

- 6 A pan of water is heated until it reaches  $100^{\circ}\text{C}$ . Once the water reaches  $100^{\circ}\text{C}$ , the heat is switched off and the temperature  $T^{\circ}\text{C}$  of the water decreases. The temperature of the water is modelled by the equation

$$T = 25 + ae^{-kt},$$

where  $t$  denotes the time, in minutes, after the heat is switched off and  $a$  and  $k$  are positive constants.

- (i) Write down the value of  $a$ . [1]
- (ii) Explain what the value of 25 represents in the equation  $T = 25 + ae^{-kt}$ . [1]

When the heat is switched off, the initial rate of decrease of the temperature of the water is  $15^{\circ}\text{C}$  per minute.

- (iii) Calculate the value of  $k$ . [3]
- (iv) Find the time taken for the temperature of the water to drop from  $100^{\circ}\text{C}$  to  $45^{\circ}\text{C}$ . [3]
- (v) A second pan of water is heated, but the heat is turned off when the water is at a temperature of less than  $100^{\circ}\text{C}$ . Suggest how the equation for the temperature as the water cools would be modified by this. [1]