

**Mathematics I**

**010**

**30 Oct.2013**

**08.30am-11.30am**

**REPUBLIC OF RWANDA**



**RWANDA EDUCATION BOARD**

**ORDINARY LEVEL NATIONAL EXAMINATIONS 2013**

**SUBJECT : MATHEMATICS 1**

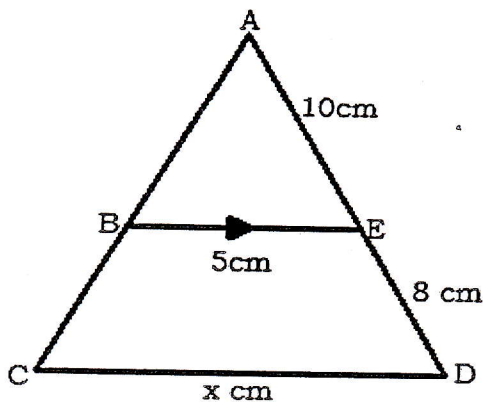
**DURATION : 3 HOURS**

**INSTRUCTIONS:**

- 1) Don't open this paper until you are told to do so.
- 2) This paper has **TWO** sections **A** and **B**.
  - **SECTION A:** Attempt **ALL** questions. (55 marks)
  - **SECTION B:** Answer any **THREE** questions. (45 marks)
- 3) You may use mathematical instruments and calculators **where necessary**.
- 4) USE A **BLUE INK PEN ONLY** TO WRITE YOUR ANSWERS AND A PENCIL TO DRAW DIAGRAMS.
- 5) SHOW CLEARLY ALL THE WORKING. **Marks will not be awarded for answers without all working steps.**

**SECTION A : ATTEMPT ALL QUESTIONS.****(55 marks)**

1. 100,000 Rwf was invested. The simple interest after 2 years was 16,000 Rwf. Find the percentage interest rate per year. (3 marks)
2. Solve for x:  $8x^2 - 2 = 0$  (3 marks)
3. A straight line passes through points (2, 8) and (x, y). If the gradient of the line is 3, Find the equation of the line. (3 marks)
4. Solve for (x, y):  
 $8x + y = 21$   
 $5x - 4y = -10$  (3 marks)
5. In a class of 50 pupils, 33 like Mathematics and 32 like science. Each pupil likes at least one subject. Put this information on a Venn diagram and find the number of pupils who like both subjects. (3 marks)
6. It is given that  $f(x) = 3x^2$  and  $g(x) = 2x + 5$ . If  $f(x) = g(x)$ , find x. (4 marks)
7. Simplify:  $\sqrt{12} \times 3\sqrt{60} \times \sqrt{45}$ . (4 marks)
8. Show that the points P (-3, -2), Q(3, 1) and R(5, 2) are collinear (i.e. Points are lying on one straight line) (4 marks)
9. Solve:  $\frac{1}{2}x - (x + 1) \geq 2$ . Illustrate the answer on a graph. (4 marks)
10. Given that y varies inversely with x, and that  $y = 4$  when  $x = 3$ ;  
(a) Find y when  $x = 6$  (3 marks)  
(b) For which value is this relation not valid? (1 mark)
11. 10,000 Rwf is divided among three pupils in the ratio 2:3:5. Find each share. (4 marks)
12. A (x, y) and B (6, 10) are points in a Cartesian plane. If A is joined to B, the midpoint of AB is (4.5, 8). Find the values of x and y. (4 marks)
13. In the figure below  $AE = 10$  cm,  $ED = 8$  cm,  $BE = 5$  cm and  $CD = x$  cm. BE is parallel to CD.



- (a) Show that triangle ABE is similar to triangle ACD. (2 marks)
  - (b) Calculate x. (2 marks)
14. Solve for x:  $(3x - 2)(x + 4) = -11$ . (4 marks)

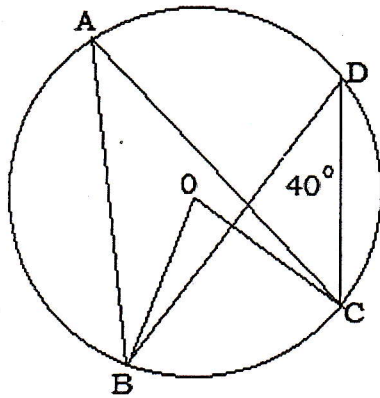
15. The figure below is a circle with centre O. Angle BDC = 40°. Find:

(a) Angle BOC.

(2 marks)

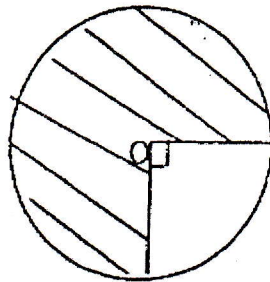
(b) Angle BAC.

(2 marks)



**SECTION B: ATTEMPT ONLY THREE QUESTIONS. (45 marks)**

16. (a) The figure below shows a part of a circle with centre O and a radius of 14 cm and  $\pi = \frac{22}{7}$ .



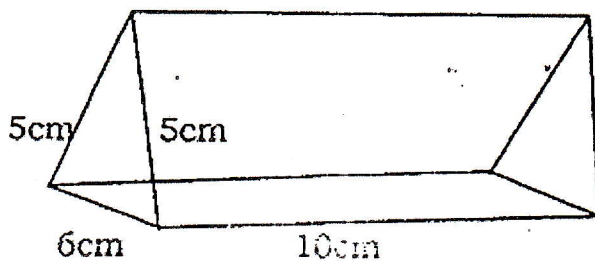
Calculate: i) the area of the shaded part.

(3 marks)

ii) the circumference of the shaded part.

(3 marks)

(b) The prism below has an isosceles triangular base. The equal sides are each 5cm and the other side is 6cm. The height of the prism is 10cm.



Calculate i) the cross section area of the prism.

(4 marks)

ii) the total surface area of the prism.

(3 marks)

iii) the volume of the prism.

(2 marks)

17. The heights in centimeters of 25 pupils are shown below.

160 155 150 160 170 160 180 155 170 155  
190 160 155 170 180 150 160 180 155 160  
155 150 160 155 160

Make a frequency table and determine the mode height, the median and the mean. (15 marks)

18. a) If  $x - 3$  is a factor of  $x^3 - 6x^2 + 11x - 6$ , find other factors of this polynomial. (7 marks)

b) Solve:  $x^3 + 5x^2 - 4x - 20 = 0$ . (8 marks)

19. a) The cost of 3 pencils and 4 exercise books is 1,350 Rwf. The cost of 5 pencils and 6 exercise books is 2,050 Rwf. Find the cost of 10 pencils and 20 exercise books.

Pencils and exercise books are all the same type. (10 marks)

b) John spends  $\frac{1}{3}$  of his monthly salary on accommodation. He spends  $\frac{1}{4}$  of the remaining salary on a car loan and  $\frac{1}{2}$  of the remaining on food. If the money left is 50,000 Rwf, find John's monthly salary. (5 marks)

20. A (0, 4), B(0, 0) and C(4, 4) are vertices of triangle ABC.

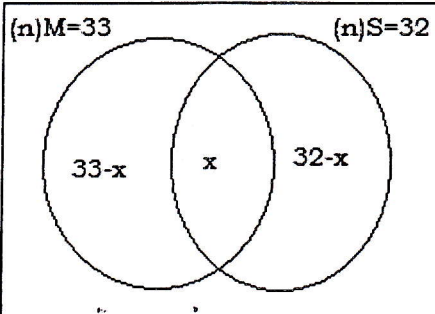
a) Draw triangle ABC on a Cartesian plane. Find the coordinates of vertices A', B' and C' the image of vertices A, B and C under a  $-90^\circ$  rotation about the origin. Draw triangle A'B'C' on the same Cartesian plane as that of triangle ABC. (6 marks)

b) Find the coordinates of A'', B'' and C'' the images of A, B and C under a reflection in line  $x = -1$ . Draw triangle A''B''C'' on the same plane as of 20 (a). (4 marks)

c) A translation T maps A (0, 4) to A'''(-1, 3). Find T. Determine the coordinates of B''' and C''' images of B (0, 1) and C (3, 4) under the translation T. Draw triangle A'''B'''C''' on the same Cartesian plane as 20 (a). (5 marks)

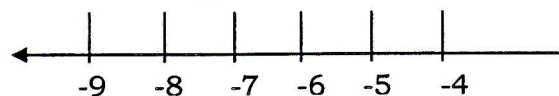
**END.**

**ANSWERS FOR NATIONAL EXAMINATION 2013.**  
**MATHEMATICS 010**  
**SECTION A**

<p>1. <math>I = \frac{PRT}{100}</math></p> $R = \frac{I \times 100}{PT} = \frac{16,000 \times 100}{100,000 \times 2}$ <p>Interest rate = 8%</p>	<p>2.</p> $8x^2 - 2 = 0$ $2(4x^2 - 1) = 0$ $2(2x - 1)(2x + 1) = 0$ $2x - 1 = 0$ $x = \frac{1}{2} \text{ or } x = -\frac{1}{2}$	<p>3. The gradient of a line = <math>\frac{y-8}{x-2}</math></p> <p>But the gradient of line is 3</p> <p>So <math>\frac{y-8}{x-2} = 3</math></p> $y - 8 = 3x - 6$ $y = 3x + 2$
<p>4. <math>\times 4 \quad 8x + y = 21 \Rightarrow (i)</math></p> $5x - 4y = -10 \Rightarrow (ii)$ $32x + 4y = 84 \Rightarrow (iii)$ $5x - 4y = \Rightarrow (iv)$ <p>(iii) + (iv) = <math>37x = 74</math></p> $x = 2$ <p>substitute x in (i)</p> $= 8 \times 2 + y = 21$ $16 + y = 21$ $y = 5$	<p>5.</p> <p><math>E=50</math></p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p>(n)M=33 <span style="float: right;">(n)S=32</span></p>  </div> <p style="text-align: right;">So <math>33 - x + x + 32 - x = 50</math></p> $65 - x = 50$ $x = 65 - 50$ $x = 15$ <p style="text-align: center;">15 pupils like both subjects</p>	
<p>6. <math>3x^2 = 2x + 5</math></p> $3x^2 - 2x - 5 = 0$ $3x^2 + 3x - 5x - 5 = 0$ $3x(x + 1) - 5(x + 1) = 0$ $(3x - 5)(x + 1) = 0$ $3x - 5 = 0$ $x = \frac{5}{3} \text{ or } x + 1 = 0$ $x = -1$	<p>7. <math>\sqrt{12} \times 3\sqrt{60} \times \sqrt{45}</math></p> $= \sqrt{4 \times 3} \times 3\sqrt{4 \times 15} \times \sqrt{9 \times 5}$ $= 2\sqrt{3} \times 6\sqrt{15} \times 3\sqrt{5}$ $= 36\sqrt{3 \times 15 \times 5}$ $= 36 \times 15$ $= 540$	<p>8.</p> $\overrightarrow{PQ} = \begin{bmatrix} 3 - (-3) \\ 1 - (-2) \end{bmatrix} = \begin{bmatrix} 6 \\ 3 \end{bmatrix}$ $\overrightarrow{QR} = \begin{bmatrix} 5 - 3 \\ 2 - 1 \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$ $\overrightarrow{PQ} = \begin{bmatrix} 6 \\ 3 \end{bmatrix} = 3 \begin{bmatrix} 2 \\ 1 \end{bmatrix} = 3\overrightarrow{QR}$ <p>Q is common and <math>\overrightarrow{PQ} // \overrightarrow{QR}</math></p> <p>So P, Q and R are collinear</p>

$$9. \frac{1}{2}x - (x + 1) \geq 2 = x - 2x - 2 \geq 4$$

$$-x \geq 6 \Rightarrow x \leq -6$$



$$10. a) y \propto \frac{1}{x} \Rightarrow y = \frac{k}{x}$$

When  $y = 4$  and  $x = 3$ , then

$$4 = \frac{k}{3} \Rightarrow k = 12$$

So  $y = \frac{12}{x}$  when  $x = 6$ , then

$$y = \frac{12}{6} = 2$$

b) When  $x = 0$ , then the relation is invalid.

11.

Total parts =  $2 + 3 + 5 = 10$   
shares are:

$$i) 10,000 \times \frac{2}{10} = 2,000\text{Rwf}$$

$$ii) 10,000 \times \frac{2}{10} =$$

30000Rwf

$$iii) 10,000 \times \frac{5}{10} =$$

5,000Rwf

12.

$$\text{Midpoint AB} = \left[ \frac{x+6}{2}, \frac{y+10}{2} \right]$$

But the meet point of AB =  $(4.5, 8)$

$$\text{So } \frac{x+6}{2} = 4.5$$

$$x + 6 = 9$$

$$x = 3$$

$$\frac{y+10}{2} = 8$$

$$y + 10 = 16$$

$$y = 6$$

13.

a) In  $\triangle ABE$  and  $\triangle ACD$ ,

$\angle A = \angle A$  (common)

$\angle ABE = \angle ACD$  (corr.  $\angle$ s =)

$\angle AEB = \angle ADC$  (corr.  $\angle$ s =)

So  $\triangle ABE$  is similar to  $\triangle ACD$

(AAA)

$$b) \frac{x}{5} = \frac{18}{10}$$

$$x = \frac{18 \times 5}{10}$$

$$x = 9$$

14.

$$(3x - 2)(x + 4) - 11 = 3x(x+4) - 2(x+4) = -11$$

$$3x^2 + 12x - 2x - 8 = -11$$

$$3x^2 + 10x + 3 = 0$$

$$3x^2 + 9x + x + 3 = 0$$

$$3x(x+3) + (x+3) = 0$$

$$(x+3)(3x+1) = 0$$

$$\text{i.e. } x+3 = 0$$

$$x = -3$$

$$3x + 1 = 0$$

$$x = -\frac{1}{3}$$

15.

a) Angle BOC = 2BDC (angle at centre of circle is 2 times the angle subtended at circumference by the same arc)

$$= 2 \times 40^\circ = 80^\circ$$

b) Angle BAC = angle BDC (angle subtended by the same arc at the circumference)

$$= 40^\circ$$

$$\therefore \text{angle BAC} = 40^\circ$$

**SECTION B.**

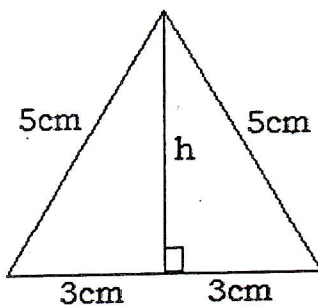
16. a) i) Area of shaded part =  $\frac{3}{4} \pi r^2$

$$= \frac{3}{4} \times \frac{22}{7} \times 14 \times 14 = 462 \text{cm}^2$$

ii) Circumference shaded part =  $\frac{3}{4} \times 2\pi r + 2r$

$$= \frac{3}{4} \times 2 \times \frac{22}{7} \times 14 + 2 \times 14 = 94 \text{cm}$$

b) i)



$$\begin{aligned} h^2 + 3^2 &= 5^2 \\ h^2 &= 25 - 9 = 16 \\ h &= \sqrt{16} = 4 \text{cm} \end{aligned}$$

Cross section area of the prism:

$$A = \frac{1}{2}bh \Rightarrow \frac{1}{2} \times 6 \times 4 = 12 \text{cm}^2$$

ii) Total surface area of the prism:

$$= 2(\text{base}) + \text{lateral surface area}$$

$$= 2(\text{base area}) = 2 \times 12 = 24 \text{cm}^2$$

$$\text{Lateral surface} = (5+5+5+6) \times 10 \text{cm}^2$$

$$= 160 \text{cm}^2$$

$$\text{Total surface area} = 24 + 160 = 184 \text{cm}^2$$

iii) The volume of the prism

$$= \text{cross-section area} \times \text{height} = 12 \times 10$$

$$= 120 \text{cm}^3$$

17.

Heights	Frequency	f(x)
150	3	450
155	7	1085
160	8	1280
170	3	510
180	3	540
190	1	190
	$\sum f = 25$	$\sum f(x) = 4055$

Mode = 160cm

Median = 160cm

Mean =  $\frac{4055}{25}$

= 162.2cm

18. a)  $x^3 - 6x^2 + 11x - 6$

$$\begin{array}{r} x^3 - 3x^2 \\ \hline \end{array}$$

$$3x^2 + 11x$$

$$\begin{array}{r} -3x^2 + 9x \\ \hline \end{array}$$

$$2x - 6$$

$$\begin{array}{r} 2x - 6 \\ \hline \end{array}$$

$$0$$

$$\begin{array}{r} x - 3 \\ \hline x^2 - 3x + 2 \end{array}$$

$$x^2 - 3x + 2 = x^2 - 2x - x + 2$$

$$= x(x - 2) - 1(x - 2)$$

$$= (x - 1)(x - 2)$$

Other factors are  $x - 1$  and  $x - 2$ 

b)  $x^3 + 5x^2 - 4x - 20 = 0$

$$= (x^3 + 5x^2) - (4x + 20) = 0$$

$$= x^2(x+5) - 4(x+5) = 0$$

$$= (x^2 - 4) - (x + 5) = 0$$

$$= (x - 2)(x + 2)(x + 5) = 0$$

$$x - 2 \neq 0 \quad x + 2 \neq 0 \quad x + 5 = 0$$

$$\therefore x = 2 \quad x = -2 \quad x = -5$$

The solutions are 2, -2 and -5.



19.

a) Let  $p$  be the cost of a pencil and  $b$  be the cost of an exercise book.

$$\text{So } 3p + 4b = 1350 \Rightarrow \text{(i)}$$

$$5p + 6b = 2050 \Rightarrow \text{(ii)}$$

Using equation (i);

$$: 9p + 12b = 4050 \Rightarrow \text{(iii)}$$

$$\begin{array}{r} - : 10p + 12b = 4100 \Rightarrow \text{(iv)} \\ \hline \end{array}$$

$$p + 0 = 50\text{Rwf}$$

$$p = 50\text{Rwf}$$

(Subtract equation: (iv) - (iii))

$$P = 50$$

Substitute  $P$  in equation (i)

$$= 3(50) + 4b = 1350$$

$$4b = 1350 - 150 = 1200$$

$$b = 300$$

$$10 \text{ pencils cost: } 10 \times 50 = 500\text{Rwf}$$

$$20 \text{ books cost: } 20 \times 300 = 6000\text{Rwf.}$$

b) Let John's monthly salary be  $x$  Rwf.

$$\text{Money left after accommodation} = \frac{2}{3}x$$

Money left after the car loan

$$= \frac{3}{4} \times \frac{2}{3}x = \frac{1}{2}x$$

$$\text{Money left after food} = \frac{1}{2} \times \frac{1}{2}x = \frac{1}{4}x$$

$$\text{but } \frac{1}{4}x = 50,000$$

$$\text{so } x = 200,000$$

$\therefore$  John's monthly salary is 200,000Rwf.

20. Teacher's guidance