Name:

Exam Style Questions

Simultaneous equations linear and non-linear

Corbettmaths

Ensure you have: Pencil, pen, ruler, protractor, pair of compasses and eraser
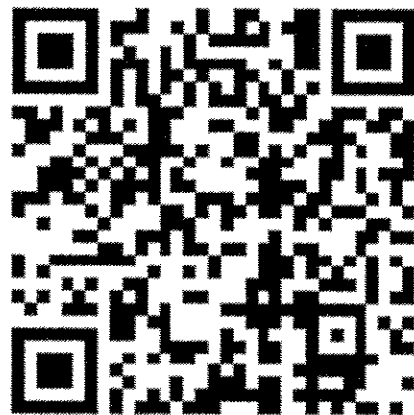
You may use tracing paper if needed

Guidance

1. Read each question carefully before you begin answering it.
2. Don't spend too long on one question.
3. Attempt every question.
4. Check your answers seem right.
5. Always show your workings

1. Solve the equations

$$x^2 + y^2 = 20 \quad -\text{①}$$
$$x + y = 6 \quad -\text{②}$$

$x = 6 - y$ making x the subject of ② & then sub into ①

$$(6-y)^2 + y^2 = 20$$
$$(6-y)(6-y) + y^2 = 20$$
$$36 - 6y - 6y + y^2 + y^2 = 20$$
$$2y^2 - 12y + 16 = 0$$
$$y^2 - 6y + 8 = 0$$
$$(y - 2)(y - 4) = 0$$
$$y = 2 \text{ or } y = 4$$

when $y = 2$
$$x + 2 = 6$$
$$x = 4$$

when $y = 4$
$$x + 4 = 6$$
$$x = 2$$

$x = 2$ and $y = 4$
or $x = 4$ and $y = 2$

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2. Solve the equations

$$xy = 24$$
$$x = y - 2$$

$$(y-2)y = 24$$
$$y(y-2) = 24$$
$$y^2 - 2y = 24$$
$$y^2 - 2y - 24 = 0$$
$$(y - 6)(y + 4) = 0$$
$$y = 6 \text{ or } y = -4$$

when $y = 6$
$$x = 6 - 2$$
$$x = 4$$

when $y = -4$
$$x = -4 - 2$$
$$= -6$$

$x = 4$ and $y = 6$
or $x = -6$ and $y = -4$

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3. Solve the simultaneous equations

$$2x - y = 7$$
$$xy = 15$$

$2x = y + 7$

$y = 2x - 7$

$x(2x - 7) = 15$

$2x^2 - 7x = 15$

$2x^2 - 7x - 15 = 0$

$(2x + 3)(x - 5) = 0$

$2x + 3 = 0 \qquad x = 5$

$2x = -3$

$x = -1.5$

when $x = 5$

$2x - y = 7$

$10 - y = 7$

$y = 3$

when $x = -1.5$

$2x - y = 7$

$-3 - y = 7$

$y = -10$

$x = 5$ and $y = 3$

or

$x = -1.5$ and $y = -10$

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4. Solve the equations

$$x^2 + y^2 = 17$$
$$x + 4y = 0$$

$x = -4y$

$(-4y)^2 + y^2 = 17$

$16y^2 + y^2 = 17$

$17y^2 = 17$

$y^2 = 1$

$y = 1$ or -1

when $y = 1$

$x + 4 = 0$

$x = -4$

when $y = -1$

$x - 4 = 0$

$x = 4$

$x = -4$ and $y = 1$

or

$x = 4$ and $y = -1$

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5. Solve the equations

$$x + 2y = 3$$
$$x^2 + 3xy = 10$$

$$x = 3 - 2y$$

$$(3-2y)^2 + 3(3-2y)y = 10$$

$$(3-2y)(3-2y) + 3y(3-2y) = 10$$

$$9 - 6y - 6y + 4y^2 + 9y - 6y^2 = 10$$

$$-2y^2 - 3y + 9 = 10$$

$$-2y^2 - 3y - 1 = 0$$

$$0 = 2y^2 + 3y + 1$$

$$(2y + 1)(y + 1) = 0$$

$$2y = -1 \qquad y = -1$$
$$y = -\tfrac{1}{2}$$

when $y = -\tfrac{1}{2}$
$$x - 1 = 3$$
$$x = 4$$

when $y = -1$
$$x - 2 = 3$$
$$x = 5$$

$$x = 4 \ \& \ y = -\tfrac{1}{2}$$

or $x = 5 \ \& \ y = -1$

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6. Solve the equations

$$x^2 + y^2 = 45$$
$$5x - 3y = 21$$

Give your answers to 1 decimal place.

$$5x = 21 + 3y$$
$$3y = 5x - 21$$
$$y = \tfrac{5}{3}x - 7$$

$$x^2 + \left(\tfrac{5}{3}x - 7\right)^2 = 45$$

$$x^2 + \left(\tfrac{5}{3}x - 7\right)\left(\tfrac{5}{3}x - 7\right) = 45$$

$$x^2 + \tfrac{25}{9}x^2 - \tfrac{35}{3}x - \tfrac{35}{3}x + 49 = 45$$

$$\tfrac{34}{9}x^2 - \tfrac{70}{3}x + 4 = 0 \quad \times 9$$

$$34x^2 - 210x + 36 = 0$$
$$17x^2 - 105x + 18 = 0$$

$$a = 17 \qquad b = -105 \qquad c = 18$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{105 \pm \sqrt{11025 - 1224}}{34}$$

$$x = \frac{105 \pm \sqrt{9801}}{34}$$

$$x = \frac{105 \pm 99}{34}$$

$$x = \frac{105 + 99}{34} \quad \text{or} \quad \frac{105 - 99}{34}$$
$$= 6 \qquad \qquad \text{or } 0.176\ldots$$

$$y = \tfrac{5}{3}x - 7 \qquad \qquad y = \tfrac{5}{3}x - 7$$
$$\qquad \qquad \qquad y = -6.7\ldots$$

$$x = 0.2 \ \& \ y = -6.7$$

or

$$x = 6 \ \& \ y = 3$$

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7. Solve the equations

$$2x + y = 11$$
$$2x^2 - y^2 = 23$$

$$y = 11 - 2x$$

$$2x^2 - (11 - 2x)^2 = 23$$

$$2x^2 - (11 - 2x)(11 - 2x) = 23$$

$$2x^2 - (121 - 44x + 4x^2) = 23$$

$$2x^2 - 121 + 44x - 4x^2 = 23$$

$$-2x^2 - 121 + 44x = 23$$

$$0 = 2x^2 - 44x + 144$$

$$0 = x^2 - 22x + 72$$

$$0 = (x - 4)(x - 18)$$

$$x = 4$$

$$8 + y = 11$$

$$y = 3$$

$$x = 18$$

$$36 + y = 11$$

$$y = -25$$

$$x = 4 \text{ and } y = 3$$
$$\text{or} \quad x = 18 \text{ and } y = -25$$

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8. Solve the equations

$$x^2 - y^2 = 7$$
$$2y = 2 + x$$

$$x = 2y - 2$$

$$(2y - 2)^2 - y^2 = 7$$

$$(2y - 2)(2y - 2) - y^2 = 7$$

$$4y^2 - 8y + 4 - y^2 = 7$$

$$3y^2 - 8y - 3 = 0$$

$$(3y + 1)(y - 3) = 0$$

$$y = -\tfrac{1}{3} \qquad y = 3$$

$$y = 3$$

$$6 = 2 + x$$

$$x = 4$$

$$y = -\tfrac{1}{3}$$

$$-\tfrac{2}{3} = 2 + x$$

$$-2\tfrac{2}{3} = x$$

$$x = 4 , \quad y = 3$$
$$\text{or} \quad x = -2\tfrac{2}{3} , \quad y = -\tfrac{1}{3}$$

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9. Solve the equations

$$x^2 + y^2 = 25$$
$$x + y = 7$$

$$x = 7 - y$$

$$(7-y)^2 + y^2 = 25$$
$$49 - 14y + y^2 + y^2 = 25$$
$$2y^2 - 14y + 24 = 0$$
$$y^2 - 7y + 12 = 0$$
$$(y-3)(y-4) = 0$$
$$y = 3 \text{ or } y = 4$$

$$x = 4, \; y = 3$$
$$\text{or}$$
$$x = 3, \; y = 4$$

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10. Solve the equations

$$y = x^2 - 5$$
$$y = 2x - 2$$

$$x^2 - 5 = 2x - 2$$
$$x^2 - 2x - 3 = 0$$
$$(x+1)(x-3) = 0$$
$$x = -1 \text{ or } x = 3$$

$$x = -1$$
$$\& \; y = -4$$
$$\text{or}$$
$$x = 3$$
$$y = 4$$

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