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TEACHING & LEARNING

ADDITIONAL MATHEMATICS

FORM 4

SIMULTANEOUS EQUATIONS

CHAPTER 4

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Prepared by :
Additional Mathematics Department
Sek Men Sains Muzaffar Syah Melaka

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Additional Mathematics – Form 4
Chapter 4 – Simultaneous Equations

Learning Objectives

1. Solve simultaneous equations in two unknowns: one linear equation and one non-linear equation.
 - 1.1 Solve simultaneous equations using the substitution method.
 - 1.2 Solve simultaneous equations involving real-life situations.

1.1 Simultaneous linear and non-linear equations in two variables

Step to solve the simultaneous equations

- i. Identify the linear equation
- ii. Make one of the variables the subject of the equation
- iii. Substitute this variable in the second equation, giving a quadratic equation in one variable.
- iv. Solve as a quadratic equation.

Activity 1

State whether each of the following equation are linear or non-linear equation.

Equation	Linear/non-linear
1. $x - 2y = 7$	
2. $x^2 + 5y^2 = 49$	
3. $x(y - 2x) = 1$	
4. $2x + 3y = 14$	
5. $x^2 + xy + y^2 = 7$	
6. $\frac{4}{x} + \frac{15}{y} = 5$	
7. $x - 2y = 2$	
8. $xy = 4$	
9. $y = 2x + 3$	
10. $y - x^2 = 2x$	

Example 1

Solve the following simultaneous equations :

$$\begin{aligned} x + y &= 6 \\ 2x^2 + y^2 &= 27 \end{aligned}$$

Example 2 [$x = 12.19$, $y = 0.55$, $x = 5.14$, $y = - 1.22$]

Solve the following simultaneous equations and give the answer correct to two decimal places.

$$\begin{aligned} \frac{x}{2} + 3y^2 &= 7 \\ x - 4y &= 10 \end{aligned}$$

Exercise 1 [Ans $x = -2$ $y = 5$, $x = 5$ $y = -2$]

Exercise 2 [$x = -1.975$, $y = 2.171$, $x = -10.02$ $y = 0.829$]

a) Solve the following simultaneous equations :

$$\begin{aligned}x + y &= 3 \\x^2 + y^2 &= 29\end{aligned}$$

b) Solve the following simultaneous equations and give the answer correct to two decimal places.

$$\begin{aligned}\frac{x}{3} - 2y &= -7 \\y^2 - xy &= 9\end{aligned}$$

c). $x + y = 7$

$$\frac{4}{x} + \frac{15}{y} = 5 \text{ Ans } [x = 5, -6 \quad y = -3, \frac{13}{3}]$$

d) $x^2 - y + 2y^2 = 12$

$$3x + 2y = 12 \text{ [ans 19. } x = \frac{36}{11}, 3 \quad y = \frac{12}{11}, \frac{3}{2}]$$

1.2 Solve simultaneous equations involving real-life situations

Real-life problems involving two unknown can be solved as described in the following steps

1. Identify the two unknowns described in the given problem. Then choose a suitable letter to represent each unknown.
2. Form two equations using these two letters based on the information described in the problem.
3. Solve the simultaneous equations accordingly and obtain the final answer as required

Example 3

a) Find the coordinate of the intersection points of the curve $\frac{x}{y} - \frac{2y}{x} = 1$ and the straight line $2x + y = 3$

Example 4

b) Given that the perimeter of a rectangle is 34 cm and its area is 72 cm^2 . Find the length and the breadth of the rectangle. [9 and 8]

Exercise 3

The straight line $x - y = 5$ intersects the curve $x^2 + 2xy + y^2 = 9$ at point P and point Q. Find the coordinates of P and Q [P(4,-1) , Q (1,-4) or P(1,-4) , Q (4,-1)]

Exercise 4

Given that the perimeter and the area of a rectangular field are 80 m and 396 m^2 respectively. Find the length and the breadth of the field. [22 , 18]

SPM Questions

SPM 2003 [$x = -2$, $y = 0$, $x = -3$, $y = 4$]
 Solve the simultaneous equations $4x + y = -8$ and
 $x^2 + x - y = 2$.

SPM 2004 [$m = 0.606$, $p = 2.606$, $m = -6.606$, $p = -4.606$]
 Solve the simultaneous $p - m = 2$ and $p^2 + 2m = 8$
 Give your answer correct to three decimal places.

SPM 2005

Solve the following simultaneous equations:
 $3x + 2y = 1$, $3x^2 - y^2 = 5x + 3y$ (camb) [(1,-1) , -7/3,4)

Enrichment exercise – Simultaneous Equations (Past years SPM questions)

- Solve the equations $4x + y + 8 = x^2 + x - y = 2$.
- Solve the simultaneous equations $\frac{x}{3} + \frac{2}{y} = 4$ and $x + 6y = 3$

3.

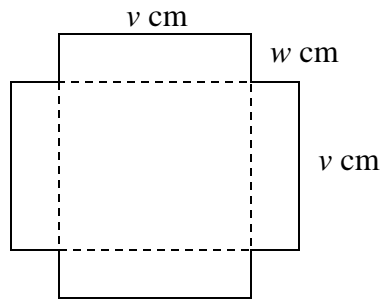


Figure 4

Figure 4 shows the net of the opened box in the shape of a cuboid. If the perimeter of the net of the box is 48 cm and the sum of the surface area is 135 cm^2 , find the possible value of v and w .

- Given the curve $y^2 = 8(1 - x)$ and the straight line $\frac{y}{x} = 4$. Without plotting a graph, calculate the intersection points for both graphs.
- Solve the simultaneous equations $2x + 3y = 9$ and $\frac{6y}{x} - \frac{x}{y} = -1$
- Solve the simultaneous equations $\frac{x}{3} - \frac{y}{2} + 3 = 0$ and $\frac{3}{x} + \frac{2}{y} - \frac{1}{2} = 0$.
- Solve the simultaneous equations $3x - 5 = 2y$ and $y(x + y) = x(x + y) - 5$
- Given that $M = 2x - y$, $N = 3x + 1$ and $R = xy - 8$. Find the values of x and y such that $2M = N = R$.

9.

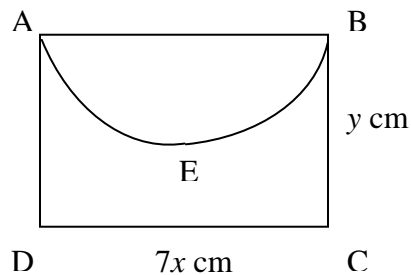


Figure 3

In figure 3, ABCD is a piece of paper in the shape of a rectangle with its area are 28 cm^2 . ABE with the shape of semicircle is cut from the paper. Perimeter of the left parts are 26 cm. Find the integer values of x and y . (Used $\pi = \frac{22}{7}$)

10. Solve the simultaneous equations below and give your answers correct to two decimal places,

$$x - 4y = 9$$

$$3y^2 = 7 - \frac{x}{2}$$

11. Solves the simultaneous equations $4x + y = -8$ and $x^2 + x - y = 2$.

12. Solve the simultaneous equations $p - m = 2$ and $p^2 + 2m = 8$. Give your answers correct to three decimals places.

13. Solve the simultaneous equations $x + \frac{1}{2}y = 1$ and $y^2 - 10 = 2x$.

Enrichment - Answer

$$1. x = -1, -4 \quad y = -2, 10$$

$$2. x = 0, 15 \quad y = \frac{1}{2}, -2$$

$$3. w = \frac{3}{2} \text{ cm}, v = 9 \text{ cm}$$

$$4. (\frac{1}{2}, 2) \text{ and } (-1, -4)$$

$$5. x = 3, x = 18$$

$$y = 1, y = -9$$

$$6. x = 9, x = -6$$

$$y = 12, y = 2$$

$$7. x = 3, y = 2$$

$$8. x = -2, y = -\frac{3}{2}$$

$$x = 9, y = 4$$

$$9. x = 4, y = 9$$

$$10. x = 11.56, x = 3.76$$

$$y = 0.64, y = -1.31$$

$$11. x = -2, -3$$

$$y = 0, 4$$

$$12. m = 0.606, -6.606$$

$$p = 2.606, -4.606$$

$$13. x = 3, -\frac{1}{2}$$

$$y = -4, 3$$