

- 1 **a** $= \frac{5-1}{5-3} = 2$ **b** $= \frac{9-7}{10-4} = \frac{1}{3}$ **c** $= \frac{5-1}{2-6} = -1$ **d** $= \frac{8-2}{2+2} = \frac{3}{2}$
- e** $= \frac{-1-3}{7-1} = -\frac{2}{3}$ **f** $= \frac{-7-5}{-5-4} = \frac{4}{3}$ **g** $= \frac{-8-0}{0+2} = -4$ **h** $= \frac{-2-6}{-7-8} = \frac{8}{15}$
- 2 **a** grad = 4 **b** grad = $\frac{1}{3}$ **c** grad = -1 **d** grad = -2
- y-int = -1 y-int = 3 y-int = 6 y-int = $-\frac{3}{5}$
- 3 **a** $y = -x - 3$ **b** $2y = x - 6$ **c** $3y = -3x + 2$ **d** $5y = 4x + 1$
- grad = -1 $y = \frac{1}{2}x - 3$ $y = -x + \frac{2}{3}$ $y = \frac{4}{5}x + \frac{1}{5}$
- y-int = -3 grad = $\frac{1}{2}$ grad = -1 grad = $\frac{4}{5}$
- y-int = -3 y-int = $\frac{2}{3}$ y-int = $\frac{1}{5}$
- 4 **a** $y - 1 = 2(x - 4)$ **b** $y + 5 = 5(x - 2)$
- c** $y - 1 = -3(x + 1)$ **d** $y - 6 = \frac{1}{2}(x - 1)$
- e** $y + \frac{1}{4} = -2(x - \frac{3}{4})$ **f** $y + 7 = -\frac{1}{5}(x + 3)$
- 5 **a** $y - 2 = 3(x - 1)$ **b** $y - 3 = -(x - 5)$
- $y = 3x - 1$ $y = -x + 8$
- c** $y + 3 = 4(x + 2)$ **d** $y - 1 = -2(x + 4)$
- $y = 4x + 5$ $y = -2x - 7$
- e** $y - 1 = \frac{1}{3}(x + 3)$ **f** $y + 2 = -\frac{5}{6}(x - 9)$
- $y = \frac{1}{3}x + 2$ $y = -\frac{5}{6}x + \frac{11}{2}$
- 6 **a** $y + 4 = x - 2$ **b** $y - 1 = \frac{1}{2}(x - 6)$ **c** $y - 8 = -4(x + 1)$
- $x - y - 6 = 0$ $2y - 2 = x - 6$ $y - 8 = -4x - 4$
- $x - 2y - 4 = 0$ $4x + y - 4 = 0$
- d** $y - 5 = \frac{2}{5}(x + 3)$ **e** $y + \frac{1}{8} = -3(x - \frac{3}{2})$ **f** $y + 7 = -\frac{3}{4}(x - \frac{2}{3})$
- $5y - 25 = 2x + 6$ $8y + 1 = -24x + 36$ $4y + 28 = -3x + 2$
- $2x - 5y + 31 = 0$ $24x + 8y - 35 = 0$ $3x + 4y + 26 = 0$
- 7 **a** grad = $\frac{13-1}{4-0} = 3$ **b** grad = $\frac{-1-9}{7-2} = -2$ **c** grad = $\frac{7-3}{2+4} = \frac{2}{3}$
- $y = 3x + 1$ $y - 9 = -2(x - 2)$ $y - 3 = \frac{2}{3}(x + 4)$
- $y = -2x + 13$ $y = \frac{2}{3}x + \frac{17}{3}$
- d** grad = $\frac{8+2}{2+\frac{1}{2}} = 4$ **e** grad = $\frac{-5+2}{18-3} = -\frac{1}{5}$ **f** grad = $\frac{0.4-4}{-2+3.2} = -3$
- $y - 8 = 4(x - 2)$ $y + 2 = -\frac{1}{5}(x - 3)$ $y - 4 = -3(x + 3.2)$
- $y = 4x$ $y = -\frac{1}{5}x - \frac{7}{5}$ $y = -3x - 5.6$

$$8 \quad \mathbf{a} \quad \text{grad} = \frac{2-0}{5-3} = 1 \qquad \mathbf{b} \quad \text{grad} = \frac{-4-8}{5+1} = -2 \qquad \mathbf{c} \quad \text{grad} = \frac{5-3}{7+5} = \frac{1}{6}$$

$$y = x - 3$$

$$x - y - 3 = 0$$

$$y - 8 = -2(x + 1)$$

$$y - 8 = -2x - 2$$

$$2x + y - 6 = 0$$

$$y - 3 = \frac{1}{6}(x + 5)$$

$$6y - 18 = x + 5$$

$$x - 6y + 23 = 0$$

$$\mathbf{d} \quad \text{grad} = \frac{-17+1}{8+4} = -\frac{4}{3}$$

$$y + 1 = -\frac{4}{3}(x + 4)$$

$$3y + 3 = -4x - 16$$

$$4x + 3y + 19 = 0$$

$$\mathbf{e} \quad \text{grad} = \frac{0+1.5}{7-2} = 0.3$$

$$y = 0.3(x - 7)$$

$$10y = 3x - 21$$

$$3x - 10y - 21 = 0$$

$$\mathbf{f} \quad \text{grad} = \frac{1-\frac{1}{10}}{3+\frac{3}{5}} = \frac{1}{4}$$

$$y - 1 = \frac{1}{4}(x - 3)$$

$$4y - 4 = x - 3$$

$$x - 4y + 1 = 0$$

$$9 \quad \mathbf{a} \quad \text{grad} = \frac{2-8}{3+6} = -\frac{2}{3}$$

$$\therefore y - 8 = -\frac{2}{3}(x + 6)$$

$$[2x + 3y - 12 = 0]$$

b sub.

$$2(9) + 3(-2) - 12 = 18 - 6 - 12 = 0$$

$\therefore C$ lies on l

$$10 \quad k - 3(2k) + 15 = 0$$

$$15 = 5k$$

$$k = 3$$

$$11 \quad 2(4p) - 4(p^2) + 5 = 0$$

$$4p^2 - 8p - 5 = 0$$

$$(2p + 1)(2p - 5) = 0$$

$$p = -\frac{1}{2} \text{ or } \frac{5}{2}$$

$$12 \quad \mathbf{a} \quad x = 0: y = 5 \qquad \mathbf{b} \quad x = 0: y = 2 \qquad \mathbf{c} \quad x = 0: y = \frac{3}{4} \qquad \mathbf{d} \quad x = 0: y = -\frac{10}{3}$$

$$y = 0: x = -\frac{5}{2}$$

$$y = 0: x = -6$$

$$y = 0: x = \frac{3}{2}$$

$$y = 0: x = 2$$

$$\left(-\frac{5}{2}, 0\right) \text{ and } (0, 5)$$

$$(-6, 0) \text{ and } (0, 2)$$

$$\left(0, \frac{3}{4}\right) \text{ and } \left(\frac{3}{2}, 0\right)$$

$$\left(0, -\frac{10}{3}\right) \text{ and } (2, 0)$$

$$13 \quad \mathbf{a} \quad x = 0 \Rightarrow y = -\frac{5}{3}$$

$$y = 0 \Rightarrow x = 6 \quad \therefore (0, -\frac{5}{3}) \text{ and } (6, 0)$$

$$\mathbf{b} \quad \text{area} = \frac{1}{2} \times 6 \times \frac{5}{3} = 5$$

$$14 \quad \mathbf{a} \quad = \sqrt{3^2 + 4^2} \\ = \sqrt{25} = 5$$

$$\mathbf{b} \quad = \sqrt{3^2 + 1^2} \\ = \sqrt{10}$$

$$\mathbf{c} \quad = \sqrt{8^2 + 15^2} \\ = \sqrt{289} = 17$$

$$\mathbf{d} \quad = \sqrt{16^2 + 12^2} \\ = \sqrt{400} = 20$$

$$\mathbf{e} \quad = \sqrt{2^2 + 5^2} \\ = \sqrt{29}$$

$$\mathbf{f} \quad = \sqrt{8^2 + 4^2} \\ = \sqrt{80} = 4\sqrt{5}$$

$$15 \quad \text{let centre be } C \therefore \text{radius} = CP = \sqrt{20^2 + 15^2} = \sqrt{625} = 25$$

$$\therefore CQ^2 = 15^2 + c^2 = 25^2$$

$$c^2 = 625 - 225 = 400$$

$$c = \pm 20$$

$$CR^2 = (k - 2)^2 + 24^2 = 25^2$$

$$(k - 2)^2 = 625 - 576 = 49$$

$$k - 2 = \pm 7$$

$$k = -5 \text{ or } 9$$

16 $AB^2 = 8^2 + 10^2 = 164$
 $AB = \sqrt{164} = 2\sqrt{41}$
radius = $\frac{1}{2}AB = \sqrt{41}$
area = $\pi \times (\sqrt{41})^2 = 41\pi$

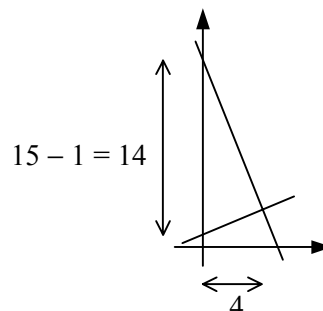
17 a $PQ = \sqrt{6^2 + 2^2} = \sqrt{40} = 2\sqrt{10}$
 $PR = \sqrt{1^2 + 17^2} = \sqrt{290}$
 $QR = \sqrt{5^2 + 15^2} = \sqrt{250} = 5\sqrt{10}$
b $PQ^2 + QR^2 = 40 + 250 = 290 = PR^2$
 \therefore by converse of Pythagoras'
 $\angle PQR$ is a right-angle
c area = $\frac{1}{2} \times PQ \times QR = 50$

18 a $(\frac{0+8}{2}, \frac{2+4}{2}) = (4, 3)$ b $(\frac{1+7}{2}, \frac{9+5}{2}) = (4, 7)$ c $(\frac{-5+3}{2}, \frac{1-7}{2}) = (-1, -3)$
d $(\frac{-5+7}{2}, \frac{-7-5}{2}) = (1, -6)$ e $(\frac{1+2}{2}, \frac{0+9}{2}) = (\frac{3}{2}, \frac{9}{2})$ f $(\frac{-1+4}{2}, \frac{-2-5}{2}) = (\frac{3}{2}, -\frac{7}{2})$
g $(\frac{2.4+0.6}{2}, \frac{3.1+4.5}{2}) = (1.5, 3.8)$ h $(\frac{0+\frac{1}{2}}{2}, \frac{3+\frac{3}{2}}{2}) = (\frac{1}{4}, \frac{9}{4})$ i $(\frac{-\frac{5}{4}-1}{2}, \frac{2-\frac{3}{5}}{2}) = (-\frac{9}{8}, \frac{7}{10})$

19 a grad = $\frac{-1-1}{4+2} = -\frac{1}{3}$
 $y - 1 = -\frac{1}{3}(x + 2)$
 $3y - 3 = -x - 2$
 $x + 3y - 1 = 0$
b mid-point of $PQ = (\frac{-2+4}{2}, \frac{1-1}{2}) = (1, 0)$
grad of $l_2 = \frac{0-4}{1-2} = 4$
 $y = 4(x - 1)$
 $y = 4x - 4$

20 a $2x + 1 = 3x - 1$ b $x + 7 = 4 - 2x$ c $5x - 4 = 3x - 1$
 $x = 2$ $3x = -3$ $2x = 3$
 $\therefore (2, 5)$ $x = -1$ $x = \frac{3}{2}$
 $\therefore (-1, 6)$ $\therefore (\frac{3}{2}, \frac{7}{2})$
d adding e $6x + 3y - 6 = 0$ f $6x + 4y = 0$
 $4x = 0$ $x + 3y + 9 = 0$ $x + 4y - 2 = 0$
 $x = 0$ subtracting subtracting
 $\therefore (0, 2)$ $5x - 15 = 0$ $5x + 2 = 0$
 $x = 3$ $\therefore (3, -4)$ $x = -\frac{2}{5}$
 $\therefore (-\frac{2}{5}, \frac{3}{5})$

21 $l: x = 0 \Rightarrow y = 1 \therefore P(0, 1)$
 $m: x = 0 \Rightarrow y = 15 \therefore Q(0, 15)$
 $l \quad x - 2y + 2 = 0$
 $m \Rightarrow 6x + 2y - 30 = 0$
adding, $7x - 28 = 0$
 $x = 4$
sub. $y = 3 \therefore R(4, 3)$
area = $\frac{1}{2} \times 14 \times 4 = 28$



1 a $y + 5 = -3(x - 3)$ [$y = 4 - 3x$]

b $\text{grad} = \frac{1+2}{4+1} = \frac{3}{5}$
 $\therefore y + 2 = \frac{3}{5}(x + 1)$

$5y + 10 = 3x + 3$
 $3x - 5y - 7 = 0$

c $3x - 5(4 - 3x) - 7 = 0$
 $18x - 27 = 0$
 $x = \frac{3}{2}$
 $\therefore P(\frac{3}{2}, -\frac{1}{2})$

2 a $\frac{k+3}{7-2} = \frac{3}{2}$

$2(k + 3) = 15$

$k = \frac{9}{2}$

b mid-point = $(\frac{2+7}{2}, \frac{-3+\frac{9}{2}}{2}) = (\frac{9}{2}, \frac{3}{4})$

perp grad = $-\frac{2}{3}$

$\therefore y - \frac{3}{4} = -\frac{2}{3}(x - \frac{9}{2})$

$12y - 9 = -8x + 36$

$8x + 12y - 45 = 0$

3 a $\text{grad} = \frac{8-4}{-5-5} = -\frac{2}{5}$

$\therefore y - 4 = -\frac{2}{5}(x - 5)$

$5y - 20 = -2x + 10$

$2x + 5y - 30 = 0$

b $M = (\frac{5+1}{2}, \frac{4+11}{2}) = (3, 7\frac{1}{2})$

c $\text{grad } OM = 7\frac{1}{2} \div 3 = \frac{5}{2}$

$\text{grad } OM \times \text{grad } AB = \frac{5}{2} \times -\frac{2}{5} = -1$

$\therefore OM$ is perpendicular to AB

4 a $l \Rightarrow 9x + 3y - 27 = 0$

subtracting, $7x - 15 = 0$

$x = \frac{15}{7}$

$\therefore A(\frac{15}{7}, \frac{18}{7})$

b l meets y -axis: $x = 0 \Rightarrow y = 9$

m meets y -axis: $x = 0 \Rightarrow y = 4$

area of $R_1 = \frac{1}{2} \times 5 \times \frac{15}{7} = \frac{75}{14}$

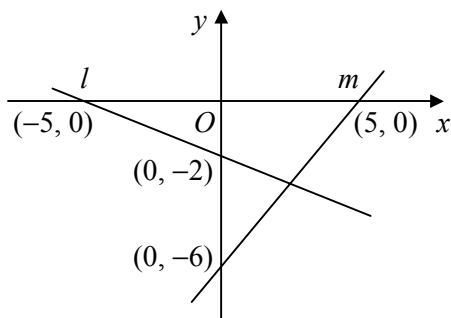
l meets x -axis: $y = 0 \Rightarrow x = 3$

m meets x -axis: $y = 0 \Rightarrow x = 6$

area of $R_2 = \frac{1}{2} \times 3 \times \frac{18}{7} = \frac{54}{14}$

area R_1 : area of $R_2 = \frac{75}{14} : \frac{54}{14} = 25 : 18$

5 a



b mid-point = $(\frac{0+5}{2}, \frac{-6+0}{2}) = (\frac{5}{2}, -3)$

sub. in l : $2(\frac{5}{2}) + 5(-3) + 10$

$= 5 - 15 + 10 = 0$

$\therefore l$ passes through mid-point of AB

6 a $\text{grad} = \frac{4+4}{5+10} = \frac{8}{15}$

$\therefore y - 4 = \frac{8}{15}(x - 5)$

$15y - 60 = 8x - 40$

$8x - 15y + 20 = 0$

b $x = 0 \Rightarrow y = \frac{4}{3}$

$y = 0 \Rightarrow x = -\frac{5}{2}$

area = $\frac{1}{2} \times \frac{5}{2} \times \frac{4}{3} = \frac{5}{3}$

c $PQ^2 = (\frac{5}{2})^2 + (\frac{4}{3})^2$

$= \frac{25}{4} + \frac{16}{9}$

$= \frac{289}{36}$

$PQ = \sqrt{\frac{289}{36}} = \frac{17}{6} = 2\frac{5}{6}$

$$7 \quad \text{a} \quad \text{grad} = \frac{-5-1}{-4+8} = -\frac{3}{2}$$

$$\therefore y - 1 = -\frac{3}{2}(x + 8)$$

$$2y - 2 = -3x - 24$$

$$3x + 2y + 22 = 0$$

$$\text{b} \quad \text{mid-point} = \left(\frac{-8-4}{2}, \frac{1-5}{2}\right) = (-6, -2)$$

$$\text{distance} = \sqrt{6^2 + 2^2} = \sqrt{40}$$

$$= 2\sqrt{10} \quad [k = 2]$$

$$9 \quad \text{a} \quad \text{grad} = \frac{6-2}{6+4} = \frac{2}{5}$$

$$\therefore y - 2 = \frac{2}{5}(x + 4)$$

$$5y - 10 = 2x + 8$$

$$2x - 5y + 18 = 0$$

$$\text{b} \quad y - 6 = -(x - 6) \quad [y = 12 - x]$$

$$\text{c} \quad \text{grad } DC = \text{grad } AB = \frac{2}{5}$$

$$\therefore \text{eqn } DC \text{ is } y - 7 = \frac{2}{5}(x + 2)$$

$$y = \frac{2}{5}x + 7\frac{4}{5}$$

$$\text{at } C: 12 - x = \frac{2}{5}x + 7\frac{4}{5}$$

$$60 - 5x = 2x + 39$$

$$x = 3$$

$$\therefore C(3, 9)$$

$$\text{d} \quad \text{grad } AC = \frac{9-2}{3+4} = 1$$

$$\text{grad } AC \times \text{grad } BC = 1 \times -1 = -1$$

$$\therefore AC \text{ is perpendicular to } BC$$

$$\therefore \angle ACB = 90^\circ$$

$$8 \quad \text{a} \quad y - 4 = \frac{1}{3}(x + 3)$$

$$3y - 12 = x + 3$$

$$x - 3y + 15 = 0$$

$$\text{b} \quad (q, 7) \Rightarrow q - (3 \times 7) + 15 = 0$$

$$\therefore q = 6$$

$$(6, 7) \Rightarrow (5 \times 6) + 7p - 2 = 0$$

$$\therefore p = -4$$

$$10 \quad \text{a} \quad \text{grad} = \frac{6-2\sqrt{3}}{\sqrt{3}-1} = \frac{6-2\sqrt{3}}{\sqrt{3}-1} \times \frac{\sqrt{3}+1}{\sqrt{3}+1}$$

$$= \frac{6\sqrt{3}+6-6-2\sqrt{3}}{3-1} = \frac{4\sqrt{3}}{2}$$

$$= 2\sqrt{3}$$

$$\text{b} \quad l: y - 2\sqrt{3} = 2\sqrt{3}(x - 1)$$

$$y = 2\sqrt{3}x$$

$$\text{when } x = 0, y = 0$$

$$\therefore \text{passes through origin}$$

$$\text{c} \quad \text{perp grad} = -\frac{1}{2\sqrt{3}}$$

$$\therefore y - 2\sqrt{3} = -\frac{1}{2\sqrt{3}}(x - 1)$$

$$2\sqrt{3}y - 12 = -x + 1$$

$$x + 2\sqrt{3}y - 13 = 0$$

- 1 a grad of $y = 3 - 2x$ is -2
parallel grad = -2
- b $2x - 5y + 1 = 0 \Rightarrow y = \frac{2}{5}x + \frac{1}{5}$
grad of $y = \frac{2}{5}x + \frac{1}{5}$ is $\frac{2}{5}$
parallel grad = $\frac{2}{5}$
- c grad of $y = 3x + 4$ is 3
perp grad = $\frac{-1}{3} = -\frac{1}{3}$
- d $x + 2y - 3 = 0 \Rightarrow y = \frac{3}{2} - \frac{1}{2}x$
grad of $y = \frac{3}{2} - \frac{1}{2}x$ is $-\frac{1}{2}$
perp grad = $\frac{-1}{-\frac{1}{2}} = 2$
- 2 a grad of $y = 4x - 1$ is 4
parallel grad = 4
 $\therefore y - 7 = 4(x - 1)$
 $y = 4x + 3$
- b grad of $y = 6 - x$ is -1
perp grad = 1
 $\therefore y - 3 = x + 4$
 $y = x + 7$
- c grad of $x - 3y = 0$ is $\frac{1}{3}$
perp grad = -3
 $\therefore y + 2 = -3(x + 2)$
 $y = -3x - 8$
- 3 a grad of $2x - 3y + 5 = 0$ is $\frac{2}{3}$
parallel grad = $\frac{2}{3}$
 $\therefore y + 1 = \frac{2}{3}(x - 3)$
 $3y + 3 = 2x - 6$
 $2x - 3y - 9 = 0$
- b grad of $3x + 4y = 1$ is $-\frac{3}{4}$
perp grad = $\frac{4}{3}$
 $\therefore y - 5 = \frac{4}{3}(x - 2)$
 $3y - 15 = 4x - 8$
 $4x - 3y + 7 = 0$
- c grad of $3x + 5y = 6$ is $-\frac{3}{5}$
parallel grad = $-\frac{3}{5}$
 $\therefore y + 7 = -\frac{3}{5}(x + 4)$
 $5y + 35 = -3x - 12$
 $3x + 5y + 47 = 0$
- 4 a mid-point = $(\frac{0+8}{2}, \frac{4+0}{2})$
 $= (4, 2)$
grad = $\frac{0-4}{8-0} = -\frac{1}{2}$
perp grad = 2
 $\therefore y - 2 = 2(x - 4)$
 $y - 2 = 2x - 8$
 $2x - y - 6 = 0$
- b mid-point = $(\frac{2+4}{2}, \frac{7+1}{2})$
 $= (3, 4)$
grad = $\frac{1-7}{4-2} = -3$
perp grad = $\frac{1}{3}$
 $\therefore y - 4 = \frac{1}{3}(x - 3)$
 $3y - 12 = x - 3$
 $x - 3y + 9 = 0$
- c mid-point = $(\frac{-3+9}{2}, \frac{-2+1}{2})$
 $= (3, -\frac{1}{2})$
grad = $\frac{1+2}{9+3} = \frac{1}{4}$
perp grad = -4
 $\therefore y + \frac{1}{2} = -4(x - 3)$
 $2y + 1 = -8x + 24$
 $8x + 2y - 23 = 0$
- 5 a grad $AB = \frac{-1+3}{4+6} = \frac{1}{5}$
grad $BC = \frac{4+1}{3-4} = -5$
- b grad $AB \times$ grad $BC = \frac{1}{5} \times -5 = -1$
 $\therefore AB$ is perpendicular to BC
 $\therefore \angle ABC = 90^\circ$
- 6 $2x - 3y + 5 = 0 \Rightarrow y = \frac{2}{3}x + \frac{5}{3} \therefore$ grad = $\frac{2}{3}$
 $3x + ky - 1 = 0 \Rightarrow y = -\frac{3}{k}x + \frac{1}{k} \therefore$ grad = $-\frac{3}{k}$
perp $\therefore \frac{2}{3} \times -\frac{3}{k} = -1$
 $k = 2$

- 7 a $\text{grad} = \frac{7-5}{1+5} = \frac{1}{3}$
 $\therefore y - 5 = \frac{1}{3}(x + 5)$
 $3y - 15 = x + 5$
 $x - 3y + 20 = 0$
- b $M = \left(\frac{-5+1}{2}, \frac{5+7}{2}\right) = (-2, 6)$
 $\text{grad } OM = \frac{6-0}{-2-0} = -3$
 $\text{grad } l \times \text{grad } OM = \frac{1}{3} \times (-3) = -1$
 $\therefore OM$ is perpendicular to l
- 8 a $p \Rightarrow y = \frac{3}{4}x + 2 \therefore \text{grad} = \frac{3}{4}$
parallel $\text{grad} = \frac{3}{4}$
 $\therefore y - 5 = \frac{3}{4}(x - 8)$
 $y = \frac{3}{4}x - 1$
- b $\text{perp grad} = -\frac{4}{3}$
 $\therefore y - 6 = -\frac{4}{3}(x + 4)$
 $3y - 18 = -4x - 16$
 $4x + 3y - 2 = 0$
- c $q \Rightarrow 3x - 4y - 4 = 0$
 $\Rightarrow 9x - 12y - 12 = 0$
 $r \Rightarrow 16x + 12y - 8 = 0$
adding, $25x - 20 = 0$
 $x = \frac{4}{5}$
 $\therefore \left(\frac{4}{5}, -\frac{2}{5}\right)$
- 9 a $\text{grad} = \frac{-5-7}{1+3} = -3$
 $\therefore y - 7 = -3(x + 3)$
 $3x + y + 2 = 0$
- b $\text{perp grad} = \frac{1}{3}$
 $\therefore l_2: y - 6 = \frac{1}{3}(x - 4)$
 $3y - 18 = x - 4$
 $x - 3y + 14 = 0$
 $l_1 \Rightarrow 9x + 3y + 6 = 0$
adding, $10x + 20 = 0$
 $x = -2$
 \therefore pt of intersection $(-2, 4)$
 \therefore dist from origin $= \sqrt{4+16} = \sqrt{20} = 2\sqrt{5}$