This exam contains 4 pages (including this cover page) and 25 problems. Check to see if any pages are missing. Enter all requested information on the top of this page, and put your initials on the top of every page, in case the pages become separated.

You may not use your books, notes, or any calculator on this exam.

You are required to show your work on each problem on this exam. The following rules apply:

- **Organize your work**, in a reasonably neat and coherent way, in the space provided. Work scattered all over the page without a clear ordering will receive very little credit.

- **Mysterious or unsupported answers will not receive full credit**. A correct answer, unsupported by calculations, explanation, or algebraic work will receive no credit; an incorrect answer supported by substantially correct calculations and explanations might still receive partial credit.

- If you need more space, use the back of the pages; clearly indicate when you have done this.

- This practice exam is much much longer than the real midterm exam. It is provided to make you more familiar with the types of questions that may appear on the real midterm exam.
1. (a) 125  
(b) 4  
(c) 9  

2. (a) True  
(b) False; for example,  
\[(x^3 + x + 1) + (-x^3 + x^2 + 5) = x^2 + x + 6.\]  
(c) True  
(d) False; for example, \(x^2 + 1.\)  

3. (a) \(f(x) \to \infty\) as \(x \to \infty\) and \(f(x) \to -\infty\) as \(x \to -\infty.\)  
(b) \(f(x) \to -\infty\) as \(x \to \infty\) and \(f(x) \to -\infty\) as \(x \to -\infty.\)  
(c) \(f(x) \to \infty\) as \(x \to \infty\) and \(f(x) \to -\infty\) as \(x \to -\infty.\)  
(d) \(f(x) \to 0\) as \(x \to \infty\) and \(f(x) \to 0\) as \(x \to -\infty.\)  
(e) \(f(x) \to 3\) as \(x \to \infty\) and \(f(x) \to 3\) as \(x \to -\infty.\)  

4. \[
\frac{x^3 + 10x^2 - 4x + 7}{x - 2} = x^2 + 12x + 20 + \frac{47}{x - 2}.
\]  
2 is not a root of \(x^3 + 10x^2 - 4x + 7.\) If it were, the answer above would be just a polynomial (without a rational function added on too).  

5. \[
x^2 + x - 9 + \frac{13x + 44}{x^2 + 2x + 5}.
\]  

6. (a) Horizontal asymptote at \(y = 1;\) vertical asymptotes at \(x = 0, x = 1,\) and \(x = 2.\)  
(b) Horizontal asymptote at \(y = 0;\) vertical asymptotes at \(x = (1 \pm \sqrt{13})/2.\)  

7. (a) 2  
(b) -2  
(c) 2/3  
(d) 0  

8. (a) \(x = 5 + \log_2 33\)  
(b) \(x = 10,000\)  

9. (a) 7  
(b) -5  
(c) 28  
(d) 2/5  

10. See the graph on the bottom left of page 228 of the textbook!  

11. (a) \(t = 3 \log_2 10\) days
(b) $4/\log_2(10/3)$ hours

12. $\log 2$

13. $4 \log_3 2$ hours

14. (a) 

$$M(t) = 100(1 + 0.05/6)^6t$$

(b) $\ln(2)/.04$

15. $\sin(\theta)$ is the $y$-value of the point on the unit circle corresponding to the angle $\theta$. Since the $y$-values of all the points on the unit circle lie in the interval $[-1, 1]$, this is the range of $\sin(\theta)$. Since any angle $\theta$ gives us a point on the unit circle with a well-defined $y$-value, the domain of $\sin(\theta)$ is all real numbers.

$\cos(\theta)$ is the $x$-value of the point on the unit circle corresponding to the angle $\theta$. Since the $x$-values of all the points on the unit circle lie in the interval $[-1, 1]$, this is the range of $\cos(\theta)$. Since any angle $\theta$ gives us a point on the unit circle with a well-defined $x$-value, the domain of $\cos(\theta)$ is all real numbers.

$\tan(\theta)$ is the slope of the line passing through the origin and the point on the unit circle corresponding to angle $\theta$. Since we can find lines of any slope, the range is all real numbers. However, we can’t talk about the slope of vertical lines (they’re infinite!), so we’re not allowed to evaluate $\tan(\theta)$ wherever the line is vertical. This happens at all odd multiples of $\pi/2$. Hence, the domain of $\tan(\theta)$ is all real numbers except add multiples of $\pi/2$.

16. (a) $\cos(5^\circ)$
   (b) $\tan(81^\circ)$
   (c) 1

17. (a) This arc sweeps out $3\pi/2$ radians. However, since I didn’t tell you the radius of the circle, you can’t tell me its length! In general, the answer will be $3\pi r/2$, where $r$ is the radius.
   (b) $18\pi/5$ in.$^2$

18. (a) $1/2$
   (b) $\sqrt{2}/2$
   (c) $-\sqrt{2}/2$
   (d) $-\sqrt{3}$

19. See the graphs on page 350 and page 359 of the textbook!

20. The other acute angle has size $35^\circ$, and the side opposite it has length $4/\tan(55^\circ)$. Finally there is a right angle, and the side opposite to it (the hypotenuse) has length $4/\sin(55^\circ)$.

21. (a) False.
   (b) False.
   (c) True.
   (d) True.
22. \( \sin(\theta) = -3/5 \) and \( \cos(\theta) = -4/5 \) (there's nothing to figure out for the second part! Oops.)

23. \( \sin^{-1}(t) \) has domain \([-1, 1]\) and range \([-\pi/2, \pi/2]\). \( \cos^{-1}(t) \) has domain \([-1, 1]\) and range \([0, \pi]\). \( \tan^{-1}(t) \) has domain \((\infty, \infty)\) and range \((-\pi/2, \pi/2)\).

24. (a) \( \pi/6 \)
   (b) \( 2\pi/3 \)
   (c) \( -\pi/4 \)
   (d) \( 0 \)
   (e) \( \pi \)
   (f) \( -\pi/4 \)

25. (a) \( \sqrt{7}/4 \)
   (b) \( -3/4 \)
   (c) \( 2\sqrt{2}/3 \).