MTH 271 Formula sheet

Trigonometric Derivative and Integral Rules

1. $D[\sin u] = \cos u\, du$
2. $D[\cos u] = -\sin u\, du$
3. $D[\tan u] = \sec^2 u\, du$
4. $D[\cot u] = -\csc^2 u\, du$
5. $D[\sec u] = \sec u \tan u\, du$
6. $D[\csc u] = -\csc u \cot u\, du$
7. $\int \sin u\, du = -\cos u + C$
8. $\int \cos u\, du = \sin u + C$
9. $\int \sec^2 u\, du = \tan u + C$
10. $\int \csc^2 u\, du = -\cot u + C$
11. $\int \sec u \tan u\, du = \sec u + C$
12. $\int \csc u \cot u\, du = -\csc u + C$
13. $\int \tan u\, du = -\ln|\cos u| + C$

Sine and Cosine for common angles

θ	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{2}{3}\pi$	$\frac{3}{4}\pi$	$\frac{5}{6}\pi$	π
$\sin\theta$	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0
$\cos\theta$	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0	$-\frac{1}{2}$	$-\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{3}}{2}$	-1

θ	$\frac{7}{6}\pi$	$\frac{5}{4}\pi$	$\frac{4}{3}\pi$	$\frac{3}{2}\pi$	$\frac{5}{3}\pi$	$\frac{7}{4}\pi$	$\frac{11}{6}\pi$	2π
$\sin\theta$	$-\frac{1}{2}$	$-\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{3}}{2}$	-1	$-\frac{\sqrt{3}}{2}$	$-\frac{\sqrt{2}}{2}$	$-\frac{1}{2}$	0
$\cos\theta$	$-\frac{\sqrt{3}}{2}$	$-\frac{\sqrt{2}}{2}$	$-\frac{1}{2}$	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1

Test 3: Derivative Tests

The first derivative test for increasing/decreasing.

Suppose that $f(x)$ is continuous on $[a, b]$ and differentiable on the open interval (a, b).
If $f'(x) > 0$ for all x in (a, b) then $f(x)$ increases on $[a, b]$.
If $f'(x) < 0$ for all x in (a, b) then $f(x)$ decreases on $[a, b]$.
If $f'(x) = 0$ for all x in (a, b) then $f(x)$ is constant on $[a, b]$.

The First Derivative Test for Local Extrema.

Let $f(x)$ be a continuous function on $[a, b]$ and c be a critical number in $[a, b]$.

1. If $f'(x) \geq 0$ on (a, c) and $f'(x) \leq 0$ on (c, b), then $f(x)$ has a local maximum of $y = f(c)$ at $x = c$.
2. If $f'(x) \leq 0$ on (a, c) and $f'(x) \geq 0$ on (c, b), then $f(x)$ has a local minimum of $y = f(c)$ at $x = c$.
3. If $f'(x)$ does not change signs at $x = c$, then $f(x)$ has no local extrema at $x = c$.

The Second Derivative Test for Concavity
Let $f(x)$ be a twice differentiable function on an interval I.

1. If $f''(x) > 0$ on I, the graph of $f(x)$ over I is concave up.
2. If $f''(x) < 0$ on I, the graph of $f(x)$ over I is concave down.

Graphing using y' and y'' :

1. Determine the points of discontinuity.
2. Determine the asymptotes (vertical, horizontal)
3. Determine the x- and y- intercepts.
4. Determine the critical point(s). (Set $f'(x) = 0$ and undefined).
5. Determine the intervals where the function f is increasing/decreasing.
6. Determine the local extrema.
7. Determine the possible point(s) of inflection. Set $f''(x) = 0$ and undefined).
8. Determine the intervals where the function f is concave up/down.
9. Determine the inflection point(s).
10. Determine extra point(s) if necessary.
11. Sketch the graph using the information obtained above.