

- ❖ *Answer all questions in this paper*
- ❖ *All necessary calculations must be shown on the same page as the rest of your answer*
- ❖ *Mathematical tables and list of formulae and squared papers are provided.*
- ❖ *Silent and non programming calculators may be used.*
- ❖ *State the degree of accuracy at the end of each answer.*

SECTION A (40 MARKS)

1. Find the value of y if $\frac{243 \times 3^{2y}}{729 \times 3^y \times 3^{(2y-1)}} = 81$.
2. If $\sin \theta = \frac{3}{5}$ and $90^\circ \leq \theta \leq 180^\circ$, find the value of $\cos \theta + \tan \theta$, without using tables or calculator.
3. A stretch of land on a map of scale 1: 50 000 has an area of 120 cm^2 . Determine the actual area of the land in km^2 .
4. A train leaves station A for station B 200 km away moving with a speed of 50 kmh^{-1} . After 30 minutes, another train leaves station A for the same destination but moving with a speed of 80 kmh^{-1} . Find the distance from station A to the point where the second train overtakes the first one.
5. Solve the pair of simultaneous equations below using the matrix method:

$$\begin{matrix} 4y - 2x = 8 \\ 2x - y = 1 \end{matrix}$$
6. If $\frac{2 + \sqrt{3}}{2 - \sqrt{3}} = p + q\sqrt{r}$, state the values of p , q and r .
7. A boy whose height is 1.5 m stands on the horizontal ground and observes that the top of a flag pole, 10 m away makes an angle of elevation of 40° . Calculate the height of the flag pole.
8. Find the equation of the line that passes through the point of intersection of the lines $y + 2x = 8$ and $2y - x = 6$ and the point $(4, 3)$.
9. Given that $\overrightarrow{OA} = \begin{pmatrix} 6 \\ -3 \end{pmatrix}$ and $\overrightarrow{AB} = \begin{pmatrix} 4 \\ 9 \end{pmatrix}$, find;
 - (i) \overrightarrow{OB} (ii) $|\overrightarrow{OB}|$.
10. Find the prime factors of 11025, and use your answer to find the square root of 11025.

SECTION B.

11. Using a pair of compasses and a ruler only
- (i) Construct triangle ABC such that $\angle C = 60^\circ$. $BC = 9.0\text{cm}$, $AC = 8.5\text{cm}$ Measure the length BA.
 - (ii) Bisect the side AB and AC. Produce the line bisectors to intersect at point M
 - (iii) Using the same centre, draw a circle to circumscribe triangle ABC. Measure the radius of the circle. Hence calculate the area of the circle.

12. A retail trader ordered for shirts from a Kampala whole sale shop as follows

	S	M	L	E
	Small	median	large	Extra large
Blue	0	40	20	0
Green	30	0	25	0
Yellow	0	20	0	10

Given below is the cost for each size of shirt.

	S	M	L	E
	Small	median	large	Extra large
Cost (Ushs)	3000	3600	4200	4800

- (a) (i) Write down a 4×3 matrix for the order of the shirts made.
- (ii) Write down a 4×1 matrix to show the cost
- (b) Given that the trader had to pay a tax of 17% of the cost of the shirts purchased, find his expenditure on the order.

13. A school has a teaching staff of 22 teachers 8 of them teach mathematics (M), 7 teach physics (P) and 4 teach chemistry (C). three teach both Mathematics and physics, and one teaches mathematics and chemistry. No teacher teaches all the three subjects. The number of teachers who teach physics and chemistry is equal to that of those who teach chemistry but not physics.

- (a) Represent the above information on a Venn diagram
- (b) Find the number of teachers who teach
 - (i) Mathematics only
 - (ii) Physics only
 - (iii) None of the three subjects
- (c) Find the probability that a teacher picked at random teaches only one or none of these subjects.

14. The table below shows the taxable and rate structure for coco cola bottling company. Mr. Kizza who earns 641,000/= as his gross monthly income is single with two dependants in the age brackets of (6 – 10) years and (11 – 19) years. In a month that had 30 days; the company allowed him the following benefits before subjecting his taxable income to taxation.

Electricity	Shs. 35,000 per month
Water	Shs. 1000 per month
Housing	Shs. 50,000 per month
Medical up keep	Shs. 240,000 per month
Transport	Shs. 7000 per month

Insurance	Shs. 20,000 per month
Marriage	Shs. 420,000 per month
Single	Shs 20,000 per month

Monthly taxable income	Rate (%)
0 – 30,000	12.0
30,001 – 80,000	16.8
80,001- 120,000	20.0
120,001 – 180,000	24.0
180,001 – 250,000	28.5
250,001 – 320,000	32.5
Above 320,000	35.0

Children		department	
Age (yrs)	Amm (shs)	Age (yrs)	Amm (shs)
0 – 10	15,000	0 – 5	20,000
11 – 20	8,000	6 – 10	28,000
Above 20	7,000	11 – 19	25,000
		Above 20	15,000

- (a) Help Mr. Kizza to calculate his
- Allowance
 - Taxable income
 - Income tax

- (b) Determine the percentage tax that goes to his taxable income

16. Using x values from -3 to 4, draw the graph $y = x^2 - x - 6$. Use your graph to solve the equations.

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

17. (a) A ladder whose base is 4m from the vertical wall reaches 6m up the wall. What is the angle between the ladder and the ground?

(b) A ship is observed moving away from the top of a cliff which is 80m high. With in a time span of 10sec, the angle of depression decreases from 30° to 20° . Determine the distance covered with in this time range. Hence find the speed of the ship in metres per sec. (ms^{-1})

18. (a) A bag contains 3red balls and 4 blue balls. Two balls are selected at random one after another without replacement. Represent this information on a tree diagram and find the probability that;

- both are blue balls
- both are of the same colour
- they are of different colours.

(b) Given that $f(x) = 3x + 4$, $g(x) = \frac{8 - x}{x^2 - 1}$

Find;

- (i) $f^{-1}(x)$
(ii) the values of x for which $g(x)$ is not defined.
19. (a) Using a ruler and a pair of compasses only construct quadrilateral ABCD where $AB = 7.7\text{cm}$, angle $ABC = 45^\circ$, angle $BAD = 150^\circ$, $AD = 8.8\text{cm}$ and $BC = 6.8\text{cm}$.
(b) Draw a circle with centre p that passes through A , C , and D
(c) Determine; (i) the length of BP
(ii) the area of the circle.
20. (a) The vertices of triangle ABC are $A(1,0)$, $B(1,2)$, $C(5,2)$ are mapped onto the triangle $A^1B^1C^1$ by the transformation matrix, M , which is $\begin{pmatrix} 1 & 0 \\ 2 & 4 \end{pmatrix}$
- (a) Find the;
- (i) Coordinates of $A^1B^1C^1$
(ii) ratio of area of ABC to $A^1B^1C^1$
- (b) (i) Plot ABC and $A^1B^1C^1$ on the same axes
(ii) Determine a matrix of the transformation which maps $A^1B^1C^1$ back to ABC .
21. A helicopter flies from Kampala due North for 400 km. it then flies on a bearing of 285° for 280km. From there it flies on a bearing of 090° for 400km. Draw a sketch diagram to show the route of the helicopter. Hence draw an accurate diagram using a scale of 1cm to represent 50km. From your diagram, find the distance and bearing of Kampala from the final destination of the helicopter.
22. The table below shows the heights (in cm) of 140 students of a certain school with their corresponding frequencies.
- | Height | frequency |
|-----------|-----------|
| 145 – 149 | 8 |
| 150 – 154 | 15 |
| 155 – 159 | 25 |
| 160 – 164 | 40 |
| 165 – 169 | 33 |
| 170 – 174 | 12 |
| 175 – 179 | 5 |
| 180 – 184 | 2 |
- (a) Calculate:
- (i) Mean
(ii) Median
- (b) Represent the heights of students on a cumulative frequency curve. Use your curve to estimate:
- (i) Lower quartile
(ii) Upper quartile
- Hence deduce the semi – interquartile range.
23. The speed $V\text{m/s}$ of a car after t seconds is given by the following table.

T(s)	0	2	4	6	8	10	12	14	16	18
V(m/s)	0	15	26	35	39	40	36	28	16	0

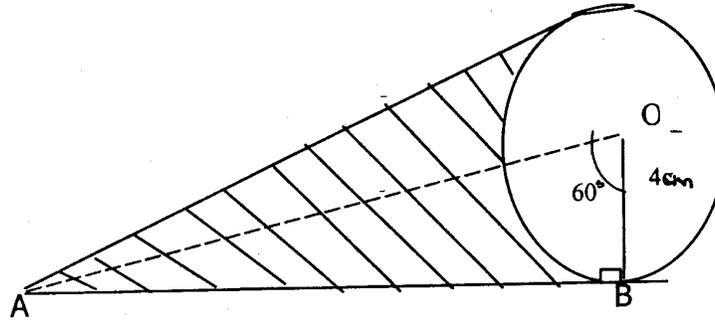
Represent the information in a graph using 1cm: 2 s on the x-axis and 1cm: 5m/s on the y-axis.

- (i) Estimate the rate at which the speed is changing when $t = 14$ s.
- (ii) Find the average rate of change of speed between $t = 2$ s and $t = 7$ s.

24. Uganda airlines agree to provide a flight on a special occasion for 160 first class passengers and 600 tourist passengers. The company must use two or more of its type A planes. Each type A plane has 20 first class seats and 30 tourist seats. Each type B plane has 20 first class seats and 60 tourist seats. The flight costs are \$10,000 for each type A plane and \$15,000 for each type B plane. If the total cost is to be held to a minimum, how many of each of plane should be used?

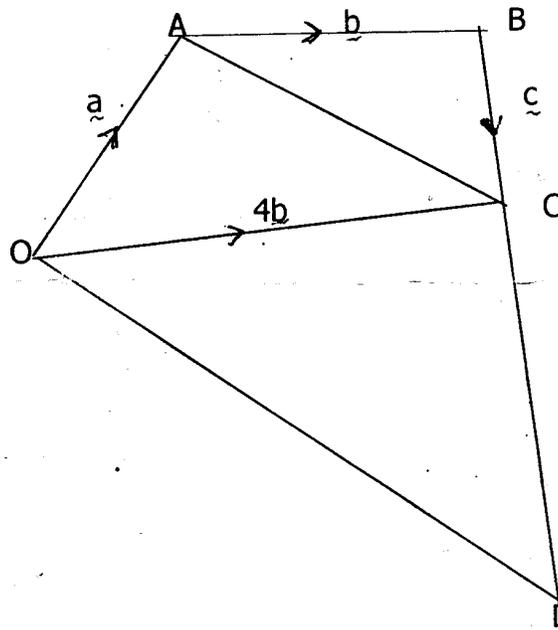
25.

(a)



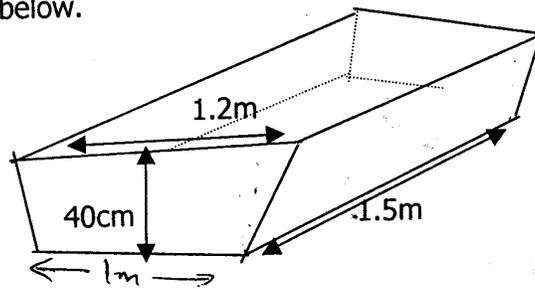
In the above diagram AB and AC are tangents to the circle with centre O. If OB is equal to 4cm and $\angle AOB = 60^\circ$, Calculate the area of the shaded region.

- (b) Two equal circles of radius 5cm. Intersect at right angles.
- Find the distance between the two centres of the circles.
 - Calculate the area of the common region of the circles.



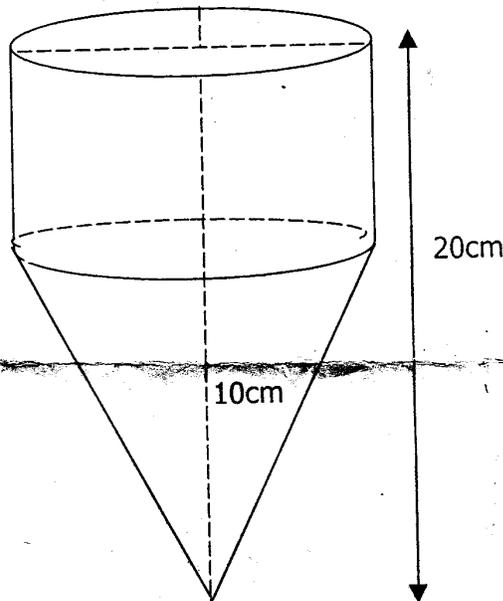
26. It is given that $\mathbf{OA} = a$, $\mathbf{AB} = b$, $\mathbf{BC} = c$, $\mathbf{OC} = 4b$.
- Express a in terms of b and c .
 - Given that $\mathbf{OD} = 4\mathbf{AC}$, express \mathbf{OD} in terms of b and c . Hence express \mathbf{CD} in terms of b and c .
- (c) What is the ratio of the area of triangle \mathbf{OCD} to \mathbf{ABC} ?
- (d) Show that \mathbf{BCD} is a straight line.

17. (a) The diagram below shows a trough with length 1.5m and trapezoidal ends as shown below.



Find the capacity in litres if it is to be used as a reservoir ($1000 \text{ cm}^3 = 1 \text{ litre}$)

(b)



The diagram above shows a toy-cup whose total height is 20cm and top radius 14cm.

- (i) The amount of water the cup can hold.
 (ii) Total surface area of the cup.
28. (a) A sum of Shs. 40,000 is invested at 15% pa compound interest, interest being added half yearly. Find the amount after two years.

29. (a) Given that matrices $A = \begin{bmatrix} 1 & 2 & -3 \\ 4 & 5 & 6 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & 1 & 1 \\ 3 & 1 & 2 \end{bmatrix}$

Find

- (i) $A + B$
 (ii) $B + A$

(b) $N = \begin{bmatrix} 2 & -2 \\ 5 & 4 \end{bmatrix}$ and $M = \begin{bmatrix} 1 & 1 \\ 5 & 2 \end{bmatrix}$

Find;

- (i) NM
 (ii) MN

(iii) does $NM = MN$

(iv) MN^{-1}

30.(a) On the same axes, draw graphs of $y = x^2 - x + 1$ and $y - 2x - 4 = 0$ for $-3 \leq x \leq 4$, using a suitable scale.

(b) Use your graphs to solve the equations;

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

(ii) $x^2 - x = 6$.

31.(a) z varies partially as x^2 and partially as x . Given that $z = 7$ when $x = 1$ and $z = 22$ when $x = 2$, find the value of z when $x = 4$.

(b) The cost of milling wheat flour is partly fixed but partly varies directly as the mass of the flour. Given that the cost of milling 2 kg of wheat flour is Shs. 500, while that of milling 4 kg of the flour is shs. 800, determine:

i) The cost of milling 6 kg of wheat.

ii) The quantity of wheat milled when the cost is sh. 1400.

32. OAPB is a parallelogram and Q is the midpoint of AP. OP meets BQ at X.

a) If $\mathbf{OA} = \mathbf{a}$ and $\mathbf{OB} = \mathbf{b}$, find \overrightarrow{BQ} and \overrightarrow{OP} in terms of \mathbf{a} and \mathbf{b} .

b) If R is point on BQ produced such that $\overrightarrow{BQ} = \overrightarrow{QR}$. Show that the points O, A and R are co-linear.

c) Given that $\overrightarrow{OX} = r\overrightarrow{OP}$ and $\overrightarrow{BX} = s\overrightarrow{BQ}$, find the scalars r and s.

d) Find the ratios $\overrightarrow{OX} : \overrightarrow{OP}$ and $\overrightarrow{BX} : \overrightarrow{XQ}$.

33. A radio company has two sections A and B that produce different radios. Section A produces a radio that requires 80 components and costs sh. 24,000. Section B produces a radio that requires 250 components and costs sh. 20,000. The company to stay in business must have a minimum of 1200 components every time production takes place and sh. 240,000 to meet the expenditures involved. The number of radios from section B should be at least three quarters those from section A. If section A and B produces x and y radios respectively,

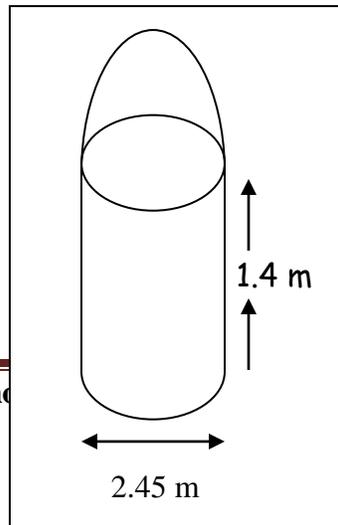
i) Represent this information by inequalities.

ii) Represent your inequalities graphically.

iii) If both sections are producing radios, state the combination that utilizes all the available money.

iv) Find the maximum amount saved.

34.



The diagram above shows a closed water tank comprising of a hemispherical part surmounted on a top of a cylindrical part. The two parts have the same diameter of 2.45 m and the cylindrical part is 1.4 m high as shown.

- i) Calculate the total surface area of the tank.
- ii) Calculate the capacity of the tank.
- iii) Calculate the number of 200 litre drums required to empty a full tank of water.

35. (a) PQRS is a square with A (0, 5), B (0, 3), C (2, 3) and D (2, 5). It is rotated through 270° about O (0, 0). Find the coordinates of A', B', C' and D' the images of A, B, C and D respectively.

(b) Given that A'B'C'D' is the reflected onto A''B''C''D'' in the line $x - y = 0$, find the coordinates of A''B''C'' and D''.

(c) Determine the matrix of a single transformation which maps A''B''C''D'' onto ABCD. Describe the matrix fully.

36. James cycles from his home to town P starting at 8:00 a.m. After one hour while cycling at a uniform speed of 30 kmhr^{-1} , he reached town Q and rested for half an hour. He then continued cycling at the same speed for another 30 km to town P.

- a) (i) Using a suitable scale, draw a distance time graph showing James's journey.
(ii) What is James's average speed?

b) If the elder sister Mary $1\frac{1}{2}$ hours later decided to follow him by

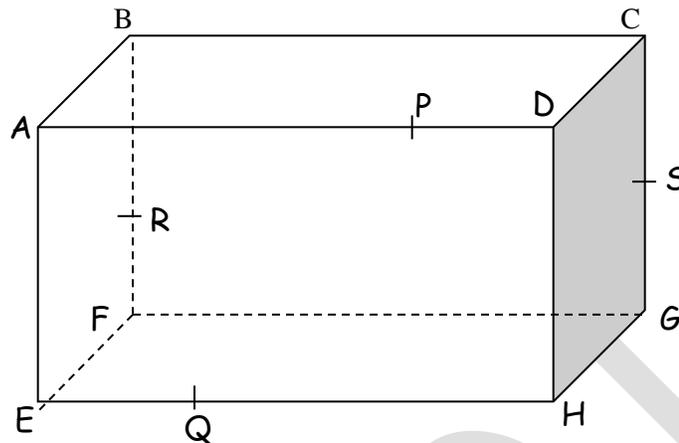
bodaboda, moving steadily at 80 kmh^{-1} , show her journey on the same axes and use it to determine:

- i) When and where Mary overtook James.
- ii) Their times of arrival at town P.
- iii) How long Mary waited at town P before James arrived.

37. St. John SS School has 1020 students. According to the school rules and regulations, students should bathe everyday (B), wash their clothes every week (W) and iron their clothes (C). During a certain month, it was found out that out of the 102 S4 students, 41 obeyed B, 35 obeyed W and 52 obeyed C. 9 students obeyed B and W, 10 students obeyed C and W only and 24 students obeyed B and C. If 17 students obeyed neither rules.

- a) Represent this information on a Venn- diagram.
- b) From the Venn –diagram, find the number of students who:
 - i) Obeyed all the three rules
 - ii) Ironed clothes only.
- c) If a student is picked at random from S4, find the probability that he/she obeyed at least two of the rules.

38.



In the figure above, R and S are midpoints of BF and CG respectively and all dimensions are in cm. Given that $EQ = 3$, $QH = 5$, $AP = 5$, $PD = 3$, $AE = 6$ and $HG = 10$, find:

- i) The lengths PQ, QR, FH and PH.
 - ii) The angle between QR and plane EHGF.
 - iii) The angle between HB and EHDA.
 - iv) The angle between EDCF and the base.
39. Draw a graph of $y = \sin x + \cos x$ for the values of x in the range $0^\circ \leq x \leq 360^\circ$, using intervals of 30° . Use your graph to solve:
- i) $\sin x + \cos x = 0$,
 - ii) $\sin x + \cos x = 1$,
 - iii) $2 \sin x = 1 - 2 \cos x$.

*** End***