

Self-assessment: 20 Further applications of calculus**1. Do not use a calculator to answer this question.**

The part of the curve with equation $y = \sin 3x$ between $x = 0$ and $x = \pi$ is rotated 2π radians around the x -axis. Find the exact value of the resulting volume of revolution.

(accessible to students on the path to grade 5 or 6) [7 marks]

2. A ball is being inflated so that the rate of change of its radius is given by $6\sqrt{t} \text{ cm s}^{-1}$, where the radius is measured in centimetres and time in seconds. After five seconds the radius of the ball is 26 cm. Find the rate of change of volume of the ball at this instant.

(accessible to students on the path to grade 3 or 4) [5 marks]

3. The volume of a cylinder is 632 cm^3 . Let r denote the radius and h the height of the cylinder.

(a) Show that the surface area of the cylinder is given by $= \frac{1264}{h} + \sqrt{2528\pi h}$.

- (b) Find the minimum possible surface area of the cylinder.

(accessible to students on the path to grade 5 or 6) [6 marks]

4. A particle moves so that its velocity (measured in ms^{-1}) depends on time (measured in seconds) according to the equation $v = 3e^{-2t} \sin t$ for $t \geq 0$.

- (a) Find the maximum velocity of the particle.
(b) Find the acceleration of the particle when $t = 3$.
(c) Find the distance travelled by the particle in the first three seconds of motion.

(accessible to students on the path to grade 3 or 4)

- (d) Initially the particle is at the origin. Find an equation for the displacement in terms of time.

(accessible to students on the path to grade 5 or 6)

[12 marks]