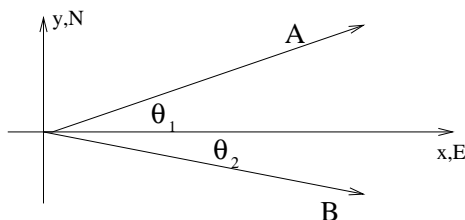


Use colored paper provided for your solution showing all work. At the end of the exam it should be stapled to the question sheet which should have your name. Please write everything pertaining to the same problem in one place if possible.

No calculators or other aids of any kind. Show all work.

The total possible number of points is 67, 60 may be considered a perfect score.

- (1) Two tug boats A and B are pulling a barge. If the barge is to move due east in the direction of the x -axis find the magnitude of the force with which B has to pull if the magnitude of the force exerted by A is 20 units, its direction is north of east making angle θ_1 with the x -axis such that $\tan \theta_1 = 3/4$ and B pulls in the direction south of east making angle θ_2 with the x -axis such that $\tan \theta_2 = 5/12$. What is the resultant of the forces exerted by A and B ? [9]



- (2) Determine whether the points $A(8, 3, -3)$, $B(-1, 6, 3)$ and $C(2, 5, 1)$ lie in a straight line. [7]
- (3) What equation must be satisfied by the three direction cosines $\cos \alpha$, $\cos \beta$, $\cos \gamma$ of any vector $\hat{v} \neq \hat{0}$? Use this equation to find the possible angles γ a vector makes with the z -axis if it is known that $\cos \alpha = 1/\sqrt{6}$, $\cos \beta = 1/\sqrt{3}$. [7]
- (4) Find parametric equations of the line through $A(4, 2, 1)$ orthogonal to the plane $2x - 3y + 4z = 0$ and find the point of intersection of line and plane. [9]
- (5) If A, B, C are points in space such that $B \neq C$ show that the distance d of A from the line BC is given by $d = |\overrightarrow{AB} \times \overrightarrow{BC}|/|BC|$. Use this to find the distance if $A(-1, -1, -1)$, $B(2, 0, 5)$, $C(1, 2, 3)$. [10]
- (6) (a) Determine the distance of the point $A(1, 0, -1)$ from the plane $2x + 3y - 4z + 5 = 0$, (b) Show that the line through A and $B(0, 2, 0)$ is parallel to the plane. [8]
- (7) Supposing $P(-1, 2, 1)$, $Q(1, -1, 0)$ and $R(2, 0, 2)$, (a) determine the area of the triangle PQR , (b) determine an equation of the plane through P, Q, R . [10]
- (8) Reduce the equation to one of the standard equations.

$$-4x^2 + y^2 + z^2 + 8x + 4z - 4 = 0$$

Classify the surface, giving its name, axis, vertex or center, whichever exist and sketch the surface. Be sure to label the coordinate axes as x, y, z . [7]