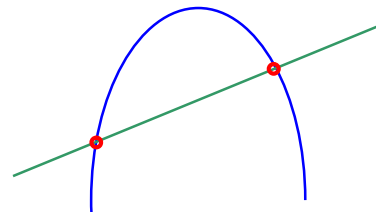


4. SIMULTANEOUS EQUATIONS

IMPORTANT NOTES:

*** Usually asked in PAPER 2, Question 1.



- (i) Characteristics of simultaneous equations:
 - (a) Involves TWO variables, usually in x and y .
 - (b) Involves TWO equations : one **linear** and the other **non-linear**.
- (ii) “Solving simultaneous equations” means finding the values of x and corresponding y which **satisfy BOTH the equations**.
- (iii) Methods of solving ::
 - (a) Starting from the LINEAR equation, express y in terms of x (or x in terms of y).
 - (b) Substitute y (or x) into the second equation (which is non-linear) to obtain a quadratic equation in the form $ax^2 + bx + c = 0$.
 - (c) Solve the quadratic equation by factorisation or by using the FORMULA $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.
- (iv) If the quadratic equation **CANNOT** be factorised, candidates will be asked to “give your answer correct to 4 significant figures” or “give your answer correct to three decimal places”.

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(I) Expansion of $(ax+b)^2$

Test yourself :

0.	$(x + a)^2 = x^2 + 2ax + a^2$	1.	$(x + 3)^2 =$	2.	$(x + 4)^2 =$
3.	$(x + 1)^2 =$	4.	$(x - 3)^2 =$	5.	$(x - 2)^2 =$
6.	$(2x + 1)^2 =$	7.	$(x + 5)^2 =$	8.	$(3x + 2)^2 =$
9.	$(4x - 5)^2 =$	10.	$(x - 6)^2 =$	11.	$(2x - 3)^2 =$
12.	$(2 + x)^2 =$	13.	$(3 - 2x)^2 =$	14.	$(1 - 3x)^2 =$
15.	$\left(\frac{x - 2}{2}\right)^2 =$	16.	$\left(\frac{4 - x}{2}\right)^2 =$	17.	$\left(\frac{5 - 3x}{3}\right)^2 =$
18.	$\left(\frac{3 - 2x}{2}\right)^2 =$	19.	$\left(\frac{1 - 2x}{3}\right)^2 =$	20.	$\left(\frac{3x - 4}{2}\right)^2 =$

(II) Expansion of $(ax + b)(cx + d)$

Test yourself:

0.	$(x + 2)(x - 3) = x^2 - 3x + 2x - 6$ $= x^2 - x - 6$	1.	$(x + 4)(x - 1) =$	2.	$(x + 3)(x + 5) =$
3.	$(x + 1)(2x - 3) =$	4.	$(x - 3)(2x + 1) =$	5.	$(3x - 2)(x + 3) =$
6.	$(2x + 1)(x - 2) =$	7.	$(2x + 5)(x - 2) =$	8.	$(x + 2)(5x - 3) =$
9.	$(2x - 3)(2x + 3) =$	10.	$(3x - 2)^2 =$	11.	$(2x - 3)(2 - x) =$
12.	$(x - 3)(x + 3) =$	13.	$(2x - 1)(x + 2) =$	14.	$(2x + 3)(2 + x) =$
15.	$(2x - 3)(2x + 4) =$	16.	$(3x - 2)(x - 5) =$	17.	$(x - 3)(2 - 3x) =$
18.	$(x - 4)(2x) =$	19.	$2(3x + 2)(x - 1) =$	20.	$3x(-3 - 2x) =$

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(III) To express y in terms of x

Test yourself:

Eg..	$2x + y = 4$ $y = 4 - 2x$	1.	$3x + y = 6$ $y =$	2.	$x + y = 3$ $y =$
Eg..	$3x - y = 6$ $3x = 6 + y$ $3x - 6 = y$ $y = 3x - 6$	3.	$2x - y = 3$	4.	$x - y = 6$
Eg..	$x + 2y = 2$ $2y = 2 - x$ $y = \frac{2-x}{2}$	5.	$x + 3y = 9$	6.	$3x + 4y = 6$
Eg..	$3x - 2y = 4$ $3x = 4 + 2y$ $3x - 4 = 2y$ $y = \frac{3x-4}{2}$	7.	$2x - 3y = 2$	8.	$x - 4y = 1$
9.	$3y - x = 5$	10.	$x - 2y = 5$	11.	$4x + 3y = 6$

(III) (b) Express x in terms of y

Eg..	$x + 3y = 2$ $x = 2 - 3y$	1.	$2y + x = 5$ $x =$	2.	$x + y = 1$ $x =$
Eg..	$4y - x = 3$ $4y = 3 + x$ $4y - 3 = x$ $x = 4y - 3$	3.	$y - x = 3$	4.	$x - y = 4$
Eg..	$3x + 2y = 4$ $3x = 4 - 2y$ $x = \frac{4-2y}{3}$	5.	$4x + 3y = 2$	6.	$2x + 4y = 3$
Eg..	$3y - 2x = 1$ $3y = 1 + 2x$ $3y - 1 = 2x$ $x = \frac{3y-1}{2}$	7.	$2x - 3y = 2$	8.	$3x - 4y = 6$
9.	$3y - 6x = 2$	10.	$\frac{1}{2}x - y = 2$	11.	$-2x + y = 4$
12.	$5x + 2y - 3 = 0, y = ?$	13.	$3y - 2x - 6 = 0, x = ?$	14.	$-3x - 4y = 2, y = ??$

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(IV) To express in the form of a general Quadratic Equation : $ax^2+bx + c = 0$

	EXAMPLE	EXERCISE
C1.	$x(3-x) = -18$ $3x - x^2 = -18$ $0 = x^2 - 3x - 18$ $x^2 - 3x - 18 = 0$	L1. $x(5-2x) = 2$
L2.	$(x+2)(x-2) = 21$	L3. $(x-1)^2 = 9$
L4.	$(3x+2)(3x-2) = 32$	L5. $(x-2)x + (x-2)^2 = 3$
L6.	$(x-2)^2 - (x-2) = 6$	L7. $x(x-1) + (x-1)^2 = 5$
L8.	$x(2x+1) + x - 4 = 0$	L9. $(4-y)^2 - 2y^2 = 2y(4-y)$
L10.	$2x(3-x) + (3-x)^2 = 1$	L11. $x^2 - 2(3-x) - (3-x)^2 + 2 = 0$
L12.	$3\left(\frac{1-3x}{2}\right)^2 + 4x\left(\frac{1-3x}{2}\right) - x^2 = 6$	L13. $\frac{2}{3x} + \frac{1}{3-3x} = 2$
L14.	$\frac{x}{2x-1} + (2x-1) = 3$	L15. $3x - \left(\frac{5-x}{2}\right)^2 = x\left(\frac{5-x}{2}\right)$

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(V) Solving Quadratic Equations $ax^2+bx+c=0$ by factorisation

	EXAMPLE	EXERCISE
C1.	$x(3-x) = -10$ $3x - x^2 = -10$ $0 = x^2 - 3x - 10$ $x^2 - 3x - 10 = 0$ $(x+2)(x-5) = 0$ $\underline{x = -2, x = 5}$	L1. $x(5-x) = 4$ Ans: $x = 1, 4$
L2.	$x(8-2x) = -10$ Ans: $x = -1, 5$	L3. $x + (x-1)^2 = 3$ Ans: $x = -1, 2$
L4.	$y(2y+1) + y = 4$ Ans: $y = -2, 1$	L5. $(4-y)^2 + y^2 - (4-y)y = 31$ Ans: $y = -1, 5$
L6.	$2x^2 + (2-x)^2 = 8$ Ans: $x = -2/3, 2$	L7. $x^2 - 2(8-x) + (8-x)^2 = 24$ Ans: $x = 3, 4$
L8.	$(3-x)^2 + x^2 = 29$ Ans: $x = -2, 5$	L9. $x + \frac{5-x}{2} = 2x \left(\frac{5-x}{2} \right)$ Ans: $x = -1/2, 5$

To solve Quadratic Equations $ax^2 + bx + c = 0$

I. By factorisation

- Can only be used for quadratic expression which can be factored.

	EXAMPLE	EXERCISE
C1.	Solve the quadratic equation $x^2 + 5x + 6 = 0$. Ans: : $x^2 + 5x + 6 = 0$ $(x + 2)(x + 3) = 0$ $x + 2 = 0$ or $x + 3 = 0$ $x = -2$ or $x = -3$	L1. Solve $x^2 - 4x - 5 = 0$. Ans: $-1, 5$
C2.	Solve the quadratic equation $2x(x - 1) = 6$. Ans: : $2x(x - 1) = 6$ $2x^2 - x - 6 = 0$ $(2x + 3)(x - 2) = 0$ $2x + 3 = 0$ atau $x - 2 = 0$ $x = -\frac{3}{2}$ atau $x = 2$	L2. Solve $x(1 + x) = 6$. Ans: $-3, 2$
L3.	Solve $(x - 3)^2 = 1$. Ans: $2, 4$	L4. Solve $1 + 2x^2 = 5x + 4$. Ans: $1, 3/2$
L3.	Solve $(2x - 1)^2 = 2x - 1$. Ans: $1/2, 1$	L4. Solve $5x^2 - 45 = 0$. Ans: $-3, 3$
L5.	Solve $(x - 3)(x + 3) = 16$. Ans: $-5, 5$	L6. Solve $3 + x - 4x^2 = 0$. Ans: $-3/4, 1$
L7.	Solve $x(x + 2) = 24$. Ans: $-6, 4$	L8. Solve $2(x^2 - 9) = 5x$. Ans: $-2, 9/2$

To Solve Quadratic Equations $ax^2 + bx + c = 0$

III. By using formula

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

	EXAMPLE	EXERCISE
C1.	<p>Solve $2x^2 - 8x + 7 = 0$ using formula, give your answer correct to 4 significant figures.</p> <p style="text-align: center;">a = 2, b = -8, c = 7</p> $x = \frac{-(-8) \pm \sqrt{(-8)^2 - 4(2)(7)}}{2(2)}$ $= \frac{8 \pm \sqrt{8}}{4}$ <p style="text-align: center;">= 2.707 or 1.293</p>	<p>L1. By using the formula, solve $2x^2 - 12x + 5 = 0$ correct to 4 s.f.</p> <p style="text-align: right;">(Ans : 5.550, 0.4505)</p>
C2.	<p>Solve $2x(2 - 3x) = -5$ using the formula, give your answer correct to 2 decimal places</p> <p style="text-align: center;">$2x(2 - 3x) = -5$ $4x - 6x^2 = -5$ $6x^2 - 4x - 5 = 0$ a = , b = , c =</p> <p>x =</p> <p style="text-align: right;">(Ans : 1.31, -0.64)</p>	<p>L2. By using the formula, solve $3 - x^2 = -3(4x - 3)$ correct to 2 decimal places</p> <p style="text-align: right;">(Ans: 0.52, 11.48)</p>
L3.	<p>Solve $x(2x - 1) = 2$ by using formula give your answer correct to 2 decimal places.</p> <p style="text-align: right;">(Ans : 1.28, -0.78)</p>	<p>L4. Solve the quadratic equation $2x(x - 4) = (1 - x)(x + 2)$. Write your answer correct to four significant figures.</p> <p style="text-align: right;">(SPM 2003)</p> <p style="text-align: right;">(Ans : 2.591, -0.2573)</p>
L5.	<p>Solve $x^2 - 4x = 2$ using formula, give your answer correct to 4 s.f.</p> <p style="text-align: right;">(Ans : 4.449, -0.4495)</p>	<p>L6. Solve the quadratic equation $x(x - 4) = (3 - x)(x + 3)$. Write your answer correct to two decimal places.</p> <p style="text-align: right;">(Ans : 3.35, -1.35)</p>

