

10

A researcher working for a frozen-food manufacturer uses the formula

$$\theta = 21 - Ae^{-kt}$$

to model the temperature of a dessert once it is taken out of a freezer.

In this model:

- θ is the temperature of the dessert in $^{\circ}\text{C}$
- t is the time in hours since the dessert was removed from the freezer
- A and k are positive constants.

10 (a)

Show how

$$\theta = 21 - Ae^{-kt}$$

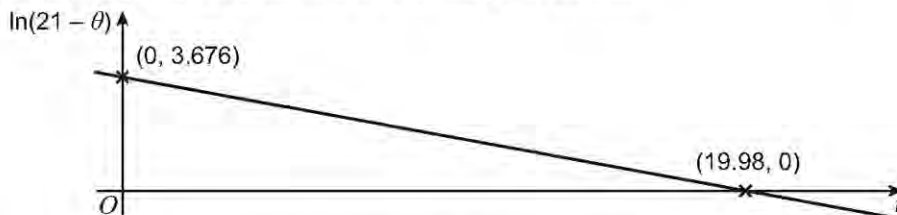
can be rearranged to obtain

$$\ln(21 - \theta) = -kt + \ln A$$

[3 marks]

10 (b)

The researcher uses measurements they have recorded to plot the graph of $\ln(21 - \theta)$ against t as shown in the diagram below.

10 (b) (i) Use the information on the graph to find the value of A

Give your answer to **three** significant figures.

[2 marks]

10 (b) (ii) Use the information on the graph to find the value of k

Give your answer to **three** significant figures.

[2 marks]

10 (b) (iii) Find the temperature of the dessert when it is initially removed from the freezer.

Give your answer to **three** significant figures.

[2 marks]

10 (c)

The dessert is ready to be eaten when its temperature reaches 4°C

Use the model to determine the time, after being removed from the freezer, for the dessert to reach this temperature.

Give your answer to the nearest 10 minutes.

[3 marks]