

Books, watches, notes or cell phones are **not** allowed. The **only** calculators allowed are the Sharp EL-531\*\*\*. You **must** show all your work, the correct answer is worth 1 mark the remaining marks are given for the work.

**Question 1.** (5 marks) Let  $\mathbf{u}$  and  $\mathbf{v}$  be unit vectors, such that the angle between them is  $\frac{2\pi}{3}$ . Find  $\|5\mathbf{u} - 2\mathbf{v}\|$ .

**Question 2.** (5 marks) Given a parallelogram with vertices  $A, B, C$  and  $D$  where  $A(2, -2, 4)$  and where the sides of the parallelogram are parallel to  $\vec{u} = (1, 2, 3)$  and  $\vec{v} = (-3, 2, 5)$ . Find the vertices  $B, C$  and  $D$ .

**Question 3.** (5 marks) Consider two  $4 \times 4$  matrices  $A$  and  $B$ , with  $\det(\text{adj}(AB)) = -8$  and  $\det(B) = 3$ . Find the determinant of  $M$ , given

$$\det(\det(B)B^TMA^{-1}) = \det(5\text{adj}(B)A^2).$$

**Question 4.** (3 marks) Determine whether the following statement is true or false. If the statement is false provide a counterexample. If the statement is true provide a proof of the statement.

If  $A$ ,  $B$  and  $C$  are  $n \times n$  matrices such that  $A\mathbf{x} = \mathbf{0}$  has infinitely many solutions then  $(A^TC^{-1} + (BA)^T)\mathbf{x} = \mathbf{0}$  has infinitely many solutions.