Name…… ADM. Number: …….

School: …..……..... Candidate's Signature ……...……..

121
Mathematics Alt. A
FORM THREE.
AUGUST 2022.
2 ½ Hours.

URANGA MATHEMATICS ASSOCIATION-2022.

Kenya Certificate of Secondary Education

MATHEMATICS
121
FORM THREE
TIME: 2 ½ HOURS

INSTRUCTIONS TO CANDIDATES:

- Write your name, school, admission number and sign in the spaces provided above.
- This paper contains **TWO** sections: Section **I** and Section **II**.
- Answer **ALL** the questions in Section **I** and **FIVE** questions from section **II**.
- All answers and working **MUST** be written on the question paper in the spaces provided below each question.
- Marks may be given for correct working even if the answer is wrong.
- Non-programmable silent electronic calculators and KNEC Mathematical tables may be used, except where stated otherwise.

FOR EXAMINERS USE ONLY

SECTION I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
3	3	3	3	3	3	4	3	3	3	3	3	4	3	3	3	50

SECTION II

17	18	19	20	21	22	23	24	Total
10	10	10	10	10	10	10	10	50

Grand Total 100%

This marking scheme consists of 14 printed pages. Erasures alterations and additions at time of coordination accepted

SECTION I (50Mks)

Attempt ALL Questions from this section

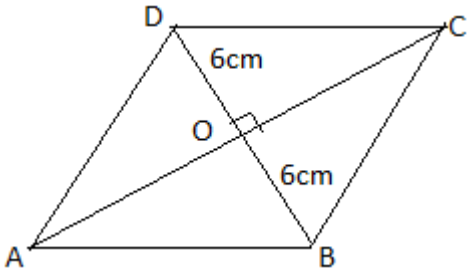
1. **Evaluate without using tables or calculator** $\frac{-2(-3^2+5)-12\div 3\ of 4}{5^{-1}-12\div 10+6}$ (3 marks)

Numerator $-2(-9+5)-12\div 12$ $-2(-4)-1$ $8-1=7$	Denominator $\frac{1}{5}-\frac{6}{5}+6$ $-1+6=5$ …. $=\frac{7}{5}=1\frac{2}{5}$	M1 M1 A1

2. **Solve the following simultaneous equation** $2^{2x+y}=8\ and\ 3^{x-y}=1$ (3 marks)

$2^{2x+y}=2^3$ $3^{x-y}=3^0$ $2x+y=3$ $x-y=0$ $3x=\quad 3$	$x=1$ $y=1$	M1 M1 A1

3. **The perimeter of a rhombus is 40 cm. Its shorter diagonal is 12 cm. Calculate its:**
   a) **Longer diagonal** (1 mark)
   b) **Height** (2 marks)

	a) One side $\frac{40}{4}=10cm$ AC=$2(\sqrt{100-36}=16cm$ b) $Area=10h=\frac{1}{2}d_1\times d_2$ $h=\frac{1}{20}\times 12\times 16$ $=9.6cm$	B1 M1 A1

4. **Under an enlargement the images of C (3, 1) and D (5, 0) are C' (1, 5) and D' (7, 2) respectively. Calculate the scale factor and the Centre of enlargement.** (3 marks)

Let Centre be $O(a,b)$ and scale$= k$ $OC'=kOC$ $OD' = kOD$ $\begin{pmatrix}1-a\\5-b\end{pmatrix}=k\begin{pmatrix}3-a\\1-b\end{pmatrix}$ $\begin{pmatrix}7-a\\2-b\end{pmatrix}=k\begin{pmatrix}5-a\\0-b\end{pmatrix}$ $1-a=3k-ak,\quad 7-a=5k-ak$ $5-b=\ k-bk,\quad 2-b=0k-bk$	$1-a=3k-ak,\quad 5-b=\ k-bk,$ $7-a=5k-ak\quad 2-b=0k-bk$ $-6\ =\ -2k\quad or\ 3\ =\ k$ $k=3$ $1-a=3(3)-a(3),\quad 2-b=0(3)-b(3)$ $1-9=-3a+a,\quad 2=-3b+b$ $-8=-2a\quad 2=-2b$ $a=4\quad b=-1$ $O(4,-1)$	M1 M1 A1

ALTERNATIVELY

Equations of lines $CC' : y=-2x+7$ and DD': $y=x-5$ meet at O, the Centre of enlargement solve simultaneously to obtain O(4,-1) Scale factor k=$\left\lvert\frac{OC'}{OC}\right\rvert=\left\lvert\frac{OD'}{OD}\right\rvert$ $=\ \frac{\left\lvert\binom{4-1}{-1-5}\right\rvert}{\left\lvert\binom{4-3}{-1-1}\right\rvert}=\frac{\left\lvert\binom{4-7}{-1-2}\right\rvert}{\left\lvert\binom{4-5}{-1-0}\right\rvert}$	$=\frac{\left\lvert\binom{3}{-6}\right\rvert}{\left\lvert\binom{1}{-2}\right\rvert}=\frac{\left\lvert\binom{-3}{-3}\right\rvert}{\left\lvert\binom{-1}{-1}\right\rvert}$ $\frac{\sqrt{45}}{\sqrt{5}}=\frac{\sqrt{18}}{\sqrt{2}}$ $\sqrt{\frac{45}{5}}=\sqrt{\frac{18}{2}}$ $=\sqrt{9}=\sqrt{9}$ k =3	B1 M1 A1

5. **Make d the subject of the formula** $\boldsymbol{p=\frac{1}{2}mn^2-\frac{gd^2}{n}}$ (3marks)

$\frac{gd^2}{n}=\frac{1}{2}mn^2-p$ $d^2=\left(\frac{1}{2}mn^2-p\right)$	$d^2=\frac{mn^3}{2g}-\frac{np}{g}$ $d=\pm\sqrt{\frac{mn^3}{2g}-\frac{np}{g}}$	M1 M1 A1

6. **The volumes of two similar solid cylinders are 4752 cm^3 and 1408 cm^3. If the area of the curved surface of the smaller cylinder is 352 cm^2, find the area of the curved surface of the larger cylinder.** (3 marks)

$Vsf = \frac{4752}{1408} = \frac{27}{8}$ $Lsf = \sqrt[3]{\frac{27}{8}} = \frac{3}{2}$ Asf= $\frac{A}{a} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$	$A = \frac{9}{4}a$ $A = \frac{9}{4} \times 352$ =792 cm^2,	M1 M1 A1

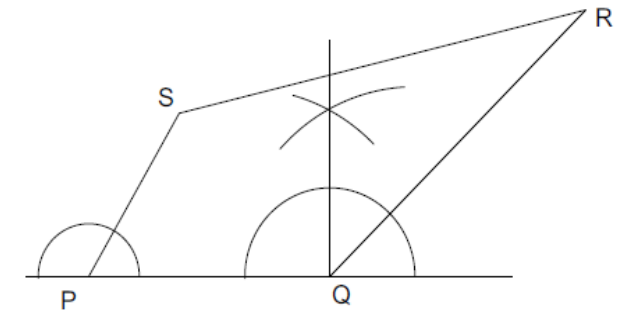
7. **A rectangular card measures 5.3cm by 2.5cm. find**
   a) **The absolute error in the area of the card.** (2marks)
   b) **The relative error in the area of the card** (2marks)

Max area= $5.35 \times 2.55 = 13.6425$ True area= $5.3 \times 2.5 = 13.25$ Min area = $5.25 \times 2.45 = 12.8625$ a) Ae=$\frac{13.6425-12.8625}{2} = 0.39$ b) Re =$\frac{0.39}{13.25} = 0.0288\ldots$ Accept 0.029	Alternative True area= $5.3 \times 2.5 = 13.25$ b) Re= $\frac{0.05}{5.3} + \frac{0.05}{2.5} = 0.02943$ a) Ae= $Re \times true\ area$ $0.02943 \times 13.25 = 0.38994$ Accept 0.39	M1 A1 M1 A1

8. **A customer deposited sh 14000 in a saving account. Find the accumulated amount after one year if interest was paid at 12% p.a compounded quarterly** (3marks)

$n = 1 \div \frac{1}{4} = 4$ $r = 12 \times \frac{1}{4} = 3$	A= $14000\left(1 + \frac{3}{100}\right)^4$ $= 15{,}757.12$	B1 M1 A1

9. **Use a ruler and a pair of compasses in this question.**
   (a) **Construct a quadrilateral PQRS in which PQ = 4 cm, QR = 6 cm, PS = 3cm, angle PQR = 135^0 and angle SPQ = 60^0.** (3 marks)

	B1 B1 B1

10. **A bus left Kitale at 8.00 a.m. and travelled towards Lodwar at an average speed of 80 km/h. At 8.30 a.m a car left Lodwar towards Kitale at an average speed of 120km/h. Given that the distance between Kitale and Lodwar is 400km. Calculate the time the two vehicles met.** (3marks)

Dist travelled by bus before car left $= 80 \times \frac{1}{2} = 40km$ Distance uncovered at 8.30am =360km	Time taken= $\frac{360}{200} = 1hr48min$ 08.30+1.48 =10.18am	

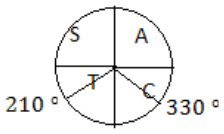
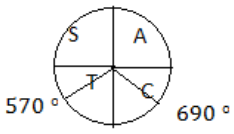
11. The sum of n terms of the sequence 3, 9, 15, 21 ... is 7500. Determine the value of n (3marks)

$a = 3, d = 6$ $7500 = \frac{n}{2}(2(3) + (n-1)6)$ $7500 = \frac{n}{2}(6 + (n-1)6)$ $7500 = \frac{6n}{2}(1 + (n-1))$	$2500 = n(n)$ $n^2 = 2500$ $n = \pm 50$ $n = 50$	M1 M1 A1

12. **Simplify the expression** $\frac{16m^2-9n^2}{4m^2-mn-3n^2}$ (3marks)

Numerator $16m^2 - 9n^2 = (4m+3n)(4m-3n)$ Denominator $4m^2 - 4mn + 3mn - 3n^2$ $4m(m-n) + 3n(m-n)$ $(m-n)(4m+3n)$	$\frac{\cancel{(4m+3n)}(4m-3n)}{(m-n)\cancel{(4m+3n)}}$ $= \frac{(4m-3n)}{(m-n)}$	M1 M1 A1

13. **Solve the equation** $\boldsymbol{Sin\,(2x+10)° = -0.5\ for\ 0° \leq x \leq 360°}$ (4marks)

$(2x+10)° = \sin^{-1} -0.5$ $= 30° \ reflex$ angles $10° \leq 2x + 10 \leq 730°$   	$2x + 10 = 210°,$ $330°$ $570°$ $690°$ $x = 100°, 160°, 280°, 340°$	B1 B1 B1 B1

14. **Use matrix method to solve the given simultaneous equation** **3x+y=7** (3marks)

5x+2y=12

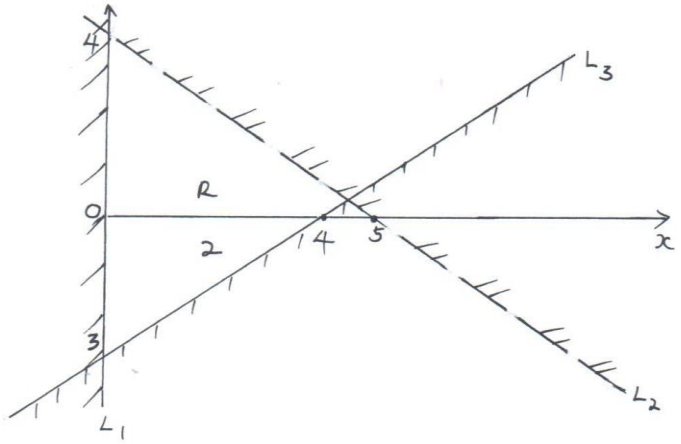
$\begin{bmatrix}3 & 1\\5 & 2\end{bmatrix}\begin{bmatrix}x\\y\end{bmatrix}=\begin{bmatrix}7\\12\end{bmatrix}$ $\begin{bmatrix}x\\y\end{bmatrix}=\begin{bmatrix}2 & -1\\-5 & 3\end{bmatrix}\begin{bmatrix}7\\12\end{bmatrix}$	$\begin{bmatrix}x\\y\end{bmatrix}=\begin{bmatrix}2\\1\end{bmatrix}$ $x=2, y=1$	M1 M1 A1

15. Use square roots and reciprocals tables to evaluate to 4 significant figures the expression.

$(0.06458)^{\frac{1}{2}}+\frac{2}{0.4327}$ (3 marks)

$(6.458\times10^{-2})^{\frac{1}{2}}$ 2.5413×10^{-1} 0.25413 $2(0.4327)^{-1}$	$=2(4.327\times10^{-1})^{-1}$ $=2\times(4.327)^{-1}\times10^{1}$ $=20\times0.2311$ $=4.622$ $=0.25413+4.622$ $=4.87613$	M1 M1 A1

16.Find the inequalities that define the region R shown in the figure below. (3 marks)

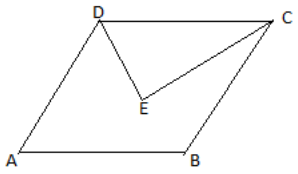


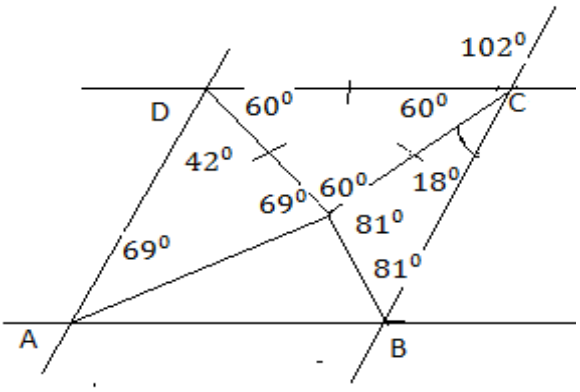
$x=0,$	$x\geq0$	Accept equivalents	B1
$\frac{x}{5}+\frac{y}{4}=1,$ $4x+5y=20,$	$4x+5y<20$		B1
$\frac{x}{4}+\frac{y}{-3}=1,$ $-3x+4y=-12$	$3x-4y\geq12$		B1

SECTION II (50Mks)

Answer five questions only in this section.

17. In the figure below ABCD is a rhombus and CDE is an equilateral triangle. Angle BCE = 18^0





Calculate the following angles.

a) **Angle ABC** (2 marks)

$180^0 - (60^0 + 18^0) = 102^0$		M1 A1

b) **Angle ADE** (2 marks)

$102^0 - 60^0 = 42^0$		M1 A1

c) **Angle DAE** (2 marks)

$\frac{1}{2}(180^0 - 42^0) = 69^0$		M1 A1

d) **Angle BEC** (2 marks)

$\frac{1}{2}(180^0 - 18^0) = 81^0$		M1 A1

e) **Angle AEB** (2 marks)

$360^0 - (69^0 + 60^0 + 81^0) = 150^0$		M1 A1

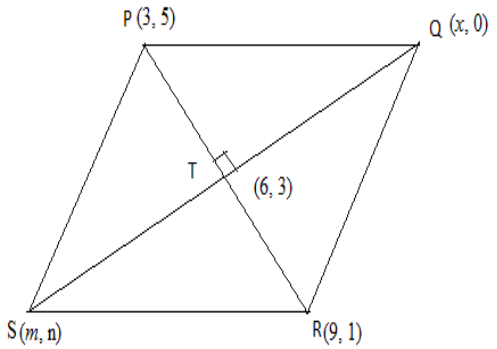
18. a) A straight line L_1 which is perpendicular to line L_2 meets L_2 whose equation is 2y+3x=5 at a point where x=3. Find the equation of line L_1 in double intercept form.

(4 marks)

$L_2: \ y = \frac{-3}{2}x + \frac{5}{2}$ $m1 = \frac{2}{3}$ $y = \frac{-3}{2}(3) + \frac{5}{2} = -2$ $(3, -2)$	$\frac{y+2}{x-3} = \frac{2}{3}$ $y = \frac{2}{3}x - 4$ $\frac{x}{6} + \frac{y}{-4} = 1$	B1 B1 M1 A1

b) A rhombus PQRS is such that Q lies on the x axis. P (3, 5) and R (9, 1) determine the coordinates of

i) **Q** (4 marks)

 $T = \left(\frac{9+3}{2}, \frac{5+1}{2}\right) = T(6,3)$	$\overrightarrow{PR}\ grad = \frac{5-1}{3-9} = \frac{-2}{3}$ $\overrightarrow{SQ}\ grad = \frac{3}{2}$ $\overrightarrow{SQ}\ Equation: \frac{y-3}{x-6} = \frac{3}{2}$ $y = \frac{3}{2}x - 6$ $0 = \frac{3}{2}x - 6, x = 4$ $Q(4,0)$	B1 M1 M1 A1

ii) **S** (2 marks)

$6 = \frac{4+m}{2} \ \ m = 8$ $3 = \frac{0+n}{2}, \ n = 6$	$S = (8,6)$	M1 A1

19. Nyongesa is a sales executive earning a salary of Kshs. 120,000 and a commission of 8% for the sales in excess of Kshs. 1,000,000. If in January he earned a total of Kshs. 480,000 in salaries and commission.

(a) **Determine the amount of sales he made in the month of January.** (4 marks)

Commission $= 480{,}000 - 120{,}000$ $= 360{,}000$ $360{,}000 = 8\%(S - 1{,}000{,}000)$	$S - 1{,}000{,}000 = 360{,}000 \times \frac{100}{8}$ $S = 1{,}000{,}000 + 4{,}500{,}000$ $S =$ Kshs 5,500,000	M1 A1 M1 A1

(b) **If the total sales in the month of February increased by 18% and in the month of March dropped by 30% respectively;**

Calculate:-

(i) **Nyongesa's commission in the month of February.** (3 marks)

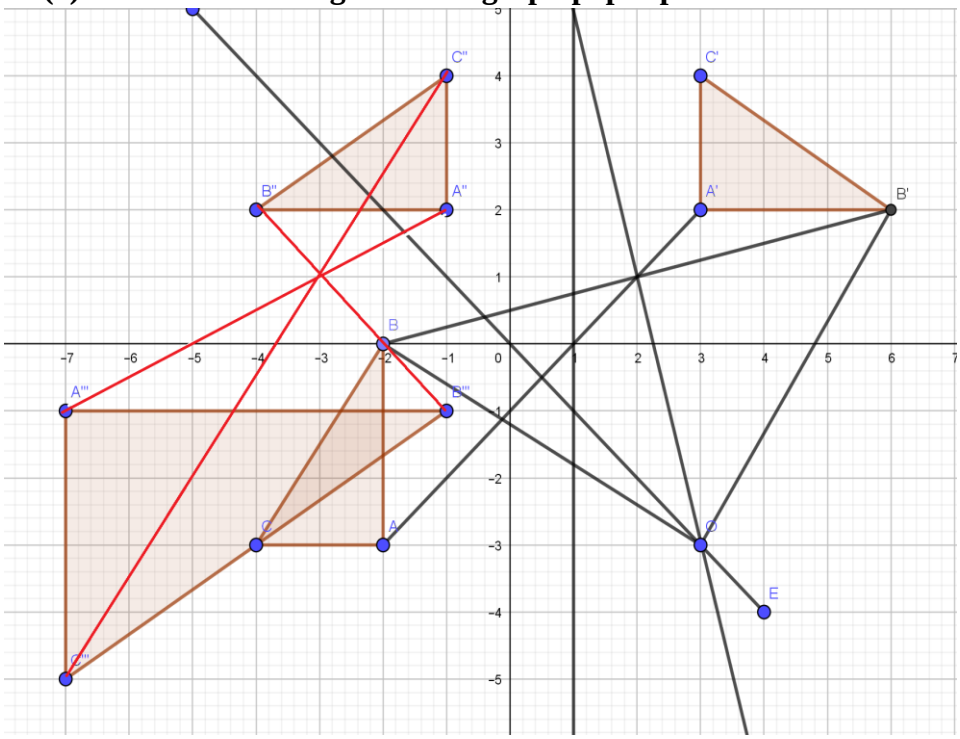
Feb sales$= \frac{118}{100} \times 5{,}500{,}000$ $=$ Kshs 6,490,000	Commission $= 8\% \times (6{,}490{,}000 - 1{,}000{,}000)$ Kshs 439,200	M1 M1 A1

(ii) **His total earning in the month of March.** (3 marks)

March sales$= \frac{70}{100} \times 6{,}490{,}000$ $=$ Kshs 4,543,000	Commission $= 8\% \times (4{,}543{,}000 - 1{,}000{,}000)$ 283,440 283,440 + 120,000 = Kshs 403,440	M1 M1 A1

20. A'(3,2), B'(6,2), C'(3,4) is the image of A(-2,-3), B(-2,0), C(-4, -3) respectively under a rotation.

(a) Plot the two triangles on the graph paper provided. (2 marks)



B1

B1

(b) By use of construction find the Centre and angle of rotation. (3 marks)

B1

B1

B1

(c) A" B"C" is the image of A'B'C' under a reflection in the line x=1. Plot A" B"C" on the same grid. (2 marks)

L1

B1

(d) A"'B"'C"' is the image of A" B"C" under an enlargement scale factor -2, Centre (-3,1). Plot A"'B"'C"' on the same grid. (2 marks)

B1

B1

(e) State the pair of triangles that are oppositely congruent. (1 mark)

- ABC and A" B"C"

OR

A" B"C" and A' B'C' B1

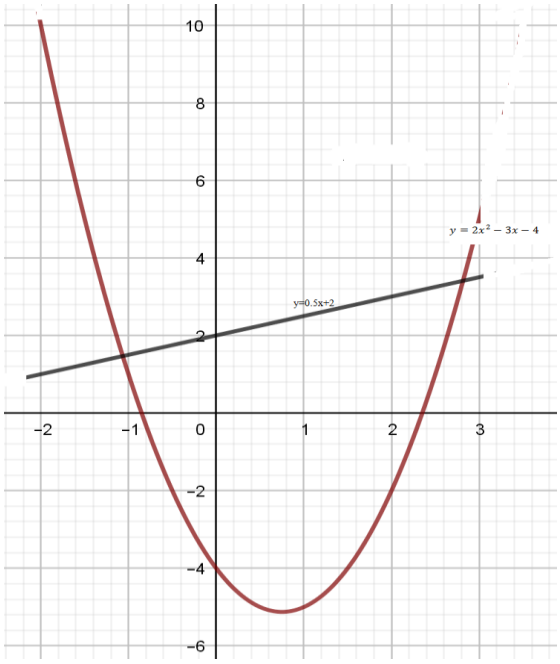
21. **(a) Complete the table below for the function $y = 2x^2 - 3x - 4$ for $-4 \leq x \leq 2$** (2 marks)

x	-2	-1	0	1	2	3
$2x^2$	**8**	2	0	2	8	**18**
$-3x - 4$	2	**-1**	-4	**-7**	**-10**	-13
y	**10**	**1**	-4	**-5**	**-2**	5

B1 5≤ correct values< 9

B2 all values correct

(b) On the grid below, draw the graph of $y = 2x^2 - 3x - 4 = 0$ for $-2 \leq x \leq 3$ (3 marks)



P1

C1

S1

(c) Use your graph to estimate the roots of $2x^2 - 3x - 4 = 0$ (2 marks)

-0.8 B1

2.4 B1

(d) Use your graph to solve $4x^2 - 7x = 12$ (3 marks)

$y = 0.5x + 2$ L1

-1.1 B1

2.8 B1

22. The marks scored by a certain number of students in a mathematics contest are as shown in the table below.

Marks	45-49	50-54	55-59	60-64	65-69	70-74	75-79	totals
f	10	11	14	41	27	18	19	140
x	47	52	57	62	67	72	77	
fx	470	572	798	2542	1809	1296	1463	8950
Cum f	10	21	35	76	103	121	140	

B1 fx column values
B1 cum f values

(a) **Calculate to 2d.p. the mean of the marks scored.** (4 marks)

$\bar{x} = \frac{\sum fx}{\sum f} = \frac{8950}{140}$ M1

$= 63.928571$ A1

$= 63.92$ B1

(b) **State the median class and hence calculate the median.** (4 marks)

Median position$= \frac{140}{2} = 70^{th}$ B1

Median $= 59.5 + \frac{(70-35)5}{41}$ M1

$= 63.76829268$ accept 63.77 A1

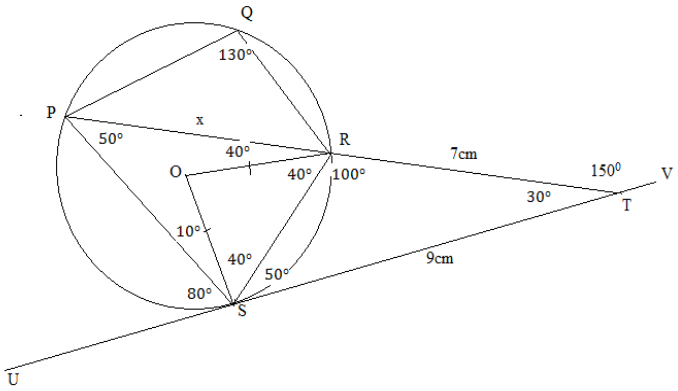
(c) **Calculate the difference between the mean and the median.** (1 mark)

$63.92 - 63.77 = 0.16$ B1

(d) **State the modal class.** (1 mark)

$60 - 64$ B1

23. In the diagram shown below O is the Centre of the circle, angle RTV=150^0 and angle RST=$50^{0,}$



a) Calculate the size of

i. <ORS (2marks)

$\frac{1}{2}(180° - 100°)$ M1

$= 40°$ A1

ii. **<USP** (2marks)

$180° - (50° + 40° + 10°)$ M1

$= 80°$ A1

iii. **<PQR** (2marks)

$180° - (40° + 10°)$ M1

$= 130°$ A1

b) Given that RT =7cm and ST=9cm, calculate to 3.s.f

i. **The length of line PR** (2marks)

$7(7 + x) = 9^2$ M1

$x = \frac{81}{7} - 7$

$= 4.5714$ A1

ii. **The radius of the circle** (2marks)

$\frac{x}{\sin 50} = 2r$ M1

$r = \frac{4.5714}{2(sin50°)}$

$= 2.984cm$ A1

24. The table below shows income tax rates for certain year.

Monthly income in Kenya Shillings (Kshs)	Taxable income	Tax rate in each shillings
0 – 10164	10164	10%
10165 – 19740	9576	15%
19740 – 29316	9576	20%
29317 – 38892	9576	25%
Over 38892		30%

A tax relief of Kshs. 1162 per month was allowed. In a certain month of the year, an employee's taxable income in the fifth band was Ksh. 2108. Calculate

a) **Employees total income in that month** (2marks)

$38892 + \frac{2108 \times 100}{30}$ M1

$= 45{,}918.\dot{6}$, Accept 45,918.70 A1

b) **The tax payable by the employee in that month.** (5marks)

Slab 1	$10{,}164 \times 10\% = 1{,}016.40$	M1
Slab 2	$9{,}576 \times 15\% = 1{,}436.40$	
Slab 3	$9{,}576 \times 20\% = 1{,}915.20$	
Slab 4	$9{,}576 \times 25\% = 2{,}394.00$	
Slab 5	2,108.00	M1
Gross tax	8,870.00	A1
Net tax/tax payable	$8{,}870.00 - 1162.00$	M1
	$= 7708.00$	A1

c) **The employee's income includes a house allowance of Ksh. 15,000 per month. The employees contributed 5% basic salary to a cooperative. Calculate the employee net pay for that month.** (3marks)

$BS = 45{,}918.70 - 15000 = 30{,}918.70$

Coop contr.$= 30{,}918.70 \times 5\% = \mathbf{1{,}545.935}$ B1

Net pay $= 45{,}918.70 - (1{,}545.935 + 7708.00)$ M1

$= 36{,}664.765$ accept 36,664.80 A1