

# ANSWERS

## EXERCISE 1.1

1. (i) Neither reflexive nor symmetric nor transitive.  
(ii) Neither reflexive nor symmetric nor transitive.  
(iii) Reflexive and transitive but not symmetric.  
(iv) Reflexive, symmetric and transitive.  
(v) (a) Reflexive, symmetric and transitive.  
(b) Reflexive, symmetric and transitive.  
(c) Neither reflexive nor symmetric nor transitive.  
(d) Neither reflexive nor symmetric nor transitive.  
(e) Neither reflexive nor symmetric nor transitive.
3. Neither reflexive nor symmetric nor transitive.
5. Neither reflexive nor symmetric nor transitive.
9. (i)  $\{1, 5, 9\}$ , (ii)  $\{1\}$
12.  $T_1$  is related to  $T_3$ .
13. The set of all triangles
14. The set of all lines  $y = 2x + c$ ,  $c \in \mathbf{R}$
15. B
16. C

## EXERCISE 1.2

1. No
2. (i) Injective but not surjective (ii) Neither injective nor surjective  
(iii) Neither injective nor surjective (iv) Injective but not surjective  
(v) Injective but not surjective
7. (i) One-one and onto (ii) Neither one-one nor onto.
9. No 10. Yes 11. D 12. A

## EXERCISE 1.3

1.  $gof = \{(1, 3), (3, 1), (4, 3)\}$
3. (i)  $(gof)(x) = |5|x - 2|$ ,  $(fog)(x) = |5x - 2|$   
(ii)  $(gof)(x) = 2x$ ,  $(fog)(x) = 8x$
4. Inverse of  $f$  is  $f$  itself

5. (i) No, since  $f$  is many-one (ii) No, since  $g$  is many-one.  
 (iii) Yes, since  $h$  is one-one-onto.
6.  $f^{-1}$  is given by  $f^{-1}(y) = \frac{2y}{1-y}$ ,  $y \neq 1$  7.  $f^{-1}$  is given by  $f^{-1}(y) = \frac{y-3}{4}$
11.  $f^{-1}$  is given by  $f^{-1}(a) = 1$ ,  $f^{-1}(b) = 2$  and  $f^{-1}(c) = 3$ .
13. (C) 14. (B)

### EXERCISE 1.4

1. (i) No (ii) Yes (iii) Yes (iv) Yes (v) Yes
2. (i)  $*$  is neither commutative nor associative  
 (ii)  $*$  is commutative but not associative  
 (iii)  $*$  is both commutative and associative  
 (iv)  $*$  is commutative but not associative  
 (v)  $*$  is neither commutative nor associative  
 (vi)  $*$  is neither commutative nor associative
- 3.
- |           |   |   |   |   |   |
|-----------|---|---|---|---|---|
| $\Lambda$ | 1 | 2 | 3 | 4 | 5 |
| 1         | 1 | 1 | 1 | 1 | 1 |
| 2         | 1 | 2 | 2 | 2 | 2 |
| 3         | 1 | 2 | 3 | 3 | 3 |
| 4         | 1 | 2 | 3 | 4 | 4 |
| 5         | 1 | 2 | 3 | 4 | 5 |
4. (i)  $(2 * 3) * 4 = 1$  and  $2 * (3 * 4) = 1$  (ii) Yes (iii) 1
5. Yes
6. (i)  $5 * 7 = 35$ ,  $20 * 16 = 80$  (ii) Yes (iii) Yes (iv) 1 (v) 1
7. No 8.  $*$  is both commutative and associative;  $*$  does not have any identity in  $\mathbf{N}$
9. (ii), (iv), (v) are commutative; (v) is associative.
11. Identity element does not exist.
12. (ii) False (ii) True 13. B

*Miscellaneous Exercise on Chapter 1*

1.  $g(y) = \frac{y-7}{10}$                       2. The inverse of  $f$  is  $f$  itself  
 3.  $x^4 - 6x^3 + 10x^2 - 3x$                       8. No                      10.  $n!$   
 11. (i)  $F^{-1} = \{(3, a), (2, b), (1, c)\}$ , (ii)  $F^{-1}$  does not exist                      12. No  
 15. Yes                      16. A                      17. B                      18. No  
 19. B

**EXERCISE 2.1**

1.  $\frac{-\pi}{6}$                       2.  $\frac{\pi}{6}$                       3.  $\frac{\pi}{6}$                       4.  $\frac{-\pi}{3}$   
 5.  $\frac{2\pi}{3}$                       6.  $-\frac{\pi}{4}$                       7.  $\frac{\pi}{6}$                       8.  $\frac{\pi}{6}$   
 9.  $\frac{3\pi}{4}$                       10.  $-\frac{\pi}{4}$                       11.  $\frac{3\pi}{4}$                       12.  $\frac{2\pi}{3}$   
 13. B                      14. B

**EXERCISE 2.2**

5.  $\frac{1}{2} \tan^{-1} x$                       6.  $\frac{\pi}{2} - \sec^{-1} x$                       7.  $\frac{x}{2}$                       8.  $\frac{\pi}{4} - x$   
 9.  $\sin^{-1} \frac{x}{a}$                       10.  $3 \tan^{-1} \frac{x}{a}$                       11.  $\frac{\pi}{4}$                       12. 0  
 13.  $\frac{x+y}{1-xy}$                       14.  $\frac{1}{5}$                       15.  $\pm \frac{1}{\sqrt{2}}$                       16.  $\frac{\pi}{3}$   
 17.  $\frac{-\pi}{4}$                       18.  $\frac{17}{6}$                       19. B                      20. D  
 21. B

*Miscellaneous Exercise on Chapter 2*

1.  $\frac{\pi}{6}$                       2.  $\frac{\pi}{6}$                       13.  $x = \frac{\pi}{4}$                       14.  $x = \frac{1}{\sqrt{3}}$   
 15. D                      16. C                      17. C

## EXERCISE 3.1

1. (i)  $3 \times 4$  (ii) 12 (iii) 19, 35,  $-5$ , 12,  $\frac{5}{2}$   
 2.  $1 \times 24, 2 \times 12, 3 \times 8, 4 \times 6, 6 \times 4, 8 \times 3, 12 \times 2, 24 \times 1; 1 \times 13, 13 \times 1$   
 3.  $1 \times 18, 2 \times 9, 3 \times 6, 6 \times 3, 9 \times 2, 18 \times 1; 1 \times 5, 5 \times 1$

4. (i)  $\begin{bmatrix} 2 & \frac{9}{2} \\ \frac{9}{2} & 8 \end{bmatrix}$  (ii)  $\begin{bmatrix} 1 & \frac{1}{2} \\ 2 & 1 \end{bmatrix}$  (iii)  $\begin{bmatrix} \frac{9}{2} & \frac{25}{2} \\ 8 & 18 \end{bmatrix}$

5. (i)  $\begin{bmatrix} 1 & \frac{1}{2} & 0 & \frac{1}{2} \\ \frac{5}{2} & 2 & \frac{3}{2} & 1 \\ 4 & \frac{7}{2} & 3 & \frac{5}{2} \end{bmatrix}$  (ii)  $\begin{bmatrix} 1 & 0 & -1 & -2 \\ 3 & 2 & 1 & 0 \\ 5 & 4 & 3 & 2 \end{bmatrix}$

6. (i)  $x=1, y=4, z=3$   
 (ii)  $x=4, y=2, z=0$  or  $x=2, y=4, z=0$   
 (iii)  $x=2, y=4, z=3$   
 7.  $a=1, b=2, c=3, d=4$   
 8. C 9. B 10. D

## EXERCISE 3.2

1. (i)  $A+B = \begin{bmatrix} 3 & 7 \\ 1 & 7 \end{bmatrix}$  (ii)  $A-B = \begin{bmatrix} 1 & 1 \\ 5 & -3 \end{bmatrix}$   
 (iii)  $3A-C = \begin{bmatrix} 8 & 7 \\ 6 & 2 \end{bmatrix}$  (iv)  $AB = \begin{bmatrix} -6 & 26 \\ 1 & 19 \end{bmatrix}$  (v)  $BA = \begin{bmatrix} 11 & 10 \\ 11 & 2 \end{bmatrix}$

2. (i)  $\begin{bmatrix} 2a & 2b \\ 0 & 2a \end{bmatrix}$  (ii)  $\begin{bmatrix} (a+b)^2 & (b+c)^2 \\ (a-c)^2 & (a-b)^2 \end{bmatrix}$   
 (iii)  $\begin{bmatrix} 11 & 11 & 0 \\ 16 & 5 & 21 \\ 5 & 10 & 9 \end{bmatrix}$  (iv)  $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

$$3. \quad (i) \begin{bmatrix} a^2+b^2 & 0 \\ 0 & a^2+b^2 \end{bmatrix} \quad (ii) \begin{bmatrix} 2 & 3 & 4 \\ 4 & 6 & 8 \\ 6 & 9 & 12 \end{bmatrix} \quad (iii) \begin{bmatrix} -3 & -4 & 1 \\ 8 & 13 & 9 \end{bmatrix}$$

$$(iv) \begin{bmatrix} 14 & 0 & 42 \\ 18 & -1 & 56 \\ 22 & -2 & 70 \end{bmatrix} \quad (v) \begin{bmatrix} 1 & 2 & 3 \\ 1 & 4 & 5 \\ -2 & 2 & 0 \end{bmatrix} \quad (vi) \begin{bmatrix} 14 & -6 \\ 4 & 5 \end{bmatrix}$$

$$4. \quad A+B = \begin{bmatrix} 4 & 1 & -1 \\ 9 & 2 & 7 \\ 3 & -1 & 4 \end{bmatrix}, \quad B-C = \begin{bmatrix} -1 & -2 & 0 \\ 4 & -1 & 3 \\ 1 & 2 & 0 \end{bmatrix}$$

$$5. \quad \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \quad 6. \quad \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$7. \quad (i) \quad X = \begin{bmatrix} 5 & 0 \\ 1 & 4 \end{bmatrix}, \quad Y = \begin{bmatrix} 2 & 0 \\ 1 & 1 \end{bmatrix} \quad (ii) \quad X = \begin{bmatrix} \frac{2}{5} & \frac{-12}{5} \\ -\frac{11}{5} & 3 \end{bmatrix}, \quad Y = \begin{bmatrix} \frac{2}{5} & \frac{13}{5} \\ \frac{14}{5} & -2 \end{bmatrix}$$

$$8. \quad X = \begin{bmatrix} -1 & -1 \\ -2 & -1 \end{bmatrix} \quad 9. \quad x=3, y=3 \quad 10. \quad x=3, y=6, z=9, t=6$$

$$11. \quad x=3, y=-4 \quad 12. \quad x=2, y=4, w=3, z=1$$

$$15. \quad \begin{bmatrix} 1 & -1 & -3 \\ -1 & -1 & -10 \\ -5 & 4 & 4 \end{bmatrix} \quad 17. \quad k=1$$

$$19. \quad (a) \text{ Rs } 15000, \text{ Rs } 15000 \quad (b) \text{ Rs } 5000, \text{ Rs } 25000$$

$$20. \text{ Rs } 20160 \quad 21. \text{ A} \quad 22. \text{ B}$$

### EXERCISE 3.3

$$1. \quad (i) \begin{bmatrix} 5 & \frac{1}{2} & -1 \end{bmatrix} \quad (ii) \begin{bmatrix} 1 & 2 \\ -1 & 3 \end{bmatrix} \quad (iii) \begin{bmatrix} -1 & \sqrt{3} & 2 \\ 5 & 5 & 3 \\ 6 & 6 & -1 \end{bmatrix}$$

$$4. \begin{bmatrix} -4 & 5 \\ 1 & 6 \end{bmatrix} \quad 9. \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}, \begin{bmatrix} 0 & a & b \\ -a & 0 & c \\ -b & -c & 0 \end{bmatrix}$$

$$10. (i) \mathbf{A} = \begin{bmatrix} 3 & 3 \\ 3 & -1 \end{bmatrix} + \begin{bmatrix} 0 & 2 \\ -2 & 0 \end{bmatrix}$$

$$(ii) \mathbf{A} = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix} + \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$(iii) \mathbf{A} = \begin{bmatrix} 3 & \frac{1}{2} & \frac{-5}{2} \\ \frac{1}{2} & -2 & -2 \\ \frac{-5}{2} & -2 & 2 \end{bmatrix} + \begin{bmatrix} 0 & \frac{5}{2} & \frac{3}{2} \\ \frac{-5}{2} & 0 & 3 \\ \frac{-3}{2} & -3 & 0 \end{bmatrix} \quad (iv) \mathbf{A} = \begin{bmatrix} 1 & 2 \\ 2 & 2 \end{bmatrix} + \begin{bmatrix} 0 & 3 \\ -3 & 0 \end{bmatrix}$$

11. A

12. B

## EXERCISE 3.4

$$1. \begin{bmatrix} \frac{3}{5} & \frac{1}{5} \\ \frac{-2}{5} & \frac{1}{5} \\ \frac{1}{5} & \frac{1}{5} \end{bmatrix}$$

$$2. \begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}$$

$$3. \begin{bmatrix} 7 & -3 \\ -2 & 1 \end{bmatrix}$$

$$4. \begin{bmatrix} -7 & 3 \\ 5 & -2 \end{bmatrix}$$

$$5. \begin{bmatrix} 4 & -1 \\ -7 & 2 \end{bmatrix}$$

$$6. \begin{bmatrix} 3 & -5 \\ -1 & 2 \end{bmatrix}$$

$$7. \begin{bmatrix} 2 & -1 \\ -5 & 3 \end{bmatrix}$$

$$8. \begin{bmatrix} 4 & -5 \\ -3 & 4 \end{bmatrix}$$

$$9. \begin{bmatrix} 7 & -10 \\ -2 & 3 \end{bmatrix}$$

$$10. \begin{bmatrix} 1 & \frac{1}{2} \\ 2 & \frac{3}{2} \end{bmatrix}$$

$$11. \begin{bmatrix} -1 & 3 \\ -1 & 1 \end{bmatrix}$$

12. Inverse does not exist.

13.  $\begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$

14. Inverse does not exist.

15.  $\begin{bmatrix} \frac{-2}{5} & 0 & \frac{3}{5} \\ \frac{-1}{5} & \frac{1}{5} & 0 \\ \frac{2}{5} & \frac{1}{5} & \frac{-2}{5} \end{bmatrix}$

16.  $\begin{bmatrix} 1 & \frac{-2}{5} & \frac{-3}{5} \\ \frac{-2}{5} & \frac{4}{25} & \frac{11}{25} \\ \frac{-3}{5} & \frac{1}{25} & \frac{9}{25} \end{bmatrix}$

17.  $\begin{bmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 2 \end{bmatrix}$

18. D

*Miscellaneous Exercise on Chapter 3*

6.  $x = \pm \frac{1}{\sqrt{2}}, y = \pm \frac{1}{\sqrt{6}}, z = \pm \frac{1}{\sqrt{3}}$

7.  $x = -1$                       9.  $x = \pm 4\sqrt{3}$

10. (a) Total revenue in the market - I = Rs 46000

Total revenue in the market - II = Rs 53000

(b) Rs 15000, Rs 17000

11.  $X = \begin{bmatrix} 1 & -2 \\ 2 & 0 \end{bmatrix}$

13. C

14. B

15. C

**EXERCISE 4.1**

1. (i) 18

2. (i) 1, (ii)  $x^3 - x^2 + 2$ 

5. (i) -12, (ii) 46, (iii) 0, (iv) 5

6. 0

7. (i)  $x = \pm\sqrt{3}$ , (ii)  $x = 2$ 

8. (B)

**EXERCISE 4.2**

15. C

16. C

## EXERCISE 4.3

1. (i)  $\frac{15}{2}$ , (ii)  $\frac{47}{2}$ , (iii) 15  
 3. (i) 0, 8, (ii) 0, 8    4. (i)  $y = 2x$ , (ii)  $x - 3y = 0$     5. (D)

## EXERCISE 4.4

1. (i)  $M_{11} = 3, M_{12} = 0, M_{21} = -4, M_{22} = 2, A_{11} = 3, A_{12} = 0, A_{21} = 4, A_{22} = 2$   
 (ii)  $M_{11} = d, M_{12} = b, M_{21} = c, M_{22} = a$   
 $A_{11} = d, A_{12} = -b, A_{21} = -c, A_{22} = a$   
 2. (i)  $M_{11} = 1, M_{12} = 0, M_{13} = 0, M_{21} = 0, M_{22} = 1, M_{23} = 0, M_{31} = 0, M_{32} = 0, M_{33} = 1,$   
 $A_{11} = 1, A_{12} = 0, A_{13} = 0, A_{21} = 0, A_{22} = 1, A_{23} = 0, A_{31} = 0, A_{32} = 0, A_{33} = 1$   
 (ii)  $M_{11} = 11, M_{12} = 6, M_{13} = 3, M_{21} = -4, M_{22} = 2, M_{23} = 1, M_{31} = -20, M_{32} = -13, M_{33} = 5$   
 $A_{11} = 11, A_{12} = -6, A_{13} = 3, A_{21} = 4, A_{22} = 2, A_{23} = -1, A_{31} = -20, A_{32} = 13, A_{33} = 5$   
 3. 7    4.  $(x - y)(y - z)(z - x)$     5. (D)

## EXERCISE 4.5

1.  $\begin{bmatrix} 4 & -2 \\ -3 & 1 \end{bmatrix}$     2.  $\begin{bmatrix} 3 & 1 & -11 \\ -12 & 5 & -1 \\ 6 & 2 & 5 \end{bmatrix}$     5.  $\frac{1}{14} \begin{bmatrix} 3 & 2 \\ -4 & 2 \end{bmatrix}$   
 6.  $\frac{1}{13} \begin{bmatrix} 2 & -5 \\ 3 & -1 \end{bmatrix}$     7.  $\frac{1}{10} \begin{bmatrix} 10 & -10 & 2 \\ 0 & 5 & -4 \\ 0 & 0 & 2 \end{bmatrix}$     8.  $\frac{-1}{3} \begin{bmatrix} -3 & 0 & 0 \\ 3 & -1 & 0 \\ -9 & -2 & 3 \end{bmatrix}$   
 9.  $\frac{-1}{3} \begin{bmatrix} -1 & 5 & 3 \\ -4 & 23 & 12 \\ 1 & -11 & -6 \end{bmatrix}$     10.  $\begin{bmatrix} -2 & 0 & 1 \\ 9 & 2 & -3 \\ 6 & 1 & -2 \end{bmatrix}$     11.  $\begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos \alpha & \sin \alpha \\ 0 & \sin \alpha & -\cos \alpha \end{bmatrix}$   
 13.  $\frac{1}{7} \begin{bmatrix} 2 & -1 \\ 1 & 3 \end{bmatrix}$     14.  $a = -4, b = 1$     15.  $A^{-1} = \frac{1}{11} \begin{bmatrix} -3 & 4 & 5 \\ 9 & -1 & -4 \\ 5 & -3 & -1 \end{bmatrix}$



$$16. \frac{1}{4} \begin{bmatrix} 3 & 1 & -1 \\ 1 & 3 & 1 \\ -1 & 1 & 3 \end{bmatrix}$$

17. B

18. B

### EXERCISE 4.6

1. Consistent

2. Consistent

3. Inconsistent

4. Consistent

5. Inconsistent

6. Consistent

7.  $x = 2, y = -3$

8.  $x = \frac{-5}{11}, y = \frac{12}{11}$

9.  $x = \frac{-6}{11}, y = \frac{-19}{11}$

10.  $x = -1, y = 4$

11.  $x = 1, y = \frac{1}{2}, z = \frac{-3}{2}$

12.  $x = 2, y = -1, z = 1$

13.  $x = 1, y = 2, z = -1$

14.  $x = 2, y = 1, z = 3$

$$15. \begin{bmatrix} 0 & 1 & -2 \\ -2 & 9 & -23 \\ -1 & 5 & -13 \end{bmatrix}, x = 1, y = 2, z = 3$$

16. cost of onions per kg = Rs 5

cost of wheat per kg = Rs 8

cost of rice per kg = Rs 8

### Miscellaneous Exercise on Chapter 4

3. 1

5.  $x = \frac{-a}{3}$

7.  $\begin{bmatrix} 9 & -3 & 5 \\ -2 & 1 & 0 \\ 1 & 0 & 2 \end{bmatrix}$

9.  $-2(x^3 + y^3)$

10.  $xy$

16.  $x = 2, y = 3, z = 5$

17. A

18. A

19. D

**EXERCISE 5.1**

2.  $f$  is continuous at  $x = 3$   
 3. (a), (b), (c) and (d) are all continuous functions  
 5.  $f$  is continuous at  $x = 0$  and  $x = 2$ ; Not continuous at  $x = 1$   
 6. Discontinuous at  $x = 2$                       7. Discontinuous at  $x = 3$   
 8. Discontinuous at  $x = 0$                       9. No point of discontinuity  
 10. No point of discontinuity                      11. No point of discontinuity  
 12.  $f$  is continuous at  $x = 1$                       13.  $f$  is not continuous at  $x = 1$   
 14.  $f$  is not continuous at  $x = 1$  and  $x = 3$   
 15.  $x = 1$  is the only point of discontinuity
16. Continuous                                      17.  $a = b + \frac{2}{3}$
18. For no value of  $\lambda$ ,  $f$  is continuous at  $x = 0$  but  $f$  is continuous at  $x = 1$  for any value of  $\lambda$ .
20.  $f$  is continuous at  $x = \pi$                       21. (a), (b) and (c) are all continuous
22. Cosine function is continuous for all  $x \in \mathbf{R}$ ; cosecant is continuous except for  $x = n\pi$ ,  $n \in \mathbf{Z}$ ; secant is continuous except for  $x = (2n+1)\frac{\pi}{2}$ ,  $n \in \mathbf{Z}$  and cotangent function is continuous except for  $x = n\pi$ ,  $n \in \mathbf{Z}$
23. There is no point of discontinuity.
24. Yes,  $f$  is continuous for all  $x \in \mathbf{R}$                       25.  $f$  is continuous for all  $x \in \mathbf{R}$
26.  $k = 6$                                       27.  $k = \frac{3}{4}$                                       28.  $k = \frac{-2}{\pi}$
29.  $k = \frac{9}{5}$                                       30.  $a = 2, b = 1$
34. There is no point of discontinuity.

**EXERCISE 5.2**

1.  $2x \cos(x^2 + 5)$                       2.  $-\cos x \sin(\sin x)$                       3.  $a \cos(ax + b)$
4.  $\frac{\sec(\tan \sqrt{x}) \cdot \tan(\tan \sqrt{x}) \cdot \sec^2 \sqrt{x}}{2\sqrt{x}}$
5.  $a \cos(ax + b) \sec(cx + d) + c \sin(ax + b) \tan(cx + d) \sec(cx + d)$
6.  $10x^4 \sin x^5 \cos x^5 \cos x^3 - 3x^2 \sin x^3 \sin^2 x^5$

$$7. \frac{-2\sqrt{2}x}{\sin x^2 \sqrt{\sin 2x^2}} \quad 8. -\frac{\sin \sqrt{x}}{2\sqrt{x}}$$

### EXERCISE 5.3

$$1. \frac{\cos x - 2}{3} \quad 2. \frac{2}{\cos y - 3} \quad 3. -\frac{a}{2by + \sin y}$$

$$4. \frac{\sec^2 x - y}{x + 2y - 1} \quad 5. -\frac{(2x + y)}{(x + 2y)} \quad 6. -\frac{(3x^2 + 2xy + y^2)}{(x^2 + 2xy + 3y^2)}$$

$$7. \frac{y \sin xy}{\sin 2y - x \sin xy} \quad 8. \frac{\sin 2x}{\sin 2y} \quad 9. \frac{2}{1 + x^2} \quad 10. \frac{3}{1 + x^2}$$

$$11. \frac{2}{1 + x^2} \quad 12. \frac{-2}{1 + x^2} \quad 13. \frac{-2}{1 + x^2} \quad 14. \frac{2}{\sqrt{1 - x^2}}$$

$$15. -\frac{2}{\sqrt{1 - x^2}}$$

### EXERCISE 5.4

$$1. \frac{e^x (\sin x - \cos x)}{\sin^2 x}, x \neq n\pi, n \in \mathbf{Z} \quad 2. \frac{e^{\sin^{-1} x}}{\sqrt{1 - x^2}}, x \in (-1, 1)$$

$$3. 3x^2 e^{x^3} \quad 4. -\frac{e^{-x} \cos(\tan^{-1} e^{-x})}{1 + e^{-2x}}$$

$$5. -e^x \tan e^x, e^x \neq (2n + 1)\frac{\pi}{2}, n \in \mathbf{N} \quad 6. e^x + 2x e^{x^2} + 3x^2 e^{x^3} + 4x^3 e^{x^4} + 5x^4 e^{x^5}$$

$$7. \frac{e^{\sqrt{x}}}{4\sqrt{x} e^{\sqrt{x}}}, x > 0 \quad 8. \frac{1}{x \log x}, x > 1$$

$$9. -\frac{(x \sin x \cdot \log x + \cos x)}{x(\log x)^2}, x > 0 \quad 10. -\left(\frac{1}{x} + e^x\right) \sin(\log x + e^x), x > 0$$

## EXERCISE 5.5

1.  $-\cos x \cos 2x \cos 3x [\tan x + 2 \tan 2x + 3 \tan 3x]$
2.  $\frac{1}{2} \sqrt{\frac{(x-1)(x-2)}{(x-3)(x-4)(x-5)}} \left[ \frac{1}{x-1} + \frac{1}{x-2} - \frac{1}{x-3} - \frac{1}{x-4} - \frac{1}{x-5} \right]$
3.  $(\log x)^{\cos x} \left[ \frac{\cos x}{x \log x} - \sin x \log(\log x) \right]$
4.  $x^x (1 + \log x) - 2^{\sin x} \cos x \log 2$
5.  $(x+3)(x+4)^2(x+5)^3(9x^2+70x+133)$
6.  $\left(x + \frac{1}{x}\right)^x \left[ \frac{x^2-1}{x^2+1} + \log\left(x + \frac{1}{x}\right) \right] + x^{1+\frac{1}{x}} \left( \frac{x+1-\log x}{x^2} \right)$
7.  $(\log x)^{x-1} [1 + \log x \cdot \log(\log x)] + 2x^{\log x-1} \cdot \log x$
8.  $(\sin x)^x (x \cot x + \log \sin x) + \frac{1}{2} \frac{1}{\sqrt{x-x^2}}$
9.  $x^{\sin x} \left[ \frac{\sin x}{x} + \cos x \log x \right] + (\sin x)^{\cos x} [\cos x \cot x - \sin x \log \sin x]$
10.  $x^{x \cos x} [\cos x \cdot (1 + \log x) - x \sin x \log x] - \frac{4x}{(x^2-1)^2}$
11.  $(x \cos x)^x [1 - x \tan x + \log(x \cos x)] + (x \sin x)^{\frac{1}{x}} \left[ \frac{x \cot x + 1 - \log(x \sin x)}{x^2} \right]$
12.  $\frac{yx^{y-1} + y^x \log y}{x^y \log x + xy^{x-1}}$
13.  $\frac{y}{x} \left( \frac{y-x \log y}{x-y \log x} \right)$
14.  $\frac{y \tan x + \log \cos y}{x \tan y + \log \cos x}$
15.  $\frac{y(x-1)}{x(y+1)}$
16.  $(1+x)(1+x^2)(1+x^4)(1+x^8) \left[ \frac{1}{1+x} + \frac{2x}{1+x^2} + \frac{4x^3}{1+x^4} + \frac{8x^7}{1+x^8} \right]; f'(1) = 120$
17.  $5x^4 - 20x^3 + 45x^2 - 52x + 11$

## EXERCISE 5.6

1.  $2t^2$
2.  $\frac{b}{a}$
3.  $-4 \sin t$
4.  $-\frac{1}{t^2}$

5.  $\frac{\cos \theta - 2 \cos 2\theta}{2 \sin 2\theta - \sin \theta}$     6.  $-\cot \frac{\theta}{2}$     7.  $-\cot 3t$     8.  $\tan t$   
 9.  $\frac{b}{a} \operatorname{cosec} \theta$     10.  $\tan \theta$

### EXERCISE 5.7

1. 2    2.  $380 x^{18}$     3.  $-x \cos x - 2 \sin x$   
 4.  $-\frac{1}{x^2}$     5.  $x(5 + 6 \log x)$     6.  $2e^x(5 \cos 5x - 12 \sin 5x)$   
 7.  $9 e^{6x}(3 \cos 3x - 4 \sin 3x)$     8.  $-\frac{2x}{(1+x^2)^2}$   
 9.  $-\frac{(1 + \log x)}{(x \log x)^2}$     10.  $-\frac{\sin(\log x) + \cos(\log x)}{x^2}$   
 12.  $-\cot y \operatorname{cosec}^2 y$

### Miscellaneous Exercise on Chapter 5

1.  $27(3x^2 - 9x + 5)^8(2x - 3)$     2.  $3 \sin x \cos x (\sin x - 2 \cos^4 x)$   
 3.  $(5x)^{3 \cos 2x} \left[ \frac{3 \cos 2x}{x} - 6 \sin 2x \log 5x \right]$   
 4.  $\frac{3}{2} \sqrt{\frac{x}{1-x^3}}$     5.  $-\left[ \frac{1}{\sqrt{4-x^2} \sqrt{2x+7}} + \frac{\cos^{-1} \frac{x}{2}}{(2x+7)^{\frac{3}{2}}} \right]$   
 6.  $\frac{1}{2}$     7.  $(\log x)^{\log x} \left[ \frac{1}{x} + \frac{\log(\log x)}{x} \right], x > 1$   
 8.  $(a \sin x - b \cos x) \sin(a \cos x + b \sin x)$   
 9.  $(\sin x - \cos x)^{\sin x - \cos x} (\cos x + \sin x) (1 + \log(\sin x - \cos x)), \sin x > \cos x$   
 10.  $x^x(1 + \log x) + ax^{a-1} + a^x \log a$   
 11.  $x^{x^2-3} \left[ \frac{x^2-3}{x} + 2x \log x \right] + (x-3)^{x^2} \left[ \frac{x^2}{x-3} + 2x \log(x-3) \right]$

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

### EXERCISE 6.1

1. (a)  $6\pi \text{ cm}^2/\text{s}$  (b)  $8\pi \text{ cm}^2/\text{s}$
2.  $\frac{8}{3} \text{ cm}^2/\text{s}$  3.  $60\pi \text{ cm}^2/\text{s}$  4.  $900 \text{ cm}^3/\text{s}$
5.  $80\pi \text{ cm}^2/\text{s}$  6.  $1.4\pi \text{ cm}/\text{s}$
7. (a)  $-2 \text{ cm}/\text{min}$  (b)  $2 \text{ cm}^2/\text{min}$
8.  $\frac{1}{\pi} \text{ cm}/\text{s}$  9.  $400\pi \text{ cm}^3/\text{s}$  10.  $\frac{8}{3} \text{ cm}/\text{s}$
11.  $(4, 11)$  and  $\left(-4, \frac{-31}{3}\right)$  12.  $2\pi \text{ cm}^3/\text{s}$
13.  $\frac{27}{8}\pi(2x+1)^2$  14.  $\frac{1}{48\pi} \text{ cm}/\text{s}$  15. Rs 20.967
16. Rs 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) Strictly decreasing for  $x < -1$  and strictly increasing for  $x > -1$
- (b) Strictly decreasing for  $x > -\frac{3}{2}$  and strictly increasing for  $x < -\frac{3}{2}$
- (c) Strictly increasing for  $-2 < x < -1$  and strictly decreasing for  $x < -2$  and  $x > -1$
- (d) Strictly increasing for  $x < -\frac{9}{2}$  and strictly decreasing for  $x > -\frac{9}{2}$









6. (i)  $0 < x < \frac{\pi}{2}$  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  $x = 2$  (ii) local minima at  $x = \frac{2}{7}$   
(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

