = (d, e, f)$ . Prove that  $\mathbf{u} \times \mathbf{v}$  is orthogonal to  $\mathbf{v}$ .