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. $\vec{r} \cdot \left(38\hat{i} + 68\hat{j} + 3\hat{k}\right) = 153$ **11.** $x - z + 2 = 0$

12. $\cos^{-1} \frac{15}{\sqrt{731}}$

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

1. Maximum Z = 16 at (0, 4)

2. Minimum Z = – 12 at (4, 0)

3. Maximum Z = $\frac{235}{19}$ at $\left(\frac{20}{19}, \frac{45}{19}\right)$

4. Minimum Z = 7 at $\left(\frac{3}{2}, \frac{1}{2}\right)$

5. Maximum Z = 18 at (4, 3)

6. Minimum Z = 6 at all the points on the line segment joining the points (6, 0) and (0, 3).

7. 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).