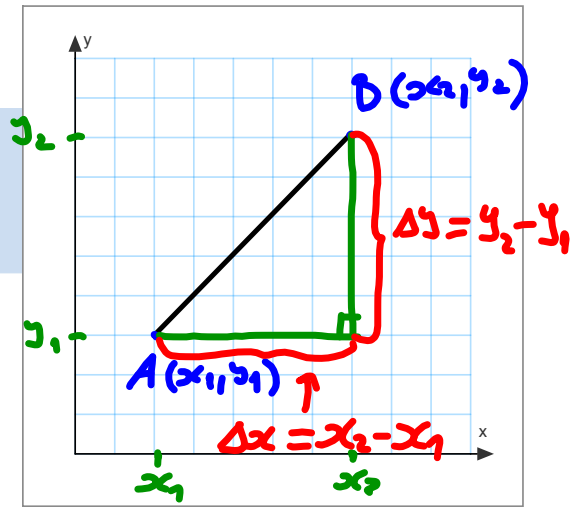


Rate of change

Average rate of change

$$\text{Average rate of change} = \frac{y_2 - y_1}{x_2 - x_1} \text{ or } \frac{\text{Rise}}{\text{Run}}$$

$$\text{rate of change} = \frac{\text{change in } y}{\text{change in } x}$$



When a graph is linear we use a rate of change. When a graph is nonlinear we use the average rate of change.

Identifying Rates of Change in a Table or Graph		
Rate of change	Table	Example of graph
Zero	The first differences are 0.	
Constant	The first differences are equal.	
Changing	The first differences are changing.	

Look for a horizontal line.

Look for a straight line.

Look for a curve.

In a table the rate of change is calculated by subtracting consecutive y-values. eg. First differences.

On a graph, the rate of change is the slope of the line between two points on the graph.

- For each table, name the variables.
- State the units of the rate of change for each table in question 1.
What does the rate of change represent?
- Refer to the tables in question 1. Determine the average rate of change between each pair of points in the table.

a)

Hours worked	Earnings (\$)
4	32
20	160

- indep. variable = hours worked
dep. var. = earnings (\$)
- \$ per hour
hourly pay (\$8 per hour)
- A.R.Ch. = $\frac{160-32}{20-4}$
= $\frac{128}{16}$
= 8

b)

Pages printed	Cost (\$)
1000	56
5000	145

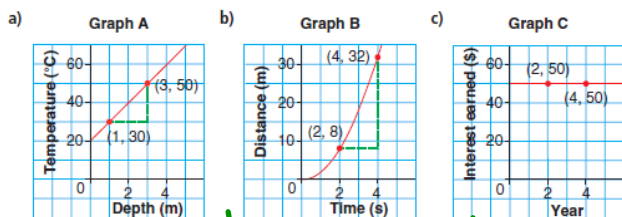
- cost (\$) and Pages printed
- \$ per number of pages printed
cost per page (\$0.02 per page)
- A.R.Ch. = $\frac{145-56}{5000-1000}$
= $\frac{89}{4000}$
= 0.02225
= 0.02

c)

Distance driven (km)	Fuel used (L)
45	3
60	12

- Fuel used (L) and Distance driven (km)
- L / km
Fuel consumption
- A.R.Ch. = $\frac{12-3}{60-45}$
= $\frac{9}{15}$
= 0.6

4. For each graph, name the variables.



Temperature (°C)
Depth (m) | Distance (m)
Time (s) | Interest earned (\$)
Year

5. State the units of the rate of change in each graph in question 4.

What does each rate of change represent?

a) °C and m Increase of temp. as depth increases
b) m/s speed
c) \$ per year amount of money earned per year

6. Refer to the graphs in question 4. Determine the average rate of change between the indicated points on the graph.

a) $A.R.Ch. = \frac{50-30}{3-1} = \frac{20}{2} = 10$
 b) $A.R.Ch. = \frac{32-8}{4-2} = \frac{24}{2} = 12$
 c) $A.R.Ch. = \frac{50-50}{4-2} = \frac{0}{2} = 0$

10. Assessment Focus

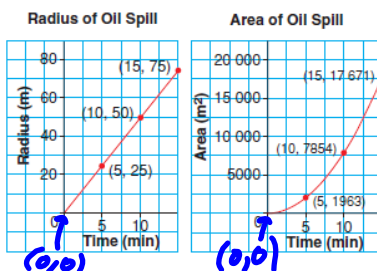
A tanker runs aground, creating a circular oil spill.

a) For each graph, calculate the average rate of change:

- i) From 0 min to 5 min
- ii) From 10 min to 15 min

What do the rates of change represent in this situation?

- b) Describe the change in the radius of the spill.
- c) Describe the change in the area of the spill.



Solution:

a) i) $A.R.Ch. = \frac{25-0}{5-0} = 5$

ii) $A.R.Ch. = \frac{75-50}{15-10} = \frac{25}{5} = 5$

Increase of the radius per minutes

$A.R.Ch. = \frac{1963-0}{5-0} = 392.6$

$A.R.Ch. = \frac{17671-7854}{15-10} = 1963.4$

Increase of the area of the spill per minutes

b) The radius of the spill increases by 5 m for every minute

c) The area of the spill increases by 392.6 m² per minute for the first five minutes and 1963.4 m² per minute from 10 minutes to 15 minutes.