

NAME:.....INDEX NO.....STREAM.....

SCHOOL.....DATE:.....

121/1

MATHEMATICS

PAPER 1

TIME: 2 ½ HOURS

## **BUNYORE-MARANDA JOINT EXAMINATIONS 2021**

MATHEMATICS

TERM III

Kenya Certificate of Secondary Education

### **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

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(b) State the name of the figure sketched (1 mark)

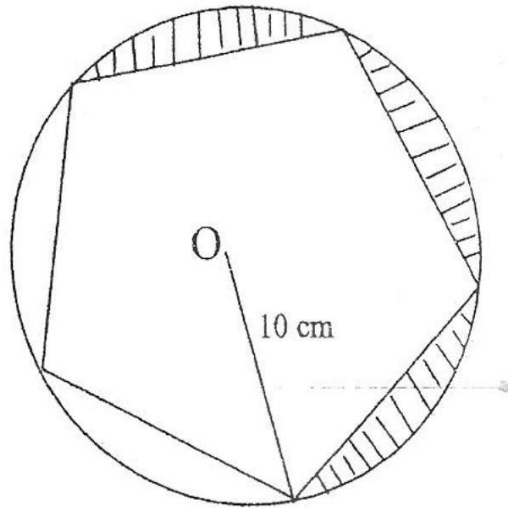
4. Without using log tables or a calculator; solve (3marks)

$$\frac{\text{Log } \frac{1}{4} + \log 64}{\text{Log } 32 - \log \frac{1}{8}}$$

5. The sum of interior angles of two regular polygons of sides;  $n$  and  $n + 2$  are in the ratio 3:4. Calculate the sum of the interior angles of the polygon with  $n$  sides. (4 marks)

6. A group of 10 soldiers set off with enough food to last 7 days. After 4 soldiers deserted. How many more days will the food last for the remaining soldiers? (3 marks)

7. The diagram below, not drawn to scale, is a regular pentagon circumscribed in a circle of radius 10cm at centre O



Find

- (a) The length of any side of the pentagon (2 marks)

- (b) The area of the shaded region (2 marks)

8. A line whose gradient is positive is drawn on the Cartesian plane and its equation is  $x - y\sqrt{3} = -3$ . Calculate the angle formed between the line and x-axis. (3 marks)

9. Find all the integral values of  $x$  which satisfy the inequality (3 marks)

$$3(1 + x) < 5x - 11 < x + 45$$

10. An arc subtends an angle of 0.9 radians at the centre of a circle whose radius is 13cm. Find the length of the arc. (2 marks)

11. The scale of a map is given as 1:50,000. Find the actual area in hectares of a region represented by a triangle of sides 6cm by 7cm (Give your answer to the nearest whole number). (3 marks)

12. Two passenger trains A and B, 240m apart are travelling at 164km/h and 88km/h respectively towards each other on a straight railway line. Train A is 150 metres long, while B is 100 metres long. Determine the time in seconds that elapses before the two trains completely pass each other. (4 marks)
13. Given that  $\cos A = 5/13$  and angle A is acute, find the value of  $2 \tan A + 3 \sin A$ . (3 marks)
14. Given that  $4x^2 - 32x - 20 + k$  is a perfect square, find k. (3 marks)

15. A watch which loses a half-minute every hour was set to read the correct time at 0545h on Monday. Determine the time, in the 12 hour system, the watch will show on the following Friday at 1945h. (3 marks)

16. Use the exchange rates below to answer this question.

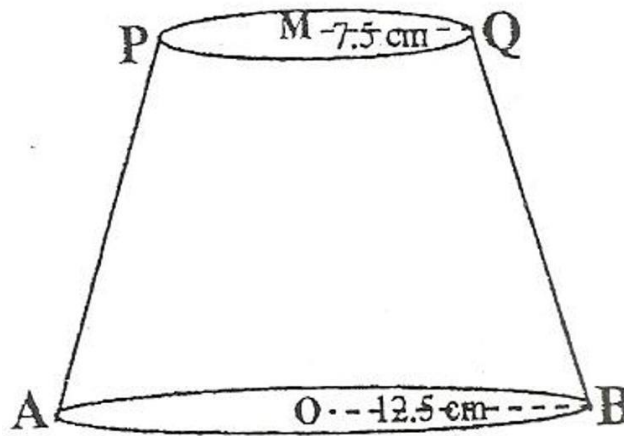
	Buying	Selling
1 US dollar	63.00	63.20
1 UK £	125.30	125.95

A tourist arriving in Kenya from Britain had 9600 UK Sterling pounds (£). He converted the pounds to Kenya shillings at a commission of 5%. While in Kenya, he spent  $\frac{3}{4}$  of this money. He changed the balance to US dollars after his stay. If he was not charged any commission for this last transaction, calculate to the nearest US dollars, the amount he received. (3 marks)

SECTION II (50 MARKS)

Answer only Five questions from this Section

17. PQCB shows a frustum of a cone. The radius of the top and bottom circular parts of the frustum are 7.5cm and 12.5cm respectively, centres M and O are 10cm apart.

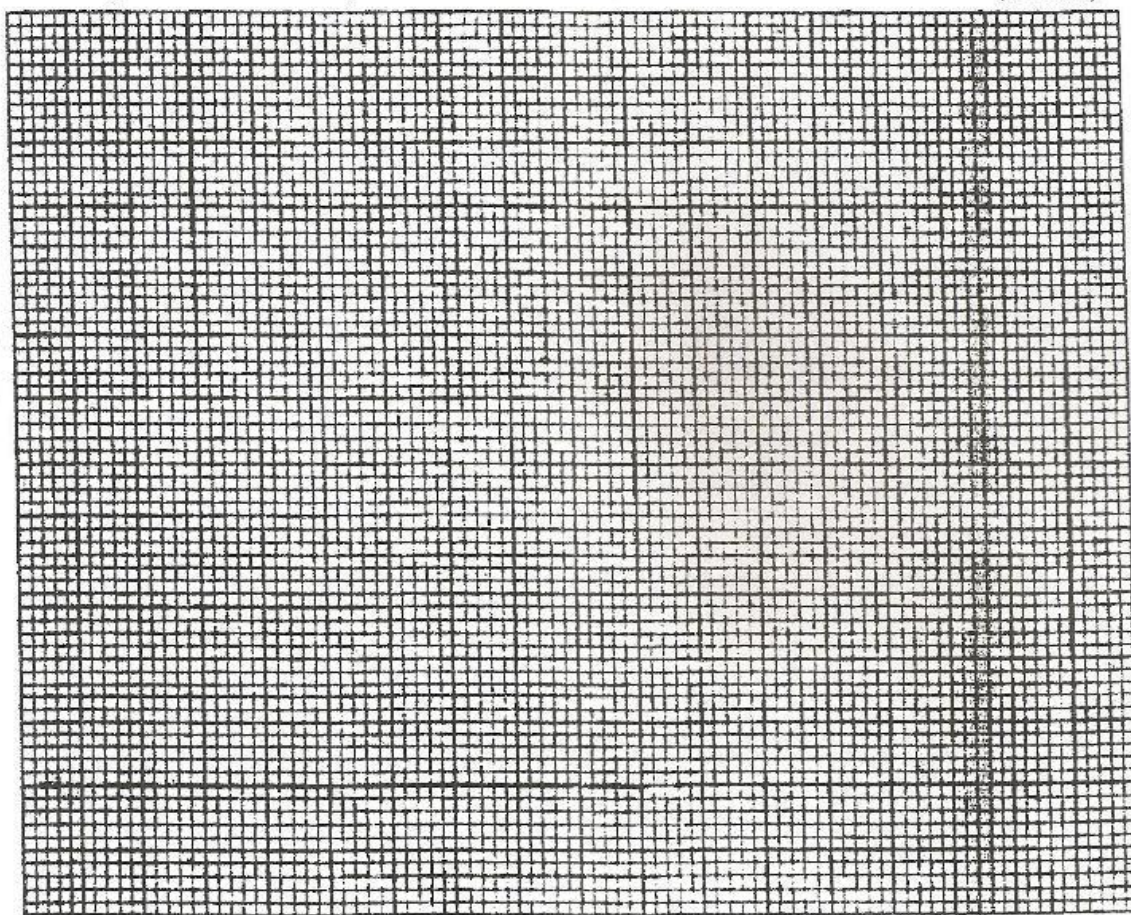


- a) Calculate the slant length QB of the frustum correct to d.p. (1 mark)
- b) Calculate the volume of frustum (5 marks)
- c) If the frustum is of solid metal and is melted down and recast into a solid cylinder having a radius of 10.5cm, calculate.
- (i) The height of cylinder correct to 3 d.p. (3 marks)
- (ii) The surface area of the cylinder (2 marks)

18. a) Complete the table below giving your values correct to 2 decimal places. (2 marks)

$x^0$	$-90^0$	$-75^0$	$-60^0$	$-45^0$	$-30^0$	$-15^0$	$0^0$	$15^0$	$30^0$	$45^0$	$60^0$	$75^0$	$90^0$
$3\cos 2x^0$	-3	-2.6 <sup>0</sup>		0	1.50		3	2.60		0	-1.50		-3
$\sin (2x+30^0)$	-0.5		-1	-0.87		0	0.5		1	0.87		0	-0.5

b) On the grid provided draw, on the same axes the graph of  $y = 3 \cos 2x$  and  $y = \sin (2x + 30^0)$  for interval  $-90^0 \leq x \leq 90^0$ . Take the scale: 1cm represent  $15^0$  on x-axis and 2cm to represent 1 unit on the y-axis. (4 marks)



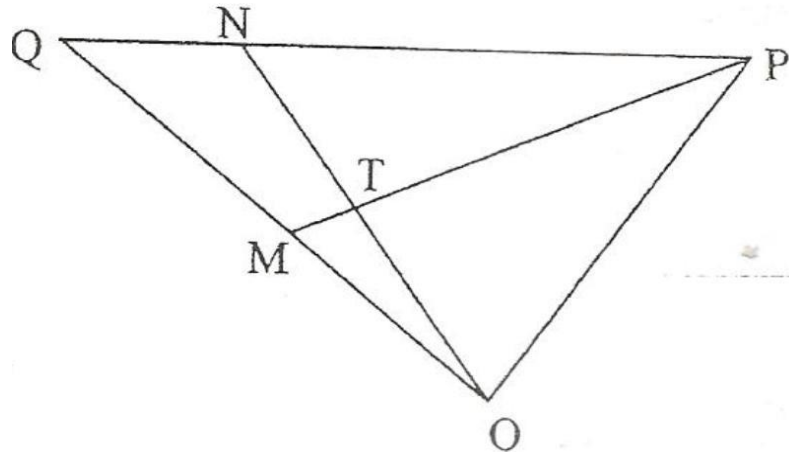
(c) Use the graph in (b) above to solve the equation.

(i)  $3\cos 2x = \sin (2x + 30)$  (2 marks)

(ii)  $6\cos 2x + 5 = 0$  (2 marks)



19. The diagram below shows a triangle OPQ in which  $QN:NP = 1:2$ ,  $OT:TN = 3:2$  and M is the midpoint of OQ.



- a) Given that  $\vec{OP} = \mathbf{p}$  and  $\vec{OQ} = \mathbf{q}$ , Express the following vectors in terms of  $\mathbf{p}$  and  $\mathbf{q}$
- $\vec{PQ}$  (1 mark)
  - $\vec{ON}$  (2 marks)
  - $\vec{PT}$  (2 marks)
  - $\vec{PM}$  (1 mark)
- b) (i) Show that point P, T and M are collinear (3 marks)
- (ii) Determine the ratio MT: TP (1 mark)

20. The displacement  $s$  meters of a particle moving along a straight line after  $t$  seconds is given by

$$S = 6t - \frac{t^3}{3} - \frac{t^2}{2} \quad (3 \text{ marks})$$

(b) Calculate:

- (i) The time when particle was momentarily at rest (3 marks)

- (ii) Its displacement by the time it comes to rest momentarily (2 marks)

- (d) Calculate the maximum speed attained (2 marks)

21. Three ports A, B and C are situated in such a way that port A is 140km on a compass bearing of  $N65^{\circ}E$  from port B. Port C is 200km on a compass bearing of  $S32^{\circ}E$  from A. A ship S is docked in the sea, 86km on a bearing of  $190^{\circ}$  from port B.

(a) Using a scale of 1cm to represent 20km, draw a diagram to show the position of ports A, B, C and ship S. (4 marks)

(b) Using your diagram find

(i) The distance between the ship and the port A (1 mark)

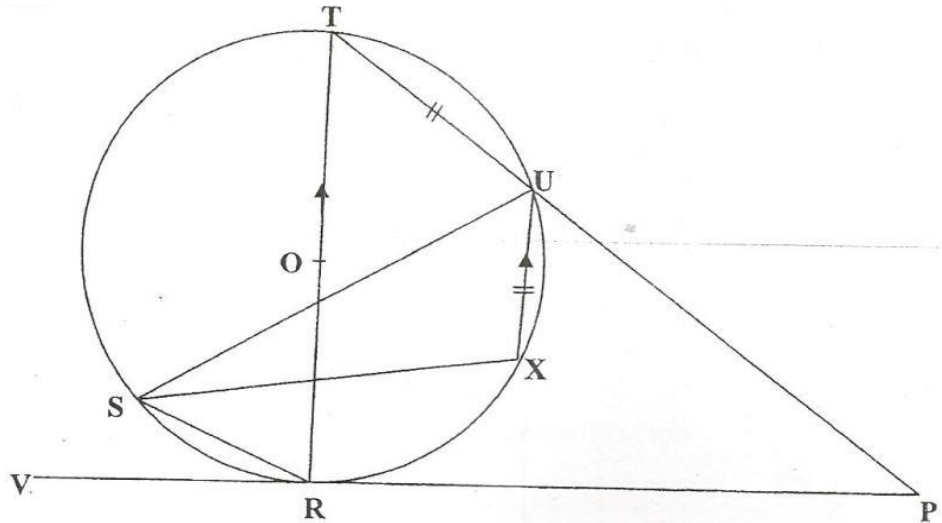
(ii) The bearing of the ship from port C (1 mark)

(iii) The distance from B to C (1 mark)

(iv) Find how far C is south of A (2 marks)

(v) Compass bearing of S from A (1 mark)

22. In the figure below, O is the centre of the circle TOR is the diameter and PRV is tangent to the circle at R.



Given that  $\angle SUR = 25^\circ$ ,  $\angle URP = 60^\circ$ ,  $TU = UX$  is parallel to the diameter; giving reasons calculate;

a)  $\angle TOU$  (2 marks)

b)  $\angle XUP$  (2 marks)

c)  $\angle STR$  (2 marks)

d) Reflex  $\angle SXU$  (2 marks)

e)  $\angle RPU$  (2 marks)

23. At an agricultural Research Centre, the length of a sample of 50 maize cobs were measured and recorded as shown in the frequency distribution table below.

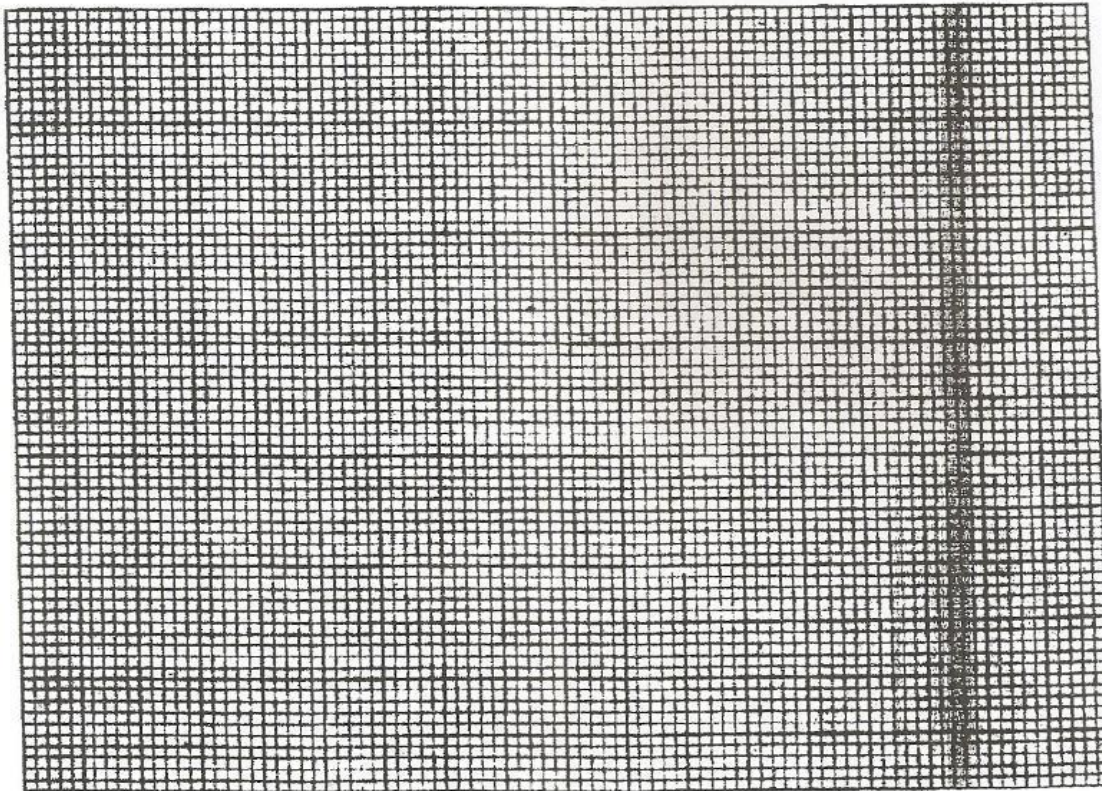
Length	10-11	12-13	14-15	16-19	20-26
No. of Labs	6	8	11	18	7

a) Calculate the mean

(3 marks)

b) Draw a histogram to represent the above information

(5 marks)



c) (i) State the class in which the median length lies

(1 mark)

(ii) Draw a vertical line, in the histogram, showing where the median length lies

(1 mark)

24. A youth group decided to raise Ksh.480,000 to buy a piece of land costing Kshs.80,000 per hectare. Before the actual payment was made, four of the members pulled out and each of those remaining had to pay an additional Kshs.20,000.

- a) If the original number of the group members was  $x$ , write down;
  - (i) An expression of how much each was to contribute originally. (1 mark)
  
  
  
  
  
  
  
  
  
  
  - (ii) An expression of how the remaining members were to contribute after the four pulled out. (1 mark)
  
- b) Determine the numbers who actually contributed towards the purchase of the land. (5 marks)
  
  
  
  
  
  
  
  
  
  
- c) Calculate the ration of the supposed original contribution to the new contribution. (1 mark)
  
  
  
  
  
  
  
  
  
  
- d) If the land was sub-divided equally, find the size of land each member got. (2 marks)

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4. When  $N = 1$  and  $M = 5$  when  $N = \frac{1}{2}$

(a) Find the equation connecting  $M$  and  $N$ . (2 marks)

(b) Calculate the value of  $M$  when  $N = \frac{2}{3}$  (1 mark)

5. Solve for  $x$  in the equation  $\frac{1}{2} \log_2 81 + \log^2 (x^2 - x/3) = 1$  (3 marks)

6. Use logarithms to evaluate  $\left( \frac{34.65 \times 0.451}{4.675} \right)^{-1/3}$  (4 marks)

7. Table below is part of tax table for annual income for the year 2010.

Taxable income in K£4 p.a.	Rate in Kshs. Per K£
Under K£4201	
From K£4201 but under K£8401	
From K£8401 but under K£1261	

In the year 2010, the tax on Oyugi's annual income was Ksh.12,000. Calculate Oyugi's annual income in K£. (3 marks)

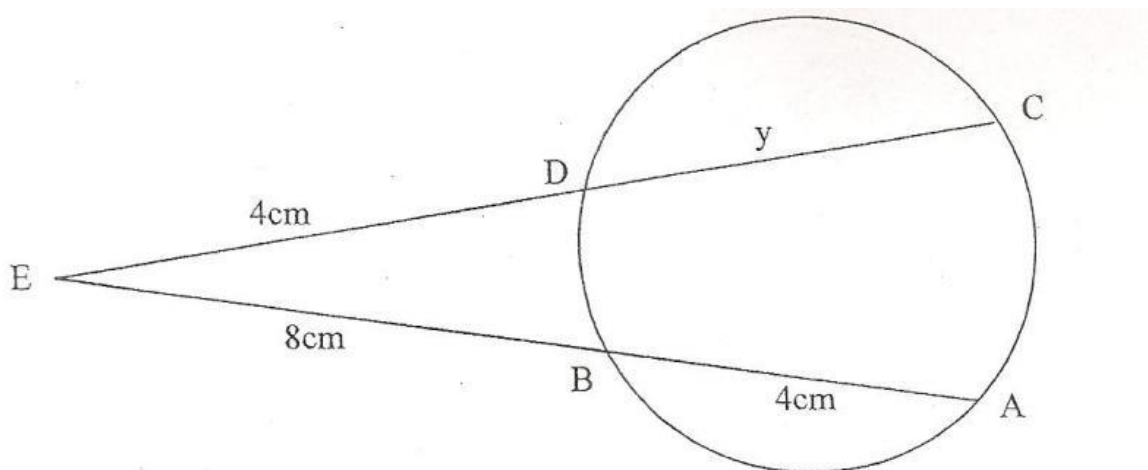
8. (a) Expand  $(1 - 2x)^6$  upto the term in  $x^3$ . (1 mark)

- (b) Use the expansion to evaluate  $(1.02)^6$  to 4 decimal places. (2 marks)

9. Given that  $OA = 2i + 5k$  and  $OB = 7i - 5j$ . A point T is on B such that  $2AT = 3TB$ . Calculate the magnitude of OT to 4 significant figures. (3 marks)

10. Find the quartile deviation for the set of data below. (2 marks)  
16, 18, 10, 8, 5, 11, 4 and 7

11. In the figure below, line AB = 4cm, BE = 8cm and DE = 4cm. Find the value of y. (2 marks)



12. Solve the following simultaneous inequalities and state all integral values for the solution.

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

$$3x + 1 \geq -17$$

(2 marks)

13. The curve  $y = ax^3 - 3x^2 - 2x + 1$  has the gradient 7 when  $x = 1$ . Find the:

(i) Value of a

(ii) Equation of the tangent to the curve at  $x = -1$

(3 marks)

14. Without using a calculator,  $\frac{\sqrt{252}}{\sqrt{32}} + \frac{\sqrt{72}}{\sqrt{28}}$ , leaving the answer in the form

$a\sqrt{b} + c$  where  $a$ ,  $b$  and  $c$  are integers. (4 marks)

15. A mixture contains two powders P and Q with masses in the ratio 3: 11. If the mixture costs sh.670 per kg and powder P costs sh.560 per kg, find the cost of a kg of powder Q. (3 marks)

16. Find the radius and the centre of a circle whose equation is

$$3x^2 + 3y^2 + 18y = 12x - 9 = 0 \quad (3 \text{ marks})$$

SECTION 11 (50 Marks)

Answer any five questions from this Section.

17. In driving to work, Buma has to pass through three sets of traffic lights. The probability that he will have to stop at any of the lights is  $\frac{3}{4}$

(a) Draw a tree diagram to represent the above information. (2 marks)

(b) Using the diagram, determine the probability that on any one journey, he will have to stop at:

(i) All the three sets. (2 marks)

(ii) Only one of the sets (2 marks)

(iii) Only two of the sets (2 marks)

(iv) None of the sets. (2 marks)

18. (a) Using a ruler and pair of compasses only, construct triangle ABC in which  $AB = 9\text{cm}$ ,  $AC = 8\text{cm}$  and angle  $BAC = 60^\circ$ . (2 marks)
- (b) On the same side of AB as C, draw the locus of a point such that angle  $APB = 60^\circ$  (3 marks)
- (c) A region T is within the triangle ABC such that  $AT > 4\text{cm}$  and angle  $ACT \geq$  angle BCT. Show the region T by shading it. (5 marks)

19. Three consecutive terms in a geometric progression are  $3^{2x+1}$ ,  $9^x$  and 81 respectively.

(a) Calculate the value of  $x$ . (3 marks)

(b) Find the common ratio of the series. (2 marks)

(c) Calculate the sum of the first 10 terms of the series. (2 marks)

(d) Given that the fifth and the seventh terms of this G.P form the first two consecutive terms of an arithmetic sequence, Calculate the sum of the first 20 terms of the arithmetic sequence. (3 marks)



(a) Sketch the curve of  $y = x^2 - 4$  (2 marks)

(b) Calculate the area bounded by the curve  $y = x^2 - 4$ , the  $x$  – axis, the lines  $x = 1$  and  $x = 4$  by using the trapexoidal rule with 6 equal strips. (3 marks)

(c) Calculate the exact area in (b) above using the method of integration. (4 marks)

(d) Find the percentage error in the area in (b) above. (1 mark)

21. A and B are two points on the latitude  $40^{\circ}\text{N}$ . The two points lie on the longitudes  $20^{\circ}\text{W}$  and  $100^{\circ}\text{E}$  respectively.

(a) Calculate:

- (i) The distance from A to B along a parallel of latitude. (3 marks)

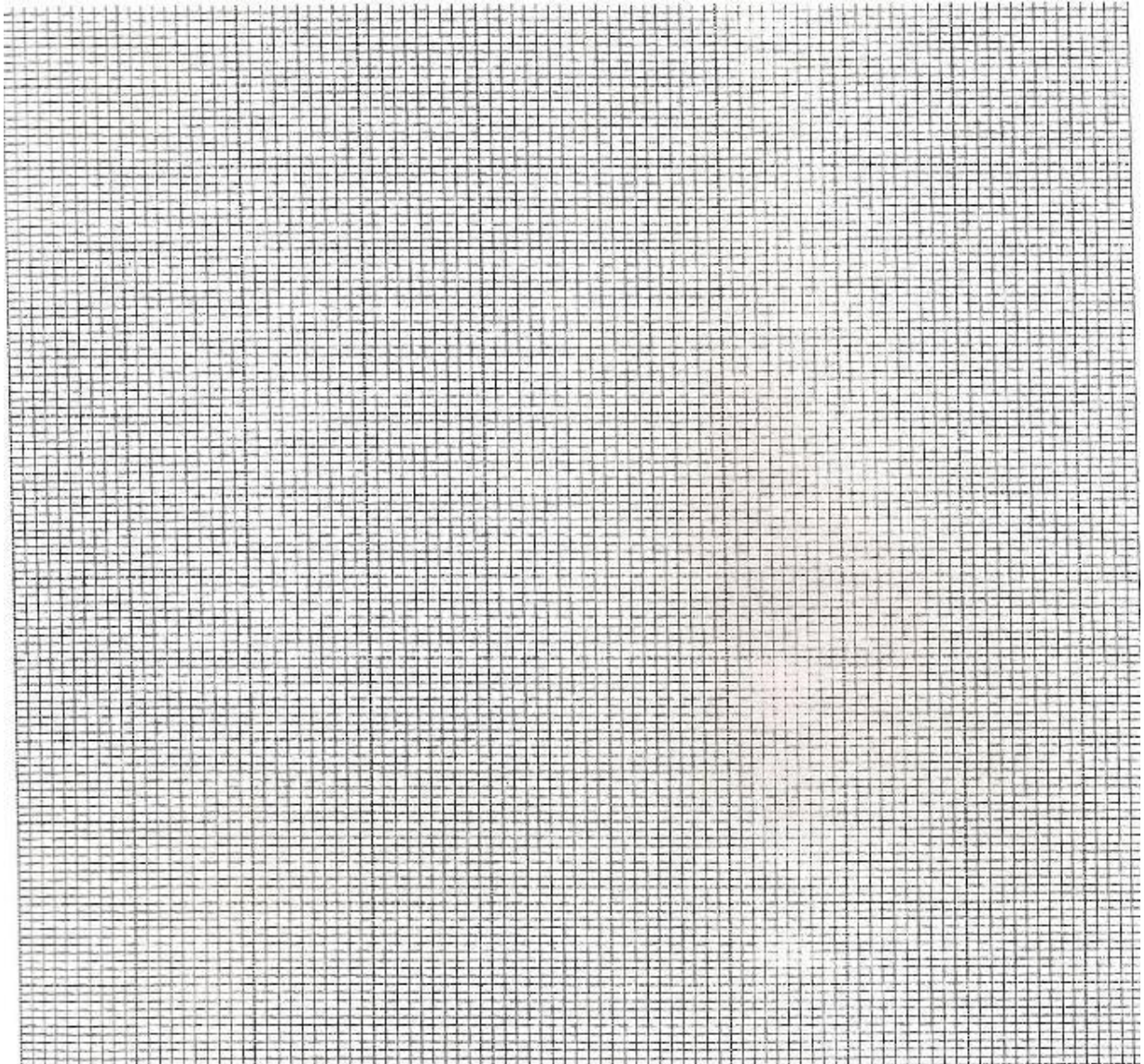
- (ii) The shortest distance from A to B along a great circle. (4 marks)

- (b) Two planes P and Q left A for B at 400 knots and 600 knots respectively. If P flew along the great circle and B along parallel latitude, which one arrived earlier and by how long. Give your answer to the nearest minute (Take  $R = 6370\text{ km}$  and  $\pi = 22/7$ ). (3 marks)

22. (a) Complete the table below for the equation  $y = x^3 - 2x^2 - 4x + 7$ . (2 marks)

x	-3	-2	-1	0	1	2	3	4
y	-26	-1		7		-2		23

(b) Using the scale 1cm to represent 1 unit on the x – axis and 1 unit to represent 5 units on the y – axis, draw the graph of  $y = x^3 - 2x^2 - 4x + 7$ . (3 marks)



(c) Use your graph to estimate the roots of the equation  $x^3 - 2x^2 - 4x + 7 = 0$  (1 mark)

(d) By drawing appropriate straight lines, use your graph to solve the equations. (2 marks)

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

(ii)  $x^3 - 2x^2 - 3x + 3 = 0$  (2 marks)

23. The cash price of a laptop was Kshs.60,500. On hire purchase terms, a deposit of Ksh.8,000 was paid followed by 11 monthly installments of Kshs.6000 each.

(a) Calculate:

(i) The cost of a laptop on hire purchase terms. (2 marks)

(iii) The percentage increase of hire purchase price compared to the cash price. (2 marks)

(b) An institution was offered a 5% discount when purchasing 25 such laptops on cash terms. Calculate the amount of money paid by the institution. (2 marks)

(c) Two other institutions X and Y, bought 25 such laptops each. Institution Y bought the laptops on cash terms with no discount by securing a loan from a bank. The bank charged 12% p.a compound interest for two years. Calculate how much more money institution Y paid than institution X. (4 marks)



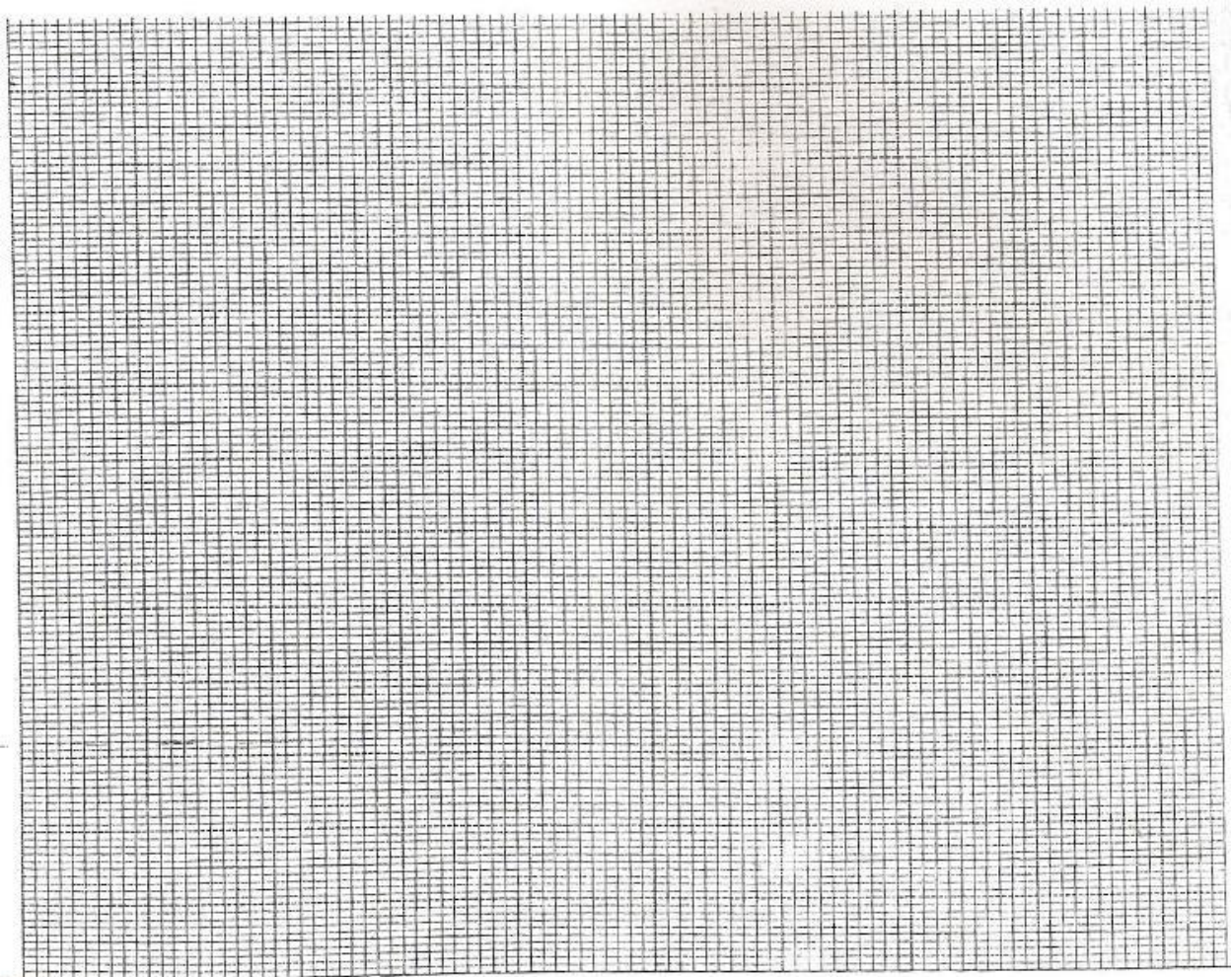
24. A manager wishes to hire two types of machine. He considers the following facts.

Machine type	Number of men operators	Floors space	Hourly profit
A	4	2	4
B	3	3	8

He has a maximum of  $24\text{m}^2$  of floor space and a maximum of 36 men available. In addition he is not allowed to hire more machines of type B than of type A.

(a) If he hires  $x$  machines of type A and  $y$  machines of type B, write down all the inequalities that satisfy the above conditions. (3 marks)

(b) On the grid provided, draw the inequalities in part (a), above and shade the unwanted region. (3 marks)



- (c) Draw a search line and use it to determine the number of machines of each type that should the manager choose to give the maximum profit. (4 marks)

- END -