

**10** As part of an experiment, Zena puts a bucket of hot water outside on a day when the outside temperature is  $0^{\circ}\text{C}$ .

She measures the temperature of the water after 10 minutes and after 20 minutes. Her results are shown below.

|                                      |    |    |
|--------------------------------------|----|----|
| <b>Time (minutes)</b>                | 10 | 20 |
| <b>Temperature (degrees Celsius)</b> | 30 | 12 |

Zena models the relationship between  $\theta$ , the temperature of the water in  $^{\circ}\text{C}$ , and  $t$ , the time in minutes, by

$$\theta = A \times 10^{-kt}$$

where  $A$  and  $k$  are constants.

**10 (a)** Using  $t = 0$ , explain how the value of  $A$  relates to the experiment.

[1 mark]

**10 (b)** Show that

$$\log_{10} \theta = \log_{10} A - kt$$

[1 mark]

**10 (c)** Using Zena's results, calculate the values of  $A$  and  $k$ .

[4 marks]

**10 (d)** Zena states that the temperature of the water will be less than  $1^{\circ}\text{C}$  after 45 minutes.

Determine whether the model supports this statement.

[3 marks]

**10 (e)** Explain why Zena's model is unlikely to accurately give the value of  $\theta$  after 45 minutes.

[1 mark]