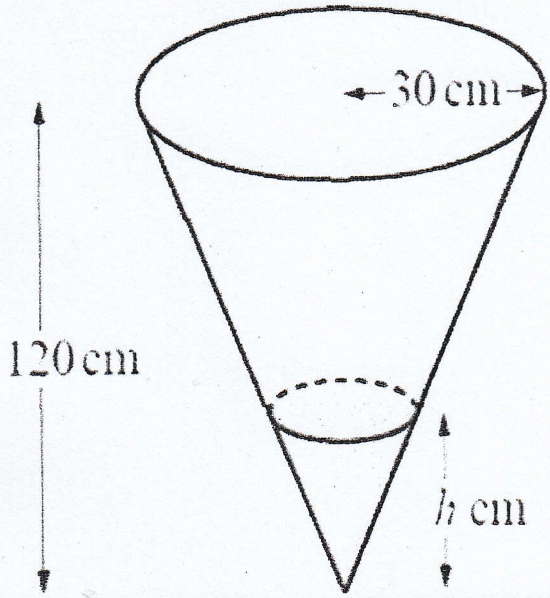
O-LEVEL MATHEMATICS PASSWORD FROM THE YEAR 2000 TO 2015

O-LEVEL REB PAST PAPERS WITH ANSWERS



The volume of a cone of height H and radius R is

$$\frac{1}{3}\pi R^2 H$$

Education's purpose is to replace an empty mind with an open one. Live and enjoy Mathematics by constant practice from these well prepared REB past paper questions with answers at the back. Remember it's not how good you are, it's how good you want to be.

Mathematics I
010
11/11/2015 08.30AM – 11.30AM

REB
Rwanda Education Board

ORDINARY LEVEL NATIONAL EXAMINATIONS, 2015

SUBJECT: MATHEMATICS I

DURATION : 3 HOURS

INSTRUCTIONS:

1. Write your names and index number on the answer booklet as they appear on your registration form and **DO NOT** write your names and index number on additional answer sheets of paper if provided.
2. Do not open this question paper until you are told to do so.
3. This paper has **TWO** sections **A** and **B.**
   - **SECTION A:** Attempt **ALL** questions. **(55 marks)**
   - **SECTION B:** Attempt any **THREE** questions **(30 marks)**
4. You may use mathematical instruments and calculators **where necessary.**
5. Use a blue or black ink pen only to write your answer and a pencil to draw diagrams.
6. Show clearly all the working. **Marks will not be awarded for the answer without all working steps.**

SECTION A: ATTEMPT ALL QUESTIONS. (55 MARKS)

1) Given that a*b = 2b + a – 1, evaluate 4*(3*5). (3 marks

2) Given that a = -2, b = 3 and c = -1, calculate the value of $\frac{4a^2-ac^3}{b+c}$ (3 marks

3) Calculate the magnitude of the vector $\vec{x} = \begin{pmatrix} 24 \\ -7 \end{pmatrix}$. (3 marks

4) Given that y is inversely proportional to x^2 and that y = 4 when x = 2, calculate the value of y when x = $\frac{1}{2}$. (3 marks)

5) Find the equation of a line which passes through points (1, 2) and (3, 6). (3 marks

6) Solve in the set of real numbers, R : $\frac{25}{9}x^2 - \frac{9}{4} = 0$. (3 marks

7) If $135_n = 75_{ten}$, find the value of n. (4 marks

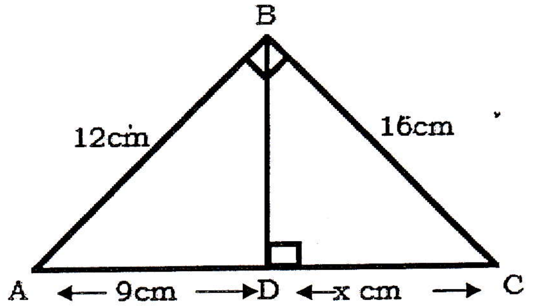
8) Given that vectors $\vec{a} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$, $\vec{b} = \begin{pmatrix} 2 \\ -7 \end{pmatrix}$ and $\vec{c} = \begin{pmatrix} -10 \\ 21 \end{pmatrix}$;

(a) Find vector $2\vec{a} + \vec{b}$. (2 marks)

(b) If $m\vec{a} + n\vec{b} = \vec{c}$, find the value of m and n. show all your working. (3 marks

9) In the figure below,

(a) show that $\triangle$ABC is similar to $\triangle$BDC. (2 marks



(b) Calculate x. (2 marks

10) The sum of two numbers is at most 48. If one number is two times the other, find the maximum possible values of the two numbers. (4 marks

11) (a) Simplify completely without using a calculator:

$$\left[2^{-3} \times 16^{1/2}\right] \div \left[81^{3/4} \times 27^{-1/3}\right]$$

(b) Find x if $3^x \div 3^2 = 27$.

12) Three students share n frw in the ratio 3 : 4 : 5. If the smallest share is 60,000frw, find:

(a) The amount n. (2 marks

(b) The two other shares. (2 marks

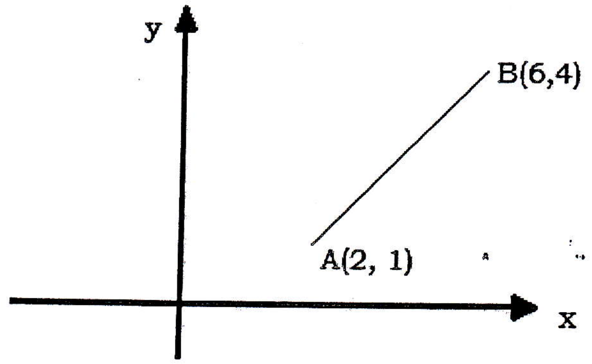
13) It is given that $f(x) = \frac{k}{x+2}$ and f (6) = 6. Find f (-14). (4 marks

14) A line with gradient 3 passes through the point A (-2, -3).
Find out:

(a) The equation of the line. (2 marks

(b) The coordinates of points where the line cuts the x - axis. (1 mark

15) Copy the sketch below and draw the image of line AB;



(a) Under a reflection in y – axis. (2 marks

(b) Under a translation $T = \begin{pmatrix} -2 \\ -1 \end{pmatrix}$. (2 marks

SECTION B: ATTEMPT ONLY THREE QUESTIONS. (45 MARKS)

16) (a) The table below shows the direct variation between time and distance covered by a man travelling at a constant speed. (8 marks)

Time(t) in hours	1	4	5	6
Distance(d) in km	4	16		

(i) Copy and complete the table.

(ii) Plot d against t on the graph

(iii) Determine the gradient of the graph

(iv) Write the equation relating d and t.

(b) A vector comprises points A (2, 3) and B (1, 6). Another vector perpendicular to the vector AB passes through points A (2, 3) and P (x, y). Find the coordinates of point P. (4 marks

(c) A line L1 passes through points P (2, 1) and Q (-1, -4). Another line L2 passes through point (3, -6). If the lines L1 and L2 are parallel, find the equation of L2.

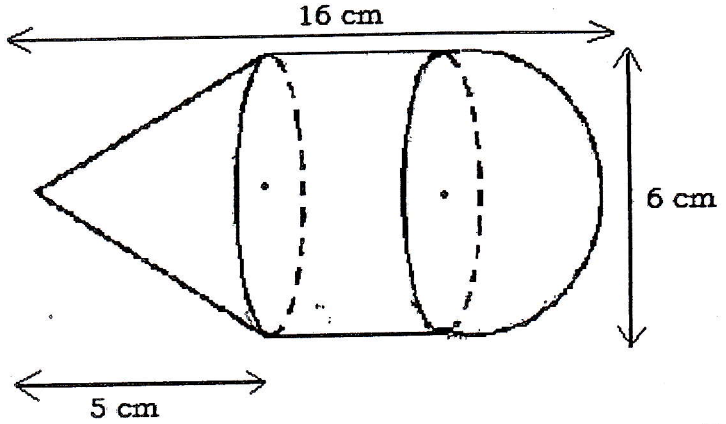
17) The polynomial $p(x) = x^3 - 5x^2 + bx + a$ is divisible by (x + 1) and leaves a remainder of 6 when it is divided by (x – 1).

(a) Find the values of the coefficients a and b. (10 marks)

(b) Hence solve p(x) = 0. (5 marks

18) (a) The internal radius of a cylindrical water tank is 60cm. the depth of water in the tank is 1.4m. Calculate the volume of the water. Express the answer in litres. Use $\pi = \frac{22}{7}$. **(3 marks)**

(b) Find the surface area and volume of the figure below. (use π = 3.14). **(8 marks)**



(c) A path 15m long and 12m wide is to be covered with square tiles of side 20cm.

Calculate: (i) the number of tiles needed. **(3 marks)**

(ii) the cost of tiles if 1 tile costs 400frw. **(1 mark)**

19) In a class of 36 students, 23 like mathematics, 15 like Physics and 13 like Chemistry. 7 students like Mathematics and Physics, 9 like Mathematics and Chemistry and 6 like Physics and Chemistry. Two of the students do not like any of the subjects.

(a) Represent this information on a Venn diagram. Find the number of students who like all the three subjects. **(11 marks)**

(b) How many students like only one of the three subjects? **(4 marks)**

20) The table below shows the marks of 51 students in a science test.

10	20	12	23	13	21	14	32	18	30	36	40	37	46	38	31	41	44
32	42	48	44	39	35	48	40	34	41	37	47	34	49	50	43	16	52
45	51	58	57	59	56	55	60	53	62	64	54	65	68	76			

(a) Make a grouped frequency table for marks starting with 10 – 19 **(12 marks)**

(b) Calculate the mean mark. **(2 marks)**

(c) What is the modal class? **(1 mark)**

END

MATHEMATICS I MARKING SCHEME, ORDINARY LEVEL NATIONAL EXAMINATIONS, 2015
SECTION A

1. $a*b = 2b + a - 1$

$4*(3*5) = 4*[(2 \times 5) + 3 - 1]$

$= 4*12$

$= (2 \times 12) + 4 - 1$

$= \mathbf{27}$

2. $\frac{4a^2 - ac^3}{b + c} = \frac{4(-2)^2 - (-2)(-1)^3}{3 + (-1)}$

$= \frac{4 \times 4 - (-2)(-1)}{2}$

$= \frac{16 - 2}{2}$

$= \frac{14}{2} = \mathbf{7}$

3.

$\vec{x} = \sqrt{24^2 + (-7)^2}$

$= \sqrt{576 + 49}$

$= \sqrt{625} = \mathbf{25}$

4. $y \propto \frac{1}{x^2} \Rightarrow y = \frac{k}{x^2}$

When $y = 4$, $x = 2$, then $4 = \frac{k}{(2)^2}$ i.e $k = 16$

The equation is $y = \frac{16}{x^2}$

When $x = \frac{1}{2}$, $y = \frac{16}{(\frac{1}{2})^2} = 16 \times 4 = \mathbf{64}$

5. Gradient of line $= \frac{6-2}{3-1} = 2$

Let (x, y) be any point on the line,

then $\frac{y-2}{x-1} = 2$.

$y - 2 = 2x - 2$

$y = 2x$

The required equation is $\mathbf{y = 2x}$

6. $\frac{25}{9}x^2 - \frac{9}{4} = 0$; $\left[\frac{5}{3}x - \frac{3}{2}\right]\left[\frac{5}{3}x + \frac{3}{2}\right] = 0$

$\frac{5}{3}x - \frac{3}{2} = 0$ or $\frac{5}{3}x + \frac{3}{2} = 0$

$x = \frac{3}{2} \times \frac{3}{5} = \frac{9}{10} = \mathbf{0.9}$

Or $x = -\frac{3}{2} \times \frac{3}{5} = -\frac{9}{10} = \mathbf{-0.9}$

7. $135_n = 1 \times n^2 + 3 \times n^1 + 5 \times n^0$

$= n^2 + 3n + 5$

So $n^2 + 3n + 5 = 75$; $n^2 + 3n - 70 = 0$

$(n^2 + 10n) - (7n + 70) = 0$

$(n + 10)(n - 7) = 0$

$n + 10 = 0$ (N/A) – Not Applicable

or $n - 7 = 0$, i.e $n = 7$

Therefore, the value of $\mathbf{n = 7}$

8. a)

$2\vec{a} + \vec{b} = 2\begin{bmatrix} -2 \\ 3 \end{bmatrix} + \begin{bmatrix} 2 \\ -7 \end{bmatrix} = \begin{bmatrix} -4 \\ 6 \end{bmatrix} + \begin{bmatrix} 2 \\ -7 \end{bmatrix} = \begin{bmatrix} -2 \\ -1 \end{bmatrix}$

b) $m\vec{a} + n\vec{b} = \vec{c}$, $m\left[\begin{pmatrix} -2 \\ 3 \end{pmatrix}\right] + n\left[\begin{pmatrix} 2 \\ -7 \end{pmatrix}\right] = \begin{pmatrix} -10 \\ 21 \end{pmatrix}$

$\begin{pmatrix} -2m \\ 3m \end{pmatrix} + \begin{pmatrix} 2n \\ -7n \end{pmatrix} = \begin{pmatrix} -10 \\ 21 \end{pmatrix}$

$-2m + 2n = -10$........(1)

$3m - 7 = 21$...........(2)

$\times 3 + (2) \times 2$: $-6m + 6m + 6n - 14n = -30 + 42$

$-8n = 12$ and $n = -\frac{3}{2} = \mathbf{-1.5}$

$m = \frac{21 - \frac{21}{2}}{3} = \frac{21}{6} = \frac{7}{2} = \mathbf{3.5}$

9. a) In $\triangle$ABC and $\triangle$BDC:

Angle ABC = angle BDC = 90°

Angle BCA = angle BCD

Therefore $\triangle$ ABC is similar to $\triangle$ BDC.

b) $(x + 9)^2 = (12)^2 + (16)^2$

$(x + 9)^2 = 144 + 256$

$x + 9 = \sqrt{400} = 20$

$x = \mathbf{11cm}$

10. a) At most means maximum use inequality $\leq$

Let x be the 1st number

2nd is two times x or 2x

The sum of the two numbers cannot exceed 48

So $2x + x \leq 48$

$3x \leq 48$

$x \leq 16$

the first number, x = **16**

the 2nd number $2x = 2 \times 16 =$ **32.**

11. a) $\left[2^{-3} \times 16^{1/2}\right] \div \left[81^{3/4} \times 27^{-1/3}\right]$

$= 2^{-3} \times$

b) $3^x \div 3^2 = 27$; $3^{x-2} = 3^3$

$x - 2 = 3$

$\mathbf{x = 5}$

12. a) Total parts = 3 + 4 + 5 = 12

The amount $n = \frac{12}{3} \times 60{,}000$Frw

= **240,000Frw**

b) Other shares: (i) $\frac{4}{3} \times 60{,}000 =$ **80,000Frw**

ii) $\frac{5}{3} \times 60{,}000$Frw = **100,000Frw**

13. $f(6) = \frac{k}{6+2} = \frac{k}{8}$

$f(6) = 6 = \frac{k}{8}$

$k = 48$

So $f(x) = \frac{48}{x+2}$; $f(-14) = \frac{48}{-14+2} = \mathbf{-4}$

14. Let B(x, y) be any point on the line, then the gradient of AB $= \frac{Y-(-3)}{X-(-2)} = \frac{Y+3}{X+2}$

a) Therefore, $\frac{Y+3}{x+2} = 3.$

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

$y + 3 = 3x + 6$

$y = 3x + 6 - 3$

$\mathbf{y = 3x + 3}$

14. b) The line cuts the x – axis where y = 0

$3x + 3 = 0$

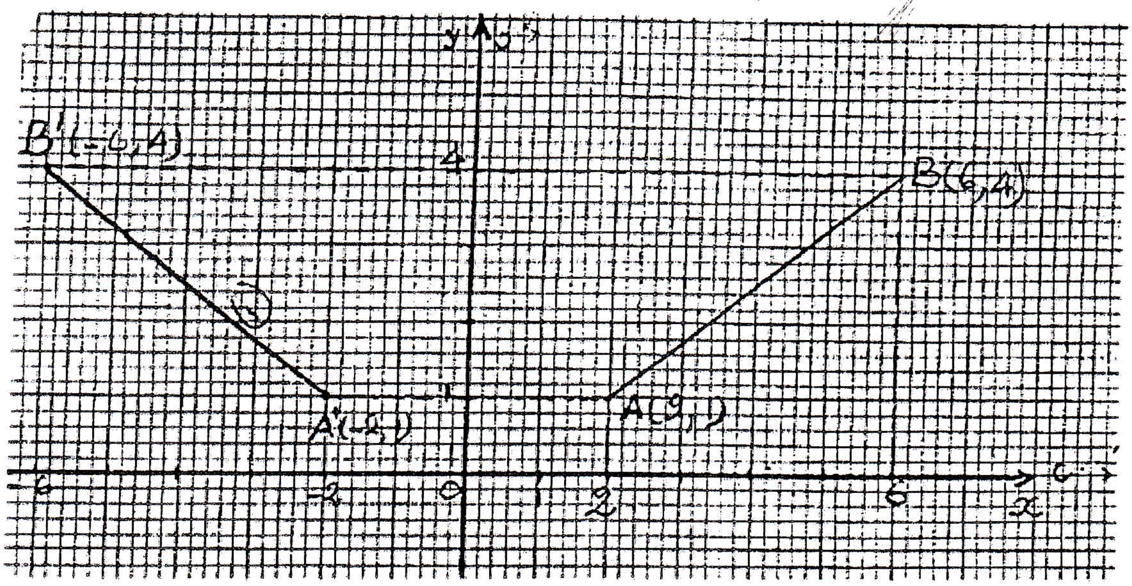
$3x = 3$

$x = \frac{-3}{3}$

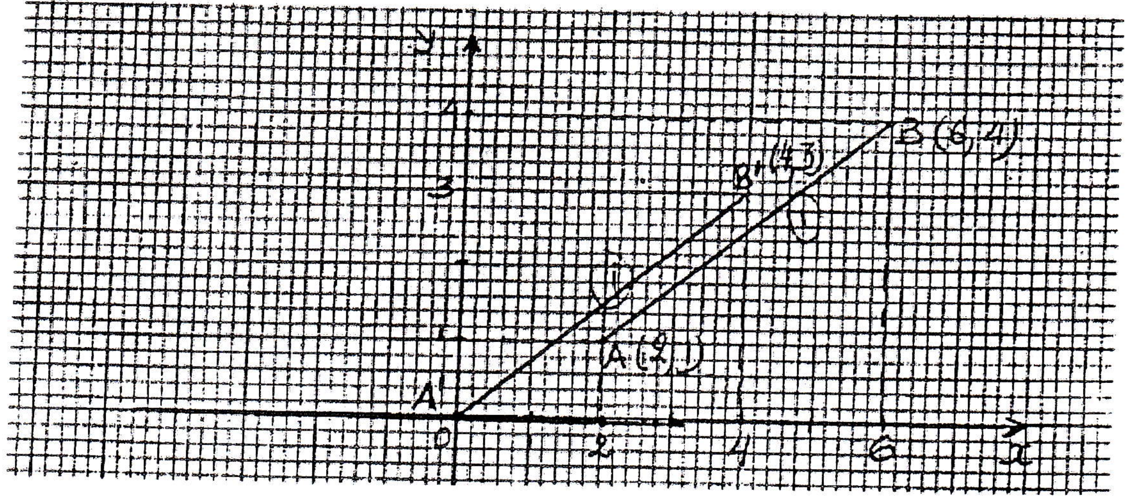
$x = -1$

the line cuts the x – axis at points **(-1, 0)**

15. a)



(b)

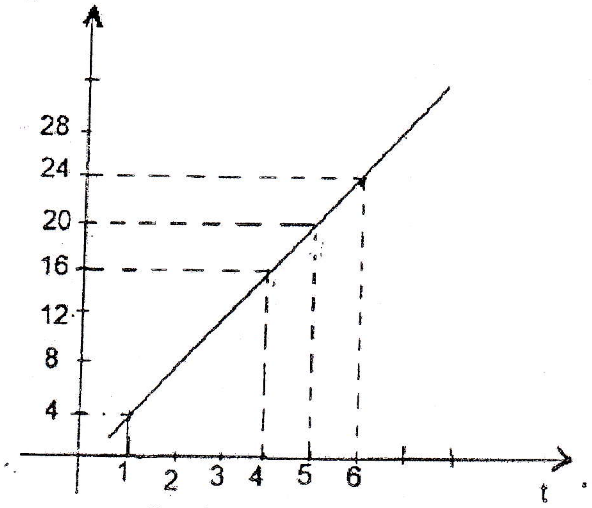


SECTION B

16. a) i)

Time(t) in hours	1	4	5	6
Distance(d) in km	4	16	**20**	**24**

ii) Graph



iii) Gradient = $\frac{y2-y1}{x1-x2} = \frac{16-4}{4-1} = \frac{12}{3} = \mathbf{4}$

iv) Equation: **d** = **4t**

17. a) p(x) = x³ - 5x² + bx + a

p(x) is divisible by x + 1⇒ p(-1) = 0

i.e -1-5 – b + a = 0 or a – b = 6 ..(i)

The remainder of the division of p(x) by x - 1 = 6

p(1) = 1 – 5 + b + a = 6 or a + b = 10...(2)

(1) + (2) ⇒ 2a = 16

a = **8**, b = **2**

16. b) The two vectors share a common point A(2, 3), so think of the other points B(1,6)

$\vec{a} = \begin{pmatrix} -ax \\ ay \end{pmatrix}$

So $\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} -1 \\ 6 \end{pmatrix}$ or P (-1, 6)

c) As the lines L1 and L2 are parallel, they have the same gradient equal to:

$\frac{-4-1}{-1-2} = \frac{-5}{-3} = \frac{5}{3}$

The equation of L2 must be of the form:

$y = \frac{5}{3}x + c$ ....(i)

Use the given point (3, -6) to find the value of y intercept c, so substitute into (i)

$-6 = \frac{5}{3}x + c$

-6 = 5 + c

c = 6 - 5

c = -11

therefore L2 has an equation $\mathbf{y = \frac{5}{3}x - 11}$

17. b) p(x) = 0

x³ - 5x² + 2x + 8 = 0 i.e (x + 1)(x² - 6x + 8) = 0

or (x + 1)(x – 2)(x – 4) = 0

x = -1

or **x = 2**

or **x = 4**

18. a) Volume, $V = \pi r^2 h$

$$= \frac{22}{7} \times 60^2 \times 140\text{cm}^3$$

$$= 1{,}584{,}000\text{cm}^3$$

$$= \mathbf{1{,}584\ litres.}$$

18. b) The 3D shape consists of three parts: conical part, cylindrical part and hemispherical part.

✓ - Conical part: slant height, $l = \sqrt{5^2 + 3^2}$
$= 5.83\text{cm}$

- surface area $= \pi r l = 3.14 \times 3 \times 5.83$
$= 54.92\text{cm}^2$

✓ Cylindrical part:

- Height, $h = 16\text{cm} - (5\text{cm} + 3\text{cm}) = 8\text{cm}$
- Curved surface are $= 2\pi rh = 3.14 \times 6 \times 8$
$= 150.72\text{cm}^2$

✓ Hemisphere part:

Surface area $= 2\pi r^2 = 2 \times 3.14 \times 3^2 = 56.52\text{cm}^2$

Total surface area $= 54.92 + 150.72 + 56.52$
$= \mathbf{262.16cm^2}$

Volume:

Cone: $V = \frac{1}{3}\pi r^2 h = \frac{1}{3} \times 3.14 \times 9 \times 5 = 47.1\text{cm}^3$

Cylinder: $V = \pi r^2 h = 3.14 \times 9 \times 8 = 226.08\text{cm}^3$

Hemisphere: $V = \frac{2}{3}\pi r^3 = \frac{2}{3} \times 3.14 \times 27 = 56.52\text{cm}^3$

Total volume $= 47.1 + 226.08 + 56.52$
$= \mathbf{329.7cm^3}$

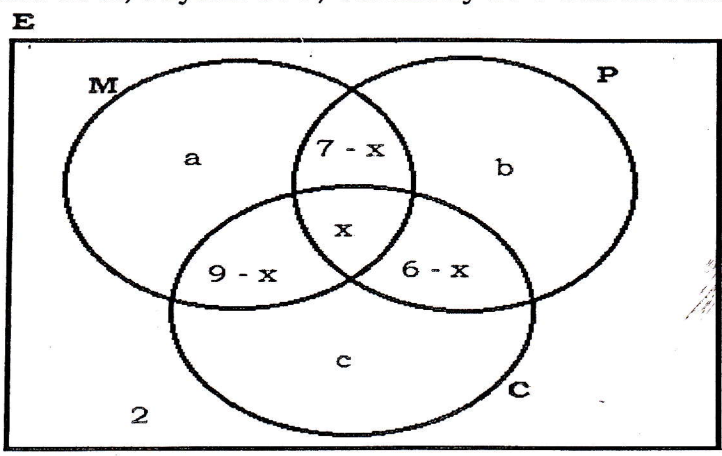
18. c) i) Area of the path $= 15\text{m} \times 12\text{m} = 180\text{m}^2$

Area of one tile $= 0.2\text{m} \times 0.2\text{m} = 0.04\text{m}^2$

Number of tiles needed $= \frac{180m^2}{0.04m^2} =$ **4500 tiles**

ii) Cost of tiles $= 4500 \times 400\text{frw}$
$= \mathbf{1{,}800{,}000frw}$

19. a) Let Mathematics be M, Physics be P, Chemistry be C and all students be E



Let x be the number of all students who like all the three subjects.

$a = 23 - (7 - x + x + 9 - x) = 23 - 16 + x = 7 + x$

$b = 15 - (7 - x + x + 6 - x) = 15 - 13 + x = 2 + x$

$c = 13 - (9 - x + x + 6 - x) = 13 - 15 + x = x - 2$

$n(E) = 7 + x + 7 - x + 9 - x + x + 2 + x + x - 2 + 2 = 36$

$31 + x = 36$

$x = 36 - 31 = 5$

The number of students who like all the three subjects is 5

b) The number of students who like only one of the subjects $= a + b + c = (7 + x) + (2 + x) + (x - 2)$
$= 7 + 3x \Rightarrow 7 + 3(5) = \mathbf{22}$

20. a)

Marks	Frequency (f)	Midpoints (x)	fx
10 – 19	6	14.5	87
20 – 29	3	24.5	735
30 – 39	12	34.5	414
40 – 49	14	44.5	623
50 – 59	10	54.5	545
60 – 69	5	64.5	322.5
70 – 79	1	74.5	74.5
	$\sum f = 51$		$\sum fx = 2139.5$

b) The mean mark, $\bar{x} = \frac{\sum fx}{\sum f} = \frac{2139.5}{51} = \mathbf{41.95}$

c) The modal class is 40 – 49 because it has a higher frequency of 14 than others.

END