# Today's Plan:

***Learning Target (standard)***: I will solve real-world related rate application problems.

***Students will***: Complete practice problems over previous concepts at the boards, put up homework problems on the board and make necessary corrections to their own work, take notes over new material and complete practice problems over new concepts.

***Teacher will***: Provide practice problems over previous concepts, check homework problems for accuracy and provide students feedback, describe and provide examples of new concepts and assign students assessment problems over new concepts.

***Assessment***: Board work, homework check and homework assignment

***Differentiation***: Students will work at the board, go over and correct homework at their seats, actively engage in lecture over new concepts, practice new concepts with the aid of other students and the teacher and complete homework assignment.

# Related Rates Review:

1) $\frac{24}{7}\ ft/\sec$

2) $\frac{157}{50\pi}\ ft/\min$

3) $-8\ ft/\sec$

4) $64\ ft/\sec$

5) $-\frac{12}{\pi}\ cm/\sec$

The position function of a point on a coordinate line is given by $s(t) = t^3 - 12t^2 + 36t - 20$, where $t$ is measured in seconds and $s(t)$ in centimeters. Describe the motion of the particle during the interval [-1,9].

$v(t) = 3t^2 - 24t + 36$ $\quad a(t) = 6t - 24$

$0 = 3(t^2 - 8t + 12)$ $\quad 0 = 6(t - 4)$

$0 = 3(t-6)(t-2)$ $\quad t = 4$ seconds

$t = 2, 6$ seconds

∴ The particle changes direction when velocity is 0 and acceleration is not 0. This happens @ times of 2 seconds & 6 seconds.

| Domain Interval | v(t) | a(t) | speed |
|---|---|---|---|
| (-1,2) | + | − | decreasing |
| (2,4) | − | − | increasing |
| (4,6) | − | + | decreasing |
| (6,9) | + | + | increasing |

∴ The particle slows down when velocity & acceleration have different signs. This happens when $-1 < t < 2$ seconds and $4 < t < 6$ seconds.

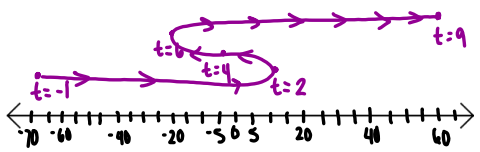
The particle speeds up when velocity & acceleration have the same signs. This happens when $2 < t < 4$ seconds and $6 < t < 9$ seconds.

| Domain Interval | 3 | t-6 | t-2 | v(t) | direction |
|---|---|---|---|---|---|
| (-1, 2) | + | − | − | + | right |
| (2, 6) | + | − | + | − | left |
| (6, 9) | + | + | + | + | right |

∴ The particle travels to the right when velocity is positive. This happens when $-1 < t < 2$ seconds and $6 < t < 9$ seconds.

The particle travels to the left when velocity is negative. This happens when $2 < t < 6$ seconds.

| | -1 | 2 | 4 | 6 | 9 |
|---|---|---|---|---|---|
| s(t) | -69 | 12 | -4 | -20 | 61 |
| v(t) | 63 | 0 | -12 | 0 | -63 |
| a(t) | -30 | -12 | 0 | 12 | 30 |



A point moves along the curve $y = -\frac{1}{2}x^2 + 8$ in such a way that the y-value is decreasing at the rate of 2 units per second. At what rate is the x changing when x = 4?

$y = -\frac{1}{2}x^2 + 8$

$\frac{dy}{dt} = -2 \text{ units/sec}$

$\frac{dx}{dt} = ?$ when $x = 4$

$\frac{dy}{dt} = -x\frac{dx}{dt}$

$-2 = -(4)\frac{dx}{dt}$

$\frac{dx}{dt} = \frac{1}{2} \text{ units/sec}$

# Related Rates:

1) A snowball is melting at a rate of 2 $ft^3$ per hour. If it remains spherical, at what rate is the radius changing when the radius of the snowball is 20 inches?

$\frac{dr}{dt} = -\frac{9}{50\pi}$ ft/hr

2) A car is traveling west on the interstate. A highway patrolman is parked 90 feet north of the interstate. The patrolman takes a radar reading and finds that the car is 150 feet from his position, and the distance separating them is increasing at a rate of 72 ft/sec. Find the speed of the car at that moment.

$\frac{dx}{dt} = 90$ ft/sec

3) A child is standing still and flying a kite. The kite remains at an altitude of 30 feet above the child's hands while traveling parallel to the ground at a rate of 10 feet per second. When the kite is 50 feet away from the child, how fast is the kite string leaving the child's hand?

$\frac{dz}{dt} = 8$ ft/sec

4) A car is 30 miles north of town, heading north at 25 miles per hour. At the same time, a truck is 40 miles east of town, traveling east at 50 miles per hour. At what rate is the distance between the two vehicles changing?

$\frac{dz}{dt} = 55$ mi/hr