



## THE UGANDA INTER SCHOOL VIRTUAL OLEVEL MATHEMATICS SEMINAR 2023.

Saturday 01<sup>st</sup> July 2023 (9:00 a.m)

### INSTRUCTIONS TO STUDENTS AND TEACHERS:

Dear students and teachers we would like to welcome you to participate in the forthcoming Mathematics seminar for senior four students. This is in preparation for the forthcoming final exams(UNEB) and the Mock Examinations. **This is a free seminar and no one should charge you any fees.**The process to be followed by both the teachers and students is suggested below:

1. Teachers share the Seminar questions with their students and ask for volunteers to discuss any of the questions. Questions should be pinned up and learners write down all the questions in their books.
2. Teachers talk to the school administrators to allow the children participate as presenters in the seminar on Saturday **01st July from 09:00am - 2:00 pm**. Other students will just be participants.
3. The student together with the teachers select atleast two best done presentations and the students to represent the school.The solutions and pictures/videos should be uploaded on padlet.<https://bit.ly/S4MATHSEMINAR2023>
4. Hold a mock presentation where all your discussants present to the rest of the class.After that release the rest of the class and record your best presenter in a very quiet environment but with good light.Record each part of the question separately .
5. The teacher could now train the student on how to present on zoom as far as sharing a screen and using the whiteboard. Alternatively the students' presentation will be loaded on the computer screen and they explain to us their solution.

### SEMINAR DETAILS

**S.4 virtual Mathematics seminar 2023.**

**Time:** 01 JULY 2023, 09:00 AM

Join Zoom Meeting

<https://rb.gy/ycpxl>

**Meeting ID:**5482356459

**Passcode:** HeLP23

Kindly register your school using the survey link <https://shorturl.at/vK059> .

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PAPER 456/1	PAPER 456/2
<ol style="list-style-type: none"> <li>1. Statistics</li> <li>2. Matrices</li> <li>3. Transformations               <ol style="list-style-type: none"> <li>(a) Translation</li> <li>(b) Enlargement</li> <li>(c) Rotation</li> <li>(d) Reflection</li> </ol> </li> <li>4. Word problems</li> <li>5. Simplification</li> <li>6. Closed figures</li> <li>7. Linear Programming</li> <li>8. Quadratic graphs</li> <li>9. Inequalities</li> <li>10. Construction</li> <li>11. Bearings</li> <li>12. Trigonometry</li> <li>13. Probability</li> <li>14. Operations</li> <li>15. Fractions</li> <li>16. Factorisation</li> <li>17. Equations &amp; Formulae</li> <li>18. Circle Properties</li> </ol>	<ol style="list-style-type: none"> <li>1. Set theory</li> <li>2. Vectors</li> <li>3. Business Math               <ol style="list-style-type: none"> <li>(a) Taxation</li> <li>(b) Intrests and commission</li> <li>(c) Exchange rates</li> <li>(d) Discounts ,Percentages</li> </ol> </li> <li>4. Kinematic graphs</li> <li>5. 3 Dimensions</li> <li>6. Functions and mappings</li> <li>7. Similarities</li> <li>8. Equation of lines</li> <li>9. Coordinate Geometry</li> <li>10. Ratios and scales</li> <li>11. Proportions/Variations               <ol style="list-style-type: none"> <li>(a) Direct</li> <li>(b) Inverse,Joint and Partial</li> </ol> </li> <li>12. Numerical concepts               <ol style="list-style-type: none"> <li>(a) Decimals</li> <li>(b) Surds</li> <li>(c) Indices</li> <li>(d) Logarithms</li> <li>(e) L.C.M and H.C.F( G.C.F)</li> </ol> </li> </ol>

**"Yesterday's failures are today's seeds that must be diligently planted to be able to abundantly harvest tomorrow's success."**

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## ALGEBRA

1. In a regular polygon, the interior angle and the exterior angle are in the ratio interior : exterior = 11 : 1 Find the number of sides of this regular polygon?
2. Simplify

$$\frac{5x^2 - 19x + 12}{x^2 - 9}$$

3. Factorise completely

(a)  $3y^3 - 12yx^2$

(c)  $a^2 - b^2 - a + b$

(b)  $2p^2 - 3pq - 2q^2 + 2q - p$

(d)  $3x^2 - 10x - 8$

4. Write as a single fraction in its simplest form.

$$\left(\frac{4}{2x-3}\right) \div \left(\frac{2x^2+14x}{2x^2+11x-21}\right)$$

5. Simplify

(a)  $\frac{4}{x-y} + \frac{2}{y-x}$

(c)  $\frac{\left(\frac{2}{5} \times 10 \frac{5}{12}\right) + 9 \frac{3}{4}}{12 \frac{11}{13} \times 2 \frac{1}{2}}$

(b)  $\left(\frac{x-3}{x-1}\right) \div \left(\frac{x^2-9}{x+1}\right)$

(d)  $\frac{3^m \times 9^{m-2}}{27^{m-1}}$

6. In the formulae below, make  $y$  the subject

(a)  $\frac{3y+a}{2y+b} = \frac{p}{q}$

(c)  $z = x - \sqrt{x^2 + y^2}$

(b)  $\frac{ay+b}{cy+d} = \frac{7}{11}$

7. Simplify the following

(a)  $\frac{4}{y-5} + \frac{3}{y-2}$

(b)  $\frac{m-2}{m^2+m-6}$

(c)  $\frac{x^3+5x^2}{x^2-25}$

(d)  $\frac{2m^2+m-6}{m^2-4}$

8. (a) If  $m * n = m^2 - n^2$  and  $a\psi b = \frac{b-a}{2}$ , find the value of  $y$  such that  $y\psi(4 * 2) = 2$   
(b) Given  $m * n = \sqrt{m^2 - n^2}$ , find  $(5 * 9) * 7$
9. (a) Use the substitution method to solve the following pair of simultaneous equations

$$5a - 34 = 3b$$

$$3a - 4b - 16 = 0$$

- (b) A total of 162 guests can be transported when a hired taxi makes 3 trips and the bus makes 2 trips. 250 guests can be transported when the taxi makes 5 trips and the bus makes 3 trips. Find the carrying capacity of each vehicle
10. (a) Find the value of  $m$  when  $134_m = 54_{\text{eight}}$

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(b) Solve the following equations:

i.

$$x + 2 = \frac{25}{x + 2}$$

ii.

$$\frac{5}{x + 1} - \frac{1}{x} = \frac{6}{x + 4}$$

11. Copy and complete the table below for the graph  $y = (x + 2)(4 - x)$

$x$	-4	-3	-2	-1	0	1	2	3
$(x + 2)$								
$(4 - x)$	8							
$y$		-7	0					

(a) On the same axes ,draw the graphs of  $y = (x + 2)(4 - x)$   
(Use a scale of 2cm:1unit on x-axis and 2cm:1unit on y-axis)

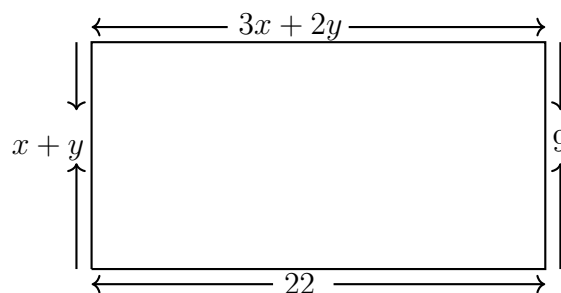
(b) Use your graph to solve the equation  $(x + 2)(4 - x) = 0$

12. Draw on the same coordinate axes the graph of  $y = 2x^2 - 3x + 1$  and  $y = 2x + 1$  for  $-3 \leq x \leq 4$ .

(a) Using your graph ,determine the points of intersection of  $y = 2x^2 - 3x + 1$  and  $y = 2x + 1$

(b) Use your graph to find the root of  $2x^2 - 3x + 1 = 0$

13. Find the values of  $x$  and  $y$



14. (a) A right angled triangle has a base length  $y$ cm and a height of  $(y - 1)$ cm.If its area is  $15\text{cm}^2$ , calculate the base length and height

(b) A rectangular room is 4 metres wider than it is high and it is 8 metres longer than it is wide.The total area of the walls is 512 square metres.Find the width of the room.

(c) Find two numbers whose sum is 42 and whose difference is 12

(d) A grand father is ten times older than his grand daughter .He is also 54 years older than her.How old is each of them

15. (a) Solve the equation

$$x - 2 = \frac{4}{x - 3}$$

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(b) Find the value of  $\sqrt{\frac{x}{y}}$  when  $x = 64^{\frac{2}{3}}$  and  $y = 3^{-2}$

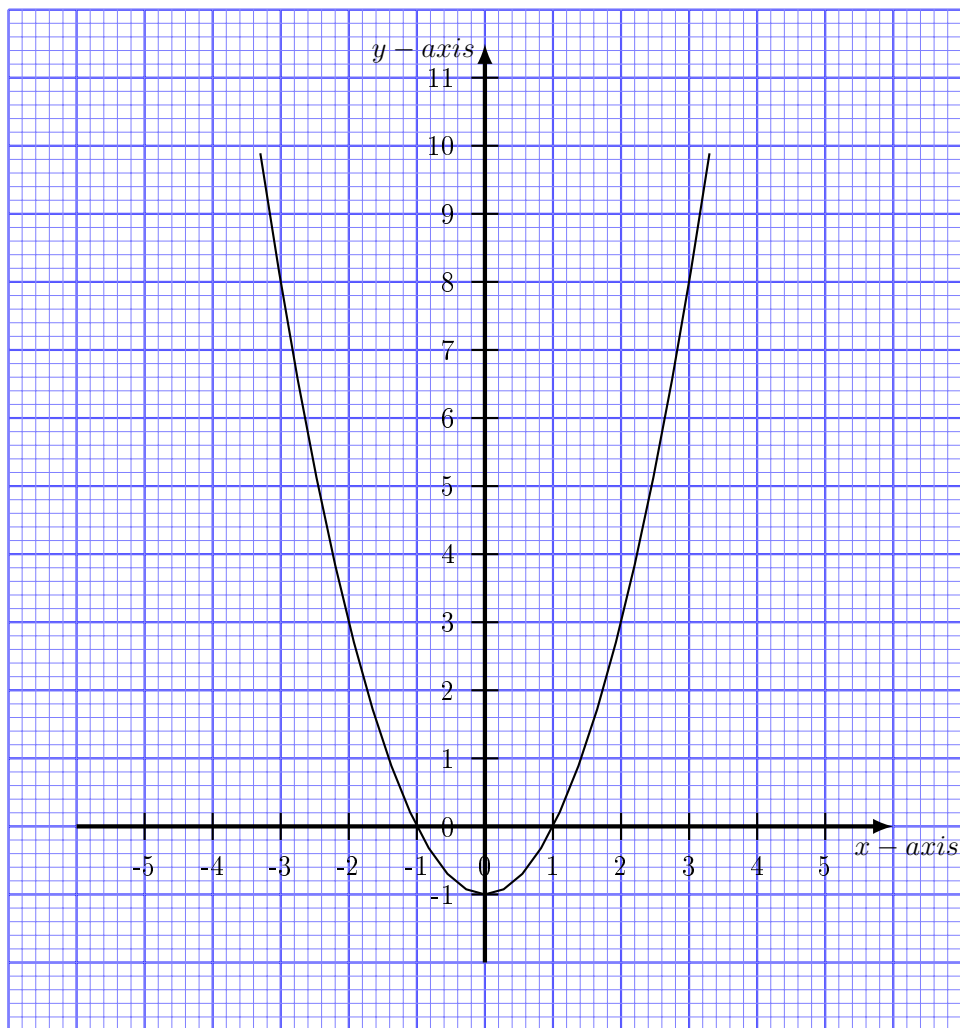
16. (a) Solve the equation.  $\frac{2x+5}{3-x} = \frac{14}{15}$

(b) Solve the simultaneous equations.

$$m = 4 - n$$

$$n^2 + 2m^2 = 67$$

17. The figure below shows a quadratic curve, find the equation of the curve



18. Express  $x^2 + 2x - 8$  in the form  $(x + a)^2 - b$  hence solve the equation  $x^2 + 2x - 8 = 0$ .

### NUMERICAL CONCEPT

19. (a) Simplify

i.  $2\log_{10} 5 + \log_{10} 4 - \log_{10} 20$

ii.  $\log 400 + \log 500 - \log 200 + 1$

(b) Simplify

- 
- |  |   |
|--|---|
| i. $\frac{5^{x+1} \times 5^{-2x}}{5^{-x}}$                             | iv. $\left(\frac{8}{27}\right)^{\frac{-2}{3}}$        |
| ii. $\frac{27^{\frac{1}{3}} \times 16^{\frac{3}{4}}}{9^{\frac{1}{2}}}$ | v. $\frac{(6a^2b^4)^2 \times (2ab)^3}{12ab^6b^8}$     |
| iii. $\frac{3^n \times 9^{n-2}}{27^{n-1}}$                             | vi. $\frac{\sqrt[3]{x}}{x^{-\frac{5}{6}}} \times x^2$ |

(c) Solve the simultaneous equations:

$$\log_4(2x + y) = 2$$

$$\log_3(5x + 3y) = 2$$

(d) Use logarithms to work out the following

i.  $\frac{87.44 \times 44.5}{0.356}$

iii.  $\sqrt[3]{\frac{0.8214 \times 30.48}{68.6}}$

ii.  $\frac{0.462 \div 34.5}{0.64 \times 54.6}$

(e) Given that  $\log a = 1.699$  and  $\log b = 1.913$ . Evaluate  $\log a^2b^{\frac{1}{3}}$

20. (a) Simplify the following

(i)  $2\sqrt{27} + 2\sqrt{12}$

(iv)  $\frac{4\sqrt{243}}{13\sqrt{75} - \sqrt{363}}$

(ii)  $\sqrt{2} + \sqrt{8} - \sqrt{32}$

(v)  $\sqrt{72} + \sqrt{50} - \sqrt{98}$

(iii)  $\sqrt{8} + \sqrt{18} + \sqrt{50}$

(vi)  $\sqrt{75} + 2\sqrt{12} - \sqrt{27}$

(b) Express the following in the form  $a + b\sqrt{c}$ , hence state the values of a, b and c

i.  $\frac{3+\sqrt{2}}{3-\sqrt{2}}$

iii.  $\frac{4\sqrt{2}}{\sqrt{12}+\sqrt{8}}$

ii.  $\frac{1-\sqrt{3}}{2-\sqrt{3}}$

iv.  $\frac{\sqrt{7}}{\sqrt{7}+\sqrt{5}}$

(c) Evaluate

$$\frac{1 + \sqrt{5}}{2 + \sqrt{5}} + \frac{1 - \sqrt{5}}{2 - \sqrt{5}}$$

21. (a) Without using a calculator, simplify:

i.  $8\frac{3}{4} \div (1\frac{1}{3} + 2\frac{5}{6})$

ii.  $\frac{1\frac{1}{5} + 4\frac{1}{2} \div 1\frac{1}{2}}{3\frac{3}{5} - 2\frac{2}{5} \times 1\frac{1}{4}}$

iii.  $(1\frac{3}{5} \div 2\frac{2}{3} \times 1\frac{4}{5}) \div (\frac{16}{35} + \frac{1}{7})$

iv.  $\frac{2}{3} \text{ of } (1\frac{1}{3} + 1\frac{1}{4})$

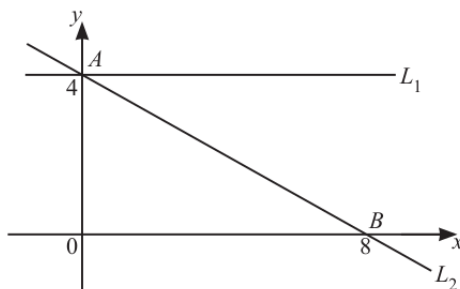
v.  $(1\frac{1}{2} - (8\frac{1}{2} \div 2\frac{1}{2})) \div (1\frac{1}{5} \text{ of } (1\frac{1}{4} + \frac{5}{3}))$

(b) Two taps A and B, together can fill water in a tank in 6 minutes. Tap A alone takes 5 minutes longer to fill the tank than tap B alone. How many minutes does it take tap B alone to fill the tank.

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22. (a) Express  $2.014545\ldots$  in the form  $M\frac{A}{B}$  hence find  $A \div M$
- (b) Convert the following recurring decimals into fractions
- |                         |                       |
|-------------------------|-----------------------|
| i. $0.555\ldots$        | iv. $2.\overline{68}$ |
| ii. $0.1555\ldots$      | v. $0.5\dot{4}$       |
| iii. $0.\dot{5}\dot{9}$ | vi. $5.4676767\ldots$ |
23. Two lighthouses can be seen from the top of a hill. The first flashes once every 8 seconds ,and the other flashes once every 15 seconds .If they flash simultaneously ,how long is it until they flash again at the same time.
24. (a) Evaluate  $\frac{(y^2)^{\frac{1}{6}}}{(9x)^{\frac{1}{2}}}$  when  $x=16$  and  $y=8$
- (b) Solve for  $x$  in  $32^{\frac{3}{5}} \div x^{\frac{1}{2}} = 2$

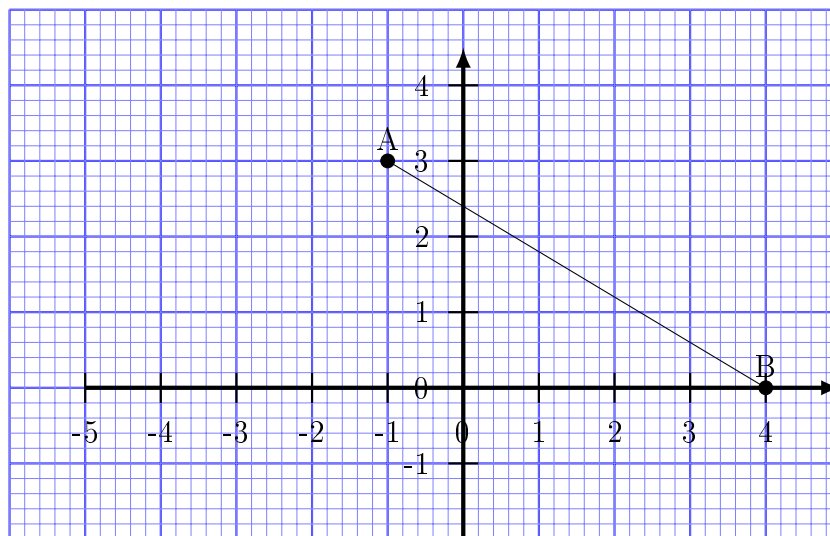
## COORDINATE GEOMETRY

25. A is the point  $(0, 4)$  and B is the point  $(8, 0)$ . The line  $L_1$  is parallel to the x-axis. The line  $L_2$  passes through A and B.



- (a) Write down the equation of  $L_1$  .
- (b) Write down the equation of  $L_2$  in the form  $y = mx + c$  .
- (c) C is the point  $(2, 3)$ . The line  $L_3$  passes through C and is perpendicular to  $L_2$  .Find the equation  $L_3$
- (d)  $L_3$  crosses the x-axis at D.Find the length of CD.
26. A line has gradient  $\frac{-2}{3}$  and its x-intercept is 6. It cuts the y-axis at point P. determine the :
- (a) equation of the line
- (b) coordinates of P.
27. (a) Find the equation of the line passing through  $(5, 5)$  and is parallel to the line  $5 - y = -3x$
- (b) Find the equation of the line passing through  $(2, 1)$  and perpendicular to the line  $4y + 7 + 3x = 0$

28. A line  $L_1$  passes through the points  $(-2, 5)$  and  $(5, 3)$ .
- Determine the equation of the line  $L_1$
  - A nother line  $L_2$  is perpendicular to  $L_1$  and also passes through the point  $(-2, 5)$ . Find the equation of  $L_2$
29. Work out the :



- the distance AB
- the equation of a line AB
- the equation of the line perpendicular to line AB that passes through  $(-2, -1)$

## STATISTICS

30.
  - Stephen's mean mark on five tests is 80. His marks on four of these tests are 68, 81, 74 and 89. Work out his mark on the fifth test.
  - The mean of the numbers  $m, 3, 2, n, 6, 4, 8$  and 7 is 6. If  $m$  is doubled the mean becomes 7. Find the values of  $m$  and  $n$
  - The ages of children who were treated in a day at a clinic are shown in the table below

Age(years)	2	3	5	8	n
Number of children	1	1	2	1	3

Their mean age was 7 years. Find the value of **n**

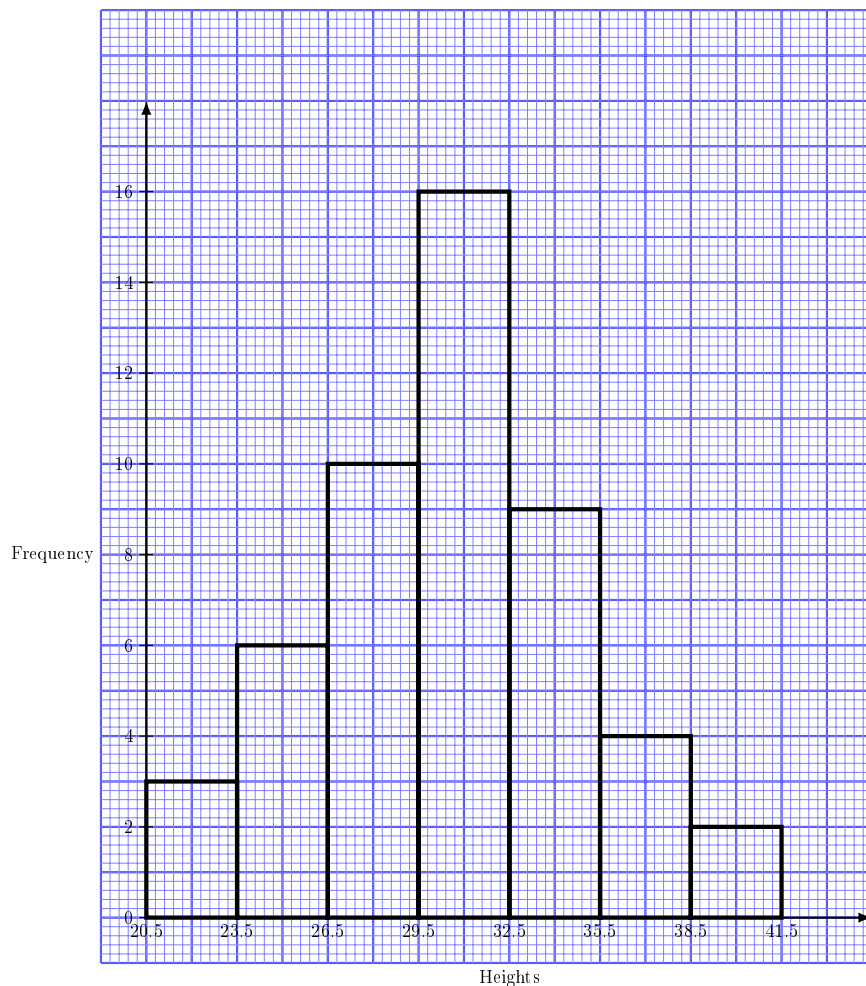
31. The table below shows the ages of 40 people treated for Malaria at a health centre

11	16	21	28	33	37	41	45	47	41
27	33	32	43	31	34	10	20	21	36
26	22	22	17	12	14	18	48	42	38
23	23	18	24	21	16	22	23	32	31



- 
- (a) Construct a frequency table starting with the class  $10 - 14$
- (b) Use the frequency table to calculate the:
- (i) Mean age of the people treated for Malaria
  - (ii) Median age of the people treated for Malaria
  - (iii) Modal age

32. The Histogram below shows the heights of tomatoes to be transplanted in a garden.



- (a) Using the histogram above, estimate the mode.
- (b) Using the Histogram construct a frequency distribution and use it to calculate
- (i) The mean height.
  - (ii) The median height.

33. The Ogive below shows the points obtained by the students in the HeLP mathematics quiz.



- (a) Using the Ogive , estimate the median points.
- (b) Using the O give construct a frequency distribution and use it to calculate
  - (i) The mean points.
  - (ii) The modal points

34. The mode of 3, 10, 8, 4, 4, 11,  $y$ , 3, 12 is 3. Find

- (a) the value of  $y$
- (b) the mean

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35. The masses of 50 babies born in Buikwe hospital were recorded as below:

Mass(kg)	Number of babies
2.0 – 2.4	4
2.5 – 2.9	6
3.0 – 3.4	10
3.5 – 3.9	12
4.0 – 4.4	9
4.5 – 4.9	4
5.0 – 5.4	3
5.5 – 5.9	2

(a) Calculate the :

i. Mean mass

ii. Median mass

(b) Draw a histogram and use it to estimate the modal mass of the babies

36. The table below shows the distribution of weights of a certain type of fruit

Weights(grams)	Cummulative Frequency
7 – 9	5
10 – 12	12
13 – 15	26
16 – 18	42
19 – 21	48
22 – 24	50

(a) Draw a histogram of the data and use it to estimate the modal weight

(b) Using an assumed mean of 14.4 ,calculate the mean weight.

37. The table below shows the heights of plants to be transplanted into a garden measured in centimetres

1.0	1.1	1.2	1.3	1.4	1.2	2.5	2.6	2.6	2.8
2.7	3.5	3.4	3.2	3.6	3.9	2.5	2.8	2.9	2.8
3.0	3.1	3.2	3.3	2.5	2.8	2.9	2.7	2.6	2.3
2.2	2.2	2.3	2.0	2.2	2.1	2.2	2.3	2.4	2.1
1.6	1.8	1.6	1.6	1.6	1.7	1.8	1.9	1.8	1.7

(a) Construct a frequency table starting with the class 1.0 – 1.4

(b) Use the frequency table to calculate the:

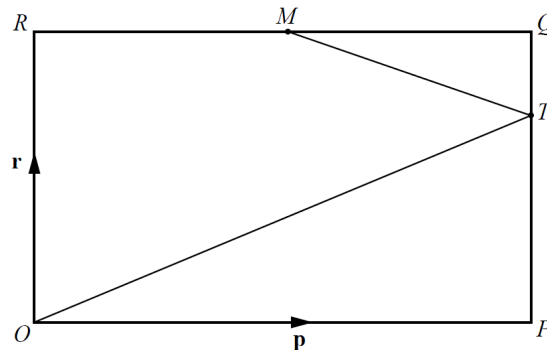
(i) Mean height

(ii) Median height

(iii) Modal height

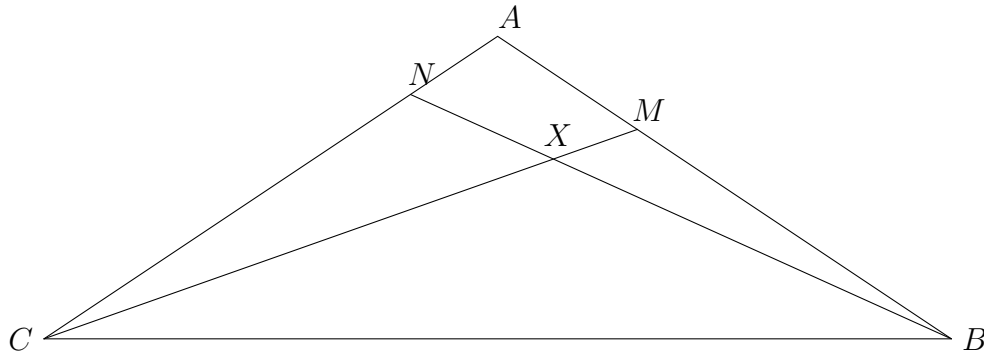
## VECTORS

38. (a) Given the vectors  $\mathbf{OA} = \begin{pmatrix} 12 \\ 16 \end{pmatrix}$ ,  $\mathbf{OB} = \begin{pmatrix} 4 \\ 1 \end{pmatrix}$ . Find
- $\mathbf{BA}$
  - $|\mathbf{BA}|$
- (b) The position vectors of  $\mathbf{P}$  and  $\mathbf{Q}$  are  $\begin{pmatrix} 15 \\ -6 \end{pmatrix}$  and  $\begin{pmatrix} 5 \\ 4 \end{pmatrix}$  respectively. Find the magnitude of  $\mathbf{PQ}$
39. Given that  $\mathbf{AO} = \begin{pmatrix} -2 \\ 2 \end{pmatrix}$ ,  $\mathbf{OB} = \begin{pmatrix} 8 \\ 4 \end{pmatrix}$  and X is a point on  $\overline{AB}$  such that  $\overline{AX} : \overline{XB} = 1 : 1$ , Find
- $\mathbf{AB}$
  - $\mathbf{AX}$
40. In triangle ABC. L, M and N are the mid point of  $\overline{BC}$ ,  $\overline{CA}$  and  $\overline{AB}$  respectively.  $\mathbf{AM} = \mathbf{a}$ ,  $\mathbf{AN} = \mathbf{b}$  and  $3\mathbf{AG} = 2\mathbf{AL}$ .
- Express in terms of vectors  $\mathbf{a}$  and  $\mathbf{b}$  the vector
    - $\mathbf{AB}$
    - $\mathbf{AC}$
    - $\mathbf{BC}$
    - $\mathbf{BG}$
    - $\mathbf{GM}$
  - Show that B, G and M lie on a straight line and that  $3\mathbf{BG} = 2\mathbf{BM}$
41. OPQR is a rectangle and O is the origin. M is the midpoint of  $\mathbf{RQ}$  and  $\mathbf{PT} : \mathbf{TQ} = 2 : 1$ .  $\overline{OP} = \mathbf{p}$  and  $\overline{OR} = \mathbf{r}$ .



- Find, in terms of  $\mathbf{p}$  and/or  $\mathbf{r}$ , in its simplest form
  - $\overline{MQ}$
  - $\overline{MT}$
  - $\overline{OT}$
- RQ and OT are extended and meet at U. Find the position vector of U in terms of  $\mathbf{p}$  and  $\mathbf{r}$ . Give your answer in its simplest form.
- $\overline{MT} = \begin{pmatrix} 2k \\ -k \end{pmatrix}$  and  $|\overline{MT}| = 180$ . Find the positive value of k

42. In triangle ABC, shown below,  $AB = \mathbf{a}$ ,  $AC = \mathbf{b}$ . Point M lies on AB such that  $AM:MB = 2:3$  and point N lies on AC such that  $AN:NC = 5:1$ , line BN intersects line MC at X.

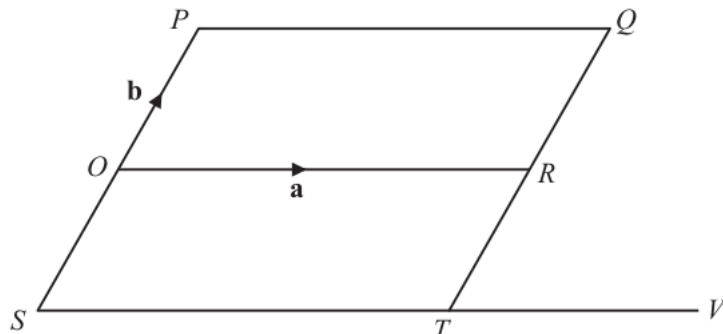


- (a) Express the following in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .
- $\mathbf{BN}$
  - $\mathbf{CM}$
- (b) Given that  $\mathbf{BX} = k\mathbf{BN}$  and  $\mathbf{CX} = r\mathbf{CM}$  where  $k$  and  $r$  are scalars. Write two different expressions for  $\mathbf{AX}$  in terms of  $\mathbf{a}$ ,  $\mathbf{b}$ ,  $k$  and  $r$
- (c) Find the values of  $k$  and  $r$
43. (a) Show that  $A(-3, -2)$ ,  $B(3, 1)$  and  $C(5, 2)$  lie on a straight line.
- (b) If  $\mathbf{r} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$ ,  $\mathbf{s} = \begin{pmatrix} 3 \\ -4 \end{pmatrix}$  and  $\mathbf{t} = \begin{pmatrix} 2 \\ 4 \end{pmatrix}$ , find
- $\mathbf{r} + \mathbf{s}$
  - $\mathbf{s} - \mathbf{t}$
  - $|\mathbf{2r}|$
  - $|\mathbf{3s} + \mathbf{2t}|$
44. OAB is a triangle in which  $\mathbf{OA} = \mathbf{a}$ ,  $\mathbf{OB} = \mathbf{b}$ . Points C and E divide lines  $\mathbf{OA}$  and  $\mathbf{AB}$  in the ratios  $1:2$  and  $3:1$  respectively. Point D lies on  $\mathbf{OE}$  such that  $OD = 2DE$ .
- (a) Find in terms of  $\mathbf{a}$  and  $\mathbf{b}$  vectors:
- $\mathbf{AB}$
  - $\mathbf{OE}$
  - $\mathbf{CB}$
- (b) Show that B, D and C are collinear.
45. In a triangle OAB,  $\mathbf{OA} = \mathbf{a}$ ,  $\mathbf{OB} = \mathbf{b}$ , P and Q are points on  $\mathbf{OA}$  and  $\mathbf{AB}$  respectively such that  $3\mathbf{OP} = \mathbf{PA}$ ,  $\mathbf{AQ} = 2\mathbf{QB}$  and N is the midpoint of  $\mathbf{OQ}$ . ANM is a straight line which is such that  $\mathbf{AN} = 5\mathbf{NM}$ . Given also that  $\mathbf{OM} = h\mathbf{OB}$ , where  $h$  is a scalar.

- (a) Express the following vectors in terms of  $\mathbf{a}$  and  $\mathbf{b}$

- $\mathbf{OQ}$
- $\mathbf{AN}$
- $\mathbf{PN}$
- $\mathbf{NB}$

- (b) Show that the points P, N and B are collinear
- (c) Find the value of h.
46. O is the origin and OPQR is a parallelogram SOP is a straight line with  $\mathbf{SO} = \mathbf{OP}$  TRQ is a straight line with  $\mathbf{TR} = \mathbf{RQ}$  STV is a straight line and  $\mathbf{ST} : \mathbf{TV} = 2 : 1$   $\mathbf{OR} = \mathbf{a}$  and  $\mathbf{OP} = \mathbf{b}$



- (a) Find, in terms of a and b, in its simplest form,
- the position vector of T
  - $\mathbf{RV}$
- (b) Show that  $\mathbf{PT}$  is parallel to  $\mathbf{RV}$
47. Given the vectors  $\mathbf{AB} = \begin{pmatrix} 7 \\ -2 \end{pmatrix}$ ,  $\mathbf{BC} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$ , and  $\mathbf{CD} = \begin{pmatrix} -6 \\ 11 \end{pmatrix}$ , find
- $\mathbf{AD}$
  - $|\mathbf{AD}|$
48. In triangle ABC, the mid points of  $\overline{BC}$ ,  $\overline{AC}$  and  $\overline{AB}$  are L, M and N respectively.  $\mathbf{AM} = \mathbf{a}$  and  $\mathbf{AN} = \mathbf{b}$ . Point G lies on  $\overline{AL}$  such that  $3\overline{AG} = 2\overline{AL}$
- $\overrightarrow{AB}$
    - $\overrightarrow{BC}$
    - $\overrightarrow{BG}$
    - $\overrightarrow{GM}$
- (b) Show that the points B, G and M are collinear

## RATIOS AND PROPORTIONS

49. A recipe for making 20 biscuits uses 150 g flour, 125 g butter and 50 g sugar.
- Write the ratio flour : butter : sugar in its simplest form.
  - Work out the amount of flour, butter and sugar needed to make 50 biscuits.
  -
50. Two solids are mathematically similar and have volumes  $81 \text{ cm}^3$  and  $24 \text{ cm}^3$ . The surface area of the smaller solid is  $44 \text{ cm}^2$ . Calculate the surface area of the larger solid.
51. An aircraft carries fuel in three tanks whose capacities are in the ratio 3 : 4 : 5. The capacity of the smallest tank is 720 litres. Calculate

- 
- (a) the capacity of the largest tank
- (b) the total capacity of the three tanks
52. (a) If  $(a + b) : (a - b) = 8 : 3$  find the ratio  $a : b$
- (b)  $y$  varies inversely as the square of  $(x + 2)$ . When  $x = 4$ ,  $y = 0.5$ . Find  $y$  in terms of  $x$ .
53. The volume of wood in a tree ( $V$ ) varies directly as the height ( $h$ ) and inversely as the square of the girth ( $g$ ). If the volume of a tree is  $144m^3$  when the height is 20m and the girth is 1.5m, what is the height of a tree with a volume of  $1000m^3$  and girth of 2m.
54.  $y$  is inversely proportional to  $x$

- (a) Copy and complete the table below

x	1	2	4	8	16	32
y					2	

- (b) What is the value of  $x$  when  $y = 64$
55. A food Aid agency carried out a survey to ascertain the average monthly expenditure on food by a family in a certain urban centre. The expenses on food were found to be in two parts: A constant expenditure and another part varying as the square of the number of children in the family. A family of 3 children needed Sh 190,000 while that of 5 children needed Sh 310,000.
- (a) Write down an expression for the total expenditure on food spent per month by a family with  $n$  children.
- (b) What is the monthly expenditure for;
- (i) A childless family?
- (ii) A family with four children?
- (c) How many children are in a family which needs an average expenditure of Sh 392,500?
56. A quantity  $p$  varies jointly as  $q$  and  $r$ . When  $p = 36$ ,  $q = 2$  and  $r = 6$ . Find the:
- (i) equation connecting  $p$ ,  $q$  and  $r$
- (ii) value of  $p$  when  $q = 0.5$  and  $r = 10$
- (iii) value of  $r$  when  $q = 4$  and  $p = 60$
57. Six people can dig a trench in 8 hours.
- (a) How long would it take:
- (i) 4 people
- (ii) 12 people

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## BUSINESS MATH

58. A house was bought at Shs 150,000. In the first year, its value appreciated by 25%, in the second year by 10% but dropped by 20% in the third year. Find its value after 3 years
59. A cash discount of 15% is allowed on a colour TV set with a marked price of Sh.900,000. Hire purchase terms are: a deposit of 30%, and 12 monthly installments of Sh.65,000. Find the percentage profit made on the hire purchase scheme over the cash payment.
60. (a) A black book was sold at UGX 19,000 making a loss of 5%.At what price should it have been sold to gain 5% profit
- (b) Mr Kaziba deposited UGX 2,000,000 on fixed deposit account at a compound interest of 20% per annum for four years.Calculate the
- (i) Amount on his fixed deposit acccount after four years
- (ii) Interest he earned after the four years.
61. A man borrowed Shs 15.6 million from a bank at a simple interest rate of 15% per annum. He has to repay the loan within 2 years in equal weekly instalments. Calculate the:
- (a) interest he paid to the bank
- (b) total amount to be paid
62. (a) A Techno smart phone was bought on hire purchase. A deposit of 50,000 was paid and a 15 monthly installments of UGX. 15,000 was required.
- i. Calculate the total amount paid on hire purchase.
- ii. If the hire purchase price is 20% higher than the cash price, find the cash price
- (b) The price of a secondhand laptop is UGX 800,000.It can be bought on hire purchase terms by making a deposit of 40% of the cash price and then 10 monthly installments of UGX 75000 per month.
- i. Find the cost of the laptop on hire purchase terms
- ii. How much more does one pay on hire purchase rather than cash terms.
63. The table below shows the tax structure on taxable income of public servants working in a certain country

Income per annum(Shs)	Tax rate%
0 – 1, 200, 000	12.5
1, 200, 001 – 2, 400, 000	30.0
2, 400, 001 – 3, 600, 000	36.5
3, 600, 001 and above	45.0

A man's gross annual income is Shs 6,460,000.His allowances are:

Housing—Shs 125,000 per month

Marriage—  $\frac{1}{10}$  of his gross annual income

Medical— Shs 354,000 per annum



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Transport— Shs 60,000 per month

Family allowances per annum for only 3 children are as follows

Shs 25,000 for each child between 10 and 18 years

Shs 32,000 for each child below 9 years

He has to pay an insurance premium of Shs48,900 per annum

He has four children with two of them below eight years, one is 16 years and the oldest is 20 years.

Calculate:

- (a) His taxable income
- (b) Income tax paid annually
- (c) Net Income

64. The table below shows the income tax rates of government employees

Taxable monthly income(Shs)	Tax rate
100,000 – 200,000	10%
200,000 – 300,000	20%
300,000 – 400,000	30%
400,000 – 500,000	40%
500,000 and over	55%

An employee who pays sh.69526 as monthly income tax is entitled to the following allowances.

- Marriage allowance:Shs126,500 per month
- Housing and transport:Shs105585 per month
- Medical care:Shs48,000 per month

Find his:

- (a) Taxable income
- (b) Gross monthly income
- (b) Net monthly income

## MATRICES

65. (a) The determinant of the matrix  $\begin{pmatrix} 6 & 2x \\ 5 & x \end{pmatrix}$  is 24, find the value of  $x$ .

(b) Given that  $A = \begin{pmatrix} 2 & 5 \\ 3 & 9 \end{pmatrix}$ ,  $B = \begin{pmatrix} -4 & \\ & 2 \end{pmatrix}$ ,  $C = \begin{pmatrix} 1 & 7 \end{pmatrix}$ . Work out the following

- (i)  $\mathbf{CB}$                       (ii)  $\mathbf{AB}$                       (iii)  $\mathbf{A}^2$                       (iv)  $\mathbf{L}^{-1}$

66. Find the values of  $x$  and  $y$  such that  $\begin{pmatrix} 4 & 1 \\ x & -1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 4 \\ 8 \end{pmatrix}$

- 
67. (a) Find the inverse of matrix  $\begin{pmatrix} 5 & 3 \\ 2 & 2 \end{pmatrix}$  and hence solve the simultaneous equations ;

$$5x + 3y = 7$$

$$2x + 2y = 2$$

- (b) The inverse matrix  $A^{-1} = \begin{pmatrix} 1 & -1 \\ -1\frac{1}{2} & 2 \end{pmatrix}$ ; Find the matrix  $A$  and deduce  $AA^{-1} = I$ , where  $I$  is a  $2 \times 2$  identity matrix
- (c) Given that matrix  $P = \begin{pmatrix} 1 & 2 \\ 4 & 5 \end{pmatrix}$ ,  $Q = \begin{pmatrix} -1 & 1 \\ 3 & 2 \end{pmatrix}$  and  $R = \begin{pmatrix} 4 & 6 \\ 10 & 15 \end{pmatrix}$ . Find matrix  $T$  such that  $T = P^2 + 3Q - R$
68. (a) Given that  $x = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ ,  $y = \begin{pmatrix} 4 \\ 5 \end{pmatrix}$  and  $z = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$ . Find the values of  $a$  and  $b$  if  $ax + by = z$
- (b) Given that  $4A + BC = N$ , where  $A = \begin{pmatrix} 0 & 1 \\ -1 & 2 \end{pmatrix}$ ,  $B = \begin{pmatrix} 1 & 3 \\ -2 & 2 \end{pmatrix}$  and  $C = \begin{pmatrix} 2 & 3 \\ 3 & -1 \end{pmatrix}$ , Find  $N$
- (c) Given that  $A = \begin{pmatrix} 3 & 0 \\ 2 & 7 \end{pmatrix}$  and  $B = \begin{pmatrix} 1 & 0 \\ 4 & y \end{pmatrix}$ . Find the value of  $k$  for which  $AB = BA$
69. Stephen and Ronald went to Mega supermarket for shopping. Stephen bought 5kg of sugar, 5 bars of soap, 8 counter books and 4 bottles of cooking oil. Ronald bought 8kg of sugar, 4 bars of soap and a dozen of counter books. The cost of sugar per kg was UGX.3500, a bar of soap was UGX 6500, a counter book was UGX .5000 and a bottle of cooking oil was UGX.3500.
- (a) Write down a
- $2 \times 4$  matrix for the items purchased by the two people
  - $4 \times 1$  matrix for the cost of each item
- (b) Calculate the :
- Expenditure of each person by matrix multiplication
  - Total expenditure of both Stephen and Ronald
- (c) Who spent more money and by how much did he spend than the other.

## PROBABILITY AND SET THEORY

70. Blessed is playing a game with these six number cards.

$$\boxed{-3}$$

$$\boxed{-2}$$

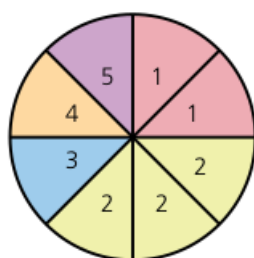
$$\boxed{2}$$

$$\boxed{3}$$

$$\boxed{5}$$

$$\boxed{7}$$

- 
- (a) She takes two cards at random, without replacement, and multiplies the two numbers to give a score. Find the probability that
- the score is 35
  - the score is a positive number.
- (b) Blessed now takes three cards at random from the six cards, without replacement, and adds the three numbers to give a total. Find the probability that her total is 5.
71. (a) Two fair dice are thrown simultaneously. Find the probability that the sum of the scores is
- four
  - less than four
  - greater than seven
- (b) A three digit number is formed using the digits 8, 5 and 7 without repeating any digit in the number formed.
- Write down the possibility space for the numbers formed
  - Find the probability that the number formed is even
72. (a) Two fair, tetrahedral dice are rolled. If each is numbered 1–4, draw a two-way table to show all the possible outcomes.
- (b) What is the probability that both dice show the same number?
- (c) What is the probability that the number on one dice is double the number on the other?
- (d) What is the probability that the sum of both numbers is prime?
73. A spinner is numbered as shown.



- (a) If it is spun once, calculate the probability of getting a:
- 1
  - 2
- (b) If it is spun twice, calculate the probability of getting a:
- 2 followed by a 4
  - 2 and 4, in any order,
  - at least one 1,

---

74. A group of 40 people were asked whether they like cricket (C) and football (F). The number liking both cricket and football was three times the number liking only cricket. Adding 3 to the number liking only cricket and doubling the answer equals the number of people liking only football. Four said they did not like sport at all.

- (a) Draw a Venn diagram to represent this information.
- (b) Calculate  $n(C \cap F)$ .
- (c) Calculate  $n(C \cap F^1)$ .
- (d) Calculate  $n(C^1 \cap F)$ .

75. Box A and box B each contain blue and green pens only. Erisa picks a pen at random from box A and Winnie picks a pen at random from box B. The probability that Erisa picks a blue pen is  $\frac{2}{3}$ . The probability that both Erisa and Winnie pick a blue pen is  $\frac{8}{15}$ .

- (a) Find the probability that Winnie picks a blue pen.
- (b) Find the probability that both Erisa and Winnie pick a green pen.

76.  $x$  is an integer.

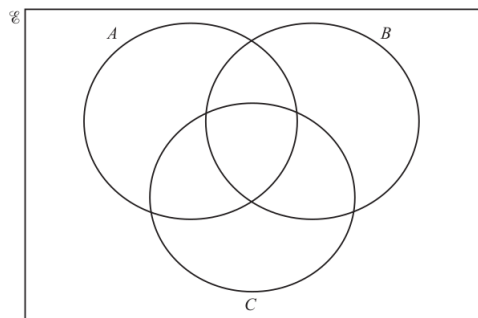
$$\epsilon = \{x : 41 \leq x \leq 50\}$$

$$A = \{x : x \text{ is an odd number}\}$$

$$B = \{x : x \text{ is a multiple of 3}\}$$

$$C = \{x : x \text{ is a prime number}\}$$

- (a) Complete the Venn diagram to show this information.

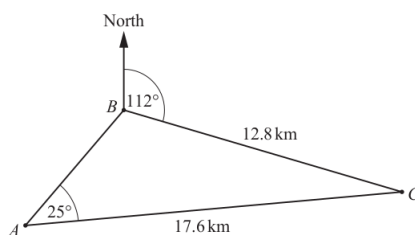


- (b) List the elements of
  - i.  $A \cap C$
  - ii.  $(B \cup C)^1$
- (c) Find  $n(A \cap B \cap C)$

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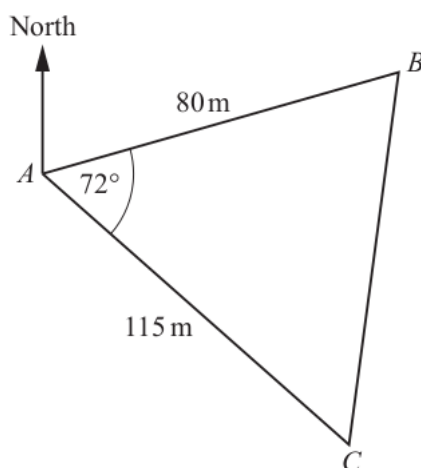
## GEOMETRICAL CONSTRUCTION

77. The diagram shows the positions of three ships A, B and C.  $AC = 17.6$  km,  $BC = 12.8$  km and angle  $BAC = 25^\circ$ . The bearing of C from B is  $112^\circ$  and angle ABC is obtuse.



Calculate the bearing of B from A.

78. The diagram shows the positions of three points A, B and C in a field.



- (a) Calculate the length BC, correct to 4 significant figures
  - (b) Calculate angle ABC.
  - (c) The bearing of C from A is  $147^\circ$ . Find the bearing of
    - i. A from B,
    - ii. B from C.
  - (d) Kaziba takes 35 seconds to run from A to C. Calculate his average running speed in kilometres per hour.
79. Police men on a helicopter leave the police headquarters H on a bearing of  $030^\circ$  to station M which is  $100$  km away. When they reached a station M they got a radio call instructing them to fly on a bearing of  $120^\circ$  to assist a family F, attacked by robbers which is  $200$  km from M.
- (a) Using a scale of **1 cm to represent 25 km**, draw a scale diagram to show the route of the helicopter.
  - (b) From your diagram, Find

- 
- (i) The distance of F from the head quarters H ,giving your answer to the nearest km
- (ii) The bearing of F from H
- (iii) The bearing of M from F
80. A plane flies from airport P due North for 300km to airport R. It then flies on a bearing of  $295^0$  for 200km to air strip Q. From there it flies on a bearing of  $090^0$  for 500km to air strip S
- (a) Use a scale of 1cm to represent 50km, draw an accurate diagram to show the route of the plane.
- (b) Find the distance between S and R.
81. Using a pair of compasses ,ruler and pencil only,construct a triangle ABC in which  $AB=10\text{cm}$ ,  $\angle ABC=60^0$  and  $\angle CAB=45^0$  .
- (a) Measure and state lengths AC and BC
- (b) Circumscribe triangle ABC
- (c) Measure and state the radius of the circle
- (d) Calculate the area of the circle
- (e) Calculate the perimeter(circumference) of the circle
82. (a) Using a ruler and a pair of compasses only ,construct triangle ABC for which angle  $ABC =150^0$  , $\overline{AB}=7.5\text{cm}$  and  $\overline{BC}=8\text{cm}$ .
- (b) Draw a circle passing through the vertices of triangle ABC
- (c) State the radius of the circle ,hence calculate the area of a circle
83. If A is north of B, C is southeast of B and on a bearing of  $160^0$  from A, find the bearing of:
- (a) A from B
- (b) A from C

## TRIGONOMETRY

84. Given that  $\cos \theta = -\frac{8}{17}$  for  $180^0 < \theta < 360^0$ , find the value of:
- (a)  $\sin \theta$
- (b)  $\tan \theta$
- (c)  $\sin^2 \theta + \cos^2 \theta$
85. (a) Solve  $3(2 + \cos x) = 5$  for  $0^0 \leq x \leq 360^0$ .
- (b) Given that  $3 \sin \beta + 2 = 0$  for  $180^0 < \beta < 360^0$  , find the two possible values of  $\beta$
86. Without using tables or calculators, evaluate leaving your answers in rational surd form.

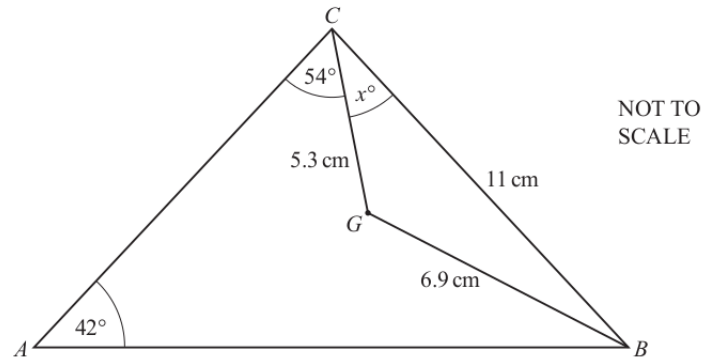
(a)  $\frac{\cos 60^\circ + \sin 60^\circ}{\tan 60^\circ}$

(c)  $\sin 30^\circ + 3 \cos 30^\circ$

(b)  $\frac{1 + \sin 60^\circ}{1 - \sin 60^\circ}$

(d)  $\frac{1 + \sin 45^\circ}{1 - \cos 45^\circ}$

87. The diagram shows triangle ABC with point G inside. CB = 11 cm, CG = 5.3 cm and BG = 6.9 cm. Angle CAB =  $42^\circ$  and angle ACG =  $54^\circ$ .



- (a) Calculate the value of  $x$ .
- (b) Calculate AC.
88. In triangle ABC, angle ACB =  $40^\circ$ , BC = 6 cm and AC = 6 cm. Find the area of the triangle.
89. Draw a graph of  $y = 3 \cos x$  for  $0 \leq x \leq 360^\circ$  using intervals of  $60^\circ$  (use a scale of  $1 \text{ cm} : 30^\circ$  on the x-axis and  $2 \text{ cm} : 1 \text{ unit}$  on the y-axis). Use your graph to solve the equation  $3 \cos x = 0$
90. A boat sets off on a trip from S. It heads towards B, a point 6 km away and due north. At B it changes direction and heads towards point C, 6 km away from and due east of B. At C it changes direction once again and heads on a bearing of  $135^\circ$  towards D, which is 13 km from C.
- (a) Calculate the distance between S and C to the nearest 0.1 km.
- (b) Calculate the distance the boat will have to travel if it is to return to S from D.
91. Two planes are flying directly above each other. A person standing at P can see both of them. The horizontal distance between the two planes and the person is 2 km. If the angles of elevation of the planes from the person are  $65^\circ$  and  $75^\circ$ , calculate:
- (a) the altitude at which the higher plane is flying,
- (b) the vertical distance between the two planes.

## FUNCTIONS

92.  $f(x) = 10 - x$ ,  $g(x) = \frac{2}{x}$ ,  $x \neq 0$ ,  $h(x) = 2^x$ ,  $j(x) = 5 - 2x$
- (a) Find
- i.  $g(\frac{1}{2})$

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ii.  $hg(\frac{1}{2})$

(b) Find  $x$  when  $f(x) = 7$

(c) Find  $x$  when  $g(x) = h(3)$

(d) Find  $j^{-1}(x)$

(e) Write  $f(x) + g(x) + 1$  as a single fraction in its simplest form.

(f)  $(f(x))^2 - ff(x) = ax^2 + bx + c$  Find the values of  $a$ ,  $b$  and  $c$ .

(g) Find  $x$  when  $h^{-1}(x) = 10$ .

93. If  $f(x) = 5 - 2x$  and  $g(x) = x^2 + 8$

(a)  $ff(-3)$

(b) Find

(i)  $g(2x)$

(ii)  $f^{-1}(x)$

94. If  $h(y) = \frac{y^2 - 1}{y + 1}$ , find:

(a)  $h(0)$

(b)  $h(2)$

(c)  $h(-4)$

(d)  $h(-5)$

95. The function  $h(x) = \frac{1}{2}x^2 + p$  and  $h(-2) = 6$ . Find the value of  $p$ .

96. Given that  $f(x) = \frac{1}{x^2 - 4x + 4}$  and ,find

(a)  $f(0)$

(b) the value of  $x$  for which  $f(x)$  is undefined

97. Given that  $f(x) = 8x + 5$  and  $g(x) = 3x - 5$ ,find

(a)  $fg(x)$

(b)  $fg(2)$

(c)  $gf(x)$

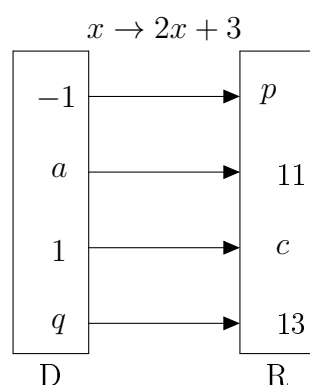
(d)  $gf(2)$

98. Given that  $f(x) = ax^2 + bx$ ,  $f(1) = 6$  and  $f(-2) = 12$ ,find:

(a) the values of **a** and **b**

(b)  $f(-2)$

99. Find the unknown values in the arrow diagram for the mapping  $x \rightarrow 2x + 3$





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100. (a) Given that  $h(x) = 2x^2 + 1$  and  $g(x) = 5x - 1$ , evaluate

i.  $h(-2)$

ii.  $h(4)$

iii.  $hg(2)$

(b) Given that  $f(x) = \frac{11x+3}{2x-7}$ . Find  $f^{-1}(x)$

101. Given that  $g(x) = \frac{2}{x^2-1}$ , find

(i)  $g^{-1}(x)$

(ii)  $g^{-1}(\frac{2}{15})$

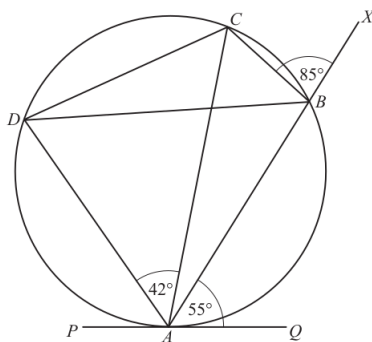
102. Given that  $h(x) = 6x - 5$ ,  $f^{-1} = \frac{2-3x}{5x}$ . Find

(i)  $f(x)$

(ii)  $fh(x)$

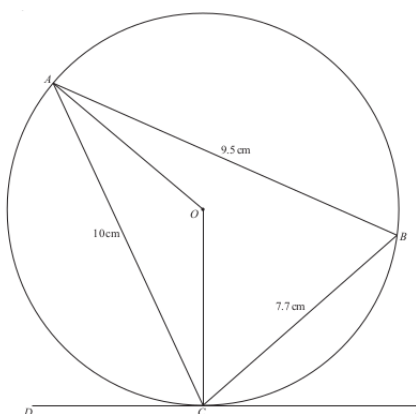
## CIRCLE PROPERTIES

103. ABCD is a cyclic quadrilateral, ABX is a straight line and PQ is a tangent to the circle at A. Angle CBX =  $85^\circ$ , angle BAQ =  $55^\circ$  and angle CAD =  $42^\circ$ . Find:



(a) angle CBD    (b) angle ACB    (c) angle ADC    (d) angle BCD    (e) angle PAD

104. A, B and C are points on the circle, centre O. DE is a tangent to the circle at C. AC = 10 cm, AB = 9.5 cm and BC = 7.7 cm.



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(a) Calculate angle ABC .Correct to 1 d.p.

(b) Find

i. angle AOC

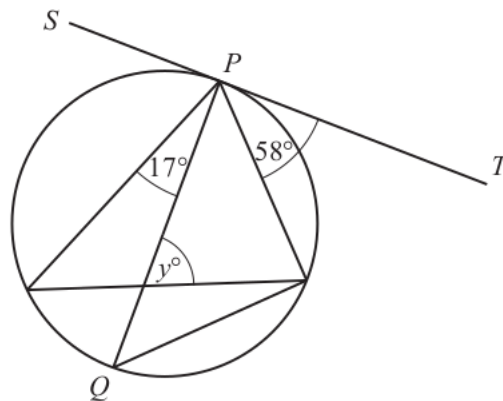
ii. angle ACO

iii. angle ACD

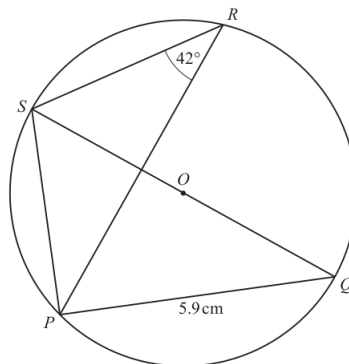
(c) Calculate the radius, OC, of the circle.

(d) Calculate the area of triangle ABC as a percentage of the area of the circle.

105. The diagram below shows a circle with diameter PQ. SPT is a tangent to the circle at P. Find the value of  $y$ .

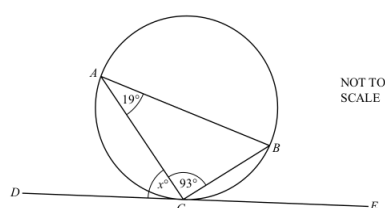


106. P, Q, R and S are points on a circle, centre O. QS is a diameter. Angle PRS =  $42^\circ$  and PQ = 5.9 cm.



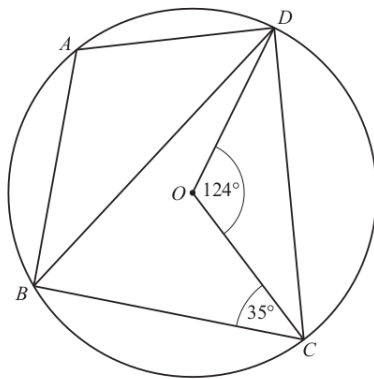
Calculate the circumference of the circle.

107. A, B and C are points on a circle. DE is a tangent to the circle at C. Angle BAC =  $19^\circ$  and angle ACB =  $93^\circ$ .



Find the value of  $x$ .

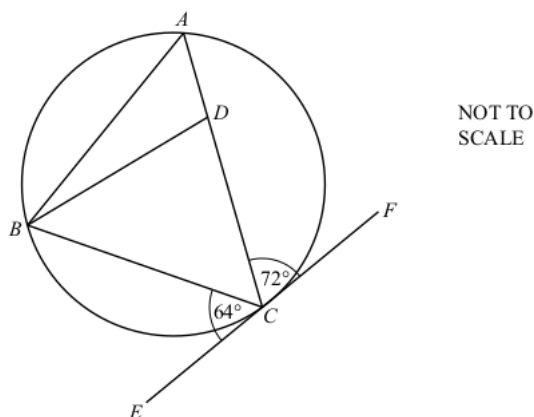
108. A, B, C and D are points on a circle, centre O. Angle  $COD = 124^\circ$  and angle  $BCO = 35^\circ$ .



Calculate the size of the angles

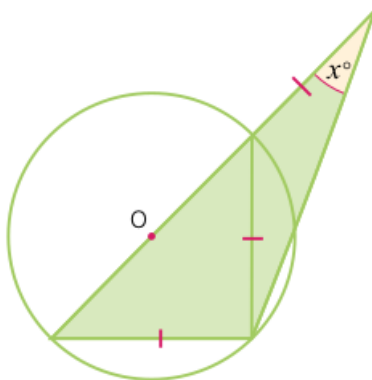
- (a) CBD
- (b) BAD

109. A, B and C are points on a circle. EF is a tangent to the circle at C. D is a point on AC. Angle CBD : Angle ABD = 3 : 1.

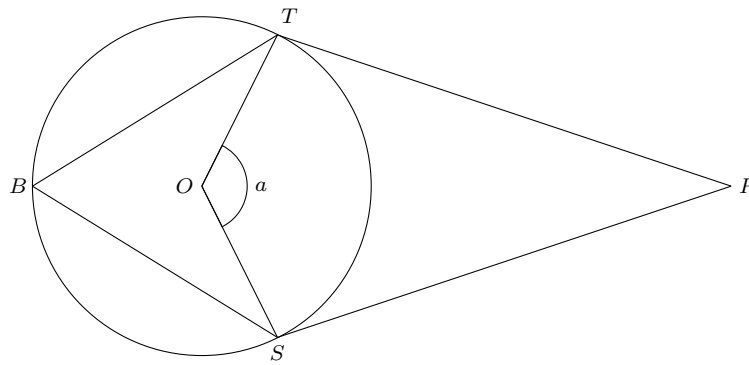


Find angle ADB.

110. Calculate the marked angle in the following diagram:

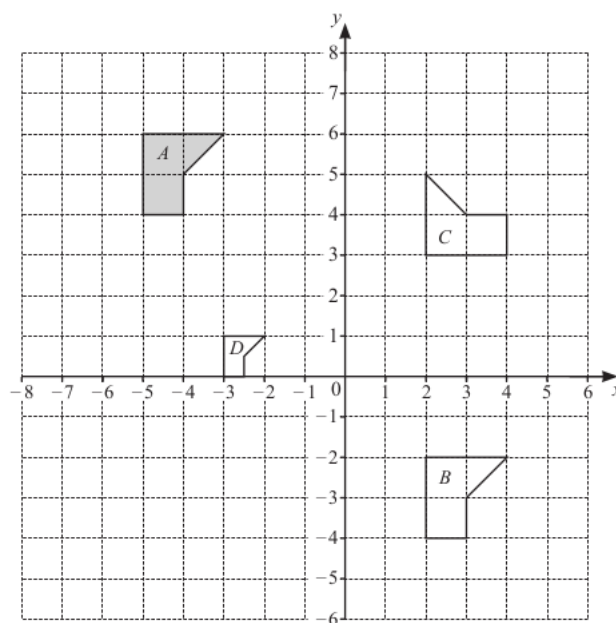


111. In the figure below PS and PT are tangents to the circle at points T and S. Given  $\angle a = 140^\circ$ . O is the centre of the circle

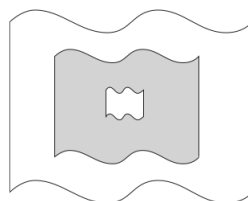


Find the size of angles **TPS** and **TBS**

## TRANSFORMATIONS

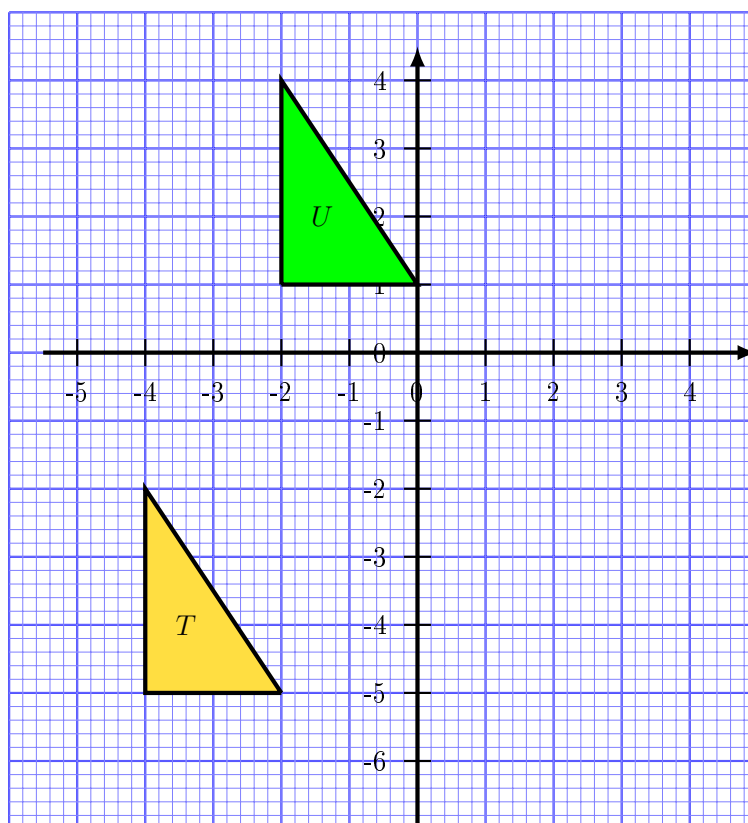


112. (a) Describe fully the single transformation that maps
- shape A onto shape B,
  - shape A onto shape C,
  - shape A onto shape D.
- (b) On the grid, draw the image of shape A after a reflection in the line  $y = x + 8$ .
113. The diagram below shows three shapes that are mathematically similar. The heights of the shapes are in the ratio small : medium : large = 1 : 5 : 8.



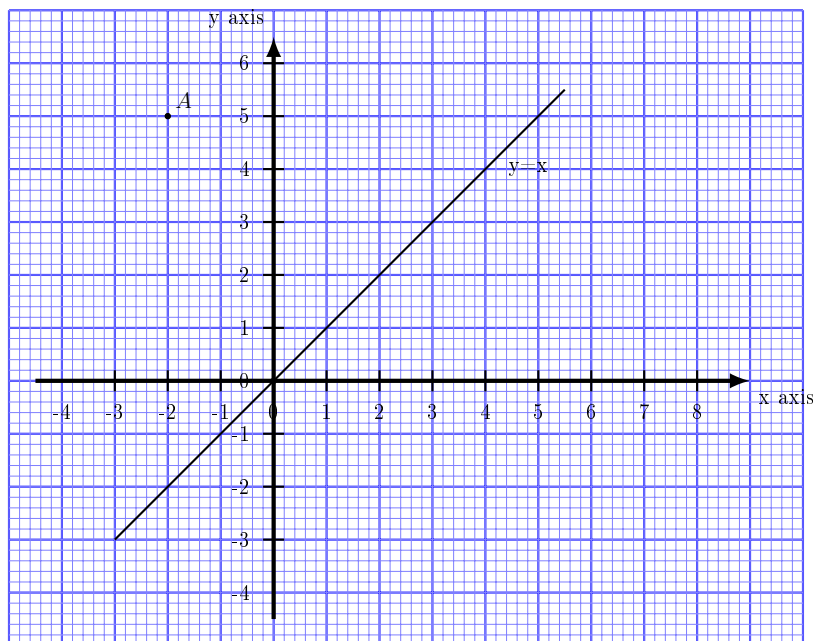
Find the ratio shaded area : total unshaded area. Give your answer in its simplest form.

114. The vertices  $R(0, 1)$ ,  $S(0, 3)$  and  $T(3, 1)$  of a triangle are mapped onto  $R^1, S^1$  and  $T^1$  by a transformation matrix  $P = \begin{pmatrix} 1 & 0 \\ 2 & 4 \end{pmatrix}$ .
- Find the coordinates of the vertices of the image triangle  $R^1S^1T^1$
  - Use the determinant of  $P$  to find the ratio of the area of triangle  $RST$  to the area of triangle  $R^1S^1T^1$
  - Determine the matrix of transformation which maps  $R^1S^1T^1$  back onto  $RST$
115. Triangle  $ABC$  has vertices  $A(-3, 0)$ ,  $B(0, 3)$  and  $C(3, 0)$ . Find the coordinates of the points  $A^1, B^1$  and  $C^1$ , the images of  $A, B$  and  $C$  respectively, under a translation with displacement vector  $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$
116. (a) Reflect the triangle  $T$  in the graph a long the line  $x = 1$  and write down the coordinates of its image.



- Draw the rotation of triangle  $T$  about  $(-2, -1)$  through  $90^\circ$  clockwise
  - Describe fully the single transformation that maps triangle  $T$  onto triangle  $U$
117. If the area of the image of a rectangle  $PQRS$  is 30 square units under the transformation matrix  $\begin{pmatrix} 3 & 2 \\ -2 & 2 \end{pmatrix}$ . Find the area of the object rectangle  $PQRS$

118. A point A(−2,5) is reflected in the line  $y = x$  which is shown on the graph



(a) Use the graph to show  $A^1$  the image of A

(b) State the coordinates of  $A^1$

119. A triangle PQR has vertices P(2, 1), Q(6, 4) and R(4, 5). PQR is mapped onto triangle  $P_1Q_1R_1$  with vertices at  $P_1(10, 3)$ ,  $Q_1(6, 0)$  and  $R_1(8, -1)$  under a rotation.  $P_1Q_1R_1$  is then mapped onto  $P_{11}Q_{11}R_{11}$  after a translation of  $\begin{pmatrix} -2 \\ 1 \end{pmatrix}$ . Find the;

(a) (i) Centre of rotation

(ii) Angle of rotation

(b) Coordinates of  $P_{11}$ ,  $Q_{11}$  and  $R_{11}$

120. Triangle ABC with vertices A(1,2), B(2,6) and C(4,2) is mapped onto triangle  $A^1B^1C^1$  by a reflection in the line  $y + x = 0$ . Triangle  $A^1B^1C^1$  is then mapped onto triangle  $A^{11}B^{11}C^{11}$  by a transformation whose matrix is  $\begin{pmatrix} 2 & 5 \\ -4 & -5 \end{pmatrix}$

(a) Use  $I(1, 0)$  and  $J(0, 1)$  to find the matrix of reflection in the line  $y + x = 0$

(b) Find the coordinates of

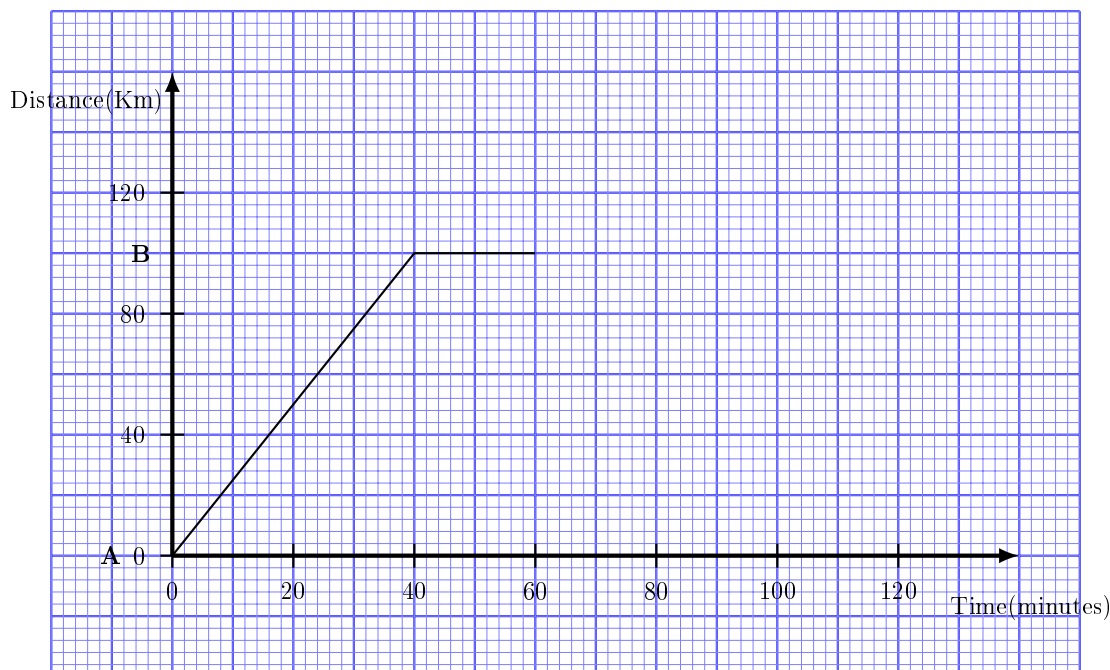
(i)  $A^1$ ,  $B^1$  and  $C^1$

(ii)  $A^{11}$ ,  $B^{11}$  and  $C^{11}$

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## KINEMATICS

121. The displacement-time graph below describes the journey of a train between two train stations, A and B

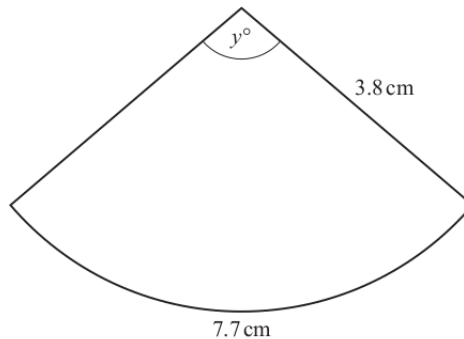


- (a) For how many minutes was the train at rest at B?
  - (b) Determine the average speed of the train, in  $\text{kmh}^{-1}$  on its journey from A to B.
  - (c) The train continued its journey away from stations A and B to another station C, which is 50 km from B. The average speed on this journey was  $60 \text{ kmh}^{-1}$ . Calculate the time, in minutes, taken for the train to travel from B to C.
  - (d) Draw the line segment which represents the journey of the train from B to C.
122. A car starts from rest ,accelerating at  $3\text{ms}^{-2}$  for 10 seconds. It then continues at this velocity for another 6 seconds and finally decelerates uniformly to rest in 4 seconds.
- (a) Draw a velocity time graph for the motion of the car
  - (b) Using your graph ,determine the deceleration of the car
  - (c) Calculate the distance travelled by the car.
  - (d) Calculate the average speed .
123. Two towns A and B are 100km apart.A cyclist starts moving from A and heads towards B at  $20\text{kmh}^{-1}$ .At the same time ,a tractor travelling at  $15\text{kmh}^{-1}$  sets off from town B and heads towards A.At what time and distance from A does the cyclist meet the tractor.
124. Kampala and Gulu are 300km apart. A car moves from Kampala to Gulu and back. Its average speed on the return journey is  $30\text{kmh}^{-1}$  greater than that on the outward journey and it takes 50 minutes less. Find the average speed of the outward journey

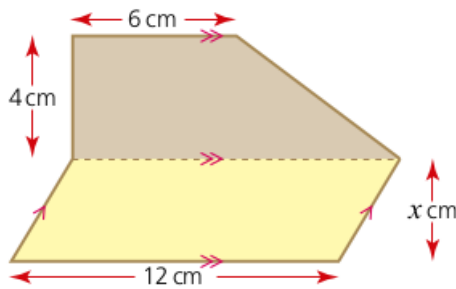
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## MENSURATION

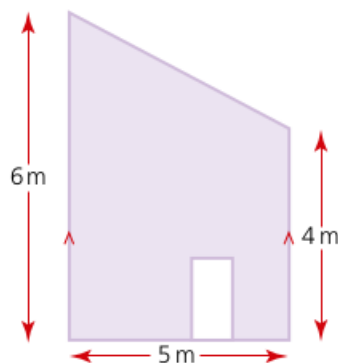
125. The diagram shows a sketch of a field planted with beans in form of a sector of a circle of radius 3.8 cm. The arc length is 7.7 cm.



- (a) Calculate the value of  $y$ .
- (b) Calculate the area of the field..
126. If the areas of this trapezium and parallelogram are equal, calculate  $x$ .

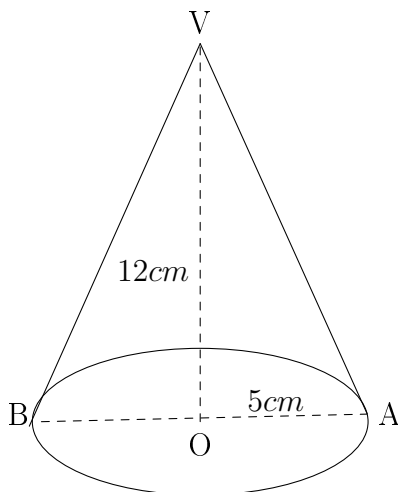


127. A cube and a cylinder have the same surface area. If the cube has an edge length of 6 cm and the cylinder a radius of 2 cm, calculate:
- (a) the surface area of the cube,
- (b) the height of the cylinder.
128. The end view of a house is as shown in the diagram (below). If the door has a width and height of 0.75 m and 2 m respectively, calculate the area of brickwork.



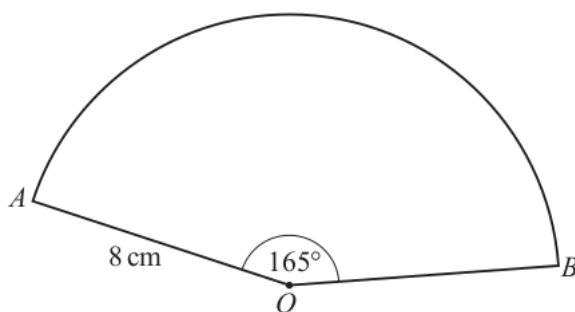


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129. The capacity of a cylindrical tin is 2.763 litres. Its height is 10.5 cm. Find its radius.
130. Two cuboids have the same surface area. The dimensions of one of them are: length = 3 cm, width = 4 cm and height = 2 cm. Calculate the height of the other cuboid if its length is 1 cm and its width is 4 cm.
131. The figure below shows a cone used to scoop poultry feeds whose base radius is 5 cm and perpendicular height OV is 12 cm.



Calculate the

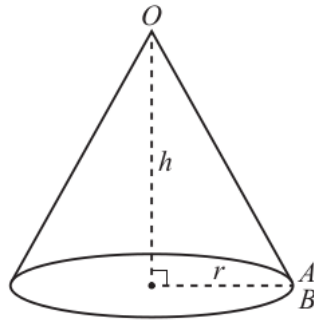
- (a) slant height VB
  - (b) angle VAB
  - (c) Total surface area of the closed cone
  - (d) Volume of feeds scooped when cone is filled to the brim.
132. The diagram shows a sector of a circle with centre O, radius 8 cm and sector angle  $165^\circ$ .



Calculate

- (a) the total perimeter of the sector.
- (b) the area of the sector is equal to the surface area of a given sphere. Calculate the radius of the sphere.

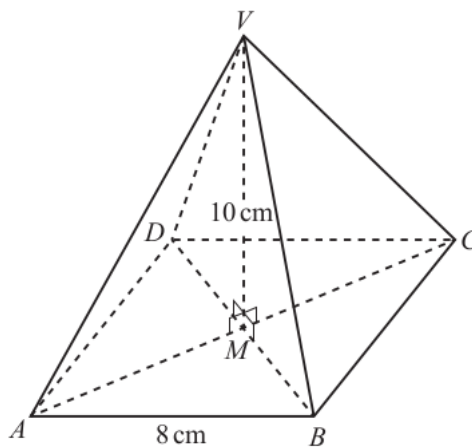
- 
- (c) A cone is made from the sector by joining OA to OB.



- Calculate the radius,  $r$ , of the cone.
- Calculate the volume of the cone.

### THREE DIMENSIONAL GEOMETRY

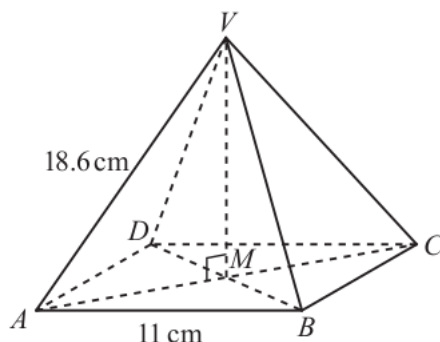
133. The diagram shows a pyramid with a square base ABCD of side length 8 cm. The diagonals of the square, AC and BD, intersect at M. V is vertically above M and  $VM = 10$  cm.



Calculate

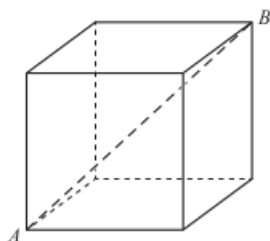
- the length AC
- slant height VB
- the angle between VA and the base.
- the angle between planes VBC and VAD

134. The diagram shows a pyramid with a square base ABCD. The diagonals AC and BD intersect at M. The vertex V is vertically above M.  $AB = 11$  cm and  $AV = 18.6$  cm.



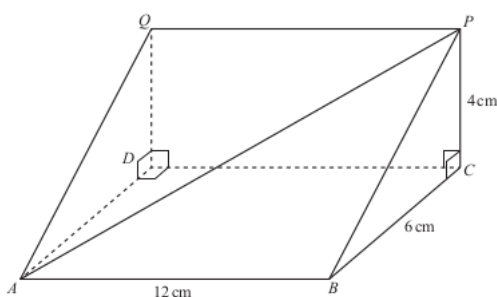
Calculate

- the length AC
  - the height VM
  - the angle AV makes with the base.
  - the angle DVB
  - the angle which the plane VBC makes with the base
135. The diagram shows a cube. The length of the diagonal AB is 8.5 cm.



Calculate

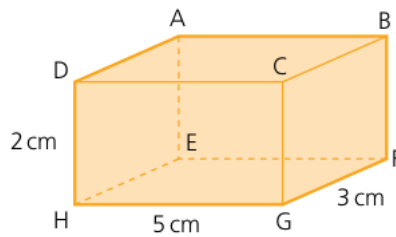
- the length of an edge of the cube.
  - the angle between AB and the base of the cube.
136. The diagram shows a triangular prism.  $AB = 12$  cm,  $BC = 6$  cm,  $PC = 4$  cm, angle  $BCP = 90^\circ$  and angle  $QDC = 90^\circ$ .



Calculate

- (a) the length DP and AC
- (b) the angle between AP and the rectangular base ABCD.

137. The figure below shows a cuboid



Calculate

- (a) the length AC
- (b) the length HB
- (c) the angle ACE
- (d) the angle between AH and the plane

## LINEAR PROGRAMMING

138. Solve the inequality  $-3x - 6 \leq x + 10$  and represent the solution on a number line

139. (a) On the same co ordinate axes, plot the following inequalities and shade off the unwanted region.

$$2x + 3y \leq 12$$

$$y \leq x$$

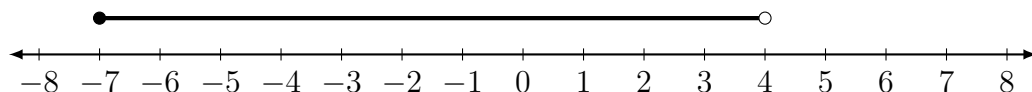
$$y \leq 4$$

$$x \geq 0$$

$$y \geq 0$$

- (b) Use your graph to find the integral values of  $x$  and  $y$  which give the minimum value for  $2x + 3y$

140. Write down the inequality represented on the number line below: .



141. Solve the following inequalities and represent each solution on a number line:

(a)  $5x + 7 < 3(x + 1)$

(d)  $5x + 3 > -11 - 2x$

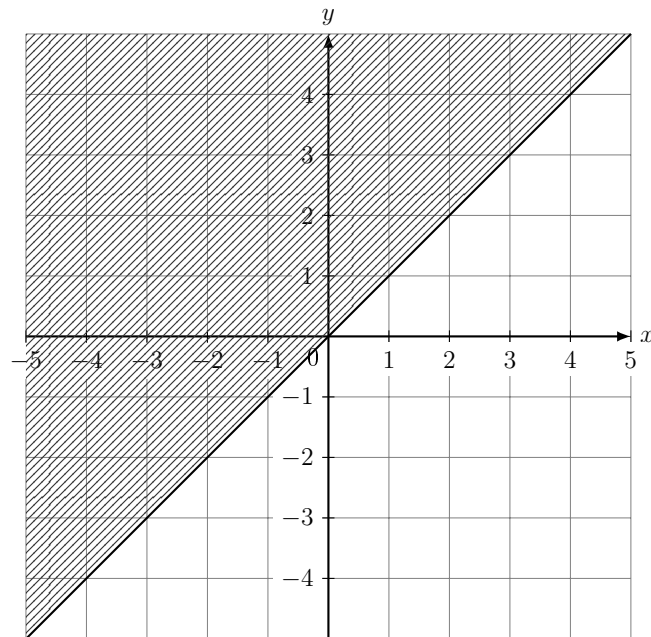
(b)  $2 - \frac{3y}{2} > y + 3$

(e)  $3(x - 1) + 2(x - 1) \leq 7x + 7$

(c)  $7(2 - x) + 1 \leq 2(2x - 9)$

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142. Determine the inequality which is represented by the shaded region on the graph below



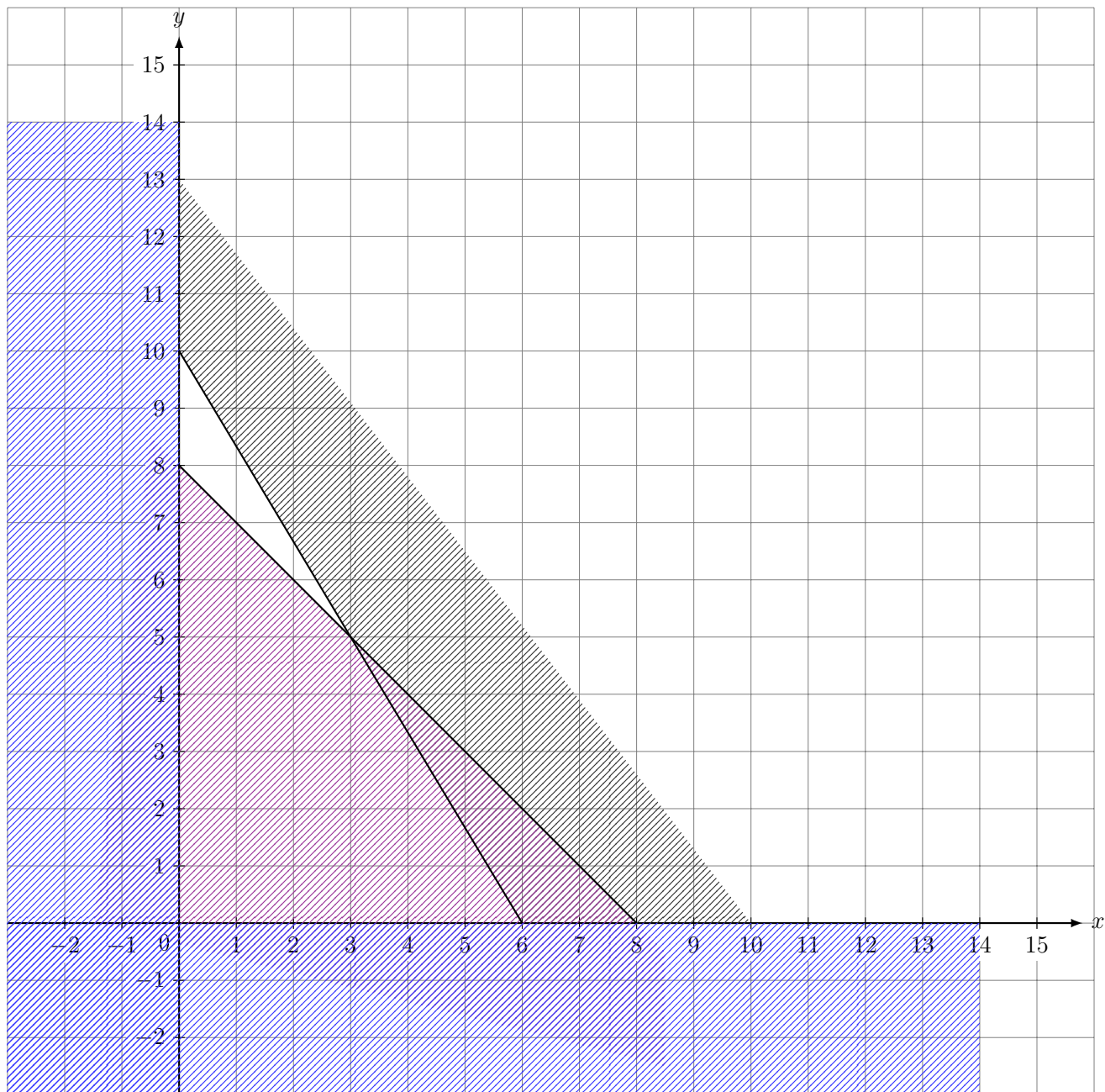
143. Judith has been sent to the nearby supermarket to buy some Apples and oranges . Apples cost sh.500 each and oranges cost sh.250 each. She is given only sh.2000 to spend. She must not buy more than 2 Apples and she must buy at least 4 oranges. She must also buy at least 6 fruits all together because her family has 6 members.

- (i) Write down 6 inequalities representing the above information
- (ii) Plot these inequalities on the same axes and shade out the unwanted regions
- (iii) List the possible combination of apples and oranges Judith can purchase.
- (iv) Find how many apples and oranges should be purchased so as to minimize her expenditure while maximizing purchases.

144. A manufacturing company makes two models **A** and **B** of a product. Each piece of model **A** requires 9 labour hours for fabricating and one labour hour for finishing. Each piece of model **B** requires 12 labour hours for fabricating and 3 labour hours for finishing. For fabricating and finishing, the maximum labour hours available are 180 and 30 respectively. The company makes a profit of UGX.80,000 on each piece of model A and UGX 120,000 on each piece of model B. If  $x$  and  $y$  are numbers of pieces of model A and model B respectively:

- (a) Write down four inequalities to represent the given information
- (b) Represent the inequalities on a graph
- (c) Use the graph to find the number of pieces of model A and model B that should be manufactured to realize a maximum profit .Hence find the maximum profit

145. (a) Write down four inequalities defined by the shaded region



(b) Using the graph ,find the integral values of  $x$  and  $y$  which give the maximum profit for  $800000x + 45000y$

END

Quantity	Formula
midpoint between $A(x_1, y_1)$ and $B(x_2, y_2)$ .	midpoint $= (\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2})$
length/distance between points $A(x_1, y_1)$ and $B(x_2, y_2)$	$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
Gradient of $A(x_1, y_1)$ and $B(x_2, y_2)$	$m = \frac{y_2-y_1}{x_2-x_1}$
Equation of line joining $A(x_1, y_1)$ and $B(x_2, y_2)$	$\frac{y-y_1}{x-x_1} = \frac{y_2-y_1}{x_2-x_1}$
Equation of a line	$y = mx + c$ , $m$ =gradient, $c$ =y-intercept
For two parallel lines i.e $y_1 = m_1x + c$ and $y_2 = m_2x + c$	$m_1 = m_2$
For two perpendicular lines i.e $y_1 = m_1x + c$ and $y_2 = m_2x + c$	$m_1.m_2 = -1$
Addition of logarithms	$\log_a x + \log_a y = \log_a xy$
Subtraction of logarithms	$\log_a x - \log_a y = \log_a \frac{x}{y}$
Power law	$\log_a x^m = m \log_a x$
Same base	$\log_a a = 1$ e.g $\log_{10} 10 = 1$
Mean	$\bar{x} = \frac{\sum fx}{\sum f}$
Mean	$\bar{x} = A + \frac{\sum fd}{\sum f}$ $d=x-A$
Mode	$M = L_1 + (\frac{d_1}{d_1+d_2})C$
Median(second quartile)	$M = L_1 + (\frac{\frac{\sum f}{2} - CF_b}{F_m})C$
Magnitude/modulus of a vector $\mathbf{A}(x,y)$	$ A  = \sqrt{x^2 + y^2}$
Compound interest formula	$A = P(1 + \frac{r}{100})^n$
Appreciation formula	$A = P(1 + \frac{r}{100})^n$
Depreciation formula	$A = P(1 - \frac{r}{100})^n$
Hire purchase(H.P)	H.P = Deposit + Total Installments
Taxable income(T.I)	T.I = Gross income -Tax free income.
Circumference of a circle	$C = 2\pi r$ or $C=\pi d$ , $d=2r$
Area of a circle	$A = \pi r^2$ , $A = \frac{\pi d^2}{4}$
The length of arc	$L = \frac{\theta}{360^\circ} 2\pi r$
Area of sector	$A = \frac{\theta}{360^\circ} \pi r^2$
Total surface area of cuboid	$T.S.A = 2(lh + wh + lw)$
Surface area of cube	$S.A = 6l^2$
Surface area of a open cone	$S.A = \pi rl$
surface area of a closed cone	$S.A = \pi r(r + l)$
Surface area of a sphere	$4\pi r^2$
Surface area of a hemisphere	$3\pi r^2$
Volume of the cylinder	$V = \pi r^2 h$
Volume of the cone	$V = \frac{1}{3} \pi r^2 h$
Volume of the sphere	$V = \frac{4}{3} \pi r^3$
Total angle sum of a polygon	$T.A.S = (n - 2)180$ , $n$ =number of sides

1. The mean for ungrouped data is calculated using the formula

$$\text{Mean} = \frac{\text{sum of data values}}{\text{number of values in the data}}$$

$$\bar{X} = \frac{\sum x}{n}$$

2. The mean for grouped data is calculated using the formula

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

Where  $\mathbf{x}$  is the class mark and  $\mathbf{f}$  is the frequency

3. The mean for grouped data when given an assumed means is calculated using the formula

$$\text{Mean} = A + \frac{\sum fd}{\sum f}$$

Where  $\mathbf{A}$  is the assumed mean or working mean

$\mathbf{d}$  is the deviation given as  $d = x - A$

4. For grouped data ,the median is calculated using

$$\text{Median} = L_1 + \left( \frac{\frac{\sum f}{2} - CF_b}{f_m} \right) \times C$$

Where

$L_1$  = Lower class boundary of the median class

$CF_b$  = Cumulative frequency before the median class

$f_m$  = frequency within the median class

$C$  = Class width

$\sum f$  = Total frequency

5. For grouped data with equal class width the mode is calculated using

$$\text{Mode} = L_1 + \left( \frac{d_1}{d_1 + d_2} \right) \times C$$

Where

$L_1$  = Lower class boundary of the modal class

$d_1$  = Modal frequency –Pre modal frequency

$d_2$  = Modal frequency –Post modal frequency

$C$  = Class width

- (a) The modal class corresponds to the class with the highest frequency