EXCEL IN ORDINARY

LEVEL

MATHEMATICS

SENIOR FOUR

"2023"

BASED ON THE OLD LOWER SECONDARY CURRICULUM

by

LWANGA WILLIAM

The only way to learn mathematics is to do mathematics.

2023 TOPICAL QUESTIONS O' LEVEL MATHEMATICS

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INTRODUCTION

This is a topical trial questions book designed to tackle major topics in the current syllabus.

The questions are graded in each topic and the main objective is to present the material in a manner for easy comprehension and understanding.

The book consists of **Some** Review sections in a number of topics which help a learner to recall several formulars where need be and there exists examples in some topics where need be in order to bring out the meaning clearly.

The main reason for the designing of this book is to provide enough questions for the students' practice in order to perfect in the subject and also provide confidence in the students after being exposed to a number of questions in this book.

It is hoped that the book will be found useful for students' revision questions at Ordinary level.

Any suggestions for improvement of this book are most welcomed, Thanks.

ACKNOWLEDGEMENT

I would like to express a sincere appreciation to all those who worked tirelessly towards the production of this Learner's workbook.

First and foremost, I would like to thank my family and friends for supporting all my initiatives both financially and spiritually, my parents Mr.William Lwanga , and Mrs. Harriet Lwanga.

My gratitude also goes to the various institutions which provided staff who natured and supported me to become the mathematics teacher I am today. My thanks goes to Broadway High School which provided the best environment to work from and best reference books.

I thank God for the wisdom he has given me to produce this volume of work. May the Almighty God bless all the students that will use this book with knowledge to encounter all mathematics problems….**AMEN**.

I welcome any suggestions for improvement to continue making my service delivery better.

OPERATIONS

1. Given that a * b = a² – b², find the value of x in $x * \sqrt{3} = 7 * 4$.
2. If p*q = p² – 3q find

    (a) 5*3
    (b) x such that [(x * 2) * 3] = 7

3. Given that $a \Delta b = \dfrac{a^2 + 2ab + b^2}{a^2 - 2ab + b^2}$ Find $(2 \Delta 1) \Delta 3$.

4. If $m\Omega n = \dfrac{m^2 + n}{(m - n)^2}$ find the value of ; i) 4Ω1   ii) -3Ω(4Ω1)

5. If a Δ b means $(a - b)^2 + 2$. Find the value of:
    (i)   2 Δ 3
    (ii)   (2 Δ 3)Δ 4

6. Given that $a * b = \dfrac{a^2 + b}{a - b}$ Find (i) 2 * 1   (ii) (2 * 1)* 4

7. Given that $a\Psi b = \dfrac{b^2 - a^2}{a^2 + b^2}$, find the values of (a) $1\Psi^- 1$ (b) $\left(1\Psi^- 1\right)\Psi^- 4$

8. Given that $a◊b = \dfrac{1}{a^{-b} - b^{-a}}$, find the value of 1◊2 .

9. If $k\varphi m = k + m + mk$. find n such that $7\phi n = 23$

10. Given that $h◊g = \left(\sqrt{h} - \sqrt{g}\right)^2$. Find the value of $\sqrt{20} ◊\sqrt{5}$ in its simplest form.

11. The operations □ and Λ are defined as $A □ B = XA + B$ and $A \Lambda B = A^2 - B$. Find the value of X if $- 4 \Lambda (2 □ 3) = 9$.

12. Given that $x\alpha y = \dfrac{xy}{x^2 - y^2}$ find the value of $(1\frac{1}{2} \alpha \frac{2}{3})\alpha 2$

LCM AND GCF (HCF)

1. Find the **L.C.M** and **H.C.F** of the following numerals 18, 36 and 45.
2. Write 3600 as a product of prime factors and hence find square root of 3600
3. Find the LCM and GCF of 36, 72 and 90.
4. Express 784 as a product of prime factors. Hence find the square root of 784.
5. Express 216 as a product of prime factors. Hence otherwise find the cube root of 216.
6. By prime factorization, find the square root of 900.
7. In a certain school two bells are sounded at intervals of 30minutes and 45 minutes. If they were last heard at 10:15am , find at what time they will be heard again together.
8. Find the L.C.M and H.C.F of 12, 24 and 56.
9. Express 9261 as a product of prime factors, hence find the cube root of 9261

10. Express 18 and 42 each as a product of its prime factors and hence find their highest common factor (HCF).

FRACTIONS AND DECIMALS

1. Simplify i) $\dfrac{2\frac{5}{6} + 2\frac{2}{15} \times \frac{5}{8}}{5\frac{1}{3} - 1\frac{7}{12}}$ ii) $3\frac{1}{5} of \left(2\frac{1}{2} + 7\frac{5}{8}\right)$ iii) $\dfrac{7\frac{1}{8} \div 2\frac{2}{3}}{\frac{1}{4}x9\frac{1}{2}}$

2. Solve for x in $\dfrac{x^2}{2} = \dfrac{4}{x}$

3. Solve the equation: i) $\dfrac{3x}{4} - \dfrac{(x-1)}{3} = \dfrac{7}{6}$ ii) $\dfrac{x}{4} + 5 = 1 + \dfrac{x}{2}$

4. Solve for the unknown in   i) $\dfrac{1}{3} - \dfrac{x-3}{5} = \dfrac{x}{2} + \dfrac{x+2}{3}$ ii) $\dfrac{3x+4}{11} - \dfrac{2x}{33} = \dfrac{26}{33}$

   iii) $\dfrac{x-1}{2} - \dfrac{1}{3} + \dfrac{x}{3} = \dfrac{2x+1}{6}$ iv) $\dfrac{v}{2} - \dfrac{v+1}{4} = \dfrac{v}{3} + 2$. v) $\dfrac{m+1}{2} + \dfrac{m-3}{4} = \dfrac{m+2}{3}$

   vi) $\dfrac{4n-1}{3} = \dfrac{5-2n}{4} + \dfrac{3p-1}{2}$ vii) $\dfrac{y+6}{5} - \dfrac{2y-5}{15} = \dfrac{1-y}{3}$ viii) $\dfrac{2w-1}{2} - \dfrac{6w-2}{4} = \dfrac{1}{2} + \dfrac{w}{3}$

5. Simplify: i) $\dfrac{5\frac{1}{4} \div 4\frac{1}{5}}{2\frac{1}{2}} + 3\frac{1}{4}$ ii) $\dfrac{2\frac{1}{2} - 3\frac{1}{2} \div 1\frac{3}{4}}{\frac{4}{7} - \frac{9}{28}}$ iii) $\dfrac{\frac{-1}{2} \div \frac{-2}{3} x8 - 4\frac{1}{2}}{\frac{3}{4} - 2\frac{3}{4} \div \frac{11}{8}}$

6. Simplify $3\frac{1}{4} of \left(\dfrac{1\frac{1}{4} - 1\frac{1}{2}}{3\frac{1}{4} + \frac{1}{2}}\right)$

7. Given that $\dfrac{x+1}{x+2} - \dfrac{x+4}{3x+6} = \dfrac{kx+a}{bx+c}$, find the values of a, b, c, k.

8. Express 2.10303….in the form $2\dfrac{a}{b}$, where a and b are integers.

9. Express $0.4\overline{18}$ as a fraction in its simplest form.

10. Express 0.3838…. as a fraction in its simplest form.

11. Express 0.4888…… in fraction in its simplest form.

12. Express 2**.**4343…. as a fraction in its simplest form

13. Express 0.3131… as a fraction in its simplest form.

14. Express the following recurring decimals as fractions in their simplest form

   (i) 0.2 22.. (ii) 0.2727   (iii) 0.3424242   (iv) 0.0729729…

15. Franco spent $\dfrac{1}{3}$ his monthly salary on rent, $\dfrac{3}{4}$ of the remainder on entertainment and saves the rest. If he spent shs.1000,000, how much did he save?

16. A ninth of the students of kapere ss prefer being with their mothers while $\dfrac{2}{9}$ with their fathers and the rest prefer none of them . If 450 students prefer their

fathers , find the number of students at kapere ss hence the number of those who prefer none of the parents .

17. A butcher sells 5kg of meat at 7,000/=. If the cost of meat is increased by 25%, determine how many kilograms of meat can be bought with the same amount of money after the increase.

18. If $\frac{2}{12}$ of the sum of money is 400,000shillings .find the $\frac{2}{5}$ of the money.

19. A tank can be filled by tap A in 1hour.T tap B takes 3hours to fill the same tank and tap C takes 2 hours to fill it, how long will it take all the three taps working together to fill the same tap?

20. The pie-chart below shows the fruits popularly sold in a daily supermarket.
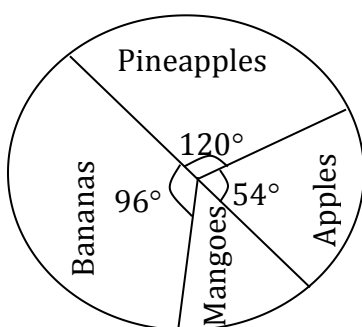
If 420 apples were sold on a given day, determine;

(i)   The total number of fruits that were sold that day.

(ii)   How many mangoes were sold that day?

BASES

1. Work out the following;   i) $3333_{\text{five}}+1342_{\text{six}}$ ii) $312_{\text{four}}+145_{\text{six}} -10011_{\text{two}}$
   iii) $22_{\text{six}}+176_{\text{eight}}$ iv) 232_9+277_9

2. Find base x give that ; i) $304_x = 422_5 + 47_8$. ii) $25_x = 21$

   iii) $102_x = 38_{ten}$ iv) $204_x = 242_{\text{eight}}$ v) $103_x + 26_x = 131_x$

   vi) $45_x = 10001_{two}$ vii) $125_x = 85_{ten}$ viii) $45_x = 41_{\text{ten}}$

3. Given that $212_n = 25_{\text{nine}}$, find the base that **n** represents

4. Given that: i) $10111001_{\text{five}} = 271_n$, ii) $212_n = 25_{nine}$ find the value of base **n**.

   ### Formula

1) Given that ; i) $d = \frac{x-m}{t}$ and ii) $z = \frac{3y^2}{4-x}$ make x the subject of formula.

2) Make n a subject of the formula. $Q = \frac{v+n}{r}$ hence find n when R = ½, b = 3 and v =7

3) Make P, the subject of the formula: $y = \sqrt{\frac{x(p-x)}{(p-1)}}$

4) Make b the subject of the formula: $L = \sqrt{\dfrac{a^2 - b^2}{cx}}$ .Hence find b

   if $a = 10, c = 2, x = \dfrac{2}{3}$ and $L = 3$.

5) Make R the subject of the formula $P = \dfrac{R^2}{(R-b)(R+b)}$

6) Solve for b in the equation $\quad e = \dfrac{\sqrt{ac(b-c)}}{ad}$

7) Make M the subject of the formula in the expression, $n = x \, 3\sqrt{\dfrac{2}{4m^2 - 1}}$

8) Make P the subject of the formula: $L^3 = \sqrt{\dfrac{a+m}{P}}$.

9) Make b the subject of the formula: $R^2 = \sqrt{t + \dfrac{Wn}{b^2}}$

10) Make x the subject of the formula: $h = \sqrt{\dfrac{x-t}{2+tx}}$

11) Make u the subject of the formula: $\quad x = \dfrac{u}{u + 2w}$

12) The sum of the ages of Amon and Betty is 20 years and twice Amon's age is 16 years more than Betty's. Find the ages of the two children.

13) Make x the subject of the formula $\dfrac{p}{q} = \dfrac{mx^2 - 2}{nx^2 + 4}$ .hence evaluate x if p = m = 2, q=4 and n = 2.

14) Make n the subject of the formula. $T = 3\sqrt{\dfrac{d - n^2}{w}}$

15) Make P the subject of the formula $M = 2n\sqrt{\dfrac{P}{P-4}}$.

16) Given that $y = 3\sqrt{\dfrac{x-1}{x+1}}$ express x in terms of y .

17) Make x the subject given $y = \sqrt{\dfrac{px^2 - 5}{qx^2 + 2}}$ $\quad$ hence find x given p=3 and y =1.

THE STRAIGHT LINE

1. A line of gradient $\frac{7}{9}$ passing through the point Q (3, 4), cuts the y–axis at a point P. Find the coordinates of P.

2. A line through (2,3) and (–1, 2) crosses at right angle, a line ax + by = 11 at point (3,2). Find the values of a and b.

3. Find the equation of the straight line passing through (2,-3) and is perpendicular to the line 2y = x + 4.

4. Find the equation of the straight line that passes through (5, 3) and is perpendicular to the line   2y = 5x – 7.

5. The gradient of line L is $\frac{3}{4}$ and it is perpendicular to another line whose gradient is $\frac{8}{n-6}$.Find n.

6. The line passing through P(b, 2) and Q((3, 5) is perpendicular to the line whose equation is 5x + 7y = 4. Determine the value of b.

7. The line joining points P(a,7) and Q(13,a) is parallel to the line whose equation is   3y + 2x = 9   Find a.

8. Find the equation of the line passing through (3, 4) and is perpendicular to the Line 4x – 3y = 12.

9. C (4, 3) is the mid point of the line segment AB formed by joining A and B (6, 5). Find the coordinates of A and hence find the equation of the line AB.

10. Find the equation of a line that passes through point $A(-1.2)$ and is perpendicular to the line $2y + 4x = 9$

11. Find the equation of a line passing through (5,2) and parallel to $3x + 5y = 6$

12. Find the equation of the perpendicular bisector of the line segment joining the points (1,4) and(3,6)   (4 marks)

13. The lines $2y + x = 4$ and $y = a + x$ intersect at the point $(b, 3)$. Find the values of a and b.

14. Given that the lines $ax + 3y = 5$, and $5x - by = 3$ intersect at the point $(1, 1)$, find $a \& b$.

15. Find the equation of a line passing through the point $(-2, -1)$ and is perpendicular to the line whose equation is $3x - y - 6 = 0$.   (04 marks)

16. Find the equation of a line which is the perpendicular bisector of a line passing through the points A(3,4) and B(-1, 6)

17. Find the equation of a line passing through the point (0, -5) and is perpendicular to the line y + 3x = 1

INDICES

1) Simplify the following ; i) $\left(\dfrac{64}{27}\right)^{\frac{-1}{3}}$ ii) $\dfrac{3^3 \times 9^2 \times 125^{\frac{1}{3}}}{9^3}$ iii) $\dfrac{2^x \times 8^{x-1}}{16^{x-1}}$

2) If a = 4.6 x 10^4 and b = 2.3 x 10^5, find in standard form, the value of a + b.

3) Solve for m given that: $3^{2m} \times 9^{2m} = 729$.

4) Find the value of x, correct to 2 significant figures, if $4^{2x} = 5$

5) Solve for x in ;   i) $2^{2-x} \times 4^{-x-1} = \dfrac{1}{64}$ ii) $3x \div \dfrac{1}{81^{(1-x)}} = 1$

6) Solve the equation $(x-4)^{\frac{1}{2}} = (\dfrac{1}{8})^{\frac{1}{3}}$

7) Find the value of $\dfrac{2\sqrt{a}}{b}$ without using a calculator when a = 1.21 x 10^{-6}
   b = 4.4 x 10^{-4} giving your answer in the form A x 10^n for n an integer.

8) Evaluate without using tables of calculator; $64^{-\frac{1}{3}} \times 16^{\frac{1}{2}} \times \left(\dfrac{125}{8}\right)^{-\frac{2}{3}}$

9) Find the value of y if $\left(\dfrac{1}{3}\right)^y \times (27)^{\frac{-2}{3}} = 9^{\frac{1}{2}}$

10) Simplify: i) $\dfrac{\left(\frac{27}{8}\right)^{-\frac{2}{3}} \times \left(\frac{9}{4}\right)^{\frac{3}{2}}}{\frac{2}{3}}$ ii) $\left(\frac{8}{125}\right)^{-\frac{2}{3}} \times \left(\frac{5}{4}\right)^{-2}$

11) Evaluate without using a table or a calculator $\left(\dfrac{1}{32}\right)^{\frac{2}{5}} \times \left(\dfrac{81}{16}\right)^{-\frac{1}{4}}$

12) Without using tables or calculator, evaluate $\dfrac{5^6 \times 27^4 \times 15^8}{81^5}$.

13) Solve for y: $32^{y-3} \times 4^{y+3} = \dfrac{128}{2^y}$

14) Solve for x : $32^x \times \dfrac{1}{8} \times 4^{x+3} = 2^{24}$

15) Given that $2^{2y} = \dfrac{1}{8}$, find the value of y.

16) Solve the equation. $(54 \times 0.5)^x = \dfrac{1}{9}$

17) Solve for x in the equation $4^{x+1} \times \left(\dfrac{1}{64}\right)^{2-x} = 2^{25}$

18) Without using mathematical table or calculator evaluate: $\left(\dfrac{27}{125}\right)^{\frac{-1}{3}} \times \left(\dfrac{81}{625}\right)^{\frac{3}{4}}$

19) Without using tables or calculators solve for x in the equation

$64^{2x} \times \dfrac{1}{16} \times 8^{x-3} = 2^{25}$

LOGARITHMS

1. (i)   Solve : log(3x +8) – 3log2 = log(x – 4)

2. Simplify: i) $\dfrac{\log 27 + \log 127}{\log 15}$

   ii) log15 - log 105 + log 70,000   iii) log 250 – log 100 + log 4

3. Simplify: i) $2\log 5 + \dfrac{1}{2}\log 81 - 2\log 3 + 2\log 2$.

   ii) $\log_2 4 - \dfrac{1}{2}\log_3 81 + \log_2 8$ iii) $\frac{1}{2}\log 16 - 2\log a/_5 + \log a^2$

4. Without using tables or calculators, find the values of x if
   $\log_2(x-2) + \log_2 2x - \log_2 6x =1$.

5. Use logarithm to solve for **x** in : $1 + \log 2 + \log x = \log 6(3x + 1)$

6. If log7 = 0.8450 and log2 = 0.3010, find the value of log49/64 .

7. Solve for x and y if $\log_x y = 2$,   xy = 8

8. Find n if $\log_n 40 = 5$

9. Evaluate without using tables or calculators; $2\log_6 3 + \log_6 12 + \log_6 8 - \log_6 24$

10. Use logarithms to evaluate $3\sqrt{(0.378 \times 249)}$ Correct your answer to 3 significant
    figures.

11. Given that $\log_{10} x = \bar{1}.322$ and $\log_{10} y = 2.456$. Without using tables or
    calculators, evaluate $\log_{10} y\sqrt{x}$.

12. Given that $\mathrm{Log}_{10} 8x^3 = 3$. Determine the value of x.

13. Use log tables to evaluate: i) $\sqrt[3]{0.045 \times 5.432}$ ii) $\dfrac{35.6}{1.47 x 12.6}$ iii) $\sqrt[4]{0.0081}$

    iv) $\dfrac{22.3^2 \, x 0.0453}{1.792 x 03.78}$ v) $\sqrt[4]{278.2}$ vi) $\sqrt[5]{\dfrac{7.25 x 6.87^3}{0.934 x 0.00712}}$

FUNCTIONS

1) Given that f(x) = 2x + 5, find: i) f(2)   ii) $f^{-1}(2)$

2) Given that $f(m) = \dfrac{m}{a} + 5$ find **a** when $f^{-1}(8) = 6$

3) Given $f(x) = \dfrac{x}{2} + 1$ and $g(x) = 2x^2$. Find gf(8).

4) Given that $f(x) = \dfrac{1 - x^2}{4x^2 - 1}$, find the values 0f x for which; (i)   f(x)= 0
   (ii)   f(x) is undefined.

5) It is given that $f(x) = \dfrac{x+k}{x-1}$ and that f(2) = 5, find:(i)Value of k
   ii)Value of f(3)

6) (a)   Given that the functions $f(x) = \frac{x+3}{2}$ and $g(x) = \frac{1-2x}{5}$
        Find; (i)   f(5)   (ii) $g^{-1}(x)$
    (b) If $f(x) = \frac{2x-8}{x^2+2x-3}$ (i) Find the value of x for which $f(x) = 0$
    (ii)Value of x if f(x) is undefined.
7) If $f(x) = 2x^2 - 3x + 2$ solve for x if $f(x+1) - f(x) = O$

8) Given that $f(x) = ax + 2b$ and that $f(-1) = 3$ and $f(0) = 4$, find the values of "a"
    and "b"

9) Given that $f(x) = \frac{1}{(2x+3)(2x-3)}$ .Find the value of x for which $\frac{1}{f(x)} = 7$.

10) Given that $f(x) = \frac{4}{2x-3}$ and $g(x) = \frac{x}{x+1}$ Find:

        i)the values of x for which $f(x)g(x) = 2\,{}^2/_3$
        ii)Find $g^{-1}(6)$
11) Given that $g(x) = x - 2x^2$ and $h(x) = 3 - x$. Determine an expression for gf(x)
    hence evaluate gf(–2).

12) Given that $f(x) = \frac{3x-2}{x^2-9}$ Find (i) f(-2) (ii) the value of x for which f(x) is

    undefined
13) Given that $f(x) = 2x + 1$ and $g(x) = x^2$.

    (a) Find the value of x if $gf(x) - fg(x) = 0$
    (b) Find $f^{-1}(-7)$
14) Find the values of p and q if $h(y) = py + q$ and $h(4) = 10$ while $h(2) = 4$.

15) Given that $k(m) = \frac{m^2+4m+1}{3m^2+5m-2}$ When is k(m) (i) zero? (ii) Undefined? Hence

    find the corresponding values of m in each case.
16) Given a function $f(x) = \frac{3-x}{x^2-4}$ Find the value of x for which

    i)$f(x) = 0$ **ii) $f(x)$ undefined**

17) Given that $f(x) = 3x^2 - 1.\ Find\ f^{-1}(x).$ Hence evaluate $f^{-1}(11)$
18) Given that $g(x) = mx + 3$ and $g(5) = 33$, find the value of

            (i). $m,$ (ii). $g(-2).$
19) Given that $f(x) = \frac{2x+a}{b-x}$, $f(0) = 1$ and the value of x for which $f(x)$ is not

    defined is $x = 2$, find the values of a and b.

20) Given $f(x) = \dfrac{x^2 + 4x\, x\, 3}{x^2 - 7x + 6}$ for what value of x is $f(x) = 0$

21) (a) Given that $g(x) = 2x^2 + ax + b$, $g(2) = 19$ and $g(3) = 32$. Find the values of a and b. Hence determine $g(-3)$
(b) If $h(x) = x^2 - 3x + 2$ and $f(x) = x - 3$. Find the value of x for which $fh(x) = hf(x)$.

22) (a). The function g is defined as $g(t) = nt^2 - 2$. Given that $g(3) = 16$, find:

    (i).   the value of n.
    (ii). $g^{-1}(6)$.
      (b).   Given that $f(x) = x + 4, g(x) = 3x^2$, find the value of x for which $gf(x) = fg(x)$.

23) Given that $h(x) = 2x - 3$ and $g(x) = x^2 - 3x$,

    i)   find $h^{-1}(x)$ and $h^{-1}(10)$.
     ii)   obtain expressions for $gh(x)$ and $hg(x)$.
       iii) Solve for x if $gh(x) = 11 + hg(x)$.

24) Given that $f(x) = \dfrac{x+5}{2}$ and $fg(x) = \dfrac{16 - 3x}{6}$, determine:-

    i) The values of x for which $fg(x) = \dfrac{x^2 + 2x - 20}{6}$

    ii) The function g(x).

25) (a) Given that $f(x) = 3x - 4$ and $g(x) = x^2$ find
    (i) f(3)   (ii) $f^{-1}(x)$ (iii) $f^{-1}(26)$
    (iv) expression for gf(x) and hence value of x for which gf(x) = 0

26) If $h(n) = \dfrac{n^2 - 6n + 8}{n^2 - 5n + 6}$ find the value of n for which

        (i) h(n) = 0
        (ii) h(n) is undefined

27) The functions f and g are defined by $f(x) = \dfrac{x}{x-5}$ and $g(x) = x + 4$. Find;

       (i) g(⁻10)
       (ii) $f^{-1}(x)$ and hence $f^{-1}(6)$
       (iii) the value of x for which gf(x) + fg(x) = 0

RATIOS

1. The ratio of x:y is 3:5 and the ratio of y:z is 2:3. Find the ratio of x:y:z.
2. Point x divides the line AB in the ratio of **3:5** if **AX** is 144cm.find **XB**

3. The ratio of boys to girls in a math club is 4:5. When 5 boys join the club and 2 girls leave, the ratio of boys to girls becomes 15:16. Find the original number of boys and girls in the club.Peter, James and David contributed sh.75, 000 such that the ratio Peter's contribution to David's was $3:2$ and that of David to James was $1:5$. How much did David contribute?
4. Given that $P:Q = 5:8$ and $Z:Q = 4:3$, find $P:Z$, hence find P when $Z = 7200$.
5. Given that $\mathbf{x^2 : 8 = 27 : x}$, find the value of **x**
6. Shillings 3,600,000 was shared among six sons, three daughters and one mother in the ratio **4 : 5 : 3** respectively, find how much each daughter got
7. John, Mary and David share profit of their business in the ratio 3:7:9 respectively. If Mary received sh. 60,000, how much was the profit?
8. Given that $\dfrac{x+3y}{2x+y} = \dfrac{5}{4}$. Find the ratio of x:y
9. Divide a sum of shillings 8,200 among A, B and C in such a way that;
   (Shares of A)   :   (Shares of B) = 2 : 5 and
   (Shares of B)   :   (Shares of C) = 3 : 4.
10. The age of **RONAH** and **JOAN** are in the the ratio of **5:2.** After **10years** the ratio of the age respectively will be **7:4.** Find the present ages.
11. A map of eagles wings child village is drawn to scale of 1:2000. If the length of the road on this map is 60cm, find the actual length on ground.
12. A piece of land 32km² is represented by an area of 8cm² on the map. Find the representative fraction (RF) of the map.
13. The representative fraction of a map is $\dfrac{1}{400,000}$. Find the actual area of a swamp (in km^2) which is represented by 5 cm^2 on the map.
14. Given that an area of 0.04cm² on the map represent 1km² on the ground. Find the **RF** of the map.
15. An area of $24.7cm^2$ was plotted on a map of scale 1:50,000. What was this area in km^2 on earth's surface.
16. The scale of a map of UMSS is 1:10,000. If a rectangular pond measures 2cm by 2.5cm on the map. Find its actual area in square metres.
17. The scale of a map is 1: 250 000. The area of a forest on the map is 16cm². Find the actual area of the forest in km².
18. Michael's plot of land measures 33.6m by 16.6m.find the area of his piece of land on a map whose scale is 1:20

VARIATIONS(PROPOTIONS)

RECALL
Variation means a change in form, position, state, quantity or quality of a thing. Variation is categorized as follows; ◊   Direct variation/ direct proportionality. ◊   Inverse variation/ inverse proportionality. ◊   Joint variation ◊   Partial variation.

Under direct and inverse variation/ proportionality, one variable depends on one another.

Direct proportionality.

NB: The word "varies as" is the same as direct proportionality.

Example Given that y varies directly as the square of x. when $y = 8$, $x = 4$. Find the value of y when $x = 2$. **Solution;** $y \propto x^2 y$ $\qquad y = kx^2$ $\qquad 8 = k \times 4^2$ $\qquad\qquad 8 = 16k$	$k = \dfrac{8}{16},$ $k = \dfrac{1}{2}$ $y = \dfrac{1}{2}x^2$, when $x = 2$, $y = ?$ $y = \dfrac{1}{2}(2)^2$ $y = \dfrac{1}{2}(4)$ $y = 2$

INVERSE PROPORTIONALITY

One variable increases with decrease in the other and vice versa.

Example Given that p varies inversely as the square of q and that $p = 9$ when $q = 4$, find the value of p when $q = 8$ **Solution;** $\qquad p \propto \dfrac{1}{q^2}$ $\qquad p = \dfrac{k}{q^2}$	when $p = 9$, $q = 4$ $9 = \dfrac{k}{4^2}$ $k = 9 \times 4^2$ $k = 144$ $p = \dfrac{144}{q^2}$	when $q = 8$, $p = ?$ $p = \dfrac{144}{8^2}$ $p = \dfrac{144}{64}$ $p = 2.25$

JOINT VARIATION

One variable depends on two or more others e.g volume (V) of a right circular cylinder is given in terms of its radius r and height (h) by formula $V = \pi r^2 h$.

$$V \propto r^2 \quad \text{and} \quad V \propto h$$
$$\text{Then } V \propto r^2 h$$

$$V = kr^2h \text{ but } k = \pi$$
$$V = \pi r^2 h$$

But under this section, both inverse and directly proportionality can be combined together.

Example		
Given that y varies directly as the square of x and inversely as s. When $y = 8$, $x = 4$ and $s = 6$. Find y when $x = 6$ and $s = 13.5$. **Solution;** $y \alpha x^2 and, y\alpha \dfrac{1}{s}$ $now, y\alpha \dfrac{x^2}{s}$	$y = k\dfrac{x^2}{s}$ NB: The first values ie $y = 8$, $x = 4$, $s = 6$ are lood to get the constant $y = k\dfrac{x^2}{s}$ $8 = k\dfrac{4^2}{6}$ $8(6) = 16k$	$k = \dfrac{8(6)}{16}$ $k = 3$ $y = 3\dfrac{x^2}{s}$ now $y = ?, x = 6,$ $s=13.5$ $y = 3\dfrac{6^2}{13.5}$ $y = \dfrac{3(36)}{13.5}$ $y = 8$

PARTIAL VARIATION

This is the type of variation that involves two constants and these are found by forming two simultaneous equations and solving them using a suitable method. ie elimination, substitution and matrices to find the value of constants. N.B: Each variable has its own constant.

Example		
P varies partly as the square of V and partly as the cube of V. When $V = 2$, $P = -20$ and when $V = -3$, $P = 135$. Find the relationship between P and V. Find the value of P when $V = -1$. **Solution;** $P \alpha V^2 + V^3$ $P = k_1V^2 + k_2V^3$ when $V = 2, P = -20$ $-20 = k_1(2)^2 + k_2(2)^3$ $4k_1 + 8k_2 = -20$ reduce by 4 $k_1 + 2k_2 = -5 \text{.....................} (i)$ when $V = -3, P = 135$ $P = k_1V^2 + k_2V^3$	$135 = k_1(-3)^2 + k^2(-3)^3$ $135 = 9k_1 + k_2(-27)$ $9k_1 - 27k_2 = 135$ reduce by 9 $k_1 - 3k_2 = 15 \text{...............}(ii)$ Solve (i) and (ii) simultaneously $k_1+2k_2 = -5 \text{...................}(i)$ $k_1- 3k_2 = 15 \text{..................}(ii)$ (i) - (ii) $k_1 + 2k_2 = -5 \; k_1$ $- 3k_2 = 15$ $0 + 2k_2 - (-3k_2) = -5 - 15$ $5k_2 = -20$ $k_2= -4$	Substitute k_2 into $k_1 - 3k_2 = 15$ $k1 - 3(-4) = 15$ $k_1 + 12 = 15$ $k_1 = 15 - 12$ $k_1 = 3 , k_2 = -4$ $P = 3V^2 - 4V^3$ $P = ?, V = -1$ $P = 3(-1)^2 - 4(-1)^3$ $P = 3 - 4(-1)$ $P = 3 + 4$ $P = 7$

1) Given **m** varies directly as **n.** when **m=20, n=4.**Find **n** when **m** is**100.**
2) Given **x** varies directly as square of **y.** when **x=80, y=4.**Find **y** when **x** is**20.**
3) Given **A** varies directly as cube of **B .** when **A=5, B=7.**Find **B** when **A** =**27.**
4) x is inversely proportional to y. x = 4 when y = 5 **find**

   (i)x when y = 2.5
   (ii)y when x = 1.25.
5) Given that P varies inversely as the square root of Q and P = 45 when Q = 25. Find the value of P when Q = 15.
6) A gems dealer finds that the value of V of a diamond is proportional to the square of its mass M.
7) If a diamond of mass 10g is worth sh14600. Find the value of a diamond of mass 30g.
8) Given that r varies inversely as the cube of t and that t = -2 when r = 4. Find:
   (a) the equation connecting r and t.
9) It takes 12 men 4 days to clear 10 acres of a certain piece of land. How many acres would 48 men working at the same rate clear in 4 days?.
10) Working together, Jose and Jane can complete an assigned task in 20 days. However, if Jose worked alone and complete half the work and then Jane takes over the task and completes the second half of the task, the task will be completed in 45 days. How long will Jose take to complete the task if he worked alone? Assume that Jane is more efficient than Jose.
11) If y is inversely proportional to the square of x . Copy and complete the table below.

X	2	-1	…………….
Y	5	……………….	1.25

12) Given that r varies inversely as the cube of t and that t = -2 when r=4.find the equation connecting r and t and hence find t when r =108.
13) (a)   Given that x varies directly as y and inversely as the square of z and that   x = y when z = 3. Calculate the value of x when y = 5 and z = 2.
    (b)   The formula $d = kv + mv^2$ gives the distance d metres travelled by a certain car
14) In being brought to rest from a speed of $v\ ms^{-1}$ by the application of breaks. If   d = 62 when v = 40 and d =117 when v = 60. Find the values of the constants k and m. If the breaks are applied when the car's speed is $50ms^{-1}$. Find the distance it travels before coming to rest.

15) It takes 6 days for 9 men to dig a trench of 108 m. how many days will 12 men take to dig a trench of 129 m, if they are to work at the same rate?

16) The quantity V varies directly as H and inversely as the square of W. Given that when W = 50, H = 100 and V = 80, find W, when H = 320 and V = 100.

17) A quantity R varies partly as the square of V and partly as the cube of V. When V = 20, R = 416 and when V = 40, R = 3264.
    (i)Form an equation relating R and V.
    (ii)Determine the value of R when V = 30.

18) (a) The cost of printing a book is partly constant and partly varies inversely as the number of pages of the book. If the cost of printing 100 pages is shs 10,500 and the cost of printing 250 pages is shs 10,200,
    (i) Find the equation connecting the cost to the number of pages printed.
    (ii) Determine the cost of printing 500 pages
    (b) Paul's is the square of his son's age. In 5 years' time, the sum of their ages will be 40. Find their present ages.

19) Mr. Okello has goats and ducks on his farm. The cost of feeding them per day partly varies as the number of the ducks and as the number of goat on the farm. He spent shs. 180,000/= on 60 ducks and 20 goats. When the number of ducks increases to 100 and that of the goats to 50, he spends shs. 325,000.

(a).   Find how much he spends on
(i).   each duck and goat.
(ii).   70 ducks and 50 goats.
(b).   If he gets a loan of shs. 1,800,000 and spends she 900,000 on each of the ducks and goats, determine the number of ducks and goats he has on farm.

20) a) If p varies jointly as q and r squared, and $p = 225$ when $q = 4$ and $r = 3$, find p when $q = 6$ and $r = 8$.

b)   The following notice was advertised by Peter Educational consultants.

PETER EDUCATION CONSULTANCY

This is to inform our esteemed customers to note that with effect from 3rd June 2015, the holiday package payments will be as follows:

A fixed consultancy fee.

A charge for each holiday package bought.

In July, Queen bought 50 copies of holiday packages and paid shs 20,000. In July, Queen also bought 30 copies of the packages and paid shs 16,000.

i)   Find an cost equation.

ii)   How many copies would Queen get if she paid shs 58,000?

FACTORISATION & EXPANSION

1. Simplify: $(a +3b)^2 - (a – 3b)^2$
2. Solve for **m** such that **: m(m+2)=m²+2**
3. Factorize completely $6x^2 + xy^2 - 2y^4$.
4. Expand : **(1-x)(2xy+8y)**
5. Factorize: $28x^2 – 7y^2$ completely and hence or otherwise find its value when
 x = 5 and y =6
6. Factorize: $3w^2 - w - 4$. Hence solve $3w^2 - w - 4 = 0$.
7. Solve the equation $\dfrac{1}{y^2 - y} - \dfrac{2y}{y-1} = \dfrac{7}{3y}$

8. Factorise completely $3y – 27y^3$

9. Factorise completely: $3px - 2py - 6qx + 4qy$

10. Factorize completely; $m^2 - m - my + y$.
11. Factorise $x^2 - y^2$ hence find the value of $7.25^2 - 2.75^2$ without using tables or calculator.
12. Without using tables or calculator, evaluate $\dfrac{7\cdot621^2 - 2.379^2}{0.5242}$

13. Without using tables or calculator, evaluate: i) $\dfrac{7\cdot66^2 - 2.34^2}{5.32x46 - 46x5.32}$

ii) $0.45x2195 - 1795x0.45$ iii) $\dfrac{100.25^2 - 100.15x100.25}{0.05}$

14. Factorize completely: $(x + 1)^2 - 9^2$.

15. Without using tables or calculator, evaluate $\dfrac{\left(6\frac{1}{2}\right)^2 - \left(2\frac{1}{3}\right)^2}{8\frac{5}{6}}$.

16. Simplify: $(4x^2 - 9) \div (2x + 3)$.
17. Factorize the expression $3x^2 - 10x + 3$. Hence find the values of x when
 $3x^2 – 10x + 3 = 0$.
18. Simplify the expression: i) $\dfrac{2x^2 - 5xy - 3y^2}{(x-3y)}$ ii) $\dfrac{2a^2 - 50a}{a^2 - 11a - 350}$

19. Solve the equation $(x – 2)^2 + 2x(x\text{-}2) = 0$
20. (a).   Expand and simplify: $(x + 3)(x^2 − x)$.

(b).   Find what must be added to $\left(x^2 − \frac{3}{4}x\right)$ to make it a perfect square.

(c).   (i).   Factorise: $(x^2 − xy + 3x − 3y) = 0$.

(ii).   Hence solve $(x^2 − xy + 3x − 3y) = 0$ when $y = 2$.

QUADRATICS

21. From an equation whose solution set is (½ , ⁻⁵/₄)in the form $ax^2 + bx + c = 0$ where a, b and c are integers.
22. Form a quadratic equation whose roots are -2 and ½.
23. Express $3y^2 + y – 2$ in the form $a(y – p)^2 + q$ hence solve the equation $3y^2+y-2=0$.
24. Express $3x^2 + 11x + 6$ in the form $p(x + q)^2 + r$. Hence solve the equation $3x^2 + 11x + 6 = 0$
25. If one of the roots of the quadratic equation $x^2 + mx + 24 = 0$ is 1.5, then what is the value of m?
26. Solve the equation: $\frac{3x+2}{x+2} = x$
27. Factorize: $3w^2 − w − 4$. Hence solve $3w^2 − w − 4 = 0$.

28. Find the value of x from $(3 + x)(14 – 3x) = 30$
29. . Factorize completely $6x^2 +7x +2$. Hence solve the quadratic equation $6x^2+7x+2= 0$.
30. Given that $x^2 − 4x + 11 = (x − a)^2 + b$. Find the values of **a** and **b.**
31. Find the roots of the equation $3x^2 – 4x + 5 = 0$ correct to 2decimal places.
32. Solve the simultaneous equations: $3x^2 + y^2 = 13$, $y – x + 3 = 0$
33. The length of a rectangular garden is **5cm** more than it's width . If the area of the garden is **24cm².**Find the width of the garden hence its perimeter.
34. A rectangle off the length **(x+2)cm** and breadth **(x)cm** has an area of **15cm².**find the value of **x** hence the perimeter of the rectangle.
35. When thirty times a number is increased by 32, the result is twice the square of the number .find the possible values of the number.

36. (a) Draw a graph of $y = (x + 1)(x – 3)$ for the domain $− 2 \leq x \leq 4$.
     Using a scale of 2cm: 1 unit on both axes
   (b) using your graph find the roots of the equations
       (i) $x^2 – 2x – 3 = 0$
       (ii) $x^2 – 3x – 1 = 0$ by drawing
37. (a) Draw a graph of $y = 6 – x – x^2$ for values of x from -4 to +3 using a scale of 2cm:1 unit on both axes.

(b) Use your graph to solve: (i) $6 - x - x^2 = 0$ (ii) $2 - x - x^2 = 0$
(c) State the range of values of x for which y is positive.

38.   Copy and complete the table below for the function $y = (3x + 1)(2x - 5))$

X	-2	-1.5	-1	-0.5	0	-.5	1	1.5	2	2.5	3	3.5	4
$(3x + 1)$													
$(2x - 5)$													
Y													

(a) Draw a graph of $y = (3x + 1)(2x - 5)$ using a scale of 2cm:1 unit on x-axis and 1cm:5 units on y – axis.

(b) Use your graph to solve: (i) $6x^2 - 3x - 5 = 0$ (ii) $6x^2 - 21x + 4 = 0$.

39. Copy and complete the table below for the function y = (2x+3)(2-x) for values of x from -4 to 4.5.

X	-4	-3.5	-3	-2.5	-2	-1.5	-1	0	1	1.5	2	2.5	3	3.5	4	4.5
Y																

(b) Draw graphs of:(i) y = (2x +3)(2 –x) (ii) y = -5(x + 1)
(c) Use your graph to solve: (i) 6 + x – 2x² = 0 (ii) 11 + 6x – 2x² = 0
(d) Determine (i) the turning point of the function.(ii) the range of values of x for which y is positive.

40. Copy and complete the table below for the function y = 2 + 3x – 2x² for values of x from – 4 to +5.

X	- 4	-3	-2	-1	0	1	2	3	4	5
Y										

(b) Draw the graph of y = 2 +3x – 2x² using a scale of 2cm: 1 unit on the x – axis and 2cm: 5units on the y- axis.
(c) From your graph read the roots of: (i) 2 +3x – 2x² = 0
       (ii) 7 + 3x – 2x² = 0   (iii) 6 + 9x – 6x² = 5x – 15

41. (a) Copy and complete the table below for $y = x^2 - 4$

x	-4	-3	-2	-1	0	1	2	3	4
y									

(b) Draw a graph of $y = x^2 - 4$ using a scale of 2cm:1 unit on the x-axis and 2cm : 2units on the y axis.

(c) Draw on the same axes, the graph of $y = 2x + 1$

(d) Use your graph to find the roots of: (i) $x^2 - 4 = 0$ (ii) $x^2 - 2x - 5 = 0$

42.(a) Draw a graph of $y = 12 - 2x - 2x^2$ for $-5 \leq x \leq 4$ using a scale of 1cm:2 units for vertical axis 2cm:1 unit for horizontal axis

    (b)   Using your graph solve the equations;

        (i) $12 - 2x - 2x^2 = 0$ $ii)$ $10 - 8x - 2x^2 = 0$

    (c)   State the equation of a line of symmetry of this curve
$$y = 12 - 2x - 2x^2$$

43.(a) Copy and complete the following table if y = 6 – x – 2x² for $-3 \leq x \leq 3$

X	−3	−2.5	−2.0	−1.5	−1.0	−0.5	0	0.5	1.0	1.5	2.0	2.5	3.0
6	6	6	6	6	6	6	6	6	6	6	6	6	6
−x													
−2x²													
Y													

  (b) Draw the graph of y = 6 – x – 2x² for $-3 \leq x \leq 3$ using your values in (a)

   (c) Use your graph to find the roots of

     (i) $6 - x = 2x^2 = 0$

     (ii) $1 + x - 2x^2 = 0$

44.(a) Draw a graph of $y = (x + 2)(2x - 1)$ for $-4 \leq x \leq 2$

    (b) Use your graph to solve

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

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

     (iii) $2x^2 + 4x - 2 = 0$

45.(a) Draw the graph of y = 10 – 2x – x² for values of x: $-5 \leq x \leq 3$.

    (b) State the maximum value of the function y = 10 – 2x – x and the corresponding value of x.

    (c) Give the equation of the line of symmetry of the curve.

    (d) Use the graph to solve the equations

     (i) 10 – 2x – x² = 0.

     (ii)   10 – 3x – x² = 5.

46.(a) Given that $y = 7 + 3x - x^2$, complete the table below.

x	− 3	− 2	− 1	0	1	2	3	4	5	6
y	− 11			7						− 11

(a) use a scale of 2cm: 1 unit on the x- axis and 2cm: 2 units on the y – axis. to draw the graph of $y = 7 + 3x - x^2$ .Hence find the roots of $7 + 3x - x^2 = 0$.

(b) On the same axes draw a suitable straight line and use your graph to solve the equation. $x^2 - 4x - 3 = 0$

(c) Determine the coordinates of the turning point of the curve.

47. (i).   Draw the graph of $y = (3x + 1)(2x - 5)$ for $-1 \le x \le 4$.

(ii).   Using the same axes, draw the graph of $y = 8x - 7$.

(iii).   Hence, find the values of x which satisfy the simultaneous equations in part (i) and (ii) above.

(iv).   Write down the simplified quadratic equation satisfied by the values of x where the two graphs intersect

SIMULTANEOUS EQUATIONS

48. solve the given pair of equation the $2x - 3y = 12$, $x + 2y + 1 = 0$

49. Solve the simultaneous equations $y = 2x^2 - 3x - 5$, $y = 10 - 2x$

50. Solve the simultaneous equations using the elimination method.
$0.2x - 0.1y = 11$, $0.1x - 0.4y = -0.8$

51. Solve the simultaneous equation: $\begin{array}{l} 3p + 2q = 3 \\ 2p + 3q = 7 \end{array}$

52. Use the graphical method to solve for x and y: $4x = 5 - 3y$, $5x - 11 = y$

53. Solve the simultaneous equation by substitution method: $\begin{array}{l} 2a + 3b = 2 \\ a - 4b = {}^- 10 \end{array}$

54. Solve the equation $\begin{array}{l} x^2 + y^2 = 5 \\ x + y \ \ = 3 \end{array}$

55. Solve simultaneously the equations: $x = y^3$ and $xy = 16$

56. A poultry farm has only chickens and pigs. When the manager of the poultry counted the heads of the stock in the farm, the number totaled up to 200. However, when the number of legs was counted, the number totaled up to 540. How many chickens were there in the farm?

57. Two wheel barrows are to carry bags of cement to ware house. If wheelbarrow A makes 7trips and B makes 6trips,they carry 140bags.if each wheel barrow makes 6trips , total of 132 bags are delivered to the ware house .determine how many bags can fit in each will barrow.

58. At **RONAH** shopping Centre, a school bag costs **b** shillings and a pair of shoes **a** shillings. Emma bought 3bags and 2pairs of shoes at 103000shillings and Iryne bought 5bags and apair of shoes. Find the cost of each bag and pair of shoes.

59. A group of members had to raise shs 3,600,000 to buy a plot of land. Each member was to contribute the same amount of money. 10 members dropped out before raising the money.
    (a) Write down expression for each members' contribution before and after the 10 Members dropped out.
    (b) After the 10 members dropped out, each member had to pay shs 60,000,000 more.
        Find;
           (i) The original number of members in the group.
           (ii) How much each member contributed.

60. The sides of an equilateral triangle are **(3x+1)cm,(y+2)cm** and **(2y-x)cm.** Determine the value of x and y hence the area of the triangle.

61. The length of consecutive sides of a rectangle are **: 3x-2y,4x-1,2x+y and (2y+3x)cm.** Find the value of **x and y** hence the it's area.

SURDS.

62. Simplify: $\dfrac{5+\sqrt{7}}{2} - \dfrac{5-\sqrt{7}}{2}$

63. Simplify i) $\sqrt{75} + 2\sqrt{12} - \sqrt{27}$

   ii) $: 5\sqrt{5} - 2\sqrt{20} + \sqrt{125}$

   iii) $\dfrac{\sqrt{1440}}{\sqrt{360}} + \dfrac{\sqrt{160}}{\sqrt{40}}$ iv) $\dfrac{\sqrt{128} - \sqrt{98} + \sqrt{200}}{\sqrt{50}}$

64. Express in the form a + b $\sqrt{c}$ and state the values of a, b and c if $\dfrac{2-2\sqrt{5}}{2+\sqrt{5}}$

65. Express $\dfrac{3}{3\sqrt{2} - 2\sqrt{5}}$ − $\dfrac{1}{2\sqrt{2} + 2\sqrt{5}}$ in the form a $\sqrt{m}$ + b $\sqrt{n}$ where a, b, m and n are integers.

66. Simplify: i) $\dfrac{3}{2\sqrt{5} + 3}$ + $\dfrac{5}{2\sqrt{5} - 3}$ in the form $a\sqrt{b}$ + c

   ii) $\dfrac{1}{3 - \sqrt{2}} + \dfrac{1}{3 + \sqrt{2}}$

67. Express $\dfrac{\sqrt{5} + 3}{\sqrt{5} + 1}$ in the form a + b$\sqrt{5}$ where a, b and c are integers.

68. Express $\dfrac{20}{2\sqrt{3} - \sqrt{2}}$ in the form $a(b\sqrt{3} + c\sqrt{2})$

69. If $\dfrac{-13}{4\sqrt{2} - 3\sqrt{5}}$ express in the form of a$\sqrt{2}$ + b$\sqrt{5}$, find a and b.

70. Simplify $\dfrac{\sqrt{63} + \sqrt{28}}{\sqrt{175} - \sqrt{63}}$ in its simplest form.

71. Express $\dfrac{3-2\sqrt{3}}{2+3\sqrt{3}}$ in the form $a+b\sqrt{c}$ and write down the values of a, b and c.

   (b)   Express and simplify without leaving a surd in

   denominator $\dfrac{1+\sqrt{2}}{\sqrt{3}+\sqrt{5}}$ $+$ $\dfrac{1-\sqrt{2}}{\sqrt{3}-\sqrt{5}}$

72. Given that $\dfrac{1}{\sqrt{2}}-\dfrac{\sqrt{2}+1}{1+3\sqrt{2}}=a\sqrt{2}+b$ where a and b are constants, find the values of a and b.

TRIGONOMETRY

73. Evaluate, without using tables or calculators: i) $\dfrac{\tan 60^{0}\,\sin 45^{0}\,\cos 45^{0}}{\tan 30^{0}\,\sin 60^{0}}$

   ii) $\cos 45^{0}+2c0s60^{0}$ iii) $\dfrac{\tan 30^{0}+\tan 60^{0}}{\sin^{2}60+\cos^{2}60^{0}}$

74. Given that $CosA = {}^{12}/_{13}$, express as fractions the values of sinA and tanA for values of A between 270^{0} and 360^{0}

75. Given that $\cos\theta=\dfrac{-3}{5}$ for $0^{0}\le\theta\le180^{0}$. Evaluate without using tables or calculator   (i) $\sin\theta$ (ii) $\tan\theta$ iii) $8\tan\theta-5\cos\theta$

76. If $3\sin A=2$ and $90\le A\le270$.   Find the value of (i)CosA ii) tanA

77. Given that $\tan\theta=\dfrac{3}{4}$ for $180^{0}\le\theta\le270^{0}$, Find the value of $5(\sin\theta-\cos\theta)$ without using tables or calculators.

78. Given that $\sin\theta=0.8$ and that $90°<\theta<270°$. Determine the value of $2\cos\theta-\tan\theta$.

79. Given that $10\cos\theta=6$ and that $180^{o}\le\theta\le360^{o}$, find $\sin\theta-\tan\theta$, without using tables or calculator.   (4marks)

80. Given that $\tan\theta=\dfrac{-5}{12}$ and θ is obtuse, without using tables or calculator, find the value of cosθ + sinθ.

81. Given that $\tan\theta=\dfrac{-5}{12}$ for $0°\le\theta\le270°$, find without using tables or calculator the value of Sinθ – Cosθ.

82. Given that $\tan\theta=\dfrac{^{-}15}{8}$ for $180^{0}<\theta<270^{0}$.Find without using tables or calculators the values of; (a) $\sin\theta$ (b) $\cos\theta$

83. Given that $\tan\theta=\dfrac{-3}{4}$ and $\mathbf{0^{0}\le\theta\le270^{0}}$ without using tables or calculator evaluate $\mathbf{10sin\theta-\dfrac{1}{4}cos\theta}$

84. A car is 120 metres from the foot of the building 80 metres high. Determine the angle of elevation of the top of the building from the car.

85. A man standing 20m away from a tall building finds that the angle of elevation of the top of the building is 60^0 and the angle of depression of the foot of the building is 40^0. Calculate the height of the building.

86. Martha is looking at the top of the building which is on the ground level with her .The angle of elevation to the top of the building is 32^0 .if she then walks distance off **30m** towards the building ,her angle of elevation changes to 45^0 . if Martha is **2.3m** tall,

i). how far was she when she started moving.

ii) How high is the building.

87. At a certain point on a level ground road , the angle of depression of the pickup truck from the top of tower is 28^0.At another point **100m** away from the first point , the angle of depression of the truck is now 35^0. **Find : i)** How far was the truck from the tower at the first point

ii)   How high is the tower

88. A man of height 1.5m is standing on the roof of his house ,which is 10m high. He can see a car on the ground at n angle of 45^0.Beyond the car stands a mast 40m high . if the top of the mast is at an angle of elevation of 30^0 from the man ,calculate

i)   How far is the car from the house

ii)   How far is the house from the mast

iii)   How far the mast is from the car

89. Two points P and Q are on a level ground and on opposite sides of a flag pole 5 $\sqrt{3}$ m tall. P is 5m from the foot of the pole and the angel of elevation of eh top of the flag pole from point Q is 45°. **Calculate;**

(a) the angle of elevation of the top of the flag pole from point P.

(b) How far is Q from the foot of the pole?

(c) How far is P from Q?

90. Three points P, Q, R are on the same ground level. A vertical pole NM stands in between P and Q such that N is the foot of the pole. The angles of elevation of P and Q from the top of a pole M are 33^0 and 56^0 respectively. Given that NQ = 25 metres, PR = 12 metres and angle QPR = 79^0. Calculate:

(i)   Height of the vertical pole.   (iii)Length of PQ

(ii)   Angle of elevation of R from M.

91. Two ships leave K harbour at the same time. One ship sails 60km on a bearing of 030° to position P. The other ship sails 100km on a bearing of 110° to position Q. (a) Calculate (i) distance PQ (ii) angle KPQ (iii) the bearing of Q from P

(b)   Both ships take t hours , to reach their positions . The speed of the faster ship is 20 km/h.   Find the

(i) value of t.   (ii) speed of the slower ship

92.(a)   In the triangle **MLN,** length **ML=8cm, LN=6cm** and **LP=hcm** is the altitude of triangle LMN and perpendicular to **MN**, angle MLN = 90°. Find
   (i)   The value of **h**
   (ii)   The area of triangle MLN
   (c) Building A is 40 metres high. The angle of depression of the top of building B from the top of A is 26°. Given A and B are 10m apart, find the height of building B *(Give your answer to 2 decimal places)*

SOLVING TRIANGLES

93. Evaluate $AREA = \sqrt{S\,(s-a)\,(s-b)(s-c)}$ where S = ½ (a + b + c) and a = 5, b = 12, c = 13.
94.. In triangle ABC, angle C = 30^0 , a = 5cm, b = 6cm, find c
95. A ship covers 60km on a bearing of 230^0. It then changes course and heads due west for 80km. Determine its distance from the starting point.
96. The interior angles of a triangle are in the ratio 2:3:4, find the size of the largest angle.
97. The three sides of a right angled triangle are in the ratio 7:5:6. Find the size of the smallest angle
98. From point **p** town **A** is **20km** away on the bearing of **040⁰**and town **B** IS 30km away 0n a bearing of 126^0. Find : i)the distance of town B from A
    ii) the bearing of A from B
    ## CONSTRUCTION
99. Using a ruler and a pair of compasses only:
    (a) Construct a triangle ABC where AB = 8cm and C is 5.4cm from A and 6.5cm   from B.
    (b) D is a point on AC produced such that AD = 7.4cm and E is 6.2cm from D on the same side as B such that angle ADE = 135^0.
   (c) Draw a circumcircle to triangle ABE. Measure (i) AE   (ii) the radius of the circumcircle.
100.   (a)   Using a ruler and a pair of compasses only, construct a triangle ABC such that AB = 8cm, AC = 10cm and angle BAC = 120°.
    (b) Drop a perpendicular from C to meet BA produced at D. Construct a circumcircle through vertices B, C and D.
    (c) Measure CD and hence calculate the area of triangle ABC.
101.   (a) Using a ruler and a pair of compasses only, construct ABCD such that AB=9cm,BC=8cm   and angle ABC= 135° .
    (c) Bisect angles ABC and BAD, and let the bisectors meet at X. Measure AX.

(c) Draw a circle that touches points A, B and X. Measure the radius and hence calculate its circumference.

102. Using a ruler, pencil and a pair of compasses only,
   (i)   Construct triangle PQR with ∠PQR = 120°, PQ = 7.5cm and PR = 11.4cm and find the length of QR.
   (ii)   Draw a perpendicular from R to PQ produced meeting PQ at S.
   (iii)   Draw a circle with Centre T and radius TS where T is a point equidistant from S and PR. Hence calculate the area of the circle. Correct your answer to 2 decimal places.

103. Using a ruler, pencil and a pair of compasses only,
   (i)   Construct triangle PQR in which PQ = 6cm, RQ = 8cm and angle PQR = 60°.
   (ii)   Inscribe a circle in the triangle and measure its radius.
   (iii)   Find the area of the circle.

104.   (a) Using a ruler and a pair of compasses only, construct quadrilateral in which PQ = 5cm, QR = 6cm and angle PQR = 60^0 and angle QRS = 120^0.
   (b) Construct a circle circumscribing triangle PRS and hence measure: (i) PS (ii) the distance from the centre of the circle to Q   (c) Find the area of the circle.

105.   (a) Construct a parallelogram PQRS, where PQ = 10cm, QR = 7cm and angle PQR = 150^0. Bisect angles PQR and SPR so that the bisectors meet at X
(b) Construct a perpendicular from X to meet PQ at M. Measure XM
(c) calculate the area of triangle PXQ

106.   (a) Using a ruler and a pair of compasses only construct a trapezium ABCD in which AB is parallel to DC and AB = 6cm, AD = 4cm DC = 3cm and angle DAB = 60°.
   (b) Drop a perpendicular from D to meat AB at M. Measure DM.
   (c) Calculate the area and perimeter of the trapezium ABCD.

107. Using a ruler and a pair of compasses only;
   (a) Construct a triangle ABC such that $∠BAC = 90^0, ∠ACB = 30^0$ and $\overline{AC} = 10cm$.measure BC.
   (b) Locate point D on $\overline{BA}$ produced such that $\overline{AD} = 7.5cm$
   (c) Construct a circle that touches points A, C and D.
   (d) Calculate the area of the sector DAC.

STATISTICS

108. The mean of the numbers; b, 3, 2, c, 6, 9, 8 and 7 is 6. If b is doubled, the mean becomes 7. Find the values of b and c.

109. In a class of 56 students, the average mark of 30 boys is 68 while that of girls is 72. Find the average mark of the whole class.

110. Six students scored a total of 420 marks in a test. If the mean mark for the first 5 students was 68, what mark did the sixth student score?

111. Find the average of **2-p,p,4-p,5,3p** and **7-2p**

112. The mean height of 35 boys in a class in 152cm. Recently other 5 boys whose mean height is 160cm joined the class. Find the new mean height of the boys in the class.

113.   The mean height in a class of 23 pupils is 150cm. Two more pupils join the class. Their heights are 152cm and 158cm respectively. Calculate the mean height of the 25 pupils.

114. The mean of three consecutive numbers is 3. Find the value of the largest number

115.   The average of 8 numbers is 30 while that of a different set of 7 numbers is 15. Find the
       Average of all the numbers.

116. In a geography test, the total mark scored by 6 students was 420.If the mean mark for the first 5 students was 68. Find the mark scored by the sixth student.

117. In a homework marked out of 20, a group of pupils obtained the following marks:
      15, 20, 18, 17, 8, 18, 16, 20, 18, 17, 12 and 19. Find the mode and median marks.

118. In a Geography examination the percentage marks for 50 boys were as follows:

35	51	83	60	61	73	44	90	70	93
56	34	52	61	43	57	40	58	88	64
52	71	25	86	79	35	73	44	71	95
63	53	48	78	65	98	28	72	67	82
46	54	62	35	70	41	63	73	50	68

   (a) Construct a frequency table taking class intervals of 21 – 30,
31 – 40, ………. 91 – 100

(b) Calculate the mean using the assumed mean of 65.5.

(c) Draw a cumulative frequency curve and estimate the median mark.

119.   The graph is a Histogram showing heights of seedlings in a nursery bed.

(a) Use it to draw a frequency distribution table .How many seedlings were considered ?
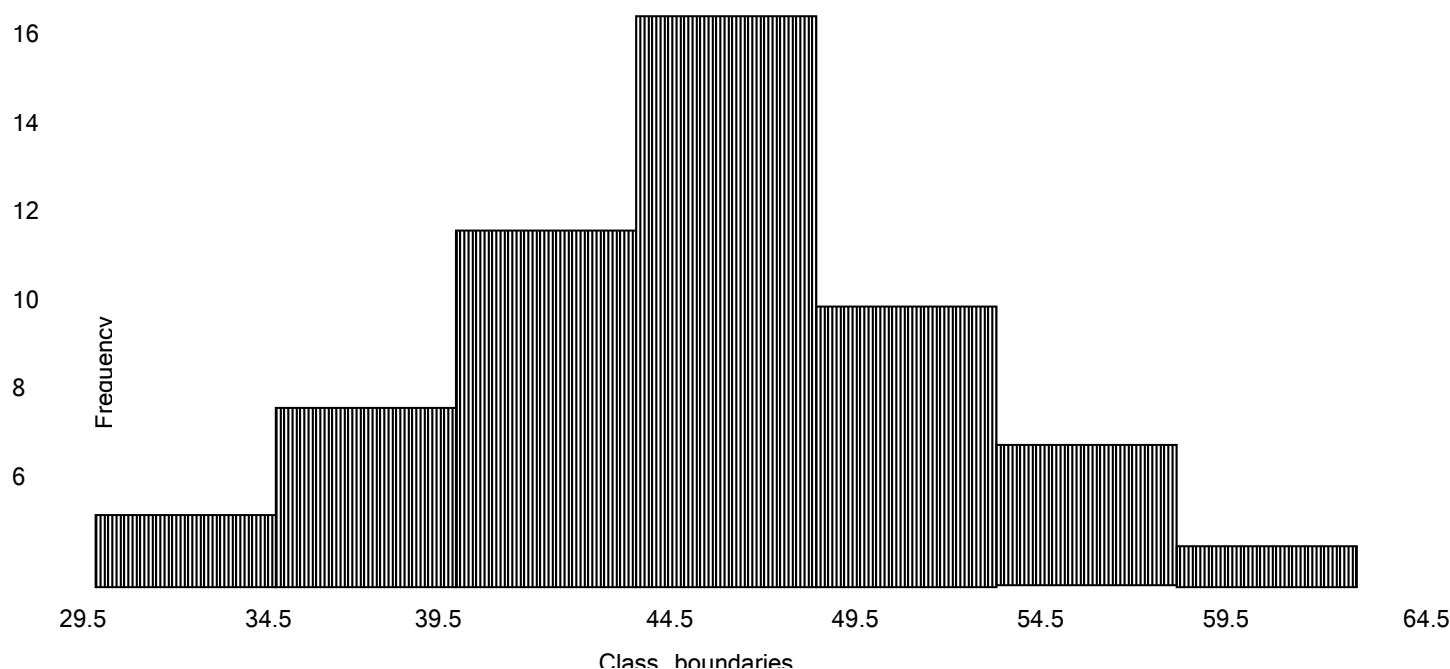
b).   Using your table

    (i)   calculate the mean height using a working mean of 44**.**5 marks

    (ii)   find the modal height

a) Construct an Ogive , From the Ogive estimate the median height of the trees

120.   A lab is testing the growth rate of a certain bacteriology culture. According to the surface area measured after 2 days, the results are given in the table below:

S.A (mm^2)	1.0 – 1.4	1.5 – 1.9	2.0 – 2.4	2.5 – 2.9	3.0 – 3.4	3.5 – 3.9
Frequency	6	10	11	14	6	3

(a) Estimate the mean surface area (S.A)

(b) Draw a histogram and use it to estimate the modal S.A.

121.   The marks below were obtained by some students in a Math test.

   51 56 67 30 21 42 34 38 83 38 75 45 34 38 58 50

   56 76 91 87 25 56 27 64 61 92 90 64 40 49 77 54

   58 46 75 52 60 66 22 94 44 52 34 64 72 80 52 44

(a) Draw a frequency distribution table of equal class intervals of 10 beginning with 20

(b) Using a Working mean of 54.5, calculate the average mark.

(c) Draw a cumulative frequency curve to represent the data and hence use it to estimate the: i) median mark. (ii) the mark at which a distinction was awarded if 20% of the students got a distinction.

122.   The table below shows marks obtained by 100 students in CRE Exam.

marks	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
Cumulative frequency	5	13	25	40	64	82	92	100

(a)   Draw a cumulative frequency curve and use it to estimate:
   (i)   The median mark
   (ii)   The mark at which a distinction was awarded if 20 students obtained a distinction.
(b)   Calculate the mean mark using the working mean of 45.5
(c)   State the modal class

123.   The daily earnings of 50 workers are given in the table below:

Earnings per day in dollars	51– 75	76– 100	101– 125	126– 150	151– 175	176– 200
Number of workers	1	4	17	15	11	2

   (i)   Draw a cumulative frequency curve and use it to estimate the median daily earnings.
   (ii)   A worker is chosen at random from that group, find the probability that he/she earns less than 126 dollars per day.
   (iii)   Estimate the modal daily earning.

124.   Sixty people were taken for measurements in a certain village . The weights obtained in kilograms   are grouped in the frequency table below.

Weight(kg)	61-63	64-66	67-69	70-72	73-75	76-78	79-81	82-84
frequency	6	**x**	9	12	11	8	**y**	2

a) Given that the average weight is 71.45kg, find the value of **x** and **y.**
b) **Calcite** the modal weight of people in this village.
(a) Draw a cumulative frequency graph for this data.
(d) Use your graph to find an estimate for the median of this data.

125.   The table below shows the heights of the seedlings in a nursery bed.

Height (cm)	$2.1 - 2.5$	$2.6 - 3.0$	$3.1 - 3.5$	$3.6 - 4.0$	$4.1 - 4.5$	$4.6 - 5.0$
Cumulative frequency	1	3	6	13	18	20

   (a) State (i) the class width   (ii) the modal class
   (b) Calculate (i) the mean   (ii) mode
   (c) Draw a cumulative frequency curve and use it to estimate the median
        height.
126.   40 students carried out an experiment and recorded the following
   measurements.

4.7	2.7	2.3	4.6	3.7	2.8	2.9	3.6
4.9	3.9	4.5	3.4	4.2	3.5	1.7	1.1
2.0	3.7	3.3	3.8	3.8	1.8	3.1	3.6
3.1	1.4	1.6	2.1	2.8	2.6	3.3	4.0

   (a).   Draw a frequency distribution table starting with
   $1.0 - 1.4$ Hence state the: (i). class size,(ii). modal class.
   (b).   Calculate the mean and median of the data.

SETS

127.   Given that D={the first ten prime numbers} P ={natural numbers less than 25}
   Find: i)   n(P∩D)   ii) n(Pᴵ∩D)
128.   Given two sets A and B such that n(A) = 12, n(B) = 13, n(A∪B) = 20
   and n(ε) = 24. Find: (i)   n(A∩B)ᴵ   (ii)   n(A∪Bᴵ)   where ε is the
   universal set and Bᴵ is the compliment of B.
129.   It is given that set A = {prime numbers less than 14} and B = {factors of 30
   less   than 14} represent the above in a Venn diagram and find (A ∩ B)'.

130.   The number of people who play football (F) or basket ball (B) is twice the
   number of people who play F and B. If n(F) = 9 and n(B) = 6, how many play
   both games?
131.   In a mathematics class, 20 students had forgotten their rulers and 17 students
   had forgotten their pencils. "Go and borrow them from someone at once" said
   Mr. Munanura. 24 students left the room. Draw a Venn diagram and find how
   many students had forgotten both?
132.   If $n(\mathcal{E}) = 17$, $n(P \cup Q) = 12$, $n(Q') = 8$, $n(P) = 10$, find;(i) $n(P \cap Q)$, (ii)
   $n(P' \cap Q')$.
133.   Sets A and B are such that n ((A) = 12, n(B) = 10, n (AUB) = 18 and
   n(A¹∩B¹) = 5. Find

(a) n (ϵ) where ϵ is the universal set **hence** n(A∩B)

134.   Given that n(D) = 23, n(CUD) = 3, n(C n D)$^{|}$ = 3, draw a Venn and find (i) n(c) (ii) n(ϵ)

135.   In a group of 10 people, 7 speak English, 4 speak French and two speak neither of the two languages. How many people in the group speak both English and French?

136.   The Venn diagram below shows the distribution of 46 members of a sports club in different sporting activities.
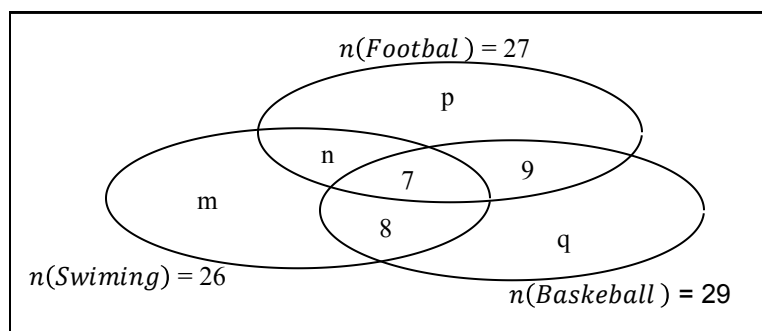
(a) Find the values of m, n, p, and q.
(b) How many members take part in only one activity?
(c) How many members play either football or basketball?

137.   In a survey of 1000 households, statistics showed that 502 used gas, 454 used electricity and 448 used oil. Of these, 158 used both electricity and gas, 160 used gas and oil and 134 used both electricity and oil.

(a) Draw a Venn diagram to represent this information.
(b) How many used (i) all the three.
                           (ii) at least two of them.
(c) If an household is chosen at random, find the probability that used exactly two sources of heat.

138.   A school hosts 22 foreign students, 8 of them do drama, 7 do music and 4 do Art. 3 do drama and Music, and one does drama and Art. None does all the three. If the number of students who do music and Art equals that of those who do Art and not music

(a) Represent the information on a Venn diagram
(b) Find the number of students who do
    (i)   music only
    (ii)   at least two of the subjects
(c) Find the probability that a student chosen at random does not do any of the subjects.

139.   A class of 50 students sat an examination which was made up of three sections A, B and C. 2 students did not attempt any question from any of the three sections. 3 attempted questions from section A only, 5 from section B only, 4 from sections A and C only while 5 attempted questions from all the three sections. Those who attempted questions from sections A and B only were 3 less than those who attempted questions from sections B and C only and three times those who attempted questions from section c only.

(a) Show this information on a Venn diagram
(b) Find how many students attempted questions
    (i)   from each section   (ii) from section C only
(c) If a student is selected from the class at random what is the probability that he or she attempted questions from at least two sections?

140.   A class of 50 students sat an exam which was made up of Sections A, B and C. Two students did not attempt any question from any of the three sections. Three attempted questions from section A only, five from section B only four from section A and C only while 5 attempted questions from all the three sections. Those who attempted questions from A and B only were 3 less than those who attempted questions from sections B and C only and three times those who attempted questions from section C only.

(a) Show these information in a Venn diagram
(b) Find how many students attempted questions
(i) from each section   (ii) from section C only.
(c) If a student is selected at random , what is the probability that he or she attempted questions from at least two sections?

141.   Below is a data of preference 0f 50 people at a party; 23 prefer bell, 26 prefer club, 27 prefer tusker, 5 prefer club and tusker but not bell, 14 prefer bell and club and 13 prefer bell and tusker. Given that 44 people prefer at least one of the drinks,

 (a). represent the above information on a Venn diagram

(b) Determine how many people prefer (i) all the drinks. (ii) only one type of drink
(c) If a person is chosen at random from the party, what is the probability that he/she doesn't prefer any of the drinks?

142.   On a wedding ceremony 71 guests were asked which flavours of Mirinda (M), Novida (N) and Fanta (F) they each prefer. It was found out that an equal number of guests preferred M and N.10 guests preferred M and F, 11 guests prefer F and N while 6 preferred M and N only. 26   preferred F and 5 preferred M only. The number of guests who preferred F only doubles those who preferred N only. (a) Represent the above information on a venn diagram

(b) Find the number of guests who;(i) Preferred N only

(ii) Preferred all the flavours

(iii) did not like any of the three

(c) If a guest is chosen at random from the group, find the probability that he/she preferred atmost two drinks.

143.   In a class of 30 students, 18 offer Fine Art (F), 14 offer Chemistry (C), 9 offer Fine Art (F) and Biology (B). 5 offer all the three subjects. 7 offer Fine Art only, 4 offer Chemistry only and 2 of them offer none of the three subjects.

(a) Represent the above information on a Venn diagram.

(b) From your Venn diagram, find the number of students who offer;

(i)   Biology only

(ii)   Fine Art and Chemistry.

144.   In a class of 100 students 60 do Mathematics (M), 45 do Physics (P) and 40 do Chemistry (C)16 do Mathematics only,8 do Physics only,5 do Chemistry only,7 take M and C but not P

(a)   Represent the information on a Venn diagram

(b)   Find the number of students who do:

(i)   All the three subjects

(ii)   None of the three subjects

(c)   Determine the probability that a student chosen at random in the class does atmost two subjects.

145.   Of the 35 candidates in senior four, 13 registered for Biology (B), 20 registered for History (H) and 17 registered for Fine Art (A). If 9 registered for both Biology and Fine Art and $n(B \cap H) = 3$, $n(B \cap H \cap A) = 2$ and $n(H \cap A \cap B') = 8$. Represent this information on a venn diagram. From the diagram,

(a).   Find

(i).   the number of candidates who registered for History only.

(ii).   the number of candidates who registered for at least two of the three subjects.

(b).   Which of the subjects had to be taken with at least one other subject?

(c).   How many candidates did not take any of the three subjects.

146.   In a mathematics class the teacher told students to bring a pen(P), a graph book (G) and a ruler (R) for use. During the next lesson it was found out that only 16 students brought all the items. 5 students did not have any of the items. 13 did not have a pen, 14 students did not have a graph book and 20 did not have a ruler. One student only had a pen, 2 students had only a graph book and no student had only a ruler.

(a)   Represent the above information a Venn diagram.

(b) How many students
    (i)   were in the class?   (ii)   had a pen and a ruler only?

(c) If a student is selected from this class at random find the probability that he had
    (i)   at least 2 items. (ii)   only one item.

147.   A school was represented by a team of forty students in a national competition in volley ball (V), football (F) and tennis (T). 18 students were selected for volley ball, 21 for football and 15 for Tennis. 7 students were selected for volley ball only, 9 for football only and 6 for tennis only. 4 were selected for all the games and 4 were selected for neither game.

(a) Represent the above information on a Venn diagram

(b) How many students played exactly two games

(c) What is the probability that a student selected at random did not play volley ball?

148.   All the 25 students of a class in a certain school do at least one of the optional subjects German (G), French (F) and Wood work (W). Given that 15 take German, 11 take French, 5 take Wood work and French, and 6 take Wood work and German only. Also $n(F \cap W^I \cap G^I) = n(F \cap G \cap W^I)$ and 2 take all the three subjects,

(a) Draw a Venn diagram to show this information.

(b) find the number of students who take
    (i) Wood work   (ii) German only

(c) If a student is picked at random from the class, find the probability that the student takes just one of these subjects.

MATRICES

149. The product of $\begin{pmatrix} 4 & 6 \\ 1 & 2 \end{pmatrix} \begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$, Find the values of a, b and d.

150. (a)   Using matrix methods find the values of x and y which satisfy the equations.

$$4x - 6y = 24$$
$$2x + 4y + 2 = 0$$

    (b)   Given that the matrix $A = \begin{pmatrix} 6 & -4 \\ -8 & 10 \end{pmatrix}$ Find the matrix B such that

$AB = \begin{bmatrix} -12 & 8 \\ 16 & -20 \end{bmatrix}$

        Hence or otherwise find the inverse of matrix A.

151. Given that $A = \begin{bmatrix} 6 & -3 \\ 5 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} -2 & 3 \\ 4 & 8 \end{bmatrix}$ Find $(3A^{-1})B$

152. Find matrix Z if MZ = X given that $M = \begin{bmatrix} 2 & 4 \\ 3 & -5 \end{bmatrix}$ and $X = \begin{bmatrix} 6 \\ -2 \end{bmatrix}$.

153. Find the matrix A if AB=C where $B = \begin{pmatrix} 5 & 1 & 0 \\ 0 & 3 & 4 \end{pmatrix}$ and $C = \begin{pmatrix} 10 & 5 & 4 \\ 5 & 8 & 12 \end{pmatrix}$.

154. Given that ($\begin{matrix} x-1 & x+1 \\ 3x & x \end{matrix}$) is a singular matrix. Find the possible values of x.

155. (a) Given the matrices $A = \begin{pmatrix} 5 & 1 \\ 0 & 2 \end{pmatrix}, B = \begin{pmatrix} -2 & 3 \\ 1 & 0 \end{pmatrix}$ and $\begin{pmatrix} 1 & 3 & -2 \\ 2 & 1 & 1 \end{pmatrix}$. Find

    (i) ABC (iii) $(A+B)C$

156. (b) Find the inverse of $\begin{pmatrix} 7 & 6 \\ 5 & 4 \end{pmatrix}$. Hence solve the simultaneous equations

    $7x + 6y = 1$
    $5x + 4y + 3 = 0$

157. Given that $R = \begin{pmatrix} 2 & a \\ 4 & 1 \end{pmatrix}$ and $T = \begin{pmatrix} 0 & 2 \\ 3 & 5 \end{pmatrix}$ and that RT is singular, find the value of a.

158. Solve the simultaneous equations using the matrix method.
    i) $0.2x - 0.1y = 11$, $0.1x - 0.4y = $-0.8   (ii) $\begin{aligned} 3x - 2y &= 13 \\ 2y + x + 1 &= 0 \end{aligned}$

159. Solve the system of simultaneous equations using matrix method
       i) $5x = 2y - 2$, $y = x - 15$
    ii) $2p + 3q = 1$, $-3p + 5q = 4$

160. Given that matrix A has no determinant, find the values of **m**
    if $A = \begin{pmatrix} 3m & m-8 \\ -6 & m-2 \end{pmatrix}$

161. Given $A = \begin{bmatrix} 1 & 3 \\ 3 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 4 \\ 2 & -2 \end{bmatrix}$ find AB + 2A

162. If $Q = \begin{bmatrix} 2 & x \\ 5 & -4 \end{bmatrix}$ find the values of x and y such that $\begin{pmatrix} 8 \\ y \end{pmatrix} = Q \begin{pmatrix} 3 \\ 2 \end{pmatrix}$

163. Find the values of x and y if $\begin{pmatrix} 3 & x \\ 2 & 1 \end{pmatrix} \begin{pmatrix} 1 \\ -1 \end{pmatrix} = \begin{pmatrix} 2 \\ y \end{pmatrix}$

164.   The matrix $A = \begin{pmatrix} a & 14 \\ 1 & b \end{pmatrix}$ and its inverse $A^{-1} = \begin{pmatrix} 1 & -7 \\ -\frac{1}{2} & 4 \end{pmatrix}$. **$AA^{-1}$ =**

I , where I is a 2 x2

Identity Matrix. Find the values of a and b.

165.   If $A = \begin{pmatrix} x & -7 \\ 4 & 6y \end{pmatrix}$ and $B = \begin{pmatrix} 17-y & -21 \\ 12 & 36 \end{pmatrix}$; find the value of x and y

given that **$3A = B$**.

166.   Given the matrix $T = \begin{pmatrix} 2x & 3 \\ x & x \end{pmatrix}$. Find the values of x for which $\det(T) = 2$.

167.   Given that $A = \begin{pmatrix} 2 & 4 \\ 1 & -1 \end{pmatrix}$ and $B = \begin{pmatrix} a & 3 \\ -2 & 5 \end{pmatrix}$ and that the determinant of

$A + B = 3$. Find the value of a.

168. (a)   Find the values of x and y from the matrix equation.

$$\begin{pmatrix} y & 4 & 2 \\ 3 & 1 & x \end{pmatrix} \begin{pmatrix} 3 \\ ^-4 \\ x \end{pmatrix} = \begin{pmatrix} 4 \\ x+17 \end{pmatrix}$$

   (b)   Use matrices to solve the simultaneous equations.

$$x + 2y = -5 , \ 3x = 13 + y.$$

   (c)   Given the matrices $P = \begin{pmatrix} 4 & ^-2 \\ 5 & 3 \end{pmatrix}$ and $Q = \begin{pmatrix} 5 & 0 & 2 \\ ^-1 & 4 & 5 \end{pmatrix}$

State the order of matrix (P.Q)

169. a)   Given $A = \begin{pmatrix} 2 & 0 & 1 \\ 4 & 3 & 6 \end{pmatrix}$ and $D = \begin{pmatrix} 2 & 3 & -1 \\ 4 & 3 & 4 \end{pmatrix}$, find matrix C such that

$3A - 2C = D$.

(b)   Grace, Hope and Sam went shopping at Capital shopper's supermarket. Hope bought 2 dozen exercise books at shs 6000 per dozen, 5kg of sugar at shs 2800per kg, 4loaves of bread at shs 3500 each and 2tins of margarine at shs 1500 each. Grace bought 3kg of sugar, 1dozen exercise books 2tins of margarine while Sam bought 3 dozen exercise books, 2tins of margarine, 4kg of sugar and 2 loaves of bread.
(i) Write the items bought as a 3 x 4 matrix and the prices of each as a row matrix
ii) By matrix multiplication, find how much each spent.

170.   Mugisha is a supplier of food to two schools X and Y. In the first week, he supplies 20Kg of rice, 5 bunches of matooke and 36kg of beans to school X. He

also supplies; 22kg of rice, 8 bunches of matooke and 45kg of beans to school Y.In the second week, he supplies; 25kg of rice, 8 bunches of matooke and 50kg of beans to school X. He also supplies; 18kg of rice, 6 bunches of matooke and 25kg of beans to school Y.

a) Find a single matrix representing the total of each item supplied to each school in the two weeks.

b) If he supplies at shs 3,000 per kg of rice, shs 30,000 a bunch of matooke and shs 2200 per kg of beans, find, by matrix multiplication, the amount he receives from each school for his supply in the two weeks.

c) Given that 10% of the total amount he receives is paid as tax and the remainder is paid for as school fees for his children Alice and Betty in the ratio of 3:5. Find how much:

    (i)   he pays as tax;

    (ii)   school fees he pays for Betty.

171. A vendor supplies bread, milk and news papers weekly to 3 families A, B and C as follows; Family A;2 loaves of bread, 3 litres of milk and a news paper .Family B; 2 litres of milk and a loaf of bread and family C; 2 news papers, 2 loaves of bread and a litre of milk.

(a)Write down a 3×3 matrix that represents all items for each family supplied in the first 2 weeks.

(b) If the vendor supplied milk at Shs,500 per litre, bread at Shs.2000 per loaf and each news paper at sh.1500.Write down a 1×3 cost matrix.

(c) By multiplying the above matrices calculate how much each family pays in 2 weeks.

(d) If the prices of each item increased by 20% by the end of 2ⁿᵈ week, how much more would the vendor earn in the third week than in the second week?

172. A member of parliament Christmas basket comes in 3 sizes: Executive, Director and Cabinet. The executive basket contains: 2 bottles of fanta, a tin of biscuits, 3 boxes of chocolates but no pot of honey, the Director contains 3 bottles of fanta, 2 tins of biscuits , a box of chocolates and 4 pots of honey. Cabinet contains a bottle of fanta , 4 boxes of chocolate and 3 pots of honey.

    (a) Write the contents of the baskets in a 3 x 4 matrix.

    (b) If a bottle of fanta costs Shs. 900, a tin of biscuits costs Shs. 6,500, a box of chocolates costs Shs. 8,200 and a pot of honey costs Shs. 3,800, write down a 4 x 1 matrix for this information.

    (c) Find by matrix multiplication the cost of the Christmas baskets.

    (d) UTL decides to send to its larges customers a total of 6 Executive baskets, 8 Director baskets and 4 cabinet baskets. Display this information in a 3 x 1 matrix. Hence by matrix multiplication, find the total cost the company meets to send these baskets.

TRANSFORMATIONS

173.   The translation T maps point P (x,y) onto $p^1(x - 4, y + 3)$
   (a) find the image Q^1 of Q $(- 1, - 4$)
   (b) find B if B^1 is $(- 3, 5)$

174.   An object of area $14.5cm^2$ is transformed on its image by $\mathbf{M} = \begin{pmatrix} 4 & 3 \\ 8 & 1 \end{pmatrix}$.
   Find the area of the image.

175.   Find the coordinates of the Centre of enlargement given that point $A(7, 1)$ is mapped onto $A'(- 2, - 2)$ by an enlargement of scale factor $- 2$.

176.   Under a transformation whose matrix is $\begin{pmatrix} x - 1 & 2 \\ - x & 3 \end{pmatrix}$, a figure whose area is $5\ cm^2$ is mapped onto a figure of area $60\ cm^2$. Find x.

177.   Find the matrix R for the reflection in line $x + y = 0$, hence, find the coordinates of P' the image of $P(5,. - 3)$ under R .

178. An object **P** whose area is **4cm²** is transformed by matrix $\mathbf{M} = \begin{pmatrix} 1 & - 2 \\ 1 & 1 \end{pmatrix}$ to its image $\mathbf{P^1}$ Find the area of $\mathbf{P^1}$

179.   a) A square whose vertices are $A(2,0), B(6,0), C(6,4) and D(2,4)$ is mapped onto $A^1B^1C^1D^1$ by a transformation represented by matrix $M = \begin{bmatrix} 0.5 & 0 \\ 0 & 0.5 \end{bmatrix}$. Find the coordinates of the vertices of square $A^1B^1C^1D^1$.

   (b) If square $A^1B^1C^1D^1$ is then mapped onto square $A^{11}B^{11}C^{11}D^{11}$ by matrix $K = \begin{bmatrix} 0 & - 1 \\ 1 & 0 \end{bmatrix}$. Find the coordinates of $A^{11}, B^{11}, C^{11} and D^{11}$.

   (c) Find a single matrix of transformation that maps ABCD onto $A^{11}B^{11}C^{11}D^{11}$

180.   . Triangle PQR whose vertices are P(4,4) , Q(8,4) and R(6,7) is given a transformation represented by matrix $.T = \begin{bmatrix} 0 & - 3 \\ -1 & 2 \end{bmatrix}$ followed by a transformation represented by matrix. $S = \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix}$ to give the final image P^1 , Q^1 , R^1 . (i) Find the coordinates of P^1 , Q^1 , R^1 .

(ii) Describe the single matrix of transformation that is represented by the combined transformations.
(iii) Obtain a single matrix that would map $P^1 Q^1 R^1$ back to PQR

181. A transformation represented by matrix $\begin{bmatrix} 6 & -4 \\ 2 & -1 \end{bmatrix}$ maps triangle KLM on to its image.K(^{I}8,3), L^I(32,11) and M^I(2,2) respectively.. The image of KLM further undergoes another transformation represented by matrix $\begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix}$. Find:

(a) the coordinates of the vertices of triangle KLM,
(b) the coordinates of the vertices of triangle s K^{II} L^{II} M^{II} and K^I L^I M^I
(c) a single matrix of transformation that would map triangle K^{II} L^{II} M^{II} onto KLM.

182. A triangle PQR with vertices P $(-2,1)$, Q(3,1) and R(0,3) is mapped onto triangle $P_1Q_1R_1$ whose vertices are $P_1 (-6,-1)$, $Q_1(9,4)$ and $R_1(0,3)$ by a transformation described by matrix M. Triangle $P_1Q_1R_1$ is further transformed by a matrix N = $\begin{bmatrix} 1 & 0 \\ -1 & 3 \end{bmatrix}$ to triangle P_2, Q_2 R_2

(a) Find
   (i)   matrix M   (ii) the co-ordinates of $P_2Q_2R_2$
(b) Find the single matrix that would map PQR onto $P_2Q_2R_2$. Describe this transformation fully.
(c) Find the area of
   (i)   PQR   (ii) $P_2R_2 Q_2$

183. (a)   Three points P (2, 3) Q (5, 3) R (3, -4) are vertices of a triangle. P^I(3, -8), Q^I(3, -5)
   and R^I (10, -7) are images of PQR under a rotation.
   (i)   Plot a graph and its image on a graph paper and find the Centre and angle of rotation.
   (ii)   Δ P^I Q^I R^I is further transformed by a translation vector T = $\begin{pmatrix} 3 \\ 6 \end{pmatrix}$. State the co-ordinates of P^{II} Q^{II} R^{II}. The image of P^I Q^I R^I

184. A triangle with vertices A(2,0), B(2,1) and C(0,1) is mapped onto triangle A'B'C' by a transformation represented by a matrix $\begin{pmatrix} 4 & 2 \\ 0 & -3 \end{pmatrix}$. Find the coordinates of the vertices of the triangle A'B'C'.

185. The image of triangle P with vertices (0,0), (0, -2), (2,0) is P' with vertices (0,0), (0, –4), (4,0) under transformation M. P' is then given a transformation N = $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ to give P''   (a)(i) Find the transformation M   (ii) Describe M fully
(a) Find the co-ordinates of P''

(b) Give a single matrix transformation which maps P onto P"

186.   WXYZ is a square with vertices W(2,0),X(6,0),Y(6,4)and Z(2,4).The square WXYZ   is mapped on to its image W'X'Y'Z' by a transformation represented by a matrix M = $\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix}$ (a) Find the coordinates of W', X', Y' and Z' under the transformation M.

(b) The image of WXYZ further under goes a transformation represented by a matrix   K = $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ Find the coordinates of the vertices of W"X"Y"Z"

(c) Draw the square WXYZ and its images on the same axes.

187.   (a) ABC is a triangle with vertices A(-1,1),B(4,1) and C(1,5).Triangle ABC is mapped onto   triangle $A'B'C'$ by a transformation represented by $T = \begin{pmatrix} -2 & -1 \\ -1 & 2 \end{pmatrix}$.   Find the coordinates of the vertices of triangle $A'B'C'$.

(b) Triangle $A'B'C'$' is then mapped onto triangle $A''B''C''$ by a transformation matrix

$K = \begin{pmatrix} 2 & 1 \\ 1 & -2 \end{pmatrix}$. Find the coordinates of the   vertices of triangle $A''B''C''$.

(c) Find a single transformation matrix which would map triangle $A''B''C''$ on to triangle ABC. Hence describe the transformation fully.

188. The points $P(1,5)$ $Q(2,2)$ $R(1,1)$ and $S(4,2)$ are the vertices of a quadrilateral PQRS.

(i) $P_1Q_1R_1S_1$ is the image of PQRS under an anti-clockwise turn of 90^0 about the origin. Find the coordinates of the vertices of P_1, Q_1, R_1 and S_1.

(ii) $P_2Q_2R_2S_2$ is the image of $P_1Q_1R_1S_1$ under a reflection in the x- axis. Find the coordinates of the vertices of quadrilateral $P_2Q_2R_2S_2$.

(iii) Find a single transformation matrix that maps quadrilateral PQRS on to $P_2Q_2R_2S_2$.

(iv) Describe the transformation in part iii) above fully.

189.   (a).   Given that $\begin{pmatrix} 3a & a-8 \\ -6 & a-2 \end{pmatrix}$ is a singular matrix; find the values of a.

(b).   Find the values of x and y for which $P'(9, 2)$ is the image of $P(x, y)$ under transformation matrix $M = \begin{pmatrix} 1 & 2 \\ 1 & 0 \end{pmatrix}$ followed by $N = \begin{pmatrix} 3 & 0 \\ 0 & 2 \end{pmatrix}$.

(c).   Identify the matrix of transformation that maps the unit square $OIKJ$ onto $O(0, 0), I'(2, 7), K'(3, 7), J'(1, 0)$.

190. A triangle ABC has vertices at the points A(1,3), B(4,1) and C(4,3).
  a) Draw the triangle ABC on graph paper using a scale of 2cm to 1 unit on both axes.
  b) The triangle ABC is mapped onto the triangle A'B'C' by an enlargement E_1, with Centre O and scale factor 2.
  (i) State the matrix which represents E_1 (ii) Find the coordinates of A', B' and C'
  c) A triangle A'B'C' is then mapped onto the triangle A''B''C'' by a reflection along the line y = –x.
      (i)   State the matrix of transformation.
      (ii)   Find the coordinates of A'' , B'' and C''.
191.   A triangle with vertices A(-1,1), B(-1 , 3) and C(-2 , 3) is mapped onto triangle A'B'C, by a

  translation $\begin{pmatrix} 2 \\ 1 \end{pmatrix}$ .Triangle A'B'C' is then rotated through +90 about the
   point (3,2) to triangle A''B''C''.
                (a)   Plot the points A, B, and C on a graph paper. Join the points to form triangle ABC.
                (b)   Find the coordinates of;
                            (i)   A'', B' and C'.   (ii)   A'', B'' and C''.
                (c) Find the Centre and angle of rotation which maps A''B''C'''' back onto ABC.
192. (a)   The vertices of a triangle RPQ are (1,3) (1,4) and (3,3) respectively.

            Find the coordinates of the image triangle $R_1 P_1 Q_1$ under the reflection in the line x-y = 0.

        (b)   The image $R_1 P_1 Q_1$ is then mapped onto $R_2 P_2 Q_2$ by a positive ¾ turn about the origin. Find the coordinates of triangle $R_2 P_2 Q_2$.

        (c)   Find a single matrix of transformation that would map $R_2 P_2 Q_2$ back to RPQ.

BUSINESS MATHEMATICS

193.   Below is an exchange rate at a certain forex. 1(£) pound sterling = 3000 Ush and 1Ksh = 25 Ush. find in pound sterling how much john will get in exchange of 42000 Ksh.
194. A tourist has US$ 1,200 which he changes to Uganda shillings (Ug. Shs) at a rate of $1 = Ug. Shs 3,000. If he has a balance of Ug. Shs 900,000 after all expenses find; (a) the amount of money spent in Ug. Shs. **Hence** his balance in US dollars

195. Exchange rates in a forex Bureau are that a US dollar to Uganda shillings is 1$ = 2785 and a Pound Sterling to US dollar is £1 = $2.59. How much Sterling will a Ugandan trader get from shs. 4,570,185.

196. A tourist arrives at the Jomo Kenyatta International Airport Nairobi with US$ 1,850. How much Kenyan money in exchange would he get if the current exchange rate is US$ 1 = K shs. 11.20?

197. Africom Uganda (U) Limited borrowed shs 5,000,000 from DFCU bank for 3 years at a compound interest of 20% per annum. Find the interest paid by the company to the bank after the 3 years.

198.   Nankya Invested sh.60, 000/= in a bank which offers 10% compound interest per Annum. How much interest will she have at the end of the third year?

199. The price of a Television set was shs. 450,000. Naleera bought it at shs. 396,000. What was the percentage discount?

200.   Mr. Moya selling second hand shirts earns a commission of 9% of the total sales. Each shirt costs shs. 7,500. Find the number of shirts sold if Mr. Moya earned a commission of shs. 297,000.

201. John borrowed shs. 2.5 million for two years at a simple interest and paid back shs. 3.7 million. What is the interest rate for the loan?

202. The prince of a house valued at 15 million shillings increased by 25% after the first year and decreased by 10% in the second year. Find the value of the house after a period of two years.

203. A trader invested shs 80,000 at 15% simple interest per year in a certain saving and credit society. After **t** years his account accumulated to shs 128,000, find **t**.

204. Find how long it takes shs 96,000 invested at $8 \frac{1}{3}$ % simple interest to amount to sh 102,000

205. Under hire purchase, an article was bought by paying a deposit of sh.70,000 followed by six monthly installments of sh.30,000 each. If the hire-purchase price was 20% higher than the cash price, determine the extra cost incurred by paying by hire-purchase rather than cash.

206.   Mr. Mukasa deposited sh 645,000 in an account in a bank that offers 12% per annum simple   interest. Calculate the amount he gets after 18months.

207. A man borrows shs. 25,000 at 10% p.a compound interest. At the end of each year he pays back shs. 10,000. How much does he still owe the bank at the beginning of the third year.

208.   The cash price of a T.V is sh. 240,000. It can be bought by either: Paying a deposit of sh. 60,000 and 15 equal monthly installments. Or 20 equal monthly installments of sh. 16,800 each.

(a) If the total payment for plan A is 25% more than the cash price, find:
   i) the amount of each instalment.
   (ii) Which plan is cheaper and by how much?

209.   How long does it take for any principal to double at an interest rate of 8% compounded semi annually

210.   Find the interest earned when sh 450,000 is invested at 8% p.a. compound interest for 4 years.

211.   Victoria deposited her earnings of **600000** and **800000 shillings** on a simple interest rates of **x%** and **y% respectively earning** an interest of **440000**shillings after two years. If victoria had deposited her total earnings for the some period of time at rate of $\left(\dfrac{x+y}{2}\right)$% , her interest wound have reduced by **20000 shillings.** Determine the values of **x** and **y**

212.   Income tax in a certain country is calculated after deducting the following allowances. Marriage Sh91,000 which is one – tenth of the gross monthly income, transport ; Sh   60,000 per month, insurance; Sh372,000 per annum, medical;sh28,000 per month, housing; Sh42,000, electricity ;Sh15, 000 and water ;Sh 500 per day. Family allowance for only 3 children at the following rates; Sh21, 500 for each child below 10 years,Sh20, 000 for each child between10 years and 15 years; Sh 15,000 for each child above 15 years. The tax rates are as shown below

Taxable income(sh)	1-80,000	80,001-180,000	180,001-280,000	280,001-380,000	380,001-500,000	Above500,000
Rates(%)	10	12	15	17.5	18	20

Mr. Okiror is married and has 4 children aged 7, 9, 14 and 20 years.
(a)Calculate Mr.Okiror's taxable income.

(b)What percentage of Mr.Okiror's gross income goes to tax?

213.   A private school's income tax structure is such that a teachers gross monthly income for the month of October has certain allowances deducted from it before its subjected to taxation. The allowances are spelt out as follows: Marriage allowance is one –tenth of the gross monthly income. Family relief is sh. 240,000 per annum.Housingsh.35,000 per month. Medical sh. 120,000 per annum. Transport sh. 1000 per day. Departmental allowance sh.15,000 per month. Administrators allowance sh. 50,000 per month Family allowance for 3 children only at the following rates.

Class level	Allowance(sh.)
A Level	6,800
O Level	7,200
Primary	9,000

Mr. Opolot is married with 4 four children and 2 of them are in primary, one in O level and the other in A Level and Mr. Opolot is not a head of Given that he earns a gross monthly income of shs. 680,000.Calculate:(a) the taxable income and the income tax he pays under the tax rates shown in the table below.

Taxable Income	Percentage tax rate
0 – 15,000	8
15,001 – 84,000	16
84,001 – 170,000	25
170,001 – 285,000	34
285,001 – 435,000	40
Above 435,000	48

   (b) Determine the percentage of his gross monthly income paid in tax.
214.   The monthly income tax in a certain country is calculated after the monthly allowances have been deducted from the gross income. The allowances includes the following: Housing   50,000/= per month, Transport   720,000/= per annum, Marriage   42,000/= per month and Insurance premium a tenth of the gross monthly salary Family allowance for only four children at the following rates; 6500/= each for a child below 12 years, 6000/= each for a child between 12 and 18 years and 5000/= each for a child above 18 years. The tax rates are as below

Taxable income (sh)	Rates (%)
First 80,000	Free
80,001 – 160,000	5
160,001 – 240,000	8.5
240,001 – 320,000	12
320,001 – 400,000	14
400,001 – 480,000	17
Above 480,000	20

Mr. Rasasi is an employee in a certain company and earn a gross monthly salary of 680,000/= per month. He is married with six children aged 4,7,13, 15, 17 and 20 years. Calculate Mr. Rasasi's(i) Total allowances   (ii) Taxable income
(iii) Income tax as a percentage of his taxable income.

215. In a certain country, the monthly gross income has certain allowances deducted from it before it is subjected to taxation. The allowances are: married man= Shs 250,unmarried =shs 15000,transport   =shs 3,000 per day ,insurance =shs 15000,electricity =shs 18000 and medical =shs 480,000 per annum.Family allowance for 4 children: Shs 9000 for each child above 18 years, shs 12000 for each child below 18 but above 10 years and 15000 for each child below 10 years of gage . Mr. Mukasa is a married man with 5 children 3 of them below 10, are aged 14 and the elder one 20 years old.

(a) Find Mukasa's taxable income and the income tax he pays under the tax rates below given that he earns shs 960,000 monthly.

Taxable income	Rate %
0 – 200000	2%
200001 – 400000	10%
400001 – 600000	18%
600001 – 800000	26.5%
above 800000	35%

(b) Express his income tax is a percentage of his gross monthly income.

216. The tax rates in a certain country for government employees are as follows:

Taxable income (shs.)	Rate (%)
80,001 − 190,0000	5.00
90,001-280,000	0.5
280,001 − 380,0000	12.00
80,001-490,000	5.0
Above 490,0000	20.0

Every employee is entitled to the following allowances:

Medical   −   720,000 per annum
Electricity   −   40,000 per month
Transport   −   2,500 per day
Housing   −   90% of his monthly medical income.

If the employee paid a monthly income tax of shs. 125,350 in June 2013, calculate;

(a).   the employee's taxable income.
(b).   the employee's monthly gross income.

217. The table below shows the tax structure on taxable incomes of employees of a certain company.

Income per month	Tax-rate (%)
50,001 – 90,000	12
90,001 – 150,000	15
150,001 – 280,000	20
280,001 – 350,000	25
350,001 – 460,000	27
460,001 – 550,000	30
550,001 – 620,000	32
620,001 – 700,000	35
700,001 and above	37

An employee earns Shs. 10,800,000 per annum. His allowances include:

Marriage	A sixteenth of his monthly income
Water and electricity	Shs. 45,000 per month
Housing allowance	Shs. 600,000 per month
Medical	Shs. 15,000 per week
Transport	Shs. 3,500 per day
Relief and insurance	Shs. 180,000 per annum

Family allowance for three children only, for children in the age bracket 2 – 10 years Shs. 12,000 per child,   between 10 – 19 years Shs. 9,000 per child and 19 and above years Shs. 5,000.

   (a) Calculate the income tax he pays given that he had five children, two of whom below 9 years – the others aged 15, 17 and 22 respectively.
   (b) Determine what percentage of his taxable income goes to tax.

218. An insurance company in Kenya offers the following tax free monthly allowances to its employees.

Housing $^1/_{12}{}^{th}$ of the gross monthly income
Electricity   shs 45,000
Relief   shs 50,000

Water   5% of the gross monthly income
Marriage   shs 480,000 per annum.
Security   shs 60,000
Allowances for only 4 children are paid at the following rates: shs 20,000 for
each child less than 7 years and shs 15,500 for each child 7 years and above.
Mr Jaburu is married with five children aged 2 years, 4 years, 6 ½ years, 9 years
and 14 years and he earns a gross monthly income of shs 840,000.
The Kenya tax structure is as follows

Taxable income (Ushs)	Tax rats (%)
01 – 50,000	Free
50,001 – 100,000	70
100,001 – 250,000	17.0
250,000 – 400,000	25.0
400,000 – 500,000	32.0
Above 500,000	49.0

Calculate the Jaburu's : (a) Taxable income. (b). Income tax as a percentage of
his gross monthly income.   (c).Net income
219.   In a certain country, the following allowances are given to people.

ALLOWANCE	AMOUNT
Marriage	10% of monthly income
Bachelor/Spinster	15% of monthly income
Biological child above 10years but below 20 years	Shs. 20,000
Biological child who is 10years or below	Shs. 30,000
Medical allowance	$\frac{1}{50}th$ of monthly income
Transport	Shs. 4,000 per day
Rent	Shs 200,000 per month

Michael is married with 3 children, 2 below 10 years of age and the other is 14
years old. Andrew is single but has two dependants aged 11 years and 15 years
respectively. Both earn a gross monthly salary of shs 1,600,000. The income
structure is given below.

Taxable income(shs)	Tax rate(%)
1 – 200,000	10
200,001 – 500,000	15
Above 500,000	20

i)   Calculate the taxable income for both Michael and Andrew.

ii)   Calculate the total amount of tax paid by both men.

220. (a)   Calculate the simple interest on Shs. 990,000 for 8 months at
          a rate of $5^1/_2$ % per annum.
          (c) The income tax rates of a certain country are shown in the table below;

Taxable Income (Shs)	01 - 200,000	200,001- 500,000	500,001 - 900,000	900,000 and above
Rate (%)	6	13	20	30

(i)   Calculate the Income tax an employee pays if the employee's
       taxable income is Ug.Shs 1,170,000.

(ii)   Given that the employees' untaxed allowances is Shs 140,750/=.
       Find the employee's net income.

VECTORS

221. The co-ordinates of A and B are (– 6, 15) and (4,5) respectively, x is a
      point on AB such that AX:XB = 1:4. Find
      (i)   AB   ii) OX

222. Given that Q $\in$ PR such that PQ: :QR = 3:2, find the co-ordinates of Q if P
      is (2,5) and R is (7 ,– 5)

223.   Point A has coordinates $(3,2)$ and $\mathbf{AB} = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$. Find the magnitude of

   $\mathbf{2OA + OB}$.

224.   Two points A and B have coordinates $(-8,2)$ and $(-2,5)$ respectively and R is
      a point on AB such that $AR:RB = 2:1$. Find the position vector of R.

225. In a parallelogram ABCD, the vertices A, B and D have coordinates (1, 0),
      $(3, -4)$ and $(3,4)$ respectively. Find the coordinates of the vertex C

226. Given the vectors $\boldsymbol{p} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$ and $\boldsymbol{q} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$, find the modulus of $\boldsymbol{p} + 2\boldsymbol{q}.$

227. Given that $\mathbf{p} = \begin{pmatrix} -2 \\ 0 \end{pmatrix}$, $\mathbf{q} = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$ and $\mathbf{r} = \begin{pmatrix} -3 \\ 2 \end{pmatrix}$, find $\mathbf{p} + 5\mathbf{q} + \mathbf{r}$. Hence find $|\mathbf{p} - 5\mathbf{q} + \mathbf{r}|$

228. The vectors p. q and r are $\begin{pmatrix} 3 \\ 1 \end{pmatrix}$, $\begin{pmatrix} -1 \\ 3 \end{pmatrix}$ *and* $\begin{pmatrix} 18 \\ -14 \end{pmatrix}$ respectively. Find scalars
    a and **b** such that a p + b q, = r

229. Given that position vectors **OP** = $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$ and **OQ** = $\begin{pmatrix} 4 \\ \cdot 1 \end{pmatrix}$. Find the coordinates of
    the mid-point of vector **PQ.**

230. Given vectors $a = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$, $b = \begin{pmatrix} 2 \\ 4 \end{pmatrix}$ and vector $c = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$, find the values of m
    and n if m**a**+n**b**=**c**

231. Given the vectors $a = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$; $b = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$ and $c = \begin{pmatrix} -1 \\ 3 \end{pmatrix}$ find the magnitude of
    a+**2b** – **c**

232. Given that $\overrightarrow{AB} = \begin{pmatrix} 6 \\ -2 \end{pmatrix}$ and $\overrightarrow{OA} = \begin{pmatrix} 4 \\ 2 \end{pmatrix}$,
    Find: i)   the position vector of B.
           ii)   the distance of B from the origin.

233. Given that $P(2,3)$ *and* $Q(8,1)$ and that that $\overrightarrow{OK} = 3\overrightarrow{OP} - ½ \overrightarrow{PQ}$. Find the coordinates of point K.

234. In triangle ABC, L, M and N are midpoints of BC, CA and AB respectively.
    AM = **m** , AN = **n** and 3AG = 2AL
    (a) Express in terms of **m** and **n**
        (i)   **AB**   ii) **AC**   iii) BC   iv) **BG**   v) **GM**
    (b) Show that the points B,G and M are collinear.

235.
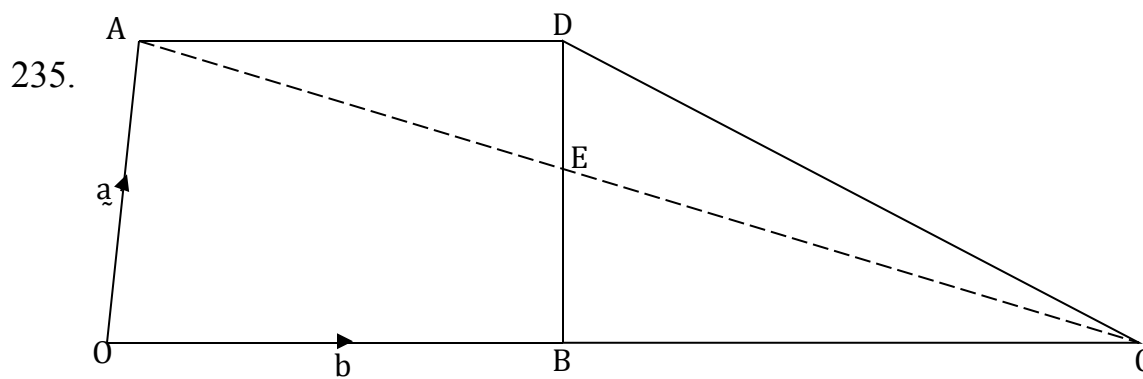
In the figure above, AD is parallel to OC and OA is parallel to BD.
30C = 50B. E is the point where AC meets BD, AE : EC = 3 : 2.
(a) Find in terms of the vectors a and b the vectors
    (i)   AC   ii) DC   iii) ED   iv) AE   v) OE
(b) Find the ratio   BE : ED.

236.   In the figure below L, M and N are the mid points of **OA** , **AB** and **OB**

respectively. G is a point on **OM** such that $OG = \dfrac{2}{3} OM$. Given that

OA = **a** and **OB** = **b** .
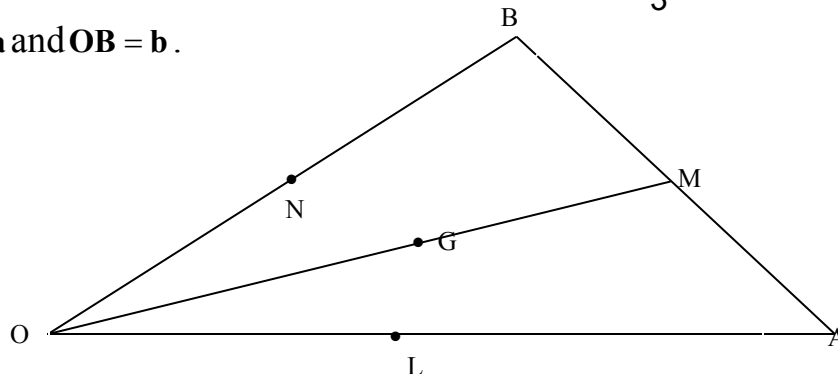
(a)Express in terms of a and b the vectors (i) **OM** (ii)**OG** (iii)**BG** (iv)**GL**
(b) Show that points B, G and L are collinear.

237.   The position vectors of three points A, B and C are $2\mathbf{a}, 4\mathbf{b}$ and $4\mathbf{c}$
respectively. M is a point on AC such that $AM : MC = 1:1$ and N is on CB such
that $CN : NB = 1:3$

(a) Express **CB** in terms of **b** and **c** .

(b) Express **AM** in terms of **a** and **c** .

(c) Express **OM** in terms of **a** and **c** .

(d) Express **MN** in terms of **a** , **b** and **c** .
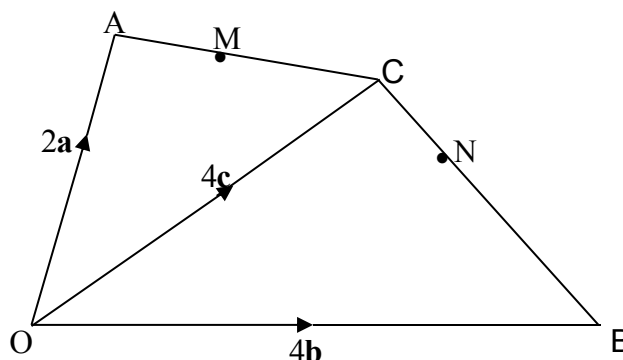
238.   In a triangle OPQ, point R lies on line PQ such that **3PR = PQ**. Point S lies
on line **OQ** and **OS** = $\dfrac{1}{4}$ **OQ,** while T lies on line **OR** such that **OT = TR.**

If OQ = **q** and OP = **p** express in terms of **p** and **q** the vectors.
(a) (i) **PQ** (ii)   **OR**   (iii)   **PT**
(b)   Show that **PT** : **TS** = 2:1.

239.   OAB is a triangle in which **OA** = **a** and **OB** = **b**. The points D and C are the
midpoints of OB and AB respectively. E is a point of OA such that 4**0E** =OA.

(a) Express in terms of **a** and **b** the vectors
(i) **AB**   ii) **OC**   **iii) EB**   iv)**EC**
(b) Show that **DC** is parallel to **OA**.

240.   the figure below, OAB is a triangle such that $3\boldsymbol{OD} = \boldsymbol{OA}$, $3\boldsymbol{OC} = \boldsymbol{OB}$. E is a point on BD such that $4\boldsymbol{BE} = 3\boldsymbol{BD}$.
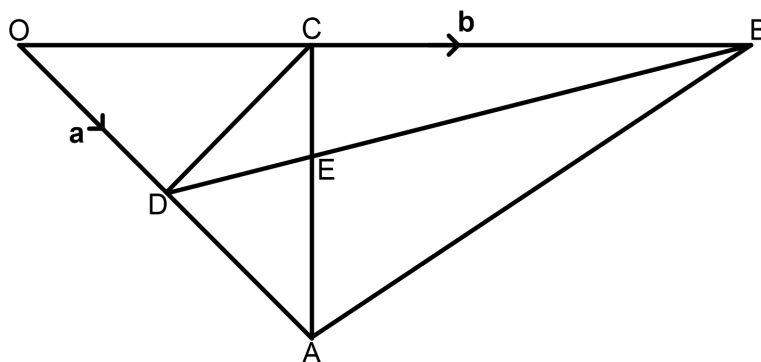
(a).   Given that $\boldsymbol{OA} = \mathbf{a}$, $\boldsymbol{OB} = \mathbf{b}$, Express the following vectors in terms of **a** and **b.**
(i). $\boldsymbol{DC}$,   (ii). $\boldsymbol{BD}$,   (iii). $\boldsymbol{AE}$,   (iv). $\boldsymbol{EC}$.
(b). Show that the points A, E and C are in a straight line.

241.   In the figure below, $\overline{PQ} : \overline{PT} = 4 : 1$, $2\overline{PS} = \overline{PY}$, $\overline{RS} : \overline{RT} = 2 : 3$,
$\overrightarrow{PT} = 3\mathbf{a}$ and $\overline{PR} = 3\mathbf{b}$.
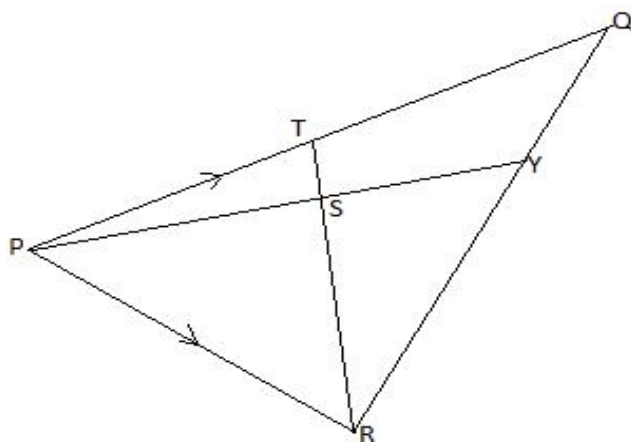
(a) Express in terms of **a** and **b**
(i) $\overrightarrow{RS}$ ii) $\overrightarrow{PY}$ iii) $\overrightarrow{RQ}$.
(b) Find the ratio of $\overline{RY}$ to $\overline{RQ}$.

BEARINGS

242.   Four towns P,Q R and S are such that town Q is 120km due east of town P. Town R is 160km due north of town Q, town S is on a bearing of 330^0 from P and on a bearing of 300^0 from R.(a) Using a scale of 1cm: 50km, determine,

  (i) the distance SP   (ii) the distance SR

  (iii) the bearing of town S from town Q.

243.   Four towns A, B, C and D are such that town B is 300km away from A on a bearing of N60ºE. Town C is 500 km away on a bearing of 150º from B and town D is 200km due west of town C.

(a) Sketch a diagram to show the position of the four towns

(b) Using a scale of 1cm: 50km, draw an accurate diagram to show the position of the four towns.

(c) Using your diagram in (b) above, find the distance and bearing of town A from D.

(d) if a plane flies directly from A to D at a speed of 20km/h.how will it take on the way?.

244.   Town B is 120 km on a bearing of 080º from town A. Town C is 140 km on a bearing of 150º from B while town D is 240 km due north of town C.

  (a) Draw an accurate scale diagram to show the relative positions of the four towns (use a scale of 1 cm to 20 km)

  (b) Find the bearing and distance of A from D

  (c) If a motorist drives at 100 kmh^{-1} between A and B, at 80 kmh^{-1} between B and C and at 120 kmh^{-1} between C and D, find his average speed for the whole journey from A to D.

245.   A plane flew due West from Port A at a speed of 280 kmh⁻¹ for ¾ hours to Port B. It then altered its course and flew North West to Port C at a speed of 220 kmh⁻¹. From there, it flew on a bearing of 060º to Port D at 240 kmh⁻¹ for 1½ hours. The total time of flight was 4½ hours.

  (i) By scale drawing, using a scale, 1 cm to 50km, determine the distance and bearing of Port A from Port D.

  (ii)Determine how long it will take the plane to fly directly from A to D and back to A at a speed of 220kmh⁻¹.

246.   Two ships leave Mombasa port M at the same time. One ship sails 500 km on a bearing of 030^0 to position A. The other ship sails 300 km on a bearing of 300^0 to position B. Use a scale of 1cm : 50 km to find

  (i)   The distance AB

  (ii)   The angle MAB

  (iii)   The bearing of B from A

247. A rally driver drives from town K due west for 180km to town L one day one. The next day he heads toward town M , 252km away on a bearing of 320^0 from town L. He then changes course the following day and drives 448km on a bearing of 060^0 to town N.

    (a) Draw a sketch showing the journey of the driver.
    (b) Calculate (i) the distance between towns N and M
            (ii) the bearing of town M from N
    (b) If he drives back to town K directly from town N at an average speed of 110km/h, find how long it took him in hours.

248. Two aero planes P and Q leave an airport at the same time. P flies on a bearing of 240° at   900km/h while Q flies due East at 750km/h.
    (a)Using a scale of 1cm to represent 100km, draw an accurate diagram showing the positions   of the two aero planes after 1hour 20minutes.
    (b) From the diagram in (a) above determine: (i) the distance between the two aero planes (ii) bearing of P from Q   (iii) the bearing of Q from P.

249. A plane flies from airport A to airport B, at a speed of 900km/h for 40 minutes on a bearing of $S45^0E$. From B it changes course and flies to airport C which is due South of A.

    (a) Using a scale of 1cm: 50km determine
        (i) how far airport C is from airport B
        (ii) how far airport A is from airport C
        (iii) the bearing of C from B.

250. A helicopter is at airport H on a bearing of 060^0 and 800km from another airport P. A third airport J is on a bearing of 135^0 and 1450km from H.
    a) Using a scale of 1cm to represent100km;
    (i) Show the relative positions of P, H and J
    (ii)Determine the distance between P and J
    (iii)   What is the bearing of P from J.
    b) A jet flying at a speed of 620km/hr left J towards P. At the same time the helicopter at H took off towards P. Find the speed at which the helicopter will fly so as to arrive at P, 50 minutes earlier than the jet.

MOTION & TRAVEL GRAPHS. (KINEMATICS)

251. A man drives for 210km. he covers the first 60km at a speed of 40km/h. if the average speed over the whole journey is 70km/h. Calculate the time taken to cover the remaining distance.

252. Two vehicles are moving towards each other between A and B, a distance of 490km.

    The car from A moves at a speed of 80kmh^{-1} and that from B moves at 60kmh^{-1}. Assuming that the two cars started moving at the same time, after how long in hours will the cars meet?

253. A car travelled at an average speed of 75km / hr for 5 hours and then it further travelled at an average speed of 60 km/ hr for 4 hours. Find the average speed of the car for the whole journey.

254. The distance between Mombasa and Nairobi is 576km.Two buses A and B travel from Nairobi to Mombasa. The average speed of bus A is 24km/hr more than that of bus B. Bus A takes 2hours lesson the journey .If bus A takes t hours for the journey, Find
    i) An equation in term of t
    ii) The time taken by bus A to
    iii) The average speed of bus B.

255. Towns A and B are 200km apart. At 8.00am, a bus left town A for town B travelling at 40kmh^{-1}. Four hours later, the bus developed a mechanical problem which took one hour fix before continuing to town B at half the original speed. One and a half hours after the bus left town A, a saloon car also left town A for town B travelling non-stop at 50kmh^{-1}
    (a) Using a scale of 2cm; 1 hour horizontally and 2cm; 20km vertically, draw a distance - time graph to show the journeys of the two vehicles.
    (b) From the graph, find
       (i) When and where from town A, the saloon car bypassed the bus.
       (ii) The difference in the times of arrival of the two vehicles in town B.
    (c) Calculate the average speed of the bus.

256. John starts cycling from his home at exactly 8:00 am at a steady speed of 16 kmh^{-1} to attend a meeting at the Gombolola headquarters, 20 km away. At the same time, Opio is sent from the Gombolola headquarters and comes at a steady speed of 6 kmh^{-1} to inform John that the meeting was postponed. Unfortunately, at exactly 8:30 am, John gets a puncture and works on it for 20 minutes before proceeding his journey carefully at 8 kmh^{-1}.

    Using a scale of 1 cm to 1 km on vertical axis and 1 cm to 10 minutes on horizontal axis;

(a). Draw the distance-time graphs on the same axes for both John and Opio.
(b). Use your graphs to determine;
    (i). the time John met Opio.
    (ii). the time when they were 3 km apart.
    (iii). The distance from the point where they met to the Gombolola headquarters.

257. Mbale is about $255\ km$ away from Kotido. A bus leaves Kotido for Mbale at $6:45\ am$ travelling at a steady speed of $50\ km\ h^{-1}$. A taxi leaves Kotido an hour later at a speed of $70\ km\ h^{-1}$ but gets a flat tire after travelling for $1\ hr\ 30\ min$. The mechanical problem was fixed after $30\ min$ and then the taxi driver decided to increase the speed by $15\ km\ h^{-1}$. Draw on the same axes, the distance – time graphs showing the journey of the bus and taxi. (Use scales of $2\ cm \equiv 30\ km$ and $2\ cm \equiv 1\ hr$).

Determine:
i) the time and distance from Mbale when the taxi over takes the bus.
ii) state the times when the two vehicles arrive at Mbale.
iii) differences in the times of arrival of the two vehicles.

258. A lorry set off from Tororo at 0730 hours at a steady speed of 40km/hr to Kampala, a distance of 180km away. After travelling for 2 hours it stopped and rested for $1^1/_2$hrs, then continued at a steady speed of 50km/hr for the rest of its journey. A car also set off from Kampala to Tororo at the same time as the lorry at a steady speed of 60km/hr but suddenly reduced its speed after 2 hours to 15km/hr due to some mechanical fault for the remaining journey.
   Using scales of 1cm to 10km and 1cm to 30 minutes on the vertical and horizontal axes respectively:
   (a) Draw distance time graphs showing the routes of the two vehicles.
   (b) Using your graphs determine the
       (i) distance between the two vehicles after 2 hours.
       (ii) difference in time of arrival at respective towns.

259. A man leaves his home at 8.00 a.m cycling to a market 21km away at a speed of 20km/h. At the same time his wife leaves the market; riding back home at a speed of 8km/h.
                (a) Calculate (i) how far from home they will meet each other.
                (ii)at what time they will meet.

(b.)   If the man's bicycle develops a fault immediately after meeting his wife hence forcing him to reduce the speed to 8km/h , at what time will he reach the market?

260.   Sylvester left UMSS at Noon and cycled towards Jinja 100km away at a steady speed of 16kmh $^{-1}$. After cycling for 180 minutes he rested for one hour at Lugazi. Then continued his journey with the same speed up to Jinja.

   Forty five minutes after the departure of Sylvester, Michael also started walking from UMSS towards Jinja at 6kmh $^{-1}$ for 1 hour and reached Kireka. He waited for 45 minutes at Kireka and later boarded a bus travelling at governed speed 32kmh $^{-1}$. It travelled for one hour and stopped at Namawojolo for another one hour; then resumed its journey at 42 kmh $^{-1}$ non stop up to Jinja.
   - (a) using a scale of 2cm: 1 hour and 2cm: 10km draw their distance time graphs on the same axes.
   - (b) From your graph determine
     - (i)   the time and distance from UMSS the bus overtook the cyclist
     - (ii)   the distance between Namawojolo and Lugazi.How long did Michael wait before Sylvester joined him at Jinja sailing club.

261.   Towns A and B are 300 km apart by road. At 7.00 a.m. Ojok leaves town A for town B driving a pick-up at a steady speed of 80 kmh $^{-1}$. After driving for 2 hours, the pick-up breaks down and he is forced to stop for half an hour after which he continues towards B at a reduced speed of 60 kmh $^{-1}$ up to town B. One and a half hours after Ojok left town B, Kase leaves town B for town A driving at a constant speed non-stop all the way to A. Using a scale of 1 cm to 1 hour on the horizontal axis and 1 cm to 50 km on the vertical axis, draw the graph of both men's journeys on the sasme pair of axes, given that both reached their respective destinations at exactly the same time. Use your graph to find

   - (a) Kase's speed in kmh $^{-1}$
   - (b) When they met and how far this was from town A
   - (c) Their time of arrival.

262.   A bus leaves Kumi at 8.30am and travels at an average speed of 70km/h. Thirty minutes later, a car leaves the same town and follows the bus at 120km/h. Calculate, how far apart they will be at 9.30a.m.

263.   A car leaves town A at 9.30a.m for town B, 100km away, at a steady speed of 60km/h. After reaching town B the car rests for 20 minutes, before resuming its journey back to town A at constant speed thus reaching A at 12.40 p.m

  (a) Using a scale of 3cm: 30min. on the Time - axis and 2cm: 10km on the Distance - axis;
draw the graph for this motion.

(b) Use your graph to determine :(i) the speed at which the car travelled back to A.

(ii) the time at which the car reached town B

264. Two towns, S and T, are connected by a road. The distance between S and T is 11km. John leaves town S at 10 00 hours and cycles along this road at a constant speed of 12km/h. After 30 minutes he stops and rests for 10 minutes. He then continues his journey to T at a constant speed, arriving at 11 00 hours.

(a)   (i)   Draw the distance – time graph for John's journey, using a scale of 2cm: 10 minutes for the horizontal axis and 2cm: 1 unit for the vertical axis.

(ii)   At what speed does John cycle after the rest.
Michael leaves town T at 10 00 hours. He walks along the same road towards S for one hour at a constant speed of 3 km/hr.

(b)   On the same graph, draw the distance-time graph for Michael's journey.

(c)   Write down the time at which John and Michael meet and the distance from town T.

PROBABILITY

265. A two-digit number is formed without repeating a digit from the digits 1,2,3,4.
(a) List down all the possible numbers.
(b) Calculate the probability that a number picked from that set is a prime number.

266. A bag contains 30 beads numbered 1, 2, 3, … , 30. A bead is drawn at random from the bag. Find the probability that the bead has the number which is (a) a multiple of 3   (b) a prime number.

267. A coin is tossed twice. (a) Write down all the possible outcomes

(b) Find the probability of getting 2 heads.

268. A bag contains 2 red and 4 blue pens. If a pen is picked at random, find the probability that it is; (i)   Red   (ii)   Red or blue

269. A bag contains 3 black balls 4 blue balls and 2 yellow balls.
(a) if two balls are picked at random without replacement find the probability that both are of the same colour.
(b) How many black balls must be added to the bag so that probability of drawing a black ball should be ½.
(c) How many yellow balls must be added to the bag so that the probability of drawing a black ball should be $^1/_5$?

270. The probability that a pupil passes in a physics examination is 0.8 and the probability that she will pass in a chemistry examination is 0.6, Find the probability that the pupil will pass in both examinations

271. The probability of picking a blue ball at random form a box containing blue and white balls is $\frac{2}{3}$ .If 8 balls were white ,how many balls were in the box altogether ?

272. A two digit number is formed from the first four prime numbers.
   (a)   Draw the table to show the possible outcomes
   (b)   Calculate the probability that a number chosen from the two digit numbers is an even number.

273. A two digit number is formed using the digits 2, 3 and 4 without repetition.
   (i)   Write down the possibility space
   (ii)   What is the probability that the number formed is divisible by three?

274. (a).   A bag contains 3 green and 2 red balls. Two balls are randomly selected from the bag without replacement. Find the probability that:
   (i).   Both are of same color.
   (ii).   The second ball is red.
   (iii).   They are of different colors.
   (b).   A regular octahedron, whose faces are numbered 1 to 8 is thrown together with a coin. Show the possible outcomes in a table. Find the probability of getting;
   (i).   "T" with prime number,
   (ii).   "H" and a number less than 4.

275. There a 5 red and 4 white balls in a bag. Two balls are picked from the bag at random one after another without replacement. Find the probability that:
   (a) both are white
   (b) they are of different colours.

276. Two bags A and B each contain similar marbles. Bag A has 4 blue marbles and 2 red marbles. Bag B contains 3 red marbles and 2 blue marbles. A bag is chosen at random and from it two marbles are picked at random in succession. Determine the probability that both

   (a) red and from bag A
   (b) blue and from different bags.
   (c) both are of the same colour and from the same bag.

LINEAR PROGRAMMING AND INEQUALITIES

277.   Find the solution set of the inequality $\frac{x}{4} + 5 \geq \frac{x}{2} + 1$

278.   Using the number line, find the solution set of $\frac{1}{2}x - 9 \leq 3 + 3\frac{1}{2}$.

279.   Solve for x the inequality $\frac{x+3}{4} - \frac{x-2}{3} < 2$.

280.   Solve the inequality $\frac{x+7}{5} - \frac{x+3}{6} \leq 1$ and show your solution on a number line.

281.   Alice and Suzan in their budget for a party decided not to spend more than Shs. 150,000. If Alice spent Shs. 25,000 more than one -fourth of what Suzan spent, form an inequality and solve it to find the maximum amount Suzan spent.

282.   Determine the solution set of the inequality $x^2 - 5x - 14 < 0$.

283.   Express $19 < 3(x + 2) < 35$ in the form $a \leq x \leq b$.

284.   Solve the inequality and show the solution on a number line $-8 < ¾\,x - 2 \leq x - 3$

285.   Solve the inequality: $1 - (4 - 2x) \leq 3x - 2$. Hence represent its solution on a number line.

286.   Express the inequality $2x - 5 \leq 7 - x \leq 13 + 5x$ in the form $p \leq x \leq q$ where p and q are integers.

287.   Solve: $3x - 2 \leq 10 + x \leq 2x + 5x$. Hence represent its solution on a number line.

288.   Determine the inequality that defines the unshaded region in the **figure(a)** below.

FIG .(a)
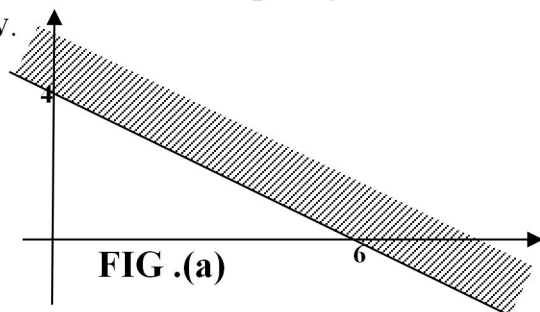
289.   A businessman wants to manufacture plastics. There are two types of machines that can make plastics buckets; type A and type B. Type A makes 120 buckets a day and occupies $20m^2$ of space and is operated by 5 men. Type B makes 80 buckets a day and occupies $24m^2$ of space and its operated by 3 men. The man has $200m^2$ of space and 40 men available.
(a) If x and y represent types A and B of the machines, write the inequalities that represent these information.
(b) Represent these inequalities on a graph.

(c) Determine the number of machines of each type the man needs so as to make as many buckets as he can a day.
(d) Find what his daily profit would be if the profit per bucket from types A and B machines were shs. 250 and 300 respectively.

290.   The manager of a cinema wishes to divide the seats available into two classes A and B. There are not more than 120 seats available. There must be at least twice as many B class as there are A class seats. Class A seats are priced at 1500 shs each and class B at 1000 shs each. At least 100,000/= should be collected at each show to meet the expenses. Taking x as the number of class A seats sold and y as the number of class B seats sold, write down the inequalities representing the above information and plot them on a graph.
From the graph;
(a) (i) Find the number of seats of each kind which must be sold to give the maximum profit
(ii) state the maximum profit.
(b) Find the least number of seats that must be sold in order to incur no loss.

291.   A factory makes two types of products A and B. The production cost of each bag of A is Sh.18,000 and that of B is Sh.24,000. It was agreed from the production unit that the number of bags of B should not exceed that twice the number of bags of A. The manager agreed that at least three bags of B are to be produced to meet the demand. Sh.300,000 is available for production of the two products. Given that X and Y are the number of bags of A and B respectively,
(a) Write down all the inequalities for the above information.
(b) Graph the inequalities.
(c) If the firm makes a profit of Sh.25,000 and 30,000 per bag of product A and B respectively, find the number of bags of each type that should be manufactured to obtain maximum profits. Hence find the maximum profits made.

292.   A shopkeeper who deals in electronics buys radios and TV sets. He can buy at most 30 of both items. On average, a radio and a TV set cost 4,000/= and 12,000/= respectively. The number of TV sets should be at most twice the number of radios. He must buy more than five TV sets.
(a)   Form all inequalities to represent the above information and graph them.
(b)   If the shopkeeper makes a profit of 600/= and 1,000/= per radio and TV respectively, find the maximum profit he makes.

293.   A school intends to transport 900 students to a field trip using a school bus and van. The bus can carry a maximum of 60 students while a van can carry a maximum of 45 students. The van has to make more than twice the number of

trips made by the bus. The total number of trips has to be less than 20. The cost per trip is shs. 100,000 and shs. 80,000 per bus and a van respectively.

(a)   Taking x and y to represent the number of trips by a bus and a van respectively. Write down five inequalities representing above information.

(b)   Use a scale of 4cm: 5 units on both axes. Graph these inequalities and shade out the unwanted regions.

(c)   List down all the possible trips made by the vehicles.

(d)   Determine the maximum expenditure incurred by the school.

294.   An auto spare dealer sells two types of lubricants A and B under the following conditions:

- He purchases type A at $ 40 per 100ml tin and type B at $ 60 per 100 ml tin.
- He also decides to buy at least 30 tins altogether of type A and B.
- He has $ 3000 available.
- He decides that at least one third of the tins should be of type B and at least half of the tins should be of type A.
- He makes a profit of $ 10 on each type A tin and a profit of $ 20 on each type B tin

If he buys x tins of type A and y tins of type B.

(a) Write down four inequalities, which represent the above information.

(b) On a graph paper, draw a graph to show the 4 inequalities in (a) above.

(c) Determine how many tins of each type that he should buy to maximize his profit.

SIMILARITY AND ENLARGEMENT

295.   Two similar cans are of volumes 911.25cm^3 and 2160cm^3. If the surface area of the larger can is 864cm^2, find the surface area of the smaller can.

296.   In a triangle ABC, M and N are points on AB and AC such that $AM : MB = AN : NC = 1 : 3$ MN is parallel to BC. If the area of triangle AMN is 8cm^2, calculate the area of triangle ABC.
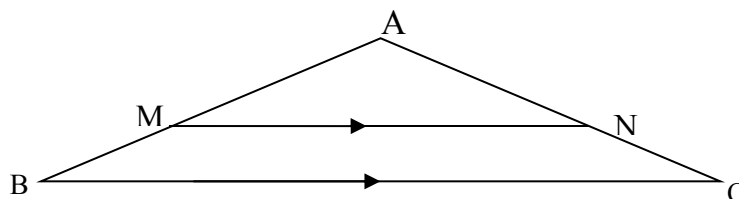
297.   Two similar cuboids A and B have heights of 40 cm and 80 cm respectively. Given that the volume of cuboid B is 500 cm^2.find the volume of cuboid A.

298.   Two similar flasks are of capacities 1.2litres and 9.6 litres .Calculate the height of   the smaller flask if the height of the bigger flask is 12cm.

299. A container has volume of 6400cm³ and surface area of 8000cm². Find the surface area of a similar container which has a volume of 2700cm³.

300. The area of a large rectangle is 100cm²and that of the smaller rectangle is 25cm²find the length of a larger rectangle if that of the smaller one is 4cm

301. Find the height of cone if a similar small cone has a height of 4cm and given the area scale is 16

302. Six men can cultivate an area of 280 m² in 2 hours. What area would 5 men cultivate in 3 hours working at the same rate?

303. (a)   Two cylinders of surface areas 180cm² and 160cm² are similar. If the volume of the
    bigger cylinder is 864cm³, calculate the volume of the smaller cylinder.
   (b)   A container made up of a metal sheet is in form of a frustrum of a cone of height 30cm with radii of its lower and upper ends as 7cm and 14cm respectively. Find the cost of milk which can completely fill the container at a rate of Shs.1,200 per litre.

304.   A container has a volume of 34,300cm³ and surface area of 49,000cm² find the Surface area of a similar container which has a volume of 12,500 cm³

305. Two similar conical flasks have heights of 32.4cm and 97.2cm. If the volume of the small flask is 3016cm³, find the volume of the big flask.

306. In the diagram (**fig (a)**) the points D and E are such that $\dfrac{AD}{DB} = \dfrac{AE}{EC} = \dfrac{1}{2}$.

Given that the area of $\triangle ABC = 45cm^2$, find the area of BDEC.

         fig(a)

                                                              fig(b)
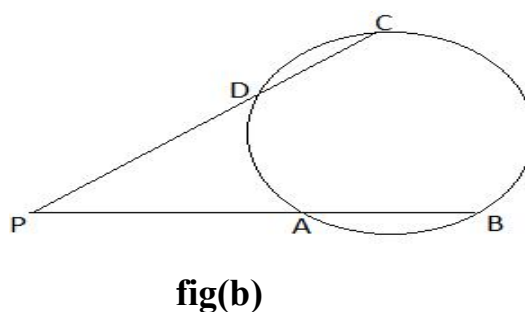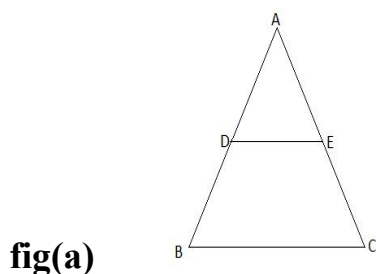
   In the figure (**b**) above $\overline{AB} = 156mm, \overline{CD} = 96mm$ and $\overline{PA}$ *is* $12mm$ shorter than $\overline{PD}$. Find the length $\overline{PA}$

307.   In the figure below, $\overline{\mathbf{PQ}}$ is parallel to $\overline{\mathbf{BC}}$. $\overline{\mathbf{AP}}$: $\overline{\mathbf{PB}} =$ 3 : 4 and $\overline{\mathbf{PQ}} =$ 4.5 cm. Calculate the length of $\overline{\mathbf{BC}}$.
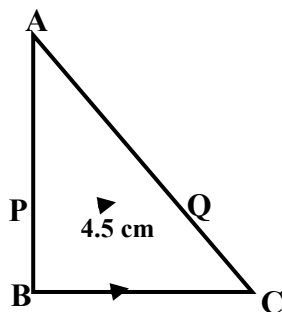
3 – DIMENSIONAL GEOMETRY

308. A right pyramid has a regular square base with each side measuring 5cm and each slanting edge is 13cm
   Find

   (i)   the height of the pyramid
   (ii)   the angle which a slanting edge makes with the base.
   (iii)   The volume of the pyramid.

309.   ABCDEFGH is a cuboid in which AB = 9cm, AD = 12cm, CF = 8cm and M is a point on

GF such that GM: ME = 1:3.
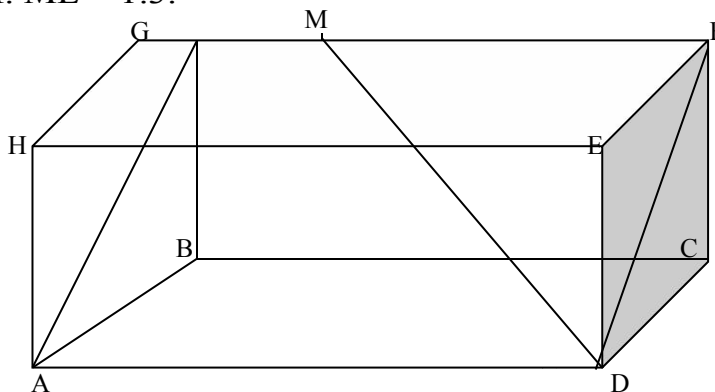
   (a) Calculate the lengths: (i) $\overline{AF}$, (ii) $\overline{MD}$.

   (b) Find the angle between (i) $\overline{AF}$ and the base. (ii) planes EFGH and AGFD.

310.   VABCD is a right pyramid with a rectangular base. Given that AB = 48cm, BC = 36cm and each slant edge is 50cm long.

(a) Calculate the height of the pyramid.
(b) the angle a slanting edge makes with the base.
(c) the angle plane BCV makes with the base.
(d) the angle between planes BCV and ADV
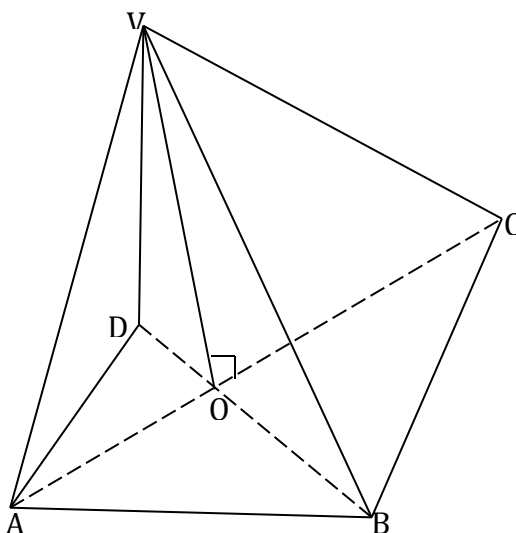
311.   The figure shows a rectangular box measuring 9cm x 8cm x 12
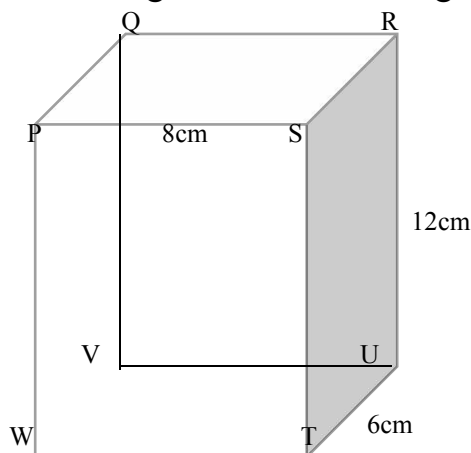
   Calculate (i) PR and PU
      (ii) the angle between PU and plane RST
      (iii) the angle between RW and plane UVWT.
312.   The figure below shows a cuboid measuring 18cm x 12cm x 12cm.
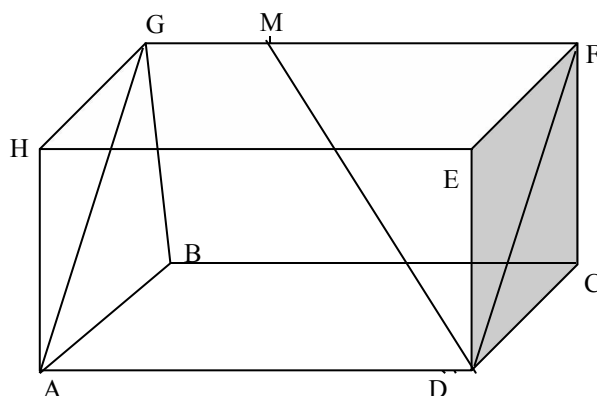
Given that M is the midpoint of GF

Calculate (a) AR

(b) the angle AR makes with plane PADT

(c) the angle between planes PQCD and ABCD

313.   The figure below shows aright pyramid with a square base of side 8m with each slanting 12m long.
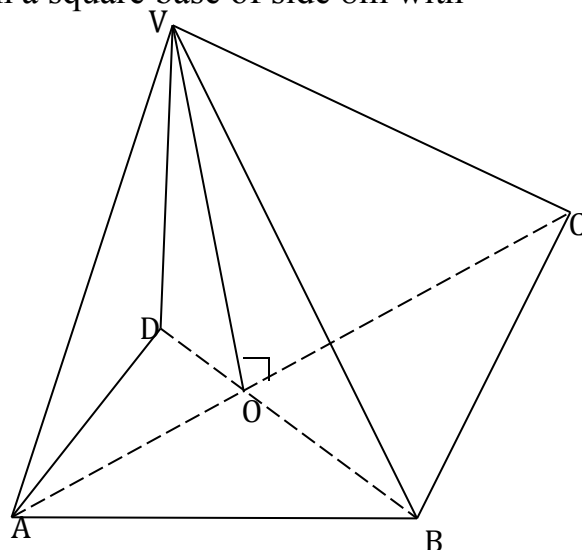
Calculate: (a) the height of the pyramid

(b) the angle between:

(i) AV and the base.

(ii) planes VBC and the base.

(c) the volume of the pyramid.

(d) the angle between planes PQM and the base

314.   Given VABC is angle pyramid with60^0 and the centre.

AB = 10cm , AD = 8cm and VC = 14cm.

(i)   Find the length of V above the base.

(ii)   Find the angle between VB and ABCD

(iii)   Find the angle between VAB and ABCD.

(iv)   Find the volume of the pyramid.
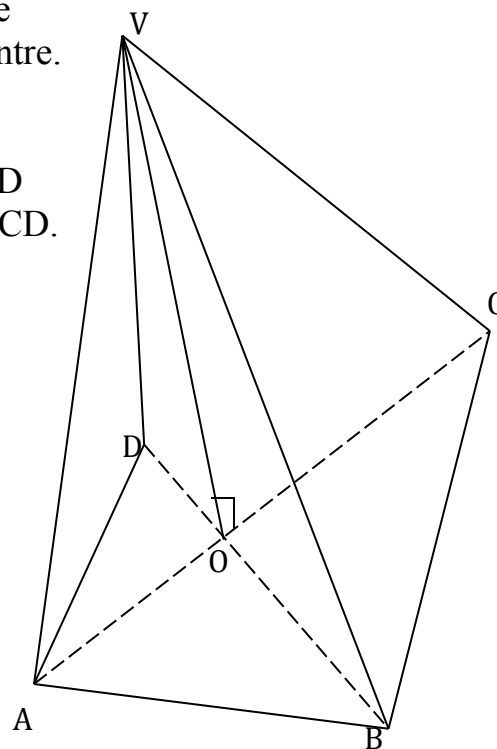
315.   The diagram below shows a cuboid PQRSTUVW, where PQ = 10cm, RQ = 8cm and QV = 12cm. X is the mid point of PS.
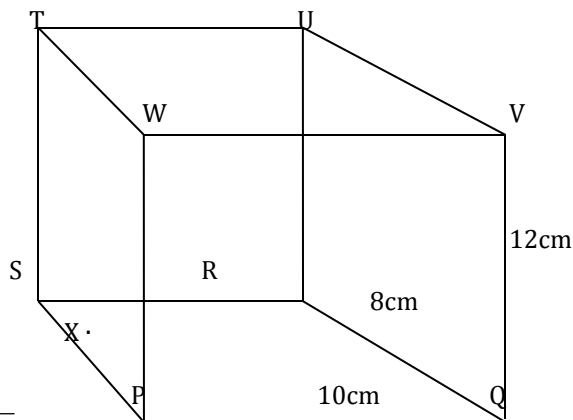
Calculate.:
(a) lengths $\overline{PU}$ and $\overline{XU}$
(b)   the angle between RU and the base.
(c) angle between the planes XUV and TWVU
(d)   the Volume of the cuboid in litres.

316.   ABCDEFGH is a cuboid in which $\overline{AB} = 8\ cm, \overline{BC} = \overline{GC} = 5\ cm$
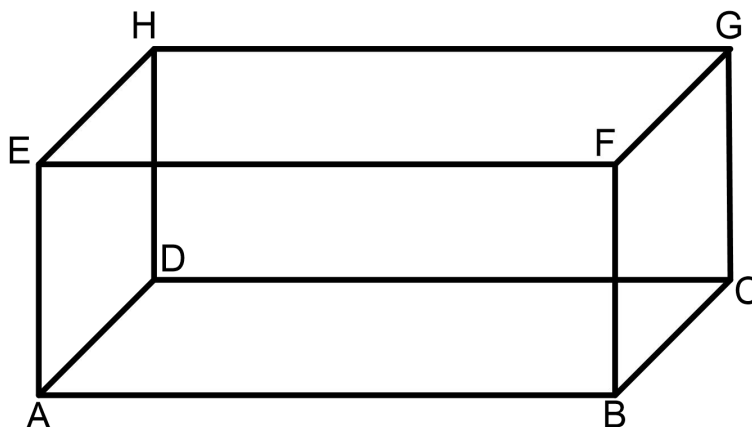
Find:
        (i).   lengths $\overline{BE}$ and $\overline{GB}$.
        (ii).   the angle between EB and plane BCGF.
        (iii).   the angle between planes EBG and BCGF.

317.   The figure below shows a net of a pyramid.
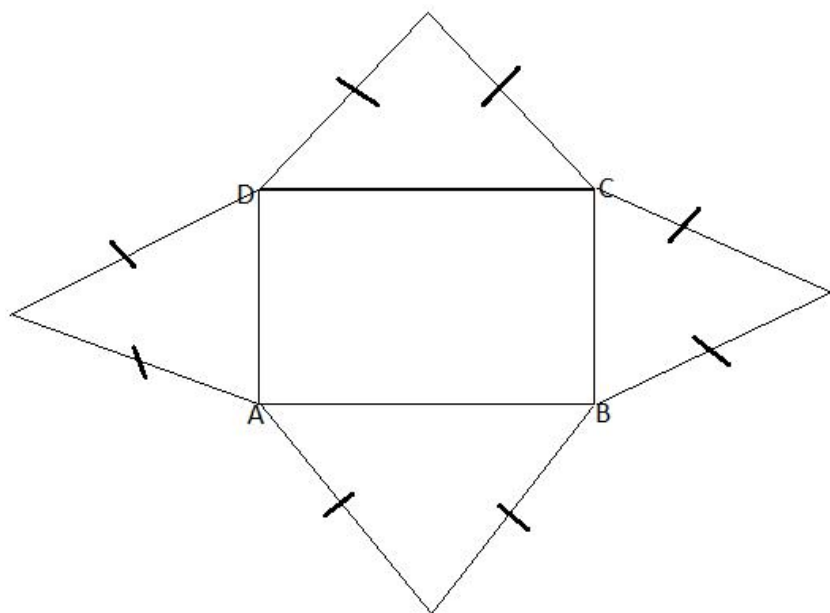
If V is the vertex of the pyramid VABCD with a rectangular base ABCD and triangles of slant sides $26\ cm$ with $AB = 16\ cm$ and $BC = 12\ cm$.

a) Draw a right pyramid showing clearly points VABCD, find the height of the pyramid.
b) Find the area of VAB.
c) Find the angle between:
   i) Edge VA and the base.
   ii) Face VAB and the base.

MENSURATION(AREAS AND VOLUMES OF SOLIDS)

318. A lamp shade BCNM is made by cutting away cone ABC from cone AMN., **AY** = 6cm   , **AX** = 18cm   and **XN** = 9cm

Calculate: (a)   (i) $\overline{CY}$
                         (ii) $\overline{AC}$
                         (iii) $\overline{AM}$
             (b)   the volume of the lampshade BCNM.
             (c)   the external surface area of the lampshade
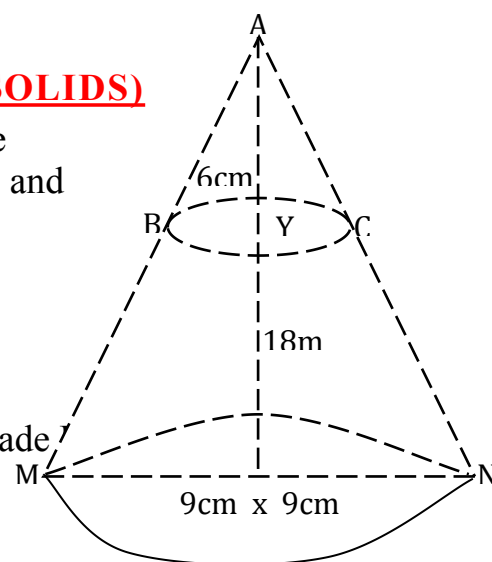
319. The diagram below fig (Q) shows a square ABCD of side $x$cm. A circle of diameter $x$cm has been cut off from the square.

fig (Q)   **fig.(R)**
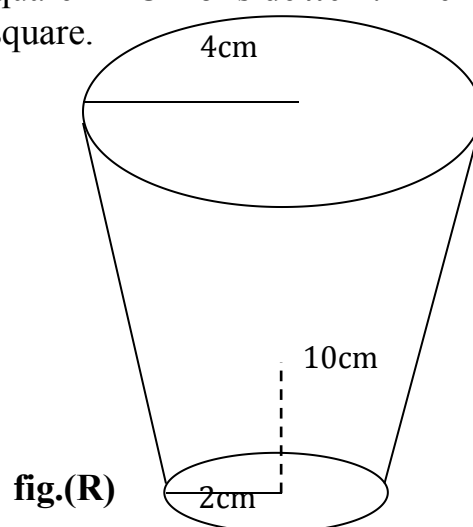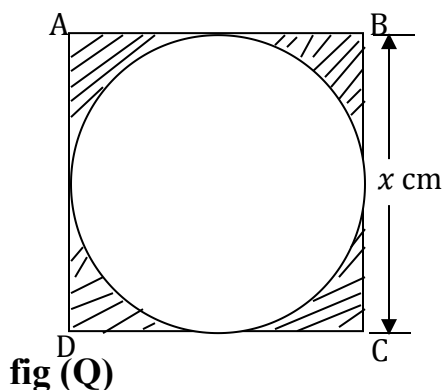
   (a) Show that the area of the shaded region is $\left(\frac{3x^2}{14}\right)$

   (b) Given that the area of the shaded region is 42cm², calculate the value of x and hence find:
     (i) The perimeter of the square.
     (ii) The perimeter of the circle.
     (iii) The perimeter of the remaining portion of the square.

320. In figure (R) above is a plastic pail with a base radius of 2cm , height of 10cm and top radius of 4cm.
   (a) Calculate the area of the curved surface of the pail.
   (b) Calculate the capacity of the pail in litres.

321. In fig.(a) below shows a metal solid consisting of a cone mounted on a hemisphere. The height of the cone is twice the radius. If the volume of the solid is 36cm³ , find the radius of the hemisphere.
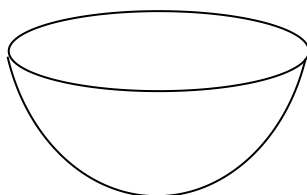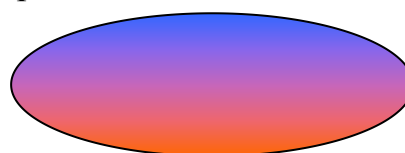
     Fig. a   **Fig. b**

322. In figure (b) above shows a cube of side 30cm. A mortice is cut inform of a cone.

    Find (i) the volume of the cut out piece.

         (ii) the surface area of the remaining piece.

323.   The figure below is a triangular tent with isosceles ends. Given that
    RW=WS=VU=VT= 5m,   RS = 8m and ST=12m.
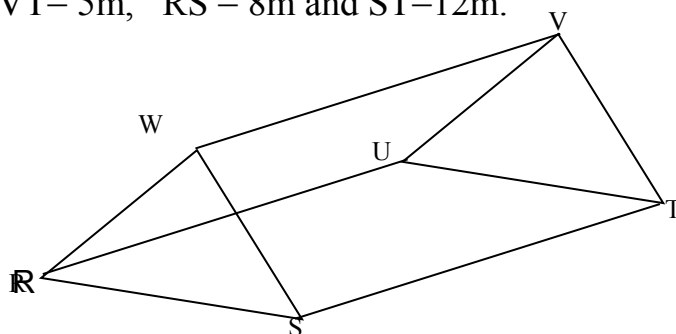
Calculate: (a) the volume of the tent.
            (b) the total surface area of the tent.
            (c) the cost of repainting this tent if a painter charge $sh.500\, per\; m^2$.
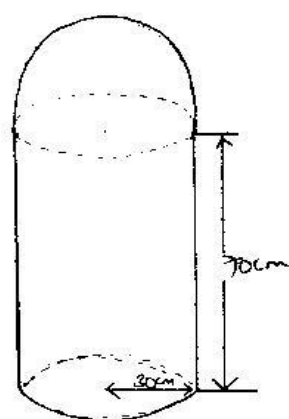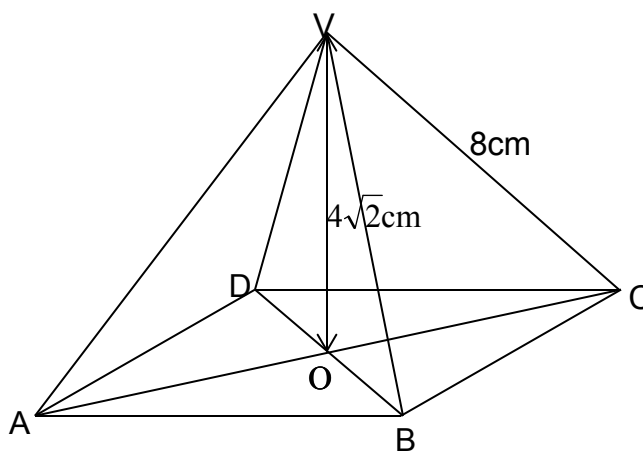
Fig. A   **Fig. B**

324.   In Figure **(A)** above shows a hot water tank made by joining a hemisphere
    of radius 30cm to an open cylinder of height 70cm.
    (a)   Calculate the total surface area of the tank.
    (b)   The tank is full of water
            (i)   Calculate the capacity of the tank in litres
            (ii)   The water drains from the tank at a rate of 3 litres per second.
                    Calculate the time, in minutes taken to empty the tank.
    $(surface\; area\; of\; a\; sphere = 4\pi r^2,\; volume\; of\; a\; sphere\; \frac{4}{3}\pi r^3)$

325.   The figure **B above** is a right pyramid with a square base ABCD, height
    $4\sqrt{2}$cm and each slanting edge of length 8cm. Calculate (i) $\overline{AB}$ (ii) the angle
    between $\overline{BV}$ and the base. (iii) the angle between plane VAB and the base .hence
    the total surface area and volume of the pyramid.

326.   The volume of a cone of height 1.0 cm is the same as that of a hemisphere of
    radius 8cm. Find the radius of the cone.

327. Determine the radius of a circle which passes through all the four vertices of a rectangle of sides 7cm and 24cm.

328.
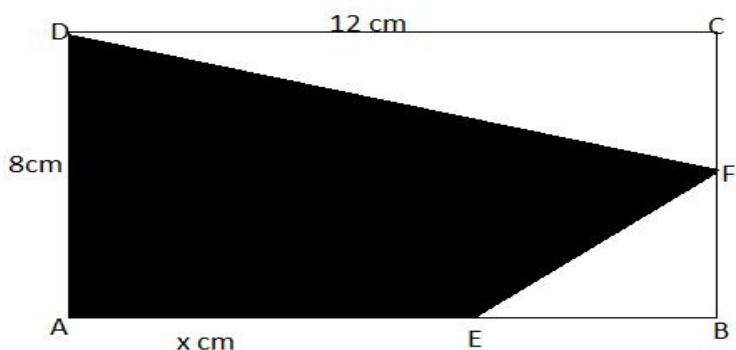
 In the figure above, ABCD is a rectangle 8cm by 12cm. $\overline{AE} = \overline{BF} = xcm.$

(a)   Find an expression for the shaded area in terms of x.

(b)   If the shaded area is 66cm², find the value of x.

(c)   Find the perimeter of the shaded polygon correct to 4significant figures.

329. The figure below is a net of a cone from a sector of radius $15\ cm$. Given that the arc $\overline{AA'}$ is of length $56.57\ cm$, find the height of the cone formed out of it.
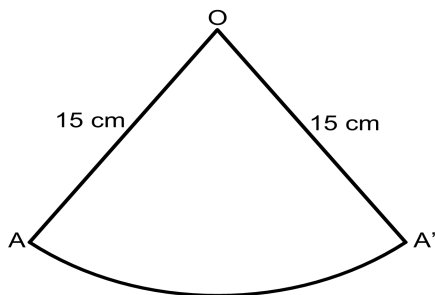
330.
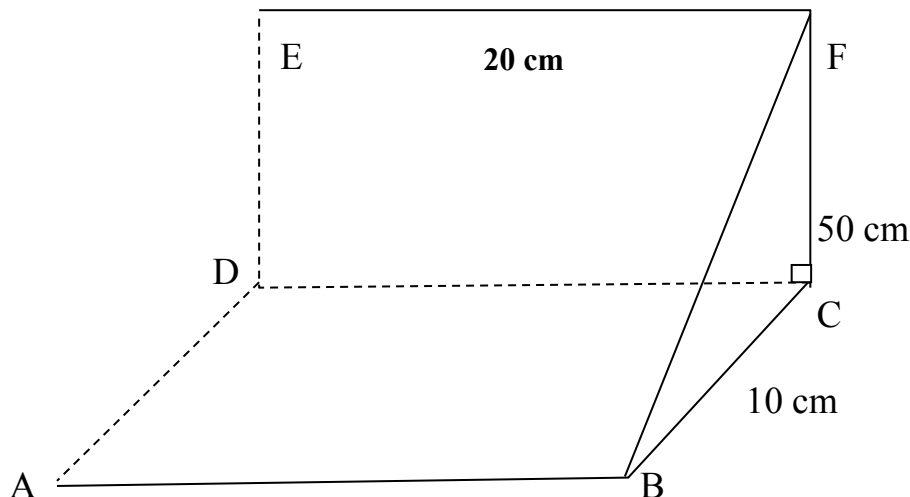
The figure shows a wedge with a rectangular base ABCD and a vertical rectangular face DCFE with EF = 20cm, BC = 10cm and FC = 50cm

    (a) Find lengths (i)   BF   (ii) AF

    (b) Calculate: (i) the angle between AF and plane ABCD

        (ii) the angle between planes ABCD and ABFE

        (iii) the volume of the wedge

CIRCLE PROPERTIES

331.   Points A, B, C, D and E lie on the circumference of a circle with centre O. as in fig (a) below. Find x and y.
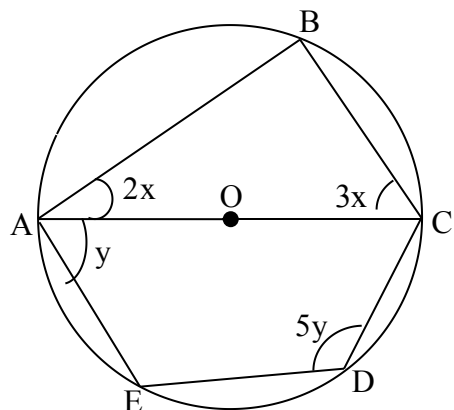
332.   The figure below shows two intersecting sectors from two circles of radii 5cm and 3cm with Centers A and O respectively. Given that $\angle BAC = 60^0$ Calculate (i) the area of sector BPCA (ii) length of arc BQC

        (ii) angle BOC

        (iii)he of the unshaded region
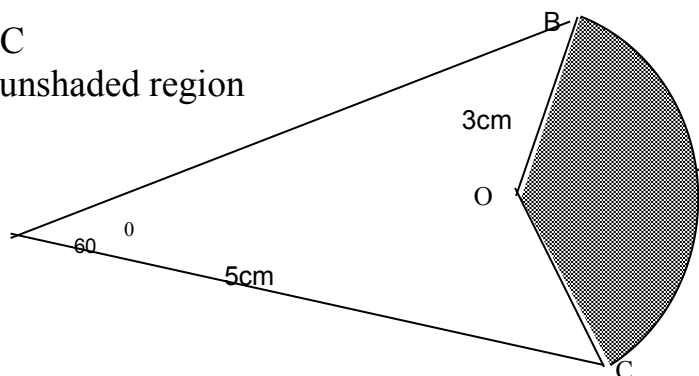
333. In the figure below MP and MQ are tangents to the circle at points P and Q respectively. O is the Centre of the circle and MP = MQ = PQ = 17cm and NPQX is a rectangle.
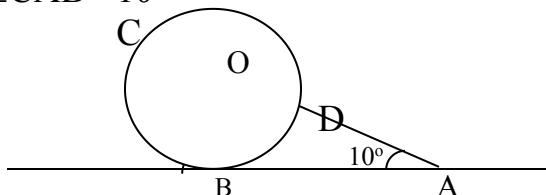
Find: (i) the obtuse angle POQ.
    (ii) the radius of the circle.
     (iii) the area of the minor sector POQ.
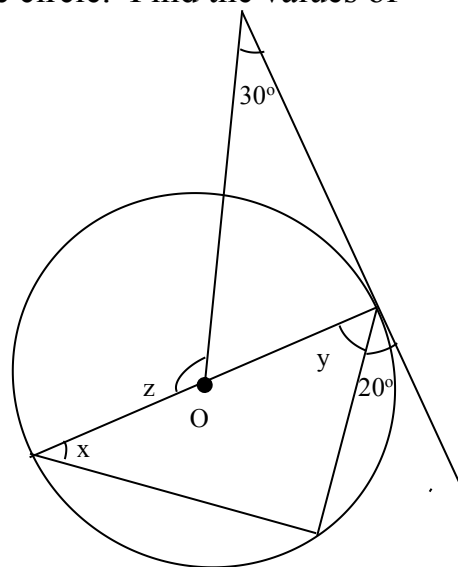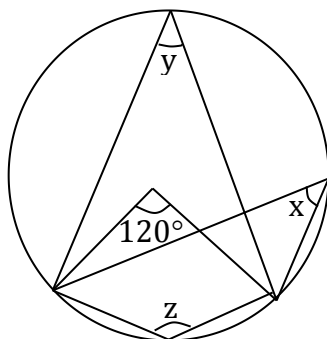   iv) the area of the shaded region
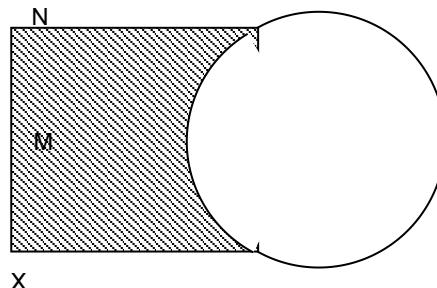
334. Given that AB is the longest chord, BC is a tangent to the circle and $\langle BCA = 70^O$. Find the values of x and y.
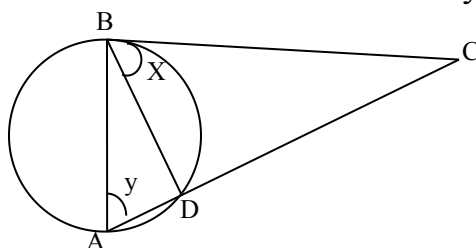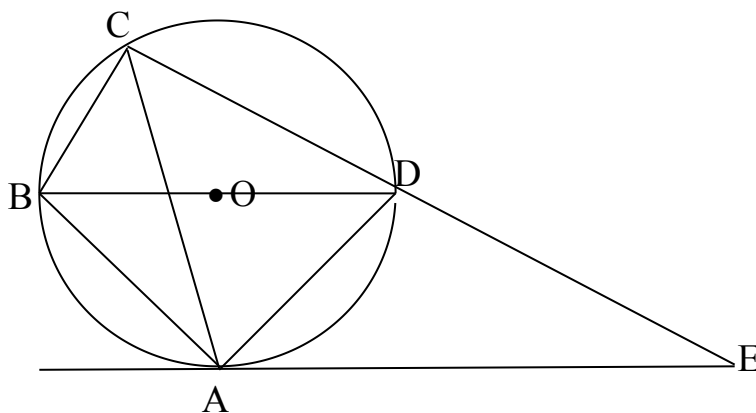
335. AB is a tangent to the circle at B, and O is the centre of the given circle. Find angle x if $\angle CAB = 10^o$

336.   In the figure, O is the centre of the circle. Find the values of
        x, y and z.

337.   In the figure below, line BD is the diameter of the circle, centre O and AE is
    a tangent. $\angle CBA = 110^{\circ}$ $\angle BAC = 26^{\circ}$
    Find; a) $\angle CDA$ b) $\angle ABD$ c) $\angle AED$

338. Find the length of the chord that subtends an angle of 50^0 at the Centre of circle of radius 20cm

339. A circle has a radius of 13cm, calculate the length of the chord which is 5cm away from the Centre of the circle.

P456/1: MATHEMATICS PAPER ONE TOPICS

1. Algebra

(a) Factorization

(b) Evaluation

(c) Simplification

(d) Word problems

2. Equations and inequalities

(a) Linear equations and variables

(b) Simultaneous equations

(c) Quadratic equations

(d) Graphic methods of solving equations

3. Linear programming

(a) Graphs

(b) Regions

(c) Maximizing and minimizing

4. Matrices

(a) Operations

(b) Determinant

(c) Inverse

(d) Systems and equations

(e) Word problems

5. 2- Dimensional geometry

(a) Closed figures

(b) Construction

(c) Trigonometry

(d) Circles and angle properties

(e) Bearings

(f) Mesuration

6. Transformation geometry

(a) Transformation

(b) The unit square

(c) Combination

(d) Symmetry

7. Statistics and probability

(a) Data presentation

(b) Measures of central tendency (mean,

mode, median)

(c) Probability

(d) Tree diagrams

P456/2: MATHEMATICS PAPER TWO TOPICS

1. Numerical concepts

(a) LCM, HCF

(b) Fractions, Estimates

(c) Indices and Logarithms

(d) Surds

(e) Ratios and proportions

(f) Percentages

2. Functions

(a) Relations and Mappings

(b) Domains and ranges

(c) Composite functions

(d) Arrow diagrams

(e) Papy-gram

3. Sets

(a) Intersection

(b) Complement

(c) Union

(d) Venn- diagrams

4. Graphs

(a) Cartesian equations

(b) Kinematics

(c) Co-ordinates

5. Vectors

(a) Vector notation

(b) Parallel vectors

(c) Magnitude of vectors

(d) Collinear vectors

6. 3- Dimensional geometry

(a) Mesuration

(b) Lines and planes

(c) Tetrahedron, pyramid, rectangular

prism, cone, sphere etc

(d) Nets

7. Business mathematics

(a) Currency and exchange rates

(b) Taxation

(c) Interest rates

(d) Discount

(e) Hire purchase

(f) Profit, loss and commission

"THERE'S NO LIMIT TO YOUR SUCCESS''   **END**