12. $\frac{6}{5}\cot\frac{t}{2}$ **13.** 0 **17.** $\frac{\sec^3 t}{at}, 0 < t < \frac{\pi}{2}$

EXERCISE 6.1

1. (a) 6π cm^2/cm (b) 8π cm^2/cm

2. $\frac{8}{3}$ cm^2/s **3.** 60π cm^2/s **4.** 900 cm^3/s

5. 80π cm^2/s **6.** 1.4π cm/s

7. (a) –2 cm/min (b) 2 cm^2/min

8. $\frac{1}{\pi}$ cm/s **9.** 400π cm^3/cm **10.** $\frac{8}{3}$ cm/s

11. (4, 11) and $\left(-4, \frac{-31}{3}\right)$ **12.** 2π cm^3/s

13. $\frac{27}{8}\pi(2x+1)^2$ **14.** $\frac{1}{48\pi}$ cm/s **15.** ₹ 20.967

16. ₹ 208 **17.** B **18.** D

EXERCISE 6.2

4. (a) $\left(\frac{3}{4}, \infty\right)$ (b) $\left(-\infty, \frac{3}{4}\right)$

5. (a) $(-\infty, -2)$ and $(3, \infty)$ (b) $(-2, 3)$

6. (a) decreasing for $x < -1$ and increasing for $x > -1$

(b) decreasing for $x > -\frac{3}{2}$ and increasing for $x < -\frac{3}{2}$

(c) increasing for $-2 < x < -1$ and decreasing for $x < -2$ and $x > -1$

(d) increasing for $x < -\frac{9}{2}$ and decreasing for $x > -\frac{9}{2}$

(e) increasing in (1, 3) and (3, ∞), decreasing in (– ∞, –1) and (– 1, 1).

8. $0 < x < 1$ and $x > 2$ **12.** A, B

13. D **14.** $a > -2$ **19.** D

EXERCISE 6.3

1. 764 **2.** $\frac{-1}{64}$ **3.** 11 **4.** 24

5. 1 **6.** $\frac{-a}{2b}$ **7.** (3, – 20) and (–1, 12)

8. (3, 1) **9.** (2, – 9)

10. (i) $y + x + 1 = 0$ and $y + x - 3 = 0$

11. No tangent to the curve which has slope 2.

12. $y = \frac{1}{2}$ **13.** (i) $(0, \pm 4)$ (ii) $(\pm 3, 0)$

14. (i) Tangent: $10x + y = 5$; Normal: $x - 10y + 50 = 0$

(ii) Tangent: $y = 2x + 1$; Normal: $x + 2y - 7 = 0$

(iii) Tangent: $y = 3x - 2$; Normal: $x + 3y - 4 = 0$

(iv) Tangent: $y = 0$; Normal: $x = 0$

(v) Tangent: $x + y - \sqrt{2} = 0$; Normal $x = y$

15. (a) $y - 2x - 3 = 0$ (b) $36y + 12x - 227 = 0$

17. (0, 0), (3, 27) **18.** (0, 0), (1, 2), (–1, –2)

19. $(1, \pm 2)$ **20.** $2x + 3my - am^2(2 + 3m^2) = 0$

21. $x + 14y - 254 = 0$, $x + 14y + 86 = 0$

22. $ty = x + at^2$, $y = -tx + 2at + at^3$

24. $\frac{x x_0}{a^2} - \frac{y y_0}{b^2} = 1$, $\frac{y - y_0}{a^2 y_0} + \frac{x - x_0}{b^2 x_0} = 0$

25. $48x - 24y = 23$ **26.** D **27.** A

EXERCISE 6.4

1. (i) 5.03 (ii) 7.035 (iii) 0.775

(iv) 0.208 (v) 0.999 (vi) 1.968

(vii) 2.962 (viii) 3.996 (ix) 3.009

(x) 20.025 (xi) 0.060 (xii) 2.948

(xiii) 3.004 (xiv) 7.904 (xv) 2.001

2. 28.21 **3.** -34.995 **4.** $0.03\ x^3\ m^3$

5. $-0.12\ x^2\ m^2$ **6.** $3.92\ \pi\ m^3$ **7.** $2.16\ \pi\ m^3$

8. D **9.** C

EXERCISE 6.5

1. (i) Minimum Value = 3 (ii) Minimum Value = – 2

(iii) Maximum Value = 10 (iv) Neither minimum nor maximum value

2. (i) Minimum Value = – 1; No maximum value

(ii) Maximum Value = 3; No minimum value

(iii) Minimum Value = 4; Maximum Value = 6

(iv) Minimum Value = 2; Maximum Value = 4

(v) Neither minimum nor Maximum Value

3. (i) local minimum at $x = 0$, local minimum value = 0

(ii) local minimum at $x = 1$, local minimum value = – 2

local maximum at $x = -1$, local maximum value = 2

(iii) local maximum at $x = \frac{\pi}{4}$, local maximum value = $\sqrt{2}$

(iv) local maximum at $x = \frac{3\pi}{4}$, local maximum value = $\sqrt{2}$

local minimum at $x = \frac{7\pi}{4}$, local minimum value = $-\sqrt{2}$

(v) local maximum at $x = 1$, local maximum value = 19

local minimum at $x = 3$, local minimum value = 15

(vi) local minimum at $x = 2$, local minimum value = 2

(vii) local maximum at $x = 0$, local maximum value $= \frac{1}{2}$

(viii) local maximum at $x = \frac{2}{3}$, local maximum value $= \frac{2\sqrt{3}}{9}$

5. (i) Absolute minimum value $= -8$, absolute maximum value $= 8$

(ii) Absolute minimum value $= -1$, absolute maximum value $= \sqrt{2}$

(iii) Absolute minimum value $= -10$, absolute maximum value $= 8$

(iv) Absolute minimum value $= 19$, absolute maximum value $= 3$

6. Maximum profit = 113 unit.

7. Minima at $x = 2$, minimum value $= -39$, Maxima at $x = 0$, maximum value $= 25$.

8. At $x = \frac{\pi}{4}$ and $\frac{5\pi}{4}$ **9.** Maximum value $= \sqrt{2}$

10. Maximum at $x = 3$, maximum value 89; maximum at $x = -2$, maximum value = 139

11. $a = 120$

12. Maximum at $x = 2\pi$, maximum value $= 2\pi$; Minimum at $x = 0$, minimum value $= 0$

13. 12, 12 **14.** 45, 15 **15.** 25, 10 **16.** 8, 8

17. 3 cm **18.** $x = 5$ cm

21. radius $= \left(\frac{50}{\pi}\right)^{\frac{1}{3}}$ cm and height $= 2\left(\frac{50}{\pi}\right)^{\frac{1}{3}}$ cm

22. $\frac{112}{\pi+4}$ cm, $\frac{28\pi}{\pi+4}$ cm **27.** A **28.** D **29.** C

Miscellaneous Exercise on Chapter 6

1. (a) 0.677 (b) 0.497

3. $b\sqrt{3}$ cm²/s **4.** $x + y - 3 = 0$

6. (i) $0 \le x \le \frac{\pi}{2}$ and $\frac{3\pi}{2} < x < 2\pi$ (ii) $\frac{\pi}{2} < x < \frac{3\pi}{2}$

7. (i) $x < -1$ and $x > 1$ (ii) $-1 < x < 1$

8. $\frac{3\sqrt{3}}{4}ab$ **9.** Rs 1000

11. length $= \frac{20}{\pi+4}$ m, breadth $= \frac{10}{\pi+4}$ m

13. (i) local maxima at $x = \frac{2}{7}$ (ii) local minima at $x = 2$

(iii) point of inflection at $x = -1$

14. Absolute maximum $= \frac{5}{4}$, Absolute minimum $= 1$

17. $\frac{4\pi R^3}{3\sqrt{3}}$ **19.** A **20.** B **21.** A

22. B **23.** A **24.** A