CHAPTER 5 Modelling With Graphs
5.6 Connecting Variation, Slope, and First Differences
Finite Differences, Constant of Variation, and Slope

Example:

a) Furnace Creek in Death Valley, California, has one of the few airports in the world that is below sea level. The table shows the altitude of an aircraft after takeoff from Furnace Creek, in relation to time. Graph the relation. Is it a direct, or partial variation?

Time (min)	Altitude (m)
0	-50
1	50
2	150
3	250

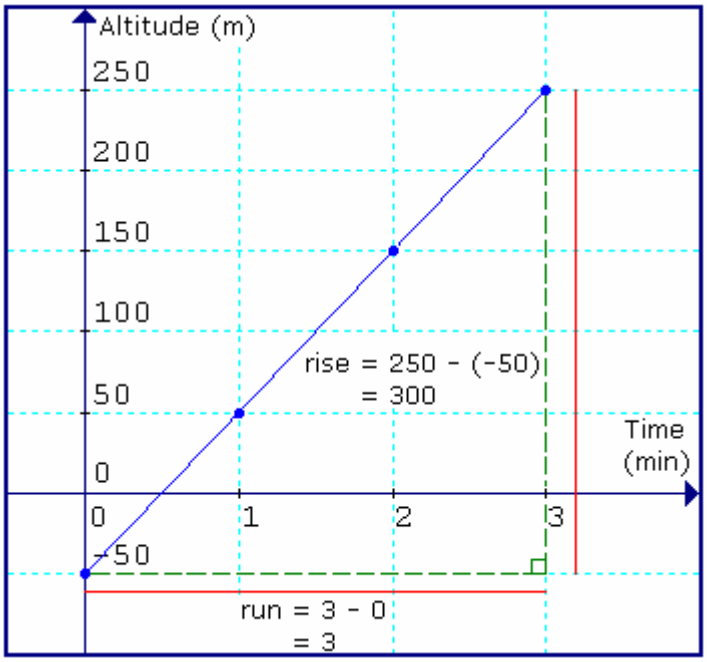
b) Determine whether the relation is linear.

c) Calculate the slope of the graph. How does the slope relate to the first differences, and the altitude of the aircraft?

d) Write the equation of the line.

Solution:

a) The graph is shown. This is a partial variation. The constant part of the variation is –50 m at 0 min.



b) The first differences are constant. This is a linear relation.

Time (min)	Altitude (m)	First Differences
0	-50	
1	50	100
2	150	100
3	250	100

c) $m = \frac{\text{rise}}{\text{run}}$

$= \frac{300}{3}$

$= 100 \ \frac{\text{m}}{\text{min}}$

The slope of the graph is 100 m/min. This value is the same as the first differences. It represents the rate of change of altitude in relation to time. The aircraft is climbing at a rate of 100 m every minute.

d) The slope is 100. The vertical intercept is –50.

The equation of the line is $A = 100t - 50$.

Practice:

1. a) Nadja's sailboat has a diesel engine that is used when sailing is not possible, such as when transiting a canal. The volume of fuel remaining in the fuel tank of her boat as she transits the Welland Canal is shown in the table. Graph the relation. Is it a direct, or partial variation?

Time (h)	Volume of Fuel (L)
0	200
4	140
8	80
12	20

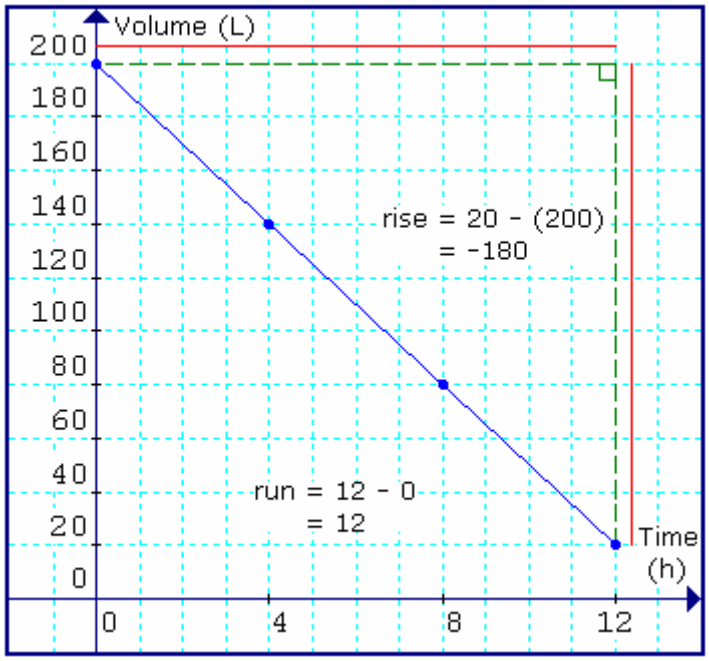
b) Determine whether the relation is linear.

c) Calculate the slope of the graph. How does the slope relate to the first differences, and the volume of fuel in the tank?

d) Write the equation of the line.

Answers:

1. a) The graph is shown. This is a partial variation. The constant part of the variation is 200 L at 0 h.



b) The first differences are constant. This is a linear relation.

Time (h)	Volume of Fuel (L)	First Differences
0	200	
4	140	-60
8	80	-60
12	20	-60

c) $m = \dfrac{\text{rise}}{\text{run}}$

$= \dfrac{-180}{12}$

$= -15$

The slope of the graph is –15 L/h.

d) The slope is –15. The vertical intercept is 200.

The equation of the line is $V = -15t + 200$.