Work as many of the following problems as you can. To assure partial credit, show your work. Calculators are permitted for this exam.

(16 pts) 1. Determine the exact values of the following expressions, or, if the expression is undefined, say so.

a) \( \sin \left( \sin^{-1} \left( -\frac{1}{2} \right) \right) \)

b) \( \sin^{-1} \left( \sin \left( \frac{5\pi}{4} \right) \right) \)

c) \( \tan \left( \tan^{-1} \left( \frac{2000\pi}{11} \right) \right) \)

d) \( \sin \left( \tan^{-1} (3) \right) \)

(10 pts) 2. Find an equation for the line through \((4, -1)\) which is perpendicular to the line \(2x + 3y = 0\).
(16 pts) 3. How many triangles are there, labelled in the standard way, with:

a) $\alpha = 25^\circ$, $c = 5$, $a = 4$

b) $\beta = 38^\circ$, $a = 5$, $b = 2$

c) $\gamma = 72^\circ$, $b = 100$, $c = 25,000$

d) $\alpha = 25^\circ$, $b = 100$, $c = 9$

(10 pts) 4. Given $\alpha = 51.3^\circ$, $b = 23.5$ and $c = 40.0$, find the remaining parts of (all) triangle(s) $ABC$ having such an angle $\alpha$ and such sides $b$ and $c$. 
5. Two ships leave port at noon; one of them a tugboat sailing steadily at 6 mph, at a bearing of N43°W; and the other a cruise ship sailing steadily at 8 mph, at a bearing of N20°E.

a) At 2 PM, what is the distance between the ships (rounded off to the nearest mile).

b) Again at 2 PM, what is the bearing from the cruise ship to the tugboat?
(10 pts) 6. Find an equation for the parabola with focus at \( F(1,1) \) and whose directrix is the line \( x = 3 \).

\[ x^2 + 12x - 8y + 44 = 0 \]

(10 pts) 7. Find the focus and directrix of the parabola given by the equation

(10 pts) 8. Find an equation for the ellipse with foci \( F(1,2) \) and \( F'(1,-4) \), and with minor axis of length 10.