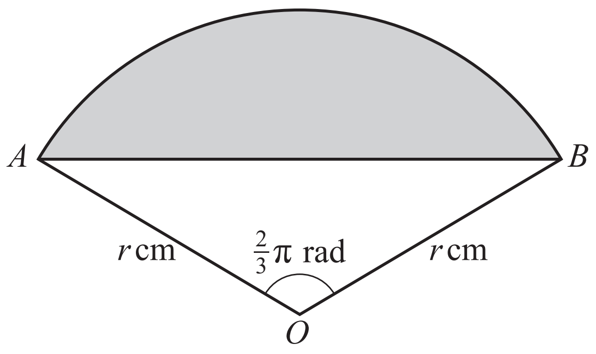

The diagram shows a sector of a circle with centre O and radius r cm. The shaded region is bounded by the chord AB and the arc AB. The size of angle AOB is $\frac{2}{3}\pi$ radians.

(a) Show that the area of the shaded region is approximately $0.614r^2$ cm^2. [2]

It is given that the radius of the circle is increasing at a rate of $0.4\,\text{cm}\,\text{s}^{-1}$.

(b) **(i)** Find the rate of increase of the area of the shaded region at the instant when $r = 20$. Give your answer correct to 2 significant figures. [3]

(ii) Find the rate of increase of the length of the arc AB. Give your answer correct to 2 significant figures. [3]