Name: MARKING GUIDE .... Class: .... Adm.No................

School: .... Date: ....

Sign:...

121/2
MATHEMATICS
PAPER 2
TIME: 2 ½ HOURS

KASSU JET EXAMINATION - 2021

Kenya Certificate to Secondary Education

Instructions

- *Write your name, class, admission number, school, date and signature in spaces provided above.*
- *The paper contains **two** sections **A** and **B.***
- *Answer **all** questions in section **A** and **any five** questions from section **B** in the spaces provided below each question.*
- *Show all the steps in your calculations giving your answers at each stage in the spaces below each question.*
- *Non-programmable silent electronic calculator and mathematical tables may be used except where stated otherwise.*

For Examiner's Use Only

SECTION A

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

SECTION B

17	18	19	20	21	22	23	24	TOTAL

PERCENTAGE SCORE

SECTION A (50 MARKS)

*(Answer **all** questions in this section in the spaces provided)*

1. Use logarithm table to evaluate. (4mks)

$$\sqrt[4]{\frac{(27\times 0.0293)^2}{\underbrace{(825-94)}_{731}\div 0.2861}}$$

No	std form	log table
27	2.7×10^1	1.4314
0.0293	2.93×10^{-2}	$\bar{2}.4669$ +
		$\bar{1}.8983$
		× 2
		$\bar{1}.7966$
731	7.31×10^2	2.8639
0.2861	2.861×10^{-1}	$\bar{1}.4566$ −
		3.5073
		$\bar{4}.2893\times\frac{1}{4}$
0.1181	$10^{-1}\times1.181$	$\bar{1}.07231$

2. Three sisters, Ann, Beatrice and Caroline together invested Ksh. 48,000 as capital and started a small business. If the share of profit is Ksh. 2,300, Ksh. 1,700 and Ksh. 800 respectively, shared proportionally. Find the capital invested by each of them. (3mks)

A : B : C

~~2300~~ : ~~1700~~ : ~~800~~

23 : 17 : 8

$\frac{23}{48} : \frac{17}{48} : \frac{8}{48}$

Ann $= \frac{23}{48}\times 48{,}000 = \text{sh. } \underline{23{,}000}$ ✓

Beatrice $= \frac{17}{48}\times 48{,}000 = \text{sh. } \underline{17{,}000}$ ✓

Caroline $= \frac{8}{48}\times 48{,}000 = \text{sh. } \underline{8{,}000}$ ✓

3. Make t the subject of formula in $x = (\frac{p+t}{t})^{\frac{1}{3}}$ (3mks)

$(x)^3 = \left[\left(\frac{p+t}{t}\right)^{\frac{1}{3}}\right]^3$

$\frac{x^3}{1} = \frac{p+t}{t}$

$x^3 t = p + t$

$x^3 t - t = p$

$\frac{t(x^3-1)}{(x^3-1)} = \frac{p}{x^3-1}$

$\therefore t = \underline{\frac{p}{(x^3-1)}}$ ✓

4. Without using a calculator or mathematical tables, express $\frac{\sqrt{3}}{1-\cos 30^0}$ in surd form and simplify. (3mks)

$\cos 30 = \frac{\sqrt{3}}{2}$

$$\frac{(\sqrt{3})2}{\left(1-\frac{\sqrt{3}}{2}\right)2}$$

$$\frac{2\sqrt{3}\,(2+\sqrt{3})}{(2-\sqrt{3})(2+\sqrt{3})}$$

$$=\frac{4\sqrt{3}+6}{4-3}$$

$$=\frac{4\sqrt{3}+6}{1}$$

$$=\underline{\underline{4\sqrt{3}+6}}$$

5. Expand and simplify $(3x-y)^4$ hence use the first three terms of the expansion to approximate the value of $(6-0.2)^4$. (3mks)

$$1.(3x)^4(-y)^0 + 4.(3x)^3(-y)^1 + 6.(3x)^2(-y)^2 + 4.(3x)^1(-y)^3 + 1(3x)^0(-y)^4$$

$$81x^4 + -108x^3y + 54x^2y^2 - 12xy^3 + y^4.$$

$$\underline{81x^4 - 108x^3y + 54x^2y^2 - 12xy^3 + y^4}$$

$3x = 6 \qquad -y = -0.2$

$\underline{\underline{x = 2}} \qquad \underline{\underline{y = 0.2}}$

$$= 81x^4 - 108x^3y + 54x^2y^2$$

$$= 81(2)^4 - (108.8.0.2) + (54.4.0.04)$$

$$= 324 - 172.8 + 8.64$$

$$= \underline{\underline{159.84}}$$

6. Find x without using tables if $3 + \log_2 3 + \log_2 x = \log_2 5 + 2$ (3mks)

$$3(\log_2 2) + \log_2 3 + \log_2 x = \log_2 5 + 2(\log_2 2)$$

$$\log_2 8 + \log_2 3 + \log_2 x = \log_2 5 + \log_2 4$$

$$\log_2(8\times 3\times x) = \log_2(5\times 4)$$

$$\frac{24x}{24} = \frac{20}{24}$$

$$\underline{\underline{x = \frac{5}{6}}}$$

7. Find the value of m for which the matrix transforms an object into a straight line. (3mks)

$$\begin{pmatrix} m^2 & 1 \\ 2m-1 & 1 \end{pmatrix} \Rightarrow \text{Singular Matrix}$$

$(M^2 \times 1) - (2M-1)1 = 0$

$M^2 - (2M-1) = 0$ $\quad S = -2$

$M^2 - 2M + 1 = 0$ $\quad P = 1$

$(M^2 - M)(M+1) = 0$ $\quad (-1, -1)$

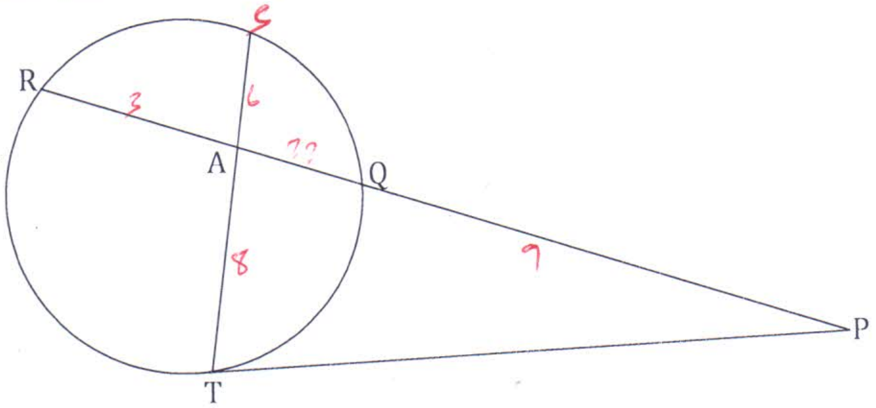
$M(M-1) - 1(M-1) = 0$

$(M-1)(M-1) = 0$

$M - 1 = 0 \quad M = 1$

$M - 1 = 0 \quad M = 1$

8. In the figure below PT is a tangent to the circle at T, PQ = 9cm, SA = 6cm, AT = 8cm and AR = 3cm. Calculate the length of;



(a) AQ (2mks)

$\frac{8 \times 6}{3} = \frac{3 \times AQ}{3}$

$AQ = 16cm$

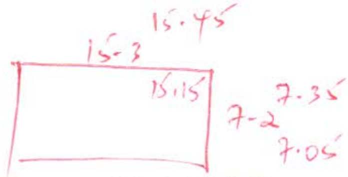
(b) PT (1mk)

$9 \times 28 = PT^2$

$PT = \sqrt{9 \times 28}$

$= \sqrt{252}$

$= 15.8745cm$



9. A right angled triangle has a base of 15.3 cm and height 7.2 cm, each measured to the nearest 3 mm. Determine the percentage error in finding the area of the triangle, giving your answer to 2 decimal places. (3mks)

Actual Area $= 15.3 \times 7.2 = 110.16$

Max. Area $= 15.45 \times 7.35 = 113.5575$

Min. Area $= 15.15 \times 7.05 = 106.8075$

$|E| = \frac{106.8075 - 113.5575}{2}$

$= \frac{6.75}{2} = 3.375$

$\% E = \frac{|E|}{A.A} \times 100$

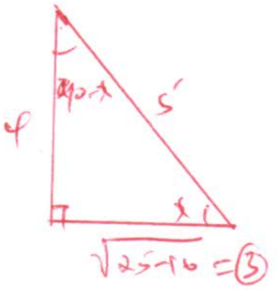
$= \frac{3.375}{110.16} \times 100$

$= 3.0637254901960784$

$= 3.06$

10. Given that sin x=*0.8,* without using a mathematical table and calculator find tan(90-x) (3mks)

$\sin x = \frac{8}{10} = \frac{4}{5}$



$\therefore \tan(90-x) = \frac{O}{A}$

$= \frac{3}{4}$

11. The point B(3,2) maps onto $B^1(7,1)$ under a translation T_1. Find T_1 (2mks)

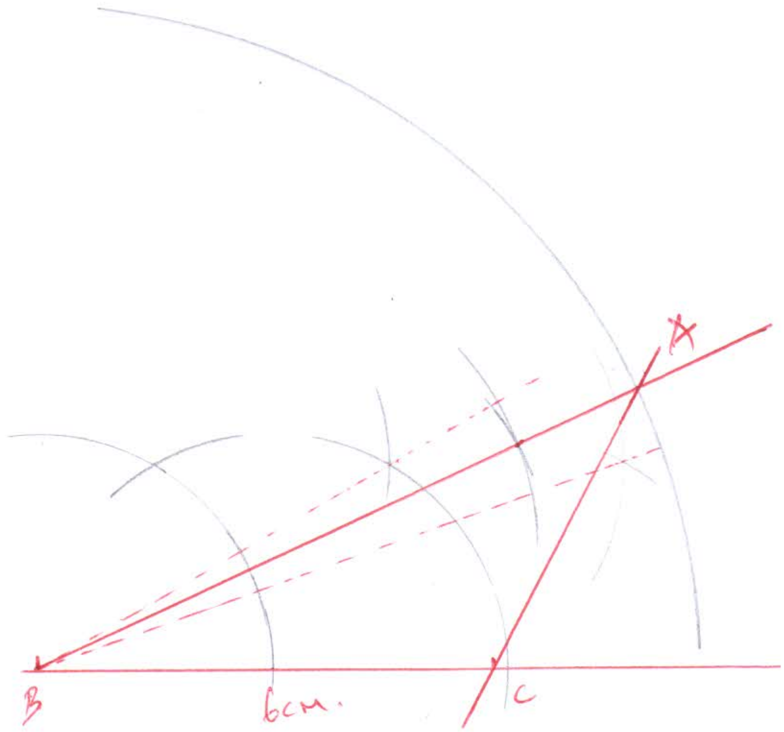
$T_1 = T' - T$

$= \begin{pmatrix} 7 \\ 1 \end{pmatrix} - \begin{pmatrix} 3 \\ 2 \end{pmatrix}$

$= \begin{pmatrix} 7-3 \\ 1-2 \end{pmatrix}$

$= \begin{pmatrix} 4 \\ -1 \end{pmatrix}$

12. Using a ruler and a pair of compasses only, construct triangle ABC in which BC=6cm, AB= 8.8cm and angle ABC= 22.5^0. (3mks)



13. Two grades of tea A and B, costing sh 100 and 150 per kg respectively are mixed in the ratio 3:5 by mass. The mixture is then sold at sh 160 per kg. Find the percentage profit on the cost price. (3mks)

$\frac{3}{8}(100) + \frac{5}{8}(150) \Rightarrow$ Cost price

$37.5 + 93.75 = Sh.\ 131.25$

Profit $= 160 - 131.25$

$= Sh\ 28.75$

% Profit $= \frac{\text{Profit}}{CP} \times 100$

$= \frac{28.75}{131.25} \times 100$

$= 21.90476190$

$= 21.9048\%$

14. The first, the third and the ninth term of an increasing AP, makes, the first three terms of a G.P. If the first term of the AP is 3, find ~~the common ratio of the GP~~, difference of the AP and common ratio of GP. (4mks)

$a, a+2d, a+8d.$

$3, 3+2d, 3+8d$

$\frac{3+8d}{3+2d} = \frac{3+2d}{3}$

$9+24d = 9+12d+4d^2$

$0 = 4d^2 - 12d$

$0 = 4d(d-3)$

$4d = 0 \quad d-3 = 0$

$d = 0 \quad d = 3$ ✓

$r = \frac{3+2(3)}{3}$

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

$= \frac{9}{3}$

$r = 3$ ✓

15. The matrix M=$\begin{pmatrix} 3 & -2 \\ -5 & y \end{pmatrix}$ maps a triangular object of area 7 square units onto one with area of 35 square units. Find the value of x. (4mks)

$|det| = A.s.f$

$A.s.f = \frac{I_A}{O_A}$

$= \frac{35}{7}$

$= 5$

$5 = 3y - 10$

$15 = 3y$

$\therefore y = 5$

16. The equation of a circle is given by $x^2+4x+y^2-2y-4=0$. Determine the centre and radius of the circle (3mks)

$x^2+4x+\left(\frac{4}{2}\right)^2+y^2-2y+\left(\frac{-2}{2}\right)^2 = 4+4+1$

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

$(x-a)^2+(y-b)^2 = r^2$

$\therefore (a,b) = (-2,1)$ & $r = 3$ units

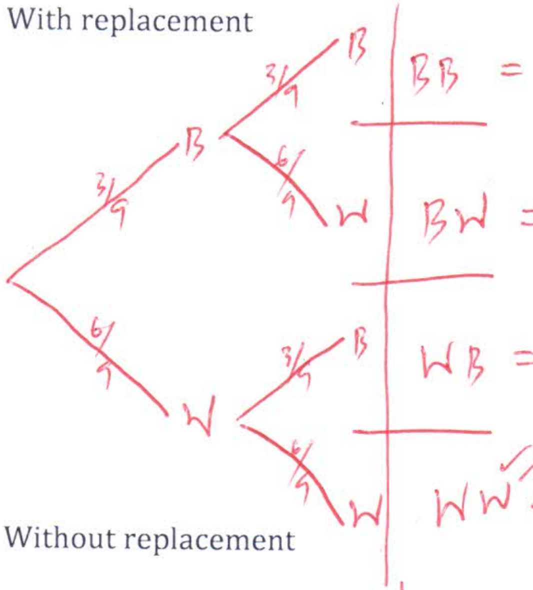
SECTION B (50 MARKS)

*(Answer any **five** questions in this section)*

17. A bag contains 3 black balls and 6 white balls. If two balls are drawn from the bag one at a time, find the:

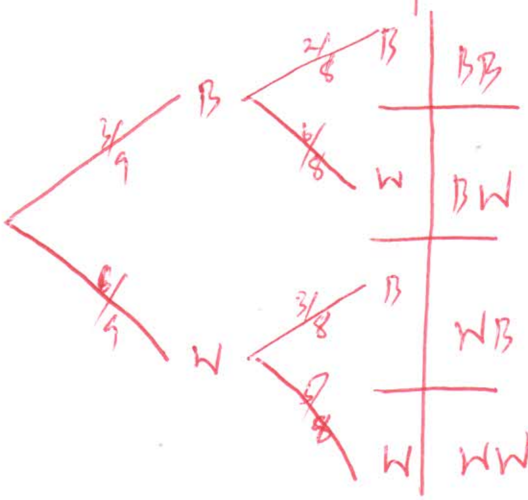
a) Probability of drawing two white balls:

i) With replacement (2mks)



$WW = \frac{6}{9} \times \frac{6}{9} = \frac{4}{9}$

ii) Without replacement (2mks)



$WW = \frac{6}{9} \times \frac{5}{8} = \frac{5}{12}$

b) Probability of drawing a black ball and white ball:

i) With replacement (3mks)

$= P(BW)$ or $P(WB)$

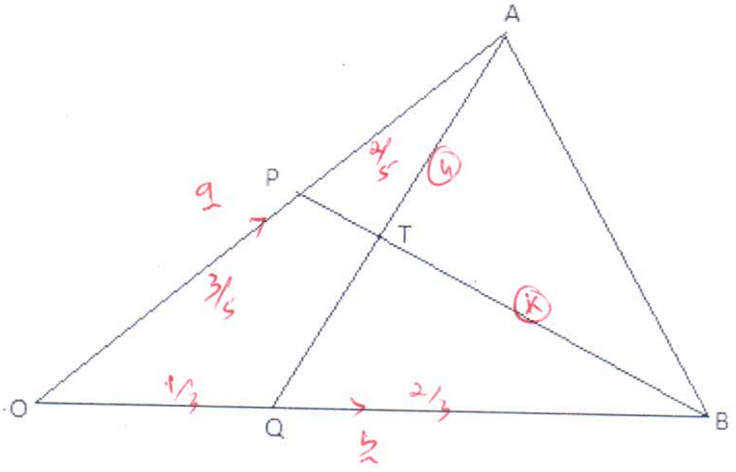
$= \left(\frac{3}{9} \times \frac{6}{9}\right) + \left(\frac{6}{9} \times \frac{3}{9}\right) = \frac{2}{9} + \frac{2}{9} = \frac{4}{9}$

ii) Without replacement. (3mks)

$= \left(\frac{3}{9} \times \frac{6}{8}\right) + \left(\frac{6}{9} \times \frac{3}{8}\right) = \frac{1}{4} + \frac{1}{4}$

$= \frac{1}{2}$.

18. In the triangle below P and Q are points on OA and OB respectively such that OP:PA = 3 : 2 and OQ : QB = 1 : 2. AQ and PQ intersect at T. Given that **OA** = **a** and **OB** = **b**.



$BT = -b + \frac{3}{5}a$

$= \frac{3}{5}a - b.$

$\frac{3-k}{5} = -\frac{1}{5}$

(a) Express AQ and PQ in terms of **a** and **b**. (2mks)

$\vec{AQ} = \vec{AO} + \vec{OQ}$

$= -a + \frac{1}{3}b$

$= \frac{1}{3}b - a$

$PQ = -\frac{3}{5}a + \frac{1}{3}b$

$= \frac{1}{3}b - \frac{3}{5}a$

(b) Taking $BT = kBP$ and $AT = hAQ$ where h and k are real numbers.

(i) Find two expressions for OT in terms of **a** and **b**. (2mks)

$OT = OA + AT$

$= a + h(\frac{1}{3}b - a)$

$= a + \frac{1}{3}hb - ha$

$= (1-h)a + \frac{1}{3}hb$

$OT = OB + BT.$

$= b + k(\frac{3}{5}a - b).$

$= b + \frac{3}{5}ka - kb.$

$= (1-k)b + \frac{3}{5}ka.$

(ii) Use the expression in b(i) above to find the values of h and k. (4mks)

a

$(1-h) = \frac{3}{5}k$

b

$\frac{1}{3}h = 1-k$

$h = 3-3k$

$1-(3-3k) = \frac{3}{5}k$

$1-3+3k = \frac{3}{5}k$

$-2 = -3k + \frac{3}{5}k$

$\frac{5}{12} \times 2 = -\frac{12}{5}k \times -\frac{5}{12}$

$k = \frac{5}{6}$

$h = 3-3k$

$= 3 - 3(\frac{5}{6})$

$= 3 - \frac{5}{2}$

$h = \frac{1}{2}$

(c) Give the ratio $BT:TP$. (2mks)

$BT:TP$

$k : 1-k$

$\frac{5}{6} : 1-\frac{5}{6}$

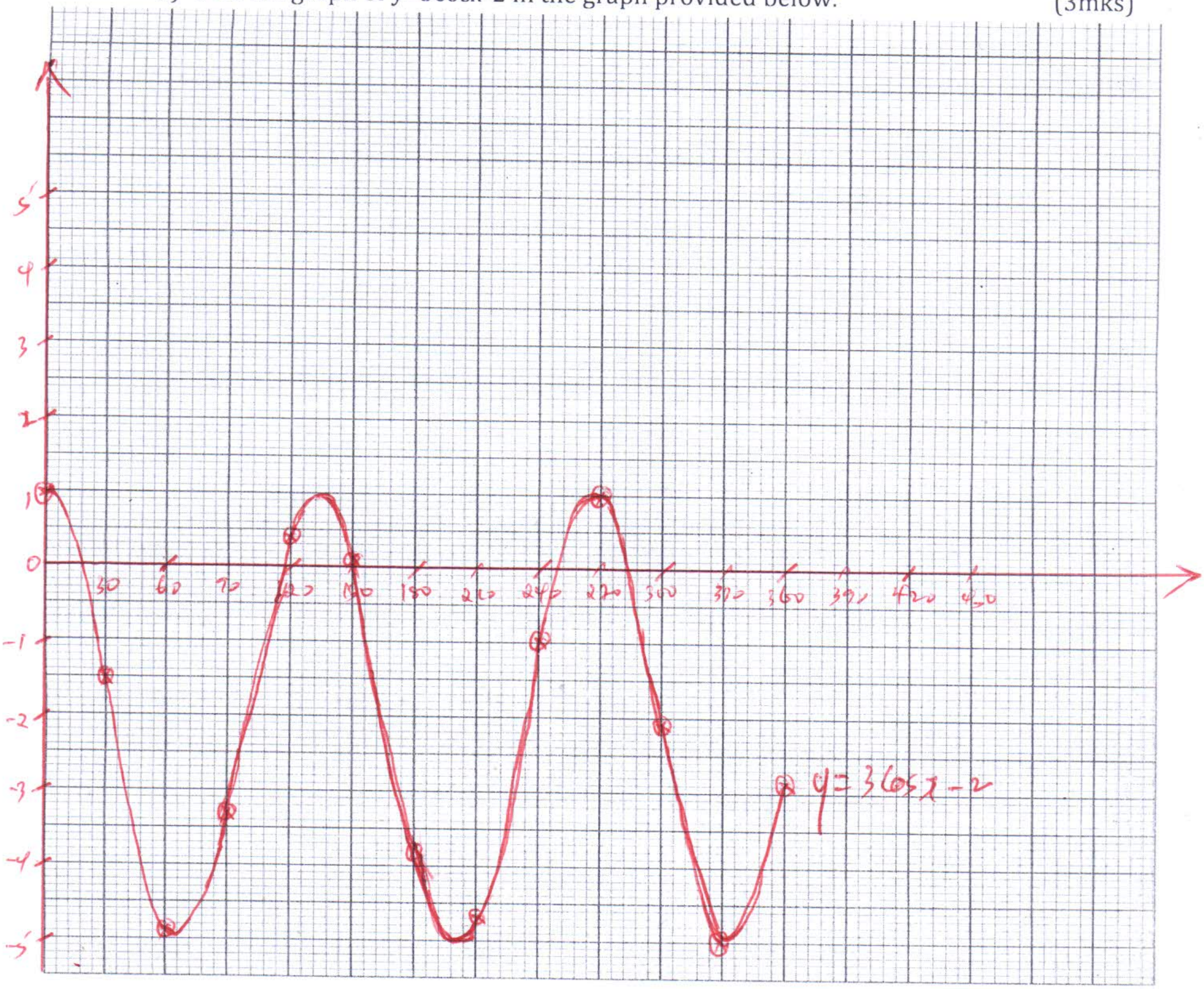
$6 \times \frac{5}{6} : \frac{1}{6} \times 6$

$\therefore BT:TP = 5:1$

19. Complete the table below for the functions $y=3\cos x-2$ for $0^0 \leq x \leq 360^0$ (2mks)

x	0	30	60	90	120	150	180	210	240	270	300	330	360
$y=3\cos x-2$	1.0	-1.5	-4.9	-3.3	0.4	0.1	-3.8	-4.7	-1.0	1.0	-2.1	-5.0	-2.9

a) Plot the graph of $y=3\cos x-2$ in the graph provided below. (3mks)



b) From the graph

i. Find the amplitude of the wave. $\frac{1 - -5}{2} = 3$ units (2mks)

ii. The period of the wave. (1mk)

270^{0}.

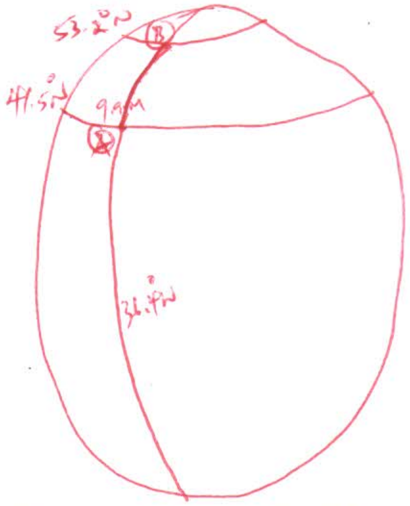
iii. Find the solution to $3\cos x=2$ (2mks)

$3\cos x - 2 = 0$

$18^{0}, 117^{0}, 150^{0}, 249, 282$

20. A plane leaves an airport A (41.5^{0}N, 36.4^{0}W) at 9:00am and flies due north to airport B on latitude 53.2^{0}N. Taking π as $\frac{22}{7}$ and the radius of the earth as 6370Km,

a) Calculate the distance covered by the plane in km (4mks)



Distance $= \frac{11.7}{360} \times 2 \times \frac{22}{7} \times 6370$

$= 1,301.3$ KM.

b) The plane stopped for 30minutes to refuel at B and flew due east to C, 2500km from B. Calculate:

i) position of C (3mks)

$\frac{\theta}{360} \times 2 \times \frac{22}{7} \times 6370 \cos 53.2 = 2500$

~~$-108.846120984558 = 2500$~~

$\frac{66.6247\theta}{66.6247} = \frac{2500}{66.6247}$

$\theta = \cancel{22.77°}$

$\theta = 37.52$

~~$36.4 - 22.97 = 13.43°$~~

~~$C(53.2°N, 13.43°W)$,~~

$37.52 - 36.4 = 1.12°$

$\therefore C(53.2°N, 1.12°E)$.

ii) The time the plane lands at C if its speed is 500km/h (3mks)

$t = D/S$

$= \frac{1,301.3}{500} + \frac{2500}{500}$

$= (2$ hrs 36 Min$) + 5$ hrs

$= 7$ hr 36 Min

7hr 36 Min
\+ 30 Min

~~8hrs 06 Mins~~

$37.52° \times 4 = 150.08$ Min
= 2hrs 30 Min

0900 hrs
0236
1136 hrs

0900 hrs
0736
1636 hrs

1636
230 +
1906 hrs

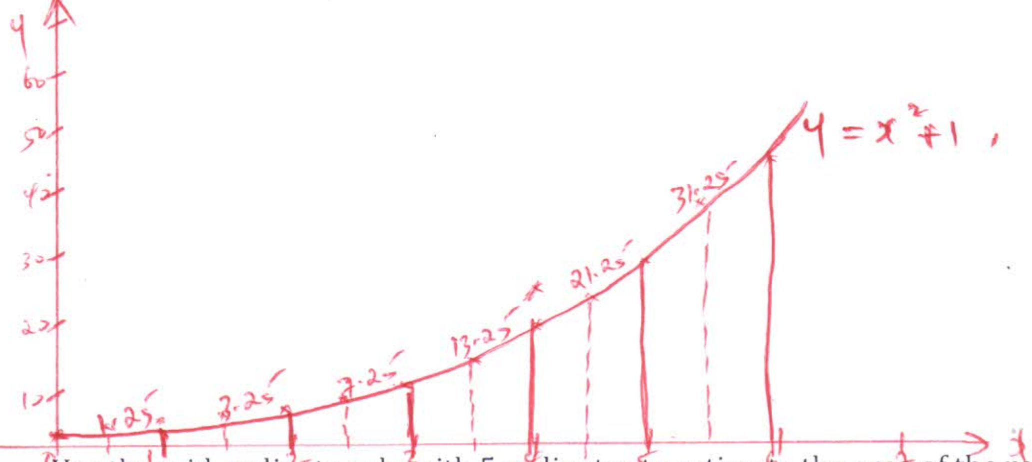
7.06 P.M.

21. The curve given by the equation $y = x^2 + 1$ is defined by the values in the table below.

(a) Complete the table by filling in the missing values. (2mks)

X	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
Y	1.0	1.25	2.0	3.25	5.0	7.25	10.0	13.25	17.0	21.25	26.0	31.25	37.0

(b) Sketch the curve for $y = x^2 + 1$ for $0 \leq x \leq 6$ (2mks)



(c) Use the mid-ordinate rule with 5 ordinates to estimate the area of the region bounded by the curve $y = x^2 + 1$, the x-axis, the lines x = 0 and x = 6. (2mks)

$A = 1(1.25 + 3.25 + 7.25 + 13.25 + 21.25 + 31.25)$

$= 1(77.5)$

$= 77.5$ sqr units

(d) Use method of integration to find the exact value of the area of the region in (c) above. (2mks)

$A = \int_0^6 (x^2+1)\,dx$

$= \left[\frac{x^3}{3} + x + c\right]_0^6$

$= \left(\frac{216}{3} + 6 + c\right) - (0 + c)$

$= 72 + 6 + c - c$

$= 78$ sqr units

(e) Calculate the percentage error involved in using the mid-ordinate rule to find the area. (2mks)

$|E| = \text{Appr. A} - \text{Actual. A}$

$= 77.5 - 78$

$= 0.5$ sqr units

$\% E = \frac{|E|}{A.A} \times 100$

$= \frac{0.5}{78} \times 100$

$= 0.64102564102564$

$= 0.6410\,\%$

22. (a) Using a ruler and pair of compasses only construct triangle PQR in which $PQ = 7.5cm$ $QR = 6.0cm$ and angle $PQR = 60^0$. Measure PR *(3mks)*

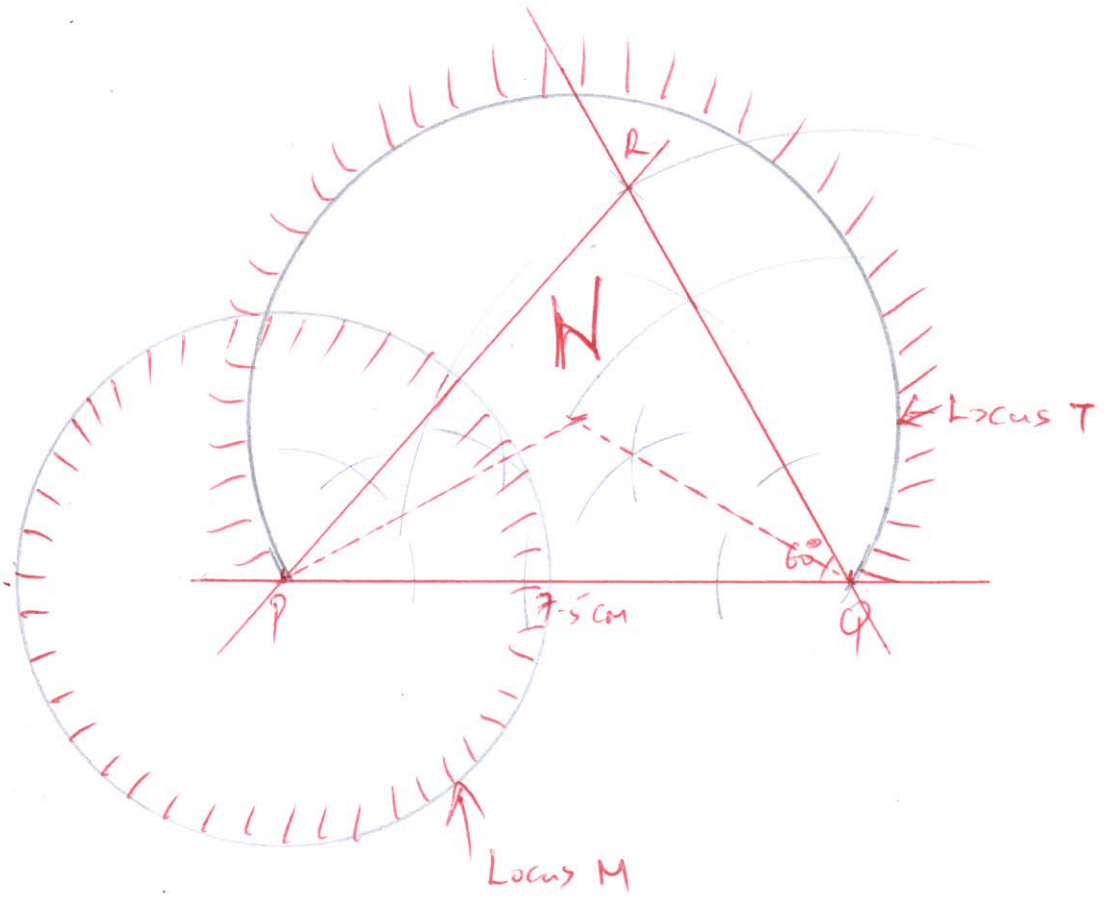
(b) On same side of PQ as R

(i) Determine the locus of a point T such that angle $PTQ = 60^0$ *(3mks)*

(ii) Construct the locus of R such that $PR = 3.5cm$. *(2mks)*

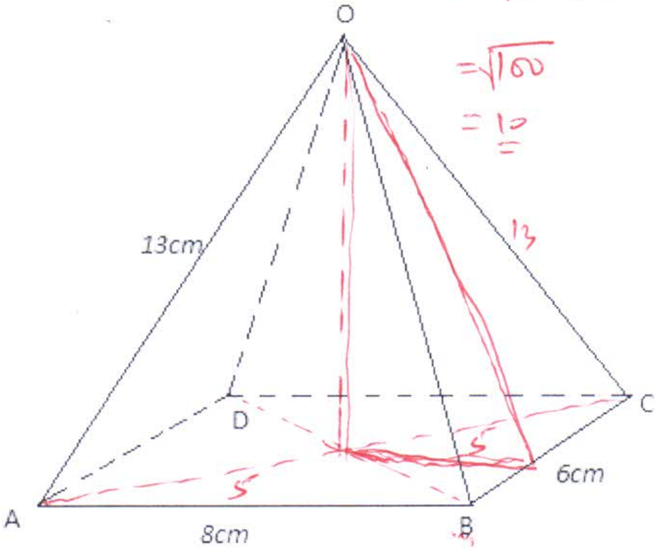
(iii)Identify the region W such that $PR \geq 3$ and angle $PTQ \geq 60^0$ by shading the unwanted part. *(2mks)*

PR = 6.9cm



23. OABCD is a right pyramid on a rectangular base with AB = 8 cm, BC = 6 cm, OA = OB = OC = OD = 13 cm. Calculate;

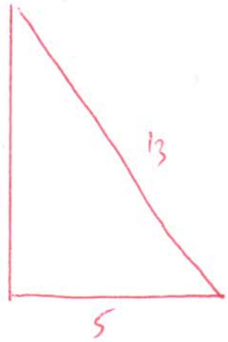
(a) the height of the pyramid. (3mks)



$= \sqrt{8^2+6^2}$

$= \sqrt{100}$

$= \underline{10}$



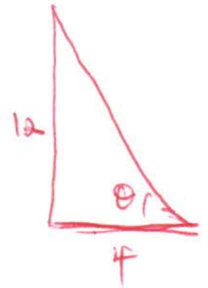
$= \sqrt{13^2-5^2}$

$= \sqrt{169-25}$

$= \sqrt{144}$

$= \underline{12\text{ cm}}$ ✓

(b) the inclination of OBC to the horizontal. (2mks)



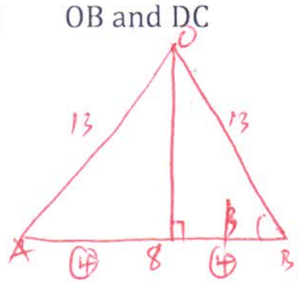
$\tan\theta = \frac{12}{4}$

$\theta = \tan^{-1} 3$

$= \cancel{1.25°}$ $\underline{71.57°}$ ✓

(c) the angle between;

(i) OB and DC (3mks)

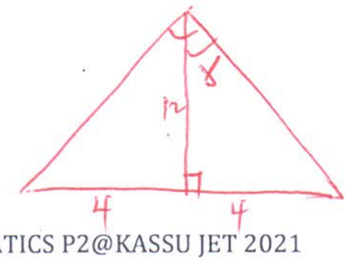


$\cos\beta = \frac{4}{13}$

$\beta = \cos^{-1} 4/13$ $= \cancel{1.26°}$ $\underline{72.08°}$ ✓

$= \cancel{0.30°}$

(ii) the planes OBC and OAD (2mks)



$\tan\gamma = \frac{4}{12}$

$\gamma = \tan^{-1} 4/12$

$= \cancel{0.32°} = 18.43°$

$\therefore 2\gamma = \cancel{0.64°} = \underline{36.87°}$ ✓

24. The games master wishes to hire two matatus for a trip. The operators have a Toyota which carries 10 passengers and a Kombi which carries 20 passengers. Altogether 120 people have to travel. The operators have only 20litres of fuel and the Toyota consumes 4 litres on each round trip and the Kombi 1 litre on each round trip. If the Toyota makes **x** round trips and the kombi **y** round trips;

(a) write down four inequalities in x and y which must be satisfied . (2mks)

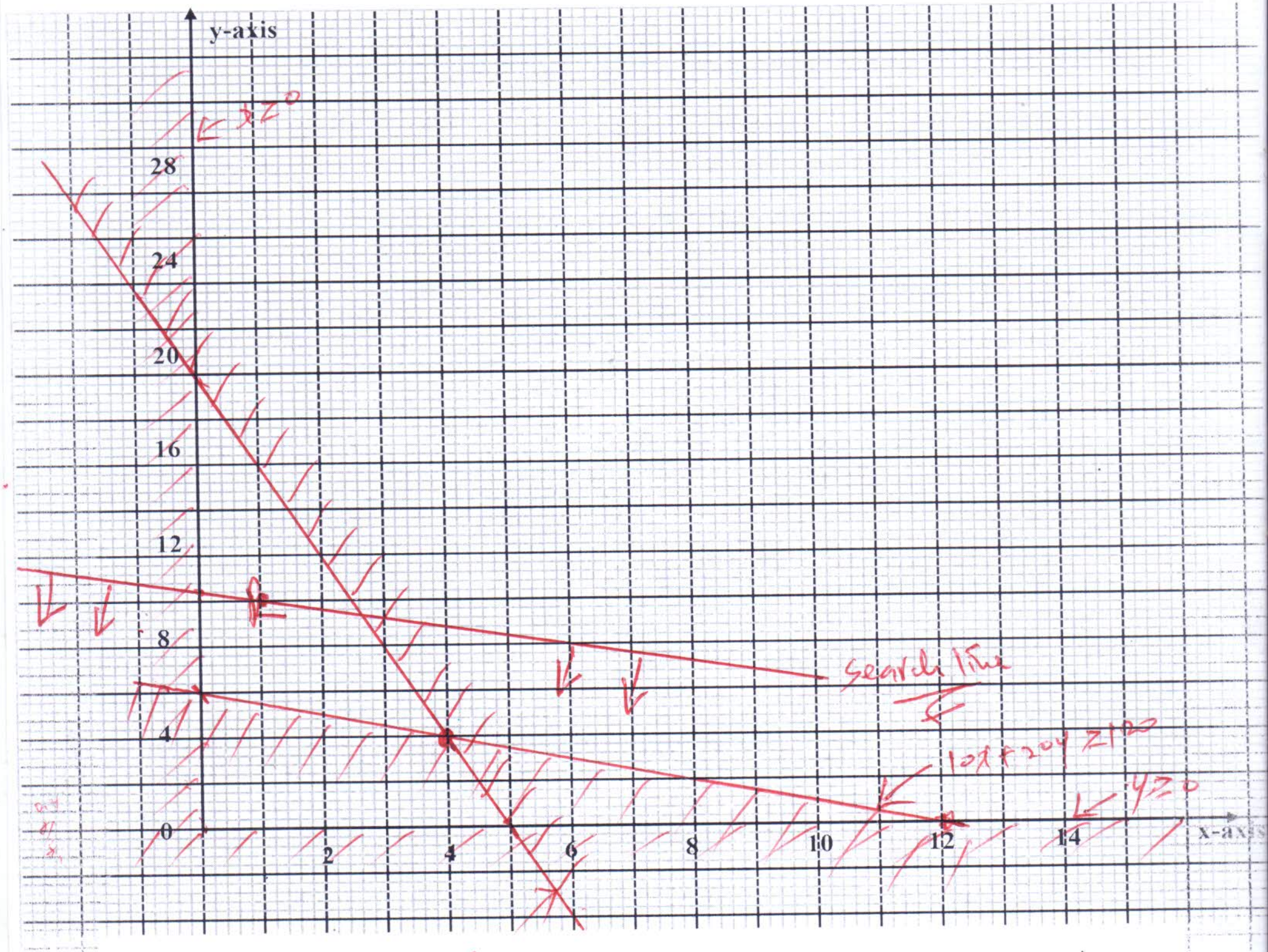
$10x + 20y \geq 120$

$4x + y \leq 20$

$x \geq 0$

$y \geq 0$

(b)Represent the inequalities graphically on the grid provided. (3mks)



$$\frac{10x}{120} + \frac{20y}{120} = \frac{120}{120}$$

$$\frac{x}{12} + \frac{y}{6} = 1$$

$$\frac{4x}{20} + \frac{y}{20} = \frac{20}{20}$$

$$\frac{x}{5} + \frac{y}{20} = 1$$

(c) The operators charge shs.100 for each round trip in the Toyota and shs.300 for each round trip in the kombi;

(i) determine the number of trips made by each vehicle so as to make the total cost a minimum. (4mks)

$100x + 300y = K$ $(1, 10)$.

$100(1) + 300(10) = K$

$100 + 3000 = K$

$K = 3100$

$\frac{100x}{3100} + \frac{300y}{3100} = \frac{3100}{3100}$

$\frac{x}{31} + \frac{y}{10.3} = 1$

Minimum cost $(4, 4)$

> 4 Toyota trips

> 4 Kombi trips

(ii) find the minimum cost. (1mk)

$100x + 300y \Rightarrow$ Cost

$100(4) + 300(4) = 400 + 1200$

$=$ sh. 1600