**6.** A tourist decides to do a bungee jump from a bridge over a river.
One end of an elastic rope is attached to the bridge and the other end of the elastic rope is attached to the tourist.
The tourist jumps off the bridge.

At time $t$ seconds after the tourist reaches their lowest point, their vertical displacement is $x$ metres above a fixed point 30 metres vertically above the river.

When $t = 0$

- $x = -20$
- the velocity of the tourist is $0\,\text{m s}^{-1}$
- the acceleration of the tourist is $13.6\,\text{m s}^{-2}$

In the subsequent motion, the elastic rope is assumed to remain taut so that the vertical displacement of the tourist can be modelled by the differential equation

$$5k\frac{\mathrm{d}^2x}{\mathrm{d}t^2} + 2k\frac{\mathrm{d}x}{\mathrm{d}t} + 17x = 0 \qquad t \geqslant 0$$

where $k$ is a positive constant.

(a) Determine the value of $k$

**(2)**

(b) Determine the particular solution to the differential equation.

**(7)**

(c) Hence find, according to the model, the vertical height of the tourist above the river 15 seconds after they have reached their lowest point.

**(2)**

(d) Give a limitation of the model.

**(1)**