Name: $\qquad$
Instructions: You must show all work to earn full credit. No calculators allowed. If you do not have room in the given space to answer a question, use the back of the formula sheet and indicate clearly which work goes with which problem.

| Problem | Maximum Points | Your Points |
| :--- | ---: | ---: |
| 1 | 12 |  |
| 2 | 12 |  |
| 3 | 8 |  |
| 4 | 12 |  |
| 5 | 18 |  |
| 6 | 12 |  |
| 7 | 12 |  |
| 8 | 6 |  |
| 9 | 8 |  |
| Total | 100 |  |

1. (12 points) Find an equation for the tangent line to the graph $y=x^{2}-5$ at the point $x=4$.
2. (12 points)
(a) Find $\sin \left(\frac{5 \pi}{4}\right)$.
(b) Find all solutions to $\cos (x)=-\frac{\sqrt{2}}{2}$.
3. (8 points) Let $g(x)=x^{5}+x^{3}+1$. Without solving the equation $g(x)=0$, use a theorem to show that there is at least one number $c$ in the interval $[-1,1]$ such that $g(c)=0$. Be sure you explain why the theorem applies.
4. (12 points) Use the definition of the derivative to find $f^{\prime}(x)$ for $f(x)=\frac{1}{2+x}$.
5. (18 points) Compute the following derivatives.
(a) $\frac{d}{d x} \frac{x^{2}}{\sqrt{x}}$
(b) $\frac{d}{d x}(3 x+1)(2 x+1)$

Hint: The answer is not $(3)(2)=6$.
(c) Find the 2nd derivative $\frac{d^{2} y}{d x^{2}}$ of $y=5 x^{3}+4 x^{2}+\cos x$
6. (12 points) Suppose someone throws a football straight up in the air and the height of the football is $h(t)=32 t-32 t^{2}$ feet where $t$ is the number of seconds since the ball was thrown.
(a) What is the velocity of the football as a function of time.
(b) At what time does the ball stop rising and start falling?
7. (12 points) Find exact values for the following limits.
(a) $\lim _{x \rightarrow 2} \frac{x^{2}-7 x+10}{x^{2}-x-2}$
(b) $\lim _{x \rightarrow 1^{-}} \frac{1}{x^{2}-1}$
8. (6 points) Find functions $f(x)$ and $g(x)$ such that the composition $f(g(x))$ is $\sqrt{1-x^{2}}$.

9. (8 points) Using the graph of $f(x)$ above, find the following limits. If a limit does not exist, then explain why.
(a) What is $\lim _{x \rightarrow-2} f(x)$ ?
(b) What is $\lim _{x \rightarrow 2} f(x)$ ?
(c) What is the $\lim _{x \rightarrow 0} f(x)$ ?
(d) Identify all $x$-values where $f(x)$ is discontinuous.

## MATH 141 - Midterm 1 Formula Sheet

## Quadratic Formula

$$
x=\frac{-b \pm \sqrt{b^{2}-4 a c}}{2 a}
$$

Common Trigonometric Ratios

| $\theta$ | 0 | $\pi / 6$ | $\pi / 4$ | $\pi / 3$ | $\pi / 2$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\cos \theta$ | 1 | $\sqrt{3} / 2$ | $\sqrt{2} / 2$ | $1 / 2$ | 0 |
| $\sin \theta$ | 0 | $1 / 2$ | $\sqrt{2} / 2$ | $\sqrt{3} / 2$ | 1 |

Obscure Trigonometry Ratios

$$
\cot \theta=\frac{\cos \theta}{\sin \theta}, \quad \csc \theta=\frac{1}{\sin \theta}
$$

## Special Trigonometry Limits

$$
\lim _{x \rightarrow 0} \frac{\sin x}{x}=1, \quad \lim _{x \rightarrow 0} \frac{\cos x-1}{x}=0
$$

