SKY-SCORES SERIES
2025 SET 1

NAME:……………………………………ADM NO………………CLASS………………

DATE……………………………………………SIGN:………………………….

121/2
MATHEMATICS
PAPER 2
TIME: 2 ½ HOURS

INSTRUCTIONS TO CANDIDATES

1. Write your name, index number, class and school in the spaces provided above.
2. This paper consists of TWO sections I & II
3. Answer ALL the questions in section I and only FIVE questions from section II
4. All answers and working must be written on the question paper in the spaces provided below each question.
5. Show all the steps in your calculations giving your answers at each stage in the spaces below each question.
6. Marks may be given for correct working even if the answer is wrong.
7. Non-programmable silent electronic calculators and KNEC mathematical tables may be used except where stated otherwise.

FOR EXAMINERS USE ONLY

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

17	18	19	20	21	22	23	24	TOTAL

GRAND TOTAL

SECTION I (50 MARKS)

Answer ALL Questions in this Section

1. By the completing the square method solve for x in $4x^2 + 6x = 5$ (3mks)

Make the coefficient of x^2 to be 1, we get $x^2 + \frac{6}{4}x = \frac{5}{4}$. Add $\left(\frac{b}{2}\right)^2$ to both sides i.e.

$\left(\frac{6}{4} \div 2\right)^2 = \left(\frac{3}{4}\right)^2$ $x^2 + \frac{6}{4}x + \left(\frac{3}{4}\right)^2 = \frac{5}{4} + \left(\frac{3}{4}\right)^2$ $\left(x + \frac{3}{4}\right)^2 = \frac{5}{4} + \frac{9}{16}$ $x + \frac{3}{4} = \sqrt{\frac{20+9}{16}}$	$x + \frac{3}{4} = \sqrt{\frac{29}{16}}$ $x + 0.75 = \pm 1.34629$ $x = 1.34629 - 0.75$ $x = 0.5963$ $x = -1.34629 - 0.75$ $x = -2.0963$

2. The length and width of a rectangle is stated as 12.40cm and 8.5cm respectively. Calculate the percentage error in the area of the rectangle. (3mks)

Working product = 12.40×8.5 $= 105.4$ Maximum product = 12.405×8.55 $= 106.06275$ Minimum product = 12.395×8.45 $= 104.73775$ Absolute error = $\frac{106.06275 - 104.73775}{2}$ $= 0.6625$	Relative error = $\frac{0.6625}{105.4}$ $= 0.00629$ Percentage error = 0.006286×100 = 0.6286%

3. Solve the equation sin 2x = 0.6428 for values of x in the range -180 ≤ x ≤ 180 (4mks)

Sine is positive in 1 st and 2 nd quadrants Sin 2x = 0.6428 $\beta = \sin^{-1} 0.6428$ So $\beta = 40^0$ We will take $2x = \beta,\ (\beta - 360^0),\ (180^0 - \beta)\ and\ (180^0 - \beta) - 360^0$ This gives us the solutions 2x = 40, 140, -320, -220 x= 20^0, 70^0, -160^0, -110^0

4. Given that $\frac{3}{3+\sqrt{5}} + \frac{3\sqrt{5}}{3-\sqrt{5}} = a + b\sqrt{5}$. Find the values of a and b (3mks)

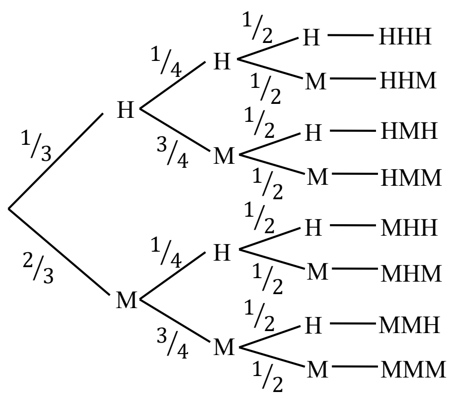
$$= \frac{3(3-\sqrt{5})+3\sqrt{5}(3+\sqrt{5})}{(3+\sqrt{5})(3-\sqrt{5})}$$

$$= \frac{3-3\sqrt{5}+9\sqrt{5}+3\times5}{9-3\sqrt{5}+3\sqrt{5}-5}$$

$$\frac{14+6\sqrt{5}}{4} = \frac{14}{4} + \frac{6\sqrt{7}}{4}$$

a $= \frac{7}{2} = 3\frac{1}{2}$ b = $= \frac{3}{2} = 1\frac{1}{2}$

5. In a shooting practice three soldiers A, B and C aim at a target. The probabilities of A, B or C hitting the target are $\frac{1}{3}$, $\frac{1}{4}$ and $\frac{1}{2}$ respectively. The three soldiers shoot at the target only once; one after the other. What is the probability that the target was hit only once? (3mks)



P(HMM) + P(MHM) + P(MMH)

$$=\left(\frac{1}{3}\times\frac{3}{4}\times\frac{1}{2}\right)+\left(\frac{2}{3}\times\frac{1}{4}\times\frac{1}{2}\right)+\left(\frac{2}{3}\times\frac{3}{4}\times\frac{1}{2}\right)$$

$$=\frac{1}{8}+\frac{1}{12}+\frac{1}{4}=\frac{11}{24}$$

6. The cash price of a cooker was shs.7500. Fatuma bought it on hire purchase by first making a down payment of shs.2250 and 15 equal monthly instalments of shs.550 each. Calculate the carrying charge and the rate of interest charged per month (3mks)

Borrowed loan=7500-2250=5250 Instalments =15×550=8250 Carrying Charge (Interest paid) =8250-5250 =shs.3000 Rate of interest $A = p\left(1+\frac{r}{100}\right)^n$	$8250 = 5250\left(1+\frac{r}{100}\right)^{15}$ $\left(1+\frac{r}{100}\right) = \left(\frac{8250}{5250}\right)^{\frac{1}{15}}$ $1+\frac{r}{100} = 1.03059$ $r = 3.059\%$

7. Given that log8=0.9031 and log7=0.8451 find log 87.5 (3mks)

$87.5 = \frac{7\times100}{8}$

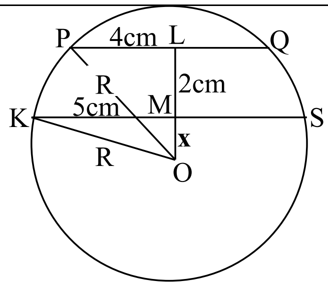
$log87.5 = log\frac{7\times100}{8}$

$= log7 + log100 - log8$

$= 0.8451+2+0.9031$

$= 1.942$

8. Two chords PQ and RS are parallel and 2cm apart. If PQ = 8cm and RS = 10cm, find the radius of the circle (3mks)



Considering triangle PLO

$R^2 = 4^2 + (2+x)^2$ and

KMO $R^2 = 5^2 + x^2$

$16+(2+x)^2 = 25+x^2$

$x^2 + 4x + 4 - x^2 = 9$

x = 1.25cm

$R^2 = 25 + 1.25^2$

R=5.154cm

9. The square of a quantity m varies partly as the square of t and partly as the cube of r. Find the percentage change in r when m and t are each decreased by 10% (3mks)

$m^2 = ct^2 + kr^3$ Make r the subject $r^3 = \frac{m^2-ct^2}{k}$ Let the change in r be p% $\left(\frac{p}{100}r\right)^3 = \frac{(0.9m)^2-c(0.9t)^2}{k}$ $\frac{p^3}{1000000}r^3 = \frac{0.81m^2-0.81ct^2}{k}$	$\frac{p^3}{1000000}r^3 = 0.81\left(\frac{m^2-ct^2}{k}\right)$ $\frac{p^3}{1000000} = 0.81$ $p^3 = 810,00$ $\sqrt[3]{p^3} = \sqrt[3]{810000}$ $p = 93.217$ 100-93.217=6.783% decrease

10. (a) expand $(a-b)^6$ (1mk)

$1(a)^6(-b)^0 + 6(a)^5(-b)^1 + 15(a)^4(-b)^2 + 20(a)^3(-b)^3 + 15(a)^2(-b)^4 + 6(a)^1(-b)^5 + 1(a)^0(-b)^6$

$= a^6 - 6a^5b + 15a^4b^2 - 20a^3b^3 + 15a^2b^4 - 6ab^5 + b^6$

(b) Use the first three terms of the expansion in (a) to find the approximate value of $(1.98)^6$ (2mks)

$1.98 = 2 - 0.02$

$a = 2$

$b = 0.02$

$=(2)^6 - 6(2)^5(0.02) + 15(2)^4(0.02)^2$

$= 60.256$

11. The first, the third and the seventh term of an increasing arithmetic progression are three consecutive terms of a geometric progression if the first term of the arithmetic progression is 10. Find the common difference of the arithmetic progression (3mks)

For the AP

n^{th} *term* $= a + (n-d)d$

AP terms $a, a+2d, a+6d$

$10, 10+2d, 10+6d$

For the GP n^{th} *term* $= ar^{n-1}$

Any consecutive terms a, ar, ar^2

$\frac{ar}{a} = \frac{10+2d}{10}$ and $\frac{ar^2}{ar} = \frac{10+6d}{10+2d}$

$r = \frac{10+2d}{10}$ and $r = \frac{10+6d}{10+2d}$

$\frac{10+2d}{10} = \frac{10+6d}{10+2d}$

$(10+2d)(10+2d) = 10(10+6d)$

$100 + 20d + 20d + 4d^2 = 100 + 60d$

$4d^2 = 20d$

$d = 5$

12. State the amplitude, period, phase angle and phase shift given that $y = 3sin\left(\frac{1}{2}x - 60\right)$.

Amplitude= 3

Period$=\frac{360}{b} = 360 \div \frac{1}{2}$

$= 360 \times 2 = 720^0$

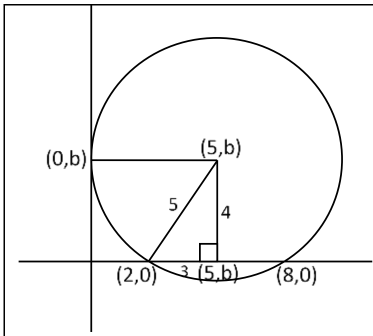
Phase angle$=60^0$,

Phase shift$=\frac{\vartheta}{b} = -60 \div \frac{1}{2}$.

$= -60 \times 2 = -120^0$

(3mks)

13. Find the equation of a circle that passes through (2,0) and (8,0) and also touches the y-axis (3mks)



R= $\sqrt{(5-0)^2+(b-b)^2} = \sqrt{25} = 5$

$R^2 = (5-2)^2 + (b-0)^2$

$9 + b^2 = 25$

b= ± 4

(a,b) = (5,4) or (5,-4)

Equation

Either (i) $(x-5)^2 + (y-4)^2 = 25$

or (ii) $(x-5)^2 + (y+4)^2 = 25$

14. Pipe X can fill an empty tank in 3 hrs while pipe Y can fill the same tank in 6 hrs. When the tank is full it can be emptied by pipe Z in 8 hrs. Pipe X and Y are opened at the same time when the tank is empty. If one hr later pipe Z is also opened, find the total time taken to fill the tank. (3mks)

<u>In 1 hr</u>

Filling

$X = \frac{1}{3}, \quad Y = \frac{1}{6}$

Emptying

$Z = \frac{1}{8}$

In 1 hr

Both X and Y fills

$\frac{1}{3} + \frac{1}{6} = \frac{1}{2}$

After 1 hr the tank is $\frac{1}{2}$ *full*

so $\frac{1}{2}$ *empty.*

All pipes in 1 hr fill

$\rightarrow \frac{1}{3} + \frac{1}{6} - \frac{1}{8} = \frac{8+4-3}{24}$

$= \frac{9}{24} = \frac{3}{8}$

So to fill the empty portion

$\frac{3}{8}$ *=1 hr*

$\frac{1}{2}$ *=x hrs*

$x = \frac{1}{2} \div \frac{3}{8} = \frac{1}{2} \times \frac{8}{3} = \frac{4}{3} = 1\frac{1}{3}$ *hrs*

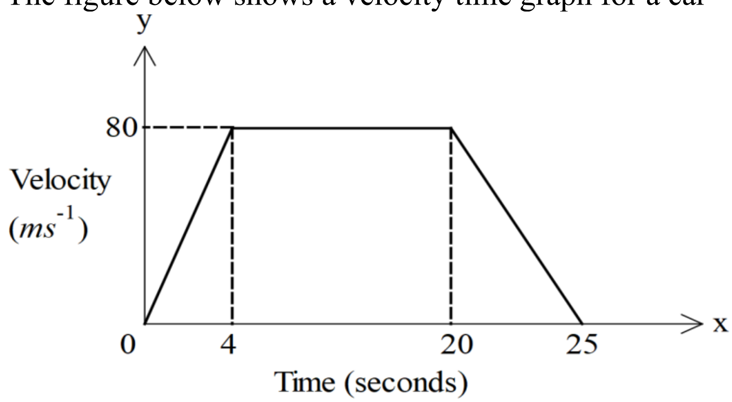
Total time taken

$= 1 + 1\frac{1}{3} = 2\frac{1}{3}$ *hrs*

15. A transformation is represented by the matrix $\begin{pmatrix} 1 & 2 \\ 3 & 2 \end{pmatrix}$. This transformation maps a triangle ABC of the area $3cm^2$ onto another triangle $A'B'C'$. Find the area of triangle $A'B'C'$. (3mks)

$Det = 2 - 6 = -4$
Det=ASF=4
Area of image =$4 \times 3 = 12cm^2$

16. The figure below shows a velocity time graph for a car



(i) Find the total distance travelled by the car (2mks)

$$= \frac{1}{2}(16 + 25)80$$
$$= 1640m$$

(ii) Calculate the deceleration of the car (2mks)

$$= \frac{0 - \frac{80m}{s}}{25 - 20s}$$
$$= -16m/s^2$$

SECTION II (50 MARKS)
Answer only five questions from this section

17. The distribution of masses (to the nearest kg) of 100 men was as follows.

Mass(kg)	50-54	55-59	60-64	65-69	70-74
No of men	1	2	4	12	22
	75-79	80-84	85-89	90-94	95-99
	20	18	11	6	4

(a) Calculate the semi-interquartile range (3mks)

weight	f	cf	x	$d = x - A$	fd	t^2	fd^2
50-54	1	1	52	-15	-15	225	225
55-59	2	3	57	-10	-20	100	200
60-64	4	7	62	-5	-20	25	100
65-69	12	19	67	0	0	0	0
70-74	22	41	72	5	110	25	550
75-79	20	61	77	10	200	100	2000
80-84	18	79	82	15	270	225	4050
85-89	11	90	87	20	220	400	4400
90-94	6	96	92	25	150	625	3750
95-99	4	100	97	30	120	900	3600
	$\sum f = 100$				$\sum fd = 1015$		$\sum fd^2 = 18,875$

Semi-interquartile range (quartile deviation)

$$= \frac{Interquartile\ range}{2} = \frac{Q_3 - Q_1}{2}$$

$$Q_3 = L + \left(\frac{\frac{3}{4}N - C}{f}\right)i = 79.5 + \left(\frac{\frac{3}{4} \times 100 - 61}{18}\right)5$$

$$= 79.5 + \left(\frac{75 - 61}{18}\right)5 = 79.5 + 3.889 = 83.39$$

$$Q_1 = L + \left(\frac{\frac{1}{4}N - C}{f}\right)i = 69.5 + \left(\frac{\frac{1}{4} \times 100 - 19}{22}\right)5$$

$$= 69.5 + \left(\frac{25 - 19}{22}\right)5 = 69.5 + 1.3636 = 70.86$$

$$Semi - interquartile\ range = \frac{83.39 - 70.86}{2} = 6.265$$

(b) Using an assumed mean of 67, calculate

(i) The mean (3mks)

$$Mean = A + \frac{\sum fd}{\sum f} = 67 + \frac{1015}{100}$$

$$= 67 + 10.15 = 77.15$$

(ii) The standard deviation (4mks)

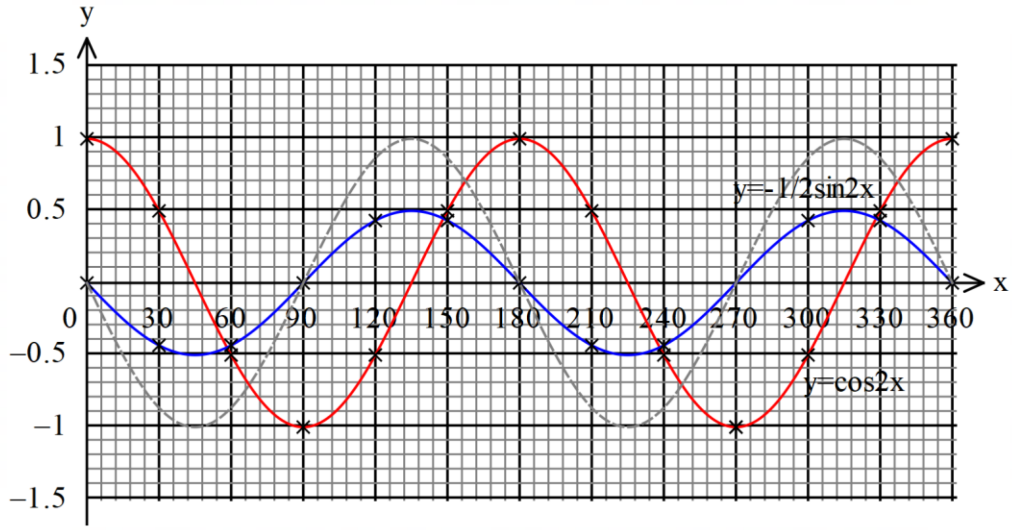
$$SD = \sqrt{\frac{\sum fd^2}{\sum f} - \left(\frac{\sum fd}{\sum f}\right)^2} = \sqrt{\frac{18875}{100} - \left(\frac{1015}{100}\right)^2}$$

$$= \sqrt{188.75 - 103.0225} = \sqrt{85.7275} = 9.259$$

18. (i) Use the graph of $y = cos2x$ and $y = -\frac{1}{2}sin2x$ to fill the table below for $0^0 \leq x \leq 360^0$. (2mks)

x	0^0	60^0	120^0	180^0	240^0	300^0	360^0
$cos2x$	1	-0.5	-0.5	1	-0.5	-0.5	1
$-\frac{1}{2}sin2x$	0	-0.433	0.433	0	-0.433	-0.433	0

(ii) On the same grid draw the graph of $y = cos2x$ and $y = -\frac{1}{2}sin2x$ (2mks)



(iii) State the period and the amplitude of the two waves (2mks)

The amplitude of $y = cos2x$ is 1 unit while period is 180^0 and the amplitude of $y = -\frac{1}{2}sin2x$ is 0.5 units while period is 180^0

(iv) Use the graph to solve the equation given by $-\frac{1}{2}sin2x = cos2x$ (2mks)

$x = 60^0, 150^0, 240^0, 330^0$

(v) Identify two transformations that maps the graph of $y = -\frac{1}{2}sin2x$ onto the graph of $y = cos2x$ (2mks)

Stretch of scale factor 2 with x-axis invariant followed by stretch of scale factor 2 with y-axis invariant

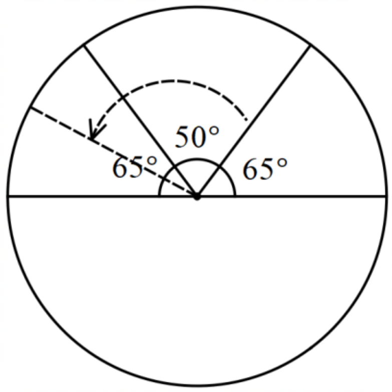
19. An aircraft takes off from an airport at P $(65^0N, 36^0E)$ and flies by the shortest route to another airport at Q $(K^0N,\ 144^0W)$ covering a total distance of 4,800 nautical miles

(a) Find the value of K (3mks)

$Along\ great\ circle$

$60nm = 1^0$

$4800nm = \frac{4800 \times 1}{60} = 80^0$



$80^0 - 50^0 = 30^0$

$65^0 - 30^0 = 35^0$

$K = 35^0$

(b) If instead the aircraft had flown along latitude 65^0 N and then along meridian 144^0 W to point Q, find how much further it would have flown in nautical miles. (3mks)

$1^0 = 60cos\beta nm$

$180^0 = 60 \times 180^0 cos65nm$

$= 4564nm$

$1^0 = 60nm$

$30^0 = 60 \times 60nm$

$= 1800nm$

$4564 + 1800 = 6364nm$

$6364 - 4800 = 1564nm$

(c) Two aircrafts take off from P and Q at the same time. Given that both fly at the same speed and that one follows the shortest route and the other flies the route described in (ii) above, state the position of the second aircraft at the time the first is landing at Q. (2mks)

$4800 - 4564 = 236nm$

$60nm = 1^0$

$236nm = \frac{236}{60} = 3.9^0$

$65 - 3.9 = 61.1^0$

$(61.1^0N, 144^0W)$

(d) If the aircraft arrived at airport Q at 1846hrs local time, what was the local time at airport P? (2mks)

$180 \times 4 = 720min$

$\frac{720}{60} = 12hrs$

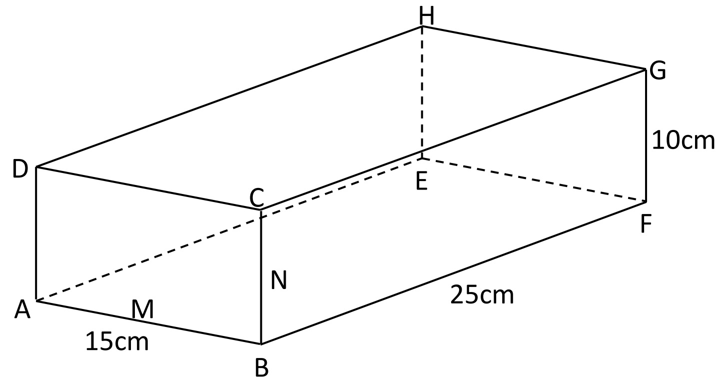
$1846hrs$

-1200

$0646hrs$

$6.46am$

20. The figure below shows a cuboid ABCDEFGH width 15cm, length 25cm and a height of 10cm.



Points M and N are midpoints of AB and BC respectively. Another point Q (not shown) lies on MN such that MQ=QN. Calculate the angle between

(a) Line CE and plane CGHD (3mks)

Ans = 10.97 cm

(b) Line NE and plane ABFE (2mks)

Ans=33.17 ^{0}

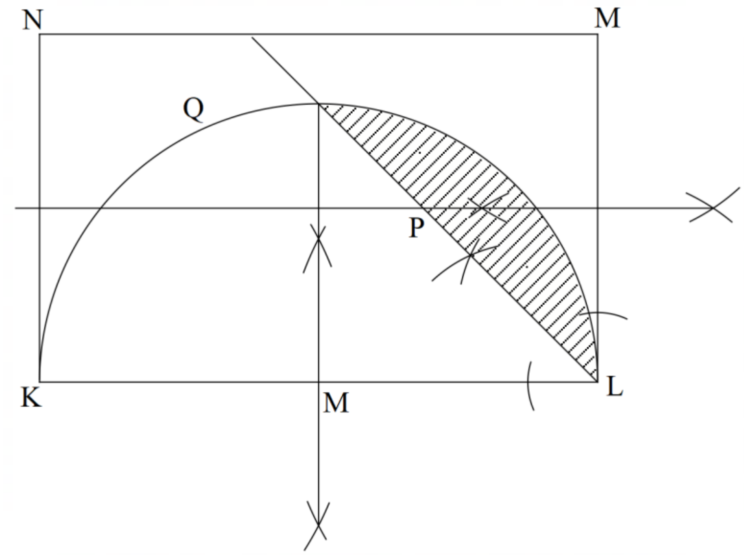
(c) Lines MN and FH (2mks)

Ans=60.64^{0}

(d) Planes QEH and FGHE. (3mks)

Ans=36.87^{0}

21. The figure KLMN below is a scale drawing of a rectangular piece of land of length KL=80m.



(a) On the figure, construct;

(i) The locus of a point P which is both equidistant from points L and M and from lines KL and LM

The locus of point P is the intersection of locus equidistant from points L and M and from lines KL and LM.

(ii) The locus of a point Q such that <KLM=90^0.

The locus of a point Q such that <KLM=$90^0$is the arc radius KM

(b) (i) Shade the region R bounded by the locus of Q and the locus of points equidistant from KL and LM,

(ii) Find the area of the region R in m^2. (Take π=3.142)

Area of the region R

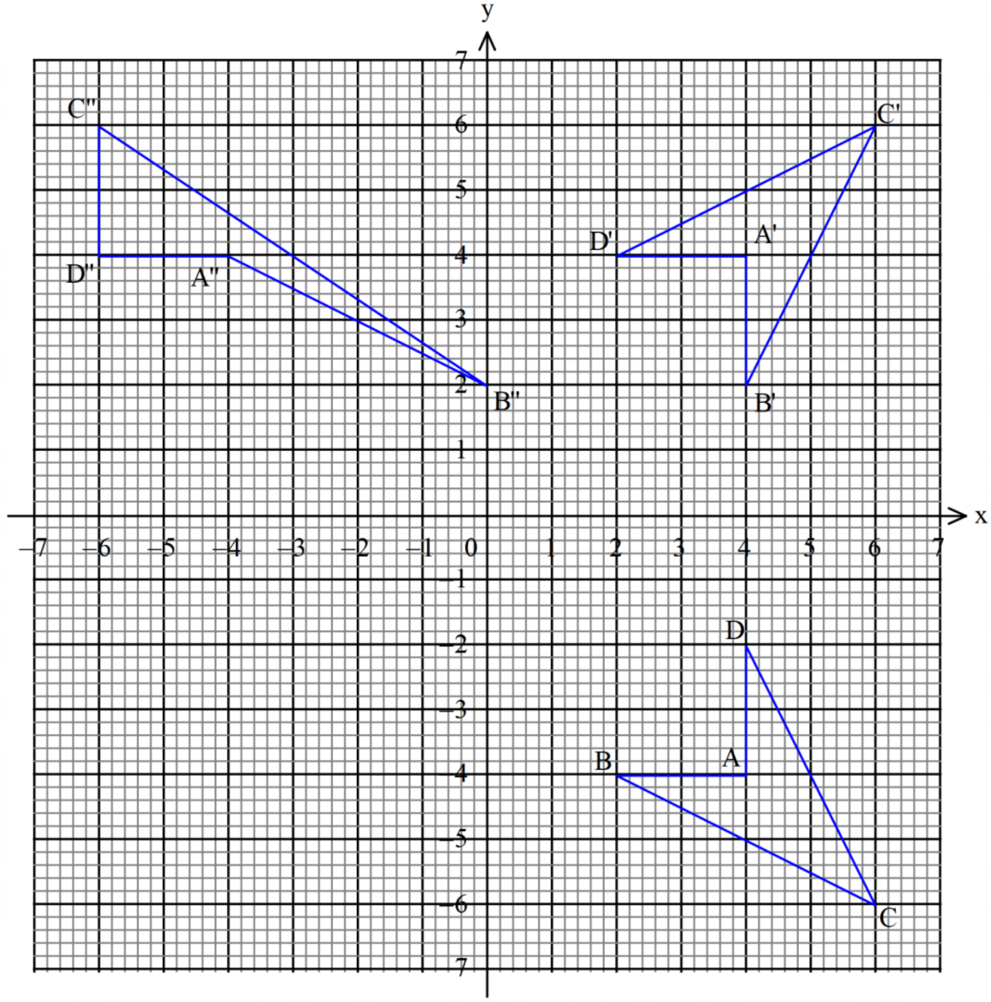
$= \frac{90}{360} \times 3.143 \times 40 \times 40 - \frac{1}{2} \times 40 \times 40$

$= 1256.8 - 800$

$= 456.8m^2$

22. A quadrilateral $ABCD$ has vertices A (4, -4), B (2, -4), C (6, -6), D (4, -2).

(a) On the grid provided draw the quadrilateral $ABCD$



(b) $A'B'C'D'$ is the image of ABCD under a positive quarter turn about the origin. On the same grid draw the image $A'B'C'D'$.

$A'(4,4), B'(4,2), C'(6,6), D'(2,4)$

(c) $A''B''C''D''$ is the image of $A'B'C'D'$ under the transformation given by the matrix $\begin{pmatrix} 1 & -2 \\ 0 & 1 \end{pmatrix}$.

(i) Determine the coordinates of $A''B''C''D''$.

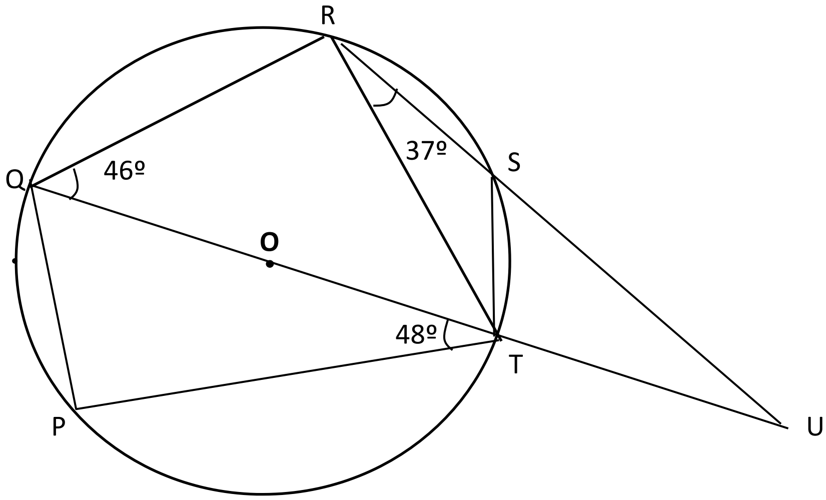
$A''(-4,4), B''(0,2), C''(-6,6), D''(-6,4)$

(ii) On the same grid draw the quadrilateral $A''B''C''D''$.

(d) Determine a single matrix that maps $ABCD$ onto $A''B''C''D''$

$\begin{pmatrix} -2 & -1 \\ 1 & 0 \end{pmatrix}$

23. In the diagram below, line QOT is a diameter. ∠QTP = 48°, ∠TQR = 46° and ∠SRT = 37°



Calculate, giving reasons in each case: -

(a) ∠RST = 180° – 46° = 134°
Opposite angel in cyclic quadrilateral
(b) ∠SUT = 180° – (46° +37° +90°)
= 180° – 173° = 7°
Sum of angles in a traingle QRU
(c) ∠ROT = 2 x 46° = 92°
Angle substended by chord RT at the centre
(d) ∠PST = 180° – (37° + 48° +44° +9°)=42° Sum of angles in a triangle PST
(e) Reflex ∠SOP = (2x 37°) + (2x 42°) = 158° . Angle subtended chord at centres is twice angle at circle
Reflex angle 360°-158°=202°

24. A tailoring business makes two types of garments, A and B. Garment A requires 3metres of material while garment B requires $2\frac{1}{2}$ metres of material. The business uses not more than 600metres of material in making both garments. It must make not more than 100 garments of type A and not less than 80 of type B each day.

(a) Write down four inequalities to represent the above information. (4mks)

$3x+2.5y \leq 600$,
$x \leq 100$
$y \geq 80$
$x \geq 0$

(b) Graph the above inequalities (3mks)

(c) If the business makes a profit of shs80 on garment A and a profit of shs60 on garment B, how many garments of each type must it make to maximize its total profit (assume all the garments are sold on the same day). (3mks)

Type A = 100
Type B = 120