

ANSWERS

EXERCISE 7.1

1. $-\frac{1}{2}\cos 2x$
2. $\frac{1}{3}\sin 3x$
3. $\frac{1}{2}e^{2x}$
4. $\frac{1}{3a}(ax+b)^3$
5. $-\frac{1}{2}\cos 2x - \frac{4}{3}e^{3x}$
6. $\frac{4}{3}e^{3x} + x + C$
7. $\frac{x^3}{3} - x + C$
8. $\frac{ax^3}{3} + \frac{bx^2}{2} + cx + C$
9. $\frac{2}{3}x^3 + e^x + C$
10. $\frac{x^2}{2} + \log|x| - 2x + C$
11. $\frac{x^2}{2} + 5x + \frac{4}{x} + C$
12. $\frac{2}{7}x^{\frac{7}{2}} + 2x^{\frac{3}{2}} + 8\sqrt{x} + C$
13. $\frac{x^3}{3} + x + C$
14. $\frac{2}{3}x^{\frac{3}{2}} - \frac{2}{5}x^{\frac{5}{2}} + C$
15. $\frac{6}{7}x^{\frac{7}{2}} + \frac{4}{5}x^{\frac{5}{2}} + 2x^{\frac{3}{2}} + C$
16. $x^2 - 3\sin x + e^x + C$
17. $\frac{2}{3}x^3 + 3\cos x + \frac{10}{3}x^{\frac{3}{2}} + C$
18. $\tan x + \sec x + C$
19. $\tan x - x + C$
20. $2 \tan x - 3 \sec x + C$
21. C
22. A

EXERCISE 7.2

1. $\log(1+x^2) + C$
2. $\frac{1}{3}(\log|x|)^3 + C$
3. $\log|1+\log x| + C$
4. $\cos(\cos x) + C$
5. $-\frac{1}{4a}\cos 2(ax+b) + C$
6. $\frac{2}{3a}(ax+b)^{\frac{3}{2}} + C$
7. $\frac{2}{5}(x+2)^{\frac{5}{2}} - \frac{4}{3}(x+2)^{\frac{3}{2}} + C$

8. $\frac{1}{6}(1+2x^2)^{\frac{3}{2}} + C$ 9. $\frac{4}{3}(x^2+x+1)^{\frac{3}{2}} + C$ 10. $2\log|\sqrt{x}-1| + C$
11. $\frac{2}{3}\sqrt{x+4}(x-8) + C$
12. $\frac{1}{7}(x^3-1)^{\frac{7}{3}} + \frac{1}{4}(x^3-1)^{\frac{4}{3}} + C$ 13. $-\frac{1}{18(2+3x^3)^2} + C$
14. $\frac{(\log x)^{1-m}}{1-m} + C$ 15. $-\frac{1}{8}\log|9-4x^2| + C$ 16. $\frac{1}{2}e^{2x+3} + C$
17. $-\frac{1}{2e^{x^2}} + C$ 18. $e^{\tan^{-1}x} + C$ 19. $\log(e^x + e^{-x}) + C$
20. $\frac{1}{2}\log(e^{2x} + e^{-2x}) + C$ 21. $\frac{1}{2}\tan(2x-3) - x + C$
22. $-\frac{1}{4}\tan(7-4x) + C$ 23. $\frac{1}{2}(\sin^{-1}x)^2 + C$
24. $\frac{1}{2}\log|2\sin x + 3\cos x| + C$ 25. $\frac{1}{(1-\tan x)} + C$
26. $2\sin\sqrt{x} + C$ 27. $\frac{1}{3}(\sin 2x)^{\frac{3}{2}} + C$ 28. $2\sqrt{1+\sin x} + C$
29. $\frac{1}{2}(\log \sin x)^2 + C$ 30. $-\log|1+\cos x| + C$ 31. $\frac{1}{1+\cos x} + C$
32. $\frac{x}{2} - \frac{1}{2}\log|\cos x + \sin x| + C$ 33. $\frac{x}{2} - \frac{1}{2}\log|\cos x - \sin x| + C$
34. $2\sqrt{\tan x} + C$ 35. $\frac{1}{3}(1+\log x)^3 + C$ 36. $\frac{1}{3}(x+\log x)^3 + C$
37. $-\frac{1}{4}\cos(\tan^{-1}x^4) + C$ 38. D
39. B

EXERCISE 7.3

1. $\frac{x}{2} - \frac{1}{8} \sin(4x+10) + C$
2. $-\frac{1}{14} \cos 7x + \frac{1}{2} \cos x + C$
3. $\frac{1}{4} \left[\frac{1}{12} \sin 12x + x + \frac{1}{8} \sin 8x + \frac{1}{4} \sin 4x \right] + C$
4. $-\frac{1}{2} \cos(2x+1) + \frac{1}{6} \cos^3(2x+1) + C$
5. $\frac{1}{6} \cos^6 x - \frac{1}{4} \cos^4 x + C$
6. $\frac{1}{4} \left[\frac{1}{6} \cos 6x - \frac{1}{4} \cos 4x - \frac{1}{2} \cos 2x \right] + C$
7. $\frac{1}{2} \left[\frac{1}{4} \sin 4x - \frac{1}{12} \sin 12x \right] + C$
8. $2 \tan \frac{x}{2} - x + C$
9. $x - \tan \frac{x}{2} + C$
10. $\frac{3x}{8} - \frac{1}{4} \sin 2x + \frac{1}{32} \sin 4x + C$
11. $\frac{3x}{8} + \frac{1}{8} \sin 4x + \frac{1}{64} \sin 8x + C$
12. $x - \sin x + C$
13. $2(\sin x + x \cos \alpha) + C$
14. $-\frac{1}{\cos x + \sin x} + C$
15. $\frac{1}{6} \sec^3 2x - \frac{1}{2} \sec 2x + C$
16. $\frac{1}{3} \tan^3 x - \tan x + x + C$
17. $\sec x - \operatorname{cosec} x + C$
18. $\tan x + C$
19. $\log |\tan x| + \frac{1}{2} \tan^2 x + C$
20. $\log |\cos x + \sin x| + C$
21. $\frac{\pi x}{2} - \frac{x^2}{2} + C$
22. $\frac{1}{\sin(a-b)} \log \left| \frac{\cos(x-a)}{\cos(x-b)} \right| + C$
23. A
24. B

EXERCISE 7.4

1. $\tan^{-1} x^3 + C$
2. $\frac{1}{2} \log |2x + \sqrt{1+4x^2}| + C$

3. $\log \left| \frac{1}{2-x+\sqrt{x^2-4x+5}} \right| + C$ 4. $\frac{1}{5} \sin^{-1} \frac{5x}{3} + C$
5. $\frac{3}{2\sqrt{2}} \tan^{-1} \sqrt{2} x^2 + C$ 6. $\frac{1}{6} \log \left| \frac{1+x^3}{1-x^3} \right| + C$
7. $\sqrt{x^2-1} - \log \left| x + \sqrt{x^2-1} \right| + C$ 8. $\frac{1}{3} \log \left| x^3 + \sqrt{x^6+a^6} \right| + C$
9. $\log \left| \tan x + \sqrt{\tan^2 x + 4} \right| + C$ 10. $\log \left| x+1 + \sqrt{x^2+2x+2} \right| + C$
11. $\frac{1}{6} \tan^{-1} \left(\frac{3x+1}{2} \right) + C$ 12. $\sin^{-1} \left(\frac{x+3}{2} \right) + C$
13. $\log \left| x - \frac{3}{2} + \sqrt{x^2-3x+2} \right| + C$ 14. $\sin^{-1} \left(\frac{2x-3}{\sqrt{41}} \right) + C$
15. $\log \left| x - \frac{a+b}{2} + \sqrt{(x-a)(x-b)} \right| + C$
16. $2\sqrt{2x^2+x-3} + C$ 17. $\sqrt{x^2-1} + 2\log \left| x + \sqrt{x^2-1} \right| + C$
18. $\frac{5}{6} \log \left| 3x^2+2x+1 \right| - \frac{11}{3\sqrt{2}} \tan^{-1} \left(\frac{3x+1}{\sqrt{2}} \right) + C$
19. $6\sqrt{x^2-9x+20} + 34 \log \left| x - \frac{9}{2} + \sqrt{x^2-9x+20} \right| + C$
20. $-\sqrt{4x-x^2} + 4 \sin^{-1} \left(\frac{x-2}{2} \right) + C$
21. $\sqrt{x^2+2x+3} + \log \left| x+1 + \sqrt{x^2+2x+3} \right| + C$
22. $\frac{1}{2} \log \left| x^2-2x-5 \right| + \frac{2}{\sqrt{6}} \log \left| \frac{x-1-\sqrt{6}}{x-1+\sqrt{6}} \right| + C$

$$23. 5\sqrt{x^2+4x+10} - 7\log|x+2+\sqrt{x^2+4x+10}| + C$$

24. B

25. B

EXERCISE 7.5

$$1. \log \frac{(x+2)^2}{|x+1|} + C$$

$$2. \frac{1}{6} \log \left| \frac{x-3}{x+3} \right| + C$$

$$3. \log|x-1| - 5\log|x-2| + 4\log|x-3| + C$$

$$4. \frac{1}{2} \log|x-1| - 2\log|x-2| + \frac{3}{2} \log|x-3| + C$$

$$5. 4\log|x+2| - 2\log|x+1| + C$$

$$6. \frac{x}{2} + \log|x| - \frac{3}{4} \log|1-2x| + C$$

$$7. \frac{1}{2} \log|x-1| - \frac{1}{4} \log(x^2+1) + \frac{1}{2} \tan^{-1} x + C$$

$$8. \frac{2}{9} \log \left| \frac{x-1}{x+2} \right| - \frac{1}{3(x-1)} + C$$

$$9. \frac{1}{2} \log \left| \frac{x+1}{x-1} \right| - \frac{4}{x-1} + C$$

$$10. \frac{5}{2} \log|x+1| - \frac{1}{10} \log|x-1| - \frac{12}{5} \log|2x+3| + C$$

$$11. \frac{5}{3} \log|x+1| - \frac{5}{2} \log|x+2| + \frac{5}{6} \log|x-2| + C$$

$$12. \frac{x^2}{2} + \frac{1}{2} \log|x+1| + \frac{3}{2} \log|x-1| + C$$

$$13. -\log|x-1| + \frac{1}{2} \log(1+x^2) + \tan^{-1} x + C$$

$$14. 3\log|x-2| + \frac{7}{x+2} + C$$

$$15. \frac{1}{4} \log \left| \frac{x-1}{x+1} \right| - \frac{1}{2} \tan^{-1} x + C$$

$$16. \frac{1}{n} \log \left| \frac{x^n}{x^n+1} \right| + C$$

$$17. \log \left| \frac{2-\sin x}{1-\sin x} \right| + C$$

$$18. x + \frac{2}{\sqrt{3}} \tan^{-1} \frac{x}{\sqrt{3}} - 3 \tan^{-1} \frac{x}{2} + C$$

$$19. \frac{1}{2} \log \left(\frac{x^2+1}{x^2+3} \right) + C$$

$$20. \frac{1}{4} \log \left| \frac{x^4 - 1}{x^4} \right| + C$$

22. B

$$21. \log \left(\frac{e^x - 1}{e^x} \right) + C$$

23. A

EXERCISE 7.6

$$1. -x \cos x + \sin x + C$$

$$3. e^x (x^2 - 2x + 2) + C$$

$$5. \frac{x^2}{2} \log 2x - \frac{x^2}{4} + C$$

$$7. \frac{1}{4} (2x^2 - 1) \sin^{-1} x + \frac{x\sqrt{1-x^2}}{4} + C$$

$$9. (2x^2 - 1) \frac{\cos^{-1} x}{4} - \frac{x}{4} \sqrt{1-x^2} + C$$

$$10. (\sin^{-1} x)^2 x + 2\sqrt{1-x^2} \sin^{-1} x - 2x + C$$

$$11. -\left[\sqrt{1-x^2} \cos^{-1} x + x \right] + C$$

$$13. x \tan^{-1} x - \frac{1}{2} \log(1+x^2) + C$$

$$15. \left(\frac{x^3}{3} + x \right) \log x - \frac{x^3}{9} - x + C$$

$$17. \frac{e^x}{1+x} + C$$

$$19. \frac{e^x}{x} + C$$

$$21. \frac{e^{2x}}{5} (2 \sin x - \cos x) + C$$

23. A

$$2. -\frac{x}{3} \cos 3x + \frac{1}{9} \sin 3x + C$$

$$4. \frac{x^2}{2} \log x - \frac{x^2}{4} + C$$

$$6. \frac{x^3}{3} \log x - \frac{x^3}{9} + C$$

$$8. \frac{x^2}{2} \tan^{-1} x - \frac{x}{2} + \frac{1}{2} \tan^{-1} x + C$$

$$12. x \tan x + \log |\cos x| + C$$

$$14. \frac{x^2}{2} (\log x)^2 - \frac{x^2}{2} \log x + \frac{x^2}{4} + C$$

$$16. e^x \sin x + C$$

$$18. e^x \tan \frac{x}{2} + C$$

$$20. \frac{e^x}{(x-1)^2} + C$$

$$22. 2x \tan^{-1} x - \log(1+x^2) + C$$

24. B

EXERCISE 7.7

1. $\frac{1}{2}x\sqrt{4-x^2} + 2\sin^{-1}\frac{x}{2} + C$
2. $\frac{1}{4}\sin^{-1}2x + \frac{1}{2}x\sqrt{1-4x^2} + C$
3. $\frac{(x+2)}{2}\sqrt{x^2+4x+6} + \log|x+2+\sqrt{x^2+4x+6}| + C$
4. $\frac{(x+2)}{2}\sqrt{x^2+4x+1} - \frac{3}{2}\log|x+2+\sqrt{x^2+4x+1}| + C$
5. $\frac{5}{2}\sin^{-1}\left(\frac{x+2}{\sqrt{5}}\right) + \frac{x+2}{2}\sqrt{1-4x-x^2} + C$
6. $\frac{(x+2)}{2}\sqrt{x^2+4x-5} - \frac{9}{2}\log|x+2+\sqrt{x^2+4x-5}| + C$
7. $\frac{(2x-3)}{4}\sqrt{1+3x-x^2} + \frac{13}{8}\sin^{-1}\left(\frac{2x-3}{\sqrt{13}}\right) + C$
8. $\frac{2x+3}{4}\sqrt{x^2+3x} - \frac{9}{8}\log\left|x+\frac{3}{2}+\sqrt{x^2+3x}\right| + C$
9. $\frac{x}{6}\sqrt{x^2+9} + \frac{3}{2}\log|x+\sqrt{x^2+9}| + C$
10. A
11. D

EXERCISE 7.8

1. $\frac{1}{2}(b^2 - a^2)$
2. $\frac{35}{2}$
3. $\frac{19}{3}$
4. $\frac{27}{2}$
5. $e - \frac{1}{e}$
6. $\frac{15+e^8}{2}$

EXERCISE 7.9

1. 2
2. $\log\frac{3}{2}$
3. $\frac{64}{3}$
4. $\frac{1}{2}$
5. 0
6. $e^4(e-1)$

7. $\frac{1}{2} \log 2$ 8. $\log\left(\frac{\sqrt{2}-1}{2-\sqrt{3}}\right)$ 9. $\frac{\pi}{2}$
10. $\frac{\pi}{4}$ 11. $\frac{1}{2} \log \frac{3}{2}$ 12. $\frac{\pi}{4}$
13. $\frac{1}{2} \log 2$ 14. $\frac{1}{5} \log 6 + \frac{3}{\sqrt{5}} \tan^{-1} \sqrt{5}$
15. $\frac{1}{2}(e-1)$ 16. $5 - \frac{5}{2} \left(9 \log \frac{5}{4} - \log \frac{3}{2} \right)$
17. $\frac{\pi^4}{1024} + \frac{\pi}{2} + 2$ 18. 0 19. $3 \log 2 + \frac{3\pi}{8}$
20. $1 + \frac{4}{\pi} - \frac{2\sqrt{2}}{\pi}$ 21. D 22. C

EXERCISE 7.10

1. $\frac{1}{2} \log 2$ 2. $\frac{64}{231}$ 3. $\frac{\pi}{2} - \log 2$
4. $\frac{16\sqrt{2}}{15}(\sqrt{2}+1)$ 5. $\frac{\pi}{4}$ 6. $\frac{1}{\sqrt{17}} \log \frac{21+5\sqrt{17}}{4}$
7. $\frac{\pi}{8}$ 8. $\frac{e^2(e^2-2)}{4}$ 9. D
10. B

EXERCISE 7.11

1. $\frac{\pi}{4}$ 2. $\frac{\pi}{4}$ 3. $\frac{\pi}{4}$ 4. $\frac{\pi}{4}$
5. 29 6. 9 7. $\frac{1}{(n+1)(n+2)}$
8. $\frac{\pi}{8} \log 2$ 9. $\frac{16\sqrt{2}}{15}$ 10. $\frac{\pi}{2} \log \frac{1}{2}$ 11. $\frac{\pi}{2}$

12. π 13. 0 14. 0 15. 0
 16. $-\pi \log 2$ 17. $\frac{a}{2}$ 18. 5 20. C
 21. C

MISCELLANEOUS EXERCISE ON CHAPTER 7

1. $\frac{1}{2} \log \left| \frac{x^2}{1-x^2} \right| + C$ 2. $\frac{2}{3(a-b)} \left[(x+a)^{\frac{3}{2}} - (x+b)^{\frac{3}{2}} \right] + C$
 3. $-\frac{2}{a} \sqrt{\frac{(a-x)}{x}} + C$ 4. $-\left(1 + \frac{1}{x^4}\right)^{\frac{1}{4}} + C$
 5. $2\sqrt{x} - 3x^{\frac{1}{3}} + 6x^{\frac{1}{6}} - 6\log(1+x^{\frac{1}{6}}) + C$
 6. $-\frac{1}{2} \log|x+1| + \frac{1}{4} \log(x^2+9) + \frac{3}{2} \tan^{-1} \frac{x}{3} + C$
 7. $\sin a \log|\sin(x-a)| + x \cos a + C$ 8. $\frac{x^3}{3} + C$
 9. $\sin^{-1} \left(\frac{\sin x}{2} \right) + C$ 10. $-\frac{1}{2} \sin 2x + C$
 11. $\frac{1}{\sin(a-b)} \log \left| \frac{\cos(x+b)}{\cos(x+a)} \right| + C$ 12. $\frac{1}{4} \sin^{-1}(x^4) + C$
 13. $\log \left(\frac{1+e^x}{2+e^x} \right) + C$ 14. $\frac{1}{3} \tan^{-1} x - \frac{1}{6} \tan^{-1} \frac{x}{2} + C$
 15. $-\frac{1}{4} \cos^4 x + C$ 16. $\frac{1}{4} \log(x^4+1) + C$
 17. $\frac{[f(ax+b)]^{n+1}}{a(n+1)} + C$ 18. $\frac{-2}{\sin \alpha} \sqrt{\frac{\sin(x+\alpha)}{\sin x}} + C$
 19. $\frac{2(2x-1)}{\pi} \sin^{-1} \sqrt{x} + \frac{2\sqrt{x-x^2}}{\pi} - x + C$

$$20. -2\sqrt{1-x} + \cos^{-1}\sqrt{x} + \sqrt{x-x^2} + C$$

$$21. e^x \tan x + C$$

$$22. -2\log|x+1| - \frac{1}{x+1} + 3\log|x+2| + C$$

$$23. \frac{1}{2} \left[x \cos^{-1} x - \sqrt{1-x^2} \right] + C$$

$$24. -\frac{1}{3} \left(1 + \frac{1}{x^2} \right)^{\frac{3}{2}} \left[\log \left(1 + \frac{1}{x^2} \right) - \frac{2}{3} \right] + C$$

$$25. \frac{\pi}{e^2}$$

$$26. \frac{\pi}{8}$$

$$27. \frac{\pi}{6}$$

$$28. 2\sin^{-1} \frac{(\sqrt{3}-1)}{2}$$

$$29. \frac{4\sqrt{2}}{3}$$

$$30. \frac{1}{40} \log 9$$

$$31. \frac{\pi}{2} - 1$$

$$32. \frac{\pi}{2} (\pi - 2)$$

$$33. \frac{19}{2}$$

$$40. \frac{1}{3} \left(e^2 - \frac{1}{e} \right)$$

$$41. A$$

$$42. B$$

$$43. D$$

$$44. B$$

EXERCISE 8.1

$$1. \frac{14}{3}$$

$$2. 16 - 4\sqrt{2}$$

$$3. \frac{32 - 8\sqrt{2}}{3}$$

$$4. 12\pi$$

$$5. 6\pi$$

$$6. \frac{\pi}{3}$$

$$7. \frac{a^2}{2} \left(\frac{\pi}{2} - 1 \right)$$

$$8. (4)^{\frac{2}{3}}$$

$$9. \frac{1}{3}$$

$$10. \frac{9}{8}$$

$$11. 8\sqrt{3}$$

$$12. A$$

$$13. B$$

EXERCISE 8.2

1. $\frac{\sqrt{2}}{6} + \frac{9}{4} \sin^{-1} \frac{2\sqrt{2}}{3}$ 2. $\left(\frac{2\pi}{3} - \frac{\sqrt{3}}{2}\right)$
3. $\frac{21}{2}$ 4. 4 5. 8
6. B 7. B

Miscellaneous Exercise on Chapter 8

1. (i) $\frac{7}{3}$ (ii) 624.8
2. $\frac{1}{6}$ 3. $\frac{7}{3}$ 4. 9 5. 4
6. $\frac{8a^2}{3m^3}$ 7. 27 8. $\frac{3}{2}(\pi - 2)$
9. $\frac{ab}{4}(\pi - 2)$ 10. $\frac{9}{2}$ 11. 2 12. $\frac{1}{3}$
13. 7 14. $\frac{7}{2}$ 15. $\frac{9\pi}{8} - \frac{9}{4} \sin^{-1} \left(\frac{1}{3}\right) + \frac{1}{3\sqrt{2}}$
16. D 17. C 18. C 19. B

EXERCISE 9.1

1. Order 4; Degree not defined 2. Order 1; Degree 1
3. Order 2; Degree 1 4. Order 2; Degree not defined
5. Order 2; Degree 1 6. Order 3; Degree 2
7. Order 3; Degree 1 8. Order 1; Degree 1
9. Order 2; Degree 1 10. Order 2; Degree 1
11. D 12. A

EXERCISE 9.2

11. D 12. D

EXERCISE 9.3

1. $y'' = 0$
2. $xy y'' + x (y')^2 - y y' = 0$
3. $y'' - y' - 6y = 0$
4. $y'' - 4y' + 4y = 0$
5. $y'' - 2y' + 2y = 0$
6. $2xyy' + x^2 = y^2$
7. $xy' - 2y = 0$
8. $xyy'' + x(y')^2 - yy' = 0$
9. $xyy'' + x(y')^2 - yy' = 0$
10. $(x^2 - 9)(y')^2 + x^2 = 0$
11. B
12. C

EXERCISE 9.4

1. $y = 2 \tan \frac{x}{2} - x + C$
2. $y = 2 \sin (x + C)$
3. $y = 1 + Ae^{-x}$
4. $\tan x \tan y = C$
5. $y = \log (e^x + e^{-x}) + C$
6. $\tan^{-1} y = x + \frac{x^3}{3} + C$
7. $y = e^{cx}$
8. $x^{-4} + y^{-4} = C$
9. $y = x \sin^{-1} x + \sqrt{1-x^2} + C$
10. $\tan y = C (1 - e^x)$
11. $y = \frac{1}{4} \log [(x+1)^2 (x^2+1)^3] - \frac{1}{2} \tan^{-1} x + 1$
12. $y = \frac{1}{2} \log \left(\frac{x^2-1}{x^2} \right) - \frac{1}{2} \log \frac{3}{4}$
13. $\cos \left(\frac{y-2}{x} \right) = a$
14. $y = \sec x$
15. $2y - 1 = e^x (\sin x - \cos x)$
16. $y - x + 2 = \log (x^2 (y + 2)^2)$
17. $y^2 - x^2 = 4$
18. $(x + 4)^2 = y + 3$
19. $(63t + 27)^{\frac{1}{3}}$
20. 6.93%
21. Rs 1648
22. $\frac{2 \log 2}{\log \left(\frac{11}{10} \right)}$
23. A

EXERCISE 9.5

1. $(x-y)^2 = Cx e^{\frac{-y}{x}}$
2. $y = x \log |x| + Cx$

3. $\tan^{-1}\left(\frac{y}{x}\right) = \frac{1}{2}\log(x^2 + y^2) + C$ 4. $x^2 + y^2 = Cx$
5. $\frac{1}{2\sqrt{2}}\log\left|\frac{x+\sqrt{2}y}{x-\sqrt{2}y}\right| = \log|x| + C$ 6. $y + \sqrt{x^2 + y^2} = Cx^2$
7. $xy \cos\left|\frac{y}{x}\right| = C$ 8. $x\left[1 - \cos\left(\frac{y}{x}\right)\right] = C\sin\left(\frac{y}{x}\right)$
9. $cy = \log\left|\frac{y}{x}\right| - 1$ 10. $ye^{\frac{x}{y}} + x = C$
11. $\log(x^2 + y^2) + 2 \tan^{-1} \frac{y}{x} = \frac{\pi}{2} + \log 2$
12. $y + 2x = 3x^2 y$ 13. $\cot\left(\frac{y}{x}\right) = \log|ex|$
14. $\cos\left(\frac{y}{x}\right) = \log|ex|$ 15. $y = \frac{2x}{1 - \log|x|} (x \neq 0, x \neq e)$
16. C 17. D

EXERCISE 9.6

1. $y = \frac{1}{5}(2\sin x - \cos x) + C e^{-2x}$ 2. $y = e^{-2x} + C e^{-3x}$
3. $xy = \frac{x^4}{4} + C$ 4. $y(\sec x + \tan x) = \sec x + \tan x - x + C$
5. $y = (\tan x - 1) + C e^{-\tan x}$ 6. $y = \frac{x^2}{16}(4\log|x| - 1) + Cx^{-2}$
7. $y \log x = \frac{-2}{x}(1 + \log|x|) + C$ 8. $y = (1+x)^{-1} \log|\sin x| + C(1+x^2)^{-1}$
9. $y = \frac{1}{x} - \cot x + \frac{C}{x \sin x}$ 10. $(x + y + 1) = C e^y$
11. $x = \frac{y^2}{3} + \frac{C}{y}$ 12. $x = 3y^2 + Cy$

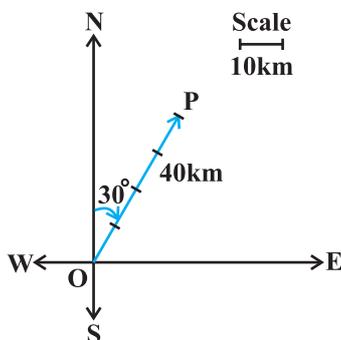
13. $y = \cos x - 2 \cos^2 x$ 14. $y(1+x^2) = \tan^{-1} x - \frac{\pi}{4}$
 15. $y = 4 \sin^3 x - 2 \sin^2 x$ 16. $x + y + 1 = e^x$
 17. $y = 4 - x - 2e^x$ 18. C 19. D

Miscellaneous Exercise on Chapter 9

1. (i) Order 2; Degree 1 (ii) Order 1; Degree 3
 (iii) Order 4; Degree not defined
3. $y' = \frac{2y^2 - x^2}{4xy}$ 5. $(x + yy')^2 = (x - y)^2 (1 + (y')^2)$
6. $\sin^{-1} y + \sin^{-1} x = C$ 8. $\cos y = \frac{\sec x}{\sqrt{2}}$
9. $\tan^{-1} y + \tan^{-1}(e^x) = \frac{\pi}{2}$ 10. $e^{\frac{x}{y}} = y + C$
11. $\log |x - y| = x + y + 1$ 12. $ye^{2\sqrt{x}} = (2\sqrt{x} + C)$
13. $y \sin x = 2x^2 - \frac{\pi^2}{2}$ ($\sin x \neq 0$) 14. $y = \log \left| \frac{2x+1}{x+1} \right|, x \neq -1$
15. 31250 16. C
17. C 18. C

EXERCISE 10.1

1. In the adjoining figure, the vector \overline{OP} represents the required displacement.



2. (i) scalar (ii) vector (iii) scalar (iv) scalar (v) scalar
(vi) vector
3. (i) scalar (ii) scalar (iii) vector (iv) vector (v) scalar
4. (i) Vectors \vec{a} and \vec{b} are coinitial
(ii) Vectors \vec{b} and \vec{d} are equal
(iii) Vectors \vec{a} and \vec{c} are collinear but not equal
5. (i) True (ii) False (iii) False (iv) False

EXERCISE 10.2

1. $|\vec{a}|=\sqrt{3}, |\vec{b}|=\sqrt{62}, |\vec{c}|=1$
2. An infinite number of possible answers.
3. An infinite number of possible answers.
4. $x = 2, y = 3$
5. -7 and $6; -7\hat{i}$ and $6\hat{j}$
6. $-4\hat{j}-\hat{k}$
7. $\frac{1}{\sqrt{6}}\hat{i}+\frac{1}{\sqrt{6}}\hat{j}+\frac{2}{\sqrt{6}}\hat{k}$
8. $\frac{1}{\sqrt{3}}\hat{i}+\frac{1}{\sqrt{3}}\hat{j}+\frac{1}{\sqrt{3}}\hat{k}$
9. $\frac{1}{\sqrt{2}}\hat{i}+\frac{1}{\sqrt{2}}\hat{k}$
10. $\frac{40}{\sqrt{30}}\hat{i}-\frac{8}{\sqrt{30}}\hat{j}+\frac{16}{\sqrt{30}}\hat{k}$
12. $\frac{1}{\sqrt{14}}, \frac{2}{\sqrt{14}}, \frac{3}{\sqrt{14}}$
13. $-\frac{1}{3}, -\frac{2}{3}, \frac{2}{3}$
15. (i) $-\frac{1}{3}\hat{i}+\frac{4}{3}\hat{j}+\frac{1}{3}\hat{k}$ (ii) $-3\hat{i}+3\hat{k}$
16. $3\hat{i}+2\hat{j}+\hat{k}$
18. (C) 19. (D)

EXERCISE 10.3

1. $\frac{\pi}{4}$
2. $\cos^{-1}\left(\frac{5}{7}\right)$
3. 0
4. $\frac{60}{\sqrt{114}}$
6. $\frac{16\sqrt{2}}{3\sqrt{7}}, \frac{2\sqrt{2}}{3\sqrt{7}}$
7. $6|\vec{a}|^2+11\vec{a}\cdot\vec{b}-35|\vec{b}|^2$
8. $|\vec{a}|=1, |\vec{b}|=1$
9. $\sqrt{13}$
10. 8

12. Vector \vec{b} can be any vector
13. $-\frac{3}{2}$
14. Take any two non-zero perpendicular vectors \vec{a} and \vec{b}
15. $\cos^{-1}\left(\frac{10}{\sqrt{102}}\right)$
18. (D)

EXERCISE 10.4

1. $19\sqrt{2}$
2. $\pm\frac{2}{3}\hat{i} \mp\frac{2}{3}\hat{j} \mp\frac{1}{3}\hat{k}$
3. $\frac{\pi}{3}; \frac{1}{2}, \frac{1}{\sqrt{2}}, \frac{1}{2}$
5. $3, \frac{27}{2}$
6. Either $|\vec{a}|=0$ or $|\vec{b}|=0$
8. No; take any two nonzero collinear vectors
9. $\frac{\sqrt{61}}{2}$
10. $15\sqrt{2}$
11. (B)
12. (C)

Miscellaneous Exercise on Chapter 10

1. $\frac{\sqrt{3}}{2}\hat{i} + \frac{1}{2}\hat{j}$
2. $x_2 - x_1, y_2 - y_1, z_2 - z_1; \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$
3. $\frac{-5}{2}\hat{i} + \frac{3\sqrt{3}}{2}\hat{j}$
4. No; take \vec{a} , \vec{b} and \vec{c} to represent the sides of a triangle.
5. $\pm\frac{1}{\sqrt{3}}$
6. $\frac{3}{2}\sqrt{10}\hat{i} + \frac{\sqrt{10}}{2}\hat{j}$
7. $\frac{3}{\sqrt{22}}\hat{i} - \frac{3}{\sqrt{22}}\hat{j} + \frac{2}{\sqrt{22}}\hat{k}$
8. 2 : 3
9. $3\vec{a} + 5\vec{b}$
10. $\frac{1}{7}(3\hat{i} - 6\hat{j} + 2\hat{k}); 11\sqrt{5}$
12. $\frac{1}{3}(160\hat{i} - 5\hat{j} + 70\hat{k})$
13. $\lambda = 1$
16. (B)
17. (D)
18. (C)
19. (B)

EXERCISE 11.1

1. $0, \frac{-1}{\sqrt{2}}, \frac{1}{\sqrt{2}}$ 2. $\pm \frac{1}{\sqrt{3}}, \pm \frac{1}{\sqrt{3}}, \pm \frac{1}{\sqrt{3}}$ 3. $\frac{-9}{11}, \frac{6}{11}, \frac{-2}{11}$
 5. $\frac{-2}{\sqrt{17}}, \frac{-2}{\sqrt{17}}, \frac{3}{17}; \frac{-2}{\sqrt{17}}, \frac{-3}{\sqrt{17}}, \frac{-2}{\sqrt{17}}; \frac{4}{\sqrt{42}}, \frac{5}{\sqrt{42}}, \frac{-1}{\sqrt{42}}$

EXERCISE 11.2

4. $\vec{r} = \hat{i} + 2\hat{j} + 3\hat{k} + \lambda(3\hat{i} + 2\hat{j} - 2\hat{k})$, where λ is a real number
 5. $\vec{r} = 2\hat{i} - \hat{j} + 4\hat{k} + \lambda(\hat{i} + 2\hat{j} - \hat{k})$ and cartesian form is

$$\frac{x-2}{1} = \frac{y+1}{2} = \frac{z-4}{-1}$$

 6. $\frac{x+2}{3} = \frac{y-4}{5} = \frac{z+5}{6}$
 7. $\vec{r} = (5\hat{i} - 4\hat{j} + 6\hat{k}) + \lambda(3\hat{i} + 7\hat{j} + 2\hat{k})$
 8. Vector equation of the line: $\vec{r} = \lambda(5\hat{i} - 2\hat{j} + 3\hat{k})$;
 Cartesian equation of the line: $\frac{x}{5} = \frac{y}{-2} = \frac{z}{3}$
 9. Vector equation of the line: $\vec{r} = 3\hat{i} - 2\hat{j} - 5\hat{k} + \lambda(11\hat{k})$
 Cartesian equation of the line: $\frac{x-3}{0} = \frac{y+2}{0} = \frac{z+5}{11}$
 10. (i) $\theta = \cos^{-1}\left(\frac{19}{21}\right)$ (ii) $\theta = \cos^{-1}\left(\frac{8}{5\sqrt{3}}\right)$
 11. (i) $\theta = \cos^{-1}\left(\frac{26}{9\sqrt{38}}\right)$ (ii) $\theta = \cos^{-1}\left(\frac{2}{3}\right)$
 12. $p = \frac{70}{11}$ 14. $\frac{3\sqrt{2}}{2}$ 15. $2\sqrt{29}$
 16. $\frac{3}{\sqrt{19}}$ 17. $\frac{8}{\sqrt{29}}$

EXERCISE 11.3

1. (a) $0, 0, 1; 2$ (b) $\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}; \frac{1}{\sqrt{3}}$
- (c) $\frac{2}{\sqrt{14}}, \frac{3}{\sqrt{14}}, \frac{-1}{\sqrt{14}}; \frac{5}{\sqrt{14}}$ (d) $0, 1, 0; \frac{8}{5}$
2. $\vec{r} \cdot \left(\frac{3\hat{i} + 5\hat{j} - 6\hat{k}}{\sqrt{70}} \right) = 7$
3. (a) $x + y - z = 2$ (b) $2x + 3y - 4z = 1$
 (c) $(s - 2t)x + (3 - t)y + (2s + t)z = 15$
4. (a) $\left(\frac{24}{29}, \frac{36}{29}, \frac{48}{29} \right)$ (b) $\left(0, \frac{18}{25}, \frac{24}{25} \right)$
 (c) $\left(\frac{1}{3}, \frac{1}{3}, \frac{1}{3} \right)$ (d) $\left(0, \frac{-8}{5}, 0 \right)$
5. (a) $[\vec{r} - (\hat{i} - 2\hat{k})] \cdot (\hat{i} + \hat{j} - \hat{k}) = 0; x + y - z = 3$
 (b) $[\vec{r} - (\hat{i} + 4\hat{j} + 6\hat{k})] \cdot (\hat{i} - 2\hat{j} + \hat{k}) = 0; x - 2y + z + 1 = 0$
6. (a) The points are collinear. There will be infinite number of planes passing through the given points.
 (b) $2x + 3y - 3z = 5$
7. $\frac{5}{2}, 5, -5$ 8. $y = 3$ 9. $7x - 5y + 4z - 8 = 0$
10. $\vec{r} \cdot (38\hat{i} + 68\hat{j} + 3\hat{k}) = 153$ 11. $x - z + 2 = 0$
12. $\cos^{-1} \left(\frac{15}{\sqrt{731}} \right)$
13. (a) $\cos^{-1} \left(\frac{2}{5} \right)$ (b) The planes are perpendicular
 (c) The planes are parallel (d) The planes are parallel
 (e) 45°
14. (a) $\frac{3}{13}$ (b) $\frac{13}{3}$
 (c) 3 (d) 2

Miscellaneous Exercise on Chapter 11

3. 90° 4. $\frac{x}{1} = \frac{y}{0} = \frac{z}{0}$ 5. 0°
6. $k = \frac{-10}{7}$ 7. $\vec{r} = \hat{i} + 2\hat{j} + 3\hat{k} + \lambda(\hat{i} + 2\hat{j} - 5\hat{k})$
8. $x + y + z = a + b + c$ 9. 9
10. $\left(0, \frac{17}{2}, \frac{-13}{2}\right)$ 11. $\left(\frac{17}{3}, 0, \frac{23}{3}\right)$ 12. $(1, -2, 7)$
13. $7x - 8y + 3z + 25 = 0$ 14. $p = \frac{3}{2}$ or $\frac{11}{6}$ or $\frac{7}{3}$
15. $y - 3z + 6 = 0$ 16. $x + 2y - 3z - 14 = 0$
17. $33x + 45y + 50z - 41 = 0$ 18. 13
19. $\vec{r} = \hat{i} + 2\hat{j} + 3\hat{k} + \lambda(-3\hat{i} + 5\hat{j} + 4\hat{k})$
20. $\vec{r} = \hat{i} + 2\hat{j} - 4\hat{k} + \lambda(2\hat{i} + 3\hat{j} + 6\hat{k})$ 22. D
23. B

EXERCISE 12.1

- Maximum $Z = 16$ at $(0, 4)$
- Minimum $Z = -12$ at $(4, 0)$
- Maximum $Z = \frac{235}{19}$ at $\left(\frac{20}{19}, \frac{45}{19}\right)$
- Minimum $Z = 7$ at $\left(\frac{3}{2}, \frac{1}{2}\right)$
- Maximum $Z = 18$ at $(4, 3)$
- Minimum $Z = 6$ at all the points on the line segment joining the points $(6, 0)$ and $(0, 3)$.
- Minimum $Z = 300$ at $(60, 0)$;
Maximum $Z = 600$ at all the points on the line segment joining the points $(120, 0)$ and $(60, 30)$.
- Minimum $Z = 100$ at all the points on the line segment joining the points $(0, 50)$

and (20, 40);

Maximum $Z = 400$ at (0, 200)

9. Z has no maximum value
10. No feasible region, hence no maximum value of Z .

EXERCISE 12.2

1. Minimum cost = Rs 160 at all points lying on segment joining $\left(\frac{8}{3}, 0\right)$ and $\left(2, \frac{1}{2}\right)$.
2. Maximum number of cakes = 30 of kind one and 10 cakes of another kind.
3. (i) 4 tennis rackets and 12 cricket bats
(ii) Maximum profit = Rs 200
4. 3 packages of nuts and 3 packages of bolts; Maximum profit = Rs 73.50.
5. 30 packages of screws A and 20 packages of screws B; Maximum profit = Rs 410
6. 4 Pedestal lamps and 4 wooden shades; Maximum profit = Rs 32
7. 8 Souvenir of types A and 20 of Souvenir of type B; Maximum profit = Rs 160.
8. 200 units of desktop model and 50 units of portable model; Maximum profit = Rs 1150000.
9. Minimise $Z = 4x + 6y$
subject to $3x + 6y \geq 80$, $4x + 3y \geq 100$, $x \geq 0$ and $y \geq 0$, where x and y denote the number of units of food F_1 and food F_2 respectively; Minimum cost = Rs 104
10. 100 kg of fertiliser F_1 and 80 kg of fertiliser F_2 ; Minimum cost = Rs 1000
11. (D)

Miscellaneous Exercise on Chapter 12

1. 40 packets of food P and 15 packets of food Q; Maximum amount of vitamin A = 285 units.
2. 3 bags of brand P and 6 bags of brand Q; Minimum cost of the mixture = Rs 1950
3. Least cost of the mixture is Rs 112 (2 kg of Food X and 4 kg of food Y).

5. 40 tickets of executive class and 160 tickets of economy class; Maximum profit = Rs 136000.
6. From A : 10,50, 40 units; From B: 50,0,0 units to D, E and F respectively and minimum cost = Rs 510
7. From A: 500, 3000 and 3500 litres; From B: 4000, 0, 0 litres to D, E and F respectively; Minimum cost = Rs 4400
8. 40 bags of brand P and 100 bags of brand Q; Minimum amount of nitrogen = 470 kg.
9. 140 bags of brand P and 50 bags of brand Q; Maximum amount of nitrogen = 595 kg.
10. 800 dolls of type A and 400 dolls of type B; Maximum profit = Rs 16000

EXERCISE 13.1

1. $P(E|F) = \frac{2}{3}$, $P(F|E) = \frac{1}{3}$
2. $P(A|B) = \frac{16}{25}$
3. (i) 0.32 (ii) 0.64 (iii) 0.98
4. $\frac{11}{26}$
5. (i) $\frac{4}{11}$ (ii) $\frac{4}{5}$ (iii) $\frac{2}{3}$
6. (i) $\frac{1}{2}$ (ii) $\frac{3}{7}$ (iii) $\frac{6}{7}$
7. (i) 1 (ii) 0
8. $\frac{1}{6}$ 9. 1 10. (a) $\frac{1}{3}$, (b) $\frac{1}{9}$
11. (i) $\frac{1}{2}, \frac{1}{3}$ (ii) $\frac{1}{2}, \frac{2}{3}$ (iii) $\frac{3}{4}, \frac{1}{4}$
12. (i) $\frac{1}{2}$ (ii) $\frac{1}{3}$ 13. $\frac{5}{9}$
14. $\frac{1}{15}$ 15. 0 16. C 17. D

EXERCISE 13.2

1. $\frac{3}{25}$ 2. $\frac{25}{102}$ 3. $\frac{44}{91}$
 4. A and B are independent 5. A and B are not independent
 6. E and F are not independent
 7. (i) $p = \frac{1}{10}$ (ii) $p = \frac{1}{5}$
 8. (i) 0.12 (ii) 0.58 (iii) 0.3 (iv) 0.4
 9. $\frac{3}{8}$ 10. A and B are not independent
 11. (i) 0.18 (ii) 0.12 (iii) 0.72 (iv) 0.28
 12. $\frac{7}{8}$ 13. (i) $\frac{16}{81}$, (ii) $\frac{20}{81}$, (iii) $\frac{40}{81}$
 14. (i) $\frac{2}{3}$, (ii) $\frac{1}{2}$ 15. (i), (ii) 16. (a) $\frac{1}{5}$, (b) $\frac{1}{3}$, (c) $\frac{1}{2}$
 17. D 18. B

EXERCISE 13.3

1. $\frac{1}{2}$ 2. $\frac{2}{3}$ 3. $\frac{9}{13}$ 4. $\frac{12}{13}$
 5. $\frac{22}{133}$ 6. $\frac{4}{9}$ 7. $\frac{1}{52}$ 8. $\frac{1}{4}$
 9. $\frac{2}{9}$ 10. $\frac{8}{11}$ 11. $\frac{5}{34}$ 12. $\frac{11}{50}$
 13. A 14. C

EXERCISE 13.4

1. (ii), (iii) and (iv) 2. $X = 0, 1, 2$; yes 3. $X = 6, 4, 2, 0$

4. (i)

X	0	1	2
P(X)	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{4}$

(ii)

X	0	1	2	3
P(X)	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{8}$

(iii)

X	0	1	2	3	4
P(X)	$\frac{1}{16}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{4}$	$\frac{1}{16}$

5. (i)

X	0	1	2
P(X)	$\frac{4}{9}$	$\frac{4}{9}$	$\frac{1}{9}$

(ii)

X	0	1
P(X)	$\frac{25}{36}$	$\frac{11}{36}$

6.

X	0	1	2	3	4
P(X)	$\frac{256}{625}$	$\frac{256}{625}$	$\frac{96}{625}$	$\frac{16}{625}$	$\frac{1}{625}$

7.

X	0	1	2
P(X)	$\frac{9}{16}$	$\frac{6}{16}$	$\frac{1}{16}$

8. (i) $k = \frac{1}{10}$ (ii) $P(X < 3) = \frac{3}{10}$ (iii) $P(X > 6) = \frac{17}{100}$

(iv) $P(0 < X < 3) = \frac{3}{10}$

9. (a) $k = \frac{1}{6}$ (b) $P(X < 2) = \frac{1}{2}$, $P(X \leq 2) = 1$, $P(X \geq 2) = \frac{1}{2}$

10. 1.5 11. $\frac{1}{3}$ 12. $\frac{14}{3}$

13. $\text{Var}(X) = 5.833$, $\text{S.D} = 2.415$

14.

X	14	15	16	17	18	19	20	21
P(X)	$\frac{2}{15}$	$\frac{1}{15}$	$\frac{2}{15}$	$\frac{3}{15}$	$\frac{1}{15}$	$\frac{2}{15}$	$\frac{3}{15}$	$\frac{1}{15}$

Mean = 17.53, $\text{Var}(X) = 4.78$ and $\text{S.D}(X) = 2.19$

15. $E(X) = 0.7$ and $\text{Var}(X) = 0.21$

16. B

17. D

EXERCISE 13.5

1. (i) $\frac{3}{32}$ (ii) $\frac{7}{64}$ (iii) $\frac{63}{64}$
2. $\frac{25}{216}$ 3. $\left(\frac{29}{20}\right)\left(\frac{19}{20}\right)^9$
4. (i) $\frac{1}{1024}$ (ii) $\frac{45}{512}$ (iii) $\frac{243}{1024}$
5. (i) $(0.95)^5$ (ii) $(0.95)^4 \times 1.2$ (iii) $1 - (0.95)^4 \times 1.2$
 (iv) $1 - (0.95)^5$
6. $\left(\frac{9}{10}\right)^4$ 7. $\left(\frac{1}{2}\right)^{20} [{}^{20}C_{12} + {}^{20}C_{13} + \dots + {}^{20}C_{20}]$
9. $\frac{11}{243}$
10. (a) $1 - \left(\frac{99}{100}\right)^{50}$ (b) $\frac{1}{2} \left(\frac{99}{100}\right)^{49}$ (c) $1 - \frac{149}{100} \left(\frac{99}{100}\right)^{49}$
11. $\frac{7}{12} \left(\frac{5}{6}\right)^5$ 12. $\frac{35}{18} \left(\frac{5}{6}\right)^4$ 13. $\frac{22 \times 9^3}{10^{11}}$
14. C 15. A

Miscellaneous Exercise on Chapter 13

1. (i) 1 (ii) 0
2. (i) $\frac{1}{3}$ (ii) $\frac{1}{2}$
3. $\frac{20}{21}$
4. $1 - \sum_{r=7}^{10} {}^{10}C_r (0.9)^r (0.1)^{10-r}$
5. (i) $\left(\frac{2}{5}\right)^6$ (ii) $7\left(\frac{2}{5}\right)^4$ (iii) $1 - \left(\frac{2}{5}\right)^6$ (iv) $\frac{864}{3125}$

6. $\frac{5^{10}}{2 \times 6^9}$

7. $\frac{625}{23328}$

8. $\frac{2}{7}$

9. $\frac{31}{9} \left(\frac{2}{3}\right)^4$

10. $n \geq 4$

11. $\frac{11}{216}$

12. $\frac{1}{15}, \frac{2}{5}, \frac{8}{15}$

13. $\frac{14}{29}$

14. $\frac{3}{16}$

15. (i) 0.5 (ii) 0.05

16. $\frac{16}{31}$

17. A

18. C

19. B

