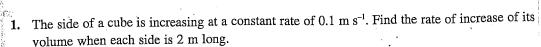
## Exercise 7.15



- 2. The volume of a spherical balloon is increasing at a constant rate of 0.05 m<sup>3</sup> s<sup>-1</sup>. Find the rate of increase of its radius when the volume of the balloon is 0.008 m<sup>3</sup>.
- 3. A spherical balloon is being inflated in such a way that its volume is increasing at a constant rate of 8 cm<sup>3</sup> s<sup>-1</sup>. Find the rate of increase of the surface area of the balloon when its radius is 10 cm.
  - 4. The radius of a circular oil slick is increasing at 1.5 m s<sup>-1</sup>. Taking  $\pi$  to be 3.14, find, to 2 significant figures, the rate at which the area of the oil slick is increasing when its radius is 300 m.
- 5. An inverted right circular cone of semi-vertical angle 45° is collecting water from a tap at a steady rate of  $18\pi$  cm<sup>3</sup> s<sup>-1</sup>. Find the rate at which the depth h of the water is rising when h = 3 cm.
- 6. A hemispherical bowl of radius 6 cm contains water which is flowing into it at a constant rate. When the height of the water is h cm, the volume V of the water in the bowl is given by  $V = \pi \left(6h^2 - \frac{1}{3}h^3\right) \text{ cm}^3.$

Find the rate at which the water level is rising when h = 3, given that the time taken to fill the bowl is 1 minute.

- 7. A ladder 5 m long is leaning against a vertical wall. The bottom of the ladder is pulled along the ground away from the wall at a constant rate of 0.4 m s<sup>-1</sup>. How fast will the top of the ladder be falling at the instant when its bottom is 3 m away from the wall?
- 8. A flask in the shape of a cone of height 20 cm and radius 8 cm is held vertex downwards. Show that when the depth of water in the flask is x cm, the volume of water is  $\frac{4}{75} \pi x^3$  cm<sup>3</sup>. Water leaks out from the vertex at the rate of 2 cm<sup>3</sup> s<sup>-1</sup>. Find the rate of change of the depth of the water when the depth is 10 cm.
- 9. A hemispherical bowl of radius 12 cm is initially full of water. Water runs out of a small hole at the bottom of the bowl at a rate of  $48\pi$  cm<sup>3</sup> s<sup>-1</sup>. When the depth of the water is x cm<sup>2</sup> show that the depth is decreasing at a rate of  $\frac{48}{x(24-x)}$  cm s<sup>-1</sup>.

Find the rate at which the depth is decreasing when

- (a) the bowl is full,
- (b) the depth is 6 cm.

[When the depth of water in the hemispherical bowl with radius r is x cm, the volume of the water is  $\frac{1}{3}\pi x^2(3r-x)$  cm<sup>3</sup>]

10. Two variables p and q are connected by the relation  $\frac{1}{p} + \frac{1}{q} = \frac{1}{k}$  where k is a constant Given that k = 10 and p decreases at the rate of 2 cm s<sup>-1</sup>, find the rate of change of q when p = 40.

## Exercise 7.15

- 1. 1.2 m<sup>3</sup> s<sup>-1</sup>
- 3. 1.6 cm<sup>2</sup> s<sup>-1</sup>
- **5.** 2 cm s<sup>-1</sup>
- 7. 0.3 ms<sup>-1</sup>
- **9.** (a)  $\frac{1}{3}$  cm s<sup>-1</sup>
- **10.**  $\frac{2}{9}$  cm s<sup>-1</sup>
- 2. 0.26 m s<sup>-1</sup>
- 4. 2800 m<sup>2</sup> s<sup>-1</sup>
- **6.**  $\frac{4}{45}$  cm s<sup>-1</sup> **8.** 0.04 cm s<sup>-1</sup>
- - (b)  $\frac{4}{9}$  cm s<sup>-1</sup>