9. A kettle contains a quantity of water.
The water is cooling down.
The temperature, θ°C, of the water at time t minutes after cooling began is modelled by the equation

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

where A and k are constants.

Given that

- at the instant cooling began, the temperature of the water was 80 °C
- 40 minutes after cooling began, the temperature of the water was 33 °C

(a) find a complete equation for the model. Give the exact value of A and the value of k to 3 significant figures.

(4)

Given that 20 minutes after cooling began, the temperature of the water was 48 °C

(b) evaluate the model.

(2)

(c) Find, according to the model, the rate of the decrease in the temperature of the water 20 minutes after cooling began.

(*Solutions relying entirely on calculator technology are not acceptable.*)

(3)