

Math 110 Final Exam

December 19, 2016

Problem(s) Score Total

Problem(s)	Score	Total

Time: 2 hour and 30 minutes

Instructions: Show all work for full credit.
No outside materials or calculators allowed.

Extra Space: Use the backs of each sheet for extra space. Clearly label when doing so.

Name: _____

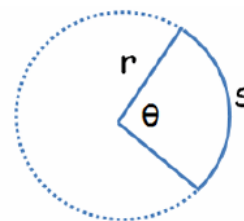
ID #: _____

Instructor/Section: _____

"I pledge by my honor that I have abided by the NJIT Academic Integrity Code."

_____ (Signature)

Circular motion and equations relating to a sector of a circle, radius r (as shown to the right).



$$A = \frac{1}{2}\theta r^2 \quad (\text{where } A \text{ is the area of the sector cut out by } \theta)$$

$$s = r\theta \quad (\text{where } s \text{ is the arc length as shown})$$

$$v = \omega r \quad (\text{where } v \text{ is velocity and } \omega \text{ is angular velocity})$$

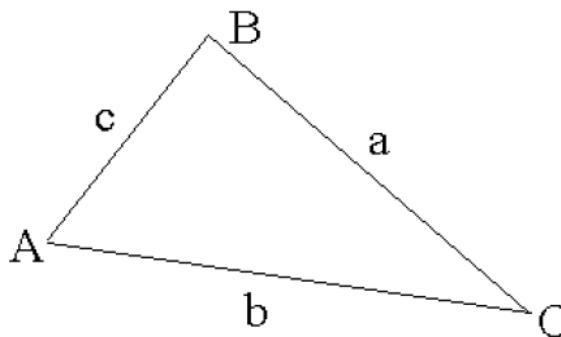
$$\sin(A+B) = \sin(A)\cos(B) + \sin(B)\cos(A)$$

$$\sin(A-B) = \sin(A)\cos(B) - \sin(B)\cos(A)$$

$$\cos(A+B) = \cos(A)\cos(B) - \sin(A)\sin(B)$$

$$\cos(A-B) = \cos(A)\cos(B) + \sin(A)\sin(B)$$

Given $\triangle ABC$ as shown to the right:



$$\frac{\sin(A)}{a} = \frac{\sin(B)}{b} = \frac{\sin(C)}{c}$$

$$a^2 = b^2 + c^2 - 2bc \cos(A)$$

$$b^2 = a^2 + c^2 - 2ac \cos(B)$$

$$c^2 = b^2 + a^2 - 2ab \cos(C)$$

$$\text{Area of } \triangle ABC = \sqrt{s(s-a)(s-b)(s-c)} \quad \text{where } s = (a+b+c)/2$$

1. (12 pts) Find the exact value of the following, or state that it is undefined.

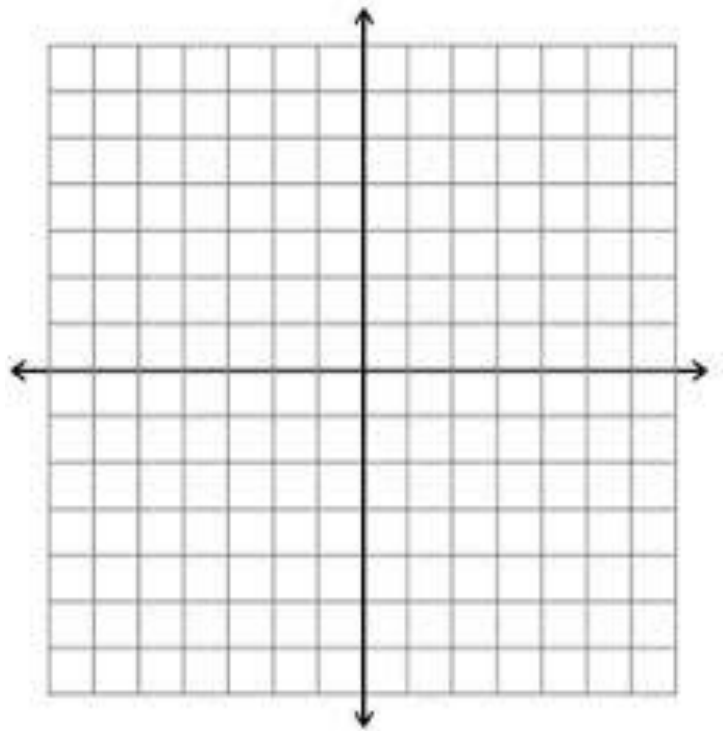
a) $\cos\left(\frac{16\pi}{3}\right)$

b) $\tan\left[\sin^{-1}\left(-\frac{4}{7}\right)\right]$

c) $4^x \cdot 2^{1-2x}$

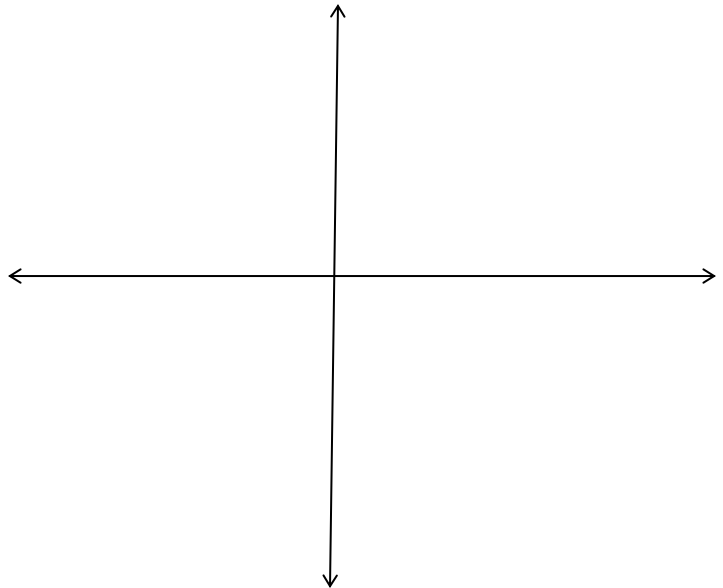
d) $\sin^2\left(\frac{5\pi}{4}\right)$

2. a) (4 pts) Sketch the equation of the ellipse on the axis below by finding and labeling the center and the vertices on the graph: $\frac{(x+1)^2}{16} + \frac{(y-2)^2}{4} = 1$.



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- b) (4 pts) Graph one period of the equation below on the set of axes by finding the amplitude, period and the quarter points. Be sure to label the 5 key points on the graph.

$$y = 3 \sin \left[\frac{1}{2}(x - \pi) \right]$$



3. (12 pts) Solve the following equation for all values of x.

a) $\log_2(x - 3) + \log_2(x - 4) = 1$

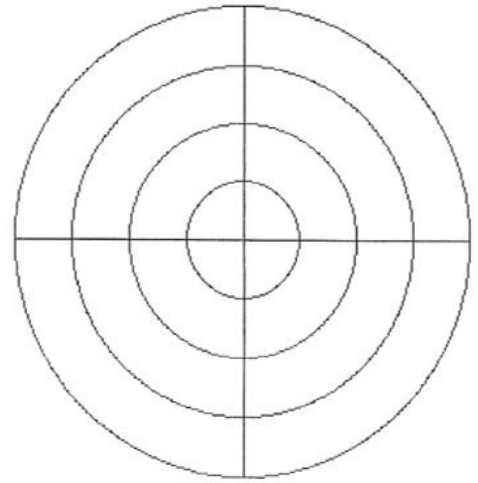
b) $e^{3x} = 4e^{2x} - 3e^x$

c) $x^3 + 2x^2 = 2x$

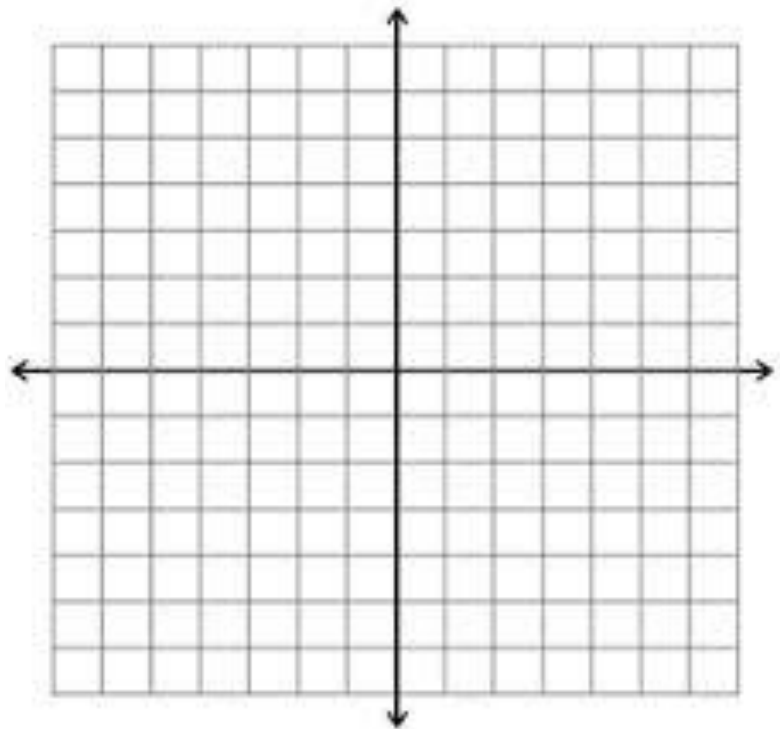
d) Solve for all values of x in $[0, 2\pi)$

$$2 \sin\left(x - \frac{\pi}{6}\right) + 1 = 2$$

4. a) (4 pts) Sketch the graph of the polar curve: $r = 2 \cos(2\theta)$ on the polar axis given below.



b) (4 pts) Use transformations or a table of values to sketch the graph of: $y = -\ln(x + 1) - 1$. Be sure to identify and label the asymptote, if any exist.



5. (12 pts) Given $\sin(\beta) = \frac{3}{5}$ with β in Quad. II and $\cos(\alpha) = \frac{5}{13}$ with α in Quad. IV. Evaluate the following.

a) $\sin(\alpha + \beta)$

b) $\cos(2\alpha)$

c) $\sin\left(\frac{\beta}{2}\right)$

d) $2\cos^2(3\beta) + 2\sin^2(3\beta)$

6. (8 pts) Find the Partial Fraction Decomposition for the following rational expression.

$$\frac{2x + 1}{x^2 + 3x + 2}$$

7. **(10 pts)** A wheel of radius 4 inches rolls 9π inches to the left. A point on the rim of this wheel has the initial Cartesian coordinates with respect to the center of the wheel of $(-\sqrt{7}, 3)$. Find the final Cartesian coordinates of this point with respect to the center of the wheel after it stops.

8. (10 pts) A system of linear equations is given below along with its associated augmented matrix form. Use any method discussed in class to solve for x, y and z.

$$\begin{cases} x - y - z = 1 \\ 2x - 3y + z = 10 \\ 2y - z = -1 \end{cases}$$

$$\left[\begin{array}{ccc|c} 1 & -1 & -1 & 1 \\ 2 & -3 & 1 & 10 \\ 0 & 2 & -1 & -1 \end{array} \right]$$

9. (10 pts) Given $A = \begin{bmatrix} 1 & 4 \\ 2 & 7 \end{bmatrix}$, $B = \begin{bmatrix} 3 & -1 \\ 4 & 0 \end{bmatrix}$ and $C = \begin{bmatrix} 2 & 1 & -2 \\ 0 & -1 & 3 \end{bmatrix}$, perform the following matrix operation, if possible. If not, explain why.

a) $B - A$

b) $3BC$

c) Solve for the unknown matrix X .

$$3A - X = 2B$$

10. (4 pts) In a triangle $\triangle ABC$, $b = \sqrt{6}$, $c = 2$ and $\angle B = 60^\circ$, find $\angle C$.

11. a) (3 pts) Given $f(x) = x^2 - 1$, evaluate the following expression. Simplify completely.
$$\frac{f(t+h) - f(t)}{h}$$

b) (3 pts) Simplify completely:
$$\frac{\sqrt[3]{x^5}}{2x^2(16x^3)^{-\frac{1}{2}}}$$