

## Rates of Change

Often, we are interested in the relationship between two quantities. Ie: the volume of a balloon varies with its height above the ground, air temperature varies with elevation, Surface Area of a sphere varies with the length of the radius.

Rate of Change is

If  $s(t)$  gives the position of a vehicle at time “t”, then the average rate of change in the position of the vehicle over a time interval is average velocity.

Average Velocity =

ie: A car drives 684 km in 6 hours.  $S(6) = 684$ . Avg. Vel. =  $684 / 6 = 114$  km/h

### Instantaneous Velocity

We want to shorten the time interval so that it becomes very close to our point.

The velocity of an object, with position function  $s(t)$  at time  $t = a$ , is;

$$V(a) = \lim_{\Delta t \rightarrow 0} \frac{\Delta s}{\Delta t} = \lim_{h \rightarrow 0} \frac{s(a+h) - s(a)}{h}$$

Velocity is the slope of the tangent to the graph of  $s(t)$  @  $P(a, s(a))$ .

Eg.1: The function  $s(t) = 8t(t + 2)$  describes the distance  $s$ , in km that a car travels after a time  $t$ , in hours for  $0 \leq t \leq 5$ .

a) Find the average velocity of the car over the following intervals.

- i)  $t = 3$  to  $t = 4$       ii)  $t = 3$  to  $t = 3.1$       iii)  $t = 3$  to  $t = 3.01$

b) Approximate the instantaneous velocity @  $t = 3$  based on your answers above. \_\_\_\_\_

c) Find the velocity @  $t = 3$  (use definition of derivative)

## MCV4U

Eg.2: Suppose that a foreign language student has learned  $N(t) = 20t - t^2$  vocabulary terms after  $t$  hours of uninterrupted study.

- a) How many terms are learned during the 3<sup>rd</sup> hour?  
(0 to 1 is the 1<sup>st</sup> hour; 1 to 2 is the 2<sup>nd</sup> hour; 2 to 3 is the 3<sup>rd</sup> hour)
- b) What is the rate of change (in terms per hour) at which the student is learning @  $t = 2$  hr.

**Homework:** p. 29 # 7, 10 - 13 , 14ab , 15 – 17 , 20 \*\*, 21 \*\*, 22 \*\*

**Homework:** p. 32/33 # 1 – 12