TG **3** A spherical bubble is expanding so that its volume increases at the constant rate of 70 mm^3 per second.

What is the rate of increase of its surface area when the radius is 10 mm?

Volume of a sphere: $V = \frac{4}{3}\pi r^3$

$$V = \frac{4}{3}\pi r^3$$

$$\frac{dV}{dr} = 4\pi r^2$$

$$\frac{dV}{dr}(10) = 4\pi(10)^2$$

$$= 400\pi$$

Also, $\frac{dV}{dt} = 70$

Using $\frac{dV}{dt} = \frac{dV}{dr} \cdot \frac{dr}{dt}$

$$70 = 400\pi \times \frac{dr}{dt}$$

$$\frac{dr}{dt} = \frac{70}{400\pi}$$

$$= \frac{7}{40\pi}$$

Surface area of a sphere: $A = 4\pi r^2$

$$A = 4\pi r^2$$

$$\frac{dA}{dr} = 8\pi r$$

$$\frac{dA}{dr}(10) = 8\pi(10)$$

$$= 80\pi$$

Also, $\frac{dr}{dt} = \frac{7}{40\pi}$

Using $\frac{dA}{dt} = \frac{dA}{dr} \cdot \frac{dr}{dt}$

$$\frac{dA}{dt} = 80\pi \times \frac{7}{40\pi}$$

$$\frac{dA}{dt} = 14$$

$\therefore$ the surface area increases at 14 mm^{2}s^{-1}

* These solutions have been provided by *projectmaths* and are not supplied or endorsed by NESA.