Mathematics I
011
09 Nov 2010   **8.30 am -11.30 am**

RWANDA NATIONAL EXAMINATIONS COUNCIL.

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ORDINARY LEVEL NATIONAL EXAMINATION 2010

SUJECTS   :   **MATHEMATICS**

**TIME**   :   **3 HOURS**

INSTRUCTIONS:

- This paper consists of **TWO** Sections **A** and **B**.

- Attempt **ALL** questions in Section **A** and any **THREE** questions in Section **B**.

- Show **ALL** working clearly.

- Calculators and mathematical instruments are allowed.

SECTION A: Answer all questions. (55 marks)

1. Simplify and express the answer in standard form: $\dfrac{0.24 \times 0.35}{0.80 \times 0.70}$.   **(3 marks)**

2. Find base n: $103_n + 26_n = 131_n$ **(4 marks)**

3. A distance of 3cm represents 6 km as the scale on a map. Find the distance on the map if the distance on land is 4.5 km?   **(2 marks)**

4. Solve: $\dfrac{3\sqrt{5} \times \sqrt{20}}{\sqrt{50} \times \sqrt{18}}$.   **(4 marks)**

5. 3 children share x Rwf in the ratio 3: 4: 5. If the smallest share is 60,000 Rfw, find x and other shares.   **(4 marks)**

6. Solve: $3x^2 + 14x + 8 = 0$.   **(4 marks)**

7. Solve the simultaneous equations: 8a + b = 21
   5a – 4b = -10.   **(4 marks)**

8. Given that O is the centre of the circle. Find x°, y° and z°.   **(4 marks)**
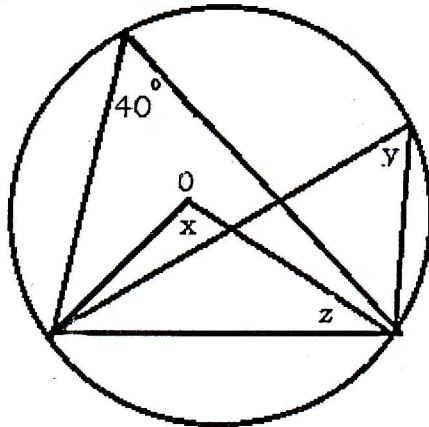
9. Solve the following equation: (y – 2) (2y + 3) – 2 (3y – 2) (y – 2) = 0.   **(4 marks)**

10. Find the reflection of A(0, 0) and B(2, 4) in (a) line y = 2.   **(2 marks)**

   (b) line x = 0.   **(2 marks)**

11. Given that $g(x) = x^2 + 4x - 9$. (a) find gf(x) if f(x) = x + 3.   **(2 marks)**

   (b) find x if gf(x) = -14.   **(2 marks)**

12. The pie chart below shows the games liked by the students in a school. 60 students like tennis.

   (a) How many students are in the school?   **(1 mark)**

   (b) How many students like each type of game?   **(3 marks)**
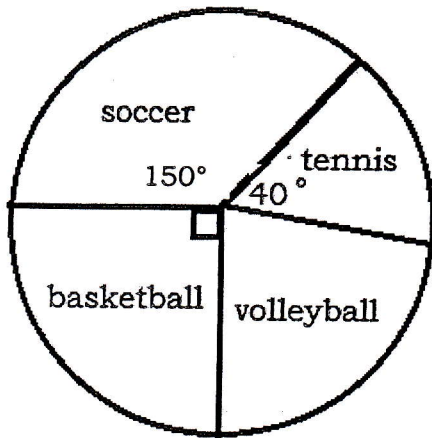
13. It is given that $\vec{a} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$ and $\vec{b} = \begin{pmatrix} 12 \\ 9 \end{pmatrix}$. (a) Find $\vec{a} - \vec{b}$. **(1 mark)**

(b) Determine the value of $|\vec{a}| + |\vec{b}|$. **(3 marks)**

14. Find the equation of a straight line which passes through points (3, 5) and (6, 9). **(4 marks)**

## SECTION B: Attempt three (3) questions only (45 marks)

15. (a) Find a, b and c in the following equation: $ax^2 + (b - 3)x + 2c - 1 = x^2 - 5x + 7$ **(3 marks)**

(b) Factorize: $2x^3 + 9x^2 + 7x - 6$. **(8 marks)**

(c) Simplify completely: $\dfrac{4x^2 - 1}{4x^2 - 4x + 1}$. **(4 marks)**

16. The table below shows the masses of 50 0-level students in a school.

Mass (kg)	64-69	70-75	76-81	82-87
Frequency	15	18	13	4

(a) Find the modal class and its limits. **(2 marks)**

(b) Determine the estimated mean and calculate the mean mass. **(13 marks)**

17. The Venn diagram below represents the number of pupils and the subjects they like.

E =
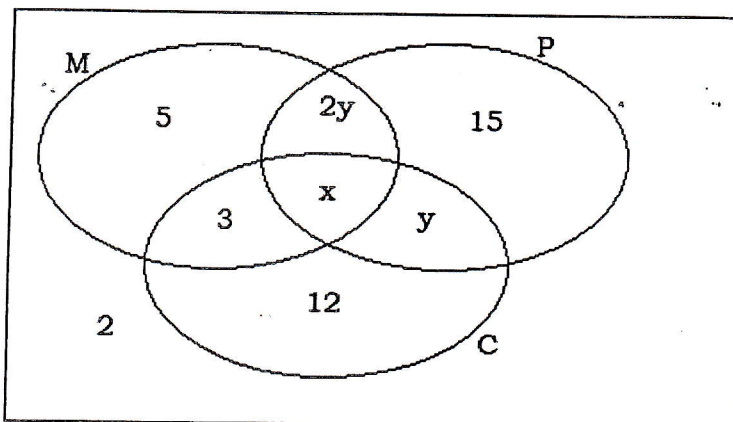
E = All pupils.

M = Pupils who like Mathematics.

P = Pupils who like Physics

C = Pupils who like chemistry.

28 pupils like Mathematics and 30 like Chemistry. How many pupils:

(a) Like all the three subjects? **(8 marks)**

(b) Like mathematics and physics? **(1 mark)**

(c) Like physics and chemistry? **(2 marks)**

(d) Like physics? **(2 marks)**

(e) Are there altogether? **(2 marks)**

18. (a) A uniform hollow pipe of length 2.1 m has an interior radius of 70 cm and an outer radius of 710mm. Find the volume of the pipe material. Express the answer in cubic meters. Take $= \frac{22}{7}$. **(7 marks)**

(b) A copper coin is 3mm thick and has a diameter of 21 mm. How many copper coins can be made from 3.5 liters of molten copper? Take $= \frac{22}{7}$. **(8 marks)**

19. (a) Mary earns 961,500 Rwf per year. She has a personal allowance of 58,000 Rwf. Income tax is charged at 25% on the first 265,000Rwf and 30% on the remaining income. Calculate the amount of gross salary and the net pay. **(11 marks)**

(b) Goods worth 827, 340 Frw are insured at 5% per year for 6 years. Find the total amount of premium paid in the period. **(4 marks)**

END

ANSWERS FOR NATIONAL EXAMINATION 2010.
MATHEMATICS
SECTION A

1.	2. $103n + 26n = 131n$
$\frac{0.24 \times 0.35}{0.80 \times 0.70} = 0.5 \times 0.3$ $= 0.15$	$= (1 \times n^2) + (0 \times 3^1) + (3 \times n^0) + (2 \times n^1) + (6 \times n^0) = (1 \times n^2) + (3 \times n^1) + (1 \times n^0)$ $= n^2 + 0 + 3 + 2n + 6 = n^2 + 3n + 1$ $= n^2 - n^2 + 2n - 3n = 1 - 3 - 6$ $= -n = -8$ $n = 8$

3. 3cm $\Rightarrow$ 6km = 600,000cm 1 cm $\Rightarrow \dfrac{1}{200,000}$ Distance on the map representing 4.5km on land $= \dfrac{3cm}{6km} \times 4.5km = 2.25cm$	**4.** $= \dfrac{3\sqrt{5} \times \sqrt{20}}{\sqrt{50} \times \sqrt{18}}$ $= \dfrac{3\sqrt{5} \times 2\sqrt{5}}{5\sqrt{2} \times 3\sqrt{2}}$ $= \dfrac{30}{30} = 1$	**5.** $x = 60,000 \times \dfrac{12}{3} = 240,000Rwf$ *Other shares are:* $240,000 \times \dfrac{4}{12} = 80,000Rwf$ *And the other share is* $240,000 \times \dfrac{5}{12} = 100,000Rwf.$
6. $3x^2 + 14x + 8 = 0$ $3x^2 + 12x + 2x + 8 = 0$ $3x(x+4) + 2(x+4) = 0$ $(3x + 2)(x + 4) = 0$ $x = \dfrac{-2}{3}$ or $x = -4$	**7.** $\quad \times 4 \mid 8a + b = 21$ $\qquad 5a - 4b = -10$ $- \quad 32a + 4b = 84$ $- \; 37a \qquad = 74$ $\qquad a = 2$ the $8 \times 2 + b = 21$ $\qquad b = 5$	**8.** $x = 80°$ $y = 40°$ $z = \dfrac{180-80}{2} = 50°$ $z = 50°$
9. $(y - 2)(2y + 3) - 2(3y - 2)(y - 2) = 0.$ $(y - 2)(2y + 3 - 6y + 4) = 0$ $(y - 2)(-4y + 7) = 0$ $y - 2 = 0$ or $-4y + 7 = 0$ $y = 2$ or $y = \dfrac{7}{4}$	**10.** a) $A(0,0) \xrightarrow{Y = 2} A^1(0,4)$ and $B(2,4 \xrightarrow{Y = 2} B^1(2,0)$ b) $A(0,0) \xrightarrow{X = 0} A^1(0,0)$ and $B(2,4) \xrightarrow{X = 0} B^1(-2,4)$	**11.** a) $g(f(x)) = (x + 3)^2 + 4(x + 3) - 19$ $= x^2 + 6x + 9 + 4x + 12 - 19$ $= x^2 + 10x + 2$ b) Then $x^2 + 10x + 2 = -14$ $x^2 + 10x + 16 = 0$ $x^2 + 8x + 2x + 16 = 0$ $x(x + 8) + 2(x + 8) = 0$ $(x + 2)(x + 8) = 0$ $x = -2$ or $x = -8$

12.

a) Number of students in the school $= \dfrac{60}{40°} \times 360° = 540$

b) Soccer students

$= 540 \times \dfrac{150°}{360°}$

$= 225$ students

Basketball students $= 540 \times \dfrac{90°}{360°} = 135$ students

Volleyball students

$= 540 \times \dfrac{(360° - (90° + 40 + 150°)}{360°}$

$= 120°$

13.

a) $\vec{a} - \vec{b} = \begin{pmatrix} 4 \\ 3 \end{pmatrix} - \begin{pmatrix} 12 \\ 9 \end{pmatrix} = \begin{pmatrix} -8 \\ -6 \end{pmatrix}$

b) $|\vec{a}| + |\vec{b}|$

$= \sqrt{4^2 + 3^2} + \sqrt{12^2 + 9^2} = 5 + 15$

$= 20$

14.

The gradient of the line $= \dfrac{9-5}{6-3} = \dfrac{4}{3}$

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

$\dfrac{y-5}{x-3} = \dfrac{4}{3} \Leftrightarrow 3y - 15 = 4x - 12$

Then $3y = 4x + 3$

$y = \dfrac{4}{3}x + 3$

$y = \dfrac{4}{3}x + 1$ or $4x - 3y + 3 = 0$

SECTOION B

15. a)

$ax^2 + (b - 3)x + 2c - 1 = x^2 - 5x + 7$

$ax^2 = x^2$

$\dfrac{ax^2}{x^2} = \dfrac{x^2}{x^2}$

$a = 1$

$xb - 3x = -5x$

$xb = -5x + 3x$

$\dfrac{xb}{x} = \dfrac{-2x}{x}$

$b = -2$

$2c - 1 = 7$

$2c = 8$

$c = 4$

b) $2x^3 + 9x^2 + 7x - 6$, $x + 2$ is a factor

$2(-2)^3 + 9(-2)^2 + 7(-2) - 6$

$2(-8) + 9(4) + 7(-2) - 6$

$-16 + 36 - 14 - 6 = 0$

	2	9	7	-6
-2		-4	-10	6
	2	5	-3	0
-3		-6	3	
	2	-1		

$2x^3 + 9x^2 + 7x - 6 = (x+2)(x+3)(2x-1)$

c)

$= \dfrac{4x^2 - 1}{4x^2 - 4x + 1}$

$= \dfrac{(2x-1)(2x+1)}{(2x-1)(2x-1)}$

$= \dfrac{2x+1}{2x-1}$

16.

a) Modal class = 70-75 and

   its limits = 69.5 - 75.5

b)

Class	Mid-interval	Difference from the estimated mean	F	Rixi
64-69	66.5	-6	15	1005
70-75	72.5	0	18	1314
76-81	78.5	6	13	1024
82-87	84.5	12	4	340
			n=50	$\sum$Rixi = 3686

Estimated mean = $\frac{3686}{50}$ = 73.72 $\simeq$ 74kg

The mean mass is = 72.5 + 0.72

$\qquad\qquad$ = 73.22

$\qquad\qquad$ $\approx$ 73.0

17.

a) x + 2y + 8 = 28

$\quad$ x + y + 15 = 30

$\quad$ i.e = x + 2y = 20 (.....i..)

$\quad$ x + y = 15 (.....ii...)

$\qquad$ x = 15-y

$\quad$ 15-y + 2y = 20

$\qquad\qquad$ y = 5, x = 10

10 students like all three subjects.

b) Maths + Physics

$\quad$ = 10 + 8 + 5 + 10 + 15 = 48

c) Physics + chemistry

$\quad$ = 15 + 15 + 10 + 10 + 5 = 55

d) Like physics = 15 + 5 + 10 + 10 = 40

e) 5 + 3 + 10 + 10 + 15 + 5 + 12 + 2 = 62

18.

a) Volume of the outer pipe – Volume of inner pipe

$\quad$ (first change everything to centimeters)

$\quad$ $\pi R^2 H - \pi r^2 h$

$\quad$ $\pi h(R - r)(R + r)$

$\quad$ = $\frac{22}{7} \times 210(71-70)(71+70)$

$\quad$ = 660 × 1 × 141

$\quad$ = 93060cm³ (change it to cubic meters)

$\quad$ = $\frac{93060}{1000000}$ = 0.09306m³

b) Volume of one coin

$\quad$ = Cross section are × thickness

$\quad$ = $(\pi r^2) \times t$

$\quad$ = $\frac{22}{7} \times \frac{21}{2} \times \frac{21}{2} \times 3$ = 1039.5mm³

But 3.5l = 3.5×1000000mm³ = 3,500,000mm³

Number of copper coins = $\frac{3,500,000}{1039.5}$

$\qquad\qquad$ = 3367 pieces

19. a) - Gross salary = 961,500 + 58,000

$$= 1,019,500$$

Income tax on the first 265,000

$$= \frac{25}{100} \times 265,000 = 66,250 \text{Rfw}$$

Net salary = 265,000 - 66,250 = 198,750

Tax on the remaining income

1,019,500 - 265,000 = 754,500

$$= \frac{30}{100} \times 754,500 = 226,350 \longrightarrow$$

b)

Premium per year = $\frac{5}{100} \times 827,340 = 41,367$

For 6 years, = 41, 367 × 6 = 248,202Rfw.

$$= 754,500 - 226,350$$

$$= 528,150 \text{Rfw}$$

Net salary = 198,750 + 528,150

$$= 726,900 \text{Rwf}$$