

## 48 HEIGHT AND WEIGHT

A mathematical model exists that relates the height  $h$  and mass  $m$  of children aged 5 to 13. Algebraically, this model follows the formula  $m = \ln 2.4 + 0.0184h$ , where  $m$  is expressed in kilograms and  $h$  is expressed in centimetres.

a) State the rule that enables you to:

- 1) Express the height of a child as a function of his/her mass by isolating  $h$ .
- 2) Express the mass of a child as a function of his/her height by isolating  $m$ .

b) Use the formula to find:

- 1) The height of a child whose mass is 30 kg.
- 2) The mass of a child who is between 130 and 150 cm tall.



## 49 LIGHTNING STRIKES



During a storm, lightning is caused by electrical discharges between two clouds or between a cloud and the earth. The intensity of electrical discharges can be found using Kirchhoff's law. In an experiment where lightning was simulated using sparks, the rule for this law was found to be  $I = I_0 e^{-1.4t}$ , where  $I$  is the electromotive force of the current in volts,  $I_0$  is the initial electromotive force of the current, and  $t$  is the duration of the discharge in seconds.

- a) How much time after the start of the discharge was the electromotive force of the current reduced by half?
- b) What rule expresses the duration of the discharge based on the electromotive force of the current?

## 50 RADIOACTIVE ELEMENTS

When radioactive elements emit radiation, their mass decreases. The term half-life is used to define the time required for the element to decay to one half of its original mass. The half-life of strontium-90 is 20 years. The half-life of polonium-218 is 3 min.

a) What rule can be used to calculate the mass of:

- 1) 20 g of strontium-90 in  $x$  years?
- 2) 1000 g of polonium-218 after  $n$  min?

b) How much time is required:

- 1) For the mass of 20 g of strontium-90 to decay by  $1/5$ ?
- 2) For the mass of 1000 g of polonium-218 to decay by 90%?



Marie Curie (1867–1934) discovered the radioactivity of thorium, polonium and radium. She was the first woman professor at the Sorbonne, and she received the Nobel Prize for Physics in 1903 and the Nobel Prize for Chemistry in 1911.



## WALKING SPEED

Different studies suggest that the average walking speed of a pedestrian in a city depends on the city's population. The theory is that the higher the population, the higher the stress level, and this stress manifests itself in how fast people walk. A person's average walking speed is estimated by the function  $v(x) = 0.01 + 0.46 \log x$ , where  $x$  is the population and  $v(x)$  is the average walking speed in metres per second.

- What is the average walking speed of pedestrians in a city of 10 000 people?
- What can be said about the population of a city where the pedestrians walk faster than 2 m/s?



## TEST YOUR MEMORY

For a particular TV game show, participants test their visual memories to win prizes. To win a mountain bike, the participants must observe 20 objects for 10 s. The objects are then hidden, and the participant has 15 s to name at least  $\frac{3}{4}$  of the objects. The data, in the table below, show the average percentage of 20 objects that a person can memorize according to the time (in seconds) allowed to memorize them.

- By regression, find the logarithmic function that relates the time spent observing 20 objects to the percentage of objects remembered.
- Explain why it is difficult to win at this game.
- According to the model, how much time is needed to memorize all 20 objects?

Observation time (s)	Percentage of objects memorized
1	20
2	35
5	45
10	65
15	75