12. **In this question you must show all stages of your working.**

Solutions relying entirely on calculator technology are not acceptable.

(a) Show that

$$\int x \sin kx \, dx = \frac{1}{k^2} \sin kx - \frac{1}{k} x \cos kx + c$$

where k is a constant and where c is an arbitrary constant.

(3)

A theme park ride lasts for 70 seconds.
The height above ground, H metres, of a passenger on the theme park ride is modelled by the differential equation

$$\frac{dH}{dt} = \frac{t \sin\left(\frac{\pi t}{5}\right)}{10H} \qquad 0 \leqslant t \leqslant 70$$

where t seconds is the time from the start of the ride.

Given that the passenger is 5 m above ground at the start of the ride

(b) find the height above ground of the passenger 52 seconds after the start of the ride.

(6)