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6.3 Intersection of straight lines and circles.

1)a) $y=0$

$$(x-2)^2 + (0-4)^2 = 52$$

$$(x-2)^2 + (-4)^2 = 52$$

$$(x-2)^2 = 52 - 16 = 36$$

$$x-2 = \sqrt{36} \rightarrow 6$$

$$x = 6+2$$

$$x = 8 \quad (8, 0)$$

b) $x=0$

$$(0-2)^2 + (y-4)^2 = 52$$

$$(-2)^2 + (y-4)^2 = 52$$

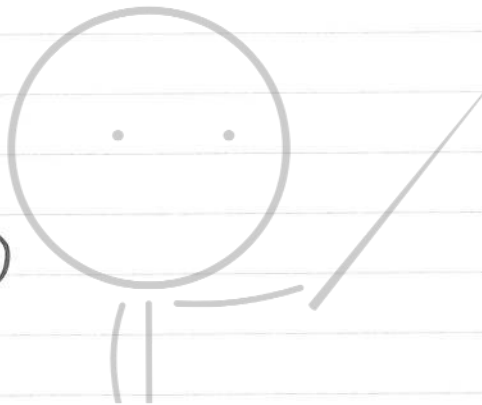
$$4 + (y-4)^2 = 48$$

$$(y-4)^2 = 48$$

$$y-4 = \sqrt{48} + 4$$

$$y = -4$$

$$(0, -4)$$



2)a) $2x + y = 7$

$$y = -2x + 7$$

$$(x-1)^2 + (-2x+7)^2 = 50$$

$$x^2 - 2x + 1 + 4x^2 - 28x + 49 = 50$$

$$5x^2 - 30x + 50 = 50$$

$$5x^2 - 30x = 0$$

$$x = 0 \quad \text{or} \quad x = 6$$

$$y = -2(0) + 7$$

$$y = -2(6) + 7$$

$$y = 7$$

$$y = -5$$

$$(0, 7)$$

$$(6, -5)$$

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3)a) $2x + y - 15 = 0$

$$y = -2x + 15$$

$$(x-1)^2 + (-2x+15-4)^2 = 50$$

$$(x-1)^2 + (-2x+11)^2 = 50$$

$$x^2 - 2x + 1 + 4x^2 - 44x + 121 = 50$$

$$5x^2 - 46x + 121 = 50 \rightarrow 5x^2 - 46x + 71 = 0 \rightarrow x^2 - 8x - 16 = 0$$

$$b^2 - 4ac$$

$$(-8)^2 - 4(1)(-16) = 0$$

meets at one point.

b) $x^2 - 8x + 16 = 0$

$$x^2 - 8x + 16 = 0$$

$$x = 4$$

$$2(4) + y - 15 = 0$$

$$8 + y = 15$$

$$y = 7$$

$$(4, 7)$$

4) $y = 2x + 6$

$$(x-5)^2 + (2x+6-2)^2 = 30$$

$$(x-5)^2 + (2x+4)^2 = 30$$

$$x^2 - 10x + 25 + 4x^2 + 16x + 16 = 30$$

$$= 5x^2 + 6x + 41 = 30$$

$$= 5x^2 + 6x + 11 = 0$$

$$a = 5$$

$$b = 6$$

$$c = 11$$

$$b^2 - 4ac$$

$$(6)^2 - 4(5)(11)$$

$$= 36 - 220 = -184$$

$b^2 - 4ac < 0$ does not meet the circle.

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5) $x^2 + y^2 = 100$

Centre is at origin and radius is at 10.

b) $3x + y - 10 = 0$

$$y = -3x + 10$$

$$x^2 + (-3x + 10)^2 = 100$$

$$x^2 + 9x^2 - 60x + 100 = 100$$

$$10x^2 - 60x = 0$$

$$x = 6 \quad \text{or} \quad x = 0$$

$$3(6) + y = 10$$

$$3(0) + y = 10$$

$$18 + y = 10$$

$$0 + y = 10$$

$$y = -8$$

$$y = 10$$

$$(6, -8)$$

$$(0, 10)$$

$$6) a) y = x + k$$

$$x^2 + (x+k)^2 - 6x - 23 = 0$$

$$x^2 + x^2 + 2kx + k^2 - 6x - 23 = 0$$

$$2x^2 + 2kx + 6x + k^2 - 23 = 0$$

$$2x^2 + 2(k-3)x + k^2 - 23 = 0$$

$$b) b^2 - 4ac = 0 \quad a = 2$$

$$(2k-6)^2 - 4(2)(k^2-23) \quad b = 2k-6$$

$$4k^2 - 24k + 36 - 8k^2 + 184 = k^2 - 23$$

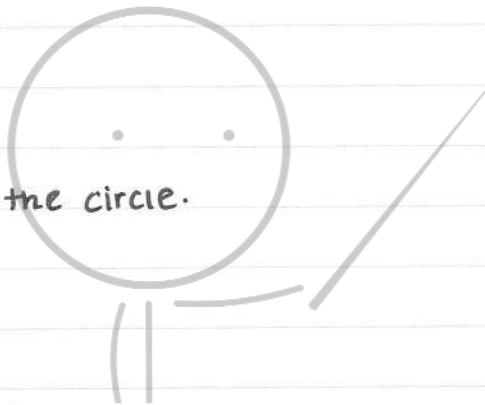
$$\underline{-4k^2 - 24k + 220 = 0}$$

$$-4$$

$$k^2 + 6k - 55 = 0$$

$$k = 5 \quad \text{or} \quad k = -11$$

c) The line is a tangent to the circle.



$$7) a) x + 11y = 119$$

$$x = -11y + 119$$

$$(-11y + 119 - 3)^2 + (y - 5)^2 = 61$$

$$(-11y + 116)^2 + (y - 5)^2 = 61$$

$$121y^2 - 2552y + 13456 + y^2 - 10y + 25 = 61$$

$$122y^2 - 2562y + 13481 = 61$$

$$122y^2 - 2562y + 13420 = 0$$

$$y^2 - 21y + 110 = 0$$

$$y = 11 \quad y = 10$$

$$x + 11(11) = 119$$

$$x + 11(10) = 119$$

$$x = 119 - 121 = -2$$

$$x = 119 - 110 = 9$$

$$\left(\begin{matrix} -2 \\ 11 \end{matrix} \right)$$

$$\text{or} \left(\begin{matrix} 9 \\ 10 \end{matrix} \right)$$

$$b) \text{ gradient } l = \frac{\Delta y}{\Delta x} = \frac{11-10}{-2-9} = \frac{1}{-11}$$

$$l_2 m = 11$$

$$y - 10.5 = 11(x - 3.5)$$

$$y = 11x - 28$$

$$\text{midpoint} = \left(\frac{-2+9}{2}, \frac{11+10}{2} \right) = \frac{7}{2}, \frac{21}{2} \cdot \left(\begin{matrix} 3.5 \\ 10.5 \end{matrix} \right)$$

7) c) Centre: (3, 5)

$$x = 3$$

$$y = 11(3) - 28$$

$$y = 33 - 28$$

$$y = 5$$

Passes through centre.

8) $x^2 + y^2 - 10x + 8y + 25 = 0$

$$x^2 - 10x + y^2 + 8y = -25$$

$$(x-5)^2 - 25 + (y+4)^2 - 16 = -25$$

$$(x-5)^2 + (y+4)^2 = 16$$

Centre: (5, -4) radius: $\sqrt{16} = 4$

$$y = kx$$

$$x^2 + (kx)^2 - 10x + 8(kx) + 25 = 0$$

$$x^2 + k^2x^2 - 10x + 8kx + 25 = 0$$

$$(1+k^2)x^2 + (8k-10)x + 25 = 0$$

a

b

c

$$b^2 - 4ac > 0$$

$$(8k-10)^2 - 4(1+k^2)(25) > 0$$

$$-36k^2 - 160k > 0$$

$$36k^2 + 160k < 0$$

$$4k(9k + 40) < 0$$

$$k > 0$$

$$k = -40/9$$

$$-40/9 < k < 0$$

9) a) (4, 7)

$$x + 3y = k$$

$$4 + 3(7) = k$$

$$4 + 21 = 25$$

$$k = 25$$

9)b) (4,7)

$$(4-p)^2 - (7-4)^2 = 45$$

$$(4-p)^2 - (3)^2 = 45$$

$$(4-p)^2 + 9 = 45$$

$$(4-p)^2 = 36$$

$$4-p = \sqrt{36} = \pm 6$$

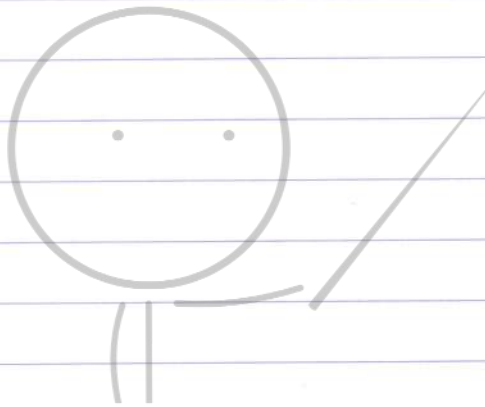
$$4-p = 6$$

$$4-p = -6$$

$$p = -2$$

$$p = 10$$

p is 10 or -2



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