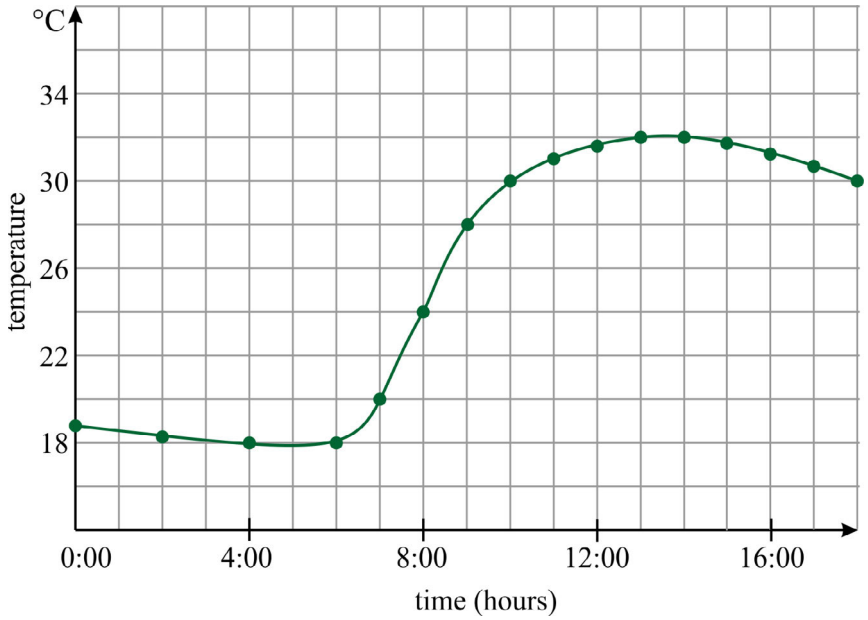
Linear versus Nonlinear Functions

Recall these facts that are true for a **linear function**:

- Its **rate of change is constant** (does not vary).
- The input & output values as ordered pairs **form a line**, when plotted in the coordinate grid.
- Any linear function can be represented with an equation of the form $y = mx + b$, where m is the rate of change and b is the initial value.

These facts give us several tools for checking whether a function is linear.

1. The graph below shows the air temperature on a certain day.



a. Is this a function? Explain.

b. Is it a linear function? How can you tell?

What is the rate of change...

c. between 0:00 and 4:00?

d. between 7:00 and 10:00?

e. Identify two time periods when the rate of change is practically zero.

f. Identify two time periods when this function is decreasing (the temperature is dropping).

g. When is the temperature rising the quickest?

2. Make up two functions for the cost of renting a bicycle as a function of time, one linear, and the other nonlinear. Give your functions as a table of values.

Function 1:

time (hours)	0	1	2	3	4	5	6	7	8	9	10
Cost ($)											

Function 2:

time (hours)	0	1	2	3	4	5	6	7	8	9	10
Cost ($)											

3. The equation $A = s^2$ gives the area of a square as a function of its side length (s).
Prove that it is *not* a linear function.

4. Mangos cost $2.50/kg. Consider the price of mangos as a function of their weight.
Is this a linear function? If yes, write an equation for it.

5. The time it takes to harvest Mr. Lee's strawberry field depends on the number of workers. We can say that the time to harvest is a function of the number of workers. In fact, Mr. Lee has figured out that it seems to approximately follow the equation $\boldsymbol{t = 80/N}$, where N is the number of workers, and t is the time in hours.

a. Compare the time it takes if there are 10 workers versus if there are 5 workers.

b. Is this a linear function? Explain.

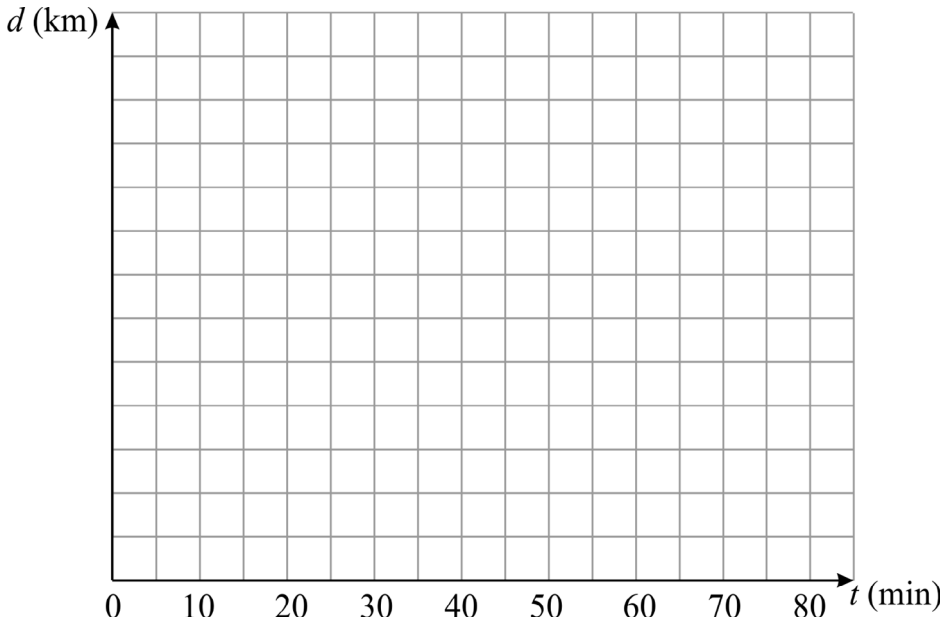
6. Give an example of a nonlinear function as an equation.
(Do not use the exact equations from this lesson.)

7. Marsha goes for a jog, but she might also walk or stop for a while.

Make up a function for the total distance Marsha has traveled, as a function of time, so that the function is not linear, yet is reasonable (could happen in reality). Fill in a table of values and make a plot.

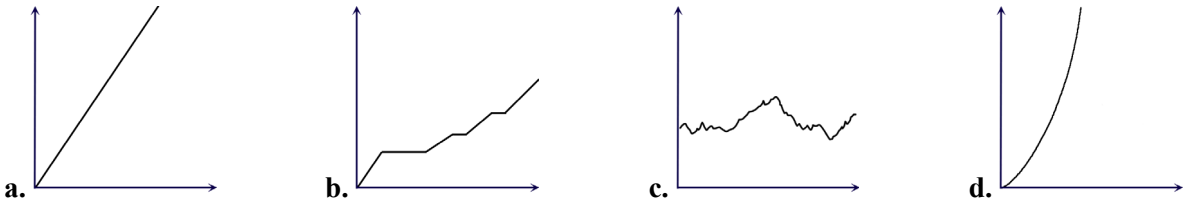
Note: An average walking speed is from 4 to 6 km/h. An average jogging speed is from 6 to 9 km/h.

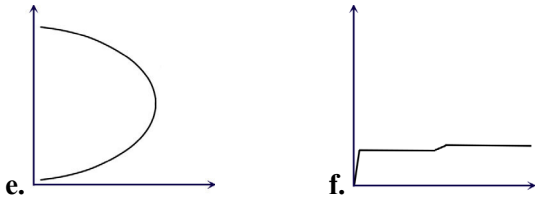
time (minutes)	0	5	10	15	20	25	30	35	40	45	50	55	60
Distance (km)													



Puzzle Corner

Match each situation with a graph.
One graph will not be matched.





(i) The total distance Henry has covered on his walk with the dogs.

(ii) The cost of potatoes as per their weight.

(iii) The unemployment rate over time.

(iv) Surface area of a cube as a function of edge length.

(v) The amount of water in a swimming pool over time.