- Pick up the new HW recording sheet for this week.

You'll need some type of a ruler or straight edge

(a student body card or ATM type card will do)

Calculus

Sequences & Series & Financial Math

Logic

Sets, Venn Diagrams, and Probability

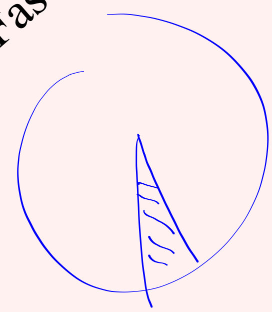
Today we will start a short, 6 day,

unit on **Calculus.**

How Steep ?

How Big ?

How Fast ?



All Assignments will be from the Differential Calculus packet, Ch. 20

There will be a Quiz on this unit on Monday, Oct. 22

and and one or two LCQ's this week

to check on your learning.

from now on, **the words "slope" and "gradient" are interchangeable.**

Last week:

Calculus Precursor assignment

From now on, the word "**slope**" and "***gradient***" **mean the same thing** $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

1. Find the equation of the straight line joining each of the following points. Use Point-Slope form (we'll need it for calculus) $y - y_1 = m(x - x_1)$ hint: first find m

   (a) (−2, −4) and (1, −7)

   (b) Then convert to *gradient-intercept* form ($y = mx + b$) a.k.a. slope-intercept form

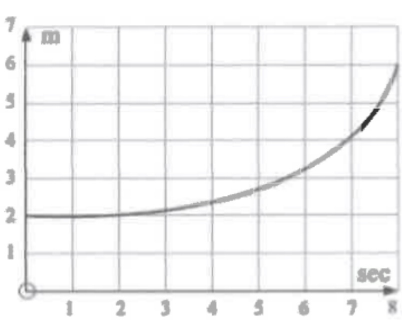
2. Find the equation of the straight lines below, given its gradient and the coordinates of a point on the straight line. *Point-slope form*

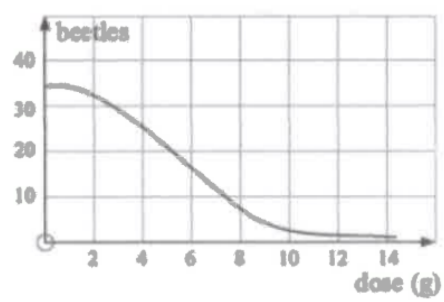
   $-\frac{1}{2}$, (5, 7)

3. New tires have a tread depth of 8 mm. After driving for 32,178 km the tread depth was reduced to 2.3 mm. What was the wearing rate of the tires in km travelled per mm of depth.

(The value you calculated can also be called the average wear rate)

5. Before answering this question, first go to question #4 on the back side. Then come back. Estimate the **average speed in graph between 2 and 7 seconds** and *average rate of beetle decrease from dose 4 to 14*





Consider a trip from Adelaide to Melbourne. The following table gives places along the way, distances travelled and time taken.

We plot the *distance travelled* against the *time taken* to obtain a graph of the situation. Even though there would be variable speed between each place we will join points with straight line segments.

Place	taken (min)	travelled (km)
Adelaide tollgate	0	0
Tailem Bend	63	98
Bordertown	157	237
Nhill	204	324
Horsham	261	431
Ararat	317	527
Midland H/W Junction	386	616
Melbourne	534	729

We can find the average speed between any two places.

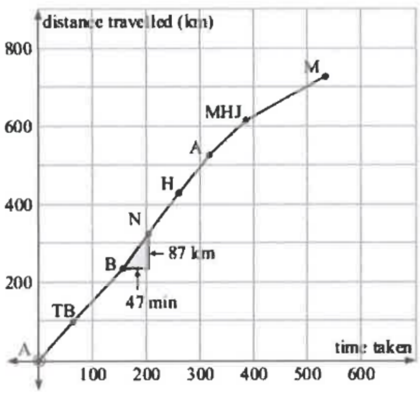
For example, the average speed from Bordertown to Nhill is:

$$\frac{\text{distance travelled}}{\text{time taken}}$$

$$= \frac{324 - 237 \text{ km}}{204 - 157 \text{ min}}$$

$$= \frac{87 \text{ km}}{\frac{47}{60} \text{ h}}$$

$$\doteqdot 111 \text{ km/h}$$

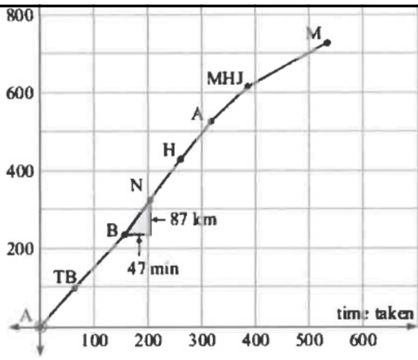


We notice that the average speed is the $\frac{y\text{-step}}{x\text{-step}}$ on the graph.

So, the average speed is the **gradient of the line segment** joining the two points which means that the faster the trip between two places, the greater the gradient of the graph.

If $s(t)$ is the distance travelled function then the average speed over the time interval from $t = t_1$ to $t = t_2$ is given by:

$$\textbf{Average speed} = \frac{s(t_2) - s(t_1)}{t_2 - t_1}.$$



	Place	taken (min)	travelled (km)	
	Adelaide tollgate	0	0	
	Tailem Bend	63	98	
	Bordertown	157	237	
	Nhill	t_1 204	324	$S(t_1)$
	Horsham	261	431	
	Ararat	317	527	
	land H/W Junction	386	616	
	Melbourne	t_2 534	729	$S(t_2)$

(7) Calculate the average speed between *Nhill* and *Melbourne*. *Then go back and answer question #4.*

Pick up:

Calculus 1.0 Notes

start with #2

2.

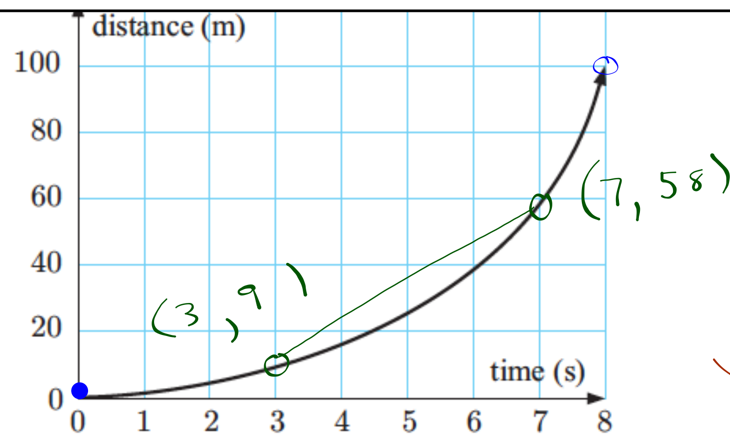
The Graph below shows how a cyclist accelerates away from an intersection.

The average speed over the first 8 seconds is

$$\frac{100\text{ m}}{8\text{ sec}} = 12.5\text{ m s}^{-1}.$$

12.5 m/s

Notice that the cyclist's early speed is quite small, but it increases as time goes by.

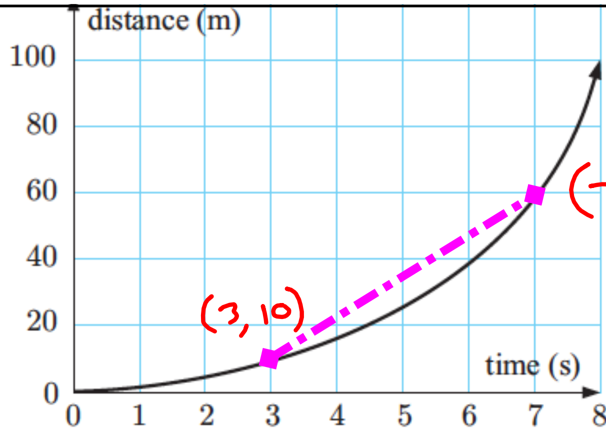


~~49 m / 4 sec~~

Estimate the average speed of the cyclist between 3 and 7 seconds

$$\text{Avg Speed} = \frac{58 - 9}{7 - 3} = \frac{49}{4} \approx 12.25\ \frac{m}{s}$$

12.3 m/s

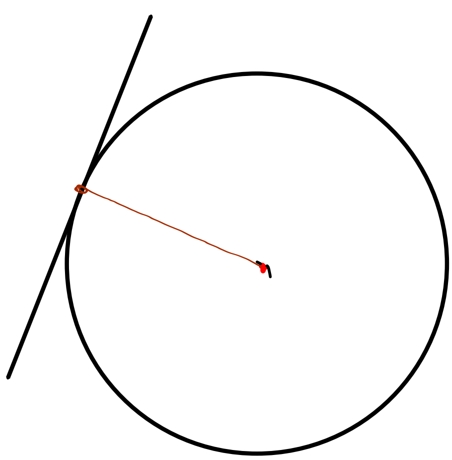


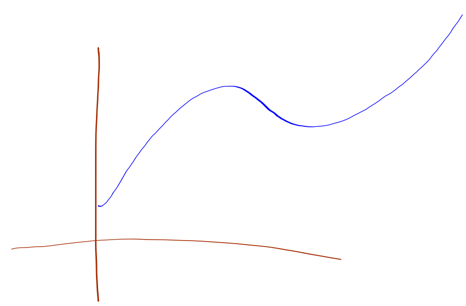
Estimate the average speed of the cyclist between 3 and 7 seconds

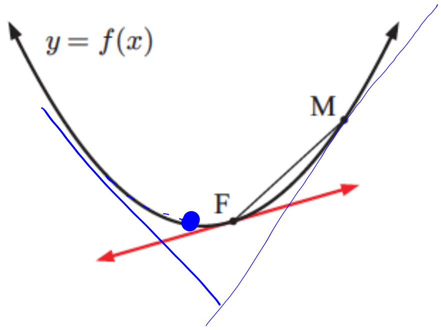
$$\text{Avg speed} = \frac{60-10}{7-3} = \frac{50}{4} = 12.5 \text{ m/sec}$$

↑ UNIT

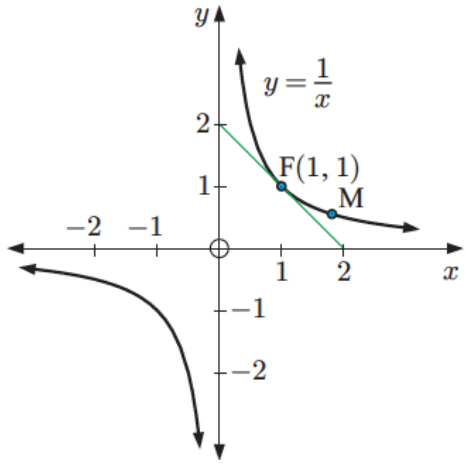
From Geometry : A tangent is a line (or segment) that touches a circle at exactly one point.



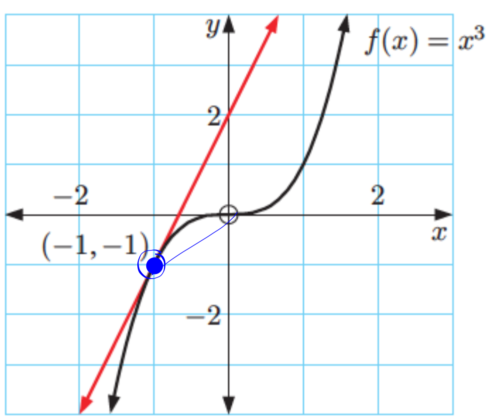




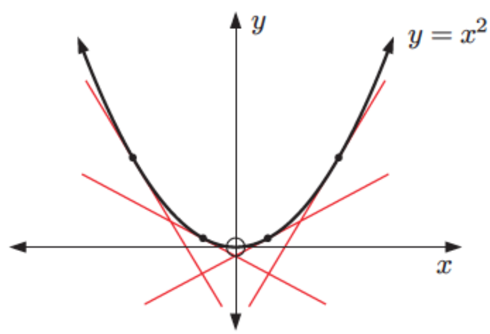
$y = f(x)$
M
F



$y = \frac{1}{x}$
F(1, 1)
M
y
x
2
1
−2
−1
−1
−2

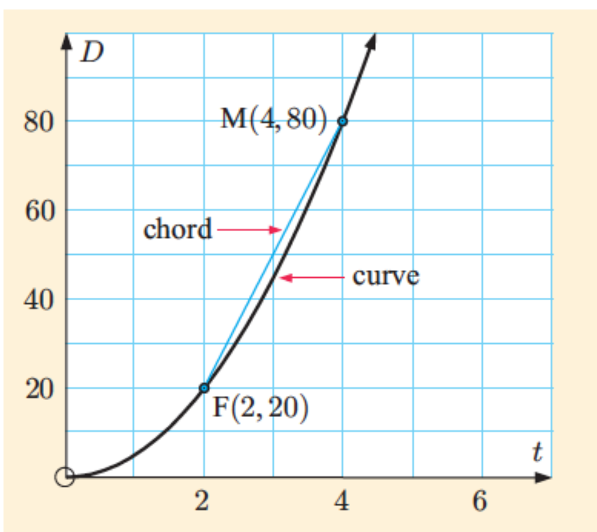


$f(x) = x^3$
y
x
2
−2
2
−2
(−1, −1)



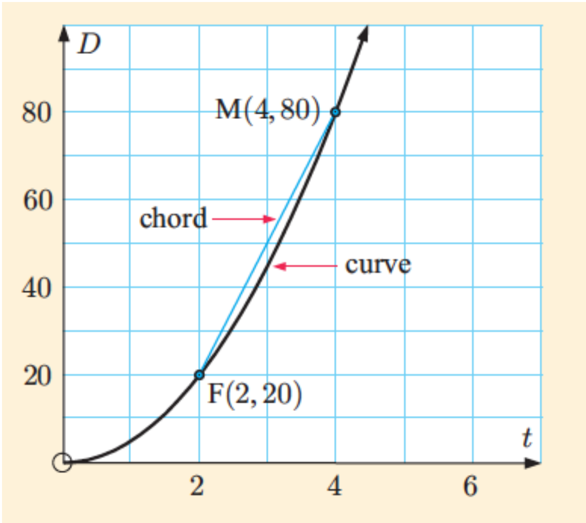
$y = x^2$
y
x

Instantaneous Rates of Change



(A)

The average speed in the interval from 2 to 4 seconds is shown



$$= \frac{\text{distance travelled}}{\text{time taken}}$$

$$= \frac{(80 - 20)\text{ m}}{(4 - 2)\text{ s}}$$

$$= \frac{60}{2}\text{ m s}^{-1}$$

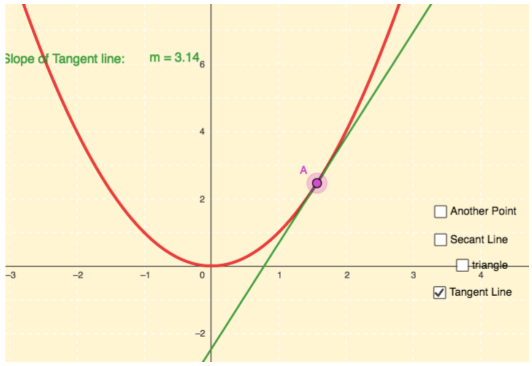
$$= 30\text{ m s}^{-1}$$

But that does <u>not</u> tell us the

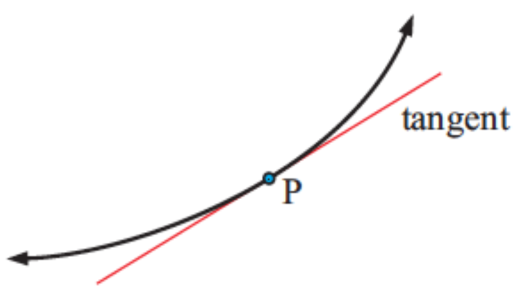
instantaneous speed

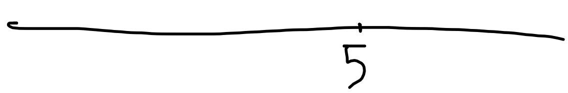
at any particular time

https://www.geogebra.org/m/sCsZxYjs



The instantaneous rate of change of a variable at a particular instant is given by the gradient of the tangent line to the graph at that point.

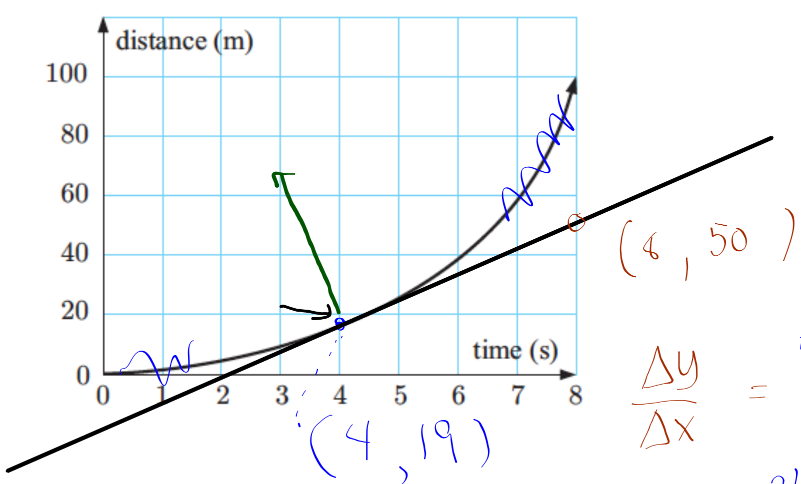




Now back to the

Cyclist problem

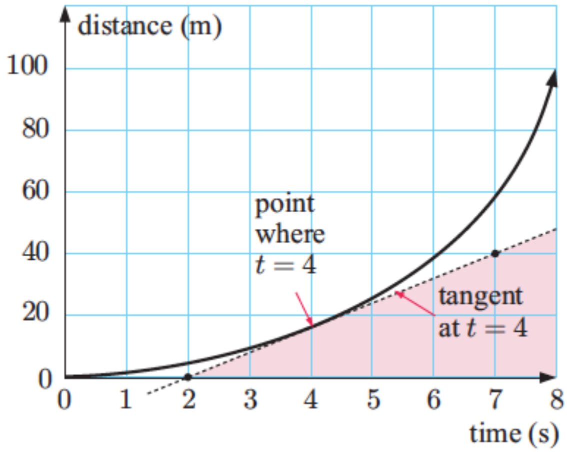
Find the instaneous speed at t = 4 seconds



$\frac{\Delta y}{\Delta x} = \frac{50-19}{8-4}$

$= \frac{31}{4}$

≈ 7.75 m/s



The tangent passes through (2, 0) and (7, 40).

$\therefore$ the instantaneous speed at $t = 4$

$= $ the gradient of the tangent

$$= \frac{(40-0)\text{ m}}{(7-2)\text{ s}}$$

$$= \tfrac{40}{5}\text{ m s}^{-1}$$

$$= 8\text{ m s}^{-1}$$

This **instantaneous rate of change** *at specific point on a curve* can be calculated

a) **visually**, by estimating the gradient (slope) of the line that is tangent *at that point*

~~b) Using the algebraic method (Algebraic Method)~~

c) Finding the derivative (tomorrow)

d) with your GDC

K. Basic Differential Calculus

Calculate the derivative at a specific point.

1. Graph the function, $f(x)$, and obtain an appropriate window.
2. Select **2nd** then **TRACE** , the select $\frac{dy}{dx}$,
3. enter the appropriate $x - value$, then **ENTER**

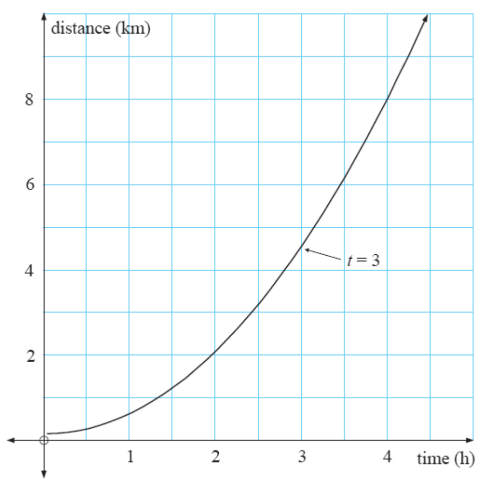
Draw Tangent Line (& calculate it's equation)

1. Graph the function, $f(x)$, and obtain an appropriate window.
2. Select **2nd** then **DRAW,** then **TANGENT**,
3. enter the appropriate $x - value$, then **ENTER**

Find the instaneous rate of change at t=3 hours

(K)

b



$f(x) = 0.5(2)^x$

✓ Graph (zoom 6)

✓ 2nd Calc

✓ $\frac{dy}{dx}$ rate of change

t=3 seconds

$\frac{dy}{dx} = 2.77$ km/hr

$y = 2\sin(x)$

$\frac{dy}{dx}$ at $x = 30$

Assignment:

Ch 20 Calculus packet: p. 565..... 1, 2
~~p. 568..... 1abc, 3~~