

SIMULTANEOUS EQUATIONS

Summary:

- 1. Equations with more than one unknown are called simultaneous equations*
- 2. Simultaneous equations can be solved using the following methods:
(i) Elimination method (ii) Substitution method (iii) Graphical method
(iv) Matrix method*
- 3. The solution to simultaneous equations must satisfy each equation.*

EXAMPLES:

- 1. Use the elimination method to solve the following simultaneous equations:*

$$(i) \ 3x + y = 11$$

$$2x + y = 8$$

$$(ii) \ 2x - y = 3$$

$$3x + 2y = 8$$

$$(iii) \ 8x - 5y = -6$$

$$4y - 13x = -15$$

$$(iv) \ \frac{x}{2} + \frac{y}{3} = 5$$

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

$$(v) \ \frac{x}{6} - \frac{2y}{3} = \frac{1}{15}$$

$$\frac{3x}{4} + \frac{y}{3} = \frac{5}{6}$$

$$(vi) \ \frac{x-3}{4} - \frac{y-2}{5} = \frac{7}{40}$$

$$\frac{4-x}{3} + \frac{3-y}{2} = \frac{3}{5}$$

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

$$\frac{2}{x} + \frac{3}{y} = 16$$

- 2. Use the substitution method to solve the following simultaneous*

equations:

(i) $4a + b = 14$

(ii) $3x + 4y = 11$

(iii) $4x + 3y = 24$

$3a - 4b = 7$

$2x + 3y = 8$

$2y - 3x = -1$

3. Solve graphically the following simultaneous equations:

(i) $x + y = 5$

(ii) $3x - y = 7$

(iii) $3x + 2y = 4$

$2x + y = 6$

$4x + y = 14$

$x + 2y = 0$

4. Solve the following simultaneous equations:

(i) $a + b = 12$

(ii) $x + y = 16$

$b + c = 11$

$y + z = 10$

$a + c = 9$

$x + z = 18$

Soln:

(i) $a + b = 12$

$+ b + c = 11$

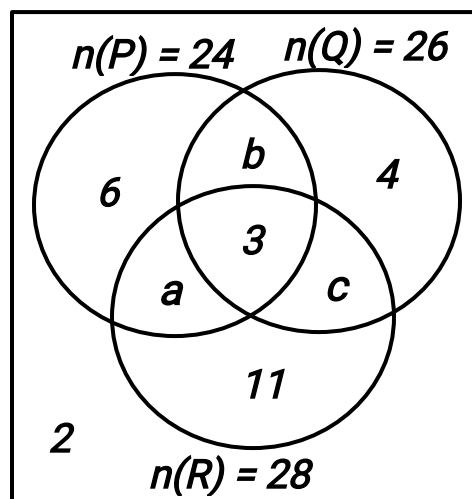
$a + c + 2b = 23$

$\Rightarrow 9 + 2b = 23$

$\therefore b = 7$

$\Rightarrow a = 12 - 7 = 5, \quad c = 11 - 7 = 4$

5. Study the Venn diagram below:



Find:

*(i) the values of **a**, **b** and **c***

(ii) $n(\varepsilon)$, where ε is the universal set

WORD PROBLEMS ON SIMULTANEOUS EQUATION

Summary:

In solving word problems on simultaneous equation, read the problem carefully and form an equation using the conditions given in the problem

EXAMPLES:

*1. Find two numbers such that one exceeds the other by **9** and their sum is **25***

Soln:

*2. The sum of the present ages of a man and his son is **60** years. Six years ago, the man's age was **5** times the son's age. Find their present ages*

*3. Shs **4000** can buy **10** bans and **5** cakes or **4** bans and **10** cakes. Find the cost of*

each ban and that of each cake.

*4. The cost of **2** pens and **5** books is **Shs 5400**. If the cost of **4** pens and **3** books is **Shs 5200**, find the:*

(i) cost of each pen and that of each book

*(ii) cost of **3** pens and **2** books*

*(iii) value of **n**, if **Shs 9000** can buy **n** pens and **n** books*

*5. A total of **162** guests can be transported when a hired taxi makes **3** trips and the*

bus makes **2** trips. **250** guests can be transported when the taxi makes **5** trips

and the bus makes **3** trips. Find the carrying capacity of each vehicle

6. A total of **120** tickets were sold for **Shs 570,000**. The cost of each adult ticket was **Shs 5,000** and that of each child was **Shs 4,000**. Find how many tickets of each kind were sold

Soln:

If x = number of adult tickets, y = number of children tickets

$$\Rightarrow x + y = 120 \text{ -----(i)}$$

$$\text{Also : } 5000x + 4000y = 570,000$$

$$\Rightarrow 5x + 4y = 570 \text{ -----(ii)}$$

$$\text{On solving, } x = 90, \quad y = 30$$

7. If Tom gives Bob **Shs 2,000**, they would have the same amount. While if Bob

gave Tom **Shs 2,200**, Tom would then have twice as much as Bob. Find how

much does each has.

Soln:

If x = Tom's original amount, y = Bob's original amount

$$\Rightarrow x - 2000 = y + 2000$$

$$\Rightarrow x - y = 4000 \text{ -----(i)}$$

$$\text{Also : } x + 2200 = 2(y - 2200)$$

$$\Rightarrow x - 2y = -6600 \text{ -----(ii)}$$

$$\text{On solving, } x = 14,600, \quad y = 10,600$$

8. A man covers a distance of **15km** in **3 hours**, partly by walking and partly by

running. If he walks at 3kmh^{-1} and runs at 9kmh^{-1} , find the distance he covers by running

Soln:

If x = distance walked, y = distance ran

$$\Rightarrow x + y = 15 \text{ -----(i)}$$

$$\text{Also : } \frac{x}{3} + \frac{y}{9} = 3$$

$$\Rightarrow 3x + y = 27 \text{ -----(ii)}$$

$$\text{On solving, } y = 9\text{km}$$

9. The points $(-3, 9)$ and $(-4, 20)$ lie on the curve $y = px + qx^2$. Find the values of p and q

10. Find the fraction which becomes $\frac{2}{3}$ when its numerator and denominator are both decreased by one and is equal to $\frac{3}{4}$ when its numerator and denominator are both increased by one

11. A two digit number in base ten is equal to five times the sum of the digits. It is nine less than the number formed by interchanging the digits. Find the number

Soln:

If the required no = xy

$$\Rightarrow xy_{\text{ten}} = 5(x + y)$$

$$(x \times 10^1) + (y \times 10^0) = 5(x + y)$$

$$10x + y = 5x + 5y$$

$$5x - 4y = 0 \text{ -----(i)}$$

$$\text{Also : } yx - xy = 9$$

$$10y + x - (10x + y) = 9$$

$$\Rightarrow y - x = 1 \text{ -----(ii)}$$

$$\text{On solving, } x = 4, y = 5$$

$$\therefore \text{ Required No} = 45$$

12. A number consists of two digits whose sum is 7. If the number formed by reversing the digits is less than the original number by 27, find the original number

Soln:

If the required no = xy

$$\Rightarrow x + y = 7 \text{ -----(i)}$$

$$\text{Also : } xy - yx = 27$$

$$10x + y - (10y + x) = 9$$

$$\Rightarrow x - y = 3 \text{ -----(ii)}$$

$$\text{On solving, } x = 5, y = 2$$

$$\therefore \text{ Required No} = 52$$

13. In a two digit number, the ten's digit is three times the unit's digit. The sum of the number and its unit's digit is 64. Find the original number

Soln:

If the required no = xy

$$\Rightarrow x = 3y \text{ -----(i)}$$

$$\text{Also : } xy + y = 64$$

$$10x + y + y = 64$$

$$\Rightarrow 5x + y = 32 \text{ ----- (ii)}$$

$$\text{On solving , } x = 6, \quad y = 2$$

$$\therefore \text{ Required No} = 62$$

14. In a two digit number, the ten's digit exceeds twice the unit's digit by 2 and the number obtained by interchanging the digits is 5 more than three times the sum of the digits. Find the original number

Soln:

If the required no = xy

$$\Rightarrow x - 2y = 2 \text{ -----(i)}$$

$$\text{Also : } yx - 3(x + y) = 5$$

$$10y + x - 3(x + y) = 5$$

$$\Rightarrow 7y - 2x = 5 \text{ ----- (ii)}$$

$$\text{On solving, } x = 8, \quad y = 3$$

$$\therefore \text{ Required No} = 83$$

EER:

1. Solve the following simultaneous equations:

$$(i) \quad 3a + 5b = 21$$

$$(ii) \quad 2x - 5y + 14 = 0$$

$$(iii) \quad 4x + 3y = 24$$

$$2a + 3b = 13$$

$$4x + 3y - 11 = 0$$

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

2. A total of 62 guests can be transported when car A makes 7 trips and car B

makes 5 trips. With 6 trips each, the two cars can carry 60 guests. Find

the

carrying capacity of each car

3. Solve the following simultaneous equations:

$$(i) \frac{x}{3} + \frac{y}{4} = 2$$

$$\frac{x}{2} - \frac{y}{3} = \frac{1}{6}$$

$$(ii) \frac{x-2}{3} + \frac{y-1}{4} = \frac{13}{12}$$

$$\frac{2-x}{2} + \frac{3+y}{3} = \frac{11}{6}$$

4. The cost of 3 plates and 5 cups is **Shs 7,600**. If 5 plates and 3 cups cost **Shs**

8,400,

(i) find the cost of each plate and each cup

(ii) By buying 18 plates and 23 cups, a discount of 3% and 8% was allowed on

each plate and each cup respectively. Calculate the percentage discount

allowed on the whole purchase

5. Solve graphically the following simultaneous equations:

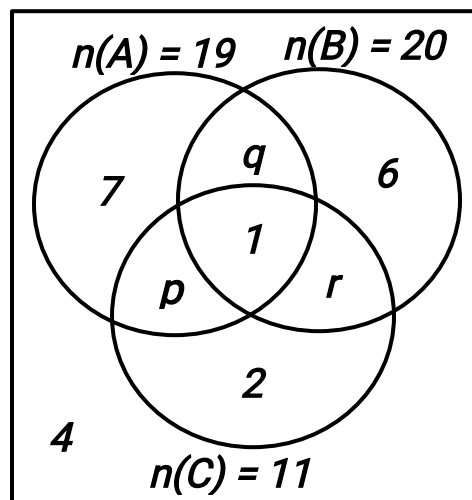
$$(i) 2x - y = 4$$

$$(ii) 3x + y = 6$$

$$x + 4y = 11$$

$$x + 2y = 7$$

6. Study the Venn diagram below:



Find:

*(i) the values of **p**, **q** and **r***

(ii) $n(\varepsilon)$, where ε is the universal set

*7. Two quantities **x** and **y** are related by the equation $y = px + qx^2$. When*

x = 2, y = 6** and when **x = 3, y = 24**. Find the values of **p** and **q

*8. A man bought **30** cups for **Shs 12,600**. He bought some at **Shs 500** each and the other at **Shs 350** each. Find how many cups of each kind were bought*

*9. The side of an equilateral triangle are **(x + 4y)cm**, **(3x + 2)cm** and **(6y – 1)cm**. Find the:*

*(i) values of **x** and **y***

(ii) perimeter of the triangle

*10. Find the fraction which becomes $\frac{1}{2}$ when its denominator is increased by **4** and is equal to $\frac{1}{8}$ when its numerator is reduced by **5***

*11. The sum of two angles of a triangle is **114°** and their difference is **48°**, find all*

the angles of the triangle

*12. The sum of the present ages of a man and his son is **85** years. Five years ago, the man was twice as old as his son. Find their present ages*

*13. The present ages of Tom and Bob are in the ratio of **5:4**. In three years time, the ratio of their ages will become **11:9** respectively. Find Bob's present age*

14. Ten years ago, a man's age was thrice as old as his son. In ten years time, the man's age will be twice as old as his son. Find their present ages

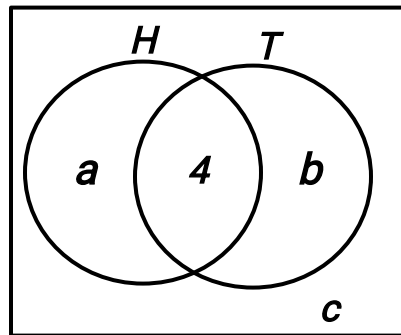
15. A man spent **Shs 29,000** to buy **4 kg** of rice and **7 kg** of meat. Later he increased each of the quantities by **1kg** thus increasing his expenditure by

Shs 5,000. Find

(i) the cost of each kg of rice and that of meat

(ii) how much would the man pay for buying **10 kg** of rice and **15 kg** of meat

16. In the Venn diagram below, **20** students play either Hockey (**H**) or Tennis (**T**)



Given that **14** and **12** students do not play Hockey and Tennis respectively,

Find the:

(i) values of **a**, **b** and **c**.

(ii) probability that a student picked at random plays neither of the games

17. In a two digit number, the unit's digit is thrice the ten's digit. If **36** is added to the number the digits are reversed. Find the original number

18. A number consists of two digits whose sum is **5**. If **9** is subtracted from

the number the digits are reversed. Find the original number

19. *A number consists of two digits whose sum is 12. If the result of dividing the number by the number with the digits reversed is $1\frac{3}{4}$, find the original number*

20. *A number consists of two digits whose sum is 8. The number obtained by interchanging the digits exceeds the original number by 18. Find the original number*

21. *Solve for x and y in the equation: $\frac{3^x \times 2^{2y}}{3^y \times 2^x} = 72$*

22. *Find two numbers whose sum is 120 and their difference is 30*

23. *The points $(1, -1)$ and $(2, 2)$ lie on the curve $y = px + qx^2$. Find the values of*

p and q

24. *Two quantities f and m are related by the equation $f = am + bm^2$. When*

$f = 72$, $m = 8$ and when $f = 28$, $m = 4$. Find the:

(i) equation connecting f and m

(ii) value of f when $m = 6$

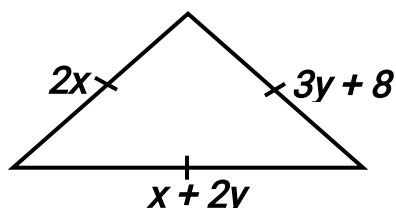
25. *Tom travelled a distance of 52km in 6 hours. He travelled partly on foot at 4kmh^{-1} and partly on a bicycle at 12kmh^{-1} . Find the distance he travelled on foot*

26. *A cyclist travels a journey of 500m in 22seconds, part of the way at 10ms^{-1}*

and the remainder at 50ms^{-1} . How far does he travel at each speed?

27. Tom is 6 years older than Bob. The ratio between the present ages of Tom and Bob is 7:5. Find their present ages

28. Find the values of x and y in the given equilateral below

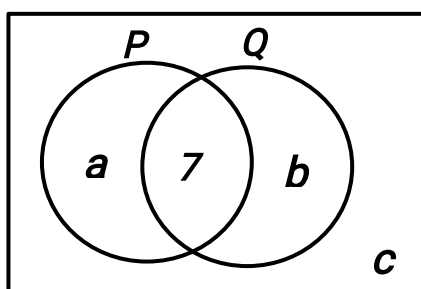


29. The cost of two tables and three chairs is **Shs 705,000**. If the table costs **Shs 40,000** more than the chair, find the cost of each table and a chair

30. The cost of 4 pens and 5 books is **Shs 10,000**. If the cost of 3 pens and 2 books is **Shs 5,100**, find the cost of 7 pens and 6 books

31. A man spends **Shs 13,000** in two days. He spends **Shs 2,000** more on the first day than on the second day. Find his expenditure on the second day

32. In the Venn diagram below, sets P and Q are such that $n(P \cup Q) = 16$, $n(P') = 7$, and $n(Q') = 6$.



Find the values of a , b and c . Hence obtain $n(\epsilon)$