14. A balloon is being inflated.

In a simple model,

- the balloon is modelled as a sphere
- the rate of increase of the radius of the balloon is inversely proportional to the square root of the radius of the balloon

At time t seconds, the radius of the balloon is r cm.

(a) Write down a differential equation to model this situation.

(1)

At the instant when $t = 10$

- the radius is 16 cm
- the radius is increasing at a rate of $0.9\,\text{cm}\,\text{s}^{-1}$

(b) Solve the differential equation to show that

$$r^{\frac{3}{2}} = 5.4t + 10$$

(5)

(c) Hence find the radius of the balloon when $t = 20$

Give your answer to the nearest millimetre.

(2)

(d) Suggest a limitation of the model.

(1)