Final Exam                                Name (Print)_________________
MTH 114, Section #______                Signature_____________________
Tuesday, May 2, 2006                   PID#_________________________

DO NOT BEGIN THIS TEST UNTIL YOU ARE TOLD TO DO SO.
This exam consists of 12 multiple choice questions and 11 open-ended questions on 11
pages, including this front page and formula sheet.

Turn in all 11 pages of this exam.

Circle the letter of the correct answer for multiple choice questions #1-12. Write your
answers on the line provided for open-ended questions #13-23.

Show your work for open-ended questions #13-23!!! NO WORK = NO CREDIT! You
must show work that supports your answer in order to get credit. Be neat and orderly.

For problems asking for EXACT answers, leave in terms of fractions, $\pi$ and $\sqrt{\text{number}}$. For decimal answers, round to 1 decimal place unless otherwise specified.

Give measurement units (feet, degrees, etc.) when appropriate.

<table>
<thead>
<tr>
<th>#</th>
<th>Score</th>
<th>Possible</th>
<th>#</th>
<th>Score</th>
<th>Possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12</td>
<td>12x6=72</td>
<td></td>
<td>19</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>10</td>
<td></td>
<td>20</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>10</td>
<td></td>
<td>21</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>14</td>
<td></td>
<td>22</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>8</td>
<td></td>
<td>23</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>8</td>
<td>TOTAL</td>
<td></td>
<td></td>
<td>200</td>
</tr>
</tbody>
</table>
Multiple Choice Questions – Circle the letter of the correct answer.  
6 points each.

1. Find the exact value of \( \csc\left(-\frac{4\pi}{3}\right) \)

   a) -2  
   b) \(-\frac{1}{2}\)  
   c) \(-\frac{2\sqrt{3}}{3}\)  
   d) \(\frac{2\sqrt{3}}{3}\)  
   e) 2

2. Find the exact value of \( \tan^{-1}\left(\tan\frac{7\pi}{4}\right) \).

   a) \(\frac{5\pi}{4}\)  
   b) \(-\frac{\pi}{4}\)  
   c) \(\frac{\pi}{4}\)  
   d) \(\frac{3\pi}{4}\)  
   e) \(\frac{7\pi}{4}\)

3. Two coterminal angles of \(\frac{12\pi}{5}\) are:

   a) \(\frac{2\pi}{5}, \frac{7\pi}{5}\)  
   b) \(\frac{2\pi}{5}, \frac{22\pi}{5}\)  
   c) \(\frac{11\pi}{5}, \frac{13\pi}{5}\)  
   d) \(\frac{14\pi}{5}, \frac{16\pi}{5}\)

4. The reference angle for \(\theta = -92^\circ\) is:

   a) -92°  
   b) 2°  
   c) 88°  
   d) 178°  
   e) 268°
5. The polar form of the rectangular equation \( x^2 + y^2 - 7x = 0 \) is:

a) \( r = 7\cos \theta \)  

b) \( r = 7\sin \theta \)  

c) \( r = 7r\cos \theta \)  

d) \( r^2 = 7x \)  

e) \( x^2 + y^2 = 7r\cos \theta \)  

f) None of these.

6. Match the graph with the correct function:

![Graph Image]

a) \( 5\cos \left( 3x - \frac{3\pi}{4} \right) \)  

b) \( -5\sin \left( \frac{2\pi}{3} x - \frac{\pi}{4} \right) \)  

c) \( 5\sin \left( \frac{2\pi}{3} x + \frac{\pi}{12} \right) \)  

d) \( 5\cos \left( \frac{2\pi}{3} x - \frac{\pi}{12} \right) \)  

e) \( -5\sin \left( 3x - \frac{3\pi}{4} \right) \)  

f) None of these.

7. The minute hand of a clock is 6 inches long. How far does the minute hand move in 25 minutes?

a) \( \frac{6}{25} \text{ inches} \)  

b) \( \frac{5}{12} \text{ inches} \)  

c) \( \frac{5\pi}{2} \text{ inches} \)  

d) \( 5 \text{ inches} \)  

\( 5\pi \text{ inches} \)
8. The largest angle of a triangle with sides 4, 7 and 9 is approximately:

a) $50^\circ$  
b) $73.4^\circ$  
c) $90^\circ$  
d) $106.6^\circ$  
e) $163.4^\circ$  
f) Not enough information.

9. A triangular garden plot has sides 4 meters and 5 meters with the angle between the sides measuring $25^\circ$. What is the approximate area of the garden?

a) $1.3 \text{ m}^2$  
b) $4.2 \text{ m}^2$  
c) $6 \text{ m}^2$  
d) $8.5 \text{ m}^2$  
e) $9.1 \text{ m}^2$

10. A polar representation of the rectangular coordinates $(-\sqrt{3}, -1)$ is:

a) $(2, \frac{\pi}{6})$  
b) $(-2, \frac{\pi}{6})$  
c) $(-2, \frac{4\pi}{3})$  
d) $(-2, \frac{\pi}{5})$  
e) None of these.

11. When tuning a piano, a technician strikes a tuning fork for the “A” above “middle C” and sets up a wave motion approximated by $d = 0.001\sin 880\pi t$, where $t$ is in seconds. The frequency (in cycles per second) of this note is:

a) $0.001$  
b) $\frac{1}{880\pi}$  
c) $\frac{1}{440}$  
d) $440$  
e) $880$

12. If $\cos x = -\frac{1}{5}$, then $\cos(x - 2\pi)$ is:

a) $-\frac{2\sqrt{6}}{5}$  
b) $-\frac{6}{5}$  
c) $-\frac{1}{5}$  
d) $\frac{1}{5}$  
e) $\frac{2\sqrt{6}}{5}$
Open-ended Questions – Points for each question are labeled.
Show your work, give EXACT answers when requested.

13. (10 points) Determine the period, phase shift, vertical shift, and range for the
   graph of \( y = -2 - 3\sec(4x + \frac{x}{3}) \).

   Period = ________________

   Phase Shift = ____________

   Vertical Shift = __________

   Range = ________________

14. (10 points) Solve the triangle(s).

   \( a = 11 \quad B = 36^\circ \quad b = 12 \)
15. (14 points) Verify the identity. Work on ONE side only:

\[
\frac{\sec\left(\frac{\pi}{2} - x\right)}{\csc x + \sin(-x)} - 1 = \tan^2 x
\]
16. (8 points) Find the EXACT value of $\csc \left( \tan^{-1} \left( -\frac{5}{4} \right) \right)$.

17. (12 points) Plot and label the following polar coordinates. Convert the points from polar to rectangular coordinates (Exact values).

   a. $\left( 2, \frac{5\pi}{6} \right)$  ( , )

   b. $\left( -4, \frac{\pi}{2} \right)$  ( , )

   c. $\left( 3, -\frac{\pi}{3} \right)$  ( , )

   d. $\left( -5, -\frac{3\pi}{4} \right)$  ( , )
18. (8 points) Find all EXACT solutions of \( x \) in \([0, 2\pi)\):

\[
\cos 2x = \frac{1}{2}
\]

19. (14 points) Find all GENERAL solutions for \( x \):

\[
\tan^2 x + \sec x = 5
\]

Give algebraic solutions only, EXACT if possible. Round all other solutions to 4 decimal places.
20. (16 points) Given $\csc u = -\frac{5}{2}$ and $\frac{3\pi}{2} < u < 2\pi$ and $\cot v = 3$ with $\sec v < 0$, find the EXACT value of:

a. $\sin (u - v)$

b. $\cos \left(\frac{u}{2}\right)$

21. (12 points) An observer’s eye is 6 feet above the floor. A painting is being viewed. The bottom of the painting is at floor level. The angle of depression from the observer’s eye to the bottom of the painting is $12^\circ$ and the angle of elevation from the observer’s eye to the top of the painting is $18^\circ$. How tall is the painting? [Draw a fully labeled diagram of the given information as part of your answer.]
22. (12 points) If you are on island C, what bearing should you navigate to go to island A?

![Diagram](image)

23. (12 points) MaCherie is driving north along a straight road in central Colorado. She looks out the left window of her car and sees Long’s Peak at a bearing of N15°W. After traveling at 45 miles per hour for 15 minutes, she looks out the window again and sees Long’s Peak at a bearing of N30°W. How far was MaCherie from Long’s Peak at the first sighting? [Draw a fully labeled diagram, showing bearings, as part of your answer.]
Math 114 Final Exam
Tuesday, May 2, 2006

Section # _____ Name ______________________ PID # _____________

FORMULA SHEET

(Sum, Difference, Double and Half Angle Formulas Only)

\[
\sin(u \pm v) = \sin u \cos v \pm \cos u \sin v \quad \cos(u \pm v) = \cos u \cos v \mp \sin u \sin v
\]

\[
\tan(u \pm v) = \frac{\tan u \pm \tan v}{1 \mp \tan u \tan v} \quad \tan(2u) = \frac{2\tan u}{1 - \tan^2 u}
\]

\[
\sin 2u = 2 \sin u \cos u \quad \cos 2u = \cos^2 u - \sin^2 u = 2 \cos^2 u - 1 = 1 - 2 \sin^2 u
\]

\[
\tan\left(\frac{u}{2}\right) = \frac{1 - \cos u}{\sin u} = \frac{\sin u}{1 + \cos u} \quad \sin\left(\frac{u}{2}\right) = \pm \sqrt{\frac{1 - \cos u}{2}} \quad \cos\left(\frac{u}{2}\right) = \pm \sqrt{\frac{1 + \cos u}{2}}
\]