1. (a) $f'(x) = 3 - \frac{6}{\sqrt{x}} = \frac{3\sqrt{x} - 6}{\sqrt{x}} \Rightarrow$ critical points at $x = 4$ and $x = 0$

(b) $f' = \underset{0}{(}---\underset{4}{|}+++ \Rightarrow$ increasing on $(4, \infty)$, decreasing on $(0, 4)$

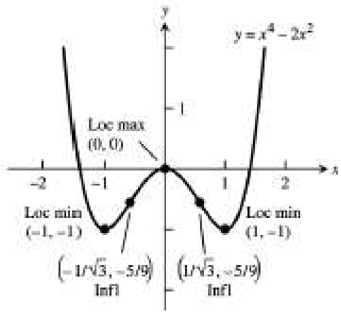
(c) Local minimum at $x = 4$

2. (a) $f(x) = \sqrt{25 - x^2} \Rightarrow f'(x) = \frac{-x}{\sqrt{25 - x^2}} \Rightarrow$ critical points at $x = 0$, $x = -5$, and $x = 5$

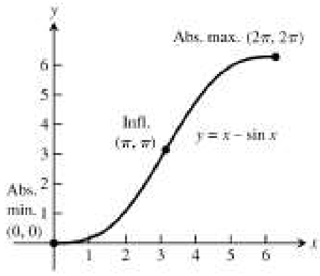
$\Rightarrow f' = \underset{-5}{(}\ +++\underset{0}{|}---\underset{5}{)}$, $f(-5) = 0$, $f(0) = 5$, $f(5) = 0 \Rightarrow$ local maximum is 5 at $x = 0$; local minimum of 0 at $x = -5$ and $x = 5$

(b) absolute maximum is 5 at $x = 0$; absolute minimum of 0 at $x = -5$ and $x = 5$

3. When $y = x^4 - 2x^2$, then $y' = 4x^3 - 4x = 4x(x+1)(x-1)$ and $y'' = 12x^2 - 4 = 12\left(x + \frac{1}{\sqrt{3}}\right)\left(x - \frac{1}{\sqrt{3}}\right)$. The curve rises on $(-1, 0)$ and $(1, \infty)$ and falls on $(-\infty, -1)$ and $(0, 1)$. At $x = \pm 1$ there are local minima and at $x = 0$ a local maximum. The curve is concave up on $\left(-\infty, -\frac{1}{\sqrt{3}}\right)$ and $\left(\frac{1}{\sqrt{3}}, \infty\right)$ and concave down on $\left(-\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}\right)$. At $x = \frac{\pm 1}{\sqrt{3}}$ there are points of inflection.



4. When $y = x - \sin x$, then $y' = 1 - \cos x$ and $y'' = \sin x$. The curve rises on $(0, 2\pi)$. At $x = 0$ there is a local and absolute minimum and at $x = 2\pi$ there is a local and absolute maximum. The curve is concave up on $(0, \pi)$ and concave down on $(\pi, 2\pi)$. At $x = \pi$ there is a point of inflection.



5. With a volume of 1000 cm and $V = \pi r^2 h$, then $h = \frac{1000}{\pi r^2}$. The amount of aluminum used per can is $A = 8r^2 + 2\pi r h = 8r^2 + \frac{2000}{r}$. Then $A'(r) = 16r - \frac{2000}{r^2} = 0 \Rightarrow \frac{8r^3 - 1000}{r^2} = 0 \Rightarrow$ the critical points are 0 and 5, but $r = 0$ results in no can. Since $A''(r) = 16 + \frac{1000}{r^3} > 0$ we have a minimum at $r = 5 \Rightarrow h = \frac{40}{\pi}$ and $h{:}r = 8{:}\pi$.

$$\tan\theta = x$$

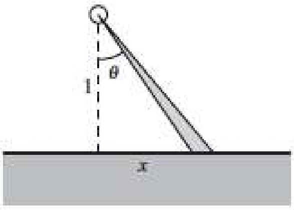
$$\frac{d\theta}{dt} = 3(2\pi)\ \text{rad/min}$$

$$\sec^2\theta\left(\frac{d\theta}{dt}\right) = \frac{dx}{dt}$$

$$\frac{dx}{dt} = \left(\tan^2\theta + 1\right)(6\pi) = 6\pi\left(x^2 + 1\right)$$

When $x = \frac{1}{2}$,

$$\frac{dx}{dt} = 6\pi\left(\frac{1}{4} + 1\right) = \frac{15\pi}{2}\text{km/min} = 450\pi\ \text{km/h}.$$



6.

$$\int \frac{t\sqrt{t}+\sqrt{t}}{t^2}\,dt = \int\left(\frac{t^{3/2}}{t^2} + \frac{t^{1/2}}{t^2}\right)dt = \int\left(t^{-1/2} + t^{-3/2}\right)dt = \frac{t^{1/2}}{\frac{1}{2}} + \left(\frac{t^{-1/2}}{-\frac{1}{2}}\right) + C = 2\sqrt{t} - \frac{2}{\sqrt{t}} + C$$

7.

$a(t) = v'(t) = 20 \Rightarrow v(t) = 20t + C$; at $(0, 0)$ we have $C = 0 \Rightarrow v(t) = 20t$. When $t = 60$, then $v(60) = 20(60) = 1200\ \frac{m}{sec}$.

8.

9. A.

$\triangle x = \frac{1-0}{2} = \frac{1}{2}$ and $x_i = i\triangle x = \frac{i}{2} \Rightarrow$ a lower sum is $\sum_{i=0}^{1}\left(\frac{i}{2}\right)^3 \cdot \frac{1}{2} = \frac{1}{2}\left(0^3 + \left(\frac{1}{2}\right)^3\right) = \frac{1}{16}$

B.

$\triangle x = \frac{1-0}{2} = \frac{1}{2}$ and $x_i = i\triangle x = \frac{i}{2} \Rightarrow$ an upper sum is $\sum_{i=1}^{2}\left(\frac{i}{2}\right)^3 \cdot \frac{1}{2} = \frac{1}{2}\left(\left(\frac{1}{2}\right)^3 + 1^3\right) = \frac{1}{2} \cdot \frac{9}{8} = \frac{9}{16}$

(a) $\sum_{k=1}^{n}\left(\frac{1}{n} + 2n\right) = \left(\frac{1}{n} + 2n\right)n = 1 + 2n^2$

(b) $\sum_{k=1}^{n}\frac{c}{n} = \frac{c}{n} \cdot n = c$

(c) $\sum_{k=1}^{n}\frac{k}{n^2} = \frac{1}{n^2}\,\frac{n(n+1)}{2} = \frac{n+1}{2n}$

10.

$|x_1 - x_0| = |-1.6 - (-2)| = 0.4$, $|x_2 - x_1| = |-0.5 - (-1.6)| = 1.1$, $|x_3 - x_2| = |0 - (-0.5)| = 0.5$, $|x_4 - x_3| = |0.8 - 0| = 0.8$, and $|x_5 - x_4| = |1 - 0.8| = 0.2$; the largest is $\|P\| = 1.1$.

11.