Read each problem **very carefully** before starting to solve it. Each problem is worth 10 points. It is necessary to show **all** your work. Correct answers without explanations are worth 0 points. GOOD LUCK!!

1. Find the exact value of the expression $\cos\left(\sin^{-1}\left(\frac{3}{4}\right) - \sin^{-1}\left(-\frac{12}{13}\right)\right)$

2. Solve the following equation in $0 \leq x < 2\pi$:

$$\sin x \cos 2x - \cos x \sin 2x = \frac{\sqrt{3}}{2}.$$

3. A radio antenna 100 feet high is located at the top of a building. At some point on the ground, a certain distance from the base of the building, the angle of elevation to the top of the antenna is 60° and the angle of elevation from the bottom of the antenna is 45°. Find the height of the building.

4. A ship leaves a port at a speed of 16 mph at a heading of 32° (clockwise direction from north). One hour later another ship leaves the port at a speed of 22 mph at a heading of 332°. What is the distance between the two ships 4 hours after the first ship leaves the port? Please show all your work.

5. Consider the following two vectors: $\vec{v} = \langle -2, 4 \rangle$ and $\vec{w} = \langle 4, -3 \rangle$. In the following questions, you must do the work algebraically and plot only when explicitly asked to do so.

(a) Plot those $\vec{v}$ and $\vec{w}$ in the Cartesian plane.

(b) Find the vector $-3 \cdot \vec{w}$.

(c) Compute exactly (no decimals) $\|\vec{v}\|$.

(d) Find the vector $\vec{v} + \vec{w}$. Plot $\vec{v} + \vec{w}$ in the same system of axes as those in Part (a).

(e) Find the unit vector in the direction of $\vec{w}$.