

- 1 a  $x = 30, 180 - 30$   
 $x = 30^\circ, 150^\circ$     b  $x = 60, 180 + 60$   
 $x = 60^\circ, 240^\circ$     c  $x = 90^\circ, 270^\circ$     d  $x = 270^\circ$
- e  $x = 30, 360 - 30$   
 $x = 30^\circ, 330^\circ$     f  $x = 45, 180 - 45$   
 $x = 45^\circ, 135^\circ$     g  $x = 180 - 45, 360 - 45$   
 $x = 135^\circ, 315^\circ$     h  $x = 180 - 60, 180 + 60$   
 $x = 120^\circ, 240^\circ$
- i  $x = 180 + 60, 360 - 60$   
 $x = 240^\circ, 300^\circ$     j  $x = 30, 180 + 30$   
 $x = 30^\circ, 210^\circ$     k  $x = 180 - 45, 180 + 45$   
 $x = 135^\circ, 225^\circ$     l  $x = 180 - 60, 360 - 60$   
 $x = 120^\circ, 300^\circ$
- 2 a  $\theta = 66.4, 360 - 66.4$   
 $\theta = 66.4^\circ, 293.6^\circ$     b  $\theta = 15.7, 180 - 15.7$   
 $\theta = 15.7^\circ, 164.3^\circ$     c  $\theta = 58.0, 180 + 58.0$   
 $\theta = 58.0^\circ, 238.0^\circ$     d  $\theta = 54.4, 180 - 54.4$   
 $\theta = 54.4^\circ, 125.6^\circ$
- e  $\theta = 5.7, 180 + 5.7$   
 $\theta = 5.7^\circ, 185.7^\circ$     f  $\theta = 79.3, 360 - 79.3$   
 $\theta = 79.3^\circ, 280.7^\circ$     g  $\theta = 180 + 36.9,$   
 $360 - 36.9$   
 $\theta = 216.9^\circ, 323.1^\circ$     h  $\theta = 180 - 35.0,$   
 $360 - 35.0$   
 $\theta = 145.0^\circ, 325.0^\circ$
- i  $\theta = 180 - 67.0,$   
 $180 + 67.0$   
 $\theta = 113.0^\circ, 247.0^\circ$     j  $\theta = 180 - 73.6,$   
 $360 - 73.6$   
 $\theta = 106.4^\circ, 286.4^\circ$     k  $\theta = 180 - 50.5,$   
 $180 + 50.5$   
 $\theta = 129.5^\circ, 230.5^\circ$     l  $\theta = 180 + 11.7,$   
 $360 - 11.7$   
 $\theta = 191.7^\circ, 348.3^\circ$
- 3 a  $x - 60 = 30, 180 - 30$   
 $= 30, 150$   
 $x = 90, 210$     b  $x + 30 = 45, 180 + 45$   
 $= 45, 225$   
 $x = 15, 195$     c  $x - 45 = 78.5, 360 - 78.5$   
 $= 78.5, 281.5$   
 $x = 123.5, 326.5$
- d  $x + 30 = 38.0, 180 + 38.0$   
 $= 38.0, 218.0$   
 $x = 8.0, 188.0$     e  $x + 45 = 180 - 60, 180 + 60$   
 $= 120, 240$   
 $x = 75, 195$     f  $x - 60 = 180 + 62.9, 360 - 62.9$   
 $= 242.9, 297.1$   
 $x = 302.9, 357.1$
- g  $x + 45 = 360 - 25.8,$   
 $360 + 25.8$   
 $= 334.2, 385.8$   
 $x = 289.2, 340.8$     h  $x + 30 = 180 - 8.0,$   
 $360 + 8.0$   
 $= 172.0, 368.0$   
 $x = 142.0, 338.0$     i  $x - 60 = -53.1, 53.1$   
 $x = 6.9, 113.1$
- j  $x - 30 = -17.5, 180 + 17.5$   
 $= -17.5, 197.5$   
 $x = 12.5, 227.5$     k  $x - 60 = -51.6, 180 - 51.6$   
 $= -51.6, 128.4$   
 $x = 8.4, 188.4$     l  $2x = 30, 180 - 30,$   
 $360 + 30, 540 - 30$   
 $= 30, 150, 390, 510$   
 $x = 15, 75, 195, 255$
- m  $2x = 50.208,$   
 $360 - 50.208,$   
 $360 + 50.208,$   
 $720 - 50.208$   
 $= 50.208, 309.792,$   
 $410.208, 669.792$   
 $x = 25.1, 154.9, 205.1, 334.9$     n  $2x = 180 + 10.370,$   
 $360 - 10.370,$   
 $540 + 10.370,$   
 $720 - 10.370$   
 $= 190.370, 349.630,$   
 $550.370, 709.630$   
 $x = 95.2, 174.8, 275.2, 354.8$     o  $2x = 180 - 69.950,$   
 $360 - 69.950,$   
 $540 - 69.950,$   
 $720 - 69.950$   
 $= 110.050, 290.050,$   
 $470.050, 650.050$   
 $x = 55.0, 145.0, 235.0, 325.0$
- p  $\frac{1}{2}x = 44.668, 180 - 44.668$   
 $= 44.668, 135.332$   
 $x = 89.3, 270.7$     q  $3x = 30.583, 180 + 30.583,$   
 $360 + 30.583,$   
 $540 + 30.583,$   
 $720 + 30.583,$   
 $900 + 30.583$   
 $= 30.583, 210.583,$   
 $390.583, 570.583,$   
 $750.583, 930.583$   
 $x = 10.2, 70.2, 130.2$   
 $190.2, 250.2, 310.2$     r  $2x = 180 - 65.481,$   
 $180 + 65.481,$   
 $540 - 65.481,$   
 $540 + 65.481$   
 $= 114.519, 245.481,$   
 $474.519, 605.481$   
 $x = 57.3, 122.7, 237.3, 302.7$

4 a  $x = 0, \pi, 2\pi$

b  $x = \frac{\pi}{3}, 2\pi - \frac{\pi}{3}$

c  $x = \frac{\pi}{4}, \pi + \frac{\pi}{4}$

$x = \frac{\pi}{3}, \frac{5\pi}{3}$

$x = \frac{\pi}{4}, \frac{5\pi}{4}$

d  $x = \pi$

e  $x = \pi - \frac{\pi}{6}, 2\pi - \frac{\pi}{6}$

f  $x = \pi + \frac{\pi}{4}, 2\pi - \frac{\pi}{4}$

$x = \frac{5\pi}{6}, \frac{11\pi}{6}$

$x = \frac{5\pi}{4}, \frac{7\pi}{4}$

g  $x + \frac{\pi}{6} = \frac{\pi}{3}, \pi + \frac{\pi}{3}$   
 $= \frac{\pi}{3}, \frac{4\pi}{3}$

h  $x - \frac{\pi}{4} = \frac{\pi}{6}, \pi - \frac{\pi}{6}$   
 $= \frac{\pi}{6}, \frac{5\pi}{6}$

i  $x + \frac{\pi}{3} = \pi - \frac{\pi}{6}, \pi + \frac{\pi}{6}$   
 $= \frac{5\pi}{6}, \frac{7\pi}{6}$

$x = \frac{\pi}{6}, \frac{7\pi}{6}$

$x = \frac{5\pi}{12}, \frac{13\pi}{12}$

$x = \frac{\pi}{2}, \frac{5\pi}{6}$

j  $x + \frac{\pi}{3} = \pi - \frac{\pi}{4}, 2\pi + \frac{\pi}{4}$   
 $= \frac{3\pi}{4}, \frac{9\pi}{4}$

k  $2x = \pi - \frac{\pi}{4}, \pi + \frac{\pi}{4},$   
 $3\pi - \frac{\pi}{4}, 3\pi + \frac{\pi}{4}$

l  $3x = \frac{\pi}{6}, \pi + \frac{\pi}{6}, 2\pi + \frac{\pi}{6},$   
 $3\pi + \frac{\pi}{6}, 4\pi + \frac{\pi}{6}, 5\pi + \frac{\pi}{6}$

$x = \frac{5\pi}{12}, \frac{23\pi}{12}$

$= \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{11\pi}{4}, \frac{13\pi}{4}$

$= \frac{\pi}{6}, \frac{7\pi}{6}, \frac{13\pi}{6}, \frac{19\pi}{6}, \frac{25\pi}{6}, \frac{31\pi}{6}$

$x = \frac{3\pi}{8}, \frac{5\pi}{8}, \frac{11\pi}{8}, \frac{13\pi}{8}$

$x = \frac{\pi}{18}, \frac{7\pi}{18}, \frac{13\pi}{18}, \frac{19\pi}{18}, \frac{25\pi}{18}, \frac{31\pi}{18}$

5 a  $\theta = -90^\circ, 90^\circ$

b  $\tan 2\theta = -1$

c  $\theta + 60 = 16.9, 180 - 16.9$

$2\theta = 180 - 45, 360 - 45$

$= 16.9, 163.1$

$-45, -45 - 180$

$\theta = -43.1^\circ, 103.1^\circ$

$= -225, -45, 135, 315$

$\theta = -112.5^\circ, -22.5^\circ,$

$67.5^\circ, 157.5^\circ$

d  $\tan(\theta - 15) = 1.85$   
 $\theta - 15 = 61.6, 61.6 - 180$   
 $= -118.4, 61.6$   
 $\theta = -103.4^\circ, 76.6^\circ$

e  $\sin 2\theta = 0.3$   
 $2\theta = 17.458, 180 - 17.458,$   
 $17.458 - 360,$   
 $-17.458 - 180$   
 $= -342.542, -197.458,$   
 $17.458, 162.542$   
 $\theta = -171.3^\circ, -98.7^\circ$   
 $8.7^\circ, 81.3^\circ$

f  $\cos 3\theta = 0.5$   
 $3\theta = 60, 360 - 60, 360 + 60,$   
 $-60, 60 - 360, -60 - 360$   
 $= -420, -300, -60,$   
 $60, 300, 420$   
 $\theta = -140^\circ, -100^\circ, -20^\circ$   
 $20^\circ, 100^\circ, 140^\circ$

g  $\sin(\theta + 110) = -1$   
 $\theta + 110 = 270$   
 $\theta = 160^\circ$

h  $\cos(\theta - 27) = 0.6$   
 $\theta - 27 = 53.1, -53.1$   
 $\theta = -26.1^\circ, 80.1^\circ$

i  $\tan \theta = \frac{7}{3}$   
 $\theta = 66.8, 66.8 - 180$   
 $\theta = -113.2^\circ, 66.8^\circ$

j  $\cos 2\theta = -0.375$   
 $2\theta = 180 - 67.976,$   
 $180 + 67.976,$   
 $67.976 - 180,$   
 $-67.976 - 180$   
 $= -247.976, -112.024,$   
 $112.024, 247.976$   
 $\theta = -124.0^\circ, -56.0^\circ,$   
 $56.0^\circ, 124.0^\circ$

k  $\tan(\theta + 92) = -\frac{1}{3}$   
 $\theta + 92 = 180 - 18.4, -18.4$   
 $= -18.4, 161.6$   
 $\theta = -110.4^\circ, 69.6^\circ$

l  $\sin \frac{1}{3}\theta = 0.25$   
 $\frac{1}{3}\theta = 14.478$   
 $\theta = 43.4^\circ$

- 6**
- a**  $2x + 30 = 45, 180 + 45$   
 $= 45, 225$   
 $2x = 15, 195$   
 $x = 7.5^\circ, 97.5^\circ$
- b**  $2x - 15 = 0, 180$   
 $2x = 15, 195$   
 $x = 7.5^\circ, 97.5^\circ$
- c**  $2x + 70 = 360 - 60, 360 + 60$   
 $= 300, 420$   
 $2x = 230, 350$   
 $x = 115^\circ, 175^\circ$
- d**  $2x + 210 = 360 + 15.070,$   
 $540 - 15.070$   
 $= 375.070, 524.930$   
 $2x = 165.070, 314.930$   
 $x = 82.5^\circ, 157.5^\circ$
- e**  $2x - 38 = 180 - 50.208,$   
 $180 + 50.208$   
 $= 129.792, 230.208$   
 $2x = 167.792, 268.208$   
 $x = 83.9^\circ, 134.1^\circ$
- f**  $2x - 56 = 180 - 17.745,$   
 $-17.745$   
 $= -17.745, 162.256$   
 $2x = 38.256, 218.256$   
 $x = 19.1^\circ, 109.1^\circ$
- g**  $3x - 24 = 42.862,$   
 $360 - 42.862,$   
 $360 + 42.862$   
 $= 42.862, 317.138,$   
 $402.862$   
 $3x = 66.862, 341.138,$   
 $426.862$   
 $x = 22.3^\circ, 113.7^\circ, 142.3^\circ$
- h**  $3x + 60 = 180 - 62.241,$   
 $360 - 62.241,$   
 $540 - 62.241$   
 $= 117.759, 297.759,$   
 $477.759$   
 $3x = 57.759, 237.759,$   
 $417.759$   
 $x = 19.3^\circ, 79.3^\circ, 139.3^\circ$
- i**  $\frac{1}{2}x + 18 = 34.890$   
 $\frac{1}{2}x = 16.890$   
 $x = 33.8^\circ$
- 7**
- a**  $x = 0.48, \pi + 0.4795$   
 $x = 0.48^\circ, 3.62^\circ$
- b**  $2x = 1.2503, 2\pi - 1.2503,$   
 $2\pi + 1.2503, 4\pi - 1.2503$   
 $= 1.2503, 5.0328,$   
 $7.5335, 11.3160$   
 $x = 0.63^\circ, 2.52^\circ, 3.77^\circ, 5.66^\circ$
- c**  $x + \frac{\pi}{4} = \pi - 0.7754,$   
 $2\pi + 0.7754$   
 $= 2.3662, 7.0586$   
 $x = 1.58^\circ, 6.27^\circ$
- d**  $\cos x = -\frac{1}{3}$   
 $x = \pi - 1.2310, \pi + 1.2310$   
 $= 1.91^\circ, 4.37^\circ$
- e**  $\frac{1}{2}x = 0.0901, \pi - 0.0901$   
 $= 0.0901, 3.0515$   
 $x = 0.18^\circ, 6.10^\circ$
- f**  $2x = \pi - 0.2213, 2\pi - 0.2213$   
 $3\pi - 0.2213, 4\pi - 0.2213$   
 $= 2.9203, 6.0619,$   
 $9.2035, 12.3451$   
 $x = 1.46^\circ, 3.03^\circ, 4.60^\circ, 6.17^\circ$
- g**  $\sin(x - \frac{\pi}{3}) = 0.75$   
 $x - \frac{\pi}{3} = 0.8481, \pi - 0.8481$   
 $= 0.8481, 2.2935$   
 $x = 1.90^\circ, 3.34^\circ$
- h**  $2x + \frac{\pi}{6} = 1.1071, \pi + 1.1071,$   
 $2\pi + 1.1071, 3\pi + 1.1071$   
 $= 1.1071, 4.2487,$   
 $7.3903, 10.5319$   
 $2x = 0.5835, 3.7251,$   
 $6.8667, 10.0083$   
 $x = 0.29^\circ, 1.86^\circ, 3.43^\circ, 5.00^\circ$
- i**  $3x = \pi - 0.6266, \pi + 0.6266,$   
 $3\pi - 0.6266, 3\pi + 0.6266,$   
 $5\pi - 0.6266, 5\pi + 0.6266$   
 $= 2.5149, 3.7682, 8.7981,$   
 $10.0514, 15.0813, 16.3346$   
 $x = 0.84^\circ, 1.26^\circ, 2.93^\circ,$   
 $3.35^\circ, 5.03^\circ, 5.44^\circ$
- j**  $\tan x = -\frac{5}{3}$   
 $x = \pi - 1.0304, 2\pi - 1.0304$   
 $x = 2.11^\circ, 5.25^\circ$
- k**  $2x - \frac{\pi}{2} = \pi - 1.2239, \pi + 1.2239,$   
 $3\pi - 1.2239, 3\pi + 1.2239$   
 $= 1.9177, 4.3655,$   
 $8.2009, 10.6487$   
 $2x = 3.4885, 5.9363,$   
 $9.7717, 12.2195$   
 $x = 1.74^\circ, 2.97^\circ, 4.89^\circ, 6.11^\circ$
- l**  $\sin 2x = -\frac{1}{6}$   
 $2x = \pi + 0.1674, 2\pi - 0.1674,$   
 $3\pi + 0.1674, 4\pi - 0.1674$   
 $= 3.3090, 6.1157,$   
 $9.5922, 12.3989$   
 $x = 1.65^\circ, 3.06^\circ, 4.80^\circ, 6.20^\circ$

8 a  $(2y - 1)(y - 1) = 0$

$y = \frac{1}{2}, 1$

b  $\sin x = \frac{1}{2}$  or 1

$x = 30, 180 - 30$  or 90

$x = 30^\circ, 90^\circ, 150^\circ$

9 a  $\sin \theta = \pm \frac{\sqrt{3}}{2}$

$\theta = 60, 180 - 60$  or  $180 + 60, 360 - 60$

$\theta = 60, 120, 240, 300$

c  $\cos \theta(2 \cos \theta + 1) = 0$

$\cos \theta = 0$  or  $-0.5$

$\theta = 90, 270$  or  $180 - 60, 180 + 60$

$\theta = 90, 120, 240, 270$

e  $\sin \theta(4 - \tan \theta) = 0$

$\sin \theta = 0$  or  $\tan \theta = 4$

$\theta = 0, 180, 360$  or  $76.0, 180 + 76.0$

$\theta = 0, 76.0, 180, 256.0, 360$

g  $(\tan \theta - 1)(\tan \theta - 2) = 0$

$\tan \theta = 1$  or 2

$\theta = 45, 180 + 45$  or  $63.4, 180 + 63.4$

$\theta = 45, 63.4, 225, 243.4$

i  $\tan^2 \theta - \tan \theta - 6 = 0$

$(\tan \theta + 2)(\tan \theta - 3) = 0$

$\tan \theta = -2$  or 3

$\theta = 180 - 63.4, 360 - 63.4$  or  $71.6, 180 + 71.6$

$\theta = 71.6, 116.6, 251.6, 296.6$

k  $4 \sin^2 \theta - 8 \sin \theta + 3 = 0$

$(2 \sin \theta - 1)(2 \sin \theta - 3) = 0$

$\sin \theta = 0.5$  or  $1.5$  [no solutions]

$\theta = 30, 180 - 30$

$\theta = 30, 150$

m  $\tan \theta = \frac{-3 \pm \sqrt{9+4}}{2}$

$\tan \theta = \frac{1}{2}(-3 \pm \sqrt{13})$

$\theta = 180 - 73.2, 360 - 73.2$  or  $16.8, 180 + 16.8$

$\theta = 16.8, 106.8, 196.8, 286.8$

b  $\tan \theta = \pm 1$

$\theta = 45, 180 + 45$  or  $180 - 45, 360 - 45$

$\theta = 45, 135, 225, 315$

d  $\sin \theta = 0$  or  $\cos \theta = 0.25$

$\theta = 0, 180, 360$  or  $75.5, 360 - 75.5$

$\theta = 0, 75.5, 180, 284.5, 360$

f  $\cos \theta = -1$  or 0.5

$\theta = 180$  or  $60, 360 - 60$

$\theta = 60, 180, 300$

h  $(3 \sin \theta - 1)(\sin \theta - 2) = 0$

$\sin \theta = \frac{1}{3}$  or 2 [no solutions]

$\theta = 19.5, 180 - 19.5$

$\theta = 19.5, 160.5$

j  $(3 \cos \theta - 2)(2 \cos \theta + 1) = 0$

$\cos \theta = -0.5$  or  $\frac{2}{3}$

$\theta = 180 - 60, 180 + 60$  or  $48.2, 360 - 48.2$

$\theta = 48.2, 120, 240, 311.8$

l  $\cos \theta = \frac{-2 \pm \sqrt{4+4}}{2}$

$\cos \theta = -1 + \sqrt{2}$  or  $-1 - \sqrt{2}$  [no solutions]

$\theta = 65.5, 360 - 65.5$

$\theta = 65.5, 294.5$

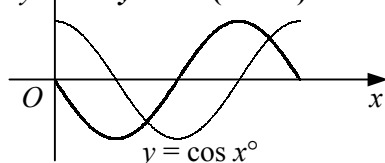
n  $3 \sin^2 \theta + \sin \theta - 1 = 0$

$\sin \theta = \frac{-1 \pm \sqrt{1+12}}{6} = \frac{1}{6}(-1 \pm \sqrt{13})$

$\theta = 180 + 50.1, 360 - 50.1$  or  $25.7, 180 - 25.7$

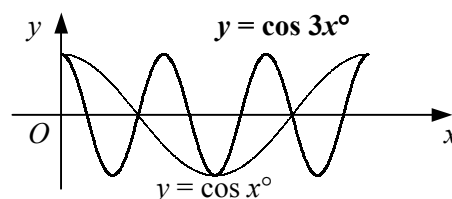
$\theta = 25.7, 154.3, 230.1, 309.9$

10 a, b  $y = \cos(x + 90^\circ)$



c  $x = 135, 315$

11 a  $y = \cos 3x^\circ$



b  $x = 0, 90, 180, 270, 360$

c  $x = 0, 45, 90, 135, 180$

- 1 a**  $4 \sin x = -\cos x$   
 $\frac{\sin x}{\cos x} = -\frac{1}{4}$   
 $\tan x = -\frac{1}{4}$
- b**  $x = 180 - 14.0, 360 - 14.0$   
 $x = 166.0^\circ, 346.0^\circ$
- 2 a** LHS =  $5 \sin^2 x + 5 \sin x + 4(1 - \sin^2 x)$   
 $= \sin^2 x + 5 \sin x + 4$   
 $= \text{RHS}$
- b**  $(\sin x + 4)(\sin x + 1) = 0$   
 $\sin x = -1$  or  $-4$  [no solutions]  
 $x = 270^\circ$
- 3 a**  $2 \sin x = \cos x$   
 $\tan x = 0.5$   
 $x = 26.6, 180 + 26.6$   
 $x = 26.6^\circ, 206.6^\circ$
- c**  $1 - \sin^2 x + 3 \sin x - 3 = 0$   
 $\sin^2 x - 3 \sin x + 2 = 0$   
 $(\sin x - 1)(\sin x - 2) = 0$   
 $\sin x = 1$  or  $2$  [no solutions]  
 $x = 90^\circ$
- d**  $3 \cos^2 x - (1 - \cos^2 x) = 2$   
 $4 \cos^2 x = 3$   
 $\cos x = \pm \frac{\sqrt{3}}{2}$   
 $x = 30, 360 - 30$  or  $180 - 30, 180 + 30$   
 $x = 30^\circ, 150^\circ, 210^\circ, 330^\circ$
- e**  $2(1 - \cos^2 x) + 3 \cos x = 3$   
 $2 \cos^2 x - 3 \cos x + 1 = 0$   
 $(2 \cos x - 1)(\cos x - 1) = 0$   
 $\cos x = 0.5$  or  $1$   
 $x = 60, 360 - 60$  or  $0, 360$   
 $x = 0, 60^\circ, 300^\circ, 360^\circ$
- f**  $3(1 - \sin^2 x) = 5(1 - \sin x)$   
 $3 \sin^2 x - 5 \sin x + 2 = 0$   
 $(3 \sin x - 2)(\sin x - 1) = 0$   
 $\sin x = \frac{2}{3}$  or  $1$   
 $x = 41.8, 180 - 41.8$  or  $90$   
 $x = 41.8^\circ, 90^\circ, 138.2^\circ$
- g**  $3 \sin^2 x = 8 \cos x$   
 $3(1 - \cos^2 x) = 8 \cos x$   
 $3 \cos^2 x + 8 \cos x - 3 = 0$   
 $(3 \cos x - 1)(\cos x + 3) = 0$   
 $\cos x = \frac{1}{3}$  or  $-3$  [no solutions]  
 $x = 70.5, 360 - 70.5$   
 $x = 70.5^\circ, 289.5^\circ$
- h**  $\cos^2 x = 3 \sin x$   
 $1 - \sin^2 x = 3 \sin x$   
 $\sin^2 x + 3 \sin x - 1 = 0$   
 $\sin x = \frac{-3 \pm \sqrt{9+4}}{2}$   
 $\sin x = \frac{1}{2}(-3 + \sqrt{13})$  or  $\frac{1}{2}(-3 - \sqrt{13})$  [no sols]  
 $x = 17.6, 180 - 17.6$   
 $x = 17.6^\circ, 162.4^\circ$
- i**  $3(1 - \cos^2 x) - 5 \cos x + 2 \cos^2 x = 0$   
 $\cos^2 x + 5 \cos x - 3 = 0$   
 $\cos x = \frac{-5 \pm \sqrt{25+12}}{2}$   
 $\cos x = \frac{1}{2}(-5 + \sqrt{37})$  or  $\frac{1}{2}(-5 - \sqrt{37})$  [no sols]  
 $x = 57.2, 360 - 57.2$   
 $x = 57.2^\circ, 302.8^\circ$
- j**  $2 \sin^2 x + 7 \sin x - 2(1 - \sin^2 x) = 0$   
 $4 \sin^2 x + 7 \sin x - 2 = 0$   
 $(4 \sin x - 1)(\sin x + 2) = 0$   
 $\sin x = 0.25$  or  $-2$  [no solutions]  
 $x = 14.5, 180 - 14.5$   
 $x = 14.5^\circ, 165.5^\circ$
- k**  $3 \sin x = 2 \tan x$   
 $3 \sin x \cos x = 2 \sin x$   
 $\sin x (3 \cos x - 2) = 0$   
 $\sin x = 0$  or  $\cos x = \frac{2}{3}$   
 $x = 0, 180, 360$  or  $48.2, 360 - 48.2$   
 $x = 0, 48.2^\circ, 180^\circ, 311.8^\circ, 360^\circ$
- l**  $(1 - \cos^2 x) - 9 \cos x - \cos^2 x = 5$   
 $2 \cos^2 x + 9 \cos x + 4 = 0$   
 $(2 \cos x + 1)(\cos x + 4) = 0$   
 $\cos x = -0.5$  or  $-4$  [no solutions]  
 $x = 180 - 60, 180 + 60$   
 $x = 120^\circ, 240^\circ$

- 4 a**  $\cos \theta = \pm 0.5$   
 $\theta = \frac{\pi}{3}, -\frac{\pi}{3}$  or  $\pi - \frac{\pi}{3}, -\pi + \frac{\pi}{3}$   
 $\theta = -\frac{2\pi}{3}, -\frac{\pi}{3}, \frac{\pi}{3}, \frac{2\pi}{3}$
- b**  $(2 \sin \theta + 1)^2 = 0$   
 $\sin \theta = -0.5$   
 $\theta = -\frac{\pi}{6}, -\pi + \frac{\pi}{6}$   
 $\theta = -\frac{5\pi}{6}, -\frac{\pi}{6}$
- c**  $(\cos \theta + 3)(\cos \theta - 1) = 0$   
 $\cos \theta = 1$  or  $-3$  [no solutions]  
 $\theta = 0$
- d**  $3 \sin^2 \theta - (1 - \sin^2 \theta) = 0$   
 $4 \sin^2 \theta = 1$   
 $\sin \theta = \pm 0.5$   
 $\theta = \frac{\pi}{6}, \pi - \frac{\pi}{6}$  or  $-\frac{\pi}{6}, -\pi + \frac{\pi}{6}$   
 $\theta = -\frac{5\pi}{6}, -\frac{\pi}{6}, \frac{\pi}{6}, \frac{5\pi}{6}$
- e**  $4 \sin^2 \theta - 5 \sin \theta + 2(1 - \sin^2 \theta) = 0$   
 $2 \sin^2 \theta - 5 \sin \theta + 2 = 0$   
 $(2 \sin \theta - 1)(\sin \theta - 2) = 0$   
 $\sin \theta = 0.5$  or  $2$  [no solutions]  
 $\theta = \frac{\pi}{6}, \pi - \frac{\pi}{6}$   
 $\theta = \frac{\pi}{6}, \frac{5\pi}{6}$
- f**  $(1 - \cos^2 \theta) - 3 \cos \theta - \cos^2 \theta = 2$   
 $2 \cos^2 \theta + 3 \cos \theta + 1 = 0$   
 $(2 \cos \theta + 1)(\cos \theta + 1) = 0$   
 $\cos \theta = -0.5$  or  $-1$   
 $\theta = \pi - \frac{\pi}{3}, -\pi + \frac{\pi}{3}$  or  $-\pi, \pi$   
 $\theta = -\pi, -\frac{2\pi}{3}, \frac{2\pi}{3}, \pi$
- 5 a** LHS =  $\sin^2 x + 2 \sin x \cos x + \cos^2 x$   
 $= (\sin^2 x + \cos^2 x) + 2 \sin x \cos x$   
 $= 1 + 2 \sin x \cos x$   
 $= \text{RHS}$
- b** LHS =  $\frac{1 - \cos^2 x}{\cos x}$   
 $= \frac{\sin^2 x}{\cos x}$   
 $= \sin x \times \frac{\sin x}{\cos x}$   
 $= \sin x \tan x$   
 $= \text{RHS}$
- c** LHS =  $\frac{1 - \sin^2 x}{1 - \sin x}$   
 $= \frac{(1 + \sin x)(1 - \sin x)}{1 - \sin x}$   
 $= 1 + \sin x$   
 $= \text{RHS}$
- d** LHS =  $\frac{(1 + \sin x)(1 - \sin x)}{\cos x(1 - \sin x)}$   
 $= \frac{1 - \sin^2 x}{\cos x(1 - \sin x)}$   
 $= \frac{\cos^2 x}{\cos x(1 - \sin x)}$   
 $= \frac{\cos x}{1 - \sin x}$   
 $= \text{RHS}$
- 6 a** LHS =  $\cos^2 x - 2 \cos x \tan x + \tan^2 x$   
 $+ \sin^2 x + 2 \sin x + 1$   
 $= \cos^2 x - 2 \sin x + \tan^2 x$   
 $+ \sin^2 x + 2 \sin x + 1$   
 $= (\cos^2 x + \sin^2 x) + \tan^2 x + 1$   
 $= 2 + \tan^2 x = \text{RHS}$
- b**  $2 + \tan^2 x = 3$   
 $\tan^2 x = 1$   
 $\tan x = \pm 1$   
 $x = \frac{\pi}{4}, \pi + \frac{\pi}{4}$  or  $\pi - \frac{\pi}{4}, 2\pi - \frac{\pi}{4}$   
 $x = \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$
- 7 a**  $f(x) = (1 - \sin^2 x) + 2 \sin x$   
 $= 2 - (\sin^2 x - 2 \sin x + 1)$   
 $= 2 - (\sin x - 1)^2$
- b** max. value of  $f(x) = 2$   
occurs when  $\sin x = 1 \therefore x = \frac{\pi}{2}$