

Rwanda National Mathematics S3 Collection (2006 - 2023)

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Top 10 study tips

1. Have all your materials ready before you begin studying: pencils, pens, papers, calculators if necessary etc.
2. Be positive. Make sure your brain holds on to the information you are learning by reminding yourself how important it is to remember the work and get the marks.
3. Take a walk outside. A change of scenery will stimulate your learning. You'll be surprised at how much more you take in after being outside in the fresh air.
4. Break up your learning sections into manageable parts. Trying to learn too much at one time will only result in a tired, unfocused and anxious brain.
5. Keep your study sessions short but effective and reward yourself with short, constructive breaks.
6. Teach your concepts to anyone who will listen. It might feel strange at first, but it is definitely worth reading your revision notes aloud.
7. Your brain learns well with colours and pictures. Try to use them whenever you can.
8. Be confident with the learning areas you know well and focus your brain energy on the sections that you find more difficult to take in.
9. Repetition is the key to retaining information you have to learn. Keep going – don't give up!
10. Sleeping at least 8 hours every night, eating properly and drinking plenty of water are all important things you need to do for your brain. Studying for exams is like strenuous exercise, so you must be physically prepared.

“ If you can’t explain it simply, you don’t understand it well enough”.
Albert Einstein

On the day of the exam ...

1. Make sure you have all the necessary stationery for your exam, i.e. pens, pencils, eraser, protractor, compass, calculator (with new batteries). Make sure you bring your ID document and examination admission letter.
2. Arrive on time, at least one hour before the start of the exam.
3. Go to the toilet before entering the exam room. You don't want to waste valuable time going to the toilet during the exam.
4. Use the 10 minutes reading time to read the instructions carefully.
5. This helps to ‘open’ the information in your brain. Start with the question you think is the easiest to get the flow going.
6. Break the questions down to make sure you understand what is being asked. If you don't answer the question properly you won't get any marks for it. Look for the key words in the question to know how to

answer it.

Try all the questions. Each question has some easy marks in it so make sure that you do all the questions in the exam.

7. Never panic, even if the question seems difficult at first. It will be linked with something you have covered. Find the connection.
8. Manage your time properly. Don't waste time on questions you are unsure of. Move on and come back if time allows.
9. Check weighting – how many marks have been allocated for your answer? Do not give more or less information than is required.
10. Write big and bold and clearly. You will get more marks if the marker can read your answer clearly.

Source: Alfie Bouwer, Sivalingam Chetty et al; 2014, ***Mind the gap, Life sciences study guide grade 12***, Department of basic education, Pretoria, South Africa.

Note: Through the questions herein are fully answered, it is highly recommended that you first read and understand the question, make your trials and then compare with what is given in the solution. It is also advisable that you read through the book several times before the final examinations.

I am certain that if a student can answer all these questions in this document with ease, he/she should be able to pass with a distinction in the ordinary level national mathematics examination.

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“Everyone is a genius. But if you judge a fish by its ability to climb a tree, it will spend its whole life believing that it is stupid. ”

Albert Einstein

“Never say you have failed until you have reached your last attempt, and never say it’s your last attempt until you have succeeded. ”

“There are no secrets to success. It’s all about preparing, hard work and learning from failure. ”

Mathematics VI

113

07 Nov 2006 08.30am -11.30 am

RWANDA NATIONAL EXAMINATIONS COUNCIL



P.O BOX 3817 KIGALI-TEL/FAX : 586871

ORDINARY LEVEL NATIONAL EXAMINATIONS 2006

SUBJECT: MATHEMATICS VI

LEVEL: TRONC COMMUN

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **TWO** sections **A** and **B**

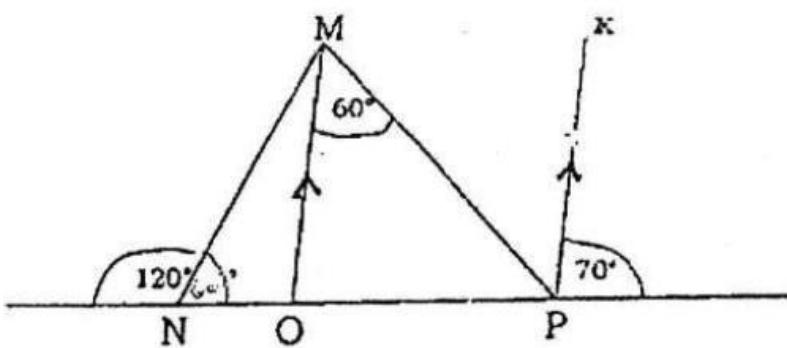
Attempt **ALL** questions in section **A** and **any THREE** questions in section **B**.

Show **ALL** working clearly.

Calculator and mathematical instruments may be used.

SECTION A: ANSWER ALL QUESTIONS**(55 MARKS)**

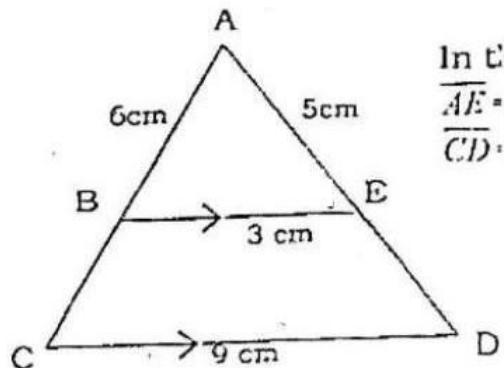
1. Simplify completely: $(0.4 \times 1\frac{2}{3}) - \frac{1}{6}$ **(3 marks)**
2. Solve for x : $3(x + 2) - 2(2x - 4) = x + 18$. **(3 marks)**
3. The simple interest for 5 years is 50,000Rwf, calculate the percentage interest rate per year. **(3 marks)**
4. Evaluate without using a calculator: $\frac{\sqrt{75} + \sqrt{27}}{\sqrt{12}}$ **(4 marks)**
5. Solve: $2x - 4 < 3x + 7$. Illustrate the solution on a graph. **(3 marks)**
- 6.



From the diagram, determine the size of:

- (a) Angle MOP **(0.5 mark)**
(b) Angle MPO **(1.5 marks)**
(c) Angle NMO **(3 marks)**
7. Given that $x = -2$ and $y = 4$, find the value of $xy^2 - 2(x - y)$ **(3 marks)**
 8. Plot the vectors to show that points R(0, 2), S(2, 4) and T(5, 7) are collinear (that the three points lie on the same line). **(4 marks)**
 9. M is inversely proportional to n. When m = 4, n = 4. Find n when m = 2. **(3 marks)**
 10. Given that functions $f(x) = x^2 - 1$ and $g(x) = 3x - 1$, find x when $fg(x) = 0$. **(4 marks)**

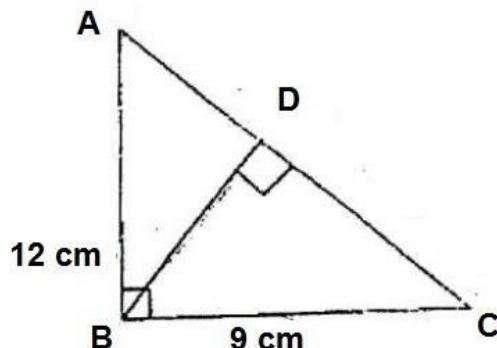
11. In the figure below, \overline{BE} is parallel to \overline{CD} . $\overline{AE} = 5\text{cm}$, $\overline{AB} = 6\text{cm}$, $\overline{BE} = 3\text{cm}$ and $\overline{CD} = 9\text{cm}$. Calculate: (a) Length BC
 (b) Length AD
- (2 marks)
 (2 marks)



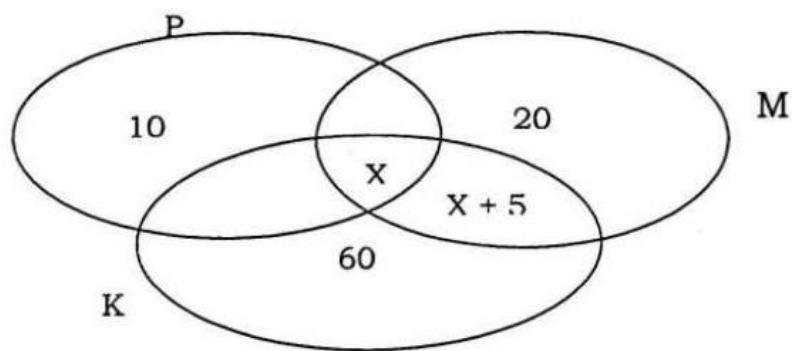
12. Solve the following simultaneous equations: (4 marks)

$$\begin{aligned}x + y &= 1 \\3x - 2y &= 8\end{aligned}$$

13. In the figure below ABC is a right angled triangle and \overline{BD} is perpendicular to \overline{AC} . Calculate \overline{BD} .



14. The Venn diagram below shows the number of senior three pupils in a school who like Mathematics (M), Physics (P) and Kinyarwanda (K). 55 pupils like Mathematics.



- a) How many pupils like the three subjects? (2 marks)

b) Find the total number of senior three pupils in the school. **(1 mark)**

c) Pupils who like Physics and Kinyarwanda only? **(1 mark)**

15. If one solution of $x^2 + ax + 6 = 0$ is -2 . Find a and the other solution. **(4 marks)**

SECTION B: Answer THREE questions (45 marks)

16. (a) Simplify completely: $\frac{6x^2+13x+6}{4x+6}$ **(5 marks)**

(b) Solve: $2x^3 + 9x^2 - 2x - 24 = 0$ **(10 marks)**

17. The weights of babies born during December 2005 at a hospital are shown in the table below:

Weight of babies	2.2	2.3	2.4	2.5	2.6	2.7	2.8	3.0
Frequency	4	2	1	5	6	8	4	9

- a) i) Find the total number of babies born in December 2005. **(1 mark)**
ii) Find the number of babies weighing more than 2.5 kg. **(1 mark)**
iii) Find the range of the masses. **(1 mark)**
iv) Find the mode of the class. **(1 mark)**
v) Find the median of the class. **(2 marks)**
vi) Find the mean mass. Correct the answer to one decimal place. **(5 marks)**

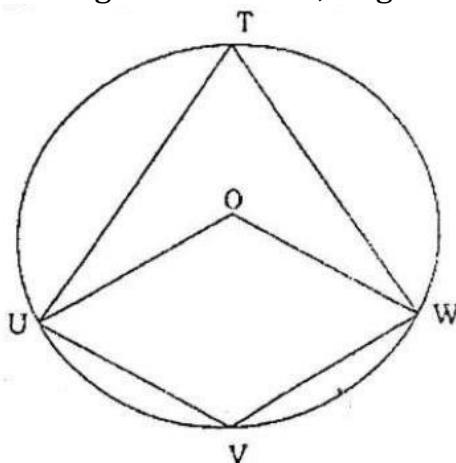
- b) If the ratio of baby girls to baby boys is 5:8, find the number of:
i) Baby girls born in December 2005. **(2 marks)**
ii) Baby boys born in December 2005. **(2 marks)**

18. (a) In a restaurant 3 cups of tea and 2 cups of coffee altogether cost 2900Rwf. In a hotel 4 cups of tea and 3 cups of coffee cost 4100Rwf. Find the cost of: i) a cup of tea.
ii) a cup of coffee. **(9 marks)**

(b) A car can be bought on cash or on hire purchase. The price of the car is 5,000,000 Rwf. By hire purchase, it can be bought by paying a 30% deposit of cash and the balance paid back in 7 months instalment of 600,000 Rwf.

- (i) Find the price of the car on hire purchase terms. **(4.5 marks)**
(ii) Calculate the extra money paid for the car by hire-purchase than cash. **(1.5 marks)**

19. The figure below is a circle with center O. Angle $UTW = 70^\circ$, angle $TWO = 40^\circ$ and angle $VUO = 35^\circ$, angle $UOW = y$, angle $TUO = z$ and $UVW = x^\circ$.



- (a) Calculate the size of angle i) x **(1 mark)**
 ii) y **(1 mark)**
 iii) z **(3 marks)**
 iv) UWT **(3 marks)**
- (b) The length of minor arc UVW is 10.99cm. Calculate the area of the circle. $\pi = 3.14$. Correct the answer to one decimal place. **(7 marks)**
20. Points A (5, 4), B (2, 2) and C (6, 2) are vertices ABC.
- (a) Use the graph paper in your answer booklet and draw triangle ABC on a Cartesian plane.
- (b) Triangle ABC is rotated anti-clockwise about the origin. If the angle of rotation is $+90^\circ$, find:
- (i) The coordinates of A' , B' and C' the images of points A, B and C.
 - (ii) Draw triangle $A', B'C'$ on the same graph as in 20(a).
- (c) The image of A (5, 4) under a translation is (3, 3). Find coordinates of images of
- (d) The image of C (6, 2) under a reflection is (2, 2). Find the equation of reflection and image of A and B.

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2006

Section A: Answer all questions

1. $(0.4 \times 1\frac{2}{3}) - \frac{1}{6} = (\frac{4}{10} \times \frac{5}{3}) - \frac{1}{6} = \frac{4}{6} - \frac{1}{6} = \frac{3}{6} = \frac{1}{2}$

2. $3(x + 2) - 2(2x - 4) = x + 18$

$$2x + 6 - 6x + 8 = x + 18$$

$$3x - 6x - x = 18 - 6 - 8$$

$$-4x = 4$$

$$4x = -4$$

$$x = -\frac{4}{4}$$

$$x = -1$$

3. The annual rate is $= \frac{50,000 \times 100}{200,000 \times 5} = 5$

The rate is 5%.

4. $\frac{\sqrt{75} + \sqrt{27}}{\sqrt{12}} \times \frac{\sqrt{12}}{\sqrt{12}} = \frac{\sqrt{900} + \sqrt{324}}{\sqrt{144}} = \frac{30+18}{12} = \frac{48}{12} = 4$

5. $2x - 4 < 3x + 7$.

$$2x - 3x < 7 + 4$$

$$-x < 11$$

$$x > -11$$

6. a) $MOP = 70^\circ$

b) $MPO = 180 - (60 + 70) = 50^\circ$

c) $NMO = 180 - (110 + 60) = 10^\circ$

7. $x = -2$ and $y = 4$

$$xy^2 - 2(x - y) = (-2)4^2 - 2(-2 - 4) = -32 + 12 = -20$$

8. $RS = \binom{2-0}{4-2} = 2\binom{2}{2} = 2\binom{1}{1}$

$$ST = \binom{5-2}{7-4} = \binom{3}{2} = 3\binom{1}{1}$$

9. M is inversely proportional to N

$$m = \frac{k}{n}$$

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

$$k = 4 \times 3$$

$$k = 12$$

$$\text{Hence } m = \frac{12}{n}$$

$$2 = \frac{12}{n}$$

$$n = \frac{12}{2}$$

$$n = 6$$

10. $f[g(x)] = (3x - 1)^2 - 1$

$$9x^2 - 6x + 1 - 1 = 0$$

$$9x^2 - 6x = 0$$

$$3x(3x - 2) = 0$$

$$x = 0 \text{ or } x = \frac{2}{3}$$

11. a) $\frac{AB}{AC} = \frac{BE}{CD} \Leftrightarrow \frac{AB}{AB+BC} = \frac{BE}{CD}$

If $BC = x \text{ cm}$

$$\frac{6}{6+x} = \frac{3}{9}$$

$$54 = 18 + 3x$$

$$3x = 54 - 18$$

$$3x = 36$$

$$x = \frac{36}{3}$$

$$x = 3$$

b) $\frac{AE}{AD} = \frac{BE}{CD} \Leftrightarrow \frac{AE}{AB+DE} = \frac{BE}{CD}$

If $ED = y \text{ cm}$

$$\text{Then } \frac{5}{5+y} = \frac{3}{9}$$

$$15 + 3y = 45$$

$$3y = 45 - 15$$

$$3y = 30$$

$$y = \frac{30}{3}$$

$$y = 10$$

$$AD = 10 + 5 = 15 \text{ cm}$$

12. $x + y = 1$ (i)

$$3x - 2y = 8$$
 (ii)

From equation (i) $x = 1 - y$

Replace the value of x in equation (ii). We get

$$3(1 - y) - 2y = 8$$

$$3 - 3y - 2y = 8$$

$$3 - 5y = 8$$

$$-5y = 8 - 3$$

$$-5y = 5$$

$$y = -\frac{5}{5}$$

$$y = -1$$

$$x = 1 - y = 1 - (-1)$$

$$x = 1 + 1$$

$$x = 2$$

13.

14. $x + x + 5 + 20 = 55$

$$2x = 55 - 25$$

$$2x = 30$$

$$x = 15$$

a) The number of pupils who like the three subjects is equal to $x = 15$

b) The total number of senior three pupils in the school

$$= 10 + x + 60 + x + 5 + 20 = 2x + 95 = 30 + 95 = 125$$

c) Pupils who like Physics and Kinyarwanda only = 0

$$15. x^2 + ax + 6 = 0$$

One solution of $x^2 + ax + 6 = 0$ is -2

$$\text{So } (-2)^2 + a(-2) + 6 = 0$$

$$4 - 2a + 6 = 0$$

$$-2a = -10$$

$$2a = 10$$

$$a = \frac{10}{2}$$

$$a = 5$$

$$x^2 + 5x + 6 = 0$$

$$\Delta = b^2 - 4ac = 5^2 - 4 \times 1 \times 6 = 25 - 24 = 1$$

$$\sqrt{\nabla} = \sqrt{1} = 1$$

$$x_1 = \frac{-b+\sqrt{\nabla}}{2a} = \frac{-5+1}{2} = \frac{-4}{2} = -2$$

$$x_2 = \frac{-b-\sqrt{\nabla}}{2a} = \frac{-5-1}{2} = \frac{-6}{2} = -3$$

The other solution is -3

SECTION B: Attempt any THREE questions in this section

$$16. \text{ (a)} \frac{6x^2+13x+6}{4x+6} = \frac{6x^2+9x+4x+6}{4x+6} = \frac{3x(2x+3)+2(2x+3)}{2(2x+3)} = \frac{(3x+2)(2x+3)}{2(2x+3)} = \frac{3x+2}{2}$$

$$\text{(b)} \quad 2x^3 + 9x^2 - 2x - 24 = 0$$

$x = -2$ is a solution of this equation.

$$\begin{array}{r} 2 & 9 & -2 & | & -24 \\ x = -2 & & -4 & -10 & | & 24 \\ \hline & 2 & 5 & -12 & | & 0 \end{array}$$

$$2x^3 + 9x^2 - 2x - 24 = (x + 2)(2x^2 + 5x - 12)$$

$$2x^2 + 5x - 12 =$$

$$\Delta = b^2 - 4ac = 5^2 - 4 \times 2 \times (-12) = 25 - 96 = 121$$

$$\sqrt{\nabla} = \sqrt{121} = 11$$

$$x_1 = \frac{-b+\sqrt{\nabla}}{2a} = \frac{-5+11}{4} = \frac{6}{4} = \frac{3}{2}$$

$$x_2 = \frac{-b-\sqrt{\Delta}}{2a} = \frac{-5-11}{4} = \frac{-16}{4} = -4$$

$$2x^3 + 9x^2 - 2x - 24 = (x+2)(x+4)(x-\frac{3}{2})$$

$$x = -2 \text{ or } x = -4 \text{ or } x = \frac{3}{2}$$

17.

i	Xi	Ri	Ric	RiXi
1	2.2	4	4	8.8
2	2.3	2	6	4.6
3	2.4	1	7	2.4
4	2.5	5	12	12.5
5	2.6	6	18	15.6
6	2.7	8	26	21.6
7	3	9	39	27
8	3	9	39	27
		$\sum Ri = 39$		$\sum RiXi = 104$

a) i) $4 + 2 + 1 + 5 + 6 + 8 + 4 + 9 = 39$

ii) $6 + 4 + 8 + 9 = 27$

iii) 0.8 kg

iv) Mode = 2.0 kg

v) Median = 2.7 kg

vi) Mean mass = 2.6 kg

b) i) 15 baby girls

ii) 24 baby boys

18. a) Let one cup of tea be x

Let one cup of coffee be y

$$3x + 2y = 2900 \quad (i)$$

$$4x + 3y = 4900 \quad (ii)$$

Multiply equation (i) by 4 and equation (ii) by 3

$$12x + 8y = 11600 \quad (iii)$$

$$12x + 9y = 12300 \text{ (iv)}$$

Then equation (iii) minus equation (iv)

$$-y = -700$$

$$y = 700$$

Replace the value of y in the equation (i)

$$3x = 2900 - 2y = 2900 - 1400 = 1500$$

$$3x = \frac{1500}{3}$$

$$x = 500$$

A cup of tea costs 500 Rwf and a cup of coffee costs 700 Rwf.

b) i) Price of the car in hire purchase:

$$\text{Deposit} = \frac{30}{100} \times 5,000,000 = 1,500,000$$

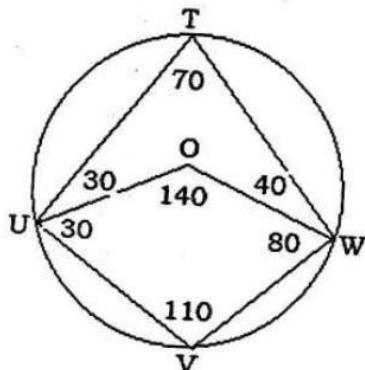
$$\text{Balance} = 5,000,000 - 1,500,000 = 3,500,000 \text{ Rwf}$$

$$6,000,000 \text{ in 7 months instalment} = 600,000 \times 7 = 4,200,000$$

$$\text{Price of the car on hire purchase terms} = 1,500,000 + 4,200,000 = 5,700,000 \text{ Frw}$$

$$\text{ii) Extra money paid for the car by hire purchase than cash} = 5,700,000 \\ - 5,000,000 = 700,000 \text{ Frw}$$

19. a)



$$\text{i)} x = 180^\circ - 70^\circ = 110^\circ$$

$$\text{ii)} y = 2x = 2 \times 70 = 140^\circ$$

$$\text{iii)} z + 30 + 40 + 80 = 180$$

$$z + 150 = 180$$

$$z = 180 - 150 = 30^\circ$$

$$\text{iv)} \text{UWT} = 115^\circ$$

b) Length of arc UVW = 10.99 cm

First find the radius of the circle $S = \frac{\theta}{360} \times 2\pi r$

$$10.99 = \frac{140}{360} \times 2 \times \frac{22}{7} \times r$$

$$10.99 = \frac{22r}{9}$$

$$22r = 98.91$$

$$r = 4.5 \text{ cm}$$

$$A = \pi r^2 = \frac{22}{7} \times 4.5 \times 4.5 = 63.5 \text{ cm}^2$$

20.

Mathematics VI

012

31 Oct 2007 08.30 – 11.30 am

RWANDA NATIONAL EXAMINATIONS COUNCIL



P.O BOX 3817 KIGALI-TEL/FAX : 586871

ORDINARY LEVEL NATIONAL EXAMINATIONS 2007

SUBJECT: MATHEMATICS VI

DURATION: 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**.

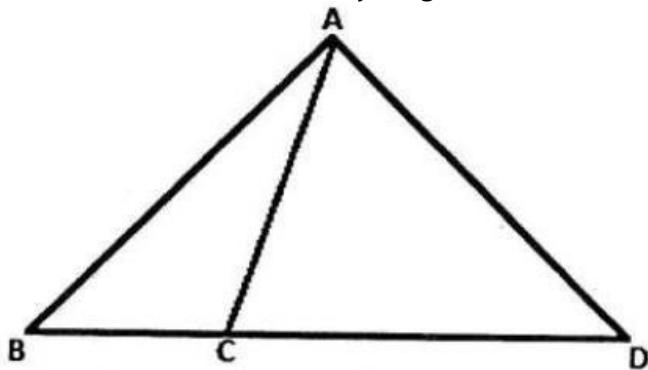
Show **ALL** working clearly

Calculators and mathematical instruments may be used except when otherwise stated.

Diagrams are not drawn to scale.

SECTION A: ANSWER ALL QUESTIONS**(55 MARKS)**

1. Calculate without using a calculator: $\frac{3.45^2 - 0.55^2}{4}$ **(3 marks)**
2. Find the equation of the line through the points $(0, 2)$ and $(2, 10)$. **(3 marks)**
3. Solve the quadratic equation: $2x^2 + 8x = -6$ **(3 marks)**
4. In a class of 40 pupils, 30 play football and 23 play basketball. 20 pupils play both games. How many pupils play neither? **(3 marks)**
5. If $f(x) = mx + n$, where m and n are integers and $f(0) = 2, f(-1) = -1$.
Find m and n . **(3 marks)**
6. In the triangle ABD , angle $ABD = x^\circ$, angle $BAC = 40^\circ$, angle $CAD = 2x^\circ$ and $\overline{AB} = \overline{AD}$. Find the size of angle ACD . **(3 marks)**

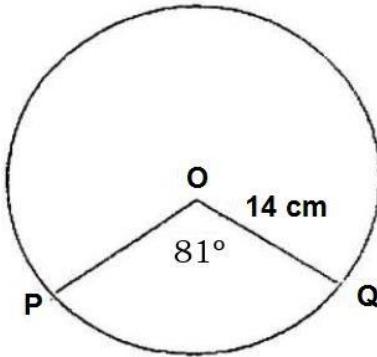


7. Solve the simultaneous equations: **(4 marks)**
 $2a + 3b = 16$
 $4a + 5b = 28$
8. 3 pupils share 36 sweets in the ratio $m: 3m: 5m$. How many sweets does each pupil get? **(4 marks)**
9. Solve the following inequality and illustrate the solution set on a number line: $0.25y - (y + 1) \geq 3$. **(4 marks)**

10. In the figure below, O is the centre of the circle. Calculate:

- (a) The length of the major arc PQ.
(b) The area of the minor sector OPQ.

(2 marks)
(2 marks)



11. 2,000,000 Rwf is invested at 12% per year compound interest. Find:

- (a) The amount of investment after 3 years.
(b) The interest after 4 months.

(2 marks)
(2 marks)

12. Under enlargement the volume of a cube is 216 cm^3 . If the volume of the object cube is 27 cm^3 , find: a) Enlargement linear scale factor. (2 marks)

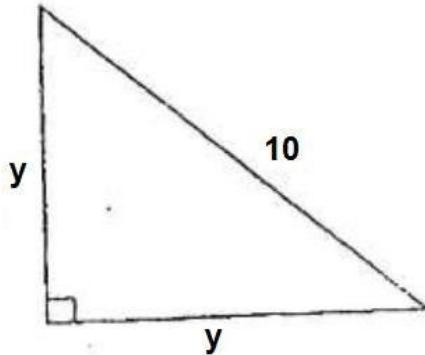
b) The total surface area of the enlarged cube.
(2 marks)

13. Given vectors $\vec{a} = \begin{pmatrix} 7 \\ -3 \end{pmatrix}$, $\vec{b} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$ and $\vec{c} = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$. Find:

- (a) $\vec{a} + \vec{b} + \vec{c}$.
(b) The length of $\vec{a} + \vec{b} + \vec{c}$.

(2 marks)
(2 marks)

14. The figure below is a right angled triangle. Show that $y = 5\sqrt{2}$. (3 marks)



15.

Section B: Answer only THREE questions (45 marks)

16. a) Given the equation $2y + x = 6$

- (i) Complete the table below:

(4 marks)

x	-2		2	4
y		3		

- ii) Plot these points on the graph paper provided in your answer booklet and join them with a line. **(6 marks)**
- iii) Use letter A to indicate where you read the value of x when $y = 0$. **(1 mark)**
- iv) Write the value of x when $y = 0$. **(1 mark)**

b) On the same graph as that of 16 (a) (ii) draw the graph of $y = 2$. Find the coordinates of intersection of $y = 2$ and $2y + x = 6$. **(3 marks)**

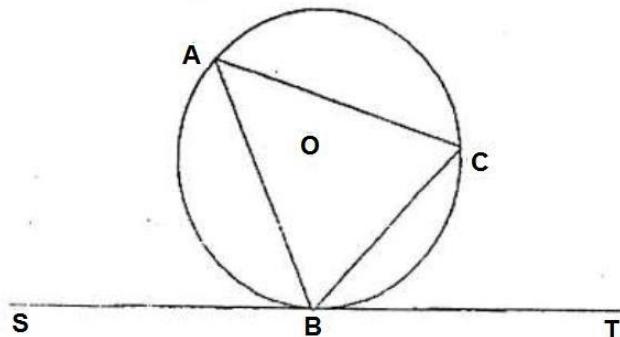
17. (a) Simplify: $\frac{2x+1}{3} - \frac{x+3}{2} + \frac{x+1}{6}$ **(5 marks)**

(b) Simplify completely: $\frac{3x^3 - 4x^2 - x + 2}{3x^2 - 6x + 3}$ **(10 marks)**

18. (a) Solve: $2x^4 + 4x^3 - 10x^2 - 12x = 0$ **(9 marks)**

(b) One of the roots of $ax^2 + 5x + 2 = 0$ is -2 , find the other root. **(6 marks)**

19. In the figure below, O is the centre of the circle. The straight line SBT is a tangent to the circle.



(a) Show that angle CBT is equal to triangle BAC. Give reasons to support your answer. **(10 marks)**

(b) If angle ACB = 37° and angle BAC = 64° , find:

- i) Angle ABS **(2 marks)**
 ii) Angle ABC **(2 marks)**
 iii) Angle CBT **(1 mark)**

20. The table below shows the marks scored by 25 pupils in a mathematics test marked out of 50.

27	35	40	42	28	40	28	42	27
28	28	35	40	42	35	40	28	35
27	40	28	35	40	28	42.		

(a) Copy the table below and complete it using the above data.

<i>Mark (X)</i>	<i>Frequenc (f)</i>	<i>F(X)</i>	Cumulative frequency

(b) Find the mode.

(c) Find the median.

(d) Find the mean.

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2007

Section A: Answer all questions

1. $\frac{3.45^2 - 0.55^2}{4} = \frac{(3.45+0.55)(3.45-0.55)}{4} = \frac{4 \times 2.9}{4} = 2.9$

2. The slope $= \frac{10-2}{2-0} = \frac{8}{2} = 4$

The equation of the line is $y - 2 = 4(x - 0)$

$$y - 2 = 4x$$

$$y = 4x + 2$$

3. $2x^2 + 8x = -6$

$$2x^2 + 8x + 6 = 0$$

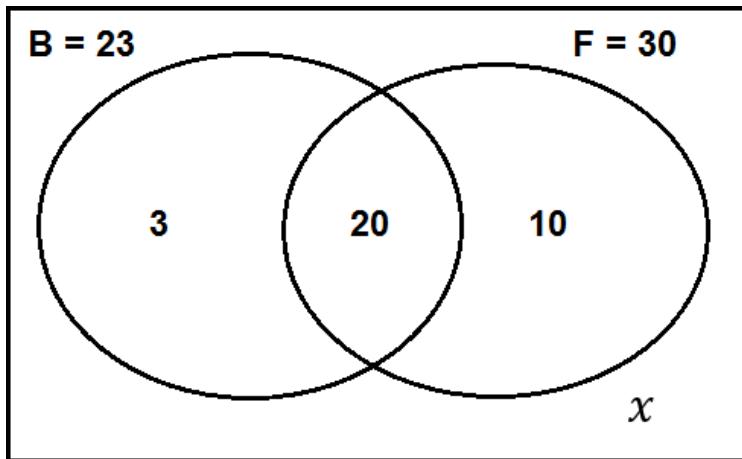
$$2x^2 + 6x + 2x + 6 = 0$$

$$2x(x + 3) + 2(x + 3) = 0$$

$$(2x + 2)(x + 3) = 0$$

$$x = -1 \text{ or } x = -3$$

4. $n(F) = 30, n(B) = 23, n(F \cap B) = 20, n(C) = 40 \quad C = 40$



$$x + 20 + 10 + 3 = 40$$

$$33 + x = 40$$

$$x = 40 - 33$$

$$x = 7$$

7 pupils play neither game.

5. $f(0) = n = 2$
 $f(-1) = -m + n = -1$

$$\begin{aligned} -m + 2 &= -1 \\ m &= 2 + 1 \\ m &= 3 \\ m = 3 \text{ and } n &= 2 \end{aligned}$$

6. $x + x + 40 + 2x = 180^\circ$

ABD is an isosceles triangle

$(AB = AD = x)$

$4x = 140$

$x = \frac{140}{4}$

$x = 35^\circ$

In triangle ACD; angle ACD = $180 - (2x + x) = 180 - (70 + 35) = 75^\circ$

7. $2a + 3b = 16 \quad (i)$

$4a + 5b = 28 \quad (ii)$

Multiply equation (1) by 2

$4a + 6b = 32 \quad (iii)$

Equation (iii) minus equation (ii)

$4a + 6b = 32$

$4a + 5b = 28$

We get $b = 4$

Using equation 1 $2a + 3 \times 4 = 16$

$2a = 16 - 12$

$2a = 4$

$a = \frac{4}{2} = 2$

8. $m + 3m + 5m = 9m$

$9m = 36$

$m = 4$

The first student will get $m = 4$ sweets

The second student will get $3m = 3 \times 4 = 12$ sweets

The third student will get $5m = 5 \times 4 = 20$ sweets

9. $0.25y - (y + 1) \geq 3$

$\frac{y}{4} - y - 1 \geq 3$

$$y - 4y - 4 \geq 12$$

$$-3y \geq 12 + 4$$

$$-3y \geq 16$$

$$-y \geq \frac{16}{3}$$

$$y \leq \frac{16}{3}$$

10. a) Length of the major arc PQ = $2 \times 14 \times \frac{22}{7} \times \frac{279}{360} = 68.2 \text{ cm}$

b) Area of the small sector OPQ = $14 \times 1 \times \frac{81}{360} \times \frac{22}{7} = 138.6 \text{ cm}^2$

11. a) 1st year = $\frac{2,000,000 \times 12 \times 1}{100} = 240,000$

$$\text{New amount after 1 year} = 2,000,000 + 240,000 = 2,240,000$$

$$2^{\text{nd}} \text{ year} = \frac{2,240,000 \times 12 \times 1}{100} = 268,800$$

$$\text{New amount after 2 years} = 2,240,000 + 268,000 = 2,508,800$$

$$3^{\text{rd}} \text{ year} = \frac{2,508,800 \times 12 \times 1}{100} = 301,056$$

$$\text{New amount after 3 years} = 2,508,800 + 301,056 = 2,809,856$$

b) Interest after 4 months = $\frac{2,000,000 \times 12 \times 4}{100 \times 12} = 80,000 \text{ Rwf}$

12. a) The homothetic ratio = $\frac{\sqrt[3]{216}}{\sqrt[2]{27}} = \frac{6}{3} = 2$

b) The enlarged edge of the cube = $\sqrt[3]{216} = 6 \text{ cm}$

$$\text{Total surface area} = 6 \times 6 \times 6 = 216 \text{ cm}^2$$

13. (a) $\vec{a} + \vec{b} + \vec{c} = \begin{pmatrix} 7 \\ -3 \end{pmatrix} + \begin{pmatrix} -2 \\ 3 \end{pmatrix} + \begin{pmatrix} -2 \\ 4 \end{pmatrix} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$

(b) The length of $\vec{a} + \vec{b} + \vec{c} = \sqrt{3^2 + 4^2} = \sqrt{9 + 16} = \sqrt{25} = 5 \text{ units}$

14. $y^2 + y^2 = 10^2$

$$2y^2 = 100$$

$$y^2 = 50$$

$$y = \sqrt{50} = \sqrt{25 \times 2} = 5\sqrt{2}$$

15. a) Under a reflection $y = 2: R(2, -1)$

b) For a rotation of -90° on $(0, 0)$; $(2, 5) \Leftrightarrow (5, 2)$

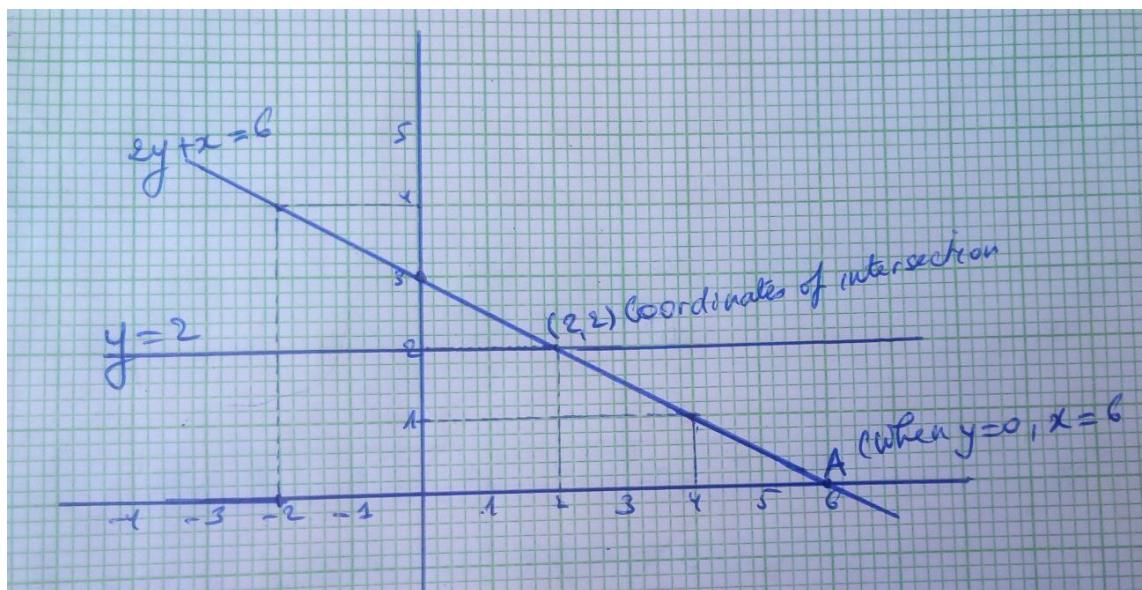
c) $T(2, 5) \Leftrightarrow (2 + (-3)), (5, (-1)) = (-1, 4)$

SECTION B: ANSWER ONLY THREE QUESTIONS

16. a)

x	-2	0	2	4
y	4	3	2	1

b)



17. (a) $\frac{2x+1}{3} - \frac{x+3}{2} + \frac{x+1}{6} = \frac{2(x+1)-3(x+3)+(x+1)}{6} = \frac{4x+2-3x-9+x+1}{6} = \frac{2x-6}{6} = \frac{2(x-3)}{6} = \frac{x-3}{3}$

(b) $\frac{3x^3-4x^2-x+2}{3x^2-6x+3} = \frac{(x-1)(x-1)(3x+2)}{3(x-1)(x-1)} = \frac{3x+2}{3}$

18. (a) $2x^4 + 4x^3 - 10x^2 - 12x = 0$

$$2x^4 + 4x^3 - 10x^2 - 12x = 2x(x^3 + 2x^2 - 5x - 6)$$

$$\begin{array}{r} 1 \quad 2 \quad -5 \quad | \quad -6 \\ x = 2 \qquad \qquad 2 \quad 8 \quad | \quad 6 \\ \hline 1 \quad 4 \quad 3 \quad | \quad 0 \end{array}$$

$$x^3 + 2x^2 - 5x - 6 = (x - 2)(x^2 + 4x + 3)$$

$$2x^4 + 4x^3 - 10x^2 - 12x = 2x(x - 2)(x^2 + 4x + 3)$$

$$x^2 + 4x + 3 =$$

$$\Delta = b^2 - 4ac = 4^2 - 4 \times 1 \times 3 = 16 - 12 = 4$$

$$\sqrt{V} = \sqrt{4} = 2$$

$$x_1 = \frac{-b+\sqrt{V}}{2a} = \frac{-4+2}{2} = \frac{-2}{2} = -1$$

$$x_2 = \frac{-b-\sqrt{V}}{2a} = \frac{-4-2}{2} = \frac{-6}{2} = -3$$

$$x^2 + 4x + 3 = (x + 3)(x + 1)$$

$$2x^4 + 4x^3 - 10x^2 - 12x = 2x(x - 2)(x + 3)(x + 1)$$

$$x = 0 \text{ or } x = 2 \text{ or } x = -3 \text{ or } x = -1$$

$$S = (-3, -1, 0, 2)$$

(b) One of the roots of $ax^2 + 5x + 2 = 0$ is -2

$$a(-2)^2 + 5(-2) + 2 = 0$$

$$4a - 10 + 2 = 0$$

$$4a - 8 = 0$$

$$4a = 8$$

$$a = \frac{8}{4}$$

$$a = 2$$

$$\text{Thus } 2x^2 + 5x + 2 = 0$$

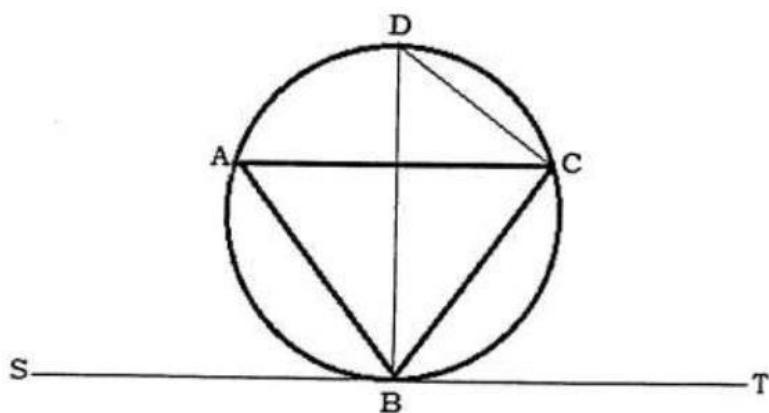
$$2x^2 + 4x + x + 2 = 0$$

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

$$(2x + 1)(x + 2) = 0$$

$$x = -\frac{1}{2} \text{ or } x = -2$$

19. a)



Draw line BD through the centre O and attach D to C. $BAC = BDC$ because they intercept the same arc.

$\text{CBT} + \text{CBD} = 90^\circ$ (diameter BD is tangent to SBT)

$\text{BDC} + \text{CBD} = 90^\circ$, thus $\text{CBT} = \text{BDC}$ but $\text{CBT} = \text{CBT}$, hence $\text{CBT} = \text{BAC}$.

b) i) Angle $\text{ABS} = \text{ACB} = 37^\circ$

ii) Angle $\text{ABS} + \text{ABC} + \text{CBT} = 180^\circ$

$$\text{Thus } 37^\circ + \text{ABC} + 64^\circ = 180^\circ$$

$$\text{ABC} = 180^\circ - 37^\circ - 64^\circ = 79^\circ$$

iii) Angle $\text{CBT} = 64^\circ$

20. (a)

Mark (X)	Frequenc (f)	F(X)	Cumulative frequency
27	3	81	3
28	7	196	10
35	5	175	15
40	6	240	21
42	4	168	25
	$\sum f = 25$	$\sum fx = 860$	

b) Mode = 28

c) The median = 35

d) The mean = $\frac{860}{25} = 34.4$

Mathematics V

012

5th Nov 2008 08.30am -11.30 am

RWANDA NATIONAL EXAMINATIONS COUNCIL



P.O BOX 3817 KIGALI-TEL/FAX : 586871

ORDINARY LEVEL NATIONAL EXAMINATIONS 2008

SUBJECT: MATHEMATICS V

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **TWO** sections **A** and **B**

Attempt **ALL** questions in section A **(55 marks)**

and any **THREE** questions in section B. **(45 marks)**

Show **ALL** working clearly.

Calculators and mathematical instruments may be used except when otherwise stated.

Diagrams are not drawn to scale.

SECTION A: ANSWER ALL QUESTIONS**(55 MARKS)**

1. Simplify completely: $(2\frac{2}{5} - \frac{3}{7}) \div 1\frac{2}{7}$ **(3 marks)**
2. Find the equation of the line parallel to $y = 4x + 1$ which passes through point $(-3, -5)$ **(3 marks)**
3. Simplify: $\frac{\sqrt{162} + \sqrt{18}}{\sqrt{32}}$ **(3 marks)**
4. Simplify: $\frac{2x^3 - 3x^2 - 2x}{2x^2 + x}, x \neq 0$ **(4 marks)**
5. Given that $104_n = 29_{ten}$ find n . **(4 marks)**
6. The base of a parallelogram is $(3x - 2)cm$ and the height is $(x + 1)$. Find the height of the parallelogram if its area is 12 cm^2 . **(5 marks)**
7. Solve the following inequality: $\{2x - (4x - 1) < 4 < +x\} \cap \{5x + 1 < x + 9\}$. Illustrate the equation on a graph. **(5 marks)**
8. There are enough cow feeds to feed 360 cows for 21 days. Find how many more cows would be needed for the same feeds to last 12 days. **(4 marks)**
9. Solve simultaneously: $y = 6 - 3x$
 $3y + 4x = 8$ **(5 marks)**
10. Solve: $(x + 1)(x + 2) = (x - 3)^2 + 5$. **(4 marks)**
11. A chord 60 cm long is in a circle with a diameter 80 cm. How far is the chord from the centre of the circle? **(2 marks)**
12. An arc subtends an angle of 72° at the centre of the circle whose radius is 10 cm. Calculate the area of the minor sector of the circle. $\pi = 3.14$.
(2 marks)

SECTION B: Answer THREE questions (45 marks)

13. (a) 10 mathematics books and 5 physics books cost 220,000 Rwf; 6 mathematics books and 8 physics books cost 232,000 Rwf. Find the cost of one physics book. **(8 marks)**
(b) Solve: $6x^3 + 5x^2 - 22x - 24 = 0$. **(7 marks)**
14. (a) Using a ruler, a pair of compasses and a protractor only, construct a triangle ABC in which line AB = 7cm, line BC = 5cm and line AC = 8cm. **(6 marks)**
(b) Measure angles A, B and C. Write the measurements you have got. **(3 marks)**

- (c) Draw a perpendicular line from line A to side BC. How long is the perpendicular line? **(4 marks)**
 (d) Calculate the area of triangle ABC. **(2 marks)**

15. If A (2, 3), B(4, -2) and C(4, -2) are vertices of triangle BC.

- (a) Plot points A, B and C on a cartesian plane. Join the points to form a triangle ABC.
 (b) Determine the coordinates of A', B' and C', the images of A, B and C respectively after a reflection in line $x = 0$. Draw triangle ABC on the same Cartesian plane as in 17 (a).
 (c) What are the coordinates of A''B'' and C'', the images of A, B and C, under a translation described by $\begin{pmatrix} 2 \\ 1 \end{pmatrix}$? Draw triangle A''B''C'' on the same Cartesian plane as in 17 (a).

16. The masses of 50 boys are given in the table below:

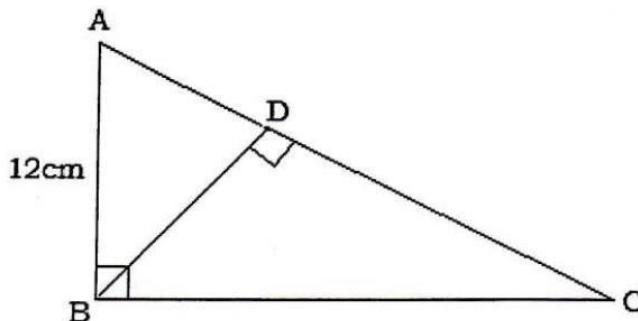
Mass (kg)	40 - 44	45 - 49	50 - 54	55 - 59
Frequency	15	18	13	4

- a) Find the modal class and its limits. **(2 marks)**
 b) Determine the working mean. **(1 mark)**
 c) Copy and complete the table using the data in the above table. **(8 marks)**

Class	Mid-interval of class x	Difference from the working mean d	Frequency	fd
40 - 44				
45 - 49				
50 - 54				
55 - 59				

- d) Find $\sum fd$. **(2 marks)**
 e) Calculate the mean mass. **(2 marks)**

17. In the figure below, triangle ABC and triangle BDC are right angled triangles.



- a) Show that triangle ABC is similar to triangle BDC. **(5 marks)**
 b) If the area of triangle ABC, find:
 i) The length DC. **(6 marks)**
 ii) The length BD **(2 marks)**

iii) The area of triangle BD.

(2 marks)

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2008

Section A: Answer all questions

1. $(2\frac{2}{5} - \frac{3}{7}) \div 1\frac{2}{7} = (\frac{12}{5} - \frac{3}{7}) \div \frac{9}{7} = \frac{84-15}{35} \div \frac{9}{7} = \frac{69}{35} \times \frac{7}{9} = \frac{69}{45}$

2. Equation of the line: $(y + 5) = 4(x + 3)$

$$y + 5 = 4x + 12$$

$$y = 4x + 12 - 5$$

$$y = 4x + 7$$

3. $\frac{\sqrt{162} + \sqrt{18}}{\sqrt{32}} \times \frac{\sqrt{32}}{\sqrt{32}} = \frac{\sqrt{5184} + \sqrt{576}}{32} = \frac{72+24}{32} = \frac{96}{32} = 3$

4. $\frac{2x^3 - 3x^2 - 2x}{2x^2 + x} = \frac{x(2x^2 - 3x - 2)}{2(x^2 + 1)} = \frac{x(2x-1)(x-1)}{2x-1} = x - 2$

5. $104_n = 29_{ten}$

$$104_n = 1 \times n^2 + 0 \times n^1 + 4 \times n^0 = n^2 + 4 = 29$$

$$n^2 = 29 - 4$$

$$n^2 = 25$$

$$n = \sqrt{25}$$

$n = +5$ or -5 (*rejected*)

Therefore $n = 5$

6. Area of a parallelogram = Base x Height = $(3x - 2)(x + 1)$

$$= 3x(x + 1) - 2(x + 1)$$

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

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

$$3x^2 + x - 14 = 0$$

$$3x^2 - 6x + 7x - 14 = 0$$

$$3x(x - 2) + 7(x - 2) = 0$$

$$(3x + 7)(x - 2) = 0$$

$$3x + 7 = 0 \text{ or } x - 2 = 0$$

$$x = -\frac{7}{3} \text{ (rejected)}$$

or $x = 2$

The height of the parallelogram is $x + 1 = 2 + 1 = 3 \text{ cm}$

7.

8. $21 \text{ days} \rightarrow 360 \text{ cows}$

$1 \text{ day} \rightarrow (360 \times 21) \text{ cows}$

$$12 \text{ days} \rightarrow \frac{360 \times 21}{12} = 630 \text{ cows}$$

More cows needed = $630 - 360 = 270$ cows

9. $y = 6 - 3x$

$$3y + 4x = 8$$

$$3(6 - 3x) + 4x = 8$$

$$18 - 9x + 4x = 8$$

$$18 - 5x = 8$$

$$5x = 18 - 8$$

$$5x = 10$$

$$x = \frac{10}{2}$$

$$x = 2$$

$$y = 6 - 3x = 6 - 3 \times 2 = 6 - 6 = 0$$

10. $(x + 1)(x + 2) = (x - 3)^2 + 5$

$$x^2 + 2x + x + 2 = x^2 - 3x - 3x + 9 + 5$$

$$x^2 + 3x + 2 = x^2 - 6x + 14$$

$$3x + 2 = -6x + 14$$

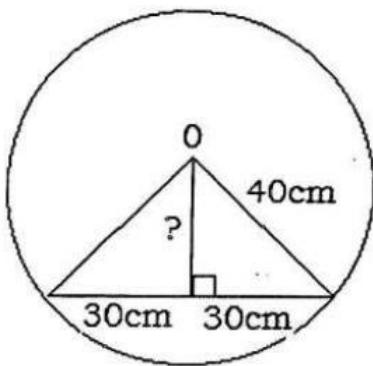
$$3x + 6x = 14 - 2$$

$$9x = 12$$

$$x = \frac{12}{9}$$

$$x = \frac{4}{3}$$

11.

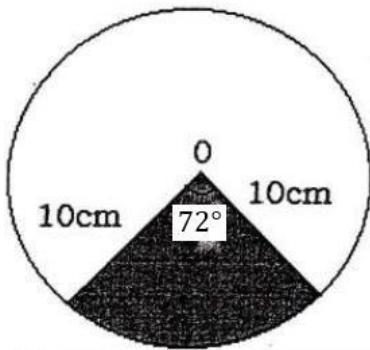


Let the required length be h

$$h^2 = 40^2 - 30^2$$

$$h = \sqrt{40^2 - 30^2} = \sqrt{1600 - 900} = \sqrt{700}$$

12.



$$\text{Area} = \frac{72}{360} \times 3.14 \times 10 \times 10 = \frac{314}{5} = 62.8 \text{ cm}^2$$

SECTION B: Attempt any THREE questions in this section

13. a) Let x be the cost a mathematics book

Let y be the cost a physics book

$$10x + 8y = 220,000 (\times 6)$$

$$6x + 8y = 232,000 (\times 10)$$

$$60x + 30y = 1,320,000 \quad (1)$$

$$60x + 80y = 2,320,000 \quad (2)$$

Equation (2) minus equation (1) we get

$$50y = 1,000,000 \quad y = \frac{1,000,000}{50} = 20,000$$

The cost of one physics book is 20,000 Frw

$$6x + 8y = 232,000$$

$$6x = 232,000 - 8y = 232,000 - 8 \times 20,000 = 232,000 - 160,000 = 72,000$$

$$6x = 72,000$$

$$x = \frac{72,000}{6} = 12,000$$

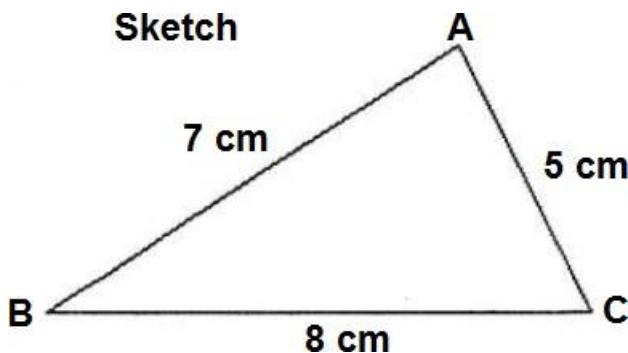
The cost of one mathematics book is 12,000 Frw

b) $6x^3 + 5x^2 - 22x - 24 = 0$

$$\begin{array}{r} 6 \quad 5 \quad -22 \quad | \quad -24 \\ x=2 \quad \quad 12 \quad 34 \quad | \quad 24 \\ \hline 6 \quad 17 \quad 12 \quad | \quad 0 \end{array}$$

$$\begin{aligned} 6x^3 + 5x^2 - 22x - 24 &= (x-2)(6x^2 + 17x + 12) \\ &= (x-2)(6x^2 + 9x + 8x + 12) \\ &= (x-2)[3x(2x+3) + 4(2x+3)] \\ (x-2)(3x+4)(2x+3) &= 0 \\ x = 2 \text{ or } 3x &= -4 \text{ or } 2x = 3 \\ x = 2 \text{ or } x &= -\frac{4}{3} \text{ or } x = \frac{3}{2} \end{aligned}$$

14. a)



b) Angle A = 40°, B = 80°, C = 60°

(Result angle range = 38° - 40° and 80° - 82°)

c) Perpendicular line = 6.9 cm

d) Area of ABC = $\frac{1}{2} \times 6.9 \times 5 = \frac{34.5}{2} = 17.25 \text{ cm}^2$

16. a) Modal class = 45 – 49

Its limits = 44.5 – 49.5 or 45 – 49

b) The mean = 47

c)

Class	Mid-interval of class x	Difference from the working mean d	Frequency	fd
40 - 44	42	-5	15	-75
45 - 49	42	0	18	0
50 - 54	52	5	13	65
55 - 59	57	10	4	40

d) $\sum fd = -75 + 0 + 65 + 40 = 30$

17. a) $\overline{ABC} = \overline{BDC}$

$\overline{ACB} = \overline{BCD}$ (common angle)

Triangle ABC and BDC share a common angle C, hence

$\overline{ACD} = \overline{BCD}$, so $\overline{BAC} = \overline{CBD}$

b) i) $\frac{1}{2} \times 12 \times BC = 54 \text{ cm}^2$

$$BC = \frac{54 \times 2}{12} = 9$$

$$AC = \sqrt{12^2 + 9^2} = \sqrt{144 + 81} = \sqrt{225} = 15 \text{ cm}$$

$$\frac{DC}{BC} = \frac{BC}{AC} = \frac{\overline{DC}}{9} = \frac{9}{15}$$

$$DC = \frac{81}{15} = 5.4 \text{ cm}$$

ii) $\frac{BD}{12} = \frac{9}{15}$

$$BD = \frac{9 \times 12}{15} = 7.2 \text{ cm}$$

iii) Area of triangle ABD = $\frac{1}{2} \times 7.2 \times (15 - 5.4) = \frac{7.2 \times 9.6}{2} = 34.56 \text{ cm}^2$

Mathematics I

011

04 Nov 2009 08.30am -11.30 am

RWANDA NATIONAL EXAMINATIONS COUNCIL



P.O BOX 3817 KIGALI-TEL/FAX : 586871

ORDINARY LEVEL NATIONAL EXAMINATIONS 2009

SUBJECT: MATHEMATICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **TWO** sections **A** and **B**

Answer **ALL** questions in section A (**55 marks**) and any **THREE** questions in section B. (**45 marks**)

Show **ALL** working clearly.

Calculator and mathematical instruments are allowed.

SECTION A: ANSWER ALL QUESTIONS**(55 MARKS)**

1. The interest on a loan is 15% per year. Find the loan if the interest for 2 years is 36,000 FRW and also calculate the whole amount of money at the end of the same period. **(2 marks)**
2. It is given that $x \rightarrow 2x$. Find the range corresponding to the domain $\{-3, -1, 9\}$. **(3 marks)**
3. Solve: $6x^2 + 7x + 2 = 0$. **(3 marks)**
4. Solve the following inequality and illustrate the answer on a number line:
 $9 < 5 - 2x$. **(3 marks)**
5. A half cylinder has a semi-circular base of diameter 20dm and height 14dm. Find its volume. $\pi = 3.14$ **(3 marks)**
6. Make A the subject of the formula: $\frac{1}{A} = \frac{1}{B} + \frac{1}{C}$ **(4 marks)**
7. Rationalize the denominator: $\frac{2}{1+3\sqrt{5}}$ **(4 marks)**
8. Given that $f(x) = (x - 7)(x + 2)$. Find x when $f(x) = 14$ **(4 marks)**
9. The area of a rhombus is 96cm^2 and one of its diagonals is 16cm. Find the length of the sides of the rhombus. **(4 marks)**
10. Find the equation of a line which passes through points (3, 7) and (-2, -3). **(4 marks)**
11. A(6,5), B(2,1), C(5,-1) and D(9,3) are coordinates of vertices of the quadrilateral ABCD. Use vectors to show that quadrilateral ABCD is a parallelogram. P is the mid-point of line BD. Find the coordinates of P. **(4 marks)**
12. Solve the following simultaneous equations:
$$\begin{aligned} 2x - 5y &= 7 \\ 4x + 3y &= 1 \end{aligned}$$
 (4 marks)
13. A: B: C is a ratio. A: B = 5:3 and B: C = 4:7. Divide 212 kg in the ratio A: B: C. **(4 marks)**
14. Find the coordinates of images of points P (-2, 2) and Q (3, 4). Under reflection in line $y = 1$. **(2 marks)**
15. The area of a square is 9cm^2 and the area of its image after enlargement, is 36cm^2 . Find the linear scale of the enlargement. **(2 marks)**

SECTION B: Answer THREE questions (45 marks)

16. (a) Using a pair of compasses and a ruler only, draw triangle MNO in which $MN = 9.8$ cm, $NO = 7$ cm and $MO = 7.4$ cm. **(6 marks)**

(b) Draw the circumference of triangle MNO and find its radius. Calculate the area of the circle. $\pi = 3.14$ **(9 marks)**

17. The table below shows the ages in years of 81 students.

Ages (years)	14	15	16	17	18	19	20
Frequency	12	8	10	21	9	11	10

Find (a) the mode age **(1 mark)**

(b) The median age **(3 marks)**

(c) The mean age **(11 marks)**

18. (a) If y is inversely proportional to x and $x = -3$, when $y = 4$, find

(i) x when $y = 2$ and (ii) y when $x = 6$ **(8 marks)**

(b) Today, a father is 30 years older than his daughter. The product of their age is 216. Find their ages in 10 years time. **(7 marks)**

19. (a) Solve: $30x^3 + 17x^2 - 58x - 24 = 0$ **(8 marks)**

(b) If $f(x) = x^2 + 4x + 1$ and $g(x) = x + 1$, find x when

i) $fg(x) = -2$ **(5 marks)**

ii) $gf(3)$. **(2 marks)**

20.a) John bought 4 calculators and 2 pens at 14,000 Rwf. Mary bought 2 calculators and 5 pens at 11,000Rwf. Find the cost of

(i) One pen

(ii) One calculator

(iii) 5 calculators and 3 pens altogether. **(9 marks)**

b) A car can be bought on hire purchase by paying 20% deposit of the cash price and 24 monthly instalments of 200,000Rwf. The cash price of the car is 4,000,000Rwf.

i) Calculate the hire purchase of the car. **(3 marks)**

ii) Determine the percentage extra money paid for the car on hire purchase than cash. **(3 marks)**

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2009

Section A: Answer all questions

1. $P = \frac{100 \times I}{R \times T}$

$$P = 120,000 \text{ Frw}$$

$$\text{Amount} = 120,000 + 36,000 = 156,000 \text{ Frw}$$

2. Domain Range

$$x \rightarrow 2x$$

$$-3 \quad (2 \times (-3)) = -6$$

$$-1 \quad (2 \times (-1)) = -2$$

$$9 \quad (2 \times 9) = 18$$

3. $6x^2 + 7x + 2 = 0$

$$6x^2 + 7x + 2 = 6x^2 + 3x + 4x + 2 = 0$$

$$= 3x(2x + 1) + 2(2x + 1) = 0$$

$$= (3x + 2)(2x + 1) = 0$$

$$3x + 2 = 0 \text{ or } 2x + 1 = 0$$

$$x = -\frac{2}{3} \text{ or } x = -\frac{1}{2}$$

4. $9 < 5 - 2x$

$$9 - 5 < -2x$$

$$4 < -2x$$

$$2 < -x$$

$$-2 > x$$

$$x < -2$$

5. Base area = $(\frac{1}{2} \times 3.14 \times 10 \times 10) \text{ dm}^2 = 157 \text{ dm}^2$

$$\text{Volume} = 157 \times 14 = 2198 \text{ dm}^3$$

6. $\frac{1}{A} = \frac{1}{B} + \frac{1}{C} = \frac{B+C}{BC}$

$$BC = A(B + C)$$

$$A = \frac{BC}{B+C}$$

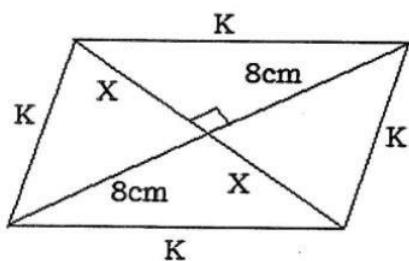
7. $\frac{2}{1+3\sqrt{5}} = \frac{2(1-3\sqrt{5})}{(1+3\sqrt{5})(1-3\sqrt{5})} = \frac{2-6\sqrt{5}}{-44} = \frac{3\sqrt{5}-1}{22}$

8. $f(x) = (x - 7)(x + 2) = 14.$

$x - 7 = 14 ; x = 21$

Or $x + 2 = 14 ; x = 12$

9.



$x \times 16 = 96$

$$16x = \frac{96}{16}$$

$x = 6 \text{ cm}$

$$6^2 + 8^2 = k^2$$

$$100 = k^2$$

$$k = \sqrt{100} = 10$$

10. $\text{Gradient} = \frac{7-3}{3-2} = 2$

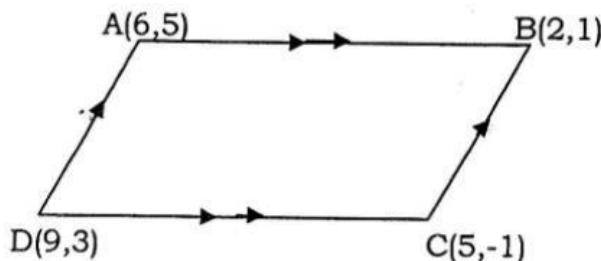
$$\text{Gradient} = \frac{Y-7}{x-3} = \frac{2}{1}$$

$$y - 7 = 2x - 6$$

$$y = 2x - 6 + 7$$

$$y = 2x + 1$$

11.



$$AB = DC$$

$$AB = \begin{pmatrix} 2 \\ 1 \end{pmatrix} - \begin{pmatrix} 6 \\ 5 \end{pmatrix} = \begin{pmatrix} -4 \\ -4 \end{pmatrix}$$

$$DC = \begin{pmatrix} 5 \\ -1 \end{pmatrix} - \begin{pmatrix} 9 \\ 3 \end{pmatrix} = \begin{pmatrix} -4 \\ -4 \end{pmatrix}$$

Therefore, ABC is a parallelogram because opposite sides are equal.

$$P\left(\frac{9+2}{2}, \frac{3+1}{2}\right)$$

$$P\left(\frac{11}{2}, 2\right)$$

$$12. \quad \begin{cases} 2|2x - 5y = 7 \\ 4x + 3y = 1 \end{cases}$$

$$\begin{cases} 4x + 3y = 1 \\ 4x - 10y = 14 \end{cases}$$

$$4x - 10y = 14$$

$$- \quad 4x + 3y = 1$$

$$-13y = 13$$

$$y = -1$$

$$2x - 5(-1) = 7$$

$$2x + 5 = 7$$

$$2x = 2$$

$$x = 1$$

$$13. \quad \frac{A}{B} = \frac{5}{3} \Rightarrow \frac{5 \times 4}{3 \times 4} = \frac{20}{12}$$

$$\frac{B}{C} = \frac{4}{7} \Rightarrow \frac{4 \times 3}{7 \times 3} = \frac{12}{21}$$

$$A : B : C = 20 : 12 : 21$$

$$\text{Total ratio} = 20 + 12 + 21 = 53$$

$$\text{Share for } A = \frac{20}{53} \times 212 = 80 \text{ kgs}$$

$$\text{Share for } B = \frac{12}{53} \times 212 = 48 \text{ kgs}$$

$$\text{Share for } C = \frac{21}{53} \times 212 = 84 \text{ kgs}$$

14. P(-2, 2); Q(3, 4)

$$P(-2; -2 + (2 \times 1)) = (-2, 0)$$

$$Q(3; -4 + (2 \times 1)) = (3, -2)$$

Or drawing and clothing in the Cartesian plane fee graph, coordinates of P' = (-2, 0) and Q' = (3, -2)

15. Scale factor of enlargement = $\frac{36}{9} = 4$

$$\text{Linear factor} = \sqrt{4} = +2 \text{ or } -2$$

SECTION B: Attempt any THREE questions in this section

16. a) Drawing (constructing) the sides first and then angles.

Construct the medians/bisections of sides

Radius ranges from 4.8 – 4.9cm

b) Circle touching the sides of the circle

$$MNO = (46^\circ - 50^\circ) \text{ i.e } \pm 49^\circ$$

$$MON = \pm 85^\circ (84^\circ - 88^\circ)$$

$$NMO = \pm 46^\circ (45^\circ - 47^\circ)$$

$$\text{Area of cylinder } \pi r^2 = 3.14 \times 4.9 \times 4.9 = 78.4 \text{ cm}^2$$

17. a) Mode = 17 years

$$\text{b) Median} = \left(\frac{\frac{n+1}{2}}{2}\right) = \frac{1}{2}(81 + 1) = 41 \text{ years}$$

c)

Age	Frequency	$f(x)$
14	12	168
15	8	120
16	10	160
17	21	357
18	9	162
19	11	209
20	10	200
	$\sum = 81$	$\sum f(x) = 1376$

$$\text{Mean age} = \frac{1376}{81} = 16.9 \approx 17 \text{ years}$$

18. $y \propto \frac{1}{k} \Rightarrow y = \frac{k}{x}$, i) When $x = -3$ and $y = 4$

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

ii) $y = \frac{-12}{6}$

$$6y = -12$$

$$y = -2$$

b) Let the father's age be x years

The daughter has $(x - 30)$ years

$$x(x - 30) = 216$$

$$x^2 - 30x = 216$$

$$x^2 - 30x - 216 = 0$$

$$x(x - 36) + 6(x - 36) = 0$$

$$(x + 6)(x - 36) = 0$$

$$x = -6 \text{ or } x = 36$$

The daughter's age is 6 years now and in 10 years the daughter will be $(10 + 6) = 16$ years. The father is now 36 years. In 10 years, the father will be $36 + 10 = 46$ years.

19. a) $30x^3 + 17x^2 - 58x - 24 = 0$

$$30x^3 + 12x^2 + 5x^2 - 60x + 2x - 24 = 0$$

$$(30x^3 + 12x^2) + (5x^2 + 2x) - (60x + 24) = 0$$

$$6x^2(5x + 2) + x(5x + 2) - 12(5x + 2) = 0$$

$$(6x^2 + x - 12)(5x + 2) = 0$$

$$6x^2 + x - 12 = 0$$

$$6x^2 + 9x - 8x - 12 = 0$$

$$3x(2x + 3) - 4(2x + 3) = 0$$

$$(3x - 4)(2x + 3) = 0$$

$$3x - 4 = 0 \text{ or } 2x + 3 = 0$$

$$3x = 4 \text{ or } 2x = -3$$

$$x = \frac{4}{3} \text{ or } x = -\frac{3}{2}$$

b) i) $fg(x) = (x + 1)^2 + 4(x + 1) + 1$

$$x^2 + 2x + 1 + 4x + 4 + 1 = 0$$

$$x^2 + 6x + 8 = 0$$

$$x(x + 2) + 4(x + 2) = 0$$

$$(x + 4)(x + 2) = 0$$

$$x = -4 \text{ or } x = -2$$

ii) $gf(x) = x^2 + 4x + 2$

$$gf(3) = 3^2 + 4(3) + 2 = 9 + 12 + 2 = 23$$

20. a) Let c represent calculators and p represent pens

$$\text{i) } \begin{cases} 4c + 2p = 14000 \\ 2c + 5p = 11000 \end{cases}$$

$$-2c + p = 7000$$

$$4p = 4000$$

$$p = 1000$$

The cost of one pen = 1000 Rwf

$$\text{ii) } 4c + 2000 = 14000$$

$$4c = 12000$$

$$c = 3000$$

The cost of one calculator = 3000 Rwf

$$\text{iii) } 5c + 3p = 5(3000) + 3(1000) = 15000 + 3000 = 18,000 \text{ Rwf}$$

The cost of 5 calculators and 3 pens = 18,000 Rwf

$$\text{b) i) Price of the car on hire purchase} = \frac{20}{100} \times 4,000,000 + 24 \times 200,000 \\ = 800,000 + 4,800,000 = 5,600,000 \text{ Rwf}$$

$$\text{ii) \% extra money paid on hire purchase} = \frac{1,600,000}{4,000,000} \times 100 = 40 \%$$

Mathematics I

011

09 Nov. 2010 08.30 – 11.30 am

RWANDA NATIONAL EXAMINATIONS COUNCIL



P.O BOX 3817 KIGALI-TEL/FAX : 586871

ORDINARY LEVEL NATIONAL EXAMINATIONS 2010

SUBJECT: MATHEMATICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **TWO** sections **A** and **B**.

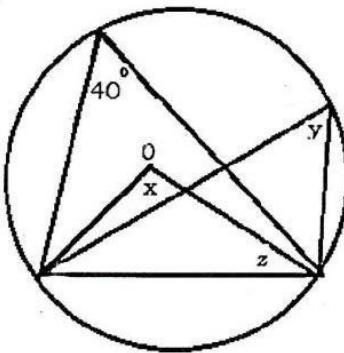
Answer **ALL** questions in section **A** and any **THREE** questions in section **B**.

Show **ALL** working clearly

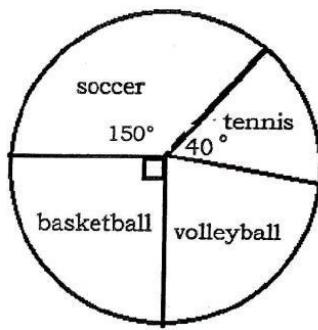
Calculators and mathematical instruments are allowed.

SECTION A: ANSWER ALL QUESTIONS**(55 MARKS)**

1. Simplify and express the answer in standard form: $\frac{0.24 \times 0.35}{0.80 \times 0.70}$ **(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 the map. Find the distance on the map if the distance on land is 4.5 km? **(2 marks)**
4. Solve: $\frac{3\sqrt{5} \times \sqrt{20}}{\sqrt{50} \times \sqrt{18}}$ **(4 marks)**
5. 3 children share x Rwf in the ratio 3: 4: 5. If the smallest share is 60,000 Rwf, find x and other shares.
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: $(y - 2)(2y + 3) - 2(3y - 2) = 0$. **(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 $a \vec{=} \begin{pmatrix} 4 \\ 3 \end{pmatrix}$ and $b \vec{=} \begin{pmatrix} 12 \\ 9 \end{pmatrix}$. (a) Find $a \vec{-} b \vec{=}$. (1 mark)

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

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

Section B: Answer only THREE questions (45 marks)

15. (a) Find a, b and c in the following equation:

$$ax^2 + (b - 3)x + 2c - 1 = x^2 - 5x + 7 \quad \text{(3 marks)}$$

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

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

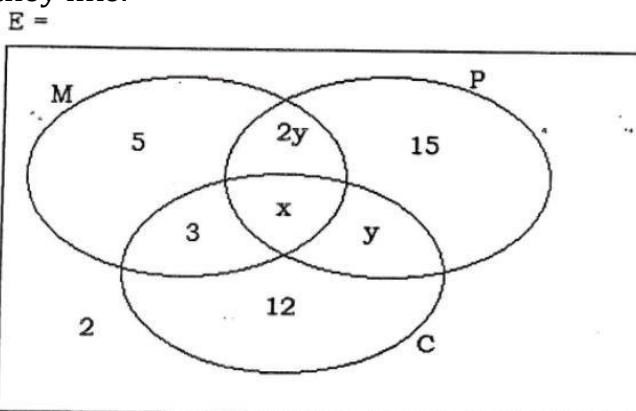
16. The table below shows the masses of 50 O-level students in a school.

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 = 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 and an outer radius of 710mm. Find the volume of the pipe material. Express the answer in cubic meters. Take $\pi = \frac{22}{7}$ **(7 marks)**

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

19. (a) Mary earns 961,500Rwf per year. She has a personal allowance of 58,000Rwf. 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 824,340Rwf are insured at 5% per year for 6 years. Find the total amount of premium paid in the period. **(4 marks)**

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2010

Section A: Answer all questions

1. $\frac{0.24 \times 0.35}{0.80 \times 0.70} = 0.3 \times 0.5 = 0.15$

2. $103_n + 26_n = 131_n$

$$(1 \times n^2) + (0 \times n^1) + (3 \times n^0) + (2 \times n^1) + (6 \times n^0) = (1 \times n^2) + (3 \times n^1) + (1 \times n^0)$$

$$n^2 + 0 + 3 + 2n + 6 = n^2 + 3n + 1$$

$$n^2 - n^2 + 2n - 3n = 1 - 3 - 6$$

$$-n = -8$$

$$n = 8$$

3. 6 km are represented by 3 cm on the map

1km is represented by $\frac{3\text{cm}}{6} = \frac{1}{2}\text{cm}$ on the map

4.5 km will be represented by $\frac{1 \times 4.5}{2} = 2.25\text{ cm}$ on the map

4. $\frac{3\sqrt{5} \times \sqrt{20}}{\sqrt{50} \times \sqrt{18}} = \frac{3\sqrt{5} \times 2\sqrt{5}}{5\sqrt{2} \times 3\sqrt{2}} = \frac{30}{30} = 1$

5. $x = 60,000 \times \frac{12}{3} = 240,000\text{Rwf}$

Other shares are: $240,000 \times \frac{4}{12} = 80,000\text{Rwf}$

And the other share is $240,000 \times \frac{5}{12} = 100,000\text{Rwf}$

6. $3x^2 + 14x + 8 = 0$

$$3x^2 + 12x + 2x + 8 = 0$$

$$3x(x + 4) + 2(x + 4) = 0$$

$$(3x + 2)(x + 4) = 0$$

$$x = -\frac{2}{3} \text{ or } x = -4$$

7. x4 [8a + b = 21]

$$5a - 4b = -10$$

$$32a + 4b = 84$$

$$37a = 74$$

$$a = \frac{74}{37} = 2$$

$$10 - 4b = -10$$

$$-4b = -10 - 10 = -20$$

$$4b = 20$$

$$b = 5$$

$$8. \quad x = 80^\circ$$

$$y = 40^\circ$$

$$z = \frac{180 - 80}{2} = 50^\circ$$

$$9. \quad (y - 2)(2y + 3) - 2(3y - 2) = 0$$

$$(y - 2)(2y + 3 - 6y + 4) = 0$$

$$(y - 2)(-4y + 7) = 0$$

$$y - 2 = 0 \text{ or } -4y + 7 = 0$$

$$y = 2 \text{ or } y = \frac{7}{4}$$

$$10. \text{ a) } A(0,0) \xrightarrow{Y=2} A^1(0,4) \text{ and}$$

$$B(2,4) \xrightarrow{Y=2} B^1(2,0)$$

$$\text{b) } A(0,0) \xrightarrow{x=0} A^1(0,0) \text{ and}$$

$$B(2,4) \xrightarrow{x=0} B^1(-2,4)$$

$$11. \text{ a) } g(f(x)) = (x + 3)^2 + 4(x + 3) - 19$$

$$= x^2 + 6x + 9 + 4x + 12 - 19$$

$$= x^2 + 10x + 2$$

$$\text{b) } x^2 + 10x + 2 = -14$$

$$x^2 + 10x + 16 = 0$$

$$x^2 + 8x + 2x + 16 = 0$$

$$x(x + 8) + 2(x + 8) = 0$$

$$(x + 2)(x + 8) = 0$$

$$x = -2 \text{ or } x = -8$$

$$12. \text{ a) Number of students in the school} = \frac{60}{40^\circ} \times 360^\circ = 540$$

$$\text{b) Soccer students} = 540 \times \frac{150^\circ}{360^\circ} = 225 \text{ students}$$

$$\text{Basketball students} = 540 \times \frac{90^\circ}{360^\circ} = 135 \text{ students}$$

$$\text{Volley ball students} = 540 \times \frac{360^\circ - (90^\circ + 40^\circ + 150^\circ)}{360^\circ} = 120 \text{ students}$$

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 $= \frac{9-5}{6-3} = \frac{4}{3}$

Let (x, y) be any point on the line $\frac{y-5}{x-3} = \frac{4}{3} \Leftrightarrow 3y - 15 = 4x - 12$

$3y = 4x + 3$

SECTION B: ANSWER ONLY THREE QUESTIONS

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

$$ax^2 = x^2$$

$$\frac{ax^2}{x^2} = \frac{x^2}{x^2} \Leftrightarrow a = 1$$

$$xb = -5x + 3x$$

$$xb = -2x$$

$$b = -2$$

$$2c - 1 = 7$$

$$2c = 8$$

$$c = 4$$

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

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

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

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

$$\begin{array}{r|rrr|r} & 2 & 9 & 7 & -6 \\ \hline -2 & \downarrow & -4 & -10 & 6 \\ \hline & 2 & 5 & -3 & 0 \\ \hline -3 & \downarrow & -6 & 3 & \\ \hline & 2 & -1 & & \end{array}$$

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

c) $\frac{4x^2-1}{4x^2-4x+1} = \frac{(2x-1)(2x+1)}{(2x-1)(2x-1)} = \frac{2x+1}{2x-1}$

16. a) Modal class = 70-75 and its limits = 69.5-75.5

b)

Class	Mid-interval	Difference from the estimated mean	F	$R_i x_i$
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	$\sum R_i x_i = 3686$

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

$$\text{The mean mass is } 72.5 + 0.72 = 73.22 \approx 73.0 \text{ kg}$$

$$17. \text{ a) } x + 2y + 8 = 28$$

$$x + y + 15 = 30$$

$$x + 2y = 20 \text{ (i)}$$

$$x + y = 15 \text{ (ii)}$$

$$\text{From (ii)} x = 15 - y$$

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

$$y = 5; x = 10$$

10 students like all three subjects

$$\text{b) Like maths and physics} = 10 + 8 + 5 + 10 + 15 = 48$$

$$\text{c) Like physics and chemistry} = 15 + 15 + 10 + 10 + 5 = 55$$

$$\text{d) Like physics} = 15 + 5 + 10 + 10 = 40$$

$$\text{e) } 5 + 3 + 10 + 10 + 15 + 5 + 12 + 2 = 62$$

$$18. \text{ a) Volume of the outer pipe} - \text{volume of inner pipe} \text{ (first change everything to centimeters)}$$

$$\text{Volume} = \pi R^2 H - \pi r^2 h = \pi h(R - r)(R + r) = \frac{\pi}{7} \times 210(71 - 70)(71 + 70)$$

$$= 660 \times 1 \times 141 = 93060 \text{ cm}^3 = 93060 \times 10^{-6} \text{ m}^3 = 0.09306 \text{ m}^3$$

$$\text{b) Volume of one coin} = \text{cross section area} \times \text{thickness} = (\pi r^2) \times t$$

$$= \frac{\pi}{7} \times \frac{21}{2} \times \frac{21}{2} \times 3 = 1039.5 \text{ mm}^3$$

$$3.5 l = 3.5 \times 1,000,000 \text{ mm}^3 = 3,500,000 \text{ mm}^3$$

$$\text{Number of copper coins} = \frac{3,500,000}{1039.5} = 3367 \text{ pieces}$$

19. a) Gross salary = 91,500 + 58,000 = 1,019,500

$$\text{Income tax on the first } 265,000 = \frac{25}{100} \times 265,000 = 66,250 \text{ Rwf}$$

$$\text{Net salary} = 265,000 - 66,250 = 198,750$$

$$\text{Tax on the remaining income} = 1,019,500 - 265,000 = 754,500$$

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

$$= 754,500 - 226,350 = 528,150 \text{ Rwf}$$

b) Premium per year = $\frac{5}{100} \times 827,350 = 41,347$

$$\text{For 6 years} = 41,347 \times 6 = 248,202 \text{ Rwf}$$

Mathematics I

009

02 Nov. 2011 08.30 am – 11.30 am

REPUBLIC OF RWANDA



RWANDA EDUCATION BOARD (REB)
P.O.BOX 3817 KIGALI. TEL/FAX: 586871

ORDINARY LEVEL NATIONAL EXAMINATIONS 2011

SUBJECT: MATHEMATICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper has **TWO** sections **A** and **B**

SECTION A: Answer **ALL** questions. **(55 marks)**

SECTION B: Answer any **THREE** questions. **(45 marks)**

Calculators and mathematical instruments may be used where necessary.

Show all the working. **No marks will be given for answers which do**

not show all the steps.

SECTION A: Attempt all questions from this section. (55 marks)

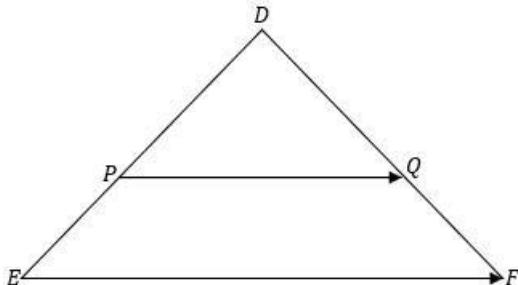
1. In a school there is enough food to feed 200 students for 15 days. For how long the food last if 50 more students join the school? **(3 marks)**
2. Some money was invested at 15% per year simple interest for 3 years. If the interest is 7200Frw, calculate the investment. **(3 marks)**
3. A (1, 4), B (1, 0) and C (3, -2) are three of the vertices of a quadrilateral ABCD. $A \rightarrow D = (4)$ and X is the mid-point of AC. Find the coordinates of X and D. **(4 marks)**
4. 80 pupils had meals at a hotel. Of these 50 had a meal of rice (R) and 45 had a meal of potatoes (P).
 - (a) Represent this information in a Venn diagram. **(2 marks)**
 - (b) Find the number of people who had a meal of R and P. **(2 marks)**
5. If the gradient of a line is 4, find the equation of this line if it passes through points (5, 3) and (x, y). **(3 marks)**
6. Think of a number, multiply it by 30 and then add 32. The result is equal to twice the square of the number. Find the number if it is greater than 0. **(3 marks)**
7. Given that $f(x) = \frac{8}{1-x^2}$ and $f(x) = -1$, find x. For which values of x is $f(x)$ not defined. **(4 marks)**
8. The diameters of two cylinders are in the ratio 3:4. The diameter of the smaller cylinder is 15cm.
 - (a) Find the circumference of the larger cylinder. $\pi = \frac{22}{7}$ **(2 marks)**
 - (b) What is the ratio of the area of the curved surfaces of the cylinders? **(2 marks)**
9. Solve the following inequality and illustrate the solution on the number line: $\frac{1}{3}x - (x + 1) \geq 3$ **(4 marks)**
10. In a triangle ABC, $\overline{AB} = 7.3\text{ cm}$, $\overline{BC} = 6.0\text{ cm}$ and $\overline{AC} = 75.0\text{ cm}$. Using a ruler and a pair of compasses only, draw accurately triangle ABC. Find the height of the triangle by construction and calculate its area. **(4 marks)**
11. Solve the following simultaneous equations:
$$\begin{aligned}4y - 3x &= 2 \\2y + 1 &= 2x\end{aligned}$$
(4 marks)
12. Three lights flash at intervals of 4, 6 and 10 seconds respectively. If they are started together, how soon after they next flash together again?

(3 marks)

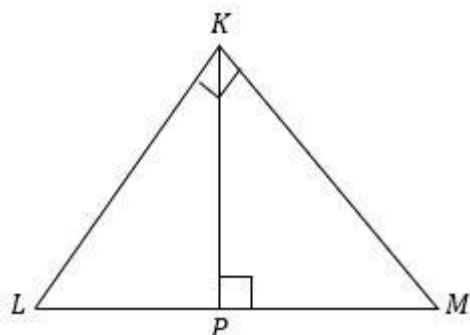
13. In the figure below $\bar{D}\bar{E} = 6\text{ cm}$, $\bar{E}\bar{F} = 12\text{ cm}$, $\bar{D}\bar{Q} = 6\text{ cm}$. Find:

- a) $\bar{Q}\bar{F}$.
- b) $\bar{P}\bar{G}$.

(2 marks)
(2 marks)



14. In the figure below, $\bar{L}\bar{M} = 9\text{ cm}$ and $\bar{K}\bar{M} = 6\text{ cm}$. Find $\bar{K}\bar{L}$ and $\bar{L}\bar{P}$. (4 marks)



15. The marks of 25 pupils on a test are:

6	8	4	5	7	9	7	5	8
4	2	6	2	5	7	1	3	6
7	4	3	7	3	5	3		

Determine:

- a) The mean mark. (2 marks)
- b) The median. (1 mark)
- c) The mode mark. (1 mark)

SECTION B: Attempt any THREE questions only. (45 marks)

16. The length of a rectangular block is 2 cm more than the width and the height is 1 cm more than two times the width. If the volume of the rectangular block is 624cm^3 , find the value of X. Hence calculate the total surface area of the block. (15 marks)

17. A helicopter flies from airport K to south for 200km. It then flies on a bearing of 255° for 250km. From there it flies on a bearing of 027° for 300km.

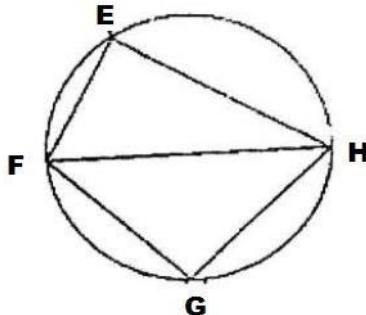
- (a) Draw an accurate diagram showing the journey of the helicopter using a scale of 1cm to represent 50km. (9 marks)

- (b) From your diagram, find the distance and bearing of K from the position of the helicopter. **(4 marks)**
 (c) Given that the helicopter flies at a steady speed of 200 km/h, find how long the whole journey took. **(2 marks)**

18. Draw on the same axes the following graphs: (a) $y = 2x + 6$ and
 (b) $y + x = 3$

From the graph determine the coordinates where the two lines intersect. **(15 marks)**

19. In the circle below \overline{FH} is the diameter of the circle, $\overline{EF} = r$, $\overline{FG} = x$ and $\overline{GH} = y$.



- (a) Show that $y^2 = r^2 + s^2 - x^2$. State your reasons clearly. **(9 marks)**
 (b) Given that $r = 8\text{cm}$ and $s = 6 \text{ cm}$, find \overline{FH} . **(3 marks)**
 (c) Find the area of triangle FGH, if triangle FGH is an isosceles triangle. **(3 marks)**

20. Q (1, 3) R (4, 3) and S (4, -3) are vertices of triangle GRS.

- (a) Plot on a graph paper points Q, R and S. Join these points to form triangle GRS. **(5 marks)**
 (b) Triangle QRS is translated by $T = \begin{pmatrix} -1 \\ 3 \end{pmatrix}$. Find the coordinates of Q', R', S' the images of Q, R and S under translation T. Plot these points on the same graph as (a) and join them to form triangle Q'R'S'. **(4 marks)**
 (c) Rotate Q'R' and S' about the origin through -90°. Find points Q'', R'' and S''. Plot these points on the same graph as (a) and join them. **(3 marks)**
 (d) Find the two successive transformations that would map triangle Q''R''S'' on to triangle QRS. **(2 marks)**

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2011

Section A: Answer all questions

1. For 200 students, food lasts 15 days

For one student, food lasts 15 days $\times 200$

For 250 students: $\frac{15 \text{ days} \times 200}{250} = 12 \text{ days}$

$$2. I = \frac{PRT}{100} \Leftrightarrow 7200 = \frac{P \times 15 \times 3}{100} \Leftrightarrow P = \frac{7200 \times 100}{15 \times 3} = 16,000 \text{ Frw}$$

3. A (1, 4), B (1, 0), C (3, -2)

$$A \rightarrow D = \begin{pmatrix} 4 \\ -1 \end{pmatrix}, AD = d - a$$

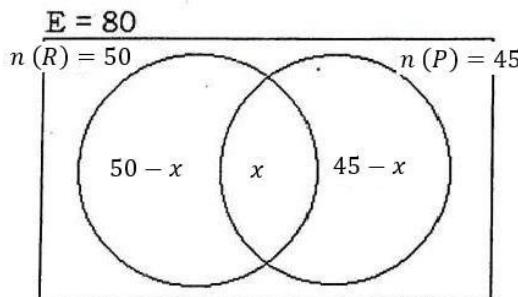
$$= \begin{pmatrix} 4 \\ -1 \end{pmatrix} = d - \begin{pmatrix} 1 \\ 4 \end{pmatrix} = \begin{pmatrix} 5 \\ 3 \end{pmatrix}$$

$$\text{Midpoint of } \overline{AC} = x$$

$$= \frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}$$

$$= \frac{3+1}{2}, \frac{-2+4}{2} = (2, 1)$$

4. (a)



- (b) Number of people who had a meal of R and P

$$= 50 - x + x + 45 - x = 80$$

$$x = 15$$

5. $y = mx + C$

$$m = 4$$

$$3 = 4(5) + C$$

$$3 = 40 + C$$

$$C = 3 - 20$$

$$C = -17$$

$$y = 4x - 17$$

The equation of the line is $y = 4x - 17$

6. $30x + 32 = 2x^2$

$$30x + 32 - 2x^2 = 0$$

$$-2x^2 + 30x + 32 = 0$$

$$-2x^2 + 32x - 2x + 32 = 0$$

$$-2x(x - 16) - 2(x - 16) = 0$$

$$(x - 16)(-2x - 2) = 0$$

$$x - 16 = 0 \text{ or } -2x - 2 = 0$$

$$x = 16 \text{ or } -2x = 2 \Leftrightarrow x = -1$$

The number is 16 since $x > 0$

7. $\frac{8}{1-x^2} = -1$

$$-1(1 - x^2) = 8$$

$$8 = -1 + x^2$$

$$x^2 - 1 - 8 = 0$$

$$x^2 - 9 = 0$$

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

$$x = 3 \text{ or } x = -3$$

8. a) The diameter of the larger cylinder = $15 \text{ cm} \times \frac{22}{7} = 20 \text{ cm}$

$$\text{Circumference} = \pi D = \frac{22}{7} \times 20 = \frac{440}{7} = 62.8 \text{ cm}$$

b) Ratio of the area of the curved surfaces of the cylinders = $\frac{3^2}{4^2} = \frac{9}{16}$

$$\text{Ratio} = 9 : 16$$

9. $\frac{1}{3}x - (x + 1) \geq 3$

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

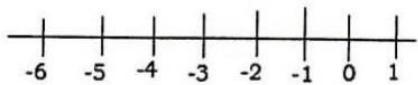
$$\frac{1}{3}x - x \geq 4$$

$$\frac{x-3x}{3} \geq 4$$

$$-2x \geq 12$$

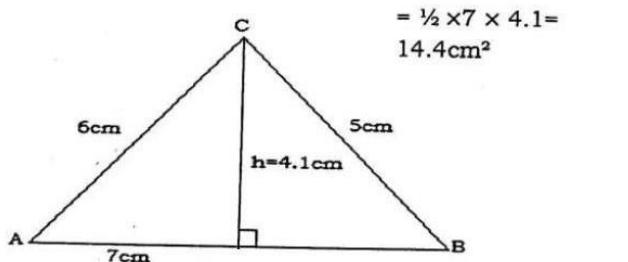
$$-x \geq 6$$

$$x \geq -6$$



10.

sketch



11.

$$1 \quad | 4y - 3x = 2$$

$$2 \quad 2y + 1 = 2x$$

$$4y - 3x = 2$$

$$- \quad 4y - 4x = -2$$

$$\hline x = 4$$

$$2y + 1 = 2x$$

$$2y + 1 = 8$$

$$2y = 7$$

$$y = 3.5$$

12.

LCM

4	6	10	2
2	3	5	2
1	3	5	3
1	1	5	5
1	1	1	

$$\text{LCM} = 2^2 \times 3 \times 5 = 60$$

The lights will together flash again after 60 seconds.

13. $\bar{D}\bar{E} = 6 \text{ cm}$, $\bar{E}\bar{F} = 12 \text{ cm}$, $\bar{D}\bar{Q} = 6 \text{ cm}$

a) $\frac{\bar{Q}\bar{F}}{\bar{D}\bar{Q}} = \frac{\bar{P}\bar{E}}{\bar{D}\bar{P}}$

$$\bar{Q}\bar{F} = \frac{\bar{P}\bar{E} \times \bar{D}\bar{Q}}{\bar{D}\bar{P}} = \frac{2\text{cm} \times 6\text{cm}}{4\text{cm}} = 3\text{cm}$$

b) $\frac{\bar{P}\bar{Q}}{\bar{E}\bar{F}} = \frac{\bar{D}\bar{P}}{\bar{D}\bar{E}}$
 $\bar{P}\bar{Q} = \frac{\bar{D}\bar{P} \times \bar{E}\bar{F}}{\bar{D}\bar{E}} = \frac{4\text{cm} \times 12\text{cm}}{6\text{cm}} = 8\text{cm}$

14. $KL^2 + KM^2 = LM^2$

$$KL^2 = 9^2 - 6^2 = 81 - 36 = 45 \text{ cm}^2$$

$$KL = \sqrt{45} = 3\sqrt{5} \text{ cm}$$

$$KL = 3\sqrt{5} \text{ cm}$$

$$\frac{LP}{KL} = \frac{KL}{KM} \Leftrightarrow LP = \frac{KL^2}{LM} = \frac{45\text{cm}^2}{9\text{cm}} = 5 \text{ cm}$$

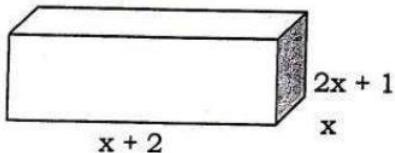
15. a) Mean mark = $\frac{\sum fx}{\sum fi} = \frac{127}{25} = 5.08$

b) Median mark = 5

c) Mode mark = 7

SECTION B: ANSWER ONLY THREE QUESTIONS

16. Let the width be x



The length is $(x + 2) \text{ cm}$

The height is $(2x + 1) \text{ cm}$

The volume is $x(x + 2)(2x + 1) \text{ cm}^3$

Volume = Area of the base x height

$$624 = 2x^3 + x^2 + 4x^2 + 2x$$

$$624 = x^2(2x + 1) + 2x(2x + 1)$$

$$624 = (x^2 + 2x)(2x + 1)$$

$$624 = 2x^3 + 5x^2 + 2x$$

$$x = 6$$

$$x - 6 = 0$$

$$\begin{array}{r}
 \boxed{2x^2 + 17x + 103} \\
 x - 6 \quad | \quad 2x^3 + 5x^2 + 2x - 624 \\
 - \underline{2x^3 - 12x^2} \\
 \hphantom{-}17x^2 + 2x \\
 - \underline{17x^2 - 102x} \\
 \hphantom{-}104x - 624 \\
 - \underline{104x - 624} \\
 \hline
 0
 \end{array}$$

$2x^3 + 5x^2 + 2x - 624 = (x - 6)(2x^2 + 17x + 104)$

$(x - 6)(2x^2 + 17x + 104) = 0$

One of the possible values of $x = 6$

$L = 8\text{cm}$, $W = 6\text{cm}$, $H = 13\text{cm}$.

$$\text{T.S.A} = 2(L \times W) + 2(L \times H) + 2(W \times H)$$

$$2(8 \times 6) + 2(8 \times 13) + 2(6 \times 13)$$

$$(2 \times 48) + (2 \times 104) + (2 \times 78)$$

$$= 96 + 208 + 156$$

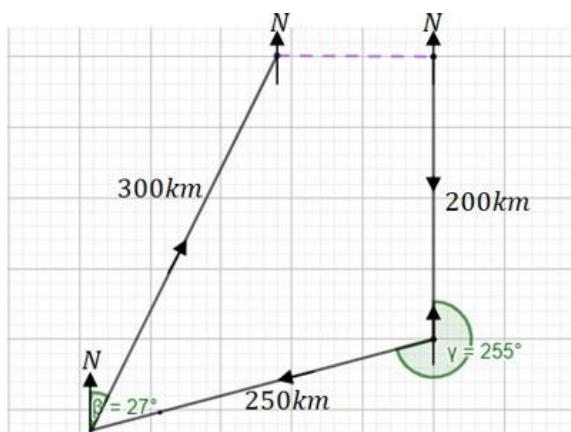
$$= 460\text{cm}^2$$

17. (a) $50\text{ km} = 1\text{ cm}$

$$200\text{ km} = 4\text{ cm}$$

$$250\text{ km} = 5\text{ cm}$$

$$300\text{ km} = 6\text{ cm}$$



b) Distance = $2.2\text{ cm} = 2.2 \times 50 = 110\text{ km}$

Bearing = 90°

c) Total distance = 200km + 250km + 300km = 750km

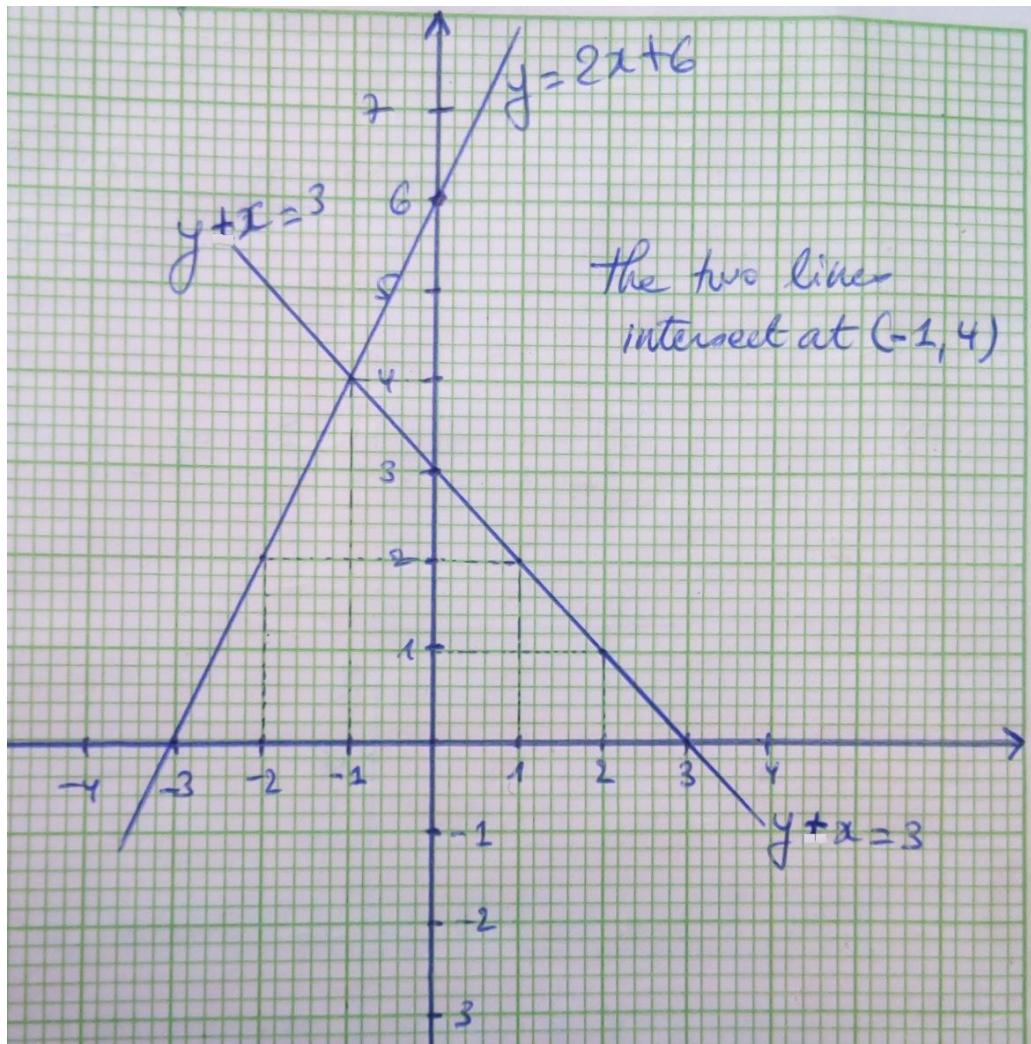
$$Time = \frac{distance}{speed}$$

$$t = \frac{750\text{km}}{200\text{km/h}} = 3\text{hrs } 45\text{ min}$$

18.

$$y = 2x + 6 \quad \text{if } y = 0, x = -3; y = 2, x = -2; y = 2, x = -2$$

$$y + x = 3 \quad \text{If } x = 0, y = 3; x = 1, y = 2; x = 3, y = 0$$



The two lines intersect at (-1, 4)

19. a) In ΔEFH , FH is the perimeter

Angle $FEH = 90^\circ$ (because the angle subtends the diameter at the circumference)

$$\overline{FH^2} = \overline{FE^2} + \overline{EH^2} = r^2 + s^2$$

$$FGH = 90^\circ$$

$$FH^2 = FG^2 + GH^2 = x^2 + y^2$$

$$r^2 + s^2 = x^2 + y^2$$

$$\text{So, } r^2 + s^2 - x^2 = y^2$$

$$y^2 = r^2 + s^2 - r^2$$

b) $\overline{FH^2} = r^2 + s^2$

$$\overline{FH^2} = 8^2 + 6^2$$

$$\overline{FH^2} = 100 \text{ cm}^2$$

$$\overline{FH} = 10 \text{ cm}$$

c) $FG = GH = x$

$$\overline{FH} = x^2 + x^2$$

$$100 = 2x^2$$

$$x = \sqrt{50}$$

$$\text{Area} = \frac{\sqrt{50} \times \sqrt{50}}{2} = \frac{50}{2} = 25 \text{ cm}^2$$

20.

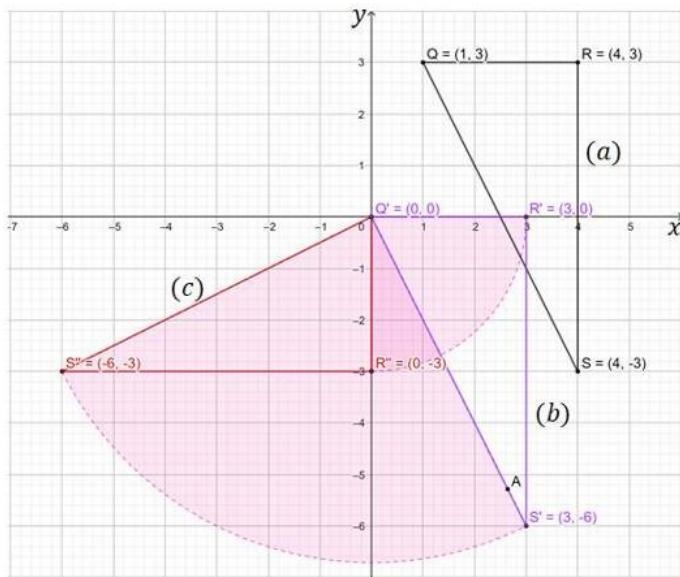
(a) $Q(1, 3)$, $R(4, 3)$ and $S(4, -3)$

$$(b) OQ' = \begin{pmatrix} -1+1 \\ -3+3 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \Rightarrow Q' = (0, 0)$$

$$OR' = \begin{pmatrix} -1+4 \\ -3+3 \end{pmatrix} = \begin{pmatrix} 3 \\ 0 \end{pmatrix} \Rightarrow R' = (3, 0)$$

$$OS' = \begin{pmatrix} -1+4 \\ -3-3 \end{pmatrix} = \begin{pmatrix} 3 \\ -6 \end{pmatrix} \Rightarrow S' = (3, -6)$$

(c) $Q''(0, 0)$, $R''(0, -3)$ and $S''(-6, -3)$



(d) 1st: Rotation of $Q''R''$ and S'' about the origin through +90°

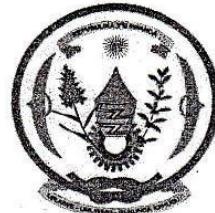
$$2^{nd}: \text{Translation of } Q', R \text{ and } S' \text{ by } T = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$$

Mathematics I

009

15 Nov. 2012 08.30 am – 11.30 am

REPUBLIC OF RWANDA



RWANDA EDUCATION BOARD (REB)
P.O.BOX 3817 KIGALI

ORDINARY LEVEL NATIONAL EXAMINATIONS 2012

SUBJECT: MATHEMATICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **TWO** sections **A** and **B**

SECTION A: Answer **ALL** questions **(55 marks)**

SECTION B: Answer any **THREE** questions. **(45 marks)**

Answer only **one** question in section C **(15 marks)**

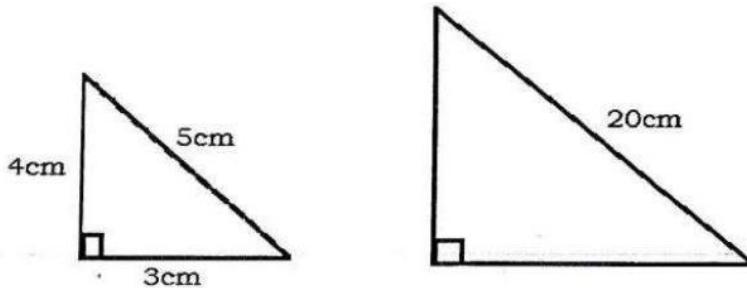
You may use a calculator and mathematical instruments **where necessary**.

Use only a blue pen and a pencil for drawing only.

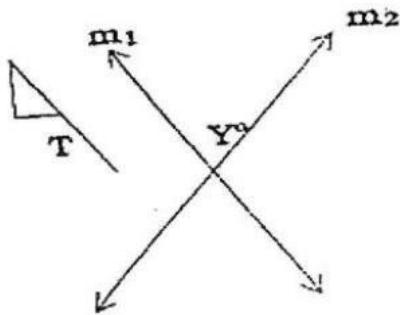
SHOW CLEARLY ALL THE WORKING. **Marks will not be awarded for answers without all working steps.**

SECTION A: Attempt all questions from this section. (55 marks)

1. Express 900 as a product of its prime factors. Hence find the square root of 900. **(3 marks)**
2. (a) Calculate without using a calculator: $3.45^2 - 1.55^2$ **(2 marks)**
(b) Divide without using a calculator: $0.9 \div 30$ **(1 mark)**
3. In a school food store, there is enough food to feed 300 students for 17 days. For how long will the food last if 40 more students join the group? **(3 marks)**
4. Solve the equation: $5x^2 + 21x - 20 = 0$ **(3 marks)**
5. The right angled triangles below are similar. Find the area of the larger triangle. **(3 marks)**

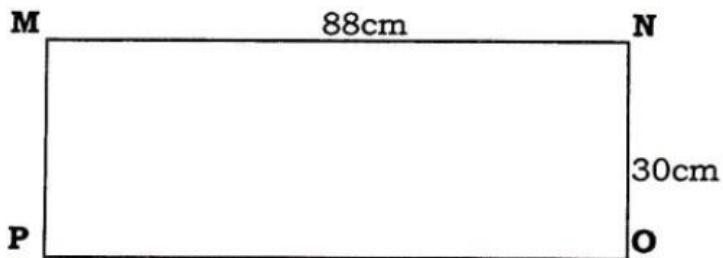


6. Solve them simultaneously: $x + 2y = 40$
 $3x = 60 - y$ **(4 marks)**
7. Find the equation of the line which passes through the points $(-1, 3)$ and $(4, 2)$. **(4 marks)**
8. Given that $f(x) = ax^2 - 7$ and $f(2) = 13$, find the value of $f(-1)$. **(4 marks)**
9. In a class of 40 students, 24 like Mathematics and 30 like Kinyarwanda. All students like at least one of the subjects. Draw a Venn diagram to represent this information. How many students like both Mathematics and Kinyarwanda? **(4 marks)**
10. Solve the equation: $\frac{3x}{2} \geq \frac{x}{4} - 10$. Illustrate the answer on a number line. **(4 marks)**
11. A point **m** divides a line segment AB, 10cm long into two parts such that one part is 4cm longer than the other. Find the length of the two parts. **(4 marks)**
12. The diagrams below show a flag T and two mirrors **m₁** and **M₂M₁(T)** in intersecting at an angle Y° . Copy the diagram and show images **M₁(T)** in **m₁** and **M₂M₁(T)** in **m₂**.



13. Given $152n = 68\text{ten}$, find n. (4 marks)

14. Find the mid-point M of the line joining the points A (1, 0) and B (9, 6).
Find length \overline{MB} . (4 marks)



If it is curved in such a way that MP and NO meet to form a hollow cylindrical figure, find the volume of the cylindrical figure formed. $\pi = \frac{22}{7}$.
(4 marks)

SECTION B: Attempt any THREE questions. (45 marks)

15. (a) Solve for x : $\frac{1}{x^2-1} + \frac{1}{x^2-4x+3} + \frac{1}{x-3} = 0$ (8 marks)

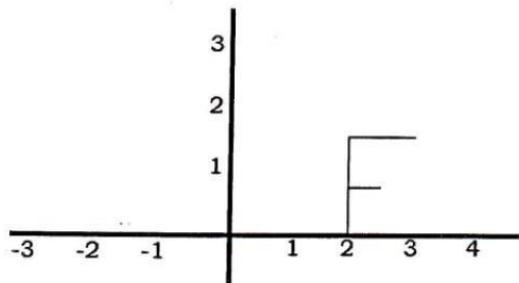
(b) Factorize completely: $f(x) = 2x^3 + 5x^2 + x - 2$. Hence find the values of x when $f(x) = 0$. (7 marks)

16. The table below shows the ages of 73 students.
Make the frequency table using the above data.

Age in years	14	15	16	17	18	19	20
Frequency	5	9	13	11	12	15	8

(a) Find the median age. (4 marks)
(b) Calculate the mean age. (11 marks)

17. Use the diagram to answer (a) and (b) below.



(a) Copy the diagram and sketch the image under

- (i) a $+90^\circ$ rotation about origin
- (ii) a -180° rotation about origin

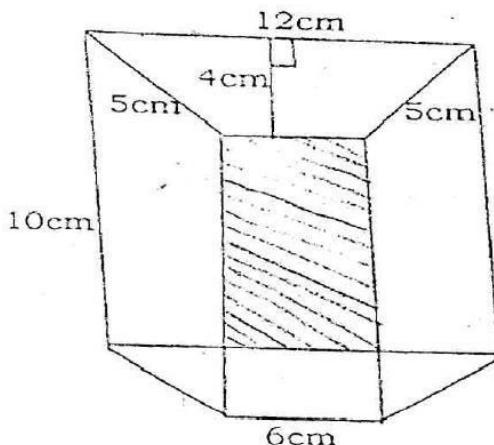
(b) Copy the diagram again and sketch the image under a translation.

- (i) $T = \begin{pmatrix} -2 \\ 1 \end{pmatrix}$
- (ii) $T = \begin{pmatrix} 4 \\ 0 \end{pmatrix}$



of under a

18. The figure below is a right trapezoidal prism.



Calculate its (a) lateral area

(5 marks)

(b) Total surface area

(7 marks)

(c) Volume

(3 marks)

19. (a) Rationalize the denominator: $\frac{\sqrt{2}}{2\sqrt{5}+\sqrt{3}}$

(b) Simplify: $\sqrt{12} \times 3\sqrt{60} \times \sqrt{45}$

(c) Simplify: $\sqrt{8} \times \sqrt{50} \times \sqrt{121}$

(d) Simplify: $\frac{5\sqrt{7}}{\sqrt{45}} \times \frac{2\sqrt{3}}{\sqrt{21}}$

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2012

Section A: Answer all questions

1.

$$\begin{array}{r|l}
 2 & 900 \\
 2 & 450 \\
 3 & 225 \\
 3 & 75 \\
 5 & 25 \\
 5 & 5 \\
 5 & 1
 \end{array}$$

$$\text{So } 900 = 2^2 \times 3^2 \times 5^2$$

$$\sqrt{900} = \sqrt{2^2 \times 3^2 \times 5^2}$$

$$= 2 \times 3 \times 5 = 30$$

2. a) $3.45^2 - 1.55^2 = (3.45 + 1.55)(3.45 - 1.55) = (5.0)(1.90) = 9.5$

b) $0.9 \div 30 = \frac{9}{10} \times \frac{1}{30} = \frac{3}{10 \times 10} = \frac{3}{100} = 0.03$

3. 300 students \rightarrow 17 days

$$\begin{aligned}
 1 \text{ student} &\rightarrow 17 \text{ days} \times 300 \\
 340 \text{ students} &\rightarrow \frac{17 \text{ days} \times 300}{340} = 15 \text{ days}
 \end{aligned}$$

4. $5x^2 + 21x - 20 = 0$

$$5x^2 + 25x - 4x - 20 = 0$$

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

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

$$x + 5 = 0 \text{ or } 5x - 4 = 0$$

$$x = -5 \text{ or } x = \frac{4}{5}$$

5. Area of the small triangle $= \frac{1}{2} \times 4 \times 3 = 6 \text{ cm}^2$

$$\text{Linear scale factor} = \frac{20}{5} = 4$$

$$\text{Area scale factor} = 4^2 = 16$$

$$\text{Area larger triangle} = 16 \times 6 = 96 \text{ cm}^2$$

6.

$$\begin{array}{r} \times 3 \\ \hline x + 2y = 40 \\ 3x + y = 60 \end{array}$$

$$= 3x + 6y = 120$$

$$- 3x + y = 60$$

$$5y = 60$$

$$y = 12$$

$$x + 24 = 40$$

$$x = 16$$

7. Let x and y be any point on the line.

$$\text{Then the gradient of the line} = \frac{y-3}{x-(-1)} = \frac{y-3}{x+1}$$

$$\text{Again the gradient of the line} = \frac{2-3}{4-(-1)} = \frac{-1}{5}$$

$$\text{So } \frac{y-3}{x+1} = \frac{-1}{5} \Leftrightarrow 5(y-3) = -1(x+1)$$

$$5y - 15 = -x - 1$$

$$5y + x = 14$$

8. $f(x) = ax^2 - 7$

$$f(2) = a(2)^2 - 7 = 13$$

$$So 4a - 7 = 13$$

$$4a = 20$$

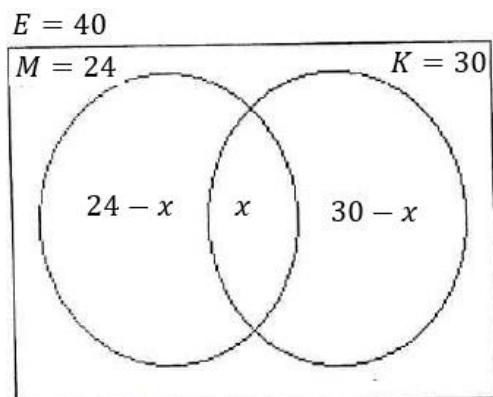
$$a = \frac{20}{5}$$

$$a = 5$$

$$f(x) = 5x^2 - 7$$

$$f(-1) = 5(-1)^2 - 7 = 5 \times 1 - 7 = 5 - 7 = -2$$

9.



$$24 - x + x + 30 - x = 40$$

$$54 - x = 40$$

$$x = 14$$

14 students like both Mathematics and Kinyarwanda.

10. $\frac{3x}{2} \geq \frac{x}{4} - 10$

$$\frac{6x}{4} \geq \frac{x-40}{4}$$

$$5x \geq -40$$

$$x \geq -8$$

11. Let one part be $x \text{ cm}$ and the other part $(x + 4) \text{ cm}$

$$x + x + 4 = 10$$

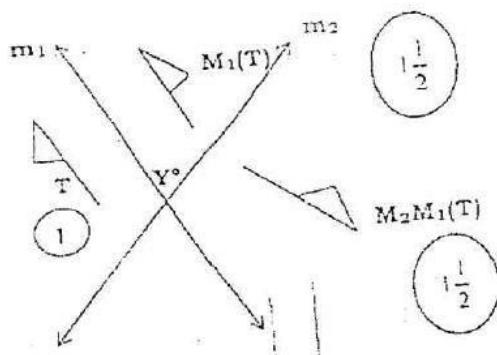
$$2x = 10 - 4$$

$$2x = 6$$

$$x = 3$$

One part is 3 cm and the other is $(3 + 4) = 7 \text{ cm}$

12.



$$13. \quad 152_n = 68_{ten}$$

$$152_n = (1 \times n^2) + (5 \times n^1) + (2 \times n^0) = n^2 + 5n + 2 = 68$$

$$n^2 + 5n + 2 - 68 = 0$$

$$n^2 + 5n - 66 = 0$$

$$n^2 + 11n - 6n - 66 = 0$$

$$(n^2 + 11n) + (-6n - 66) = 0$$

$$n(n + 11) - 6(n + 11) = 0$$

$$(n - 6)(n + 11) = 0$$

$$n - 6 = 0 \quad n + 11 = 0$$

$$n = -11 \quad (\text{Rejected})$$

Or

$$n = 6$$

$$14. \quad \text{Midpoint } M = \frac{1+9}{2}, \frac{6+0}{2} = 5, 3$$

$$\overline{MB} = \binom{9-5}{6-3} = \binom{4}{3}$$

$$\overline{MB} = \sqrt{4^2 + 3^2} = \sqrt{16 + 9} = \sqrt{25} = 5$$

$$15. \quad \text{Perimeter} = \pi D = 88 \text{ cm}$$

$$D = \frac{\text{Perimeter}}{\frac{22}{7}} = 88 \text{ cm} \times \frac{7}{22} = 28 \text{ cm}$$

$$r = \frac{28}{2} = 14 \text{ cm}$$

$$V = \pi r^2 h = \frac{22}{7} \times 14 \text{ cm} \times 14 \text{ cm} \times 30 \text{ cm} = 18480 \text{ cm}^3$$

SECTION B: ANSWER ONLY THREE QUESTIONS

16. a) $\frac{1}{x^2-1} + \frac{1}{x^2-4x+3} + \frac{1}{x-3} = 0$

$$\frac{1}{(x-1)(x+1)} + \frac{1}{(x-3)(x-1)} + \frac{1}{x-3} = 0$$

$$\frac{x-3}{(x-1)(x+1)(x-3)} + \frac{x+1}{(x-3)(x-1)(x+1)} + \frac{(x-1)(x+1)}{x-3} = 0$$

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

$$x - 3 + x + 1 + x^2 - 1 = 0$$

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

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

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

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

$$x = -3 \text{ or } x = 1$$

x = 1 is not valid

b)

$$2x^3 + 5x^2 + x - 2$$

$$\begin{array}{r} 2x^3 - x^2 \\ 6x^2 + x \\ \hline 6x^2 - 3x \\ \hline 4x - 2 \\ \hline 0 \end{array}$$

$$\begin{aligned} x^2 + 3x + 2 &= x^2 + 2x + x + 2 \\ &= x(x + 2) + (x + 2) \\ &= (x + 2)(x + 1) \end{aligned}$$

So $2x^3 + 5x^2 + x - 2 = (2x - 1)(x + 2)(x + 1)$

$$x = -2 \text{ or } x = -1 \text{ or } x = -\frac{1}{2}$$

17.

Age in years	14	15	16	17	18	19	20
Frequency	5	9	13	11	12	15	8
Cumulative frequency	5	14	27	38	50	65	73

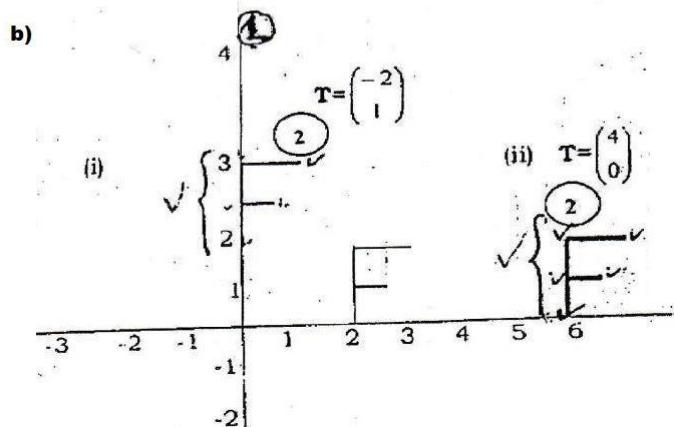
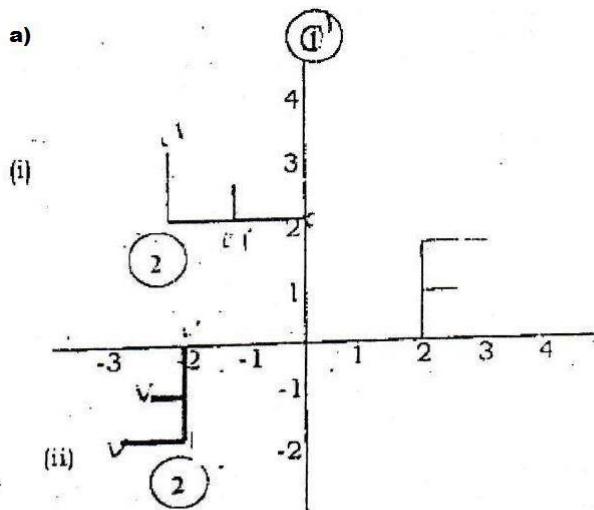
a) Median age = the $\frac{1}{2}(N + 1)^{th}$ age = the $\frac{1}{2}(73 + 1)^{th}$ age = the 37th age

b)

Age (x)	Frequency (f)	Fx
14	5	70
15	9	135
16	13	208
17	11	187
18	12	216
19	15	285
20	8	160
	$\sum x = 73$	$\sum fx = 1261$

$$\text{Mean age} = \frac{1261}{73} = 17.27$$

18.



19. a) Lateral area = base perimeter \times height

$$= (5 + 6 + 5 + 12) \times 12 = 28 \times 10 = 280 \text{ cm}^2$$

b) Total surface area = lateral area + area of 2 bases

$$= \text{base area} = \frac{1}{2} \times 4 \times (6 + 12) = 36 \text{ cm}^2$$

$$\text{Area of 2 bases} = 2 \times 36 = 72 \text{ cm}^2$$

$$\text{Total area} = 280 + 72 = 352 \text{ cm}^2$$

$$\text{c) Volume} = \text{base area} \times \text{height} = 36 \times 10 = 360 \text{ cm}^3$$

$$20. \text{ (a)} \quad \frac{\sqrt{2}}{2\sqrt{5}+\sqrt{3}} = \frac{\sqrt{2}(2\sqrt{5}-\sqrt{3})}{(2\sqrt{5}+\sqrt{3})(2\sqrt{5}-\sqrt{3})} = \frac{2\sqrt{10}-\sqrt{6}}{4\times 5 - 3} = \frac{2\sqrt{10}-\sqrt{6}}{17}$$

$$\text{(b)} \quad \sqrt{12} \times 3\sqrt{60} \times \sqrt{45} = \sqrt{4 \times 3} \times 3\sqrt{4 \times 15} \times \sqrt{9 \times 5}$$

$$= 2\sqrt{3} \times 6\sqrt{15} \times 3\sqrt{5} = 36\sqrt{3} \times \sqrt{15} \times \sqrt{5} = 36 \times 15 = 540$$

$$\text{(c)} \quad \sqrt{8} \times \sqrt{50} \times \sqrt{121} = \sqrt{4 \times 2} \times \sqrt{25 \times 2} + \sqrt{11 \times 11} = 2\sqrt{2} \times 5\sqrt{2} + 11$$

$$= 10\sqrt{2 \times 2} + 11 = 10 \times 2 + 11 = 31$$

$$\text{(d)} \quad \frac{5\sqrt{7}}{\sqrt{45}} \times \frac{2\sqrt{3}}{\sqrt{21}} = \frac{5\sqrt{7} \times 2\sqrt{3}}{\sqrt{9 \times 5} \times \sqrt{7} \times \sqrt{3}} = \frac{5\sqrt{7} \times 2\sqrt{3}}{\sqrt{9 \times 5} \times \sqrt{7} \times \sqrt{3}} = \frac{5 \times 2}{3\sqrt{5}} = \frac{10\sqrt{5}}{3\sqrt{5} \times \sqrt{5}} = \frac{2\sqrt{5}}{3}$$

Mathematics I

010

30 Oct 2013 08.30 am – 11.30 am

REPUBLIC OF RWANDA



RWANDA EDUCATION BOARD (REB)
P.O.BOX 3817 KIGALI

ORDINARY LEVEL NATIONAL EXAMINATIONS 2013

SUBJECT: MATHEMATICS I

DURATION: 3 HOURS

INSTRUCTIONS:

- 1) Do not open this question paper until you are told to do so.
- 2) This paper consists of **TWO** sections **A** and **B**.

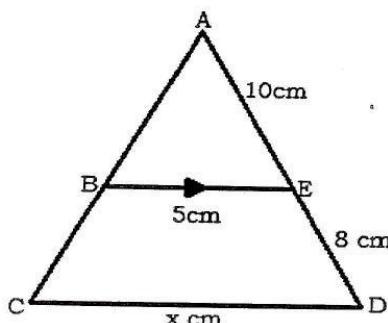
SECTION A: Attempt **ALL** questions **(55 marks)**

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 from this section. (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) :
$$\begin{aligned} 8x + y &= 21 \\ 5x - 4y &= -10 \end{aligned}$$
 (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.
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.



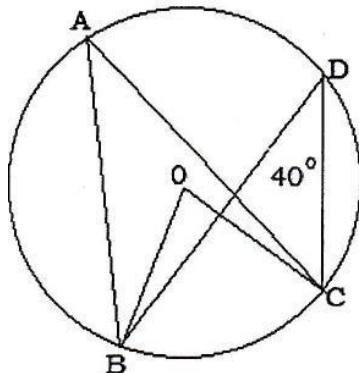
- (a) Show that triangle ABE is similar to triangle ACD. **(2 marks)**

(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)**

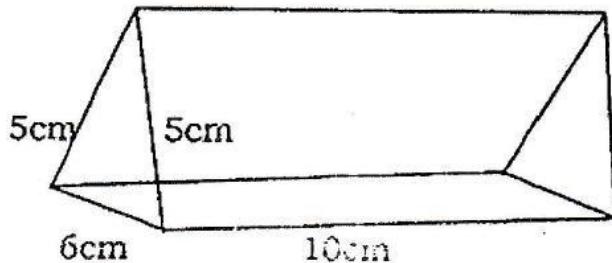


SECTION B: ATTEMPT ANY THREE QUESTIONS. (30 MARKS)

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° 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)

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2013

Section A: Answer all questions

1. $I = \frac{PRT}{100}$

$$R = \frac{I \times 100}{PT} = \frac{16,000 \times 100}{100,000 \times 2} = 8\%$$

Interest rate = 8 %

2. $8x^2 - 2 = 0$

$$2(4x^2 - 1) = 0$$

$$2(2x - 1)(2x + 1) = 0$$

$$2x - 1 = 0 \text{ or } 2x + 1 = 0$$

$$x = \frac{1}{2} \text{ or } x = -\frac{1}{2}$$

3. The gradient of a line = $\frac{y-8}{x-2}$

The gradient of line is 3

$$\text{So } \frac{y-8}{x-2} = 3$$

$$y - 8 = 3x - 6$$

$$y = 3x + 2$$

4.

$$\times 4 \quad 8x + y = 21 \Rightarrow (\text{i})$$

$$5x - 4y = -10 \Rightarrow (\text{ii})$$

$$32x + 4y = 84 \Rightarrow (\text{iii})$$

$$5x - 4y = \Rightarrow (\text{iv})$$

$$(\text{iii}) + (\text{iv}) = 37x = 74$$

$$x = 2$$

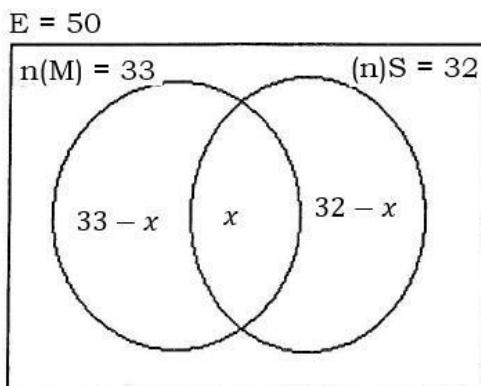
substitute x in (i)

$$= 8 \times 2 + y = 21$$

$$16 + y = 21$$

$$y = 5$$

5.



$$\text{So } 33 - x + x + 32 - x = 50$$

$$65 - x = 50$$

$$x = 65 - 50 = 15$$

15 pupils like both subjects.

6. $3x^2 = 2x + 5$

$$3x^2 - 2x - 5 = 0$$

$$3x^2 + 3x - 5x - 5 = 0$$

$$3x(x + 1) - 5(x + 1) = 0$$

$$(3x - 5)(x + 1) = 0$$

$$3x - 5 = 0 \text{ or } x + 1$$

$$x = \frac{5}{3} \text{ or } x = -1$$

7. $\sqrt{12} \times 3\sqrt{60} \times \sqrt{45}$

$$= \sqrt{4 \times 3} \times 3\sqrt{4 \times 15} \times \sqrt{9 \times 5}$$

$$= 2\sqrt{3} \times 6\sqrt{15} \times 3\sqrt{5}$$

$$= 36\sqrt{3 \times 15 \times 5} = 36 \times 15 = 540$$

8.

$$\overrightarrow{PQ} = \begin{bmatrix} 3 - (-3) \\ 1 - (-2) \end{bmatrix} = \begin{bmatrix} 6 \\ 3 \end{bmatrix}$$

$$\overrightarrow{QR} = \begin{bmatrix} 5 - 3 \\ 2 - 1 \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$$

$$\overrightarrow{PQ} = \begin{bmatrix} 6 \\ 3 \end{bmatrix} = 3 \begin{bmatrix} 2 \\ 1 \end{bmatrix} = 3\overrightarrow{QR}$$

Q is common and $\overrightarrow{PQ} // \overrightarrow{QR}$

So P, Q and R are collinear

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 are $= 2 + 3 + 5 = 10$

Shares are: i) $10,000 \times \frac{2}{10} = 2,000 FRW$

ii) $10,000 \times \frac{3}{10} = 3,000 FRW$

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

12.

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

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

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 $\triangle ACD$, A = 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) $\frac{x}{5} = \frac{18}{10}$

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

$x = 9$

100

$$14. (3x - 2)(x + 4) = -11$$

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

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

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

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

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

$$i.e. x + 3 = 0 \text{ or } 3x + 1 = 0$$

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

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 = BDC (angle subtended at the circumference) = 40°

Angle BAC = 40°

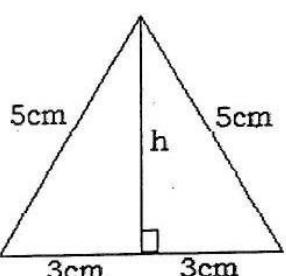
SECTION B: ANSWER ONLY THREE QUESTIONS

$$16. \text{ a) i) Area of shaded part} = \frac{3}{4}\pi r^2 = \frac{3}{4} \times \frac{22}{7} \times 14 \times 14 = 462 \text{ cm}^2$$

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 = cross-section area x height

$$= 12 \times 10 = 120 \text{ cm}^3$$

17.

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

$$\text{Mode} = 160 \text{ cm}$$

$$\text{Median} = 160 \text{ cm}$$

$$\text{Mean} = \frac{4055}{25} = 162.2 \text{ cm}$$

18.

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

$$\begin{array}{r}
 \underline{x^3 - 3x^2} \\
 3x^2 + 11x \\
 \underline{-3x^2 + 9x} \\
 2x - 6 \\
 \underline{2x - 6} \\
 0 \\
 \underline{x - 3} \\
 x^2 - 3x + 2
 \end{array}$$

$$\begin{aligned}
 x^2 - 3x + 2 &= x^2 - 2x - x + 2 \\
 &= x(x - 2) - 1(x - 2) \\
 &= (x - 1)(x - 2)
 \end{aligned}$$

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

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

$$\begin{aligned}
 &= (x^3 + 5x^2) - (4x + 20) = 0 \\
 &= x^2(x+5) - 4(x+5) = 0 \\
 &= (x^2 - 4) - (x + 5) = 0 \\
 &= (x - 2)(x + 2)(x + 5) = 0
 \end{aligned}$$

$$\begin{array}{ccc}
 x - 2 \neq 0 & x + 2 \neq 0 & x + 5 = 0 \\
 | & | & \\
 x = 2 & x = -2 & x = -5
 \end{array}$$

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

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

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

Using equation (i)

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

$$\underline{- 10p + 12b = 4100 \text{ (iv)}}$$

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

Subtract equation (iv) - (iii) $p = 50$

Substitute p in equation (i)

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

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

$$B = 300$$

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

20 books cost: $20 \times 300 = 6,000\text{Rwf}$

b) Let John's monthly salary be $x\text{Rwf}$.

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

$$\text{Money left after the car loan} = \frac{3}{4} \times \frac{2}{3}x = \frac{1}{2}x$$

$$\text{Money left after food} = \frac{1}{2} \times \frac{1}{3}x = \frac{1}{4}x$$

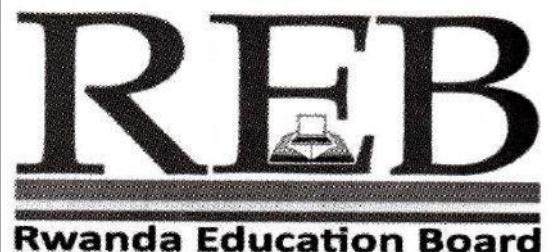
$$\text{But } \frac{1}{4}x = 50,000 \text{ so } x = 200,000$$

John's monthly salary is 200,000Rwf

20.

**Mathematics I
010**

29 Oct. 2014 08.30 am – 11.30 am



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2014

SUBJECT: MATHEMATICS I

DURATION: 3 HOURS

INSTRUCTIONS:

- 1) Do not open this question paper until you are told to do so.
- 2) This paper consists of **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 from this section. (55 marks)

1. Simplify: $0.42^2 - 0.58^2$ without using a calculator. **(3 marks)**
2. Simplify the fractions completely: $(2\frac{2}{5} \div 1\frac{6}{10}) \times 0.02$ **(3 marks)**
3. Find the inverse function of $g(x) = 3 + 4x$. **(2 marks)**
4. A piece of land is represented by a rectangle of 300cm^2 on a map. Determine the actual area of the land in hectares (ha). The scale is 1: 15,000. **(3 marks)**
5. Solve: $\frac{2x-5}{x^2-4} = \frac{5}{x-2}$ **(5 marks)**
6. To pass a certain interview, a candidate must pass both oral test (R) and a written test (W). Of the candidates who attend the interview 70% passed R, 60% passed W and 150% passed R but not W. Four candidates failed both tests. How many candidates passed the interview? **(4 marks)**
7. Solve the following simultaneous equations: $2x + 3y = 5$
 $3x + 2y = 10$ **(4 marks)**
8. Solve the following inequality: $2x - \frac{1}{3}(4x - 1) < \frac{3}{4} + x$. Illustrate the solution on the number line. **(4 marks)**
9. Calculate the distance between points A (-5, 4) and B (3, -2). **(4 marks)**
10. Find the magnitude of vector $z \rightarrow + 2w \rightarrow$, given that $z \rightarrow = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$ and $w \rightarrow = \begin{pmatrix} 4 \\ 2 \end{pmatrix}$. **(4 marks)**
11. (a) Find the sum of the interior angles of a pentagon. **(2 marks)**
(b) The sum of the interior angles of a polygon is 900° . How many sides has the polygon? **(2 marks)**
12. The longest side of a right angled triangle is 15cm and the other two sides are x cm and $(x + 3)$ cm respectively. Find x and calculate the area of the triangle. **(4 marks)**
13. A (1, 4), B (1, 0) and C (3, -2) are three of the vertices of a quadrilateral ABCD. $A \rightarrow D \rightarrow = \begin{pmatrix} 4 \\ -1 \end{pmatrix}$ and X is the mid-point of AC. Find the coordinates of D and X . **(4 marks)**
14. Solve: $6x^2 + x - 2 = 0$ **(3 marks)**
15. a) Simplify: $36^{1/2} + 27^{2/3}$ **(2 marks)**
b) Solve for x: $4^x = 32$ **(2 marks)**

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

16.a) Two lines, one passing through points $(0, 4)$ and $(3, 1)$ and the other passing through point $(-3, 2)$, are parallel. Find the equations of these lines. **(7 marks)**

b) If $f(x) = 2x + 3$ and $g(x) = 3x - 1$, calculate:

(i) $f(-1)$

(ii) $g(-4)$

(iii) $fog(x)$

(iv) $gof(x)$

(v) $gof\left(-\frac{1}{6}\right)$

(vi) $fog\left(-\frac{1}{6}\right)$

(8 marks)

17.a) A triangle with vertices A, B and c whose coordinates are $(2, 0)$, $(5, 4)$ and $(6, 1)$ respectively is given a translation $t^{\rightarrow} = \begin{pmatrix} -3 \\ 7 \end{pmatrix}$. Find the images vertices: (i) A'; (ii) B'; (iii) C'. **(5 marks)**

b) A $(-5, -1)$, B $(-2, -1)$ and C $(-4, -2)$ are vertices of triangle ABC.

(i) Plot points A, B and C on a graph paper using a scale of 1cm to represent 1 unit on each axis. Join the points to form triangle ABC. **(4 marks)**

(ii) Triangle ABC is enlarged by a scale factor of -2 with the origin $(0, 0)$ as the centre of enlargement. On the same graph as 17.b)(i) above, draw the image A'B'C' of triangle ABC. **(3 marks)**

(iii) Draw triangle A'' B' C'' which is the image of triangle ABC under a reflection in line $y = 0$. Use the same graph as that of 17.b) (i) above.

(3 marks)

18. a) Mr. RWEMA buys a certain number of pens for £1.40 and the number of pence that each one costs him is 4 more than the number of pens that he buys. Find the cost of each pen. £ = pound (British currency) and $1£ = 100$ pence. **(5 marks)**

b) Solve: $6x^3 + 11x^2 - 3x - 2 = 0$

(10 marks)

19. The table below shows the marks scored by 52 students in marked a test out of 50

12	18	24	29	37	45	47	38	31	24
19	13	14	20	25	32	39	40	33	25
21	14	40	33	26	21	15	16	22	27
34	41	41	35	27	22	16	17	27	22
28	44	42	35	18	22	28	36	43	18
23	36								

- a) Make a grouped frequency table for the marks starting with 12 - 19.
b) Find the modal class and its limits. Calculate the mean. **(15 marks)**

20. a) Given that the points $(4, -1)$, $(1, 5)$ and $(-3, k)$ lie on a straight line, calculate the value of k .
b) The data below show a relation between x and y .

x	3	4	5	6	7
y	10	13	16	19	22

By plotting y against x on a graph, determine the gradient of the graph hence deduce the relation between y and x . Write the equation connecting y and x .

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2014

Section A: Answer all questions

1. $0.42^2 - 0.58^2 = (0.42 - 0.58)(0.42 + 0.58) = -0.16 \times 1 = -0.16$

2. $(2\frac{2}{5} \div 1\frac{6}{10}) \times 0.02 = (\frac{12}{5} \div \frac{16}{10}) \times 0.02 = (\frac{12}{5} \times \frac{10}{16}) \times 0.02 = (\frac{3}{1} \times \frac{2}{4}) \times 0.02$
 $= \frac{3}{2} \times 0.02 = 0.03$

3. $g(x) = 3 + 4x$ or

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

$$g(x)^{-1} = \frac{x-3}{4}$$

4. $k = \frac{1}{15,000}, Image = 300 \text{ cm}^2, Object = ?$

$$\text{We have } k^2 = \frac{300}{Object} \quad i.e \frac{1}{225000000} = \frac{300}{Object}$$

$$\begin{aligned} So, object &= 225000000 \times 300 = 675 \times 10^8 \text{ cm}^2 = 675 \times 10^4 \text{ m}^2 \\ &= 675 \text{ ha} \end{aligned}$$

5. $\frac{2x-5}{x^2-4} = \frac{5}{x-2}$

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

$$2x^2 - 4x - 5x + 10 = 5x^2 - 20$$

$$-3x^2 - 9x + 30 = 0$$

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

$$\Delta = b^2 - 4ac = 3^2 - 4 \times 1 \times (-10) = 9 + 40 = 49$$

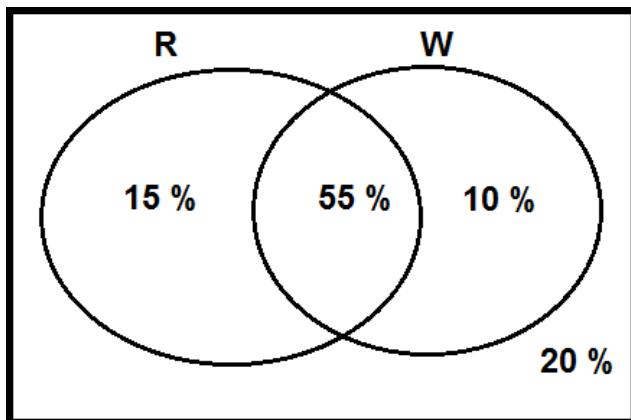
$$\sqrt{\Delta} = \sqrt{49} = 7$$

$$x_1 = \frac{-b + \sqrt{\Delta}}{2a} = \frac{-3 + 7}{2} = \frac{4}{2} = 2 \text{ rejected}$$

$$x_2 = \frac{-b - \sqrt{\Delta}}{2a} = \frac{-3 - 7}{2} = \frac{-10}{2} = -5$$

$$\text{So, } S = \{-5\}$$

6.



The 4 candidates who failed both tests correspond to 20 %.

$$20\% \rightarrow 4$$

$$1 \% \rightarrow \frac{4}{20} = \frac{1}{5}$$

$$55 \% \rightarrow \frac{1}{5} \times 55 = 11$$

The number of candidates who passed the interview.

$$7. \quad 2x + 3y = 5 \quad \times -3$$

$$3x + 2y = 10 \quad \times 2$$

$$-6x - 9y = -15 \quad (1)$$

$$6x + 4y = 20 \quad (2)$$

By adding the equation (1) and (2) we get

$$-5y = 5$$

$$y = -1$$

$$2x + 3y = 3$$

$$2x + 3(-1) = 5$$

$$2x - 3 = 5$$

$$2x = 8$$

$$x = \frac{8}{4}$$

$$x = 2$$

$$8. \quad 2x - \frac{1}{3}(4x - 1) < \frac{3}{4} + x$$

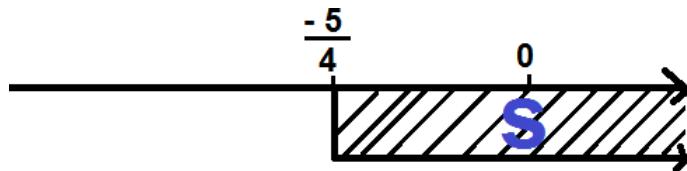
$$\frac{6x - 4x + 1}{3} < \frac{3 + 4x}{4}$$

$$\underline{2x+1} < \underline{4x+3}$$

$$8x + 4 < 12x + 9$$

$$-4x < 5$$

$$x < -\frac{5}{4}$$



9. $d(A, B) = \sqrt{(3 + 5)^2 + (-2 - 4)^2}$

$$= \sqrt{8^2 + 6^2}$$

$$= \sqrt{64 + 36}$$

$$= \sqrt{100}$$

= 10 length units

10. $\vec{z} = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$ and $\vec{w} = \begin{pmatrix} 4 \\ 2 \end{pmatrix}$

$$\vec{z} + 2\vec{w} = \begin{pmatrix} -2 \\ 4 \end{pmatrix} + 2\begin{pmatrix} 4 \\ 2 \end{pmatrix} = \begin{pmatrix} -2 \\ 4 \end{pmatrix} + \begin{pmatrix} 8 \\ 4 \end{pmatrix} = \begin{pmatrix} 6 \\ 8 \end{pmatrix}$$

The magnitude of $\vec{z} + 2\vec{w} = \sqrt{6^2 + 8^2} = \sqrt{36 + 64} = \sqrt{100} = 10$

11. By formula $\sum_{int \ angles} = (n - 2) \times 180^\circ$

where n is the number of sides of the polygon.

a) So, we have $n = 5$ for a pentagon

$$\sum_{int \ angles} = (n - 2) \times 180^\circ = (5 - 2) \times 180^\circ = 540^\circ$$

The sum of the interior angles of a pentagon is 540° .

b) We have $\sum_{int \ angles} = (n - 2) \times 180^\circ$

where n is the number of sides of the polygon.

$$So, 900^\circ = (n - 2) \times 180^\circ$$

$$900^\circ = 180n - 360^\circ$$

$$180n = 1260^\circ$$

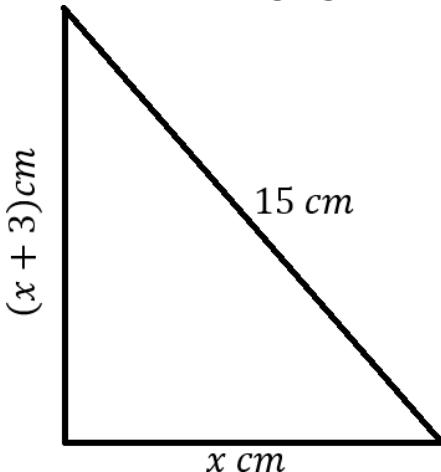
$$18n = 126^\circ$$

$$n = \frac{125}{18}$$

$$n = 7$$

The given polygon has seven sides.

12. We have the following right triangle



With Pythagorean Theorem, we have

$$15^2 = (x + 3)^2 + x^2$$

$$225 = x^2 + 6x + 9 + x^2$$

$$2x^2 + 6x - 216 = 0$$

$$x^2 + 3x - 108 = 0$$

$$\Delta = b^2 - 4ac = 3^2 - 4 \times 1 \times (-108) = 9 + 432 = 441$$

$$\sqrt{\Delta} = \sqrt{441} = 21$$

$$x_1 = \frac{-b + \sqrt{\Delta}}{2a} = \frac{-3 + 21}{2} = \frac{18}{2} = 9$$

$$x_2 = \frac{-b - \sqrt{\Delta}}{2a} = \frac{-3 - 21}{2} = \frac{-24}{2} = -12 \text{ rejected as it is } < 0$$

So, $x = 9 \text{ cm}$

The area of that triangle is $A = \frac{1}{2} \times x \times (x + 3)$

$$= \frac{1}{2} \times 9 \times 12 \text{ cm}^2 = 54 \text{ cm}^2$$

13. A (1, 4), B (1, 0) and C (3, -2)

$$A \rightarrow D \rightarrow (-1) = (4)$$

Let $D(x, y)$

$$A \rightarrow D \rightarrow = (x - 4, y + 1) \text{ we get}$$

$$(4) = (x-4) \quad i.e. \begin{cases} x-4=4 \\ y+1=-1 \end{cases} \quad i.e. \begin{cases} x=8 \\ y=-2 \end{cases}$$

So, $D(8, -2)$ i.e. the coordinates of D are $(8, -2)$.

We know that the mid-point of AC has the coordinates $(\frac{1+3}{2}, \frac{4-2}{2})$

i.e. $x(2, 1)$

The coordinates of x are $(2, 1)$

$$14. \ 6x^2 + x - 2 = 0$$

$$\Delta = b^2 - 4ac = 1^2 - 4 \times 4 \times (-2) = 1 + 48 = 49$$

$$\sqrt{\Delta} = \sqrt{49} = 7$$

$$x_1 = \frac{-b+\sqrt{\Delta}}{2a} = \frac{-1+7}{12} = \frac{6}{12} = \frac{1}{2}$$

$$x_2 = \frac{-b-\sqrt{\Delta}}{2a} = \frac{-1-7}{12} = \frac{-8}{12} = -\frac{3}{4}$$

$$S = \left\{ -\frac{2}{3}, \frac{1}{2} \right\}$$

$$15. \text{ a)} \ 36^{\frac{1}{2}} + 27^{\frac{2}{3}} = (6^2)^{\frac{1}{2}} + (3^3)^{\frac{2}{3}}$$

$$= 6 + 3^2$$

$$= 6 + 9$$

$$= 15$$

$$b) 4^x = 32$$

$$2^{2x} = 2^5$$

$$2x = 5$$

$$x = \frac{5}{2}$$

SECTION B: ANSWER ONLY THREE QUESTIONS

16. a) The equation of the line passing through the points (0, 4) and (3, 1) is given by

$$y - 1 = \frac{1-4}{3-0}(x - 3)$$

$$y - 1 = -(x - 3)$$

$$y = -x + 4$$

$$y + x = 4$$

The gradient of this line is -1. The gradient of the line passing through the points (-3, 2) and parallel to the line $y = -x + 4$ is also -1.

Its equation is $y - 2 = -(x + 3)$

$$y = -x - 1$$

$$y + x = -1$$

b) $f(x) = 2x + 3$ and $g(x) = 3x - 1$:

$$(i) f(-1) = 2(-1) + 3 = 1$$

$$\text{(ii)} \ g(-4) = 3(-4) - 1 = -13$$

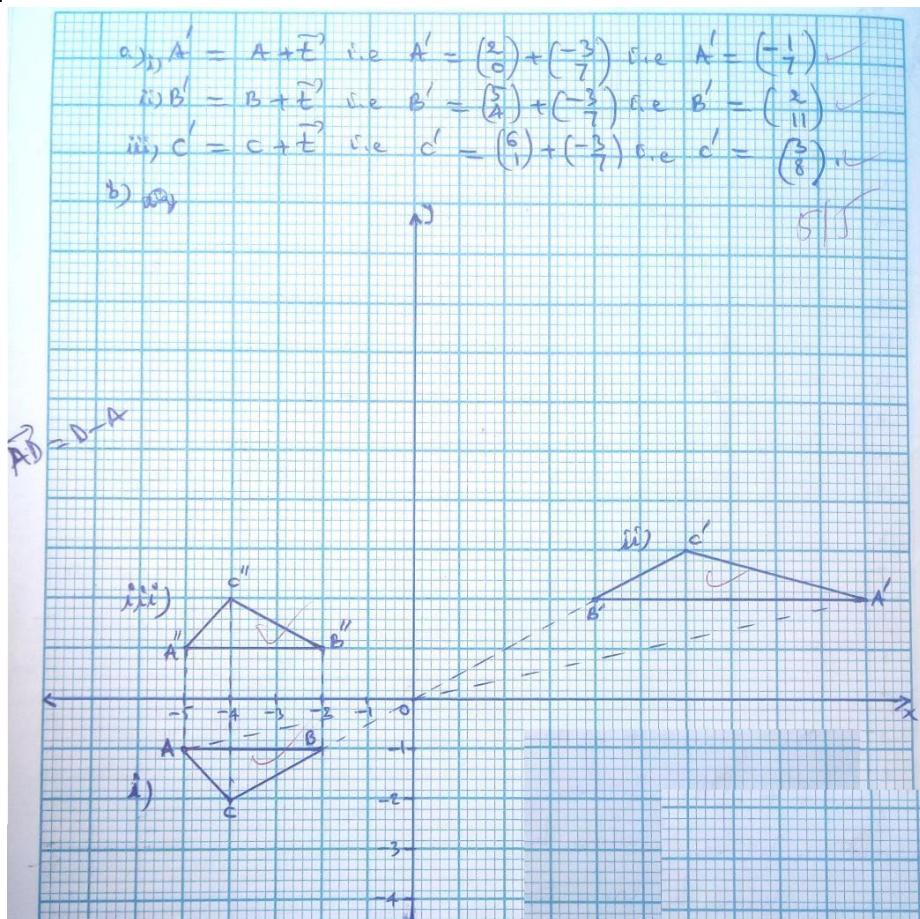
$$\begin{aligned}
 \text{(iii)} \quad f \circ g(x) &= f[g(x)] = f[3x - 1] \\
 &= 2(3x - 1) + 3 \\
 &= 6x - 2 + 3 \\
 &= 6x + 1
 \end{aligned}$$

$$\begin{aligned}
 \text{(iv)} \quad g \circ f(x) &= g[f(x)] = g[2x + 3] \\
 &= 3(2x + 3) - 1 \\
 &= 6x + 9 - 1 \\
 &= 6x + 8
 \end{aligned}$$

$$\text{(v)} \quad g \circ f(-\frac{1}{6}) = 6(-\frac{1}{6}) + 8 = -1 + 8 = 7$$

$$\text{(vi)} \quad f \circ g(x) = 6(-\frac{1}{6}) + 1 = -1 + 1 = 0$$

17.



18. Let x be the number of pens he buys. One pen costs $x + 4$ pence.

As $1 \text{ £} = 100$ pence, then $1 \text{ £} = 140$ pence

As he buys x pens for 1.4 £ , then we get:

$$x(x + 4) = 140$$

$$x^2 + 4x - 140 = 0$$

$$\Delta = b^2 - 4ac = 4^2 - 4 \times 1 \times (-140) = 16 + 560 = 576$$

$$\sqrt{\Delta} = \sqrt{576} = 24$$

$$x_1 = \frac{-b+\sqrt{\Delta}}{2a} = \frac{-4+24}{2} = \frac{20}{2} = 10$$

$$x_2 = \frac{-b-\sqrt{\Delta}}{2a} = \frac{-4-24}{2} = \frac{-28}{2} = -14 \text{ rejected as it is } < 0$$

As $x = 14$, then $x + 4 = 14$

The cost of each pen is 14 pence or 0.14 £.

b) $6x^3 + 11x^2 - 3x - 2 = 0$

$\text{Div } (2) = \{\pm 1, \pm 2\}$

For $x = -2$, we have $6(-2)^3 + 11(-2)^2 - 3(-2) - 2$

$$\begin{aligned} &= 6 \times -8 + 11 \times 4 + 6 - 2 \\ &= -48 + 44 + 6 - 2 \\ &= 0 \end{aligned}$$

So $x + 2$ is a factor of $6x^3 + 11x^2 - 3x - 2 = 0$

$$\begin{array}{r} 6 & 11 & -3 & -2 \\ x = -2 & & -12 & 2 \\ \hline 6 & -1 & -1 & 0 \end{array}$$

So $6x^3 + 11x^2 - 3x - 2 = 0$

$$(6x^2 - x - 1)(x + 2) = 0$$

$$6x^2 - x - 1 = 0 \text{ or } x + 2 = 0$$

$$6x^2 - x - 1 = 0$$

$$\Delta = b^2 - 4ac = (-1)^2 - 4 \times 6 \times (-1) = 1 + 24 = 25$$

$$\sqrt{\Delta} = \sqrt{25} = 5$$

$$x_1 = \frac{-b+\sqrt{\Delta}}{2a} = \frac{-(-1)+5}{12} = \frac{6}{12} = \frac{1}{2}$$

$$x_2 = \frac{-b-\sqrt{\Delta}}{2a} = \frac{-(-1)-5}{12} = \frac{-4}{12} = -\frac{1}{3}$$

$$x + 2 = 0$$

$$x = -2$$

$$S = \left\{ -2, -\frac{1}{3}, \frac{1}{2} \right\}$$

19.

Class	f_i (Frequency)	x_i (Mid – mark)	$f_i x_i$
12 - 19	12	15.5	186
20 - 27	16	23.5	376
28 - 35	10	31.5	315
36 - 43	11	39.5	434.5
44 - 51	3	47.5	142.5
	$\sum f_i = 52$		$\sum f_i x_i = 1454$

- b) The modal class is the class 20 – 27
Its limits are 20 and 27.

$$\text{The mean } \bar{x} = \frac{1}{n} \sum_{i=1}^n f_i x_i = \frac{1}{52} \times 1454 = 27.962$$

20. a) Given that the points (4, 1), (1, 5) and (-3, k) lie on a straight line,
we have:

$$\frac{5+1}{1-4} = \frac{k-5}{-3-1}$$

$$\frac{6}{-3} = \frac{k-5}{-4}$$

$$-24 = -3k + 15$$

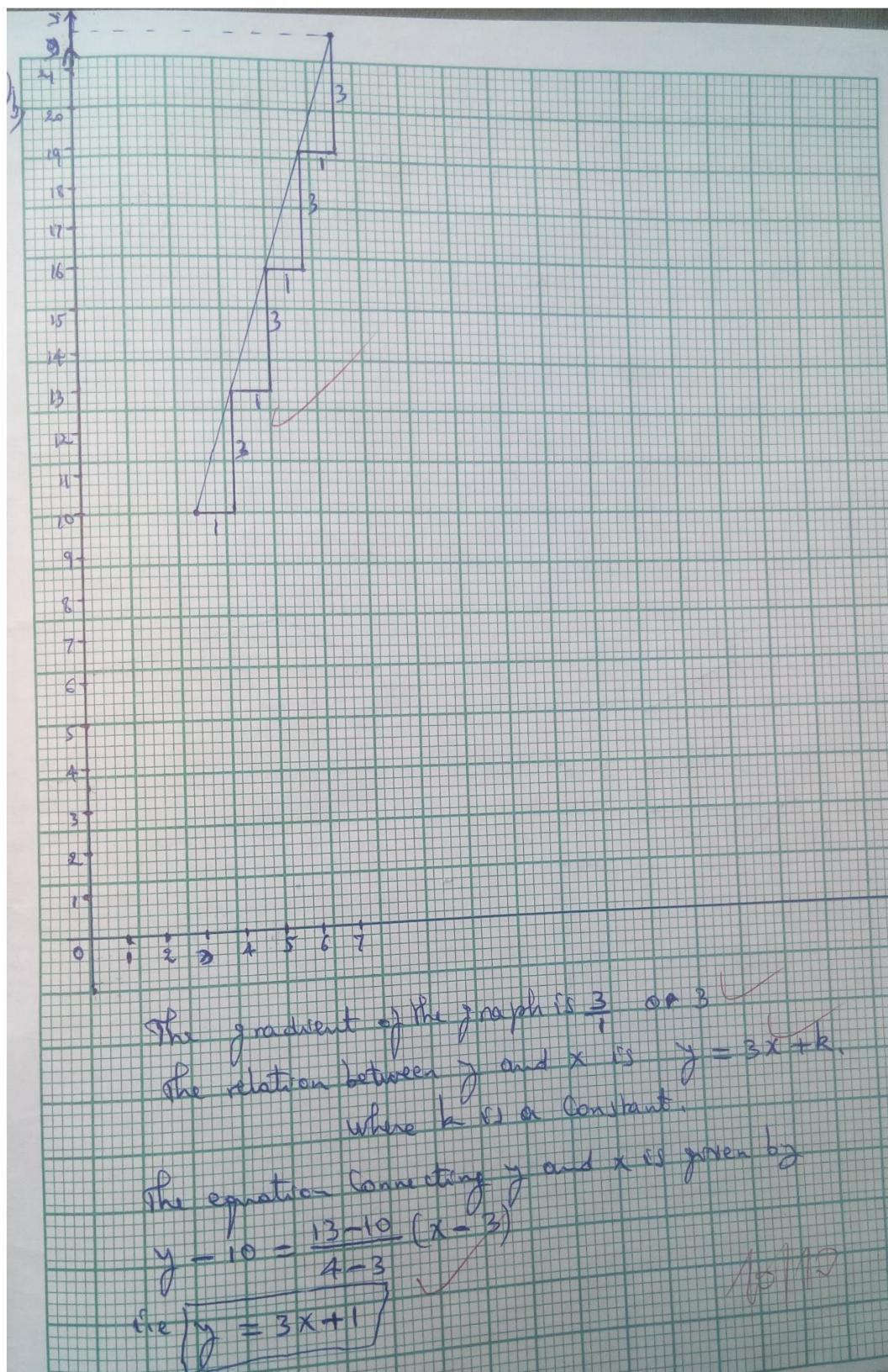
$$3k = 39$$

$$k = \frac{39}{3}$$

$$k = 13$$

The value of k is 13.

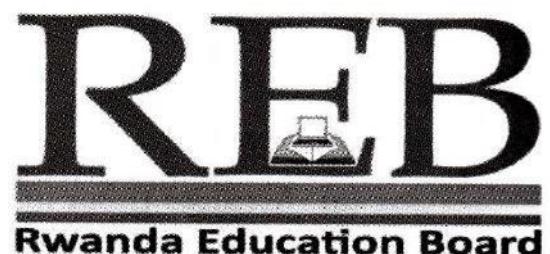
b)



Mathematics I

010

11/11/2015 08.30 AM – 11.30 AM



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 paper until you are told to do so.
3. This paper consists of **TWO** sections **A** and **B**.

SECTION A: Attempt **ALL** questions **(55 marks)**

SECTION B: Answer any **THREE** questions. **(45 marks)**

4. You may use mathematical instruments and calculators **where necessary**.
5. Use a blue ink pen only to write your answers and a pencil to draw diagrams.
6. Show clearly all the working. **Marks will not be awarded for answers without all working steps.**

SECTION A: Attempt all questions from this section. (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 $x^{\rightarrow} = \langle \begin{smallmatrix} 2 \\ 4 \\ 7 \end{smallmatrix} \rangle$ (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, \mathbb{R} : $\frac{25}{9}x^2 - \frac{9}{4} = 0$. (3 marks)
7. If $135_n = 75_{10}$, find the value of n . (3 marks)
8. Given that vectors $a^{\rightarrow} = \langle \begin{smallmatrix} -2 \\ 3 \end{smallmatrix} \rangle$, $b^{\rightarrow} = \langle \begin{smallmatrix} 2 \\ 7 \end{smallmatrix} \rangle$ and $c^{\rightarrow} = \langle \begin{smallmatrix} -10 \\ 21 \end{smallmatrix} \rangle$;
 - (a) Find vectors $a^{\rightarrow} + b^{\rightarrow}$ (2 marks)
 - (b) If $ma^{\rightarrow} + nb^{\rightarrow} = c^{\rightarrow}$, find the value of m and n . Show all your working. (3 marks)
9. In the figure below,
 - (a) Show that ΔABC is similar to ΔBDC . (3 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:

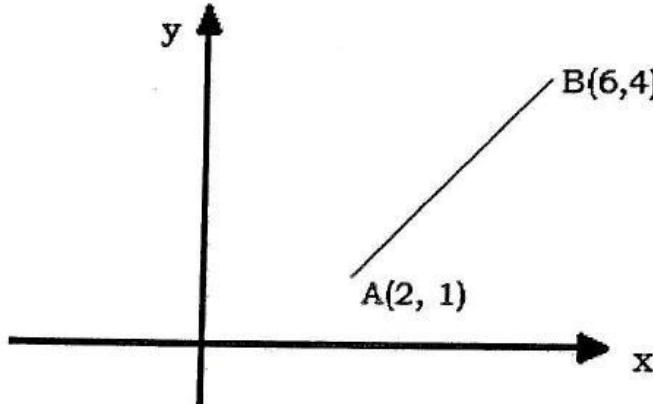
$$(2^{-3} \times 16^2) \div (81^4 \times 27^{-3})$$
 (2 marks)
- (b) Find x if $3^x \div 3^2 = 27$ (2 marks)
12. Three students share n frw in the ratio 3 : 4 : 5. If the smallest share is 60,000frw, find: (a) The amount n. (2 marks)
 (b) The two other shares. (2 marks)

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

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 ANY 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		

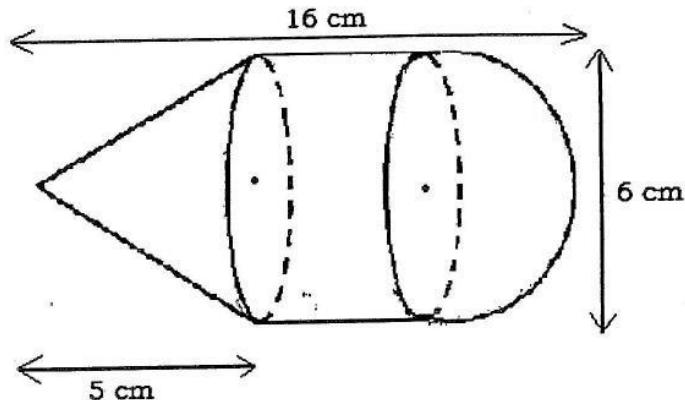
- (i) Copy and complete the table.
- (ii) Plot d against t on the graph.
- (iii) Determine the gradient of the graph
- (iv) Write the equation relating d and t.
- (b) A vector comprises points A (2, 3) and B (1, 6). Another vector perpendicular to the vector AB passes through points A (2, 3) and P (x, 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. **(3 marks)**

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 $\pi = 3.14$) **(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)**

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2015

Section A: Answer all questions

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

$$4 * (3 * 5) = 4 * [(2 \times 5) + 3 - 1] = 4 * 12 = (2 \times 12) + 4 - 1 = 27$$

2. $\frac{4a^2 - ac^3}{b+c} = \frac{4(-2)^2 - (-2)(-1)^3}{3+(-1)} = \frac{4 \times 4 - (-2)(-1)}{2} = \frac{16-2}{2} = \frac{14}{2} = 7$

3. $x' = \sqrt{24^2 + (-7)^2} = \sqrt{576 + 49} = \sqrt{625} = 25$

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

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 $y = 2x$

6. $\frac{25}{9}x^2 - \frac{9}{4} = 0$

$$\left(\frac{5}{3}x - \frac{3}{2}\right)\left(\frac{5}{3}x + \frac{3}{2}\right) = 0$$

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

$$\frac{5}{3}x = \frac{3}{2}$$

$$10x = 9$$

$$x = \frac{9}{10} = 0.9$$

$$\frac{5}{3}x = -\frac{3}{2}$$

$$10x = -9$$

$$x = -\frac{9}{10} = -0.9$$

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

$$= n^2 + 3n + 5$$

$$\text{So } n^2 + 3n + 5 = 75$$

$$n^2 + 3n - 70 = 0$$

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

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

$$n + 10 = 0$$

$$\text{or } n - 7 = 0$$

$$n = -10 \text{ (Rejected because } n > 0)$$

$$\text{or } n = 7$$

Therefore the value of $n = 7$.

$$8. \quad \text{a) } 2a^\rightarrow + b^\leftrightarrow = 2\left(\begin{smallmatrix} -2 \\ 3 \end{smallmatrix}\right) + \left(\begin{smallmatrix} 2 \\ -7 \end{smallmatrix}\right) = \left(\begin{smallmatrix} -4 \\ 6 \end{smallmatrix}\right) + \left(\begin{smallmatrix} 2 \\ -7 \end{smallmatrix}\right) = \left(\begin{smallmatrix} -2 \\ -1 \end{smallmatrix}\right)$$

$$\text{b) } ma^\rightarrow + nb^\leftrightarrow = c^\rightarrow$$

$$m\left(\begin{smallmatrix} -2 \\ 3 \end{smallmatrix}\right) + n\left(\begin{smallmatrix} 2 \\ -7 \end{smallmatrix}\right) = \left(\begin{smallmatrix} -10 \\ 21 \end{smallmatrix}\right)$$

$$\left(\begin{smallmatrix} -2m \\ 3m \end{smallmatrix}\right) + \left(\begin{smallmatrix} 2n \\ -7n \end{smallmatrix}\right) = \left(\begin{smallmatrix} -10 \\ 21 \end{smallmatrix}\right)$$

$$-2m + 2n = -10 \quad (1)$$

$$3m - 7n = 21 \quad (2)$$

Multiply equation (1) by 3 and equation (2) by 2. We get

$$-6m + 6n = -30 \quad (3)$$

$$6m - 14n = 42 \quad (4)$$

Add equation (3) and (4)

$$-8n = 12$$

$$8n = -12$$

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

$$-2m + 2n = -10$$

$$2m = 7$$

$$-2m = -2n + 10$$

$$2m = 2n - 10 = 2 \times -\frac{3}{2}$$

$$+ 10 = -3 + 10 = 7$$

$$m = \frac{7}{2} = 3.5$$

9. a) In triangle ΔABC and ΔBDC
 Angle ABC = angle BDC = 90°
 Angle BCA = angle BCD
 Therefore ΔABC is similar to ΔBDC .
- b) $(x + 9)^2 = (12)^2 + (16)^2 = 144 + 256 = 400$
 $(x + 9) = \sqrt{400} = 20$
 $x + 9 = 20$
 $x = 20 - 9$
 $x = 11 \text{ cm}$

10. At most means less or equal to or \leq Let x be the 1st number
 The second 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 is $x = 16$
 The second number is $2x = 16 \times 2 = 32$

11. a) $(2^{-3} \times 16^2)^{\frac{1}{3}} \div (81^{\frac{3}{4}} \times 27^{-\frac{1}{3}}) = (2^{-3} \times 4)^{\frac{1}{3}} \div (3^{4 \times \frac{3}{4}} \times 3^{3 \times -\frac{1}{3}})$
 $= \frac{2^{-3} \times 2^2}{3^3 \times 3^{-1}} = \frac{2^{-1}}{3^2} = \frac{1}{9 \times 2} = \frac{1}{18}$

b) $3^x \div 3^2 = 27$
 $3^{x-2} = 3^3$
 $x - 2 = 3$
 $x = 3 + 2 = 5$

12. a) Total parts = $3 + 4 + 5 = 12$
 The amount $n = \frac{12}{3} \times 60,000 \text{ FRW} = 240,000 \text{ FRW}$
- b) Other shares: i) $\frac{4}{3} \times 60,000 \text{ FRW} = 80,000 \text{ FRW}$
 ii) $\frac{5}{3} \times 60,000 \text{ FRW} = 100,000 \text{ FRW}$

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

$$k = 8 \times 6 = 48$$

$$\text{So } f(x) = \frac{48}{x+2}$$

$$f(-14) = \frac{48}{-14+2} = \frac{48}{-12} = -4$$

14. Let $B(x, y)$ be any point on the line, then the gradient of

$$AB = \frac{y-(-3)}{y-(-2)} = \frac{y+3}{x+2}$$

a) Therefore $\frac{y+3}{x+2} = 3$

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

$$y + 3 = 3x + 6$$

$$y = 3x + 6 - 3$$

$$y = 3x + 3$$

- b) The line cuts the x -axis where $y = 0$

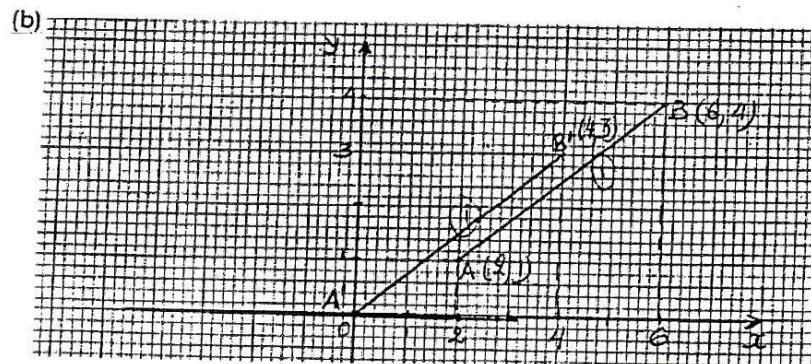
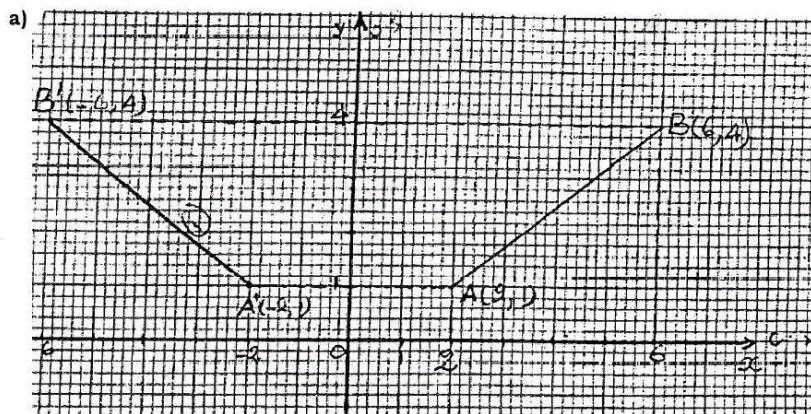
$$3x + 3 = 0$$

$$3x = -3$$

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

The line cuts the x -axis at points $(-1, 0)$.

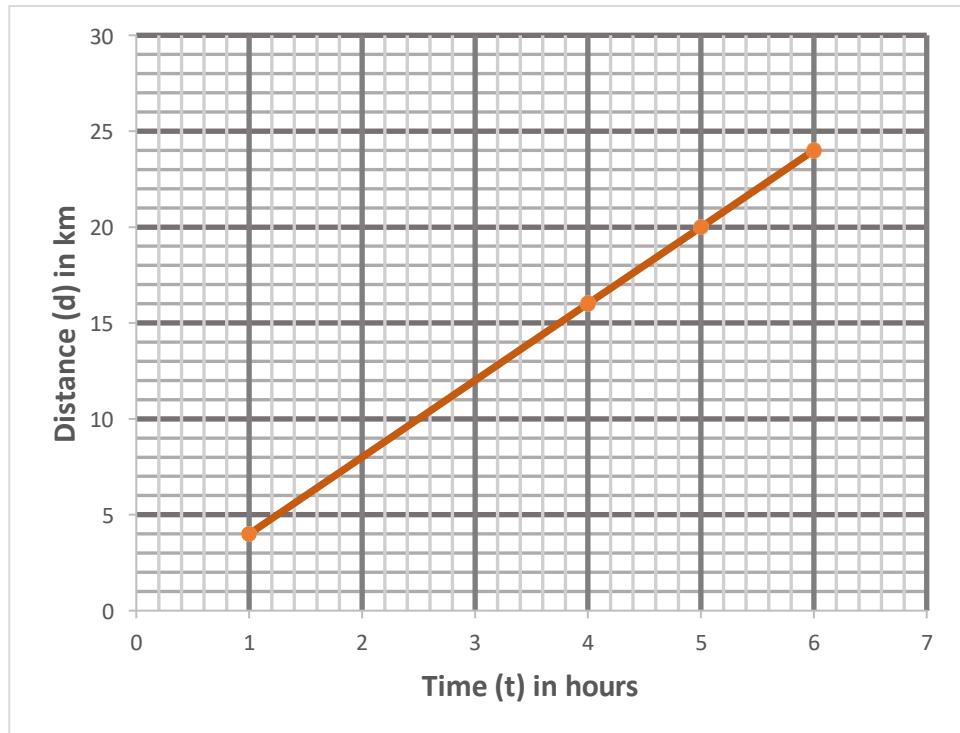
15.



16. a) i)

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

ii)



iii) Gradient = $\frac{y_2 - y_1}{x_2 - x_1} = \frac{16 - 4}{4 - 1} = 4$

iv) Equation: $d = 4t$

b) The two vectors share a common point A (2, 3), so think of other points

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

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

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

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

The equation of L2 must be of the form

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

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

$$-6 = \frac{5}{3} \times 3 + c \quad (i)$$

$$-6 = 5 + c$$

$$c = -6 - 5 = -11$$

$$c = -11$$

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

17. a) $p(x) = x^3 - 5x^2 + bx + a$

$$p(x) \text{ is divisible by } x + 1 \Rightarrow p(-1) = 0$$

$$\text{i.e. } -1 - 5 - b + a = 0 \text{ or } a - b = 6 \quad (i)$$

The remainder of the division of $p(x)$ by $x - 1$ is equal to 6

$$p(1) = -1 - 5 + b + a = 6 \text{ or } a + b = 10 \quad (ii)$$

(i) + (ii) we get

$$2a = 16$$

$$a = \frac{16}{2} = 8$$

$$a - b = 6$$

$$b = a - 6 = 8 - 6 = 2$$

b) $p(x) = 0 \quad x^3 - 5x^2 + 2x + 8 = 0 \quad i.e. (x + 1)(x^2 - 6x + 8) = 0$

$$\text{or } (x + 1)(x - 2)(x - 4) = 0$$

$$x = -1$$

$$\text{or } x = 2$$

$$\text{or } x = 4$$

18. a) Volume, $V = \pi r^2 h = \frac{22}{7} \times 60^2 \times 140 \text{ cm}^3 = 1,584,000 \text{ cm}^3 = 1,584 \text{ litres}$

Volume:

$$\text{Cone: } V = \frac{1}{3} \pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 9 \times 5 \text{ cm}^3 = 47.1 \text{ cm}^3$$

$$\text{Cylinder: } V = \pi r^2 h = \frac{22}{7} \times 9 \times 8 \text{ cm}^3 = 226.01 \text{ cm}^3$$

$$\text{Hemisphere: } V = \frac{2}{3} \pi r^3 = \frac{2}{3} \times \frac{22}{7} \times 27 \text{ cm}^3 = 56.52 \text{ cm}^3$$

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

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

Conical part: slant height $l = \sqrt{5^2 + 3^2} = \sqrt{34} = 5.83\text{ cm}$

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

Cylindrical part: Height $h = 16 \text{ cm} - (5 \text{ cm} + 3 \text{ cm}) = 8 \text{ cm}$
 Curved surface area $= 2\pi r l = 2 \times 3.14 \times 3 \times 8 = 150.72 \text{ cm}^2$

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

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

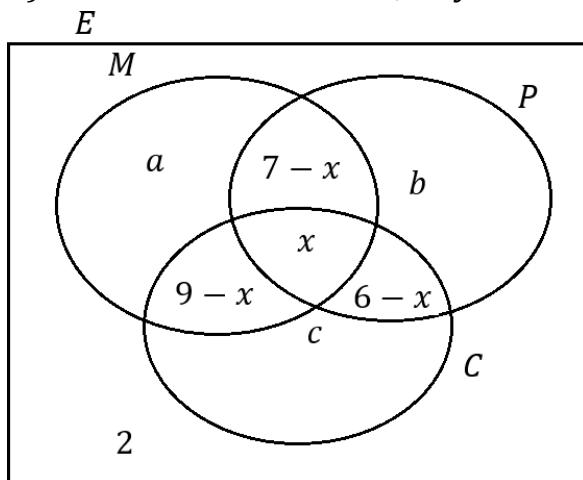
c) i) Area of the path $= 15 \text{ m} \times 12 \text{ m} = 180 \text{ m}^2$

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

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

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

19. a) Let Mathematics be M, Physics be P and chemistry be C.



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

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

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

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

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

$$31 + x = 36$$

$$x = 36 - 31 = 5$$

$$x = 5$$

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

b) The number of students who like only one subject

$$= a + b + c = (7 + x) + (2 + x) + (x - 2) = 7 + 3x = 2 + 3 \times 5 = 22$$

20. a)

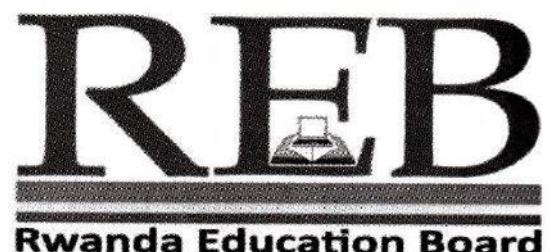
Mark classes	Frequency (f)	Mid-points (x)	fx
10 - 19	6	14.5	87
20 - 29	3	24.5	735
30 - 39	12	34.5	414
40 - 49	14	44.5	623
50 - 59	10	54.5	545
60 - 69	5	64.5	322.5
70 - 79	1	74.5	74.5
	$\sum f = 51$		$\sum fx = 2139.5$

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

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

Mathematics I
010

09 Nov. 2016 08.30 am – 11.30 am



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2016

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 paper until you are told to do so.
3. This paper consists of **TWO** sections **A** and **B**.

SECTION A: Attempt **ALL** questions **(55 marks)**

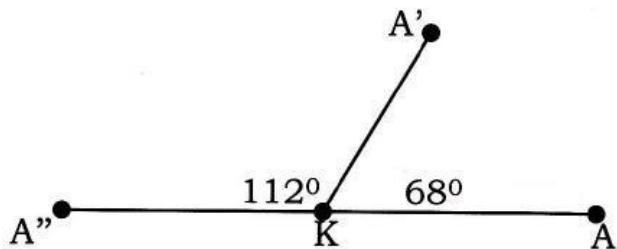
SECTION B: Answer any **THREE** questions. **(45 marks)**

4. You may use mathematical instruments and calculators **where necessary**.
5. Use a blue ink pen only to write your answers and a pencil to draw diagrams.
6. Show clearly all the working. **Marks will not be awarded for answers without all working steps.**

SECTION A: Attempt all questions from this section. (55 marks)

1. Simplify and express the answer in standard form: $\frac{0.085 \times 0.0084}{1.7 \times 0.007}$ (4 marks)
2. (a) Find the next two missing terms: 1, 2, 4, 7, (3 marks)
(b) What is the 10th term in 2(a) above? (2 marks)
3. Using a ruler, a pencil and a pair of compasses only, construct a triangle ABC such that lengths AB = 8.7cm, AC = 10.6cm and angle BAC = 60°. Find the length of BC. [You must show all your construction lines.] (4 marks)
4. Given the function $f(x) = \frac{x+4}{-x+4}$
(a) Evaluate $f(-\frac{1}{4})$ (2 marks)
(b) Calculate the value of x for which f(x) is not defined. (2 marks)
5. Solve for x, over the set of real numbers, IR: $\frac{x+1}{2} - \frac{x-7}{3} = \frac{x}{3}$ (3 marks)
6. Solve for x, over IR: $x^2 - x - 90 = 0$. (3 marks)
7. Line A is parallel to line B. Line B passes through points (4, 5) and (1, -4). Find the equation of line A if it passes through (0, -1). (4 marks)
8. Given that m is directly proportional to the cube of t and t = 4, when m = 8, find the value of t when m = 27. (4 marks)
9. Use vectors to prove that the points M (-7, -6), N (1, -10) and O (3, -11) lie on a straight line. (4 marks)
10. Given that $f(x) = 2x + 1$ and $g(x) = x^2 - 9$, find the value of x if $gf(x) = 0$. (4 marks)
11. The longest side of a triangle twice the length of the shortest side. The third side is 7cm less than the longest side and the perimeter of the triangle is 78cm. Find the lengths of the sides of the triangle. (3 marks)
12. A man pays for the following items as follows: a pair of shoes 6,000Frw, a pair of trousers 5,000Frw, 4 shirt 4,000Frw and a pair of socks 3,000Frw. Draw an accurate pie chart for this information. (4 marks)
13. If $\frac{5}{\sqrt{5}} + \sqrt{20} = a\sqrt{5}$, find the value of a. (4 marks)
14. Given that $a \vec{=} \begin{pmatrix} 7 \\ 4 \end{pmatrix}$ and $b \vec{=} \begin{pmatrix} 21 \\ r \end{pmatrix}$ are parallel vectors, find the value of r. (3 marks)

15. Point A is rotated 68° about K and then by 112° about K.



Find a single rotation that has the same effect as this.

(2 marks)

SECTION B: ATTEMPT ANY THREE QUESTIONS

(45 MARKS)

16. (a) At a factory, a worker's wages for a 40-hour week is 120,000Frw. She is paid 10% of her weekly wages for every 2 hours that she works overtime. At the end of a certain week she received 216,000Frw. Calculate the number of hours of overtime that she worked. (5 marks)

(b) A laptop costs 257,000Frw. A student takes the laptop on hire purchase. The student has to pay a deposit of 15,000Frw and 25 monthly instalments of 12,400Frw. Calculate:

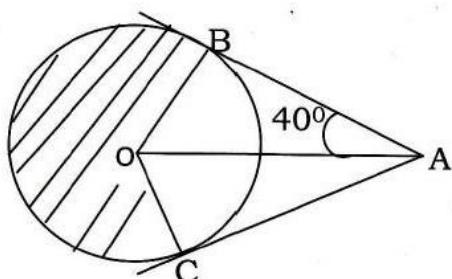
(i) The total amount paid for the laptop under the hire purchase agreement. (3 marks)

(ii) The difference between the amount paid under hire purchase and the cost price. (2 marks)

(c) A car was bought for 33,000,000Frw. The value of the car depreciated each year by 15% of its value at the beginning of the year.

Calculate the value of the car after three years. (5 marks)

17. The diagram below is a circle with centre O. \overline{OB} and \overline{OC} are radii, \overline{AB} and \overline{AC} are tangents to the circle.



(a) Show that triangle ABO is congruent to triangle ACO. (4 marks)

(b) Find:

(i) The size of angle AOB. (2 marks)
(ii) The size of angle CAO. (2 marks)

(c) Given that $\overline{AO} = 13\text{cm}$ and, $\overline{OC} = 5\text{cm}$.

Calculate:

(i) The area of triangle ACO. (3 marks)
(ii) The area of the shaded region. [Express your answer to the

nearest tenth, use $\pi = 3.14$]

(4 marks)

18. (a) If $\vec{a} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$ and $\vec{b} = \begin{pmatrix} -12 \\ 6 \end{pmatrix}$, calculate $2\vec{a} - 0.5\vec{b}$. **(3 marks)**

(b) The points a (-3, 2), b (2, -3) and c(6, 1) are in a Cartesian plane.

(i) Determine the column vectors of $\vec{a}, \vec{b}, \vec{c}$ and $\vec{b} + \vec{c}$. **(6 marks)**

(ii) Calculate the length of \vec{a}, \vec{b} and \vec{c} . **(3 marks)**

(iii) Hence show that triangle abc is right angled triangle at b. **(3 marks)**

19. (a) Given that $p(x) = 6x^3 + 35x^2 + 19x - 30$

(i) Prove that -5 is a zero of $p(x)$ and hence factorize it completely.

(7 marks)

(ii) Find the values of x for which $p(x) = 0$. **(1 mark)**

(b) Solve for x, over the set of real numbers: $\frac{x+2}{x-2} + \frac{x-2}{x+2} = \frac{8-4x}{x^2-4}$ **(7 marks)**

20. A teacher found that students were taking too long to answer a statistics question in every mathematics examination. She asked students to answer a statistics question and she recorded how long it took each student. Below are the times in minutes the teacher recorded.

35	39	31	32	35	32	31	29	26	35	31
39	29	39	34	29	39	39	26	27	32	39
32	39	26	35	34	26	32	35	32	34	.

(a) Draw a frequency table for this data and calculate the mean time (correct to the nearest whole number). **(10 marks)**

(b) The statistics question is worth 15% of the total marks in a three hour mathematics examination paper.

(i) How long should each student spend on the statistics question?

(1 mark)

(ii) What is the percentage of students who were spending too long on the statistics question? **(3 marks)**

(c) How many students spent:

(i) The longest time? **(1 mark)**

(ii) The shortest time? **(1 mark)**

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2016

Section A: Answer all questions

$$1. \frac{0.085 \times 0.0084}{1.7 \times 0.007} = \frac{8.5 \times 10^{-2} \times 8.4 \times 10^{-3}}{1.7 \times 7 \times 10^{-3}} = \frac{8.5 \times 8.4 \times 10^{-5}}{1.7 \times 7 \times 10^{-3}}$$

$$= 5 \times 1.2 \times 10^{-2} = 6 \times 10^{-2}$$

2. a) Given that 1, 2, 4, 7,, etc

First term = 1

2nd term = 2 = 1st term + 1 = 1 + 1 = 2

3rd term = 4 = 2nd term + 2 = 2 + 2 = 4

4th term = 7 = 3rd term + 3 = 4 + 3 = 7

5th term = 11 = 4th term + 4 = 7 + 4 = 11

6th term = 16 = 5th term + 5 = 11 + 5 = 16

b) 4th term = 1st term + 1 + 2 + 3 = 1 + 1 + 2 + 3 = 7

10th term = 1 + 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 = 46

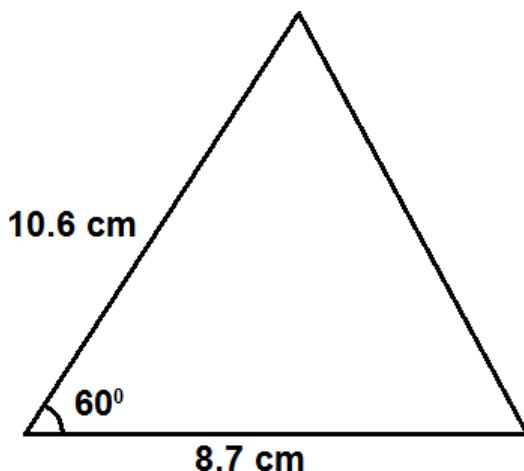
Or 7th term = 16 + 6 = 22

8th term = 22 + 7 = 29

9th term = 29 + 8 = 37

10th term = 37 + 9 = 22

3.



$$4. \ f(x) = \frac{x+4}{-x+4}$$

$$\text{a)} \ f(x) = \frac{x+4}{-\frac{1}{4}+4} = \frac{\frac{-1+16}{4}}{\frac{15}{4}} = \frac{15}{4} = \frac{15}{145} \times 4 = \frac{15}{36.25}$$

$$-x+4 \quad -\left(-\frac{1}{4}\right)+4 \quad \frac{1+16}{16} \quad \frac{17}{4} \quad 4 \quad \overline{17} \quad 17$$

b) $f(x)$ is not defined for $-x + 4 = 0$ or $x = 4$

5. $\frac{x+1}{2} - \frac{x-7}{3} = \frac{x}{3}$
 $(\frac{x+1}{2} - \frac{x-7}{3}) = \frac{x}{3} \quad 6$

$$3x + 3 - 2x + 14 = 2x$$

$$x + 17 = 2x$$

$$2x - x = 17$$

$$x = 17$$

6. $x^2 - x - 90 = 0$

$$\Delta = b^2 - 4ac = 1^2 + 4 \times 1 \times 90 = 1 + 360 = 361$$

$$\sqrt{\Delta} = \sqrt{361} = 19$$

$$x_1 = \frac{-b + \sqrt{\Delta}}{2a} = \frac{1+19}{2} = \frac{20}{2} = 10$$

$$x_2 = \frac{-b - \sqrt{\Delta}}{2a} = \frac{1-19}{2} = \frac{-18}{2} = -9$$

7. Line B passes through points (4, 5) and (1, -4)

Gradient of line B is $\frac{-4-5}{1-4} = 3$

A is parallel to B if they have the same gradient.

Line A passes through the point (0, -1)

The equation of A is $y + 1 = 3(x - 0)$

$$y + 1 = 3x$$

$$y = 3x - 1$$

8. $m = kt^3 \Leftrightarrow k = \frac{m}{t^3}$

$$t = \sqrt[3]{\frac{m}{k}}$$

$$m = 8, t = 4$$

$$k = \frac{8}{4^3} = \frac{8}{64} = \frac{1}{8}$$

$$\text{For } m = 27, \text{ we have } t = \sqrt[3]{\frac{27}{\frac{1}{8}}} = \sqrt[3]{216} = 6$$

9. $M \xrightarrow{-10+6} N \xrightarrow{-11+10} = ({}^{1+7}) = ({}^8)$

$$N \xrightarrow{-11+10} O \xrightarrow{3-1}$$

-4

$$)=\left(\begin{array}{c} 2 \\ -1 \end{array}\right)$$

$$M \rightarrow N \rightarrow O$$

$$\binom{8}{-4} = 4 \binom{2}{-1}$$

And N is a common point therefore M, N, O lie on a straight line.

10. $f(x) = 2x + 1$ and $g(x) = x^2 - 9$

$$gf(x) = 0$$

$$g(2x + 1) = 0$$

$$(2x + 2)^2 - 9 = 0$$

$$(2x + 1 - 3)(2x + 1 + 3) = 0$$

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

$$2x - 2 = 0 \text{ or } 2x + 4 = 0$$

$$x = 1 \text{ or } x = -2$$

11. Let x be the smallest side

Let $2x$ be the longest side

Let $2x - 7$ be the smallest side

$$x + 2x + 2x - 7 = 78$$

$$5x = 78 + 7$$

$$5x = 85$$

$$x = \frac{85}{5}$$

$$x = 17$$

The shortest side = 17 cm

The longest side = $17 \times 2 = 34$ cm

The third side = $34 - 7 = 27$ cm

12. Total amount = $6,000 + 5,000 + 4,000 + 3,000 = 18,000$ RWF

Then $18,000 \rightarrow 360^\circ$

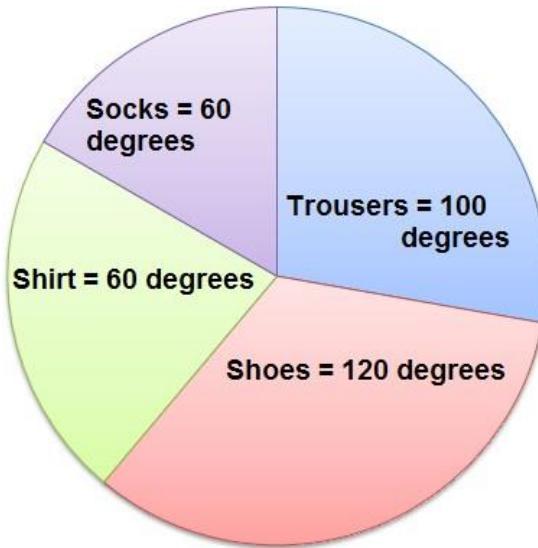
$$1,000 \rightarrow \frac{360^\circ \times 1,000}{18,000} = 20^\circ$$

$$6,000 \rightarrow \frac{360^\circ \times 6,000}{18,000} = 120^\circ$$

$$5,000 \rightarrow \frac{360^\circ \times 5,000}{18,000} = 100^\circ$$

$$4,000 \rightarrow \frac{360^\circ \times 4,000}{18,000} = 80^\circ$$

$$3,000 \rightarrow \frac{360^\circ \times 3,000}{18,000} = 60^\circ$$



13. $\frac{5}{\sqrt{5}} + \sqrt{20} = \frac{5\sqrt{5}}{5} + 2\sqrt{5} = 3\sqrt{5}$

This mean that $3\sqrt{5} = a\sqrt{5} \Leftrightarrow a = 3$

14. $a^{\rightarrow} = \begin{pmatrix} 7 \\ 4 \end{pmatrix}$

$b^{\leftrightarrow} = \begin{pmatrix} 21 \end{pmatrix} \Leftrightarrow 7r - 4(21) = 0$

$7r = 84$

$r = \frac{84}{7}$

$r = 12$

15. Angle of rotation $68^\circ + 112^\circ = 180^\circ$

The centre of rotation is k.

SECTION B: ANSWER ONLY THREE QUESTIONS

16. a) 40 hours per week $\rightarrow 120,000 FRW$

For 2 supplementary hours: $\frac{120,000 \times 10}{100} = 12,000 FRW$

For 1 supplementary hours: $6,000 FRW$

Surplus on salary: $210,000 FRW - 120,000 FRW = 96,000 FRW$

Supplementary hours: $\frac{96,000}{6,000} = 16 \text{ hours}$

b) Cost price = $257,000 FRW$

i) Total amount paid on hire purchase

$$= (25 \times 12,000) + 15,000 = 325,000 FRW$$

ii) Difference = $325,000 - 257,00 = 68,000 FRW$

c) Cost price = 33,000 FRW

$$\text{Depreciation} = \frac{33,000,000 \times 15}{100} = 4,950,000 \text{ FRW}$$

Cost price at the end of first year

$$= 33,000,000 - 4,950,000 = 28,050,000 \text{ FRW}$$

$$\text{Depreciation} = \frac{28,050,000 \times 15}{100} = 4,207,500 \text{ FRW}$$

Cost price at the end of second year

$$= 28,050,000 - 4,207,500 = 23,842,500 \text{ FRW}$$

$$\text{Depreciation} = \frac{23,842,500 \times 15}{100} = 3,376,325 \text{ FRW}$$

Cost price at the end of second year

$$= 23,842,500 - 3,376,325 = 20,266,125 \text{ FRW}$$

Or

$$\begin{aligned}\text{Total amount after depreciation} &= P \left(1 - \frac{r}{100}\right)^n \\ &= 33,000,000 \left(1 - \frac{15}{100}\right)^3 \\ &= 33,000,000(0.85)^3 \\ &= 33,000,000(0.644125) \\ &= 20,266,125 \text{ FRW}\end{aligned}$$

17. a) $\overline{OB} = \overline{OC}$ (= radii of the circle)

$\overline{AB} = \overline{AC}$ (= tangents from A)

OA is common side

b) i) $AOB = 180^\circ - (90^\circ + 40^\circ) = 50^\circ$

ii) $CA = 180^\circ - (90^\circ + 50^\circ) = 40^\circ$

c) i) $\overline{AC}^2 = \overline{OA}^2 - \overline{OC}^2$

$$= 13^2 - 5^2$$

$$= 169 - 25$$

$$= 144$$

$$\overline{AC} = 12 \text{ cm}$$

$$\begin{aligned}Area &= \frac{\overline{AC} \times \overline{OC}}{2} \\ &= \frac{12 \times 15}{2}\end{aligned}$$

$$= 30 \text{ } cm^2$$

ii) Shaded region = $360^\circ - 100 = 260^\circ$

$$\begin{aligned} \text{Shaded region} &= \frac{\alpha^\circ \times r^2 \times \pi}{360^\circ} \\ &= \frac{260^\circ \times 5^2 \times 3.14}{360^\circ} = 56.694 \text{ cm}^2 = 56.7 \text{ cm}^2 \end{aligned}$$

$$\overline{OB} = \overline{OC}$$

$$OBA = OCA = 90^\circ$$

$$\begin{aligned} 18. \text{ a)} \quad 2\vec{a} - \frac{1 \leftrightarrow}{2} \vec{b} &= 2\binom{3}{4} - \frac{1}{2} \binom{-12}{6} \\ &= \binom{6+6}{8-3} \\ &= \binom{12}{5} \end{aligned}$$

$$\begin{aligned} \text{b) i)} \quad \vec{a} \xrightarrow{\rightarrow\rightarrow} \vec{b} \xrightarrow{\rightarrow\rightarrow} &= \binom{2+3}{-3-2} = \binom{5}{-5} \\ \vec{b} \xrightarrow{\rightarrow\rightarrow} \vec{c} \xrightarrow{\rightarrow\rightarrow} &= \binom{6-2}{1+3} = \binom{4}{4} \\ \vec{a} \xrightarrow{\rightarrow\rightarrow} \vec{c} \xrightarrow{\rightarrow\rightarrow} &= \binom{6+3}{1-2} = \binom{9}{-1} \end{aligned}$$

$$\begin{aligned} \text{ii) } \|\vec{a} \xrightarrow{\rightarrow\rightarrow} \vec{b} \xrightarrow{\rightarrow\rightarrow}\| &= \sqrt{5^2 + (-5)^2} = \sqrt{25 + 25} = \sqrt{50} \\ \|\vec{b} \xrightarrow{\rightarrow\rightarrow} \vec{c} \xrightarrow{\rightarrow\rightarrow}\| &= \sqrt{4^2 + (4)^2} = \sqrt{16 + 16} = \sqrt{32} \\ \|\vec{a} \xrightarrow{\rightarrow\rightarrow} \vec{c} \xrightarrow{\rightarrow\rightarrow}\| &= \sqrt{9^2 + (-1)^2} = \sqrt{81 + 1} = \sqrt{82} \end{aligned}$$

c) abc is a right angled triangle at b because

$$\sqrt{82}^2 = \sqrt{50}^2 + \sqrt{32}^2$$

$$82 = 50 + 32$$

$$m_{ab} = \frac{-3-2}{2+5} = -1$$

$$m_{bc} = \frac{1+3}{6-2} = 1$$

$$m_{ab} \times m_{bc} = -1 \times 1 = -1$$

$$\vec{a} \xrightarrow{\rightarrow\rightarrow} \vec{b} \xrightarrow{\rightarrow\rightarrow} = \binom{5}{-5}$$

$$\vec{b} \xrightarrow{\rightarrow\rightarrow} \vec{c} \xrightarrow{\rightarrow\rightarrow} = \binom{4}{4}$$

$\vec{a} \xrightarrow{\rightarrow\rightarrow} \vec{b} \xrightarrow{\rightarrow\rightarrow}$ is perpendicular $\vec{b} \xrightarrow{\rightarrow\rightarrow} \vec{c} \xrightarrow{\rightarrow\rightarrow} \Leftrightarrow$

$$\vec{a} \cdot \vec{b} = 0 \quad 5 \times 4 + (-5) \times 4 = 0$$

$$\begin{aligned}
 19. \text{ i) } P(-5) &= 6(-5)^3 + 35(-5)^2 + 19(-5) - 30 \\
 &= 6(-125) + 35(25) - 95 - 30 \\
 &= -750 + 875 - 125 \\
 &= 0 \quad -5 \text{ is a zero of } p(x) \text{ and } x + 5 \text{ is a factor.}
 \end{aligned}$$

$$\begin{array}{r}
 6 \qquad 35 \qquad 19 \qquad | \qquad -30 \\
 x = -5 \qquad \qquad -30 \quad -25 \qquad | \qquad 30 \\
 \hline
 6 \qquad 5 \qquad -6 \qquad | \qquad 0
 \end{array}$$

$$\begin{aligned}
 Q(x) &= 6x^2 + 5x - 6 \\
 &= 6x^2 + 9x - 4x - 6 \\
 &= (6x^2 + 9x) - (4x + 6) \\
 &= 3x(2x + 3) - 2(2x + 3) \\
 &= (2x + 3)(3x - 2)
 \end{aligned}$$

$$\text{Then } P(x) = (x + 5)(2x + 3)(3x - 2)$$

$$P(x) = 0 \Leftrightarrow x + 5 = 0 \text{ or } 2x + 3 = 0 \text{ or } 3x - 2 = 0$$

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

$$\text{ii) } \frac{x+2}{x-2} + \frac{x-2}{x+2} = \frac{8-4x}{x^2-4}$$

$$\frac{(x+2)^2 + (x-2)^2}{(x-2)(x+2)} = \frac{8-4x}{x^2-4}$$

$$x^2 + 4x + 4 + x^2 - 4x + 4 - 8 + 4x = 0 \text{ and } x^2 - 4 = 0$$

$$x^2 - 4 = 0 \text{ and } x \neq 2 \text{ and } x \neq -2$$

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

$$x = 0 \text{ or } x = -2 \text{ (rejected)}$$

20.

x_i	f_i	$x_i f_i$
26	4	104
27	1	27
29	3	87
31	3	93
32	6	192
34	3	102
35	5	175
39	7	273
	$\sum f = 32$	$\sum x_i f_i = 1053$

$$\bar{X} = \frac{1053}{32} = 32.9 \cong 33$$

b) i) 100 % $\rightarrow 180 \text{ minutes}$

$$15 \% \rightarrow \frac{180 \times 15}{100} = 27 \text{ minutes}$$

$$\text{ii)} \frac{27 \times 100}{32} = 84 \%$$

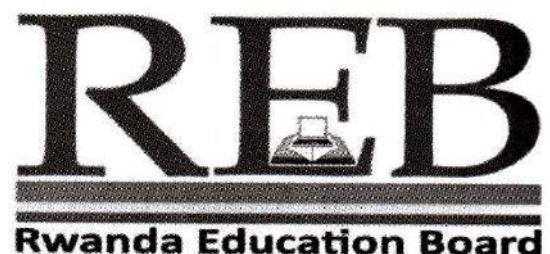
c) i) 7 students

ii) 4 students

Mathematics I

010

21/11/2017 08.30 AM – 11.30 AM



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2017

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 paper until you are told to do so.
- 3) This paper consists of **TWO** sections **A** and **B**.

SECTION A: Attempt **ALL** questions **(55 marks)**

SECTION B: Answer any **THREE** questions. **(45 marks)**

- 4) You may use mathematical instruments and calculators **where necessary**.
- 5) Use a blue ink pen only to write your answers and a pencil to draw diagrams.
- 6) Show clearly all the working. **Marks will not be awarded for answers without all working steps.**

SECTION A: ATTEMPT ALL QUESTIONS. (55 MARKS)

- 1) Solve the following equation: $3(x - 1) - (x + 9) = 0$. **(3marks)**
- 2) Find n given that: $45_n = 41_{\text{ten}}$. **(3marks)**
- 3) Solve for x : $2x^3 = 54$. **(3marks)**
- 4) Given that $a = 3$, $b = -2$ and $c = 4$, find the value of:
$$ab^2 - bc + ac$$
 (3marks)
- 5) The interest on a loan is 24% per annum. How much is a loan that bears interest of 6,000 Frw after one year? **(3marks)**
- 6) The area of a trapezium is 24cm^2 . Its height is x and its parallel sides are $(2x)\text{cm}$ and $(x + 7)\text{cm}$. Find the value of x . **(4marks)**
- 7) A number (P) is increased by 80%. The new number is then increased by 60% giving a final result of 144. Find the original number (P). **(4marks)**
- 8) In the figure below and are tangents to the circle. CD is a diameter and angle $DAB = 40^\circ$. Find angle BCD . **(4marks)**
- 9) It is given that $g(x) = 3(x + 2)$ and $f(x) = 3x + 2$. Find $gf(4)$. **(4marks)**
- 10) If y is inversely proportional to x and $y = 40$ when $x = 3$, find y when $x = 2.5$ **(4marks)**
- 11) The exterior angles of a pentagon measure respectively y° , 60° , 75° , y° , and 85° . Find the value of y° . **(4marks)**
- 12) Solve the following simultaneous equations:
$$\begin{aligned} 8x + y &= 21 \\ 5x - 4y &= -10 \end{aligned}$$
 (4marks)
- 13) Find the equation of the line with gradient 5 and passing through the point $(1, 9)$. **(4marks)**
- 14) Solve the following inequality:
$$\frac{1}{3}x - (x + 1) \geq 2$$
 (4marks)

15) In a class of 50 students, 40 like Mathematics (M) and 25 like Science (S). Some students (X) like both subjects and 2 do not like any of the two subjects. How many students like both Mathematics and Science? **(4marks)**

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

16) Factorize completely: $P(x) = 6x^3 - 5x^2 - 12x - 4$ and hence find the values of x when $P(x) = 0$. **(15marks)**

17) The curved surface of a cylindrical tin is 628cm^2 and its height is 10cm. $\pi = 3.14$. Find:

(a) The radius of the circular base. **(4marks)**

(b) The total surface area of the tin. **(5marks)**

(c) The volume of the tin. **(2marks)**

(d) The largest number of tins which will fill the box of length = 80cm, width = 60cm and height = 40cm. **(4marks)**

18) The following table gives the ages of 73 students and the frequency.

Ages in years , x	14	15	16	17	18	19	20
Frequency, f	5	9	13	11	12	15	8

(a) Copy the table below and complete it. **(9marks)**

Age, x	Frequency, f	fx	Cumulative frequency
14			
15			
16			
17			
18			
19			
20	$\sum f =$	$\sum fx =$	

(b) Find the mode age. **(1mark)**

(c) Determine the median age. **(3marks)**

(d) Calculate the mean age. **(2marks)**

19) (a) Use vectors $a \vec{=} \begin{pmatrix} -5 \\ 12 \end{pmatrix}$, $b \vec{=} \begin{pmatrix} 3 \\ 6 \end{pmatrix}$ and $c \vec{=} \begin{pmatrix} -4 \\ -2 \end{pmatrix}$ to determine:

(i) $a \vec{+} b \vec{-} c \vec{=}$ **(2marks)**

(ii) The modulus of \vec{a} . **(3marks)**

- (b) K (4, 7), L (2, 3) and M (4, -1) are three vertices of a rhombus KLMN.
- (i) Use vectors to prove that triangle KLM is an isosceles triangle. **(3marks)**
- (ii) Find the coordinates of N. **(2marks)**
- (c) Show that the points P (-3, -2), Q (3, 1) and R (5, 2) are collinear. **(3marks)**
- (d) Vectors $s^{\rightarrow} = \begin{pmatrix} 7 \\ 4 \end{pmatrix}$ and $t^{\rightarrow} = \begin{pmatrix} 21 \\ r \end{pmatrix}$ are parallel. Find the value of r. **(2marks)**
- 20) The vertices of triangle STV are S (0, 2), T (0, 5) and V (0, 3). In the same Cartesian plane, draw:
- (a) The triangle STV. **(6marks)**
- (b) (i) The triangle S'T'V', image of triangle STV under reflection in y-axis. **(3marks)**
- (ii) The triangle S''T''V'', image of triangle STV under a rotation about the origin through -90° . **(3marks)**
- (iii) The triangle S'''T'''V''', image of triangle STV under translation, $T = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$. **(3marks)**

(Use the graph in your answer booklet to answer this question).

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2017

Section A: Answer all questions

1. $3(x - 1) - (x + 9) = 0$

$$3x - 3 - x - 9 = 0$$

$$2x - 12 = 0$$

$$2x = 12$$

$$x = 6$$

2. $45_n = 41_{\text{ten}}$.

$$4 \times n^1 + 5 \times n^0 = 4 \times 10^1 + 1 \times 10^0$$

$$4n + 5 = 40 + 1$$

$$4n = 36$$

$$n = 9$$

3. $2x^3 = 54$

$$x^3 = 27$$

$$x^3 = 3^3$$

$$x = 3$$

4. $a = 3, b = -2$ and $c = 4$

$$ab^2 - bc + ac = 3(-2)^2 - 2 \times 4 + 3 \times 4$$

$$= 3 \times 4 + 8 + 12 = 32.$$

5. Let L be that loan

$$\frac{L \times 24}{100} = 6000$$

$$24L = 600,000$$

$$L = \frac{600,000}{24} = 25,000 \text{ FRW}$$

6. The area $A = 24 \text{ cm}^2$. The height is x and the parallel sides are $(2x)\text{cm}$ and $(x+7)\text{cm}$.

$$\text{The area } A = \frac{(b+B)h}{2} \text{ where } b \text{ and } B \text{ are the two parallel sides.}$$

$$\text{i.e } 24 = \frac{(2x+x+7)x}{2}$$

$$(3x + 7)x = 48$$

$$3x^2 + 7x - 48 = 0$$

$$\Delta = b^2 - 4ac = 7^2 - 4 \times 3 \times (-48) = 49 + 12 \times 48 = 625$$

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

$$x_1 = \frac{-b+\sqrt{\nabla}}{2a} = \frac{-7+25}{6} = \frac{18}{6} = 3$$

$$x_2 = \frac{-b-\sqrt{\nabla}}{2a} = \frac{-7-25}{6} = \frac{-32}{6} \text{ discarded as } x > 0$$

7. First increase is $\frac{80}{100} \times P = \frac{4}{5}P$

The value becomes $P + \frac{4}{5}P = \frac{9}{5}P$

Second increase is $\frac{60}{100} \times \frac{9}{5}P = \frac{3}{5} \times \frac{9}{5}P = \frac{27P}{25}$

The value becomes $\frac{9P}{5} + \frac{27P}{25} = 144$

$$45P + 27P = 3600$$

$$72P = 3600$$

$$P = \frac{3600}{72} = 50$$

The original number P is 50

8. As \overline{AB} and \overline{AD} are tangents then $\overline{AB} = \overline{AD}$ and the triangle ABD is isosceles triangle.

From this, the angles ADB and ABD are equal

$$\text{i.e } \angle ADB = \angle ABD = \frac{180^\circ - 40^\circ}{2}$$

$$\text{i.e } \angle ADB = \angle ABD = \frac{140^\circ}{2} = 70^\circ$$

The angle ADC is a right angle (i.e 90°)

As $\angle ADB = 70^\circ \Rightarrow \angle BDC = 90^\circ - 70^\circ = 20^\circ$

We know that $\angle CBD = 90^\circ$

So, $\angle BCD = 180^\circ - 90^\circ - 20^\circ = 70^\circ$

So, the angle BCD is 70° .

9. $g(x) = 3(x + 2)$ and $f(x) = 3x + 2$.

$$\begin{aligned}g[f(x)] &= g(3x + 2) \\&= 3x(3x + 2 + 2) \\&= 3x(3x + 4) \\&= 9x + 12\end{aligned}$$

$$\text{So } gf(4) = 9 \times 4 + 12$$

$$\begin{aligned}&= 36 + 12 \\&= 48\end{aligned}$$

$$gf(4) = 48$$

$$\begin{aligned}10. \quad y \sim \frac{1}{x} \Rightarrow y &= \frac{k}{x} \\40 &= \frac{k}{3} \quad k = 120\end{aligned}$$

$$\text{When } x = 2.5, \quad y = \frac{120}{2.5}$$

$$y = 48$$

11. The sum of the exterior angles of any pentagon is 360°

$$\text{i.e. } y + 60^\circ + 75^\circ + y + 85^\circ = 360^\circ$$

$$y + 220^\circ = 360^\circ$$

$$2y = 140^\circ$$

$$y = 70^\circ$$

12.

$$\begin{aligned}8x + y &= 21 & (\text{x4}) \\5x - 4y &= -10 & (\text{x1})\end{aligned}$$

$$\begin{array}{rcl}32x + 4y &=& 84 & (\text{Adding vertically}) \\+ & 5x - 4y &=& -10\end{array}$$

$$\begin{aligned}37x &= 74 \\x &= 2\end{aligned}$$

$$\text{For } x = 2 \Rightarrow 8 \times 2 + y = 21$$

$$y + 16 = 21$$

$$y = 21 - 16$$

$$y = 5$$

13. The gradient $m = 5$, the point $(x_1, x_2) = (1, 9)$

We know that $y - y_1 = m(x - x_1)$

$$y - 9 = 5(x - 1)$$

$$y = 5x - 5 + 9$$

$y = 5x + 4$ (The required equation)

14. $\frac{1}{3}x - (x + 1) \geq 2$

$$\frac{1}{3}x - x - 1 \geq 2$$

$$x - 3x - 3 \geq 6$$

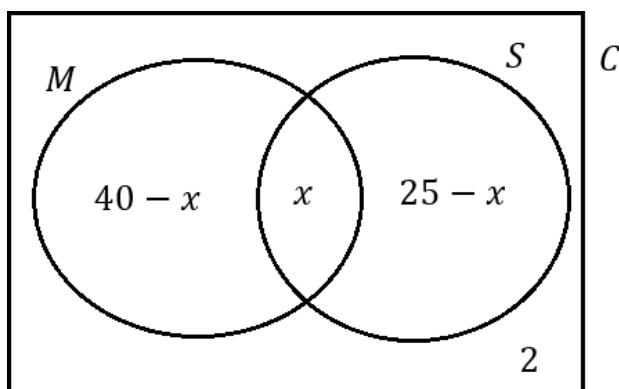
$$-2x \geq 6 + 3$$

$$-2x \geq 9$$

$$2x \geq -9$$

$$x \geq -\frac{9}{2}$$

15. Let M be the set of the students who like maths and S be the set of those who like science. We have



C is the class

We have $40 - x + x + 25 - x + 2 = 50$

$$-x = 50 - 67$$

$$-x = -17$$

$$x = 17$$

So, the students who like both Mathematics and science are 17.

SECTION B: Attempt any THREE questions in this section

16. $P(x) = 6x^3 - 5x^2 - 12x - 4$

$$\text{Div } (-4) = \{\pm 1, \pm 2, \pm 4\}$$

$$\begin{aligned} P(1) &= 6 \times 1^3 - 5 \times 1^2 - 12 \times 1 - 4 \\ &= 6 - 5 - 12 - 4 \neq 0 \end{aligned}$$

$$\begin{aligned} P(-1) &= 6 \times (-1)^3 - 5 \times (-1)^2 - 12 \times (-1) - 4 \\ &= -6 - 5 + 12 - 3 \neq 0 \end{aligned}$$

$$\begin{aligned} P(2) &= 6 \times 2^3 - 5 \times 2^2 - 12 \times 2 - 4 \\ &= 6 \times 8 - 5 \times 4 - 24 - 4 \\ &= 48 - 20 - 28 = 0 \end{aligned}$$

$x - 2$ is a factor of $P(x)$

$$\begin{array}{r|rrr|r} 6 & -5 & -12 & & -4 \\ \hline x = 2 & & 12 & 14 & 4 \\ \hline & 6 & 7 & 2 & 0 \end{array}$$

$$6x^3 - 5x^2 - 12x - 4 = (x - 2)(6x^2 + 7x + 2)$$

For $6x^2 + 7x + 2$, suppose $Q(x) = 6x^2 + 7x + 2$

Let $6x^2 + 7x + 2 = 0$

$$\Delta = b^2 - 4ac = 7^2 - 4 \times 6 \times (2) = 49 - 48 = 1$$

$$\sqrt{\nabla} = \sqrt{1} = 1$$

$$x_1 = \frac{-b+\sqrt{\nabla}}{2a} = \frac{-7+1}{12} = \frac{-6}{12} = -\frac{1}{2}$$

$$x_2 = \frac{-b-\sqrt{\nabla}}{2a} = \frac{-7-1}{12} = \frac{-8}{12} = -\frac{2}{3}$$

$$6x^2 + 7x + 2 = 6\left(x + \frac{1}{2}\right)\left(x + \frac{2}{3}\right)$$

$$\text{Finally } 6x^3 - 5x^2 - 12x - 4 = (x - 2) \times 6\left(x + \frac{1}{2}\right)\left(x + \frac{2}{3}\right)$$

$$6x^3 - 5x^2 - 12x - 4 = 6(x - 2)\left(x + \frac{1}{2}\right)\left(x + \frac{2}{3}\right)$$

$$\text{When } P(x) = 0, 6\left(x - 2\right)\left(x + \frac{1}{2}\right)\left(x + \frac{2}{3}\right) = 0$$

$$x - 2 = 0 \text{ or } x + \frac{1}{2} = 0 \text{ or } x + \frac{2}{3} = 0$$

$$x = 2 \text{ or } x = -\frac{1}{2} \text{ or } x = -\frac{2}{3}$$

17. Curved surface is $A_2 = 628 \text{ cm}^2$

The height $h = 10 \text{ cm}$ and $\pi = 3.14$

a) The curved surface $A_L = 2\pi r \times h$

$$\text{So } 628 = 2 \times 3.14 \times r \times 10$$

$$r = \frac{628}{62.8} = 10 \text{ cm}$$

The radius of the circular base is $r = 10 \text{ cm}$

b) The curved surface is $A_L = 628 \text{ cm}^2$

$$\begin{aligned}\text{The total area of the circular base is } & 2 \times \pi \times r^2 = 2 \times 3.14 \times 10^2 \text{ cm}^2 \\ & = 6.28 \times 100 = 628 \text{ cm}^2\end{aligned}$$

The total surface area of the tin is $628 \text{ cm}^2 + 628 \text{ cm}^2 = 1256 \text{ cm}^2$

c) The volume of the tin is $V = \pi r^2 h = 3.14 \times 10^2 \times 10 \text{ cm}^3$

$$= 3.14 \times 1000 \text{ cm}^3 = 3140 \text{ cm}^3$$

The required volume is $V = 3140 \text{ cm}^3$

d) The length $L = 80 \text{ cm}$, the width $l = 60 \text{ cm}$ and the height $h = 40 \text{ cm}$

The volume of the box is $V_B = L \times l \times h = 80 \times 60 \times 40 \text{ cm}^3 = 192,000 \text{ cm}^3$

The number of tins which will fill the box is $n = \frac{192000 \text{ cm}^3}{3140 \text{ cm}^3/\text{tin}} = 61.15 \text{ tins}$

The required largest number of tins is then 62.

18. a)

Age, x	Frequency	f(x)	Cumulative frequency
14	5	70	5
15	9	135	14
16	13	208	27
17	11	187	38
18	12	216	50
19	15	285	65
20	8	160	73
	$\sum f = 73$	$\sum fx = 1261$	

b) The mode is 19 (its frequency is the highest).

c) The median age is $Me = \frac{x_{n+1}}{2}$ (as n is odd)

$$Me = \frac{x_{73+1}}{2} = X_{37} = 17 \text{ (from the table)}$$

d) The mean age $X = \frac{\sum fx}{\sum f} = \frac{1251}{73} = 17.3$

19. (a) $a^{\rightarrow} = \begin{pmatrix} -5 \\ 12 \end{pmatrix}, b^{\rightarrow} = \begin{pmatrix} 3 \\ 6 \end{pmatrix} \text{ and } c^{\rightarrow} = \begin{pmatrix} -4 \\ -2 \end{pmatrix}$

$$(i) \quad a^{\rightarrow} + b^{\rightarrow} - c^{\rightarrow} = \begin{pmatrix} -5 \\ 12 \end{pmatrix} + \begin{pmatrix} 3 \\ 6 \end{pmatrix} - \begin{pmatrix} -4 \\ -2 \end{pmatrix} = \begin{pmatrix} 2 \\ 20 \end{pmatrix}$$

$$(ii) \quad \text{The modulus of } a^{\rightarrow} \text{ is } \|a^{\rightarrow}\| = \sqrt{(-5)^2 + 12^2} = \sqrt{25 + 144} = \sqrt{169} =$$

13 length units

$$(b) \quad K^{\rightarrow\rightarrow\rightarrow} L^{\rightarrow\rightarrow} = L^{\rightarrow\rightarrow} - K^{\rightarrow\rightarrow} = \begin{pmatrix} 2 \\ 7 \end{pmatrix} - \begin{pmatrix} 4 \\ -4 \end{pmatrix} = \begin{pmatrix} -2 \\ 11 \end{pmatrix}$$

$$\|K^{\rightarrow\rightarrow\rightarrow} L^{\rightarrow\rightarrow}\| = \sqrt{(-2)^2 + (-4)^2} = \sqrt{4 + 16} = \sqrt{20} = 2\sqrt{5}$$

$$L^{\rightarrow\rightarrow\rightarrow} M^{\rightarrow\rightarrow\rightarrow} = M^{\rightarrow\rightarrow\rightarrow} - L^{\rightarrow\rightarrow\rightarrow} = \begin{pmatrix} 4 \\ -1 \end{pmatrix} - \begin{pmatrix} 2 \\ 3 \end{pmatrix} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$$

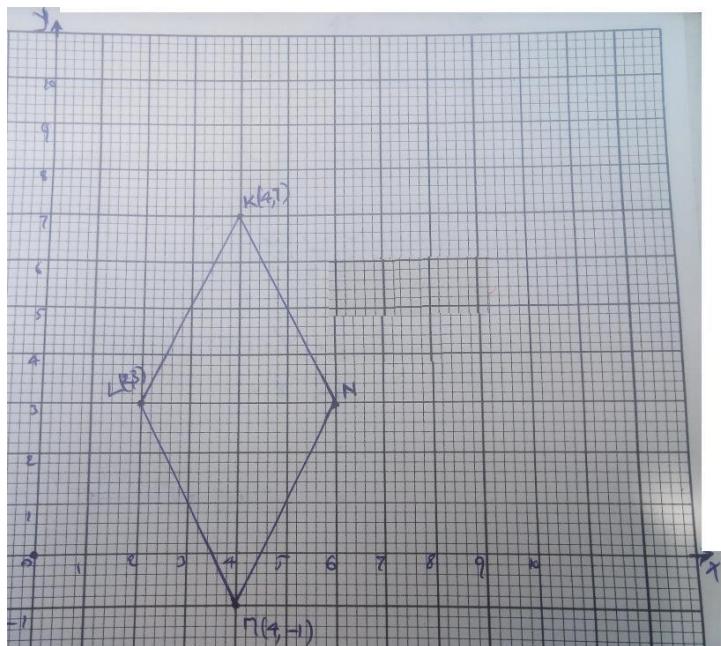
$$\|L^{\rightarrow\rightarrow\rightarrow} M^{\rightarrow\rightarrow\rightarrow}\| = \sqrt{(2)^2 + (-4)^2} = \sqrt{4 + 16} = \sqrt{20} = 2\sqrt{5}$$

As KL and LM are two sides of the triangle KLM and $\|K^{\rightarrow\rightarrow\rightarrow} L^{\rightarrow\rightarrow}\| = \|L^{\rightarrow\rightarrow\rightarrow} M^{\rightarrow\rightarrow\rightarrow}\|$

the side KL and LM are equal. Therefore, the triangle KLM is

isosceles.

ii)



Let $N(x, y)$

We have $x = 6$ and $y = 3$

So the coordinates of N are $x = 6$ and $y = 3$ or $N(6, 3)$.

c) The points $P(-3, -2)$, $Q(3, 1)$ and $R(5, 2)$ are collinear if $\vec{PQ} = k\vec{QR}$

$$\vec{PQ} = \begin{pmatrix} 3 \\ 1 \end{pmatrix} - \begin{pmatrix} -3 \\ -2 \end{pmatrix} = \begin{pmatrix} 6 \\ 3 \end{pmatrix}$$

$$\vec{QR} = \begin{pmatrix} 5 \\ 2 \end{pmatrix} - \begin{pmatrix} 3 \\ 1 \end{pmatrix} = \begin{pmatrix} 2 \\ 1 \end{pmatrix}$$

As $\vec{PQ} = 3\vec{QR}$ the given points are collinear.

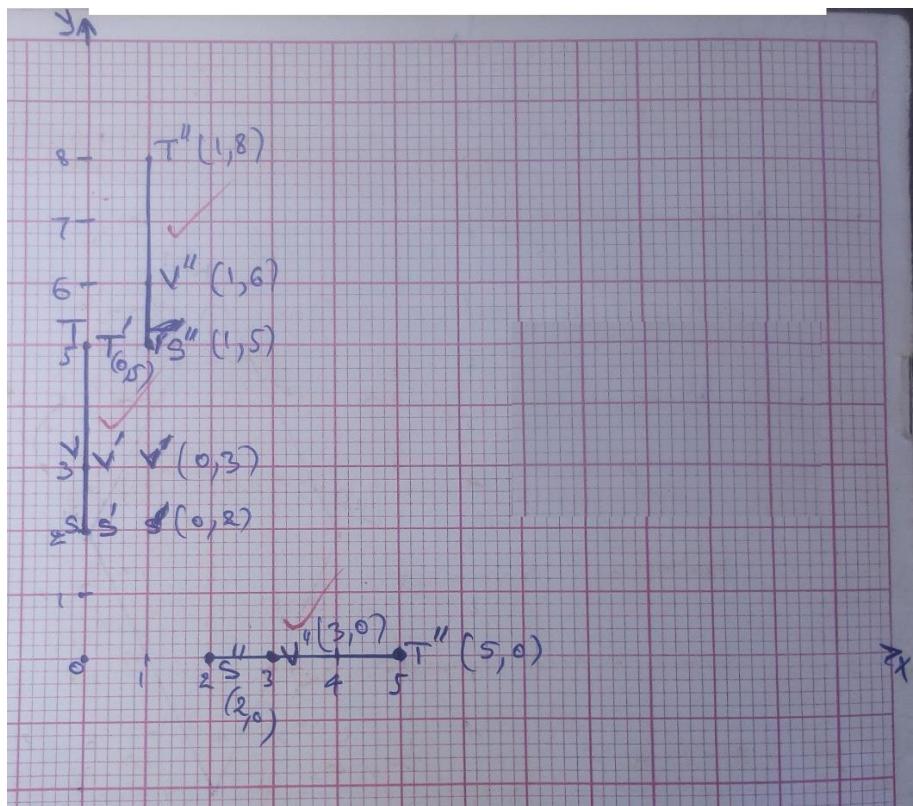
d) $s = \begin{pmatrix} 7 \\ 4 \end{pmatrix}$ and $t = \begin{pmatrix} 21 \\ r \end{pmatrix}$ are parallel

$$t = ks \text{ i.e } \begin{pmatrix} 21 \\ r \end{pmatrix} = k \begin{pmatrix} 7 \\ 4 \end{pmatrix}$$

$$\text{Or } \begin{cases} 21 = 7k \\ r = 4k \end{cases} \Rightarrow \begin{cases} k = 3 \\ r = 12 \end{cases}$$

The required value of r is 12.

20.



MATHEMATICS I

010

20/11/2018 08.30 AM – 11.30 AM



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2018

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 paper until you are told to do so.
- 3) This paper consists of **TWO** sections **A** and **B**.

SECTION A: Attempt **ALL** questions **(55 marks)**

SECTION B: Answer any **THREE** questions. **(45 marks)**

- 4) You may use mathematical instruments and calculators **where necessary**.
- 5) Use a blue ink pen only to write your answers and a pencil to draw diagrams.
- 6) Show clearly all the working. **Marks will not be awarded for answers without all working steps.**

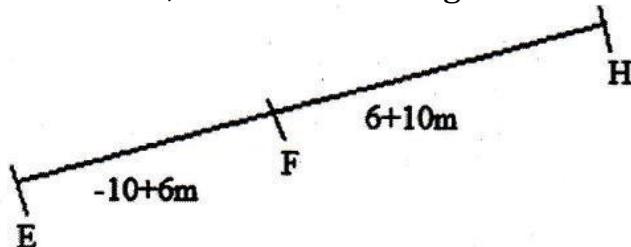
SECTION A: Attempt all questions from this section. (55 marks)

1. Expand the following: $(64x^2 - 25y^2)$ (2 marks)
 2. If $a - b = 2$ and $a^2 + b^2 = 20$, find the value of ab . (3 marks)
 3. Find the cardinal of Z set if $Z = \{\text{Natural numbers between } 20 \text{ and } 50, \text{ which are divisible by } 7\}$ (3 marks)
 4. Solve the following inequality in IR: $\frac{3}{4}x - \frac{4}{5}x \geq \frac{1}{2}$ (3 marks)
 5. The number of elements in each region of the Venn diagram is given.
- If $n(M \cup N) = 98$; find x .
- (4 marks)
6. Rationalize the denominator:
- $$\frac{-7\sqrt{2} + 3\sqrt{6}}{5\sqrt{6} + 2\sqrt{2}} =$$
7. Think of a number, I add 7 to it and double the result; the answer is 44. What is the number? (4 marks)
 8. A business woman has 8,000,000 Fr-w in the bank. The bank pays her an interest rate of 7% per year. How much money does she have after two years? (4 marks)
 9. A cell map is drawn to a scale of 4:80 000. What length on the map represents a distance of 10 000m? (4 marks)
 10. Find the coordinates of point T, given that $O \rightarrow \rightarrow \rightarrow T = O \rightarrow \rightarrow \rightarrow A + O \rightarrow \rightarrow \rightarrow B$ if $A = (20)$ and $B = (20, -8)$. (4 marks)
 11. At sellers of mobile phone, the price of a phone was marked down by 10%. If the old price was 400,000Frw, calculate its actual selling price. (4 marks)
 12. In a group of 70 people, 32 like soft drinks and 47 like beer and each person likes at least one of the two drinks. How many like both soft drinks and beer? (4 marks)

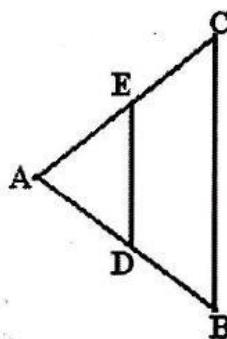
13. Solve the following simultaneous equations. (4 marks)

$$\begin{cases} 3y + 2x = 5 \\ 4y + 3x = 7 \end{cases}$$

14. In the following figure, the length of the segment EH = 44cm, find the value of the real number m, then find the length of EF and FH. (4 marks)



15. In the figure given below, DE IBC. If AD = x cm, DB = x-2 cm, AE = x -1 cm, then find the value of x. (4 marks)



SECTION B: ATTEMPT ANY THREE QUESTIONS (45 Marks)

16. (a) In a group of 100 persons, 72 people can speak English and 43 can speak French.

- (i) How many people can speak English only? (3 marks)
- (ii) How many people can speak French only? (3 marks)
- (iii) How many people can speak both English and French? (3 marks)

(b) Given that $\vec{x} = \begin{pmatrix} 0 \\ 12 \end{pmatrix}$, $\vec{y} = \begin{pmatrix} -8 \\ 6 \end{pmatrix}$, $\vec{z} = \begin{pmatrix} -8 \\ 6 \end{pmatrix}$

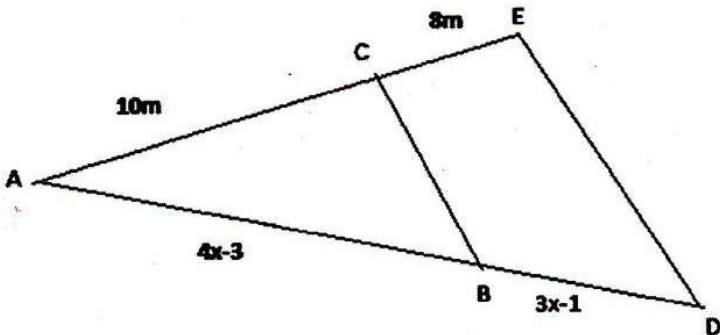
Calculate:

- (i) $\vec{x} + \vec{y} - \vec{z}$ (2marks)
- (ii) $3\vec{x} - 2\vec{y} + 2\vec{z}$ (2marks)
- (iii) $\frac{1}{2}(\vec{x} - \vec{y}) - 3\vec{z}$ (2marks)

17. (a) A father is 33 years older than his son and one year ago he was four times as old as his son.

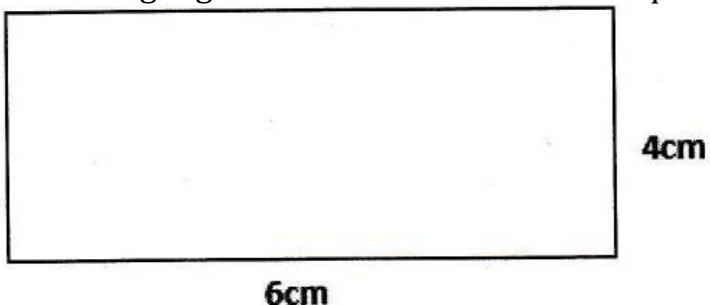
- (i) Find the present age of the father. (3 marks)
- (ii) Find the Present age of the son. (3 marks)

(b) In the triangle AED



- (i) Use Thales Theorem to find the value of x in m. **(3 marks)**
 (ii) Find the length of side $A \rightarrow B \rightarrow$ of the triangle. **(2 marks)**
 (iii) Find the length of side $B \rightarrow D \rightarrow$ of the triangle. **(2 marks)**
 (iv) Find the length of side $A \rightarrow D \rightarrow$ of the triangle. **(2 marks)**

18. (a) Study the rectangle given below and answer the questions that follow.



- (i) Calculate its area. **(2 marks)**
 (ii) If it is enlarged with a scale factor of 6, find its area. **(3 marks)**
 (b) A garden on the map has an area of 20cm^2 . Calculate its actual area if the map scale is 1:500 **(3 marks)**
 (c) If $f(x) = 2+x$ and $g(x) = 3-x$
 Calculate:
 (i) $f(2) =$ **(1 mark)**
 (ii) $fog(x) =$ **(2 marks)**
 (iii) $gof(x) =$ **(2 marks)**
 (iv) $gof(-5) =$ **(2 marks)**

19. Study the following table which shows the score obtained by students of senior two in Mathematics Midi-term Test out of 20 marks and answer the questions that follow:

16	12	11	12	11	12	12	11	12	11	16
18	18	11	20	11	12	13	11	13	13	16
18	13	14	13	14	14	13	13	19	19	17
18	15	14	14	13	15	15	15	15	15	17

- (a) Copy the frequency table given below and complete it with the above data. **(10 marks)**

Marks, x	Frequency, f	fx	Cumulative frequency
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
	$\sum f =$	$\sum fx =$	

- (b) What is the mode mark? Explain your answer. **(1 mark)**
 (c) Determine the mean mark. **(2 marks)**
 (d) Calculate the number of Students in S2 if all students attended the Test. **(2 marks)**

20.

- (a) A triangle with vertices M, N and P whose coordinates are $\left(\frac{10}{5}, 0\right)$, O $\left(\frac{15}{3}, \frac{24}{6}\right)$ and $\left(\frac{12}{2}, 1\right)$ respectively is given a translation $\tilde{t} = \begin{pmatrix} -\frac{12}{4} \\ 7 \end{pmatrix}$.
 Find the image vertices:
 (i) J' **(3marks)**
 (ii) K' **(3marks)**
 (iii) P' **(3marks)**
- (b) If A (1,2) and B (3,1) are two points on the line:
 (i) Find the slope of the line. **(2marks)**
 (ii) Find the equation of the line passing through the given point A and B. **(3marks)**
 (iii) Find its y- intercept. **(1mark)**

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2018

SECTION A: Answer all questions

1. $(64x^2 - 25y^2) = (8x + 5y)(8x - 5y)$

2. $\begin{cases} a - b = 2 \\ a^2 + b^2 = 20 \end{cases}$

$$a - b = 2 \Leftrightarrow (a - b)^2 = 4$$

$$a^2 - 2ab + b^2 = 4$$

$$a^2 + b^2 = 4 + 2ab$$

$$\text{So } a^2 + b^2 = 4 + 2ab = 20$$

$$2ab = 20 - 4 = 16 \quad ab = \frac{16}{2} = 8$$

3. $Z = \{21, 28, 35, 42, 49\}$

4. $\frac{3}{4}x - \frac{4}{5}x \geq \frac{1}{2}$

$$\frac{15x - 16x}{20} \geq \frac{10}{20}$$

$$-x \geq 10$$

$$x \leq -10$$

$$S =]-\infty, -10[$$

5. $n(M \cup N) = 98$

$$-2x + 88 + 2x - 2x + 50 = 98$$

$$-2x = 98 - 138$$

$$-2x = -40$$

$$2x = 40$$

$$x = \frac{40}{2} = 20$$

6.
$$\frac{-7\sqrt{2}+3\sqrt{6}}{5\sqrt{6}+2\sqrt{2}} = \frac{(-7\sqrt{2}+3\sqrt{6})(5\sqrt{6}-2\sqrt{2})}{(5\sqrt{6}+2\sqrt{2})(5\sqrt{6}-2\sqrt{2})} = \frac{118-41\sqrt{12}}{142}$$

7. $(I + 7) \times 2 = 44$

$$I + 7 = 22$$

$$I = 22 - 7$$

$$I = 15$$

8. After two years = $8,000,000 + \frac{2 \times 8,000,000 \times 7}{100} = 9,120,000 FRW$

9. The length on the map = $\frac{10,000 \times 4}{80,000} = 0.5 m$

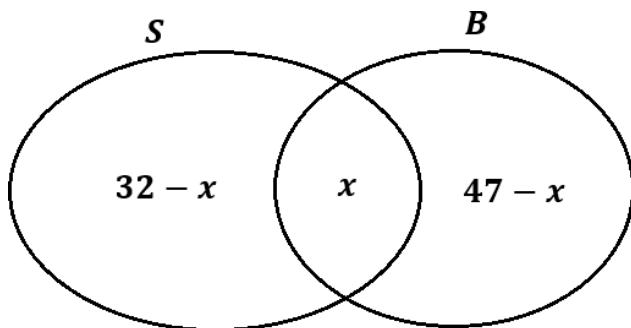
10. $O^{++}T^{++} = O^{++}A^{++} + O^{++}B^{++}$

$$O^{++}T^{++} = \binom{x}{y} = \binom{12}{20} + \binom{20}{-8} = \binom{32}{12}$$

$$O^{++}T^{++} = (32, 12)$$

11. The actual selling price = $400,000 - \frac{400,000 \times 10}{100}$
 $= 400,000 - 40,000 = 360,000 FRW$

12.



$$32 - x + x + x + 47 - x = 70$$

$$-x = 70 - 79$$

$$-x = -9$$

$$x = 9$$

13. $\begin{cases} 3y + 2x = 5 \\ 4y + 3x = 7 \end{cases} \quad (1) \quad (2)$

Multiply the equation (1) by 4 and the equation (2) by - 3

$$\begin{cases} 12y + 8x = 20 \\ -12y - 9x = -21 \end{cases} \quad (3) \quad (4)$$

Add equation (3) and equation (4)

$$8x - 9x = 20 - 21$$

$$-x = -1$$

$$x = 1$$

14. The value of m

$$EF + FH = 44$$

$$-10 + 6m + 6 + 10m = 44$$

$$16m = 44 + 10 - 6$$

$$16m = 48 \quad m = \frac{48}{16} = 3$$

$$m = 3$$

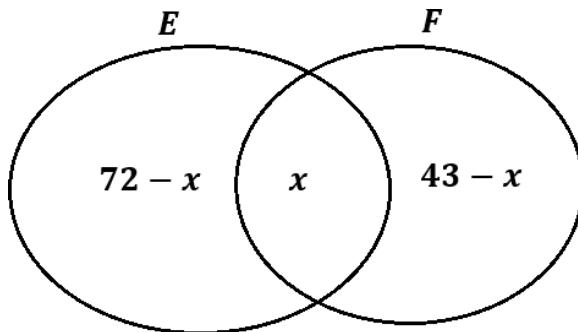
$$EF = -10 + 6m = -10 + 6 * 3 = 8$$

$$FH = 6 + 10m = 6 + 10 * 3 = 36$$

15.

Section B: Answer only 3 questions

16. a)



$$72 - x + x + 43 - x = 100$$

$$115 - x = 100$$

$$-x = 100 - 115$$

$$-x = -15$$

$$x = 15$$

i) English speaker : $72 - x = 72 - 15 = 57$

ii) French speaker : $43 - x = 43 - 15 = 28$

iii) English and French speaker : $100 - (28 + 57) = 15$

b) $\vec{x} = \begin{pmatrix} 0 \\ 12 \end{pmatrix}, \vec{y} = \begin{pmatrix} -8 \\ 6 \end{pmatrix}, \vec{z} = \begin{pmatrix} -8 \\ 6 \end{pmatrix}$

i) $\vec{x} + \vec{y} - \vec{z} = \begin{pmatrix} 0 \\ 12 \end{pmatrix} + \begin{pmatrix} -8 \\ 6 \end{pmatrix} - \begin{pmatrix} -8 \\ 6 \end{pmatrix} = \begin{pmatrix} 0 \\ 12 \end{pmatrix}$

ii) $3\vec{x} - 2\vec{y} + 2\vec{z} = 3\begin{pmatrix} 0 \\ 12 \end{pmatrix} - 2\begin{pmatrix} -8 \\ 6 \end{pmatrix} + 2\begin{pmatrix} -8 \\ 6 \end{pmatrix} = \begin{pmatrix} 0 \\ 12 \end{pmatrix}$

iii) $\frac{1}{2}\vec{x} - \vec{y} - 3\vec{z} = \frac{1}{2}\left\{\begin{pmatrix} 0 \\ 12 \end{pmatrix} - \begin{pmatrix} -8 \\ 6 \end{pmatrix}\right\} - 3\begin{pmatrix} -8 \\ 6 \end{pmatrix} = \begin{pmatrix} 28 \\ -15 \end{pmatrix}$

17. a) Let x be the age of the son.

The age of the father is $x + 33$

$$x + 32 = 4(x - 1)$$

$$x + 32 = 4x - 4$$

$$3x = 36$$

$$x = \frac{36}{12}$$

$$x = 3$$

i) The present age of the father is $12 + 33 = 45$

ii) The present age of the son is 12 years.

b) In the triangle AED: $\frac{AC}{CE} = \frac{AB}{BD} \Leftrightarrow \frac{10}{8} = \frac{4x-3}{3x-1}$

i) The value of x :

$$10(3x - 1) = 8(4x - 3)$$

$$30x - 10 = 32x - 24$$

$$30x - 32x = -24 + 10$$

$$-2x = -14$$

$$2x = 14$$

$$x = \frac{14}{2}$$

$$x = 7$$

ii) The length of side AB: $4x - 3 = 4 \times 7 - 3 = 28 - 3 = 25 \text{ m}$

iii) The length of side BD: $3x - 1 = 3 \times 7 - 1 = 21 - 1 = 20 \text{ m}$

iv) The length of side AD: $AB + BD = 25 + 20 = 45 \text{ m}$

18. a) i) Area = $6 \text{ cm} \times 4 \text{ cm} = 24 \text{ cm}^2$

ii) Its area = $(6 \times 6) \times (4 \times 6) = 36 \times 24 = 864 \text{ cm}^2$

b) Calculate its actual area if the map scale is 1:500 is

$$\frac{20 \times 500}{1} = 10,000 \text{ cm}^2$$

c) $f(x) = 2 + x$

$$g(x) = 3 - x$$

$$(i) f(2) = 2 + 2 = 4$$

$$(ii) f \circ g(x) = f[g(x)] = 2 + (3 - x) = 5 - x$$

$$(iii) g \circ f(x) = g[f(x)] = 3 - 2 - x = 1 - x$$

$$(iv) g \circ f(-5) = 1 - (-5) = 1 + 5 = 6$$

19. a)

Marks, x	Frequency, f	$f(x)$	Cumulative frequency
11	7	77	7
12	6	72	13
13	8	104	21
14	5	70	26
15	6	90	32
16	3	48	35
17	2	34	37
18	4	72	41
19	2	38	43
20	1	20	44
	$\sum f = 44$	$\sum fx = 625$	

b) The mode is 13 because it has the highest frequency of 8.

c) The mean mark: $X = \frac{\sum x}{\sum f} = \frac{625}{44} = 14.2$

d) There are 44 students in S2.

20. $N = \left(\frac{10}{5}, 0\right), M = \left(\frac{15}{3}, \frac{24}{6}\right) \text{ and } P = \left(\frac{12}{2}, 1\right)$

$$\vec{t} = \left(\begin{smallmatrix} \frac{12}{2} \\ 7 \end{smallmatrix} \right)$$

$$i) N' = \left(\begin{smallmatrix} \frac{10}{5} \\ 0 \end{smallmatrix} \right) + \left(\begin{smallmatrix} -\frac{12}{4} \\ 7 \end{smallmatrix} \right) = \left(\begin{smallmatrix} -\frac{20}{7} \\ 7 \end{smallmatrix} \right) = \left(\begin{smallmatrix} -1 \\ 7 \end{smallmatrix} \right)$$

$$ii) N' = \left(\begin{smallmatrix} \frac{15}{24} \\ 6 \end{smallmatrix} \right) + \left(\begin{smallmatrix} -\frac{12}{4} \\ 7 \end{smallmatrix} \right) = \left(\begin{smallmatrix} -\frac{24}{12} \\ 11 \end{smallmatrix} \right) = \left(\begin{smallmatrix} 2 \\ 11 \end{smallmatrix} \right)$$

$$iii) P' = \left(\begin{smallmatrix} 2 \\ 1 \end{smallmatrix} \right) + \left(\begin{smallmatrix} -\frac{12}{4} \\ 7 \end{smallmatrix} \right) = \left(\begin{smallmatrix} 6 \\ 1 \end{smallmatrix} \right) + \left(\begin{smallmatrix} -3 \\ 7 \end{smallmatrix} \right) = \left(\begin{smallmatrix} 3 \\ 8 \end{smallmatrix} \right)$$

$$b) i) \text{Slope } m = \frac{x_2 - x_1}{y_2 - y_1} = \frac{3 - 1}{1 - 2} = \frac{2}{-1} = -2$$

$$ii) L = y_2 - y_1 = m(x_2 - x_1)$$

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

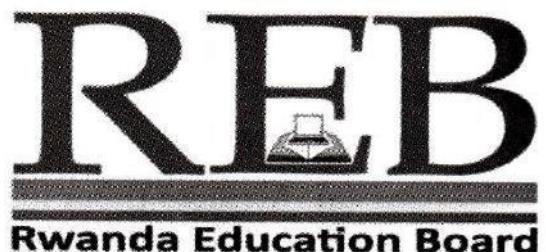
$$y = -2x + 4$$

$$iii) \text{Its } y \text{ intercept is } y = (4, 0)$$

Mathematics I

010

12/11/2019 08.30 AM – 11.30 AM



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2019

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 paper until you are told to do so.
- 3) This paper consists of **TWO** sections **A** and **B**.

SECTION A: Attempt **ALL** questions **(55 marks)**

SECTION B: Answer any **THREE** questions. **(45 marks)**

- 4) You may use mathematical instruments and calculators **where necessary**.
- 5) Use a blue ink pen only to write your answers and a pencil to draw diagrams.
- 6) Show clearly all the working. **Marks will not be awarded for answers without all working steps.**

SECTION A: Attempt all questions. (55 marks)

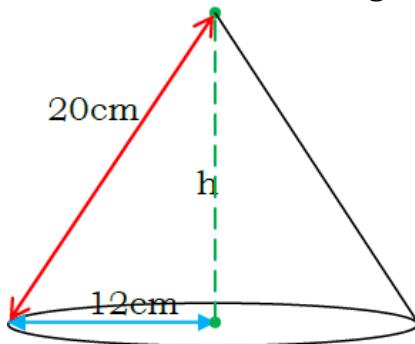
1. Simplify the following: (3 marks)

$$\frac{2}{\sqrt{3}+2} + \frac{\sqrt{5}}{\sqrt{3}-2}$$

2. Solve in IR: (4 marks)

$$\begin{cases} 3x - y = 4 \\ -3y + 2x = -9 \end{cases}$$

3. Determine the volume of the following diagram (use $\pi = 3.14$) (4 marks)



4. If set A has 256 subsets, how many elements are there in the set A? (2 marks)

5. If two functions $f(x)$ and $g(x)$ are defined as follow:

$$\begin{aligned} f: x \rightarrow R: f(x) &= \sqrt{x+1} \text{ and} \\ g: R \rightarrow R': g(x) &= \frac{1}{x^2} \end{aligned}$$

Calculate a) $gof(x)$ (2 marks)
b) $fog(x)$ (2 marks)

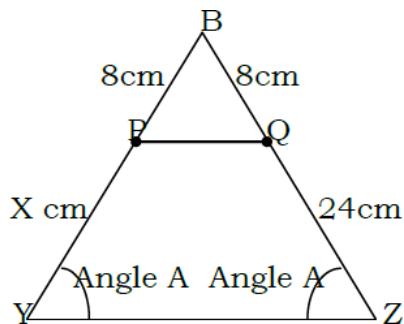
6. A business woman has deposited 3,500,000FRW in a bank for two years at a compound interest rate of 10% per year. Calculate the total amount she will receive after 2 years. (4 marks)

7. Solve in R: $(3^{2x})(9^{x-1}) = 81$ (3 marks)

8. The length of a rectangular garden is twice its width. If the perimeter is 72 meters;

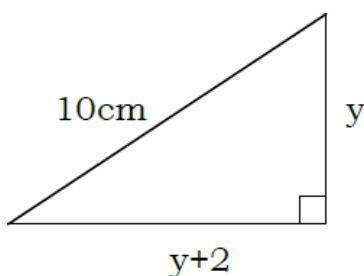
- i) Find the length and the width of the garden. (2 marks)
ii) Find the area of the garden. (1 mark)

9. Study the figure below. Find the value of X. (4 marks)



10. Seats for Mathematics, Physics and Biology in a school are in the ratio 5: 7: 8. There is a proposal to increase these seats by 40%, 50% and 75% respectively. What will be the ratio of increased seats? **(4 marks)**

11. a) Solve for y in the figure below. **(3 marks)**
 b) Find the perimeter of the figure. **(1 mark)**

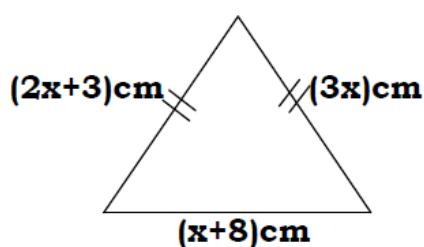


12. a) Change 703_8 to base six.
 b) The following figure represents the diagram of a scooter. Use it to answer the questions below:



If the diagram of the scooter is drawn to a scale of 1:20, find the actual length of the scooter. **(2 marks)**

13. Study the figure below and answer the following questions:

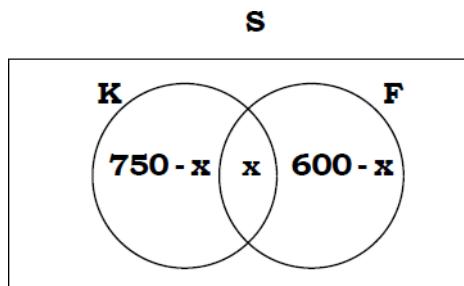


- a) Find the value of x . **(2 marks)**
 b) What is the length of each side of the triangle? **(1 mark)**

c) Find the perimeter of the figure.

(1 mark)

14. All 1200 students (**S**) at a certain school lean Kinyarwanda (**K**), French (**F**) or both. Using the following Venn diagram,



- a) Calculate the number of students who learn both languages. **(2 marks)**
 - b) Calculate the number of students who learn Kinyarwanda only. **(1 mark)**
 - c) Calculate the number of students who learn French only. **(1 mark)**
15. It is given that vectors $\vec{a} = \begin{pmatrix} 6 \\ 8 \end{pmatrix}$, $\vec{b} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$ and $\vec{c} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$
- i) Find $2(\vec{a} + \vec{b} - \vec{c})$
 - ii) Determine the value of $|\vec{a}| + |\vec{b}|$

SECTION B: Attempt only three questions (45 marks)

16. A primary school had 1200 students enrolled in 2013 and 1500 students in 2016. If the student population P grows as a linear function of time t, where t is the number of years after 2013.
- a) How many students will be enrolled in the school in 2020? **(9 marks)**
 - b) Find a linear function that relates the student population to the time t. **(6 marks)**

- 17.a) The cost of producing X tools by a company is given by the function $C(x) = 1200x + 5500$ in FRW

- i) What is the cost of 100 tools? **(2 marks)**
 - ii) What is the cost of 101 tools? **(2 marks)**
 - iii) Find the difference between the cost of 101 and 100 tools? **(3 marks)**
 - iv) Find the slope of the graph. **(2 marks)**
 - v) Interpret the slope. **(3 marks)**
- b) Given $f(x) = 2x^2 + 4x - 3$,
find $f(2a + 3)$ **(3 marks)**

- 18.a) Out of 34 students in a class, 20 did Kinyarwanda Test and 18 did French test. The number of students who did both tests is twice that of those who did none of the tests.

Using a Venn diagram, find the number of students who did:

- i) Tests for both subject. **(2 marks)**
- ii) None of the subject tests. **(2 marks)**
- iii) Only one test of a subject. **(2 marks)**

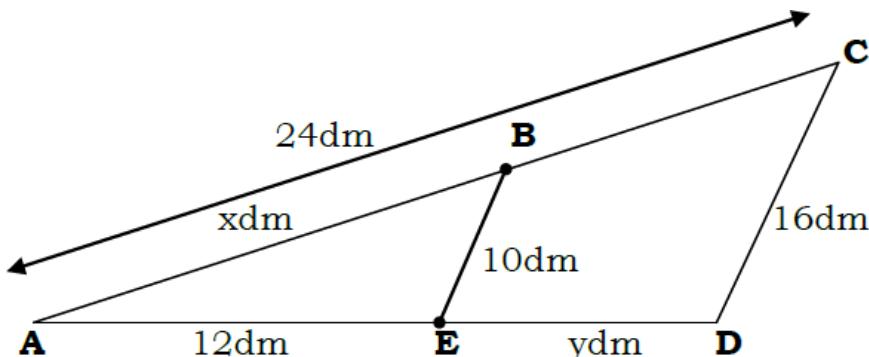
b) If f is the function defined in $R \rightarrow R: f(x) = 2x^2 + 1$, find the inverse of the function f . **(3 marks)**

c) Given the points A (-1, 3) and B (-2, 5)

i) Calculate the slope of the line passing through the points A and B. **(2 marks)**

ii) Find the equation of the line that passes through the points A and B. **(4 marks)**

19. a) Study the figure below then find the value of x and y . **(6 marks)**



b) Consider the points A (5, 2), B (3, -1) and C (7, 3).

Find

i) BA and BC **(4 marks)**

ii) Show if BA and BC are orthogonal. **(2 marks)**

Explain your answer. **(1 mark)**

c) Find the value of $a^\rightarrow = (1, 7)$ and b^\rightarrow if a^\rightarrow and b^\rightarrow are orthogonal. **(2 marks)**

20. The following data represent the marks of 53 students in a chemistry test

18	20	20	20	20	21	20	17	19	20
13	18	22	26	20	19	22	15	18	27
16	23	24	17	25	24	16	20	26	15
21	17	23	16	21	17	26	16	23	19

- i) Construct a grouped frequency distribution table with 5 classes by completing the table below: **(8 marks)**

Mark classes	Midpoint	Frequency	f(x)	Cumulative frequency
13-15	14	3		
16-				
25-27		5		
		$\sum f =$	$\sum fx =$	

- ii) How many students did the chemistry test? **(1 mark)**
 iii) Calculate the mean mark? **(2 marks)**
 What is the modal class of the distribution? Explain your answer. **(2 marks)**
 v) Determine the median of the distribution. **(2 marks)**

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2019

SECTION A: Answer all questions

$$1. \frac{2}{\sqrt{3}+2} + \frac{\sqrt{5}}{\sqrt{3}-2} = \frac{2(\sqrt{3}-2)}{(\sqrt{3}+2)(\sqrt{3}-2)} + \frac{\sqrt{5}(\sqrt{3}+2)}{(\sqrt{3}-2)(\sqrt{3}+2)} = \frac{2\sqrt{3}-4+\sqrt{15}+2\sqrt{5}}{(\sqrt{3}+2)(\sqrt{3}-2)}$$

$$= \frac{2\sqrt{3}+\sqrt{15}+2\sqrt{5}-4}{3-4} = 4 - 2\sqrt{3} - \sqrt{15} - 2\sqrt{5}$$

2.

$$\begin{cases} 3x - y = 4 & (1) \\ -3y + 2x = -9 & (2) \end{cases}$$

$$y = 3x - 4$$

Substitute y into (2) we get $-3(3x - 4) + 2x = -9$

$$-9x + 12 + 2x = -9$$

$$-7x = -21$$

$$7x = 21$$

$$x = \frac{21}{7} = 3$$

$$y = 3x - 4 = 3 \times 3 - 4 = 9 - 4 = 5$$

$$3. \text{ The height} = \sqrt{(20)^2 + (12)^2} = \sqrt{400 + 144} = \sqrt{544} = 16 \text{ cm}$$

The volume

$$V = \frac{1}{3}\pi r^2 H = \frac{1}{3} \times 3.14 \times (12)^2 \times 16 = \frac{1}{3} \times 3.14 \times 144 \times 16 = 2411.52 \text{ cm}^3$$

4. Number of the set (Ns) = 256

$$N_s = 256$$

$$256 = 2^n$$

$$2^8 = 2^n$$

$$n = 8$$

Therefore, there are 8 elements in the set A.

$$5. f(x) = \sqrt{x+1}, g(x) = \frac{1}{x^2}$$

$$a) gof(x) = g[f(x)] = g(\sqrt{x+1}) = \frac{1}{(\sqrt{x+1})^2} = \frac{1}{x+1}$$

$$b) fog(x) = f[g(x)] = f\left(\frac{1}{x^2}\right) = \sqrt{\frac{1}{x^2} + 2} = \sqrt{\frac{1+x^2}{x^2}} = \sqrt{\frac{x^2+1}{x^2}}$$

$$6. P_t = P(1 + \frac{r}{100})^t$$

$$P = 3,500,000; r = 10 \text{ and } t = 2$$

$$\frac{P}{2} = 3,500,000 \left(1 + \frac{10}{100}\right)^2 = 3,500,000 (1 + 0.1)^2 = 3,500,000(1.01)^2$$

$$= 4,235,000 \text{ RWF}$$

$$7. (3^{2x})(9^{x-1}) = 81$$

$$3^{2x}3^{2x-2} = 3^4$$

$$3^{2x+2x-2} = 3^4$$

$$3^{4x-2} = 3^4$$

$$2x - 4 = 4$$

$$4x = 6$$

$$x = \frac{3}{2} = 1.5$$

8. Let x be the length of the garden

Let y be the width of the garden

Let p be the perimeter of the garden

Let A be the area of the garden

i) We have $p = 2(x + y)$

$$x + y = \frac{p}{2} \text{ with } x = 2y$$

$$\text{So } 2y + y = \frac{72}{2} \text{ or } 3y = 36$$

$$y = 12$$

$$x = 2y = 24$$

The length of the garden = 24 m

The width of the garden = 12 cm

ii) Area = length x width = 24 cm x 12 cm = 288 cm²

9. From Thales Theorem we have: $\frac{x}{8} = \frac{24}{8} \Leftrightarrow x = 8 \text{ cm}$

10. 40% of 5 is equal $\frac{40 \times 5}{100} = 2$

The new set portion becomes $5 + 2 = 7$ for Mathematics

For physics, 50% of 7 is equal $\frac{50 \times 7}{100} = \frac{7}{2}$

The new set portion for Physics becomes $7 + \frac{7}{2} = \frac{21}{2}$

For Biology, 75% of 8 is equal $\frac{75 \times 8}{100} = 6$

The new set portion for Biology becomes $8 + 6 = 14$

The new ratio is then $7:\frac{21}{2}:14$ or $14:21:28$ or $2:3:4$

The ratio of increased seats is $2:3:4$

11. From Pythagorean theorem

$$(y + 2)^2 = 10^2$$

$$2y^2 + 4y + 4 - 100 = 0$$

$$2y^2 + 4y - 96 = 0$$

$$(y + 8)(y - 6) = 0$$

$$y = -8 \text{ (discarded)}$$

$$\text{or } y = 6$$

The length of a segment must be a positive number therefore $y = 6$ cm

Base of the triangle = $6 + 2 = 8$ cm

Height = 6 cm

b) The perimeter = 10 cm + 8 cm + 6 cm = 24 cm

12. a) Before change 703_8 into base 10

$$\begin{aligned} 703_8 &= 3 \times 8^0 + 0 \times 8^1 + 7 \times 8^2 \\ &= 3 \times 1 + 0 + 7 \times 64 \\ &= 3 + 448 \\ &= 451_{10} \end{aligned}$$

Convert 451_{10} into base 6

x	x/6	Remainder
451	75	1
75	12	3
12	2	0
2	0	2

$$703_8 = 2031_6$$

b) Let l be the actual length, we have:

$$\frac{l}{20} = 3.5$$

$$l = 20 \times 3.5 = 70 \text{ cm}$$

13. a) $2x + 3 = 3x$

$$x = 3 \text{ cm}$$

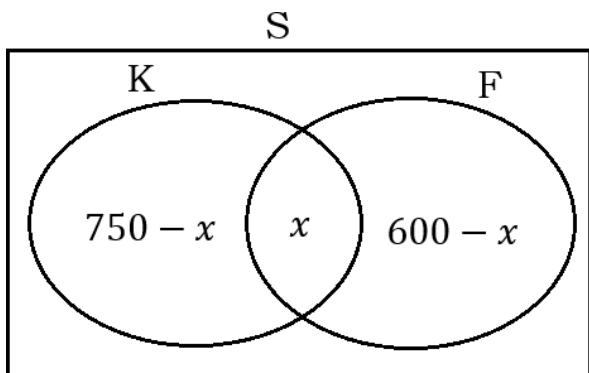
b) The side $(2x + 3)\text{cm} = (2 \times 3 + 3) = 9 \text{ cm}$

$$\text{The side } (x + 8)\text{cm} = (3 + 8) = 11 \text{ cm}$$

$$\text{The side } (3x)\text{cm} = (3 \times 3) = 9 \text{ cm}$$

c) The perimeter of the figure $= (9 + 11 + 9)\text{cm} = 29 \text{ cm}$

14.



a) We have $750 - x + x + 600 - x = 1200 \text{ or } x = 150$

The number of students who learn both languages is 150.

b) The number of students who learn Kinyarwanda only is

$$750 - 150 = 600 \text{ students.}$$

c) The number of students who learn French only is

$$600 - 150 = 450 \text{ students.}$$

15. $\vec{a} = \begin{pmatrix} 6 \\ 8 \end{pmatrix}, \vec{b} = \begin{pmatrix} 1 \\ 2 \end{pmatrix} \text{ and } \vec{c} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$

i) $2(\vec{a} + \vec{b} - \vec{c}) = 2\left\{\begin{pmatrix} 6 \\ 8 \end{pmatrix} + \begin{pmatrix} 1 \\ 2 \end{pmatrix} - \begin{pmatrix} 2 \\ -3 \end{pmatrix}\right\} = \begin{pmatrix} 12 \\ 16 \end{pmatrix} + \begin{pmatrix} 2 \\ 4 \end{pmatrix} - \begin{pmatrix} 4 \\ -6 \end{pmatrix} = \begin{pmatrix} 10 \\ 26 \end{pmatrix}$

$$2(\vec{a} + \vec{b} - \vec{c}) = \begin{pmatrix} 10 \\ 26 \end{pmatrix}$$

ii) $|\vec{a}| + |\vec{b}| = \sqrt{6^2 + 8^2} + \sqrt{1^2 + 2^2} = \sqrt{36 + 64} + \sqrt{5}$
 $= \sqrt{100} + \sqrt{5} = 10 + \sqrt{5}$

Section B: Answer only 3 questions

16. For $t = 0$, $P(0) = 1200$ that is the initial number of students at school. $P(t) = kt + c$ is the linear function modeling the problem or the total number of students of the school after the time t (in years).

a) $t = 2016 - 2013 = 3$ years

From the relation $P(t) = kt + c$, we get

$$P(0) = 0 + c \text{ i.e. } c = 1200$$

$$\text{i.e } P(t) = kt + 1200$$

$$P(3) = 3k + 1200$$

$$1500 = 3k + 1200$$

$$3k = 1500 - 1200$$

$$3k = 300$$

$$K = 100$$

From 2013 to 2020, $t = 7$ years

$$\text{So } P(7) = 7 \times 100 + 1200 = 1900 \text{ students.}$$

The number of students who will be enrolled in school in 2020 is 1200 students.

b) The equation model of the problem is $P(t) = kt + 1200$

$$\text{i.e } P(t) = 100t + 1200$$

$$k = 100 \text{ and } c = 1200$$

$$\text{The required linear function is } P(t) = 100t + 1200$$

17. a) i) $c(x) = 1200x + 5500$

$$c(100) = 1200 \times 100 + 5500 = 120000 + 5500$$

$$c(100) = 126,700 \text{ RWF}$$

$$\text{ii}) c(101) = 1200 \times 101 + 5500 = 121200 + 5500 = 126,700 \text{ RWF}$$

$$\text{iii}) c(101) - c(100) = (126,700 - 125,500) = 1200 \text{ RWF}$$

iv) $c(x) = 1200x + 5500$ is a linear equation. The slope is 1200.

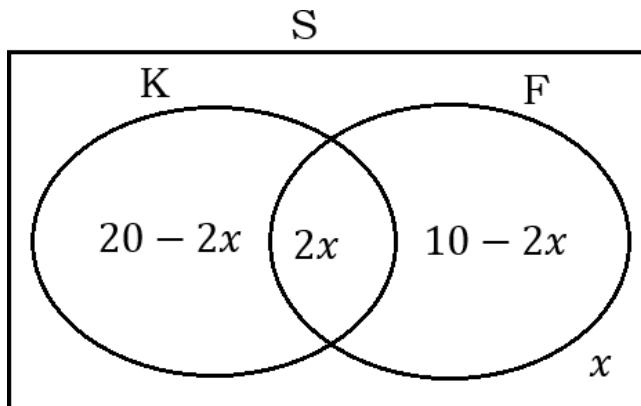
v) Let $y = kx + m$ be the slope-intercept form of the line.

We have $k = \frac{y_2 - y_1}{x_2 - x_1}$ where $P_1(x_1, y_1)$ and $P_2(x_2, y_2)$ are two points of the line.

b) $f(x) = 2x^2 + 4x - 3$

$$\begin{aligned}f(2a+3) &= 2(2a+3)^2 + 4(2a+3) - 3 \\&= 2(4a^2 + 12a + 9) + 8a + 12 - 3 \\&= 8a^2 + 24a + 18 + 8a + 9 \\&= 8a^2 + 32a + 27\end{aligned}$$

18. a) Let S be the number of students who did none of the tests. We have:



$$20 - 2x + 2x + 18 - 2x + x = 34$$

$$-x = 34 - 18 - 20$$

$$x = 4$$

- i) The students who did both subjects are $2 \times 4 = 8$ students.
- ii) The students who did none of the two subjects are 4 students.
- iii) The students who did one test of a subject is $20 - 8 + 18 - 8$ or 22 students.

b) Let $y = 2x^2 + 1$

$$y - 1 = 2x^2$$

$$x^2 = \frac{y-1}{2}$$

$$x = \pm \sqrt{\frac{y-1}{2}}$$

$$\text{So } f^{-1} = +\sqrt{\frac{x-1}{2}} \text{ or } f^{-1} = -\sqrt{\frac{x-1}{2}}$$

c) i) The slope is $m = \frac{5-3}{-2+1} = \frac{2}{-1} = -2$

ii) The required equation is $y = -2x + c$

As the line passes through $(-1, 3)$ we have

$$3 = -2(-1) + c$$

$$3 = 2 + c$$

$$c = 3 - 2 = 1$$

The required equation is then $y = -2x + 1$

19. a) By Thales theorem, we have

$$\frac{x}{24} = \frac{12}{y+12} = \frac{10}{16}$$

With $\frac{x}{24} = \frac{10}{16}$ we get

$$16x = 240$$

$$x = \frac{240}{16} = 15 \text{ dm}$$

With $\frac{12}{y+12} = \frac{10}{16}$ we get

$$10y + 120 = 192$$

$$10y = 72$$

$$\text{or } y = 7.2 \text{ dm}$$

b) A (5, 2), B (3, -1) and C (7, -3)

i) $B \rightarrow A \rightarrow = (5 - 3, -3 + 1) = (2, 3)$

$$BA = |B \rightarrow A \rightarrow| = \sqrt{2^2 + 3^2} = \sqrt{13} \text{ length units}$$

$$B \rightarrow C \rightarrow = (7 - 3, -3 + 1) = (4, -2)$$

$$BC = |B \rightarrow C \rightarrow| = \sqrt{4^2 + (-2)^2} = \sqrt{16 + 4} = \sqrt{20} \text{ length units}$$

ii) BA and BC are orthogonal if $2 \times 4 + 3 \times -2 = 0$

$$2 \times 4 + 3 \times -2 = 8 - 6 = 2 \neq 0$$

So BA and BC are not orthogonal.

$B \rightarrow A \rightarrow = (x_1, y_1)$ and $B \rightarrow C \rightarrow = (x_2, y_2)$ are orthogonal.

$$\text{If } B \rightarrow A \rightarrow \cdot B \rightarrow C \rightarrow = 0 \text{ i.e. } x_1 \cdot x_2 + y_1 \cdot y_2 = 0$$

That is not the case for BA and BC.

c) The question is incomplete and unclear.

20. i)

Mark classes	Midpoint	Frequency	f(x)	Cumulative frequency
13-15	14	3	42	3
16-18	17	11	187	14
19-21	20	14	280	28
22-24	23	7	161	35
25-27	26	5	130	40
		$\sum f = 40$	$\sum fx = 800$	

ii) The students who did the chemistry test are 40.

iii) The mean mark is $x = \frac{\sum fx}{n} = \frac{800}{40} = 20 \text{ marks}$

iv) The modal class is 19-21 as it is the one with the highest frequency (14).

v) Class median: $\frac{n}{2} = \frac{40}{2} = 20$

The median is in the 3rd class 19-21

The median M is given by $M = L_m + \left(\frac{\frac{n}{2} - F}{f_m} \right) \times i$

Where n = 40 (total frequency)

f_m = frequency of the class median = 14

L_m = lower boundary of the class = 18.5

F: Cummulative frequency before median class = 14

i = class width = 3

$$M = 18.5 + \left(\frac{\frac{40}{2} - 14}{14} \right) \times 3 = 18.5 + \left(\frac{10 - 14}{14} \right) \times 3 = 18.5 - 9 = 9.5$$

Mathematics I
010
20/07/2021 08.30 AM – 11.30 AM



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2020-2021

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 paper until you are told to do so.
- 3) This paper consists of **TWO** sections **A** and **B**.

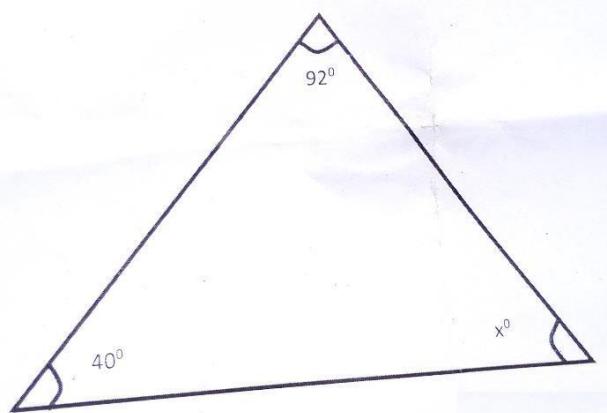
SECTION A: Attempt **ALL** questions **(55 marks)**

SECTION B: Answer any **THREE** questions. **(45 marks)**

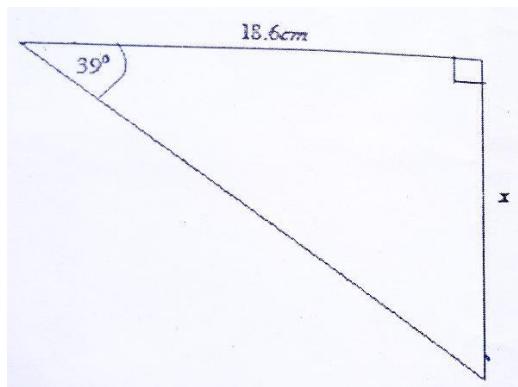
- 4) You may use mathematical instruments and a calculator **where necessary**.
- 5) Use a **blue or black ink pen only** to write your answers and a pencil to draw diagrams.
- 6) Show clearly all the working. **Marks will not be awarded for answers without all working steps.**

SECTION A: Attempt all questions.**(55 marks)**

1. Workout the value of $\frac{4r^2-t}{5}$ when $r = 3$ and $t = 1$ **(2 marks)**
2. When 110 is added to a certain number and the sum is divided by 3, the result is 4 times the original number. What is the original number? **(3 marks)**
3. Find the inverse of $g(x) = 2x^2 - 1$ **(4 marks)**
4. Solve the following equation in R
$$\frac{7+2x}{3} = \frac{7x+1}{4}$$
 (4 marks)
5. In the figure below calculate the value of angle x .



6. Solve the simultaneous equation using substitution method. **(4 marks)**
$$\begin{cases} y - 1 = 2x \\ 3y - 4x = 13 \end{cases}$$
7. Rationalize the following expression: $\frac{\sqrt{5}}{\sqrt{15} + \sqrt{10}}$ **(3 marks)**
8. In a right-angled triangle ABC, AD is the altitude from vertex A to the hypotenuse. If AD = 12cm and DC = 18cm, find the length named x of segment BD. **(4 marks)**
9. Calculate the length marked x in the triangle below: **(4 marks)**



10. Given that $(\begin{smallmatrix} x-8 \\ 2y+1 \end{smallmatrix})$ is a null vector, find the values of x and y . **(4 marks)**

11. Calculate an arithmetic mean of a Junior student's marks in five subjects:

Mathematics 20 marks;

Kinyarwanda 15 marks;

English 12 marks;

Chemistry 16 marks;

Physics 10 marks.

(4 marks)

12. Find the equation of the straight line passing through the points $(1, 2)$ and $(-2, 6)$ **(4 marks)**

13. Find the value of a in the following: $a^2 = 71_{nine}$ **(4 marks)**

14. If \vec{u} and \vec{v} are two vectors such that $\vec{u} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$ and $\vec{v} = \begin{pmatrix} -1 \\ 2 \end{pmatrix}$.

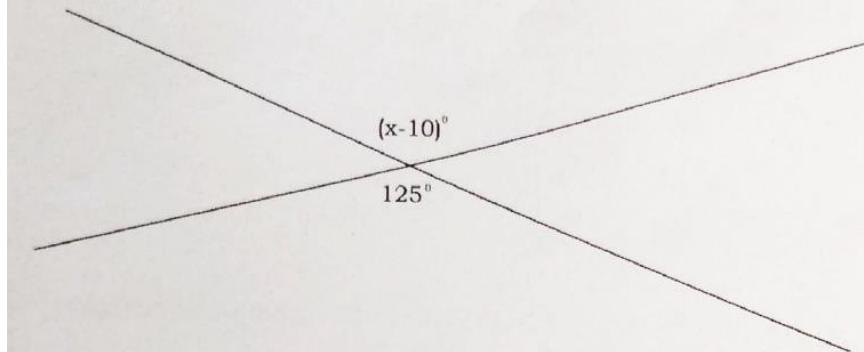
Find $-\vec{v} + 2\vec{u}$

(4 marks)

15. Observe the figure below and answer the following questions:

(a) Explain the relationship between angles in the figure. **(2 marks)**

(b) Find the value of x in the figure. **(2 marks)**



SECTION B: Attempt only three questions (45 marks)

16. (a) All the 240 students at a certain school learn Kinyarwanda or English or both. 150 learn Kinyarwanda and 120 learn English.

(i) How many students learn both languages? **(5 marks)**

(ii) How many students learn English only? **(3 marks)**

(iii) How many students learn Kinyarwanda only? **(3 marks)**

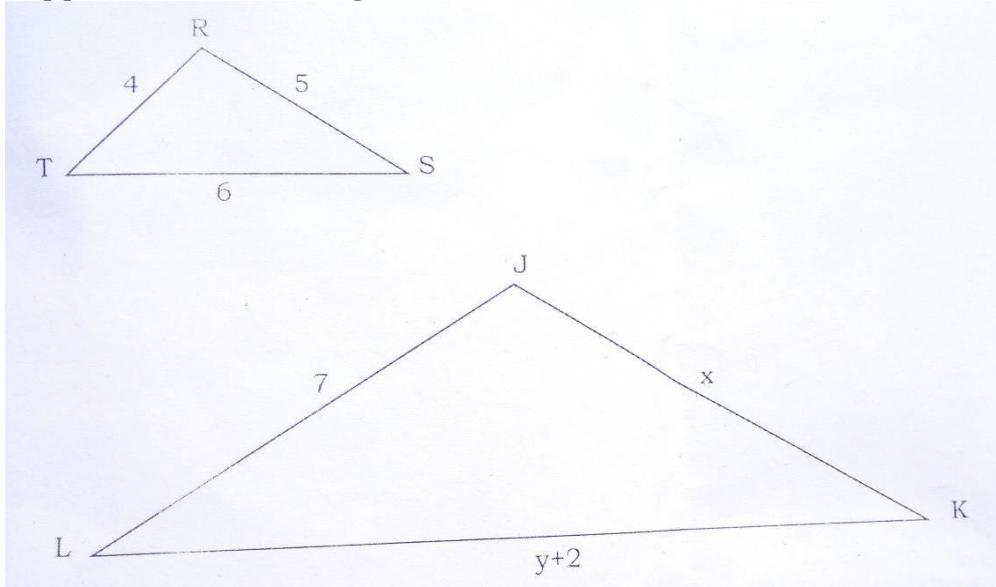
(b) An open cylinder has a radius of 1.4cm and a height of 30cm. Calculate its total surface area. **(4 marks)**

17. (a) A triangle ABC has vertices $A(0,0)$; $B(10,2)$ and $C(2,6)$.

Find the coordinates of the points A' , B' and C' , the images of A , B and C respectively, under a translation with displacement vector $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$. **(9 marks)**

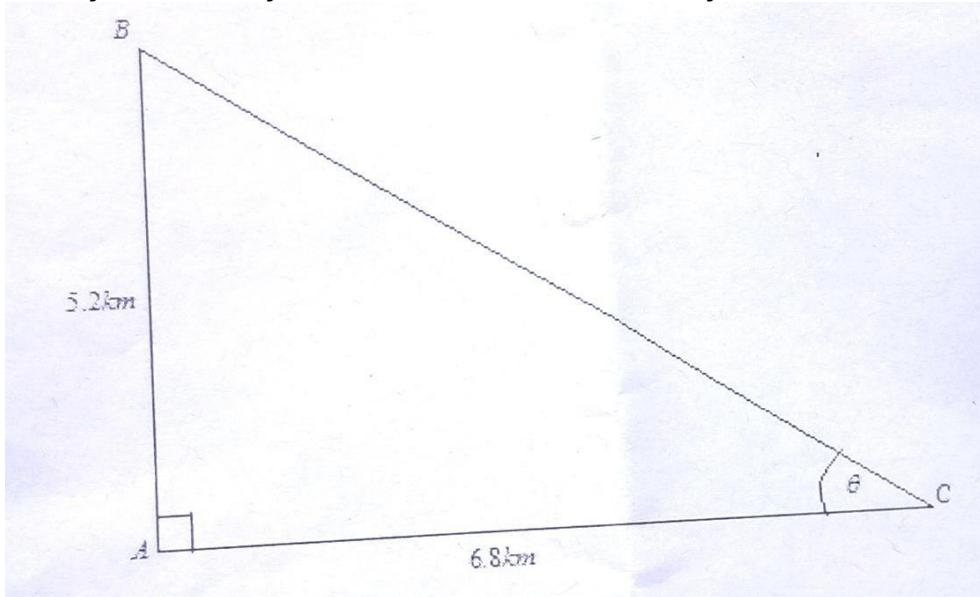
(b) Find the value of x in the equation $31_x - 17_x = 16_x$ **(6 marks)**

18. Suppose that two triangles below ΔRST and ΔJKL are similar.



- | | |
|--|------------------|
| (a) Find the value of x | (5 marks) |
| (b) Find the value of x | (5 marks) |
| (c) Determine the length of \overline{LK} (Give your answer in cm) | (3 marks) |
| (d) Determine the length of \overline{JK} (Give your answer in cm) | (2 marks) |

19. The diagram below shows three places: City A, City B and City C which are on the same horizontal plane. Suppose that City B is 5.2km due North of City A and City C is 6.8km due East of City A.



From this diagram answer the following questions:

- | | |
|--|------------------|
| (a) Calculate the distance from City C to City B.
(Give your correct answer to 1 decimal place) | (7 marks) |
| (b) Calculate the size of the angle marked θ in the diagram.
(Give your correct answer to 1 decimal place) | (8 marks) |

20. The data below shows the heights of students (in cm) at a certain school taken by a tailor in order to make their school uniform.

Height (in cm)	Frequency, f
150-154	5
155-159	2
160-164	6
165-169	8
170-174	9
175-179	11
180-184	8
185-189	3

(a) Complete the following table: (10 marks)

Height (in cm)	Midpoint, x	Frequency, f	fx	Cumulative frequency
150-154		5		
155-159		2		
160-164		6		
165-169		8		
170-174		9		
175-179		11		
180-184		8		
185-189		3		
		$\sum f =$	$\sum fx =$	

(b) Calculate the mean height. (2 marks)
 (c) Calculate the median class height. (2 marks)

(d) What is the modal class? Explain why.

(1 mark)

MARKING GUIDE OF ORDINARY LEVEL MATHEMATICS NATIONAL EXAMINATION 2020-2021

SECTION A: Answer all questions

1. $\frac{4r^2-t}{5} = \frac{4 \times 3^2 - 1}{4} = \frac{4 \times 9 - 1}{5} = \frac{36 - 1}{5} = \frac{35}{5} = 7$

2. Let x be the number

$$\frac{110+x}{3} = 4x$$

$$110 + x = 12x$$

$$12x - x = 110$$

$$11x = 110$$

$$x = \frac{110}{11}$$

$$x = 10$$

3. $g(x) = 2x^2 - 1$

$$y = 2x^2 - 1$$

$$x = 2y^2 - 1$$

$$x + 1 = 2y^2$$

$$\frac{x+1}{2} = y^2$$

$$y = \sqrt{\frac{x+1}{2}}$$

$$\text{Thus, } g^{-1}(x) = \sqrt{\frac{x+1}{2}}$$

4. $\frac{7+2x}{3} = \frac{7x+1}{4}$

$$4(7 + 2x) = 3(7x + 1)$$

$$28 + 8x = 21x + 3$$

$$8x - 21x = 3 - 28$$

$$-13x = -25$$

$$\frac{-13x}{-13} = \frac{-25}{-13}$$

$$x = \frac{25}{13}$$

5. $x^\circ + 40^\circ + 92^\circ = 180^\circ$

$$x^\circ + 132^\circ = 180^\circ$$

$$x^\circ = 180^\circ - 132^\circ$$

$$x^\circ = 48^\circ$$

6. $\begin{cases} y - 1 = 2x & (1) \\ 3y - 4x = 13 & (2) \end{cases}$

$$y = 2x + 1$$

Replace the value of y in the equation (2)

$$3(2x + 1) - 4x = 13 \quad (2)$$

$$6x + 3 - 4x = 13$$

$$2x + 3 = 13$$

$$2x = 13 - 3$$

$$2x = 10$$

$$x = \frac{10}{2}$$

$$\mathbf{x = 5}$$

Replace the value of x in the equation (1)

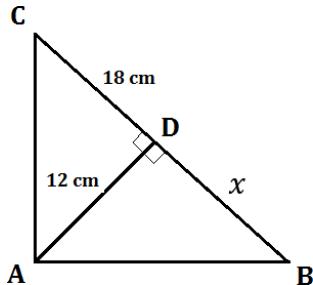
$$y - 1 = 2 \times 5$$

$$y = 10 + 1$$

$$\mathbf{y = 11}$$

7.
$$\begin{aligned} \frac{\sqrt{5}}{\sqrt{15}+\sqrt{10}} &= \frac{(\sqrt{5})(\sqrt{15}-\sqrt{10})}{(\sqrt{15}+\sqrt{10})(\sqrt{15}-\sqrt{10})} = \frac{(\sqrt{75}-\sqrt{50})}{15-10} = \frac{\sqrt{25 \times 3} - \sqrt{25 \times 2}}{5} \\ &= \frac{5\sqrt{3}-5\sqrt{2}}{5} = \frac{5(\sqrt{3}-\sqrt{2})}{5} = \sqrt{3} - \sqrt{2} \end{aligned}$$

8.



$$\frac{AD}{DC} = \frac{BD}{AD}$$

$$AD^2 = DC \times BD$$

$$AD = \sqrt{DC \times BD}$$

$$12^2 = x \times 18$$

$$144 = 18x$$

$$x = \frac{144}{18}$$

$$x = 8\text{cm}$$

$$9. \tan 39^\circ = \frac{x}{18.6 \text{ cm}}$$

$$x = 18.6 \text{ cm} \times \tan 39^\circ$$

$$x = 15.1 \text{ cm}$$

$$10. \binom{x-8}{2y+1} = \binom{0}{0}$$

$$x - 8 = 0$$

$$x = 8$$

$$2y + 1 = 0$$

$$2y = -1$$

$$y = -\frac{1}{2}$$

$$11. Mean = \frac{20+15+12+16+10}{5} = \frac{73}{5} = 14.6$$

$$12. \frac{y-y_1}{x-x_1} = \frac{y_2-y_1}{x_2-x_1}$$

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

$$\frac{y-2}{x-1} = \frac{4}{-3}$$

$$-3(y-2) = 4(x-1)$$

$$-3y + 6 = 4x - 4$$

$$-3y = 4x - 4 - 6 - 3y = 4x - 10$$

$$y = -\frac{4}{3}x + \frac{10}{3}$$

$$13. a^2 = (7 \times 9^1) + (1 \times 9^0) = 63 + 1 = 64$$

$$a^2 = 64 = 8^2$$

$$a^2 = 8^2$$

$$a = 8$$

$$14. u^{\rightarrow} = \binom{2}{-3} \text{ and } v^{\rightarrow} = \binom{-1}{2}$$

$$-v^{\rightarrow} + 2u^{\rightarrow} = -(-1) + 2(2) = (1) + (4) = (5)$$

15. (a) They are vertically opposite angles.

(b) $x - 10^\circ = 125^\circ$

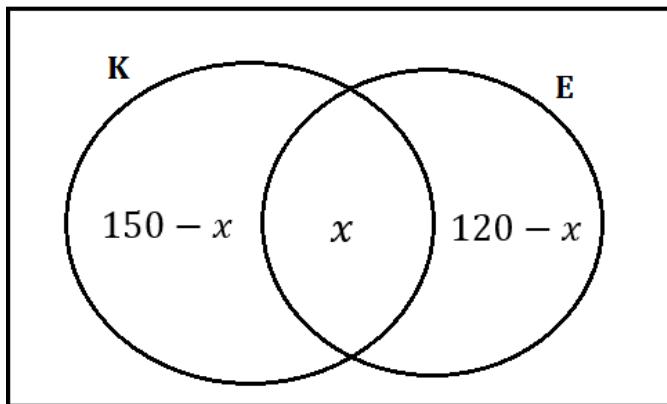
$$x = 125^\circ + 10^\circ$$

$$x = 135^\circ$$

SECTION B: Attempt only three questions (45 marks)

16. (a)

240 students



$$150 - x + x + 120 - x = 240$$

$$150 + 120 - x = 240$$

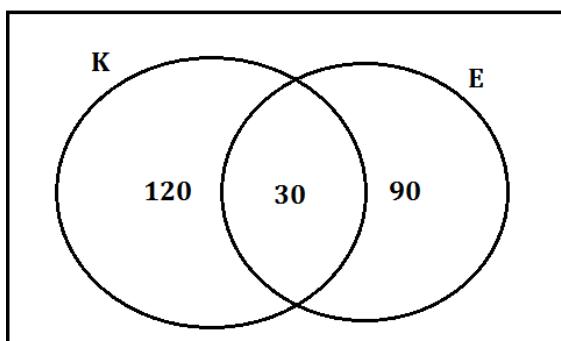
$$270 - x = 240$$

$$-x = 240 - 270$$

$$-x = -30$$

$$x = 30$$

240 students

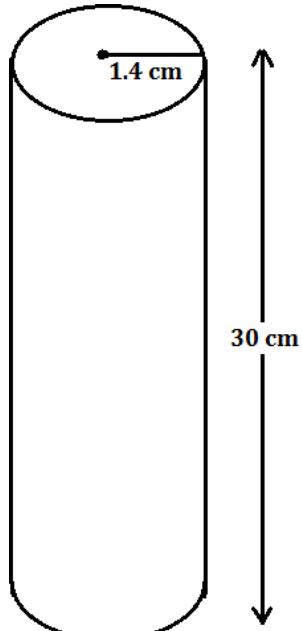


(i) Students who learn both languages = 30

(ii) Students who learn English only = 90

(iii) Students who learn Kinyarwanda = 120

(b)



$$SB = \pi r^2 = \frac{22}{7} \times 1.4^2 = 6.16 \text{ cm}^2$$

$$LS = 2\pi rh = 2 \times \frac{22}{7} \times 1.4 \times 30 = 264 \text{ cm}^2$$

$$TS = 6.16 \text{ cm}^2 + 264 \text{ cm}^2 = 270.16 \text{ cm}^2$$

17. a) A(0,0); B(10,2) and C(2,6). v^3 (2)

$A' (0+2, 0+3), B'(10+2, 2+3)$ and $C'(2+2, 6+3)$

$A'(2, 3), B'(12, 5)$ and $C'(4, 9)$

b) $31x - 17x = 16x$

$$3x + 1 - x - 7 = x + 6$$

$$3x - x - x = 6 + 7 - 1$$

$$x = 12$$

18. a) $\frac{4}{7} = \frac{5}{x}$

$$4x = 7 \times 5$$

$$x = \frac{7 \times 5}{4} = \frac{35}{4} = 8.75$$

b) $\frac{4}{7} = \frac{6}{y+2}$ $4(y+2) = 7 \times 6$

$$4y + 8 = 42$$

$$4y = 42 - 8$$

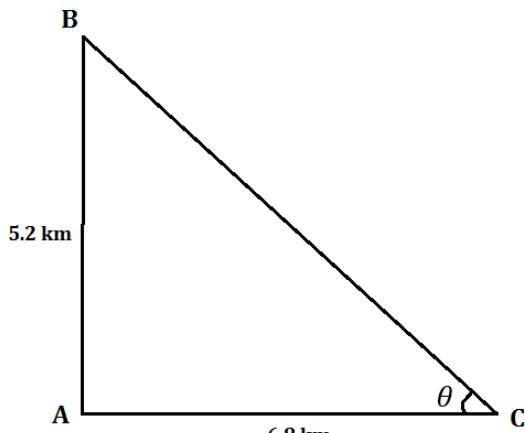
$$4y = 34$$

$$y = 8.5$$

c) $\overline{LK} = y + 2 = 8.5 + 2 = 10.5 \text{ cm}$

d) $\overline{JK} = x = 8.5 \text{ cm}$

19.



$$\overline{BC}^2 = \overline{AC}^2 + \overline{AB}^2 = (6.8)^2 + (5.2)^2 = 46.24 + 27.04 = 73.28 \text{ km}^2$$

$$\overline{BC} = \sqrt{73.28 \text{ km}^2} = 8.56 \text{ km}$$

b) $\tan \theta = \frac{5.2 \text{ km}}{6.8 \text{ km}} = 0.7647$

$$\theta = \tan^{-1}(0.7647) = 37.4^\circ$$

20. (a)

Height (in cm)	Midpoint, x	Frequency, f	fx	Cumulative frequency
150-154	152	5	760	5
155-159	157	2	314	7
160-164	162	6	972	13
165-169	167	8	1336	21
170-174	172	9	1548	30
175-179	177	11	1947	41
180-184	182	8	1092	47
185-189	187	3	561	50

		$\sum f = 50$	$\sum fx$ = 8530	
--	--	---------------	---------------------	--

$$(b) \text{ Mean} = \frac{\sum f_i x_i}{\sum f_i} = \frac{8530}{50} = 170.6 \text{ cm}$$

(c) The median class is the class whose cumulative frequency is the least cumulative frequency greater than $\frac{\sum f_i}{2} = \frac{50}{2} = 25$
The median class height is **170 - 174** with **cumulative frequency = 30**.

(d) The modal class is the class with the highest frequency. It is **175 - 179**

Mathematics I

010

25/07/2023 8:30 AM – 11.30 AM



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2022-2023

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 if provided.
- 2) Do not open this paper until you are told to do so.
- 3) This paper has **TWO** sections: **A** and **B**.

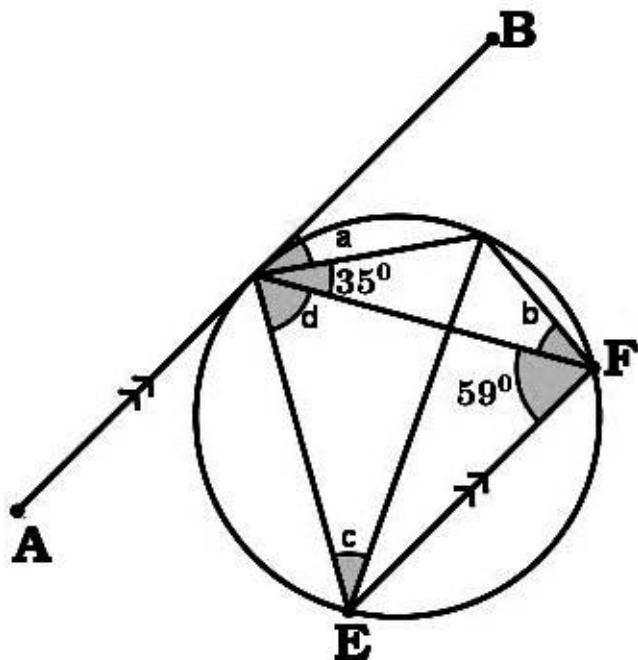
SECTION A: Attempt **ALL** questions. **(55 marks)**

SECTION B: Attempt **ONLY THREE** questions. **(45 marks)**

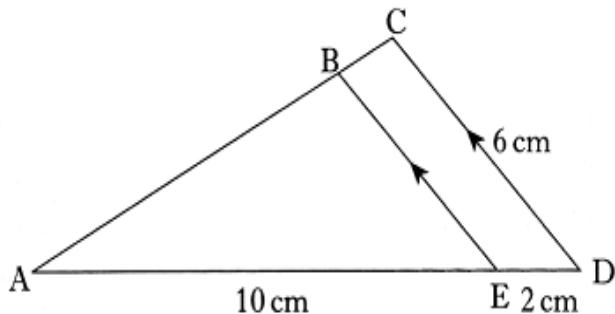
- 4) You may use mathematical instruments and a calculator **where necessary**.
- 5) Use a **blue or black ink pen only** to write your answers and a **pencil** to draw diagrams.
- 6) Show clearly all the working steps. **Marks will not be awarded for the answer without all working steps.**

SECTION A: ATTEMPT ALL QUESTIONS (55 marks)

- 1) Without using a calculator, evaluate : $7.2 \times (3.75^2 - 1.25^2)$ **(3 marks)**
- 2) Simplify $\frac{x^2 - 4x + 4}{x^2 - 4}$ **(3 marks)**
- 3) Rationalize the denominator of the expression $\frac{5}{\sqrt{3} - \sqrt{2}}$ **(3 marks)**
- 4) Given the vector $\vec{u} = \begin{pmatrix} 5 \\ 3 \end{pmatrix}$ and $\vec{v} = \begin{pmatrix} -7 \\ -13 \end{pmatrix}$, find the components of:
- $\frac{1}{2}(\vec{u} + \vec{v})$ **(2 marks)**
 - $4\vec{u} - \vec{v}$ **(3 marks)**
- 5) Solve for x in the equation $4x - \frac{3x+1}{2} - \frac{7x+9}{3} = 0$ **(5 marks)**
- 6) Solve the following system by elimination method :
- $$\begin{cases} 3x - 6y = 24 \\ 5x + 4y = 12 \end{cases}$$
- (4 marks)**
- 7) Find the value of the polynomial $\frac{5}{6}p^2q - 2p + q - 4r$ if $p = 12$, $q = 7$ and $r = 9$ **(3 marks)**
- 8) In the diagram below, the segments AB and EF are parallel. Find the angles marked by letters **a**, **b**, **c** and **d**. **(4 marks)**

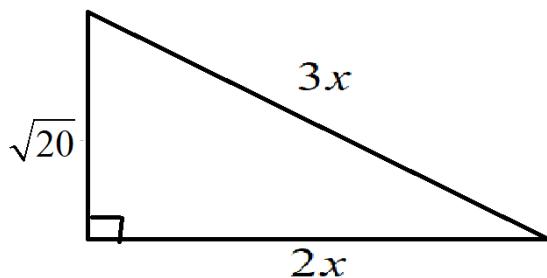


- 9) In the diagram shown below, the lines BE and CD are parallel.



Calculate the length of BE **(3 marks)**

- 10) Given that $235_x = 95_{10}$. Find the value of x . **(4 marks)**
- 11) If 720,000 FRW is invested for 9 months at an annual simple interest rate of 15%.
- How much interest will be earned? **(2 marks)**
 - What is the amount of investment after 9 months? **(2 marks)**
- 12) Find the value of x in the triangle below.



(3 marks)

- 13) State the formula of probability for:
- Mutually exclusive events. **(1 mark)**
 - Independent events. **(1 mark)**
- 14) The sum of three consecutive integers is 21. Find the integers. **(5 marks)**
- 15) Given the functions $f(x) = 5x$ and $g(x) = 2x - 2$,

Find:

- $fog(x)$ **(2 marks)**
- $gof(x)$ **(2 marks)**

SECTION B: ATTEMPT THREE QUESTIONS ONLY (45 marks)

16) The table below shows the marks obtained by students of senior 3 in a certain school.

70	62	55	40	90
68	70	64	68	62
64	40	68	79	62
62	64	90	55	98
55	68	62	64	62

- a) Construct a frequency table. **(6 marks)**
- b) Find the median mark. **(3 marks)**
- c) Find the mode mark. **(3 marks)**
- d) Find the mean mark. **(3 marks)**

17) The expression $P(x) = 2x^3 + ax^2 + bx + 6$ is exactly divisible by $x - 2$, and on division by $x + 1$ gives a remainder of -12 .

- a) Calculate the values of a and b. **(8 marks)**
- b) Factorize completely the expression $P(x)$. **(4 marks)**
- c) Hence solve the equation $P(x) = 0$ **(3 marks)**

18) In a certain school there are 87 students in S3. 43 of these play tennis, 42 play football, 47 play volleyball, 15 play tennis and volleyball, 17 play volleyball and football, 21 play tennis and football. Each student plays at least one of the three games.

- a) Represent this information in a venn diagram. **(9 marks)**
- b) Find the number of students who play all the three games. **(4 marks)**
- c) Find the number of students who play two of these games only. **(2 marks)**

19) The points A(-5, 3.5), B(1, 0.5) and C(-6, -6) are the vertices of a triangle.

- a) Find the lengths of AB, AC and BC. **(6 marks)**
- b) Show that ABC is an isosceles triangle. **(4 marks)**
- c) Find the midpoint, P, of AB. **(3 marks)**
- d) Find the length of PC. **(2 marks)**

20) A(2, 4), B(6, 4) and C(7, 2) are the vertices of a triangle. Find the image of the triangle under reflection in the line:

(15 marks)

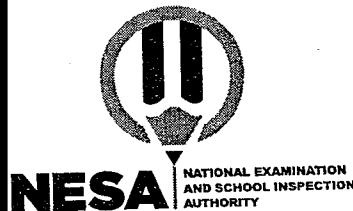
- a) x-axis, labelling them as A' B' C'.
- b) y-axis, labelling them as A'' B'' C''.
- c) Write down the coordinates for each image.

----- END -----

Mathematics

PM

18/07/ 2022 09: 00-11: 00 AM



Pupil's complete index number

Province/ City	District	Sector	School	Level	Pupil	Year
<input type="text"/>						

Pupil's names

Surname:.....

Other names:.....

NB: PUPIL'S INDEX NUMBER AND NAMES
MUST BE WRITTEN AS THEY APPEAR ON THE
REGISTRATION FORM

PRIMARY LEAVING NATIONAL EXAMINATIONS, 2021-2022 MATHEMATICS

Duration: Two hours

Marks: /100

INSTRUCTIONS

- 1 Do not open this question paper until you are told to do so.
- 2 Attempt **ALL** questions in this paper.
- 3 Read each question carefully before answering it.
- 4 Answer the questions in the space provided on this question paper.
- 5 Show your working clearly. Marks will be given for showing steps.
All rough work must be done in the space under each question.
- 6 You must use a **blue** or **black** pen.
- 7 You are allowed to use a ruler, and a protractor.
- 8 **You are NOT allowed to use a calculator.**

ATTEMPT ALL QUESTIONS IN THIS PAPER (100 marks)

Do rough work below each question	Show the working steps and final answer in this column
1) Write the following number in figures: Nine million nine thousand eighty seven. (2 marks)	
2) Write the place value of digits 7 and 1 in the number 180,493.27 (2 marks)	
3) Arrange the following numbers from the lowest to the highest $\frac{2}{3}$; -1; 0.5 ; 100;-100;0.82;-1; 5 (2 marks)	
4) Convert 432,000sec=....days ...hours (2 marks)	
5) Find the next two numbers in the following sequence 3; 9; 27; 81;; (2 marks)	
6) Use the divisibility test method to check if 23,760 is divisible by 11. (2 marks)	
7) Solve $4x - 8 = 10x - 20$ (2 marks)	
8) Workout $\frac{3}{4}x\left(\frac{2}{5} + \frac{3}{7}\right) =$ (2 marks)	

9) Calculate $4.5\text{kg} + 113\text{dag} = \dots \text{kg}$ (2 marks)	
10) 4 % of the learners in P5 are boys. If there are 45 boys in the class, how many learners are in the class? (2 marks)	
11) Simplify $\frac{\sqrt{225} + \sqrt{169}}{\sqrt{16}} =$ (2 marks)	
12) Calculate the sum of 524,321 and 17,674,329. (2 marks)	
13) One Mathematics book costs 5,200Frw. How much do 8 similar books cost? (2 marks)	
14) Multiply 896,327 by 121. (2 marks)	

15) Use quick multiplication to calculate $625 \times 99 =$	(2 marks)
16) Workout the following without using a number line a) $(-6) + (+2) =$ b) $(+12) \times (-8) =$	(1 mark) (1 mark)
17) Find the greatest common Factor (GCF) of 24; 36 and 40.	(2 marks)
18) A class has 56 pupils. There are 14 boys in the class. Find the ratio of boys to girls in the class.	(2 marks)

19) Gakire has 12 notes of 2,000Frw, 20 notes of 5,000Frw, 15 notes of 500Frw and 10 coins of 100Frw. Calculate the total amount of money that Gakire has.

(2 marks)

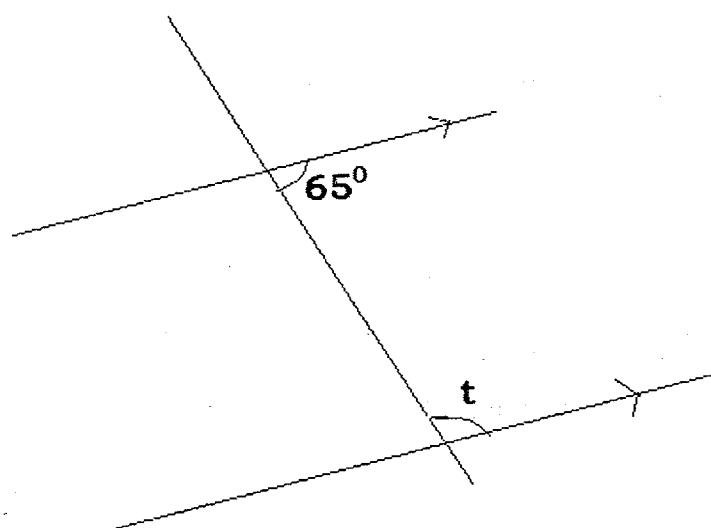
20) Round off 4,620,850 to the nearest hundred thousands.

(2 marks)

21) Simplify $5^6 \times 5^2 \div 5^3 =$

(2 marks)

- 22) Find the size of angle t in the figure below.
(2 marks)



- 23) Convert $\frac{10}{16}$ into a decimal number.
(2 marks)

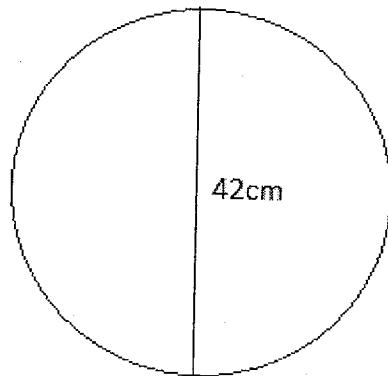
- 24) During COVID-19 Lockdown, a certain cell volunteers distributed equally 7,827,831 kg of beans among 333 families. How many kilograms did each family get? **(2 marks)**

25) Use measurement table to convert the following:

a) $26dm^3 = \dots \dots hg$ (1 mark)

b) $9,700\ell = \dots \dots m^3$ (1 mark)

26) Calculate the circumference of the figure below
(use $\pi = \frac{22}{7}$) (3 marks)

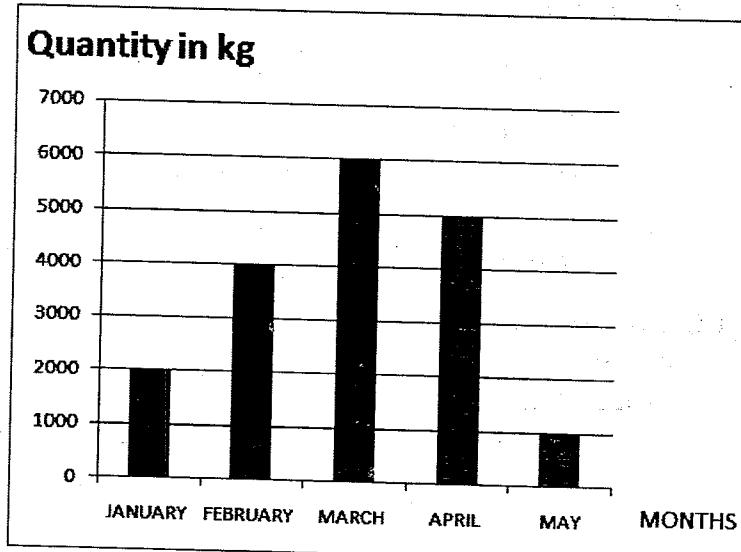


27) Electric poles are fixed 20 metres apart. Find the distance from the first to 101th pole.

(3 marks)

<p>28) A man covered 120 km of a journey. This is only $\frac{3}{4}$ of the whole journey. Calculate the total distance covered for the whole journey. (3 marks)</p>	
<p>29) A trader bought a Radio at 950,000 Frw. He later sold it to a customer at 1,250,000Frw. What was his percentage profit? (3 marks)</p>	
<p>30) The LCM of two numbers is 40. One of the numbers is 20. If their GCF is 5, find the second number. (3 marks)</p>	
<p>31) (a) The area of a rectangular table is $160m^2$. If its width is 8m. Find the length of the table. (3 marks)</p> <p>(b) A wooden box has a volume of $9,000,000cm^3$. If Its length is 2 m and width 1.5 m.</p> <p>(i) Find its area. (2 marks)</p> <p>(ii) Find its height. (2 marks)</p>	

32) Study the graph below which shows the potatoes in kg sold at a shop in 5 months and answer the questions that follow.



- (a) In which month did the shopkeeper sell the highest quantity of potatoes? **(1 mark)**
- (b) In which month did the shopkeeper sell the smallest quantity of potatoes? **(1 mark)**
- (c) Find the total kilograms of potatoes sold in all the five months **(2 marks)**
- (d) If one kg of potatoes costs 550Frw, how much money did the shopkeeper get from the sale of potatoes in all five months? **(3 marks)**

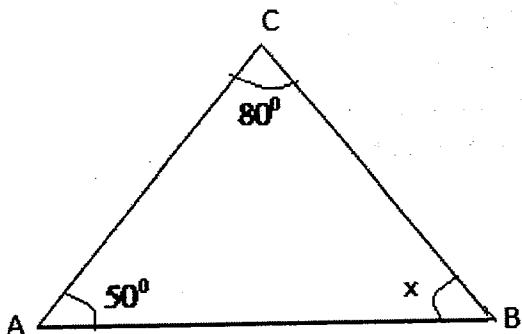
33) A P6 pupil was sent to the market with 30,000frw to buy the items shown in the table below.

a) Complete the table.

(5 marks)

Items	Price/cost per item	Total amount
3kg of beans /Kg	3,000frw
6kg of sugar	1,500frw/kg
5kg of meat	... /Kg	15,000frw
..... Loaves of bread	800frw/loaf	2,400frw
Total expenditure	 Frw
b) Find the balance		(2 marks)
Balance	Frw

34) (a) Find the value of angle x in the triangle CAB below. (3 marks)



(b) Two Vehicles A and B moved towards each other. They started moving at 9:00 am and met at 11:00 am. Their speeds were 60 km/hr and 55 km/hr respectively. What distance had each covered by the time they met? **(4 marks)**

35) (a) By using the following digits 8; 0; 5; 7; 1; 6. Write the biggest whole number formed by these digits. **(2 marks)**

(b) A businesswoman has 300 kg/600kg of mixed beans which she sells at 280Frw/kg. If the mixture contains 200kg of the first type which cost 360Frw/kg. Find the price of one kg of the second type. **(5 marks)**

END

Mathematics I
010
20/07/2021 08.30 AM – 11.30 AM



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2020-2021

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 paper until you are told to do so.
- 3) This paper consists of **TWO** sections **A** and **B**.

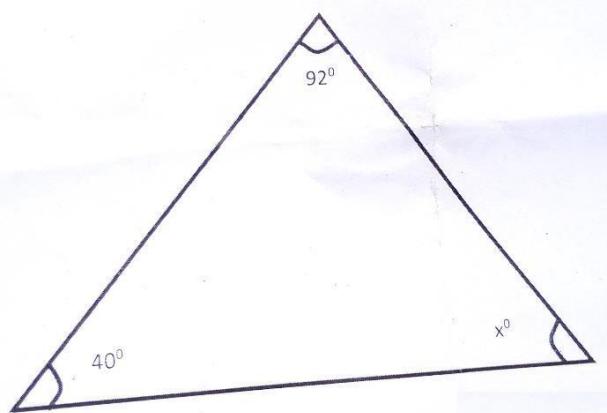
SECTION A: Attempt **ALL** questions **(55 marks)**

SECTION B: Answer any **THREE** questions. **(45 marks)**

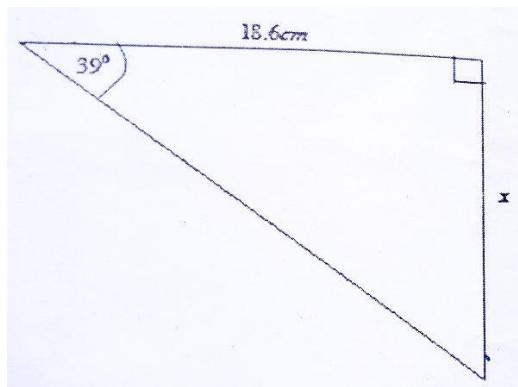
- 4) You may use mathematical instruments and a calculator **where necessary**.
- 5) Use a **blue or black ink pen only** to write your answers and a pencil to draw diagrams.
- 6) Show clearly all the working. **Marks will not be awarded for answers without all working steps.**

SECTION A: Attempt all questions.**(55 marks)**

1. Workout the value of $\frac{4r^2-t}{5}$ when $r = 3$ and $t = 1$ **(2 marks)**
2. When 110 is added to a certain number and the sum is divided by 3, the result is 4 times the original number. What is the original number? **(3 marks)**
3. Find the inverse of $g(x) = 2x^2 - 1$ **(4 marks)**
4. Solve the following equation in R
$$\frac{7+2x}{3} = \frac{7x+1}{4}$$
 (4 marks)
5. In the figure below calculate the value of angle x .



6. Solve the simultaneous equation using substitution method. **(4 marks)**
$$\begin{cases} y - 1 = 2x \\ 3y - 4x = 13 \end{cases}$$
7. Rationalize the following expression: $\frac{\sqrt{5}}{\sqrt{15} + \sqrt{10}}$ **(3 marks)**
8. In a right-angled triangle ABC, AD is the altitude from vertex A to the hypotenuse. If AD = 12cm and DC = 18cm, find the length named x of segment BD. **(4 marks)**
9. Calculate the length marked x in the triangle below: **(4 marks)**



10. Given that $(\begin{smallmatrix} x-8 \\ 2y+1 \end{smallmatrix})$ is a null vector, find the values of x and y . **(4 marks)**

11. Calculate an arithmetic mean of a Junior student's marks in five subjects:

Mathematics 20 marks;

Kinyarwanda 15 marks;

English 12 marks;

Chemistry 16 marks;

Physics 10 marks.

(4 marks)

12. Find the equation of the straight line passing through the points $(1, 2)$ and $(-2, 6)$ **(4 marks)**

13. Find the value of a in the following: $a^2 = 71_{nine}$ **(4 marks)**

14. If \vec{u} and \vec{v} are two vectors such that $\vec{u} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$ and $\vec{v} = \begin{pmatrix} -1 \\ 2 \end{pmatrix}$.

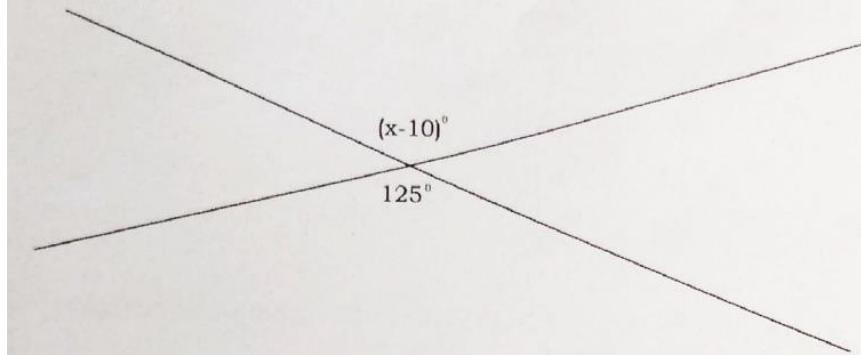
Find $-\vec{v} + 2\vec{u}$

(4 marks)

15. Observe the figure below and answer the following questions:

(a) Explain the relationship between angles in the figure. **(2 marks)**

(b) Find the value of x in the figure. **(2 marks)**



SECTION B: Attempt only three questions (45 marks)

16. (a) All the 240 students at a certain school learn Kinyarwanda or English or both. 150 learn Kinyarwanda and 120 learn English.

(i) How many students learn both languages? **(5 marks)**

(ii) How many students learn English only? **(3 marks)**

(iii) How many students learn Kinyarwanda only? **(3 marks)**

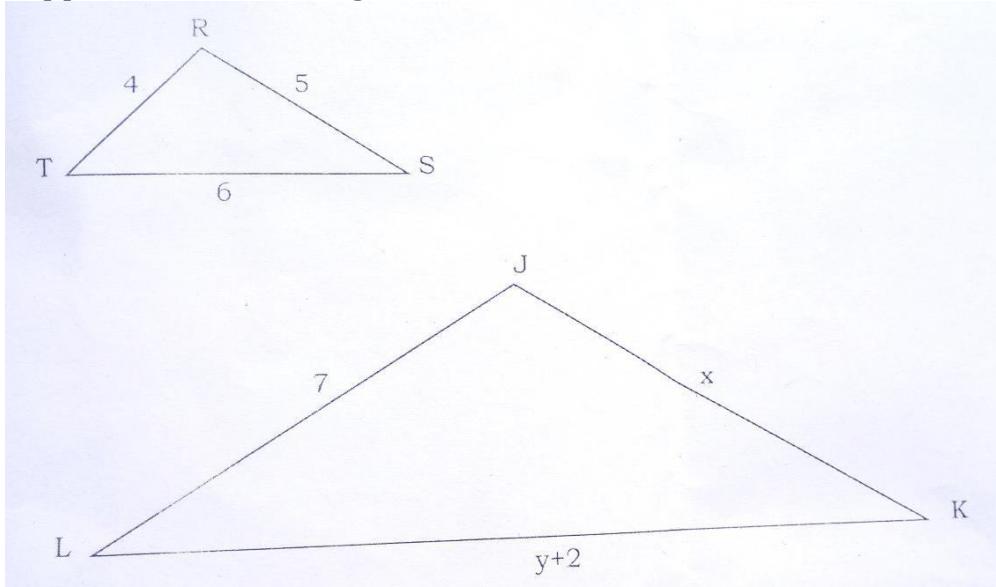
(b) An open cylinder has a radius of 1.4cm and a height of 30cm. Calculate its total surface area. **(4 marks)**

17. (a) A triangle ABC has vertices $A(0,0)$; $B(10,2)$ and $C(2,6)$.

Find the coordinates of the points A' , B' and C' , the images of A , B and C respectively, under a translation with displacement vector $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$. **(9 marks)**

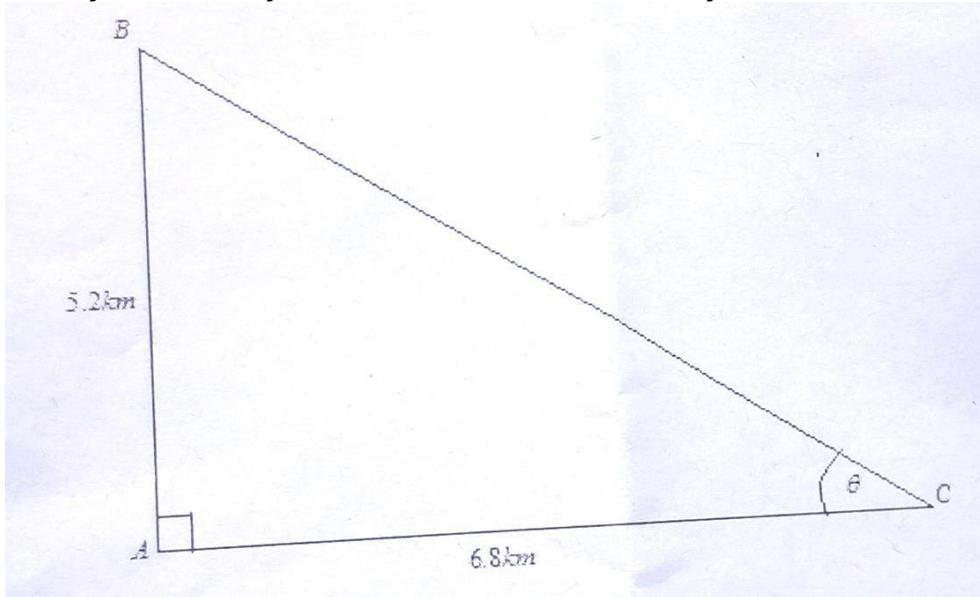
(b) Find the value of x in the equation $31_x - 17_x = 16_x$ **(6 marks)**

18. Suppose that two triangles below ΔRST and ΔJKL are similar.



- | | |
|--|------------------|
| (a) Find the value of x | (5 marks) |
| (b) Find the value of x | (5 marks) |
| (c) Determine the length of \overline{LK} (Give your answer in cm) | (3 marks) |
| (d) Determine the length of \overline{JK} (Give your answer in cm) | (2 marks) |

19. The diagram below shows three places: City A, City B and City C which are on the same horizontal plane. Suppose that City B is 5.2km due North of City A and City C is 6.8km due East of City A.



From this diagram answer the following questions:

- | | |
|--|------------------|
| (a) Calculate the distance from City C to City B.
(Give your correct answer to 1 decimal place) | (7 marks) |
| (b) Calculate the size of the angle marked θ in the diagram.
(Give your correct answer to 1 decimal place) | (8 marks) |

20. The data below shows the heights of students (in cm) at a certain school taken by a tailor in order to make their school uniform.

Height (in cm)	Frequency, f
150-154	5
155-159	2
160-164	6
165-169	8
170-174	9
175-179	11
180-184	8
185-189	3

(a) Complete the following table: (10 marks)

Height (in cm)	Midpoint, x	Frequency, f	fx	Cumulative frequency
150-154		5		
155-159		2		
160-164		6		
165-169		8		
170-174		9		
175-179		11		
180-184		8		
185-189		3		
		$\sum f =$	$\sum fx =$	

(b) Calculate the mean height. (2 marks)
 (c) Calculate the median class height. (2 marks)

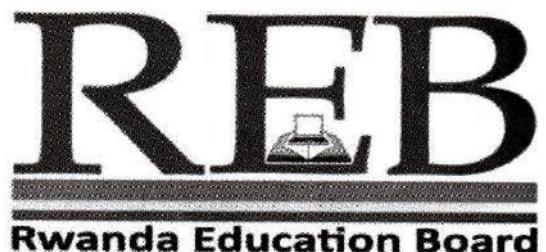
(d) What is the modal class? Explain why.

(1 mark)

Mathematics I

010

12/11/2019 08.30 AM – 11.30 AM



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2019

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 paper until you are told to do so.
- 3) This paper consists of **TWO** sections **A** and **B**.

SECTION A: Attempt **ALL** questions **(55 marks)**

SECTION B: Answer any **THREE** questions. **(45 marks)**

- 4) You may use mathematical instruments and calculators **where necessary**.
- 5) Use a blue ink pen only to write your answers and a pencil to draw diagrams.
- 6) Show clearly all the working. **Marks will not be awarded for answers without all working steps.**

SECTION A: Attempt all questions. (55 marks)

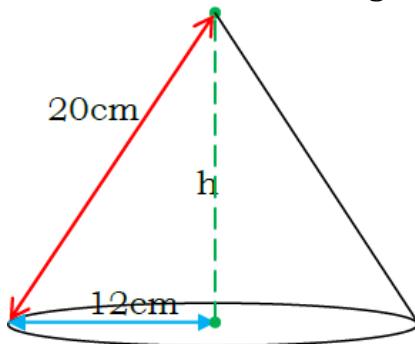
1. Simplify the following: (3 marks)

$$\frac{2}{\sqrt{3}+2} + \frac{\sqrt{5}}{\sqrt{3}-2}$$

2. Solve in IR: (4 marks)

$$\begin{cases} 3x - y = 4 \\ -3y + 2x = -9 \end{cases}$$

3. Determine the volume of the following diagram (use $\pi = 3.14$) (4 marks)



4. If set A has 256 subsets, how many elements are there in the set A? (2 marks)

5. If two functions $f(x)$ and $g(x)$ are defined as follow:

$$\begin{aligned} f: x \rightarrow R: f(x) &= \sqrt{x+1} \text{ and} \\ g: R \rightarrow R': g(x) &= \frac{1}{x^2} \end{aligned}$$

Calculate a) $gof(x)$ (2 marks)
b) $fog(x)$ (2 marks)

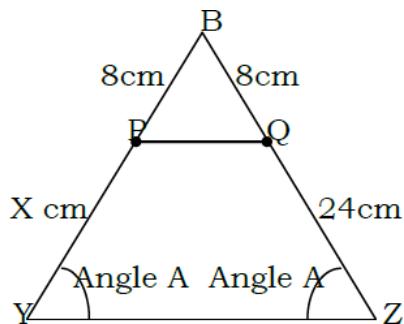
6. A business woman has deposited 3,500,000FRW in a bank for two years at a compound interest rate of 10% per year. Calculate the total amount she will receive after 2 years. (4 marks)

7. Solve in R: $(3^{2x})(9^{x-1}) = 81$ (3 marks)

8. The length of a rectangular garden is twice its width. If the perimeter is 72 meters;

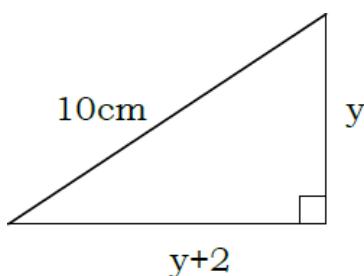
- i) Find the length and the width of the garden. (2 marks)
ii) Find the area of the garden. (1 mark)

9. Study the figure below. Find the value of X. (4 marks)



10. Seats for Mathematics, Physics and Biology in a school are in the ratio 5: 7: 8. There is a proposal to increase these seats by 40%, 50% and 75% respectively. What will be the ratio of increased seats? **(4 marks)**

11. a) Solve for y in the figure below. **(3 marks)**
 b) Find the perimeter of the figure. **(1 mark)**

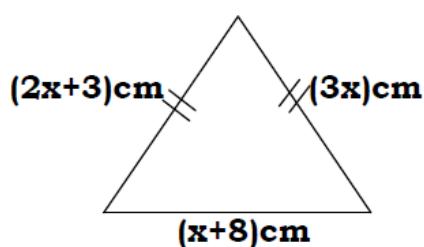


12. a) Change 703_8 to base six.
 b) The following figure represents the diagram of a scooter. Use it to answer the questions below:



If the diagram of the scooter is drawn to a scale of 1:20, find the actual length of the scooter. **(2 marks)**

13. Study the figure below and answer the following questions:

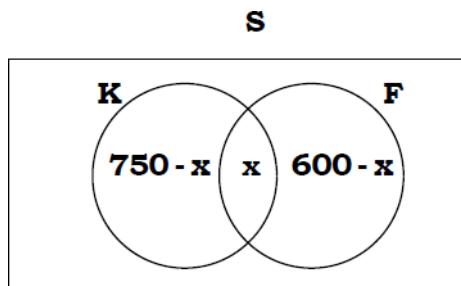


- a) Find the value of x . **(2 marks)**
 b) What is the length of each side of the triangle? **(1 mark)**

c) Find the perimeter of the figure.

(1 mark)

14. All 1200 students (**S**) at a certain school lean Kinyarwanda (**K**), French (**F**) or both. Using the following Venn diagram,



- a) Calculate the number of students who learn both languages. **(2 marks)**
 - b) Calculate the number of students who learn Kinyarwanda only. **(1 mark)**
 - c) Calculate the number of students who learn French only. **(1 mark)**
15. It is given that vectors $\vec{a} = \begin{pmatrix} 6 \\ 8 \end{pmatrix}$, $\vec{b} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$ and $\vec{c} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$
- i) Find $2(\vec{a} + \vec{b} - \vec{c})$
 - ii) Determine the value of $|\vec{a}| + |\vec{b}|$

SECTION B: Attempt only three questions (45 marks)

16. A primary school had 1200 students enrolled in 2013 and 1500 students in 2016. If the student population P grows as a linear function of time t, where t is the number of years after 2013.
- a) How many students will be enrolled in the school in 2020? **(9 marks)**
 - b) Find a linear function that relates the student population to the time t. **(6 marks)**

- 17.a) The cost of producing X tools by a company is given by the function $C(x) = 1200x + 5500$ in FRW

- i) What is the cost of 100 tools? **(2 marks)**
 - ii) What is the cost of 101 tools? **(2 marks)**
 - iii) Find the difference between the cost of 101 and 100 tools? **(3 marks)**
 - iv) Find the slope of the graph. **(2 marks)**
 - v) Interpret the slope. **(3 marks)**
- b) Given $f(x) = 2x^2 + 4x - 3$,
find $f(2a + 3)$ **(3 marks)**

- 18.a) Out of 34 students in a class, 20 did Kinyarwanda Test and 18 did French test. The number of students who did both tests is twice that of those who did none of the tests.

Using a Venn diagram, find the number of students who did:

- i) Tests for both subject. **(2 marks)**
- ii) None of the subject tests. **(2 marks)**
- iii) Only one test of a subject. **(2 marks)**

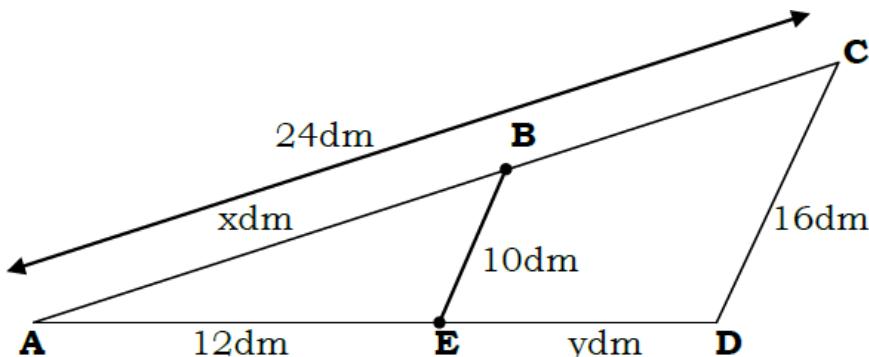
b) If f is the function defined in $R \rightarrow R: f(x) = 2x^2 + 1$, find the inverse of the function f . **(3 marks)**

c) Given the points A (-1, 3) and B (-2, 5)

i) Calculate the slope of the line passing through the points A and B. **(2 marks)**

ii) Find the equation of the line that passes through the points A and B. **(4 marks)**

19. a) Study the figure below then find the value of x and y . **(6 marks)**



b) Consider the points A (5, 2), B (3, -1) and C (7, 3).

Find

i) BA and BC **(4 marks)**

ii) Show if BA and BC are orthogonal. **(2 marks)**

Explain your answer. **(1 mark)**

c) Find the value of $a^\rightarrow = (1, 7)$ and b^\rightarrow if a^\rightarrow and b^\rightarrow are orthogonal. **(2 marks)**

20. The following data represent the marks of 53 students in a chemistry test

18	20	20	20	20	21	20	17	19	20
13	18	22	26	20	19	22	15	18	27
16	23	24	17	25	24	16	20	26	15
21	17	23	16	21	17	26	16	23	19

- i) Construct a grouped frequency distribution table with 5 classes by completing the table below: **(8 marks)**

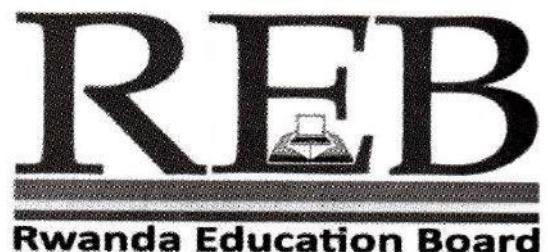
Mark classes	Midpoint	Frequency	f(x)	Cumulative frequency
13-15	14	3		
16-				
25-27		5		
		$\sum f =$	$\sum fx =$	

- ii) How many students did the chemistry test? **(1 mark)**
 iii) Calculate the mean mark? **(2 marks)**
 What is the modal class of the distribution? Explain your answer. **(2 marks)**
 v) Determine the median of the distribution. **(2 marks)**

MATHEMATICS I

010

20/11/2018 08.30 AM – 11.30 AM



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2018

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 paper until you are told to do so.
- 3) This paper consists of **TWO** sections **A** and **B**.

SECTION A: Attempt **ALL** questions **(55 marks)**

SECTION B: Answer any **THREE** questions. **(45 marks)**

- 4) You may use mathematical instruments and calculators **where necessary**.
- 5) Use a blue ink pen only to write your answers and a pencil to draw diagrams.
- 6) Show clearly all the working. **Marks will not be awarded for answers without all working steps.**

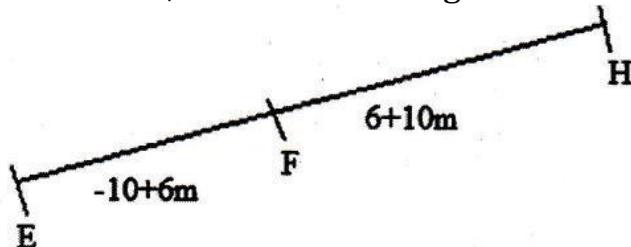
SECTION A: Attempt all questions from this section. (55 marks)

1. Expand the following: $(64x^2 - 25y^2)$ (2 marks)
 2. If $a - b = 2$ and $a^2 + b^2 = 20$, find the value of ab . (3 marks)
 3. Find the cardinal of Z set if $Z = \{\text{Natural numbers between } 20 \text{ and } 50, \text{ which are divisible by } 7\}$ (3 marks)
 4. Solve the following inequality in IR: $\frac{3}{4}x - \frac{4}{5}x \geq \frac{1}{2}$ (3 marks)
 5. The number of elements in each region of the Venn diagram is given.
- If $n(M \cup N) = 98$; find x .
- (4 marks)
6. Rationalize the denominator:
- $$\frac{-7\sqrt{2} + 3\sqrt{6}}{5\sqrt{6} + 2\sqrt{2}} =$$
7. Think of a number, I add 7 to it and double the result; the answer is 44. What is the number? (4 marks)
 8. A business woman has 8,000,000 Fr-w in the bank. The bank pays her an interest rate of 7% per year. How much money does she have after two years? (4 marks)
 9. A cell map is drawn to a scale of 4:80 000. What length on the map represents a distance of 10 000m? (4 marks)
 10. Find the coordinates of point T, given that $O \rightarrow \rightarrow \rightarrow T = O \rightarrow \rightarrow \rightarrow A + O \rightarrow \rightarrow \rightarrow B$ if $A = (20)$ and $B = (20, -8)$. (4 marks)
 11. At sellers of mobile phone, the price of a phone was marked down by 10%. If the old price was 400,000Frw, calculate its actual selling price. (4 marks)
 12. In a group of 70 people, 32 like soft drinks and 47 like beer and each person likes at least one of the two drinks. How many like both soft drinks and beer? (4 marks)

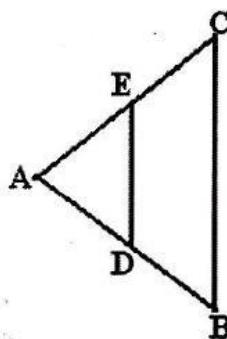
13. Solve the following simultaneous equations. (4 marks)

$$\begin{cases} 3y + 2x = 5 \\ 4y + 3x = 7 \end{cases}$$

14. In the following figure, the length of the segment EH = 44cm, find the value of the real number m, then find the length of EF and FH. (4 marks)



15. In the figure given below, DE IBC. If AD = x cm, DB = x-2 cm, AE = x -1 cm, then find the value of x. (4 marks)



SECTION B: ATTEMPT ANY THREE QUESTIONS (45 Marks)

16. (a) In a group of 100 persons, 72 people can speak English and 43 can speak French.

- (i) How many people can speak English only? (3 marks)
(ii) How many people can speak French only? (3 marks)
(iii) How many people can speak both English and French? (3 marks)

(b) Given that $\vec{x} = \begin{pmatrix} 0 \\ 12 \end{pmatrix}$, $\vec{y} = \begin{pmatrix} -8 \\ 6 \end{pmatrix}$, $\vec{z} = \begin{pmatrix} -8 \\ 6 \end{pmatrix}$

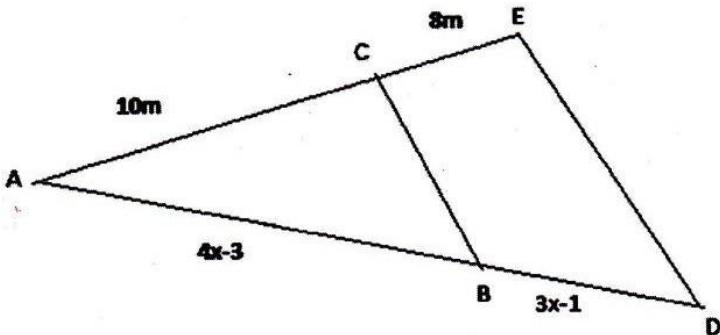
Calculate:

- (i) $\vec{x} + \vec{y} - \vec{z}$ (2marks)
(ii) $3\vec{x} - 2\vec{y} + 2\vec{z}$ (2marks)
(iii) $\frac{1}{2}(\vec{x} - \vec{y}) - 3\vec{z}$ (2marks)

17. (a) A father is 33 years older than his son and one year ago he was four times as old as his son.

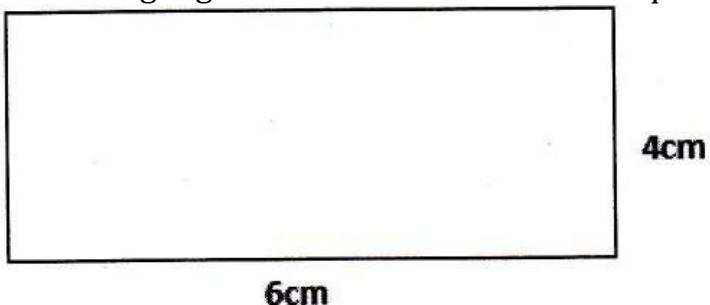
- (i) Find the present age of the father. (3 marks)
(ii) Find the Present age of the son. (3 marks)

(b) In the triangle AED



- (i) Use Thales Theorem to find the value of x in m. **(3 marks)**
 (ii) Find the length of side $A \rightarrow B$ of the triangle. **(2 marks)**
 (iii) Find the length of side $B \rightarrow D$ of the triangle. **(2 marks)**
 (iv) Find the length of side $A \rightarrow D$ of the triangle. **(2 marks)**

18. (a) Study the rectangle given below and answer the questions that follow.



- (i) Calculate its area. **(2 marks)**
 (ii) If it is enlarged with a scale factor of 6, find its area. **(3 marks)**
 (b) A garden on the map has an area of 20cm^2 . Calculate its actual area if the map scale is 1:500 **(3 marks)**
 (c) If $f(x) = 2+x$ and $g(x) = 3-x$
 Calculate:
 (i) $f(2) =$ **(1 mark)**
 (ii) $fog(x) =$ **(2 marks)**
 (iii) $gof(x) =$ **(2 marks)**
 (iv) $gof(-5) =$ **(2 marks)**

19. Study the following table which shows the score obtained by students of senior two in Mathematics Midi-term Test out of 20 marks and answer the questions that follow:

16	12	11	12	11	12	12	11	12	11	16
18	18	11	20	11	12	13	11	13	13	16
18	13	14	13	14	14	13	13	19	19	17
18	15	14	14	13	15	15	15	15	15	17

- (a) Copy the frequency table given below and complete it with the above data. **(10 marks)**

Marks, x	Frequency, f	fx	Cumulative frequency
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
	$\sum f =$	$\sum fx =$	

- (b) What is the mode mark? Explain your answer. **(1 mark)**
 (c) Determine the mean mark. **(2 marks)**
 (d) Calculate the number of Students in S2 if all students attended the Test. **(2 marks)**

20.

- (a) A triangle with vertices M, N and P whose coordinates are $\left(\frac{10}{5}, 0\right)$, O

$\left(\frac{15}{3}, \frac{24}{6}\right)$ and $\left(\frac{12}{2}, 1\right)$ respectively is given a translation $\tilde{t} = \begin{pmatrix} -\frac{12}{4} \\ 7 \end{pmatrix}$.

Find the image vertices:

- (i) J' **(3marks)**
- (ii) K' **(3marks)**
- (iii) P' **(3marks)**

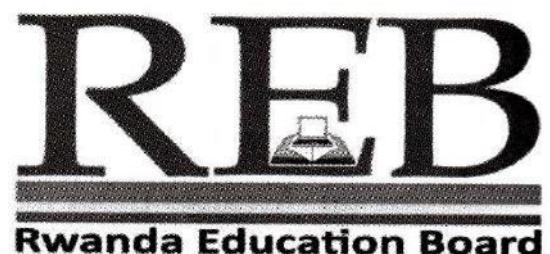
- (b) If A (1,2) and B (3,1) are two points on the line:

- (i) Find the slope of the line. **(2marks)**
- (ii) Find the equation of the line passing through the given point A and B. **(3marks)**
- (iii) Find its y- intercept. **(1mark)**

Mathematics I

010

21/11/2017 08.30 AM – 11.30 AM



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2017

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 paper until you are told to do so.
- 3) This paper consists of **TWO** sections **A** and **B**.

SECTION A: Attempt **ALL** questions **(55 marks)**

SECTION B: Answer any **THREE** questions. **(45 marks)**

- 4) You may use mathematical instruments and calculators **where necessary**.
- 5) Use a blue ink pen only to write your answers and a pencil to draw diagrams.
- 6) Show clearly all the working. **Marks will not be awarded for answers without all working steps.**

SECTION A: ATTEMPT ALL QUESTIONS. (55 MARKS)

- 1) Solve the following equation: $3(x - 1) - (x + 9) = 0$. **(3marks)**
- 2) Find n given that: $45_n = 41_{\text{ten}}$. **(3marks)**
- 3) Solve for x : $2x^3 = 54$. **(3marks)**
- 4) Given that $a = 3$, $b = -2$ and $c = 4$, find the value of:
$$ab^2 - bc + ac$$
 (3marks)
- 5) The interest on a loan is 24% per annum. How much is a loan that bears interest of 6,000 Frw after one year? **(3marks)**
- 6) The area of a trapezium is 24cm^2 . Its height is x and its parallel sides are $(2x)\text{cm}$ and $(x + 7)\text{cm}$. Find the value of x . **(4marks)**
- 7) A number (P) is increased by 80%. The new number is then increased by 60% giving a final result of 144. Find the original number (P). **(4marks)**
- 8) In the figure below and are tangents to the circle. CD is a diameter and angle $DAB = 40^\circ$. Find angle BCD . **(4marks)**
- 9) It is given that $g(x) = 3(x + 2)$ and $f(x) = 3x + 2$. Find $gf(4)$. **(4marks)**
- 10) If y is inversely proportional to x and $y = 40$ when $x = 3$, find y when $x = 2.5$. **(4marks)**
- 11) The exterior angles of a pentagon measure respectively y° , 60° , 75° , y° , and 85° . Find the value of y° . **(4marks)**
- 12) Solve the following simultaneous equations:
$$\begin{aligned} 8x + y &= 21 \\ 5x - 4y &= -10 \end{aligned}$$
 (4marks)
- 13) Find the equation of the line with gradient 5 and passing through the point $(1, 9)$. **(4marks)**
- 14) Solve the following inequality:
$$\frac{1}{3}x - (x + 1) \geq 2$$
 (4marks)

15) In a class of 50 students, 40 like Mathematics (M) and 25 like Science (S). Some students (X) like both subjects and 2 do not like any of the two subjects. How many students like both Mathematics and Science? **(4marks)**

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

16) Factorize completely: $P(x) = 6x^3 - 5x^2 - 12x - 4$ and hence find the values of x when $P(x) = 0$. **(15marks)**

17) The curved surface of a cylindrical tin is 628cm^2 and its height is 10cm. $\pi = 3.14$. Find:

(a) The radius of the circular base. **(4marks)**

(b) The total surface area of the tin. **(5marks)**

(c) The volume of the tin. **(2marks)**

(d) The largest number of tins which will fill the box of length = 80cm, width = 60cm and height = 40cm. **(4marks)**

18) The following table gives the ages of 73 students and the frequency.

Ages in years , x	14	15	16	17	18	19	20
Frequency, f	5	9	13	11	12	15	8

(a) Copy the table below and complete it. **(9marks)**

Age, x	Frequency, f	fx	Cumulative frequency
14			
15			
16			
17			
18			
19			
20	$\sum f =$	$\sum fx =$	

(b) Find the mode age. **(1mark)**

(c) Determine the median age. **(3marks)**

(d) Calculate the mean age. **(2marks)**

19) (a) Use vectors $a \vec{=} \begin{pmatrix} -5 \\ 12 \end{pmatrix}$, $b \vec{=} \begin{pmatrix} 3 \\ 6 \end{pmatrix}$ and $c \vec{=} \begin{pmatrix} -4 \\ -2 \end{pmatrix}$ to determine:

(i) $a \vec{+} b \vec{-} c \vec{=}$ **(2marks)**

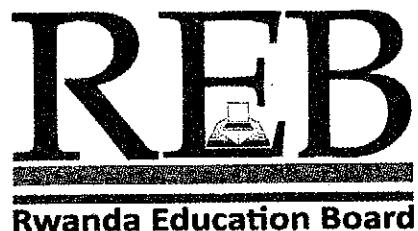
(ii) The modulus of \vec{a} . **(3marks)**

- (b) K (4, 7), L (2, 3) and M (4, -1) are three vertices of a rhombus KLMN.
- (i) Use vectors to prove that triangle KLM is an isosceles triangle. **(3marks)**
- (ii) Find the coordinates of N. **(2marks)**
- (c) Show that the points P (-3, -2), Q (3, 1) and R (5, 2) are collinear. **(3marks)**
- (d) Vectors $s^{\rightarrow} = \begin{pmatrix} 7 \\ 4 \end{pmatrix}$ and $t^{\rightarrow} = \begin{pmatrix} 21 \\ r \end{pmatrix}$ are parallel. Find the value of r. **(2marks)**
- 20) The vertices of triangle STV are S (0, 2), T (0, 5) and V (0, 3). In the same Cartesian plane, draw:
- (a) The triangle STV. **(6marks)**
- (b) (i) The triangle S'T'V', image of triangle STV under reflection in y-axis. **(3marks)**
- (ii) The triangle S''T''V'', image of triangle STV under a rotation about the origin through -90° . **(3marks)**
- (iii) The triangle S'''T'''V''', image of triangle STV under translation, $T = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$. **(3marks)**

(Use the graph in your answer booklet to answer this question).

Mathematics I
010

09 Nov. 2016 08.30am - 11.30am



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2016

SUBJECT: MATHEMATICS I

DURATION: 3 HOURS

INSTRUCTIONS:

- 1) Write your name 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 paper until you are told to do so.
- 3) This paper has **TWO** sections: **A** and **B**.
 - **SECTION A:** Attempt **ALL** questions. **(55marks)**
 - **SECTION B:** Attempt **ONLY** any **THREE** questions. **(45marks)**
- 4) You may use mathematical instruments and calculators **where necessary**.
- 5) Use a **blue or black pen only** to write your answers and a pencil to draw diagrams.
- 6) Show clearly all the working. **Marks will not be awarded for the answer without all working steps.**

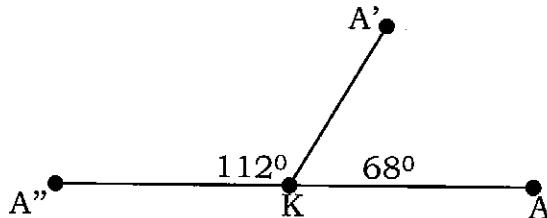
SECTION A: ATTEMPT ALL QUESTIONS.**(55 MARKS)**

- 1) Simplify and express the answer in standard form: $\frac{0.085 \times 0.0084}{1.7 \times 0.007}$. **(4marks)**
- 2) (a) Find the next two missing terms: 1, 2, 4, 7,,
(b) What is the 10th term in 2(a) above? **(3marks)**
(2marks)
- 3) Using a ruler, a pencil and a pair of compasses only, construct a triangle ABC such that lengths AB = 8.7cm, AC = 10.6cm and angle BAC = 60°.
Find the length of BC. [You must show all your construction lines.] **(4marks)**
- 4) Given the function $f(x) = \frac{x+4}{-x+4}$,
(a) evaluate $f(-\frac{1}{4})$. **(2marks)**
(b) calculate the value of x for which $f(x)$ is not defined. **(2marks)**
- 5) Solve for x, over the set of real numbers, IR: $\frac{x+1}{2} - \frac{x-7}{3} = \frac{x}{3}$. **(3marks)**
- 6) Solve for x, over IR: $x^2 - x - 90 = 0$. **(3marks)**
- 7) Line A is parallel to line B. Line B passes through points (4,5) and (1,-4).
Find the equation of line A if it passes through (0,-1). **(4marks)**
- 8) Given that m is directly proportional to the cube of t and t = 4 when m = 8, find the value of t when m = 27. **(4marks)**
- 9) Use vectors to prove that the points M(-7,-6), N(1,-10) and O(3,-11) lie on a straight line. **(4marks)**
- 10) Given that $f(x) = 2x + 1$ and $g(x) = x^2 - 9$, find the value of x if $gf(x) = 0$. **(4marks)**
- 11) The longest side of a triangle is twice the length of the shortest side. The third side is 7cm less than the longest side and the perimeter of the triangle is 78cm.
Find the lengths of the sides of the triangle. **(3marks)**
- 12) A man pays for the following items as follows: a pair of shoes 6,000Frw, a pair of trousers 5,000Frw, a shirt 4,000Frw and a pair of socks 3,000Frw.
Draw an accurate pie chart for this information. **(4marks)**
- 13) If $\frac{5}{\sqrt{5}} + \sqrt{20} = a\sqrt{5}$, find the value of a. **(4marks)**

- 14) Given that $\vec{a} = \begin{pmatrix} 7 \\ 4 \end{pmatrix}$ and $\vec{b} = \begin{pmatrix} 21 \\ r \end{pmatrix}$ are parallel vectors, find the value of r.

(3marks)

- 15) Point A is rotated 68° about K and then by 112° about K.



Find a single rotation that has the same effect as this.

(2marks)

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

- 16) (a) At a factory, a worker's wages for a 40-hour week is 120,000Frw. She is paid 10% of her weekly wages for every 2 hours that she works overtime. At the end of a certain week she received 216,000Frw. Calculate the number of hours of overtime that she worked.

(5marks)

- (b) A laptop costs 257,000Frw. A student takes the laptop on hire purchase. The student has to pay a deposit of 15,000Frw and 25 monthly instalments of 12,400Frw.

Calculate:

- (i) the total amount paid for the laptop under the hire purchase agreement.

(3marks)

- (ii) the difference between the amount paid under hire purchase and the cost price.

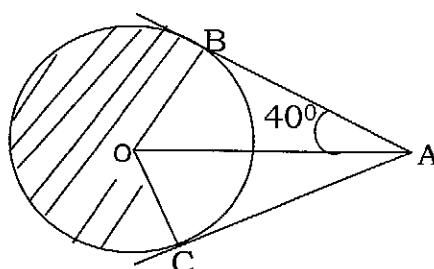
(2marks)

- (c) A car was bought for 33,000,000Frw. The value of the car depreciated each year by 15% of its value at the beginning of the year.

Calculate the value of the car after three years.

(5marks)

- 17) The diagram below is a circle with centre O. \overline{OB} and \overline{OC} are radii, \overline{AB} and \overline{AC} are tangents to the circle.



- (a) Show that triangle ABO is congruent to triangle ACO.

(4marks)

(b) Find:

- (i) the size of angle AOB.

(2marks)

- (ii) the size of angle CAO.

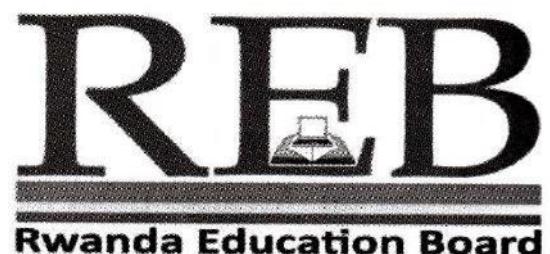
(2marks)

- (c) Given that $\overline{AO} = 13\text{cm}$ and $\overline{OC} = 5\text{cm}$.
 Calculate:
 (i) the area of triangle ACO. (3marks)
 (ii) the area of the shaded region. [Express your answer to the nearest tenth, use $\pi = 3.14$] (4marks)
- 18) (a) If $\vec{a} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$ and $\vec{b} = \begin{pmatrix} -12 \\ 6 \end{pmatrix}$, calculate $2\vec{a} - 0.5\vec{b}$. (3marks)
 (b) The points a(-3,2), b(2,-3) and c(6,1) are in a Cartesian plane.
 (i) Determine the column vectors of \vec{ab} , \vec{ac} and \vec{bc} . (6marks)
 (ii) Calculate the length of \vec{ac} , \vec{ab} and \vec{bc} . (3marks)
 (iii) Hence show that triangle abc is right angled triangle at b. (3marks)
- 19) (a) Given that $p(x) = 6x^3 + 35x^2 + 19x - 30$.
 (i) Prove that -5 is a zero of $p(x)$ and hence factorize it completely. (7marks)
 (ii) Find the values of x for which $p(x) = 0$. (1mark)
 (b) Solve for x, over the set of real numbers: $\frac{x+2}{x-2} + \frac{x-2}{x+2} = \frac{8-4x}{x^2-4}$ (7marks)
- 20) A teacher found that students were taking too long to answer a statistics question in every mathematics examination. She asked students to answer a statistics question and she recorded how long it took each student. Below are the times in minutes the teacher recorded.
- | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|
| 35 | 39 | 31 | 32 | 35 | 32 | 31 | 29 | 26 | 35 | 31 |
| 39 | 29 | 39 | 34 | 29 | 39 | 39 | 26 | 27 | 32 | 39 |
| 32 | 39 | 26 | 35 | 34 | 26 | 32 | 35 | 32 | 34 | |
- (a) Draw a frequency table for this data and calculate the mean time (correct to the nearest whole number). (10marks)
 (b) The statistics question is worth 15% of the total marks in a three hour mathematics examination paper.
 (i) How long should each student spend on the statistics question? (1mark)
 (ii) What is the percentage of students who were spending too long on the statistics question? (2marks)
 (c) How many students spent :
 (i) the longest time? (1mark)
 (ii) the shortest time? (1mark)

Mathematics I

010

11/11/2015 08.30 AM – 11.30 AM



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 paper until you are told to do so.
3. This paper consists of **TWO** sections **A** and **B**.

SECTION A: Attempt **ALL** questions **(55 marks)**

SECTION B: Answer any **THREE** questions. **(45 marks)**

4. You may use mathematical instruments and calculators **where necessary**.
5. Use a blue ink pen only to write your answers and a pencil to draw diagrams.
6. Show clearly all the working. **Marks will not be awarded for answers without all working steps.**

SECTION A: Attempt all questions from this section. (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 $x^{\rightarrow} = \langle \begin{smallmatrix} 2 \\ 4 \\ 7 \end{smallmatrix} \rangle$ (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, \mathbb{R} : $\frac{25}{9}x^2 - \frac{9}{4} = 0$. (3 marks)
7. If $135_n = 75_{\text{ten}}$, find the value of n . (3 marks)
8. Given that vectors $a^{\rightarrow} = \langle \begin{smallmatrix} -2 \\ 3 \end{smallmatrix} \rangle$, $b^{\rightarrow} = \langle \begin{smallmatrix} 2 \\ 7 \end{smallmatrix} \rangle$ and $c^{\rightarrow} = \langle \begin{smallmatrix} -10 \\ 21 \end{smallmatrix} \rangle$;
 - (a) Find vectors $a^{\rightarrow} + b^{\rightarrow}$ (2 marks)
 - (b) If $ma^{\rightarrow} + nb^{\rightarrow} = c^{\rightarrow}$, find the value of m and n . Show all your working. (3 marks)
9. In the figure below,
 - (a) Show that ΔABC is similar to ΔBDC . (3 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:

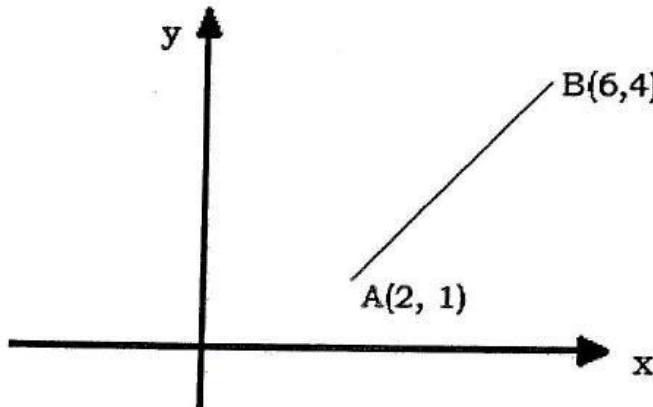
$$(2^{-3} \times 16^2) \div (81^4 \times 27^{-3})$$
 (2 marks)
- (b) Find x if $3^x \div 3^2 = 27$ (2 marks)
12. Three students share n frw in the ratio $3 : 4 : 5$. If the smallest share is 60,000frw, find: (a) The amount n . (2 marks)
- (b) The two other shares. (2 marks)

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

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 ANY 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		

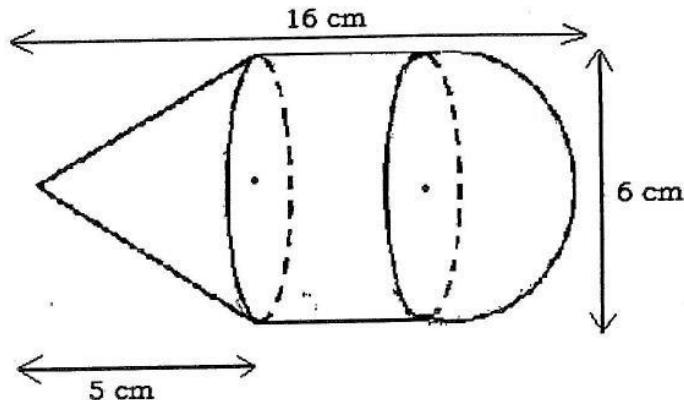
- (i) Copy and complete the table.
- (ii) Plot d against t on the graph.
- (iii) Determine the gradient of the graph
- (iv) Write the equation relating d and t.
- (b) A vector comprises points A (2, 3) and B (1, 6). Another vector perpendicular to the vector AB passes through points A (2, 3) and P (x, 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. **(3 marks)**

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 $\pi = 3.14$) **(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)**

Mathematics I

010

29 Oct. 2014 08.30AM - 11.30AM



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2014

SUBJECT: MATHEMATICS I

DURATION: 3 HOURS

INSTRUCTIONS:

- 1) Do not 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:** Attempt any **THREE** questions. **(45 marks)**
- 3) You may use mathematical instruments and calculators **where necessary**.
- 4) USE A **BLUE or BLACK 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 the answer without all working steps.

SECTION A : ATTEMPT ALL QUESTIONS. (55 marks)

1. Simplify: $0.42^2 - 0.58^2$ without using a calculator. **(3 marks)**
2. Simplify the fractions completely : $\left(2\frac{2}{5} \div 1\frac{6}{10}\right) \times 0.02$ **(3 marks)**
3. Find the inverse function of $g(x) = 3+4x$. **(2 marks)**
4. A piece of land is represented by a rectangle of 300cm^2 on a map. Determine the actual area of the land in hectares (ha). The scale is 1: 15,000. **(3 marks)**
5. Solve : $\frac{2x-5}{x^2-4} = \frac{5}{x-2}$ **(5 marks)**
6. To pass a certain interview, a candidate must pass both oral test(R) and a written test(W).
Of the candidates who attend the interview 70% passed R, 65% passed W and 15% passed R but not W.
Four candidates failed both tests . How many candidates passed the interview ? **(4 marks)**
7. Solve the following simultaneous equations :
$$\begin{aligned} 2x + 3y &= 5 \\ 3x + 2y &= 10 \end{aligned}$$
 (4 marks)
8. Solve the following inequality: $2x - \frac{1}{3}(4x - 1) < \frac{3}{4} + x$. Illustrate the solution on the number line . **(4 marks)**
9. Calculate the distance between points A(-5,4) and B(3,-2). **(4 marks)**
10. Find the magnitude of vector $\vec{z} + 2\vec{w}$, given that $\vec{z} = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$ and $\vec{w} = \begin{pmatrix} 4 \\ 2 \end{pmatrix}$. **(4 marks)**
11. (a)Find the sum of the interior angles of a pentagon.
(b) The sum of the interior angles of a polygon is 900° .
How many sides has the polygon ? **(2 marks)**
(2 marks)
12. The longest side of a right angled triangle is 15cm and the other two sides are x cm and $(x + 3)$ cm respectively. Find x and calculate the area of the triangle. **(4 marks)**
13. A (1,4) , B (1,0) and C (3,-2) are three of the vertices of a quadrilateral ABCD. $\vec{AD} = \begin{pmatrix} 4 \\ -1 \end{pmatrix}$ and X is the mid-point of AC.
Find the coordinates of D and X . **(4 marks)**
14. Solve: $6x^2 + x - 2 = 0$. **(3 marks)**

15 (a) Simplify : $36^{\frac{1}{2}} + 27^{\frac{2}{3}}$.

(2 marks)

(b) Solve for x : $4^x = 32$.

(2 marks)

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

16. a) Two lines, one passing through points $(0, 4)$ and $(3, 1)$ and the other passing through point $(-3, 2)$, are parallel. Find the equations of these lines.

b) If $f(x) = 2x + 3$ and $g(x) = 3x - 1$, calculate :

(7 marks)

(i) $f(-1)$

(ii) $g(-4)$

(iii) $fog(x)$

(iv) $gof(x)$

(v) $gof\left(-\frac{1}{6}\right)$

(8 marks)

(vi) $fog\left(-\frac{1}{6}\right)$

17. a) A triangle with vertices A, B and C whose coordinates are $(2, 0)$, $(5, 4)$ and $(6, 1)$ respectively is given a translation $t = \begin{pmatrix} -3 \\ 7 \end{pmatrix}$.

(5 marks)

Find the images vertices: (i) A' ; (ii) B' ; (iii) C' .

b) A $(-5, -1)$, B $(-2, -1)$ and C $(-4, -2)$ are vertices of triangle ABC.

(4 marks)

(i) Plot points A, B and C on a graph paper using a scale of 1cm to represent 1 unit on each axis. Join the points to form triangle ABC.

(ii) Triangle ABC is enlarged by a scale factor of -2 with the origin $(0,0)$ as the centre of enlargement. On the same graph as 17.b)(i) above, draw the image $A'B'C'$ of triangle ABC.

(3marks)

(iii) Draw triangle $A''B''C''$ which is the image of triangle ABC under a reflection in line $y = 0$. Use the same graph as that of 17.b) (i) above .

(3 marks)

18. a) Mr. RWEMA buys a certain number of pens for £1.40 and the number of pence that each one costs him is 4 more than the number of pens that he buys. Find the cost of each pen.
£=pound (British currency) and $1\text{£}=100$ pence.

(5 marks)

b) Solve : $6x^3 + 11x^2 - 3x - 2 = 0$.

(10 marks)

19. The table below shows the marks scored by 52 students in a test marked out of 50

12	18	24	29	37	45	47	38	31	24
19	13	14	20	25	32	39	40	33	25
21	14	40	33	26	21	15	16	22	27
34	41	41	35	27	22	16	17	27	22
28	44	42	35	18	22	28	36	43	18
23	36								

- a) Make a grouped frequency table for the marks starting with 12 – 19. **(15 marks)**
- b) Find the modal class and its limits. Calculate the mean.

20. a) Given that the points $(4, -1)$, $(1, 5)$ and $(-3, k)$ lie on a straight line, calculate the value of k . **(5 marks)**

- b) The data below show a relation between x and y .

x	3	4	5	6	7
y	10	13	16	19	22

(10 marks)

By plotting y against x on a graph, determine the gradient of the graph hence deduce the relation between y and x . Write the equation connecting y and x .

Mathematics I

010

30 Oct 2013 08.30 am – 11.30 am

REPUBLIC OF RWANDA



RWANDA EDUCATION BOARD (REB)
P.O.BOX 3817 KIGALI

ORDINARY LEVEL NATIONAL EXAMINATIONS 2013

SUBJECT: MATHEMATICS I

DURATION: 3 HOURS

INSTRUCTIONS:

- 1) Do not open this question paper until you are told to do so.
- 2) This paper consists of **TWO** sections **A** and **B**.

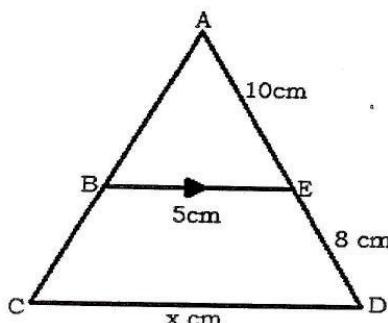
SECTION A: Attempt **ALL** questions **(55 marks)**

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 from this section. (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) :
$$\begin{aligned} 8x + y &= 21 \\ 5x - 4y &= -10 \end{aligned}$$
 (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.
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.



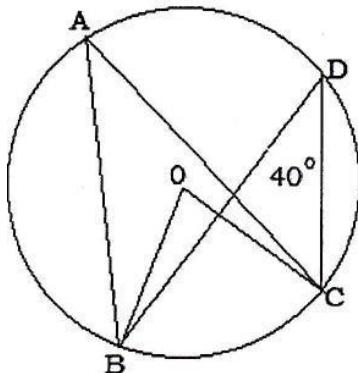
- (a) Show that triangle ABE is similar to triangle ACD. **(2 marks)**

(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)**

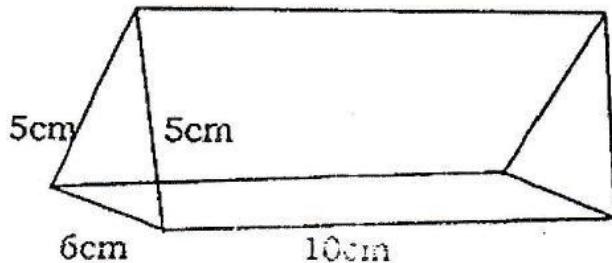


SECTION B: ATTEMPT ANY THREE QUESTIONS. (30 MARKS)

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° 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)

Mathematics I

009

15 Nov. 2012 08.30 am – 11.30 am

REPUBLIC OF RWANDA



RWANDA EDUCATION BOARD (REB)
P.O.BOX 3817 KIGALI

ORDINARY LEVEL NATIONAL EXAMINATIONS 2012

SUBJECT: MATHEMATICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **TWO** sections **A** and **B**

SECTION A: Answer **ALL** questions **(55 marks)**

SECTION B: Answer any **THREE** questions. **(45 marks)**

Answer only **one** question in section C **(15 marks)**

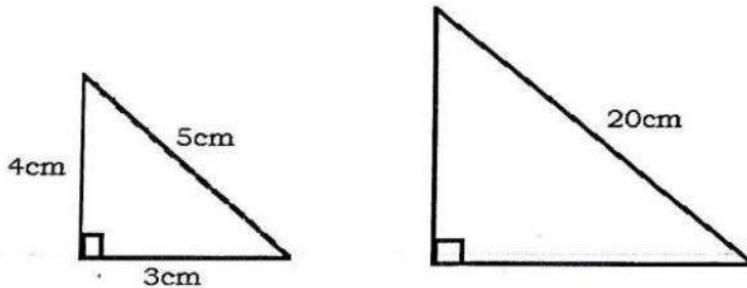
You may use a calculator and mathematical instruments **where necessary**.

Use only a blue pen and a pencil for drawing only.

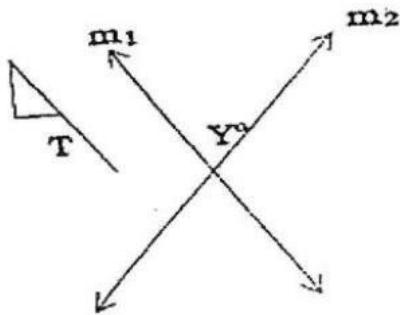
SHOW CLEARLY ALL THE WORKING. **Marks will not be awarded for answers without all working steps.**

SECTION A: Attempt all questions from this section. (55 marks)

1. Express 900 as a product of its prime factors. Hence find the square root of 900. **(3 marks)**
2. (a) Calculate without using a calculator: $3.45^2 - 1.55^2$ **(2 marks)**
(b) Divide without using a calculator: $0.9 \div 30$ **(1 mark)**
3. In a school food store, there is enough food to feed 300 students for 17 days. For how long will the food last if 40 more students join the group? **(3 marks)**
4. Solve the equation: $5x^2 + 21x - 20 = 0$ **(3 marks)**
5. The right angled triangles below are similar. Find the area of the larger triangle. **(3 marks)**

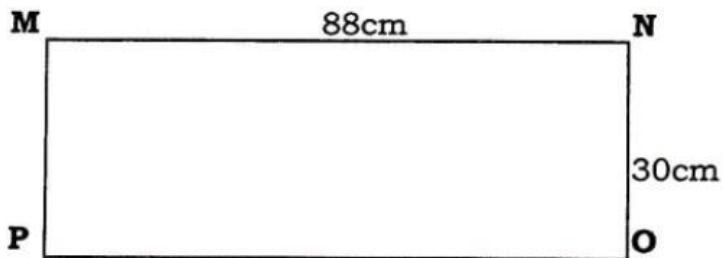


6. Solve them simultaneously: $x + 2y = 40$
 $3x = 60 - y$ **(4 marks)**
7. Find the equation of the line which passes through the points $(-1, 3)$ and $(4, 2)$. **(4 marks)**
8. Given that $f(x) = ax^2 - 7$ and $f(2) = 13$, find the value of $f(-1)$. **(4 marks)**
9. In a class of 40 students, 24 like Mathematics and 30 like Kinyarwanda. All students like at least one of the subjects. Draw a Venn diagram to represent this information. How many students like both Mathematics and Kinyarwanda? **(4 marks)**
10. Solve the equation: $\frac{3x}{2} \geq \frac{x}{4} - 10$. Illustrate the answer on a number line. **(4 marks)**
11. A point **m** divides a line segment AB, 10cm long into two parts such that one part is 4cm longer than the other. Find the length of the two parts. **(4 marks)**
12. The diagrams below show a flag T and two mirrors **m₁** and **M₂M₁(T)** in intersecting at an angle Y° . Copy the diagram and show images **M₁(T)** in **m₁** and **M₂M₁(T)** in **m₂**.



13. Given $152n = 68\text{ten}$, find n. (4 marks)

14. Find the mid-point M of the line joining the points A (1, 0) and B (9, 6).
Find length \overline{MB} . (4 marks)



If it is curved in such a way that MP and NO meet to form a hollow cylindrical figure, find the volume of the cylindrical figure formed. $\pi = \frac{22}{7}$.
(4 marks)

SECTION B: Attempt any THREE questions. (45 marks)

15. (a) Solve for x : $\frac{1}{x^2-1} + \frac{1}{x^2-4x+3} + \frac{1}{x-3} = 0$ (8 marks)

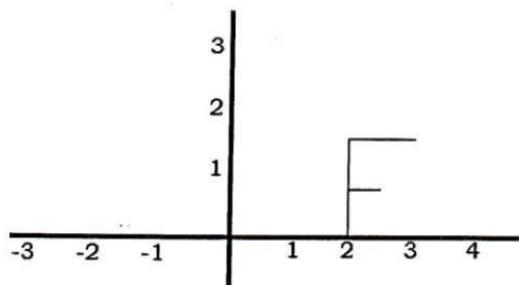
(b) Factorize completely: $f(x) = 2x^3 + 5x^2 + x - 2$. Hence find the values of x when $f(x) = 0$. (7 marks)

16. The table below shows the ages of 73 students.
Make the frequency table using the above data.

Age in years	14	15	16	17	18	19	20
Frequency	5	9	13	11	12	15	8

(a) Find the median age. (4 marks)
(b) Calculate the mean age. (11 marks)

17. Use the diagram to answer (a) and (b) below.



(a) Copy the diagram and sketch the image under

- (i) a $+90^\circ$ rotation about origin
- (ii) a -180° rotation about origin

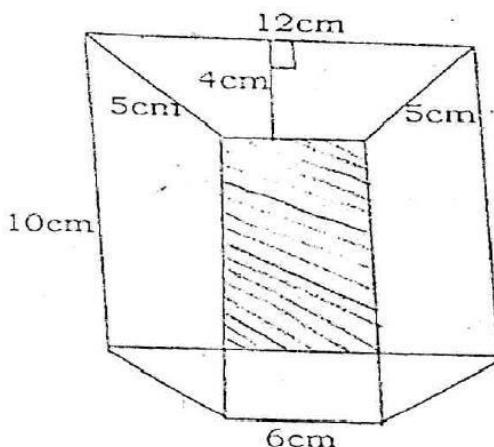
(b) Copy the diagram again and sketch the image under a translation.

- (i) $T = \begin{pmatrix} -2 \\ 1 \end{pmatrix}$
- (ii) $T = \begin{pmatrix} 4 \\ 0 \end{pmatrix}$



of under a

18. The figure below is a right trapezoidal prism.



Calculate its (a) lateral area

(5 marks)

(b) Total surface area

(7 marks)

(c) Volume

(3 marks)

19. (a) Rationalize the denominator: $\frac{\sqrt{2}}{2\sqrt{5}+\sqrt{3}}$

(b) Simplify: $\sqrt{12} \times 3\sqrt{60} \times \sqrt{45}$

(c) Simplify: $\sqrt{8} \times \sqrt{50} \times \sqrt{121}$

(d) Simplify: $\frac{5\sqrt{7}}{\sqrt{45}} \times \frac{2\sqrt{3}}{\sqrt{21}}$

Mathematics I

009

02 Nov. 2011 08.30 am – 11.30 am

REPUBLIC OF RWANDA



RWANDA EDUCATION BOARD (REB)
P.O.BOX 3817 KIGALI. TEL/FAX: 586871

ORDINARY LEVEL NATIONAL EXAMINATIONS 2011

SUBJECT: MATHEMATICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper has **TWO** sections **A** and **B**

SECTION A: Answer **ALL** questions. **(55 marks)**

SECTION B: Answer any **THREE** questions. **(45 marks)**

Calculators and mathematical instruments may be used where necessary.

Show all the working. **No marks will be given for answers which do**

not show all the steps.

SECTION A: Attempt all questions from this section. (55 marks)

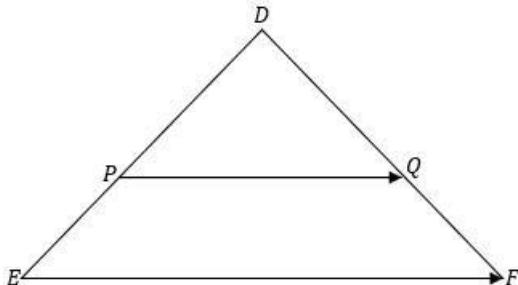
1. In a school there is enough food to feed 200 students for 15 days. For how long the food last if 50 more students join the school? **(3 marks)**
2. Some money was invested at 15% per year simple interest for 3 years. If the interest is 7200Frw, calculate the investment. **(3 marks)**
3. A (1, 4), B (1, 0) and C (3, -2) are three of the vertices of a quadrilateral ABCD. $A \rightarrow D = (4)$ and X is the mid-point of AC. Find the coordinates of X and D. **(4 marks)**
4. 80 pupils had meals at a hotel. Of these 50 had a meal of rice (R) and 45 had a meal of potatoes (P).
 - (a) Represent this information in a Venn diagram. **(2 marks)**
 - (b) Find the number of people who had a meal of R and P. **(2 marks)**
5. If the gradient of a line is 4, find the equation of this line if it passes through points (5, 3) and (x, y). **(3 marks)**
6. Think of a number, multiply it by 30 and then add 32. The result is equal to twice the square of the number. Find the number if it is greater than 0. **(3 marks)**
7. Given that $f(x) = \frac{8}{1-x^2}$ and $f(x) = -1$, find x. For which values of x is $f(x)$ not defined. **(4 marks)**
8. The diameters of two cylinders are in the ratio 3:4. The diameter of the smaller cylinder is 15cm.
 - (a) Find the circumference of the larger cylinder. $\pi = \frac{22}{7}$ **(2 marks)**
 - (b) What is the ratio of the area of the curved surfaces of the cylinders? **(2 marks)**
9. Solve the following inequality and illustrate the solution on the number line: $\frac{1}{3}x - (x + 1) \geq 3$ **(4 marks)**
10. In a triangle ABC, $\overline{AB} = 7.3\text{ cm}$, $\overline{BC} = 6.0\text{ cm}$ and $\overline{AC} = 75.0\text{ cm}$. Using a ruler and a pair of compasses only, draw accurately triangle ABC. Find the height of the triangle by construction and calculate its area. **(4 marks)**
11. Solve the following simultaneous equations:
$$\begin{aligned}4y - 3x &= 2 \\2y + 1 &= 2x\end{aligned}$$
(4 marks)
12. Three lights flash at intervals of 4, 6 and 10 seconds respectively. If they are started together, how soon after they next flash together again?

(3 marks)

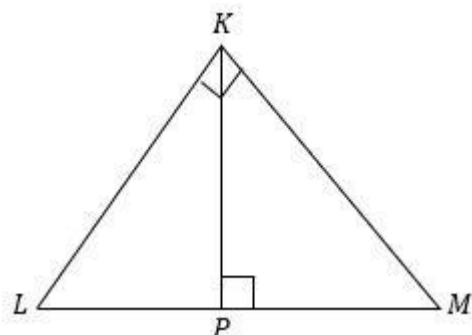
13. In the figure below $\bar{D}\bar{E} = 6\text{ cm}$, $\bar{E}\bar{F} = 12\text{ cm}$, $\bar{D}\bar{Q} = 6\text{ cm}$. Find:

- a) $\bar{Q}\bar{F}$.
- b) $\bar{P}\bar{G}$.

(2 marks)
(2 marks)



14. In the figure below, $\bar{L}\bar{M} = 9\text{ cm}$ and $\bar{K}\bar{M} = 6\text{ cm}$. Find $\bar{K}\bar{L}$ and $\bar{L}\bar{P}$. (4 marks)



15. The marks of 25 pupils on a test are:

6	8	4	5	7	9	7	5	8
4	2	6	2	5	7	1	3	6
7	4	3	7	3	5	3		

Determine:

- a) The mean mark. (2 marks)
- b) The median. (1 mark)
- c) The mode mark. (1 mark)

SECTION B: Attempt any THREE questions only. (45 marks)

16. The length of a rectangular block is 2 cm more than the width and the height is 1 cm more than two times the width. If the volume of the rectangular block is 624cm^3 , find the value of X. Hence calculate the total surface area of the block. (15 marks)

17. A helicopter flies from airport K to south for 200km. It then flies on a bearing of 255° for 250km. From there it flies on a bearing of 027° for 300km.

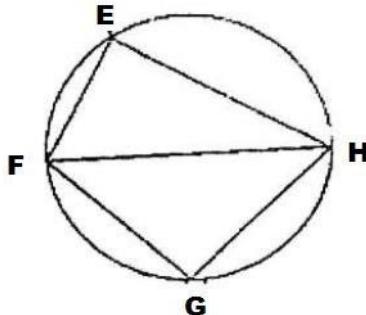
- (a) Draw an accurate diagram showing the journey of the helicopter using a scale of 1cm to represent 50km. (9 marks)

- (b) From your diagram, find the distance and bearing of K from the position of the helicopter. **(4 marks)**
(c) Given that the helicopter flies at a steady speed of 200 km/h, find how long the whole journey took. **(2 marks)**

18. Draw on the same axes the following graphs: (a) $y = 2x + 6$ and
(b) $y + x = 3$

From the graph determine the coordinates where the two lines intersect. **(15 marks)**

19. In the circle below \overline{FH} is the diameter of the circle, $\overline{EF} = r$, $\overline{FG} = x$ and $\overline{GH} = y$.



- (a) Show that $y^2 = r^2 + s^2 - x^2$. State your reasons clearly. **(9 marks)**
(b) Given that $r = 8\text{cm}$ and $s = 6 \text{ cm}$, find \overline{FH} . **(3 marks)**
(c) Find the area of triangle FGH, if triangle FGH is an isosceles triangle. **(3 marks)**

20. Q (1, 3) R (4, 3) and S (4, -3) are vertices of triangle GRS.

- (a) Plot on a graph paper points Q, R and S. Join these points to form triangle GRS. **(5 marks)**
(b) Triangle QRS is translated by $T = \begin{pmatrix} -1 \\ 3 \end{pmatrix}$. Find the coordinates of Q', R', S' the images of Q, R and S under translation T. Plot these points on the same graph as (a) and join them to form triangle Q'R'S'. **(4 marks)**
(c) Rotate Q'R' and S' about the origin through -90°. Find points Q'', R'' and S''. Plot these points on the same graph as (a) and join them. **(3 marks)**
(d) Find the two successive transformations that would map triangle Q''R''S'' on to triangle QRS. **(2 marks)**

Mathematics I

009

02 Nov.2010 8.30am - 11.30am

REPUBLIC OF RWANDA



RWANDA EDUCATION BOARD (REB)
P.O.BOX 3817 KIGALI. TEL/FAX: 586871

ORDINARY LEVEL NATIONAL EXAMINATIONS 2011

SUBJECT: MATHEMATICS I

DURATION: 3 HOURS

INSTRUCTIONS :

This paper has **TWO** sections **A** and **B**.

SECTION A: Answer **ALL** questions. **(55marks)**

SECTION B : Answer any **THREE** questions. **(45 marks)**

Calculators and mathematical instruments may be used where necessary .

Show clearly all the working. **No marks will be given for answers which do not show all the steps.**

SECTION A: ATTEMPT ALL QUESTIONS (55marks)

1. In a school there is enough food to feed 200 students for 15 days.

For how long will the food last if 50 more students join the school? **(3 marks)**

2. Some money was invested at 15% per year simple interest for

3 years. If the interest is 7200frw, calculate the investment. **(3 marks)**

3. A(1, 4), B(1, 0) and C(3, -2) are three of the vertices of a

quadrilateral ABCD. $\vec{AD} = \begin{pmatrix} 4 \\ -1 \end{pmatrix}$ and X is the mid-point of \overline{AC} .

Find the coordinates of X and D. **(4 marks)**

4. 80 pupils had meals at a hotel. Of these 50 had a meal of rice(R) and 45 had a meal of potatoes (P).

(a) Represent this information in a Venn diagram. **(2 marks)**

(b) Find the number of people who had a meal of R and P. **(2 marks)**

5. If the gradient of a line is 4, find the equation of this line if it passes through points (5, 3) and (x, y) . **(3 marks)**

6. Think of a number, multiply it by 30 and then add 32. The result is equal to twice the square of the number. Find the number if it is greater than 0. **(3 marks)**

7. Given $f(x) = \frac{8}{1-x^2}$ and $f(x) = -1$, find x . For which values of x is $f(x)$ not defined? **(4 marks)**

8. The diameters of two cylinders are in the ratio 3 : 4. The diameter of the smaller cylinder is 15cm.

(a) Find the circumference of the larger cylinder. $\pi = \frac{22}{7}$. **(2 marks)**

(b) What is the ratio of the area of the curved surfaces of the cylinders? **(2 marks)**

9. Solve the following inequality and illustrate the solution on the

number line : $\frac{1}{3}x - (x+1) \geq 3$. **(4 marks)**

10. In a triangle ABC, $\overline{AB} = 7.3\text{cm}$, $\overline{BC} = 6.0\text{ cm}$ and $\overline{AC} = 5.0\text{ cm}$.

Using a ruler and a pair of compasses only, draw accurately triangle ABC. Find the height of the triangle by construction and calculate its area. **(4 marks)**

11. Solve the following simultaneous equations:

$$4y - 3x = 2$$

$$2y + 1 = 2x$$

(4 marks)

12. Three lights flash at intervals of 4, 6 and 10 seconds respectively.

They are started together. How soon after will they next flash together again ?

(3 marks)

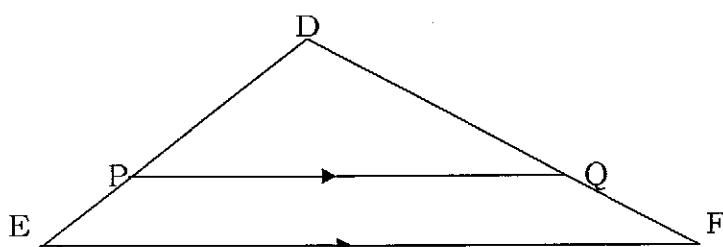
13. In the figure below $\overline{DE} = 6 \text{ cm}$, $\overline{EF} = 12 \text{ cm}$, $\overline{PE} = 2 \text{ cm}$ and $\overline{DQ} = 6 \text{ cm}$.

Find: (a). QF .

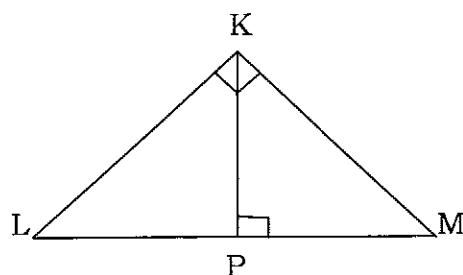
(2 marks)

(b) PQ .

(2 marks)



14. In the figure below, $\overline{LM} = 9 \text{ cm}$ and $\overline{KM} = 6 \text{ cm}$. Find \overline{KL} and \overline{LP} . **(4 marks)**



15. The marks of 25 pupils on a test are : 6 8 4 5 7 9 7 5 8

4 2 6 2 5 7 1 3 6

7 4 3 7 3 5 3

Determine (a) the mean mark.

(2 marks)

(b) the median.

(1 mark)

(c) the mode mark.

(1 mark)

SECTION B: Answer Three questions only (45 marks)

16. The length of a rectangular block is 2cm more than the width and the height is 1cm more than two times the width. If the volume of the rectangular block is 624 cm^3 , find the value of x hence calculate the total surface area of the block. **(15 marks)**

17. A helicopter flies from airport K due south for 200km.

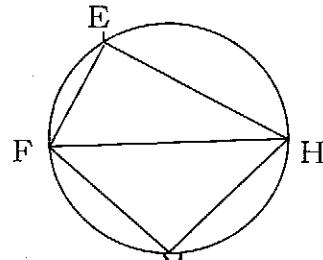
It then flies on a bearing of 255° for 250 km. From there it flies on a bearing of 027° for 300 km.

- (a) Draw an accurate diagram showing the journey of the helicopter using a scale of 1cm to represent 50 km. **(9 marks)**
 (b) From your diagram, find the distance and bearing of K from the final position of the helicopter. **(4 marks)**
 (c) Given that the helicopter flies at a steady speed of 200km/hr, find how long the whole journey took. **(2 marks)**

18. Draw on the same axes the following graphs: (a) $y = 2x + 6$ and
 (b) $y + x = 3$

From the graph determine the coordinates where the two lines intersect. **(15 marks)**

19. In the circle below \overline{FH} is the diameter of the circle, $\overline{EF} = r$, $\overline{EH} = s$,
 $FG = x$ and $GH = y$.



- (a) Show that $y^2 = r^2 + s^2 - x^2$. State your reasons clearly. **(9 marks)**
 (b) Given that $r = 8\text{cm}$ and $s = 6\text{cm}$, find \overline{FH} . **(3 marks)**
 (c) Find the area of triangle FGH, if triangle FGH is an isosceles triangle. **(3 marks)**

20. Q(1, 3), R(4, 3) and S(4, -3) are vertices of triangle QRS.

(a) Plot on a graph paper points Q, R and S. Join these points to form triangle QRS. **(5 marks)**

(b) Triangle QRS is translated by $T = \begin{pmatrix} -1 \\ -3 \end{pmatrix}$. Find the coordinates of Q', R', S', the images of Q, R and S under translation T.

Plot these points on the same graph as (a) and join them to form triangle Q'R'S'. **(4 marks)**

(c) Rotate Q'R'S' about the origin through -90° . Find points Q'', R' and S''. Plot these points on the same graph as (a) and join them. **(4 marks)**

(d) Find two successive transformations that would map triangle Q''R''S'' on to triangle QRS. **(2 marks)**

Mathematics I

011

04 Nov 2009 08.30am -11.30 am

RWANDA NATIONAL EXAMINATIONS COUNCIL



P.O BOX 3817 KIGALI-TEL/FAX : 586871

ORDINARY LEVEL NATIONAL EXAMINATIONS 2009

SUBJECT: MATHEMATICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **TWO** sections **A** and **B**

Answer **ALL** questions in section A (**55 marks**) and any **THREE** questions in section B. (**45 marks**)

Show **ALL** working clearly.

Calculator and mathematical instruments are allowed.

SECTION A: ANSWER ALL QUESTIONS**(55 MARKS)**

1. The interest on a loan is 15% per year. Find the loan if the interest for 2 years is 36,000 FRW and also calculate the whole amount of money at the end of the same period. **(2 marks)**
2. It is given that $x \rightarrow 2x$. Find the range corresponding to the domain $\{-3, -1, 9\}$. **(3 marks)**
3. Solve: $6x^2 + 7x + 2 = 0$. **(3 marks)**
4. Solve the following inequality and illustrate the answer on a number line:
 $9 < 5 - 2x$. **(3 marks)**
5. A half cylinder has a semi-circular base of diameter 20dm and height 14dm. Find its volume. $\pi = 3.14$ **(3 marks)**
6. Make A the subject of the formula: $\frac{1}{A} = \frac{1}{B} + \frac{1}{C}$ **(4 marks)**
7. Rationalize the denominator: $\frac{2}{1+3\sqrt{5}}$ **(4 marks)**
8. Given that $f(x) = (x - 7)(x + 2)$. Find x when $f(x) = 14$ **(4 marks)**
9. The area of a rhombus is 96cm^2 and one of its diagonals is 16cm. Find the length of the sides of the rhombus. **(4 marks)**
10. Find the equation of a line which passes through points (3, 7) and (-2, -3). **(4 marks)**
11. A(6,5), B(2,1), C(5,-1) and D(9,3) are coordinates of vertices of the quadrilateral ABCD. Use vectors to show that quadrilateral ABCD is a parallelogram. P is the mid-point of line BD. Find the coordinates of P. **(4 marks)**
12. Solve the following simultaneous equations:
$$\begin{aligned} 2x - 5y &= 7 \\ 4x + 3y &= 1 \end{aligned}$$
 (4 marks)
13. A: B: C is a ratio. A: B = 5:3 and B: C = 4:7. Divide 212 kg in the ratio A: B: C. **(4 marks)**
14. Find the coordinates of images of points P (-2, 2) and Q (3, 4). Under reflection in line $y = 1$. **(2 marks)**
15. The area of a square is 9cm^2 and the area of its image after enlargement, is 36cm^2 . Find the linear scale of the enlargement. **(2 marks)**

SECTION B: Answer THREE questions (45 marks)

16. (a) Using a pair of compasses and a ruler only, draw triangle MNO in which MN = 9.8 cm, NO = 7cm and MO = 7.4 cm. **(6 marks)**

(b) Draw the circumference of triangle MNO and find its radius. Calculate the area of the circle. $\pi = 3.14$ **(9 marks)**

17. The table below shows the ages in years of 81 students.

Ages (years)	14	15	16	17	18	19	20
Frequency	12	8	10	21	9	11	10

Find (a) the mode age **(1 mark)**

(b) The median age **(3 marks)**

(c) The mean age **(11 marks)**

18. (a) If y is inversely proportional to x and $x = -3$, when $y = 4$, find

(i) x when $y = 2$ and (ii) y when $x = 6$ **(8 marks)**

(b) Today, a father is 30 years older than his daughter. The product of their age is 216. Find their ages in 10 years time. **(7 marks)**

19. (a) Solve: $30x^3 + 17x^2 - 58x - 24 = 0$ **(8 marks)**

(b) If $f(x) = x^2 + 4x + 1$ and $g(x) = x + 1$, find x when

i) $fg(x) = -2$ **(5 marks)**

ii) $gf(3)$. **(2 marks)**

20.a) John bought 4 calculators and 2 pens at 14,000 Rwf. Mary bought 2 calculators and 5 pens at 11,000Rwf. Find the cost of

(i) One pen

(ii) One calculator

(iii) 5 calculators and 3 pens altogether. **(9 marks)**

b) A car can be bought on hire purchase by paying 20% deposit of the cash price and 24 monthly instalments of 200,000Rwf. The cash price of the car is 4,000,000Rwf.

i) Calculate the hire purchase of the car. **(3 marks)**

ii) Determine the percentage extra money paid for the car on hire purchase than cash. **(3 marks)**

Mathematics V

012

5th Nov 2008 08.30am -11.30 am

RWANDA NATIONAL EXAMINATIONS COUNCIL



P.O BOX 3817 KIGALI-TEL/FAX : 586871

ORDINARY LEVEL NATIONAL EXAMINATIONS 2008

SUBJECT: MATHEMATICS V

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **TWO** sections **A** and **B**

Attempt **ALL** questions in section A **(55 marks)**

and any **THREE** questions in section B. **(45 marks)**

Show **ALL** working clearly.

Calculators and mathematical instruments may be used except when otherwise stated.

Diagrams are not drawn to scale.

SECTION A: ANSWER ALL QUESTIONS**(55 MARKS)**

1. Simplify completely: $(2\frac{2}{5} - \frac{3}{7}) \div 1\frac{2}{7}$ **(3 marks)**
2. Find the equation of the line parallel to $y = 4x + 1$ which passes through point $(-3, -5)$ **(3 marks)**
3. Simplify: $\frac{\sqrt{162} + \sqrt{18}}{\sqrt{32}}$ **(3 marks)**
4. Simplify: $\frac{2x^3 - 3x^2 - 2x}{2x^2 + x}, x \neq 0$ **(4 marks)**
5. Given that $104_n = 29_{ten}$ find n . **(4 marks)**
6. The base of a parallelogram is $(3x - 2)cm$ and the height is $(x + 1)$. Find the height of the parallelogram if its area is 12 cm^2 . **(5 marks)**
7. Solve the following inequality: $\{2x - (4x - 1) < 4 < +x\} \cap \{5x + 1 < x + 9\}$. Illustrate the equation on a graph. **(5 marks)**
8. There are enough cow feeds to feed 360 cows for 21 days. Find how many more cows would be needed for the same feeds to last 12 days. **(4 marks)**
9. Solve simultaneously: $y = 6 - 3x$
 $3y + 4x = 8$ **(5 marks)**
10. Solve: $(x + 1)(x + 2) = (x - 3)^2 + 5$. **(4 marks)**
11. A chord 60 cm long is in a circle with a diameter 80 cm. How far is the chord from the centre of the circle? **(2 marks)**
12. An arc subtends an angle of 72° at the centre of the circle whose radius is 10 cm. Calculate the area of the minor sector of the circle. $\pi = 3.14$.
(2 marks)

SECTION B: Answer THREE questions (45 marks)

13. (a) 10 mathematics books and 5 physics books cost 220,000 Rwf; 6 mathematics books and 8 physics books cost 232,000 Rwf. Find the cost of one physics book. **(8 marks)**
(b) Solve: $6x^3 + 5x^2 - 22x - 24 = 0$. **(7 marks)**
14. (a) Using a ruler, a pair of compasses and a protractor only, construct a triangle ABC in which line AB = 7cm, line BC = 5cm and line AC = 8cm. **(6 marks)**
(b) Measure angles A, B and C. Write the measurements you have got. **(3 marks)**

- (c) Draw a perpendicular line from line A to side BC. How long is the perpendicular line? **(4 marks)**
 (d) Calculate the area of triangle ABC. **(2 marks)**

15. If A (2, 3), B(4, -2) and C(4, -2) are vertices of triangle BC.

- (a) Plot points A, B and C on a cartesian plane. Join the points to form a triangle ABC.
 (b) Determine the coordinates of A', B' and C', the images of A, B and C respectively after a reflection in line $x = 0$. Draw triangle ABC on the same Cartesian plane as in 17 (a).
 (c) What are the coordinates of A''B'' and C'', the images of A, B and C, under a translation described by $\begin{pmatrix} 2 \\ 1 \end{pmatrix}$? Draw triangle A''B''C'' on the same Cartesian plane as in 17 (a).

16. The masses of 50 boys are given in the table below:

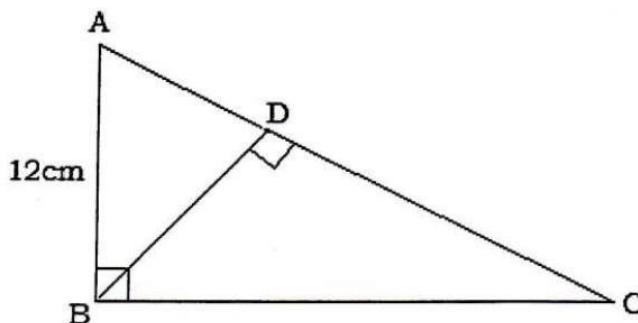
Mass (kg)	40 - 44	45 - 49	50 - 54	55 - 59
Frequency	15	18	13	4

- a) Find the modal class and its limits. **(2 marks)**
 b) Determine the working mean. **(1 mark)**
 c) Copy and complete the table using the data in the above table. **(8 marks)**

Class	Mid-interval of class x	Difference from the working mean d	Frequency	fd
40 - 44				
45 - 49				
50 - 54				
55 - 59				

- d) Find $\sum fd$. **(2 marks)**
 e) Calculate the mean mass. **(2 marks)**

17. In the figure below, triangle ABC and triangle BDC are right angled triangles.



- a) Show that triangle ABC is similar to triangle BDC. **(5 marks)**
 b) If the area of triangle ABC, find:
 i) The length DC. **(6 marks)**
 ii) The length BD **(2 marks)**

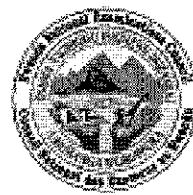
iii) The area of triangle BD.

(2 marks)

Mathematics VI

RWANDA NATIONAL EXAMINATIONS COUNCIL

012



31 Oct. 2007

8h30-11h30

P.O.BOX 3817 KIGALI-TEL/FAX : 586871

ORDINARY LEVEL NATIONAL EXAMINATION 2007

SUBJECT : MATHEMATICS VI

TIME : 3 HOURS

INSTRUCTIONS :

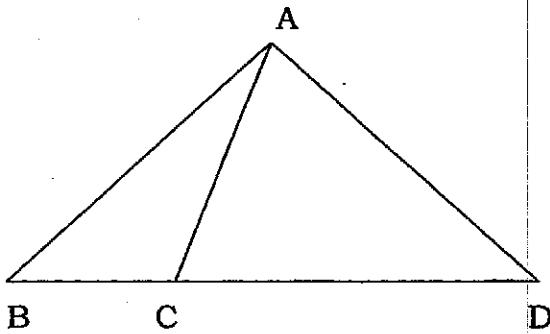
This paper has two sections A and B.

- Answer ALL questions in section A and THREE questions in section B.
- Show ALL the working clearly.
- **Calculators and mathematical instruments may be used except where otherwise stated.**
- Diagrams are not drawn to scale.

Section A : Answer ALL questions. (55 marks)

$$3.45^2 - 0.55^2$$

1. Calculate **without** using a calculator : $\frac{3.45^2 - 0.55^2}{4}$. **(3marks)**
2. Find the equation of the line through the points (0,2) and (2,10). **(3marks)**
3. Solve the quadratic equation : $2x^2 + 8x = -6$. **(3marks)**
4. In a class of 40 pupils, 30 play football and 23 play basketball. If 20 pupils play both games, how many pupils play neither? **(3marks)**
5. Given $f(x) = mx+n$, where m and n are integers and $f(0) = 2$, $f(-1) = -1$, find m and n. **(3marks)**
6. In the triangle ABD, angle ABD = x° , angle BAC = 40° , angle CAD = $2x^\circ$ and $\overline{AB} = \overline{AD}$. Find the size of angle ACD.



(3marks)

7. Solve the simultaneous equations :

$$2a + 3b = 16$$

$$4a + 5b = 28$$

(4marks)

8. Three pupils share 36 sweets in the ratio $m : 3m : 5m$. How many sweets does each pupil get? **(4marks)**
9. Solve the following inequality and illustrate the solution set on a number line : $0.25y - (y+1) \geq 3$. **(4marks)**

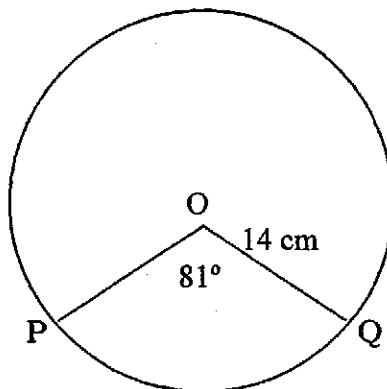
10. In the figure below, O is the centre of the circle.

Calculate : (a) the length of the major arc PQ.

(2marks)

(b) the area of the minor sector OPQ. ($\pi = \frac{22}{7}$).

(2marks)



11. 2,000,000frw is invested at 12% per year compound interest.

Find (a) the amount of investment after 3 years.

(2marks)

(b) the interest after 4 months.

(2marks)

12. Under enlargement the volume of a cube is 216 cm^3 . If the volume of the object cube is 27 cm^3 , find :

(a) Enlargement linear scale factor.

(2marks)

(b) The total surface area of the enlarged cube

(2marks)

13. Given vectors $\vec{a} = \begin{pmatrix} 7 \\ -3 \end{pmatrix}$, $\vec{b} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$ and $\vec{c} = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$,

find (a) the column vector for $\vec{a} + \vec{b} + \vec{c}$.

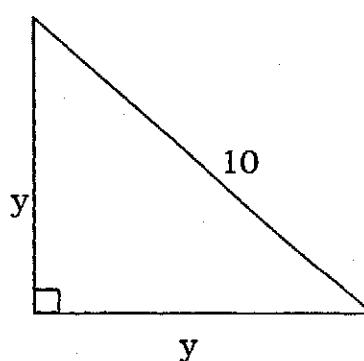
(1mark)

(b) the length of $\vec{a} + \vec{b} + \vec{c}$.

(3marks)

14. The figure below is a right angled triangle. Show that $y = 5\sqrt{2}$.

(4mark)



15. Find the image of the point (2,5) under :

(a) A reflection in $y = 2$.

(1mark)

(b) -90° rotation about (0,0).

(2marks)

(c) A translation $\begin{pmatrix} -3 \\ -1 \end{pmatrix}$.

(2marks)

SECTION B : Answer THREE questions only. (45 marks)

16. (a) Given the equation $2y + x = 6$

(i) complete the table below

x	-2		2	4
y		3		

(4marks)

(ii) Plot these points on the graph paper provided in your answer booklet and join them with a line.

(6marks)

(iii) Use letter A to indicate where you read the value of x when y = 0.

(1mark)

(iv) Write the value of x when y=0.

(1mark)

(b) On the same graph as that of 16 (a) (ii) draw the graph of $y = 2$.

Find the coordinates of intersection of $y = 2$ and $2y + x = 6$.

(3marks)

17. (a) Simplify : $\frac{2x+1}{3} - \frac{x+3}{2} + \frac{x+1}{6}$.

(5marks)

(b) Simplify completely : $\frac{3x^3 - 4x^2 - x + 2}{3x^2 - 6x + 3}$.

(10marks)

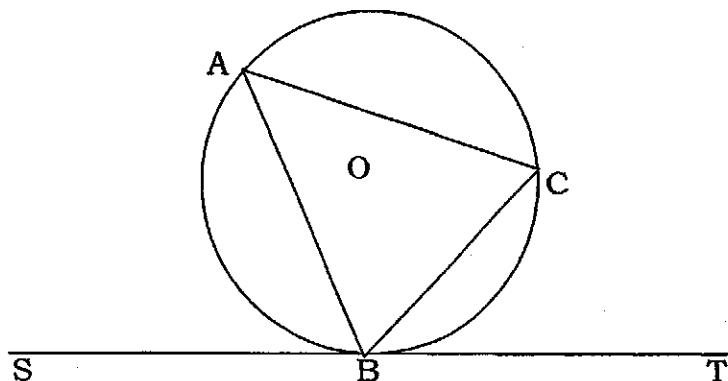
18. (a) Solve : $2x^4 + 4x^3 - 10x^2 - 12x = 0$.

(9marks)

(b) One of the roots of $ax^2 + 5x + 2 = 0$ is -2, find the other root.

(6marks)

19. In the figure below, O is the centre of the circle. The straight line SBT is a tangent to the circle.



(a) Show that angle CBT is equal to angle BAC. Give reasons to support your statements. (11marks)

(b) If angle ACB=37° and angle BAC = 64°, find
 (i) angle ABS.
 (ii) angle ABC.
 (iii) angle CBT. (1mark)
(2marks)
(1mark)

20. The table below shows the marks scored by 25 pupils in a mathematics test marked out of 50.

27	35	40	42	28	40	28	42	27
28	28	35	40	42	35	40	28	35
27	40	28	35	40	28	42.		

(a) Copy the table below and complete it using the above data.

Mark x	Frequency f	$f(x)$	Cumulative frequency

$$\sum f =$$

$$\sum f(x) =$$

(11marks)

- (b) Find the mode.
 (c) Find the median.
 (d) Find the mean.

(1mark)
(2marks)
(1mark)

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Mathematics VI

113

07 Nov 2006 08.30am -11.30 am

RWANDA NATIONAL EXAMINATIONS COUNCIL



P.O BOX 3817 KIGALI-TEL/FAX : 586871

ORDINARY LEVEL NATIONAL EXAMINATIONS 2006

SUBJECT: MATHEMATICS VI

LEVEL: TRONC COMMUN

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **TWO** sections **A** and **B**

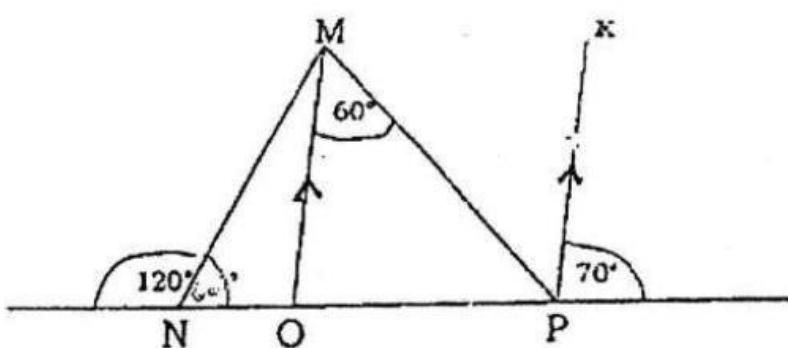
Attempt **ALL** questions in section **A** and **any THREE** questions in section **B**.

Show **ALL** working clearly.

Calculator and mathematical instruments may be used.

SECTION A: ANSWER ALL QUESTIONS**(55 MARKS)**

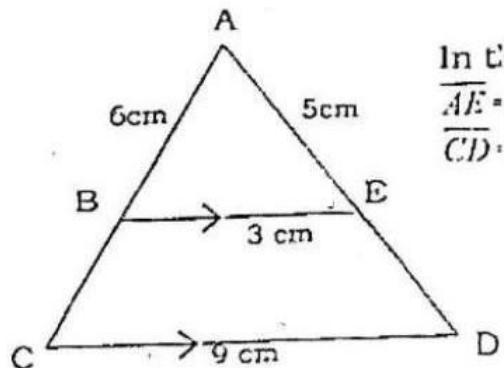
1. Simplify completely: $(0.4 \times 1\frac{2}{3}) - \frac{1}{6}$ **(3 marks)**
2. Solve for x : $3(x + 2) - 2(2x - 4) = x + 18$. **(3 marks)**
3. The simple interest for 5 years is 50,000Rwf, calculate the percentage interest rate per year. **(3 marks)**
4. Evaluate without using a calculator: $\frac{\sqrt{75} + \sqrt{27}}{\sqrt{12}}$ **(4 marks)**
5. Solve: $2x - 4 < 3x + 7$. Illustrate the solution on a graph. **(3 marks)**
- 6.



From the diagram, determine the size of:

- (a) Angle MOP **(0.5 mark)**
(b) Angle MPO **(1.5 marks)**
(c) Angle NMO **(3 marks)**
7. Given that $x = -2$ and $y = 4$, find the value of $xy^2 - 2(x - y)$ **(3 marks)**
 8. Plot the vectors to show that points R(0, 2), S(2, 4) and T(5, 7) are collinear (that the three points lie on the same line). **(4 marks)**
 9. M is inversely proportional to n. When $m = 4$, $n = 4$. Find n when $m = 2$. **(3 marks)**
 10. Given that functions $f(x) = x^2 - 1$ and $g(x) = 3x - 1$, find x when $fg(x) = 0$. **(4 marks)**

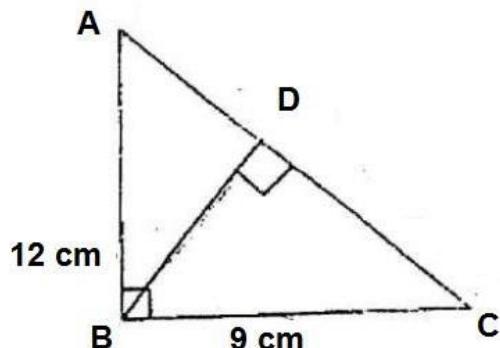
11. In the figure below, \overline{BE} is parallel to \overline{CD} . $\overline{AE} = 5\text{cm}$, $\overline{AB} = 6\text{cm}$, $\overline{BE} = 3\text{cm}$ and $\overline{CD} = 9\text{cm}$. Calculate: (a) Length BC
 (b) Length AD
- (2 marks)
 (2 marks)



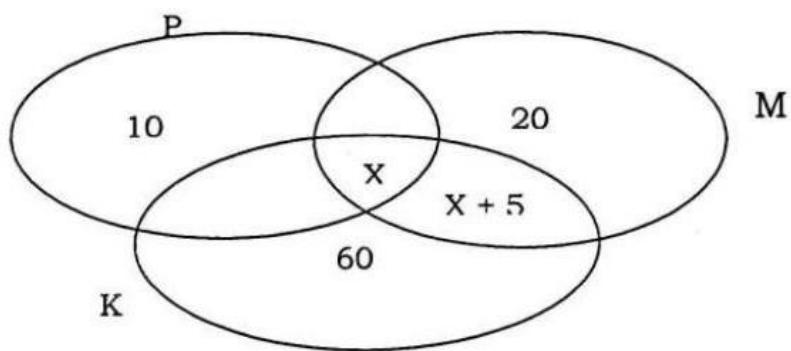
12. Solve the following simultaneous equations: (4 marks)

$$\begin{aligned}x + y &= 1 \\3x - 2y &= 8\end{aligned}$$

13. In the figure below ABC is a right angled triangle and \overline{BD} is perpendicular to \overline{AC} . Calculate \overline{BD} .



14. The Venn diagram below shows the number of senior three pupils in a school who like Mathematics (M), Physics (P) and Kinyarwanda (K). 55 pupils like Mathematics.



- a) How many pupils like the three subjects? (2 marks)

b) Find the total number of senior three pupils in the school. **(1 mark)**

c) Pupils who like Physics and Kinyarwanda only? **(1 mark)**

15. If one solution of $x^2 + ax + 6 = 0$ is -2 . Find a and the other solution. **(4 marks)**

SECTION B: Answer THREE questions (45 marks)

16. (a) Simplify completely: $\frac{6x^2+13x+6}{4x+6}$ **(5 marks)**

(b) Solve: $2x^3 + 9x^2 - 2x - 24 = 0$ **(10 marks)**

17. The weights of babies born during December 2005 at a hospital are shown in the table below:

Weight of babies	2.2	2.3	2.4	2.5	2.6	2.7	2.8	3.0
Frequency	4	2	1	5	6	8	4	9

- a) i) Find the total number of babies born in December 2005. **(1 mark)**
ii) Find the number of babies weighing more than 2.5 kg. **(1 mark)**
iii) Find the range of the masses. **(1 mark)**
iv) Find the mode of the class. **(1 mark)**
v) Find the median of the class. **(2 marks)**
vi) Find the mean mass. Correct the answer to one decimal place. **(5 marks)**

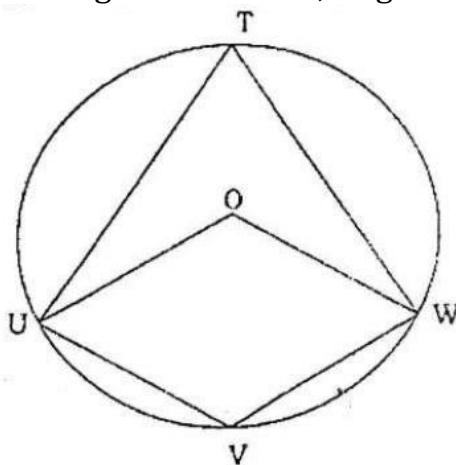
- b) If the ratio of baby girls to baby boys is 5:8, find the number of:
i) Baby girls born in December 2005. **(2 marks)**
ii) Baby boys born in December 2005. **(2 marks)**

18. (a) In a restaurant 3 cups of tea and 2 cups of coffee altogether cost 2900Rwf. In a hotel 4 cups of tea and 3 cups of coffee cost 4100Rwf. Find the cost of: i) a cup of tea.
ii) a cup of coffee. **(9 marks)**

(b) A car can be bought on cash or on hire purchase. The price of the car is 5,000,000 Rwf. By hire purchase, it can be bought by paying a 30% deposit of cash and the balance paid back in 7 months instalment of 600,000 Rwf.

- (i) Find the price of the car on hire purchase terms. **(4.5 marks)**
(ii) Calculate the extra money paid for the car by hire-purchase than cash. **(1.5 marks)**

19. The figure below is a circle with center O. Angle $UTW = 70^\circ$, angle $TWO = 40^\circ$ and angle $VUO = 35^\circ$, angle $UOW = y$, angle $TUO = z$ and $UVW = x^\circ$.



- (a) Calculate the size of angle i) x **(1 mark)**
ii) y **(1 mark)**
iii) z **(3 marks)**
iv) UWT **(3 marks)**
- (b) The length of minor arc UVW is 10.99cm. Calculate the area of the circle. $\pi = 3.14$. Correct the answer to one decimal place. **(7 marks)**
20. Points A (5, 4), B (2, 2) and C (6, 2) are vertices ABC.
- (a) Use the graph paper in your answer booklet and draw triangle ABC on a Cartesian plane.
- (b) Triangle ABC is rotated anti-clockwise about the origin. If the angle of rotation is $+90^\circ$, find:
- (i) The coordinates of A' , B' and C' the images of points A, B and C.
 - (ii) Draw triangle $A', B'C'$ on the same graph as in 20(a).
- (c) The image of A (5, 4) under a translation is (3, 3). Find coordinates of images of
- (d) The image of C (6, 2) under a reflection is (2, 2). Find the equation of reflection and image of A and B.

Mathematics VII

113

16 Nov. 2005

8h30 – 11h30

RWANDA NATIONAL EXAMINATIONS COUNCIL



P.O. BOX 3817 KIGALI-TEL/FAX : 586871

NATIONAL EXAMINATION 2005

SUBJECT : MATHEMATICS VII

LEVEL : TRONC-COMMUN

DURATION : 3 HOURS

INSTRUCTIONS :

- This paper has TWO Sections A and B.
- Answer all questions in Section A and **any three** questions in Section B.
- Calculators and mathematical instruments may be used.

SECTION A : Answer ALL questions (55 Marks)

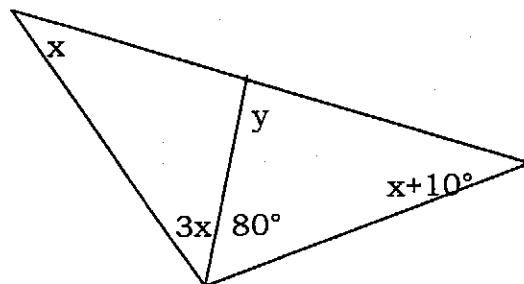
1. Simplify $(2\frac{1}{2} \div 7\frac{1}{2}) + \frac{1}{4}$. (3marks)
2. Given that $f(x) = 2(x - 1)$, find
 - (a) $f(-2)$. (1mark)
 - (b) the value of x such that $f(x) = -8$. (2marks)
3. Simplify the following completely: $\frac{3(m-y) - 2(m-3y)}{m^2 - 9y^2}$. (3marks)
4. At a certain factory, the salary of a worker for 40 hours per week is 20 000frw. The worker is paid 10% of the weekly salary for every 2 hours that he works overtime. If at the end of a certain week he received 36 000frw, find the number of hours he worked overtime. (3marks)
5. Solve the inequality: $2y - \frac{7(y-1)}{2} > 17$. (3marks)
6. It is given that $\vec{x} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$ and $\vec{y} = \begin{pmatrix} 12 \\ 9 \end{pmatrix}$. Find
 - (a) the column vector of $\vec{y} - \vec{x}$. (1mark)
 - (b) the value of $|\vec{x}| + |\vec{y}|$. (3marks)
7. The equation of line A is $2y = 3x + 4$. Line B passes through points $(1;0)$ and $(a;2)$. If line A is parallel to line B, find the value of a . (4marks)
8. In the diagram below show that triangle CDE is similar to triangle CAB.

 (4marks)
9. Musa, Sarah and Peter share 1000kg of sugar in the ratio $2:x:5$ respectively. If Musa gets 200kg of sugar, how much sugar does Sarah get? (4marks)

10. Solve $(x + 3)(x - 4) = 18$.

(4marks)

11. In the figure below find the value of y .



(4marks)

12. (a) Copy the table below and complete it.

x	1	2	4	8		20
y			5		2	1

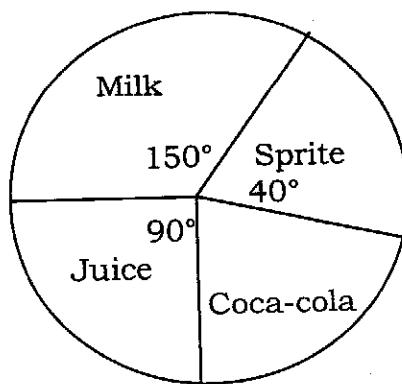
(3marks)
(1mark)

(b) Find the equation connecting x and y .

13. Determine the area enclosed by the lines
 $x = 3$, $y = -1$ and $x + y = 5$.

(4marks)

14. The pie chart below shows the drinks popularly liked by students in a certain school.



If 60 students like sprite, determine

(3marks)
(1mark)

- (a) the number of students who like each type of drink.
(b) the total number of students in the school.

15. A (3,0) is a point in a Cartesian plane.

(a) If A(3,0) is mapped on to point B(5,2) by a translation, find the image of C(2,-3) under the same translation.

(2marks)

(b) Find the coordinates of image of A

(i) under a reflection in y-axis.

(1mark)
(1mark)

(ii) under a quarter turn rotation about the origin.

SECTION B: Answer any THREE questions (45 Marks)

16. (a) Solve simultaneously:

$$\begin{aligned}x + y &= 3 \\ 2x^2 + y^2 + 3x &= 15\end{aligned}$$

(10marks)

(b) Use answer from 16(a) and solve: $\frac{m^2y - 3m + 2}{4 - y} = 0$.

(5marks)

17. The table below shows the ages of 31 secondary school students:

15	14	15	16	17	18	14	20	17
16	20	17	19	19	14	15	20	14
18	19	17	20	17	14	14	15	18
20	19	14	19					

(a) Copy the table below and complete it.

Ages (x)	Frequency (f)	fx	Commutative frequency
	$\sum f =$	$\sum fx =$	

(b) State the mode.

(1 ½ marks)

(c) Find the median age.

(1mark)

(d) Calculate the average age.

(1 ½ marks)

(1mark)

18. (a) Solve: $2x^3 - 5x^2 - 9x + 18 = 0$, $x \in \mathbb{R}$.

(10marks)

(b) Factorise and simplify completely: $\frac{x^4 - 6x^3 + 9x^2}{x^3 - 3x^2}$.

(5marks)

19. The distance between two schools G and K is 432km. A bus transporting students leaves school G at 7.00 a.m for school K. The bus travels at an average speed of 72 km/h. One and half hours later a mini-bus leaves school G at a steady speed of 108km/h heading for school K. All the two vehicles travel non stop until they arrive in school K.

(a) Calculate the times when the two vehicles arrive in school K. (3marks)

(b) On a graph and on the same axes show the journeys of the two vehicles.

(8marks)

- (c) Use your graph to estimate the
- (i) time and distance from school G when the minibus overtakes the bus. **(2marks)**
 - (ii) the distance at 10.00 a.m between the two vehicles. **(1mark)**
 - (iii) the time when the bus is 16km behind the mini-bus. **(1mark)**

20. A sample of 100 men was taken to find out how many were literate (L), married (M) or had an income generating project (P).
The following were the findings:

$$n(L) = 47, n(M) = 59, n(P) = 52, n(L \cap M) = 30$$

$$n(L \cap P) = 24 \text{ and } n(M \cap P) = 34.$$

14 of the men were literate, unmarried and without an income generating project.

- (a) Represent this information on Venn diagram. **(9marks)**
- (b) Determine the number of men who were
 - (i) literate, married and had an income generating project. **(3marks)**
 - (ii) neither literate nor married. **(3marks)**

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