Chapter 6

Exercise 6A

1 **a** $a = -4, b = 1$

b $a = -5, b = 2, c = -1$

c $a = 4, b = -2, c = 0$

2 **a** $(x, \theta) = \left(-\sqrt{3}, \frac{5\pi}{6}\right)$

b $(x, \theta) = \left(\sqrt{3}, \frac{-5\pi}{6}\right)$

3 0 resultant force; all forces cancel.

4 **a** $\underset{\sim}{F}_3 = \begin{pmatrix} -15 \\ -37 \end{pmatrix}$

b $40N$

5 $15.13N$

6 **a** $\underset{\sim}{q} = \begin{pmatrix} 12.4 \\ -6.3 \end{pmatrix}$

b $14N$

7 **a** $\begin{pmatrix} -470 \\ 235 \\ 290 \end{pmatrix}$

b $600N$

8 $x = 120, y = -210, z = -280, 370N$

Exercise 6B

1 **a** 3

b $\frac{3}{\sqrt{2}}$

c $-\frac{15\sqrt{3}}{2}$

d $-\sqrt{15}$

e 4

f -3

2 **a** -4

b -4

c $8 - \sqrt{6}$

d 22

e $6 - 2\sqrt{15}$

f $1 + 6\sqrt{2}$

3 **a** 24

b -14

4 **a** -81

b -12

5 5

6 -2

7 **a** -1

b -21

c 25

Exercise 6C

1 answers in radians

a 1.48

b 1.9368

c 1.3807

2 answers in radians

a 0.868

b 1.412

c 0.3319

3 0.782 radians

4 **a** $E(6,0,5)$

$B(6,3,0)$

$G(0,3,5)$

b 1.3386 radians

5 **a** $B(8,8,0)$

b 0.7716 radians

6 **a** $P(8,0,0)$

$R(0,6,0)$

b 1.014197

7 **a** $A(8,0,0)$

$B(8,5,0)$

$F(8,5,6)$

b $(8,5,2)$

c 0.2089 radians

8 a 0.8218 radians

b 35.5

9 a $AY = \begin{pmatrix} 0 \\ 7 \\ -11 \end{pmatrix}$

$AX = \begin{pmatrix} 6 \\ \frac{29}{2} \\ -\frac{25}{2} \end{pmatrix}$

b 0.4186 radians

10 a $A(8,0,0)$

$D(0,0,15)$

$E(8,0,15)$

b $P(8,0,5)$

$Q\left(8,\frac{27}{5},15\right)$

$R(2,0,15)$

c 1.2473 radians

d 43.49

11 a 8 km

b 1.4836 radians

12 a $\begin{pmatrix} 6 \\ 11 \\ 33 \end{pmatrix}$

$\sqrt{1246}N$

b 0.2666 radians

13 148.29

Exercise 6D

1 a $3 * 5 + 2(-3) + (-1)9 = 0 \Rightarrow$ perpendicular

b $2 * 3 - 2 * 3 = 0 \Rightarrow$ perpendicular

c $2 * 6 + 8\ (-5) + 7 * 4 = 0 \Rightarrow$ perpendicular

d $(-1)\ 8 + (-3)\ (-10) + (-2)\ 11 = 0 \Rightarrow$ perpendicular

e $4\ (-1) + (-3)\ 2 + (-5)\ (-2) = 0 \Rightarrow$ perpendicular

f $6 * 5 + 8 * 3 + 9\ (-6) = 0 \Rightarrow$ perpendicular

2 a acute a.b > 0

b obtuse, q.r < 0

c obtuse, u.v < 0

d acute, AB.AC > 0

3 QP.QR = 0 ⇒ perpendicular at Q

4 AB.BC = 0 ⇒ perpendicular

5 0.5

6 0.5

7 $\{(-1.5),(5)\}$

8 a $\overrightarrow{AB} = \begin{pmatrix} 2 \\ 3 \\ 6 \end{pmatrix}$

$\overrightarrow{CD} = \begin{pmatrix} 1 \\ 2 \\ 5 \end{pmatrix}$

b $\left\{\left\{p = -\frac{4}{3}\right\},\left\{q = \frac{1}{3}\right\}\right\}$

9 $\{\{k = -5\},\{k = 5\}\}$

10 $\{\{y = -2\},\{y = 4\}\}$

Exercise 6E

1 a $a \bullet b = a1b1 + a2b2 + a3b3$

$b \bullet a = a1b1 + a2b2 + a3b3$ **(1)**

b $a \bullet (b + c) = a1b1 + a2b2 + a3b3 + a1c1 + a2c2 + a3c3$

c $a \bullet b + a \bullet c = a1b1 + a2b2 + a3b3 + a1c1 + a2c2 + a3c3$ **(2)**

2 a $\frac{65}{2}$

b 16

c $-\frac{73}{2}$

3 a $25\left(1 - \frac{1}{\sqrt{2}}\right)$

b $25\left(2 - 3\sqrt{2}\right)$

4 $\theta = 60°$

5 9

6 **a** $\frac{75}{2}$

b 25

7 $\sqrt{19}$

8 $(u + v) \bullet (u + v) = u \bullet u + 2u \bullet v + v \bullet v$

$= |u|^2 + 2u \bullet v + |v|^2$

However we are told this $= u \bullet u + v \bullet v$ which equals $|u|^2 + |v|^2$

So $u \bullet v = 0$ therefore right angled at B

9 **a** -3

b Obtuse

10 $10\sqrt{3}$, 4

11 $\overrightarrow{BA} = a - b$

$\overrightarrow{BC} = -(a + b)$

$\overrightarrow{BA} \bullet \overrightarrow{BC} = -(a + b) \bullet (a - b) = |b|^2 - |a|^2$

But $|b|^2 = |a|^2$ so dot product is $0 \Rightarrow$ right angled at B