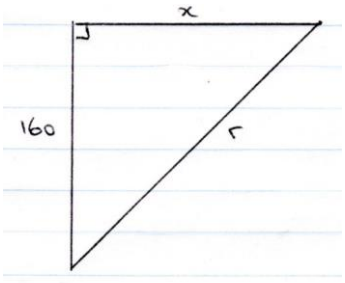
TG ROC **4** A hot air balloon is at a constant height of 160 metres above the ground, and moving parallel to the ground, at a speed of 20 metres per minute. Find the rate at which the balloon is moving away from an observer on the ground at the time when the distance from the observer to the balloon is 400 metres.



When $r = 400$, then $400^2 = x^2 + 160^2$

$\therefore x = \sqrt{400^2 - 160^2}$

$= \sqrt{134\,400}$

As $r^2 = x^2 + 160^2$

$r = (x^2 + 160^2)^{\frac{1}{2}}$

$$\frac{dr}{dx} = \frac{1}{2}(x^2 + 160^2)^{-\frac{1}{2}}.2x$$

$$= \frac{x}{\sqrt{x^2 + 160^2}}$$

$$\frac{dr}{dx}(\sqrt{134\,400}) = \frac{\sqrt{134\,400}}{\sqrt{134\,400 + 160^2}}$$

$= 0.916515139\ldots$

$= 0.9165$ (4 dec pl)

Using $\frac{dr}{dt} = \frac{dr}{dx} \times \frac{dx}{dt}$

$= 0.9165 \times 20$

$= 18.33030278\ldots$

$= 18.33$ (2 dec pl)

$\therefore$ balloon moving away at 18.33 ms^{-1}.