

MECS CLUSTER JOINT EXAMINATION
 Form Four End of Term One Examination 2020
121/1
MATHEMATICS
Paper 1
2½ Hours

SECTION A (50 MARKS) ANSWER ALL QUESTIONS IN THIS SECTION

1. Evaluate without using tables or a calculator. $\frac{2}{3}$ of $(1\frac{1}{2} + \frac{3}{4}) - \frac{1}{4} \times \frac{1}{8} \div \frac{1}{16}$ (3 marks)
 $\frac{4}{5}(3\frac{1}{4} - 1\frac{3}{8}) \div (2\frac{1}{2} \div 5\frac{1}{3})$

2. Use logarithms to evaluate $\frac{16.49^2 \times \sqrt{0.6318}}{327.5}$ (4 marks)

3. A Kenyan bank buys and sells foreign currencies as shown below.

| | Buying (Ksh) | Selling (Ksh) |
|----------------------|--------------|---------------|
| 1 Hong Kong Dollar | 9.74 | 12.03 |
| 1 South African Rand | 9.77 | 12.11 |

A tourist arrived in Kenya with 105,000 Hong Kong Dollars and changed the whole amount to Kenya Shillings. While in Kenya he spent Ksh 403,879 and changed the balance to South African Rand before leaving for South Africa. Calculate the amount he received. (4 marks)

4. Without using mathematical tables or a calculator evaluate. $\frac{\sqrt[3]{675 \times 135}}{\sqrt{2025}}$ (2 marks)

5. The size of an interior angle of a regular polygon is $3x^\circ$ while its exterior angle is $(2x - 20)^\circ$. Find the number of sides of the polygon. (3 marks)

6. Use tables of squares, square roots and reciprocals to evaluate to 3 decimal places.
 $3.045^2 + \frac{1}{\sqrt{49.24}}$ (3Marks)

7. Find the quadratic equation whose roots are $-\frac{1}{2}$ and 3 (3 Marks)

8. Solve the simultaneous inequality below and represent the combined solution of a number line.
 $2x - 5 \leq 10 - 3x < x + 18$ (3Marks)

9. Given that $\cos(x - 20)^\circ = \sin(2x + 32)^\circ$ and x is an acute angle. Find $\tan(x - 4)$ (3 marks)

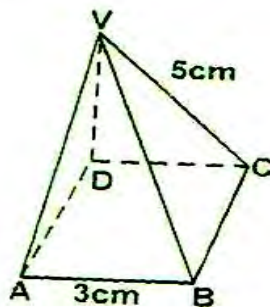
10. Two similar containers have masses 256kgs and 128kgs respectively. If the surface of the smaller container has an area of 810cm^2 . Find the surface area of the larger container. (3 marks)

11. A truck left Nairobi at 7a.m for Nakuru at an average speed of 60km/hr. At 8 a.m a bus left Nakuru for Nairobi at an average speed of 120km/hr. How far from Nairobi did the vehicles meet if Nairobi is 160 km from Nakuru. (3 marks)

12. Using a ruler and a pair of compasses only, draw a line $AB = 7\text{cm}$ long. Construct $\angle BAC = 67.5^\circ$. Use line AC to divide AB into 3 equal parts. (2 marks)

13. Given the vectors $\mathbf{a} = \begin{bmatrix} 3 \\ -2 \end{bmatrix}$, $\mathbf{b} = \begin{bmatrix} -1 \\ 2 \end{bmatrix}$ and $\mathbf{c} = \begin{bmatrix} -4 \\ 2 \end{bmatrix}$ find $|3\mathbf{a} - 4\mathbf{b} + \frac{1}{2}\mathbf{c}|$ giving your answer to 4 significant figures. (3 marks)

14. The figure below shows a right pyramid with square base of side 3cm and a slant edge of 5cm. Draw its net. (3 Marks)



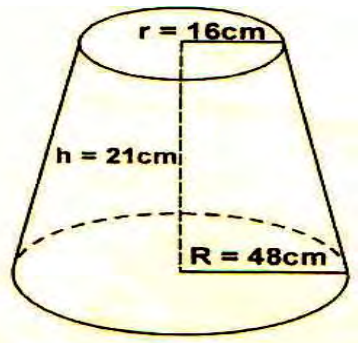
15. Express 1.441441..... in the form $\frac{p}{q}$ where p and q are integers. ($q \neq 0$) (3mks)

16. Find the smallest number which leaves a remainder of 11 when divided by 12 or 18 or 30 (3marks)

SECTION B (50 MARKS)

ATTEMPT FIVE QUESTIONS ONLY IN THIS SECTION

17. The figure below a frustum of a solid cone of base radius 48cm and top radius 16cm. The height of the frustum is 21cm. (Take $\pi = \frac{22}{7}$) calculate:



- (a) The height of the original solid cone. (2 Marks)
- (b) The volume of the solid frustum. (3 Marks)
- (c) The total surface area of the frustum. (5 Marks)

18. The following are masses of 25 people taken in a clinic.

| | | | | |
|----|----|----|----|----|
| 20 | 35 | 29 | 45 | 60 |
| 66 | 56 | 29 | 48 | 37 |
| 59 | 64 | 24 | 28 | 32 |
| 35 | 45 | 48 | 52 | 55 |
| 54 | 55 | 36 | 39 | 35 |

- (a) Using a class width of 8 and starting with the lowest mass of the people. Make a frequency distribution table for the data. (3 Marks)
- (b) Calculate the median mass of the people. (3 Marks)
- (c) On the grid provided, draw a histogram to represent the information. (4 Marks)

19. A straight line passes through the points (8, -2) and (4, -4)

- (a) Write its equation in the form $ax + by + c = 0$ where a, b and c are integers. (3 Marks)
- (b) If the line in (a) above cuts the x-axis at point P, determine the coordinates of P. (2 Marks)
- (c) Another line which is perpendicular to the line in (a) above passes through point P and cuts the y-axis at the point Q. Determine the coordinates of point Q. (3 Marks)
- (d) Find the length of QP (2 Marks)

20. Three towns X, Y and Z are such that X is on a bearing of 120° and 20 km from Y. Town Z is on a bearing of 220° and 12km from X.

- a) Using a scale of 1cm to represent 2km, show the relative position of the places. (3 marks)
- b) Find;
 - i) The distance between Y and Z (2 marks)
 - ii) The bearing of X from Z (1 mark)
 - iii) The bearing of Z from Y. (1 mark)
 - iv) The area of the figure bounded by XYZ. (3 marks)

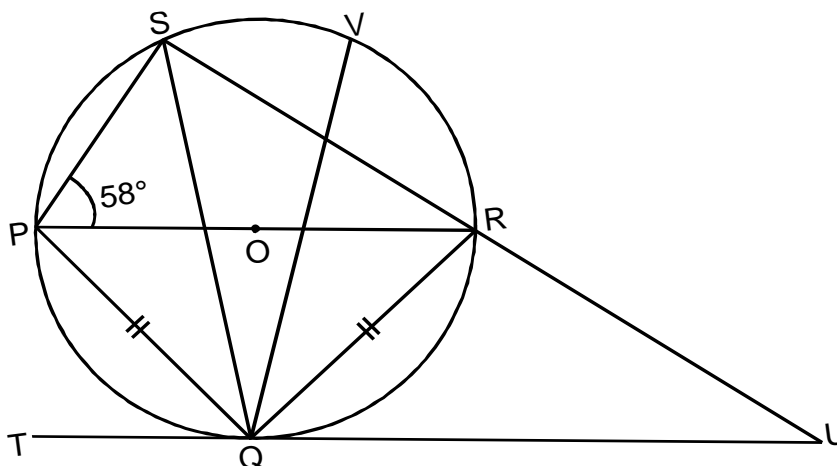
21. a) A rectangular tank of base 2.4m by 2.8m and a height of 3m contains 3600litres of water initially. Water flows into the tank at the rate of 0.5litres per second. Calculate:

- i) The amount needed to fill the tank (2marks)
- ii) The time in hours and minutes required to fill the tank completely (3marks)
- b). Pipe A can fill the empty tank in 3hours while pipe B can fill the same tank in 6hours. When the tank is full, it can be emptied by pipe C in 8hours. Pipes A and B are opened at the same time when the tank is empty. If one hour later pipe C is also opened, find the total time taken to fill the tank. (5marks)

22. Three farmers Koech, Kipsang and Echesa decided to buy a plot valued at kshs 1, 300, 000. They raised kshs. 900,000 in the ratio 2:3:5. The balance was got as a loan from a bank at an interest of 15% p.a

- (a) Calculate the amount contributed by each of them. (3mks)
- (b) They cleared the loan from the bank after three years in the same ratio as their contribution. Calculate,
 - (i) The total amount repaid in the bank. (3mks)
 - (ii) The difference in amounts repaid by Kipsang and Echesa (2mks)
 - (iii) After the three years they sold the plot at a profit of 20%. Find the amount they received from the sale. (2mks)

23. In the figure below POR is the diameter of circle centre O, $PQ = QR$ and $\angle SPR = 58^\circ$. TQU is a tangent to the circle at Q. V is a point on the minor arc SR.



- (a) Calculate the size of the following angles giving reasons for your answer.
- (i) $\angle QPS$ (2 marks)
 - (ii) Reflex $\angle QOS$ (2 marks)
 - (iii) $\angle QVS$ (2 marks)
 - (iv) $\angle QVR$ (2 marks)
- (b) Given that $SR = 5\text{cm}$ and $RU = 4\text{cm}$ find UQ . (2 marks)

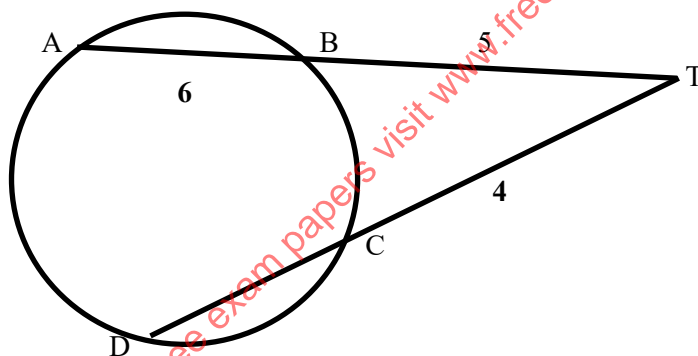
24. Triangle ABC has vertices A (1, 2), B (2, 3) and C (4, 1) while triangle $A^1B^1C^1$ has vertices A^1 (1, -2), B^1 (2, -3) and C^1 (4, -1).

- (a) Draw triangle ABC and $A^1B^1C^1$ on the same grid. (2 marks)
- (b) Describe fully a single transformation that maps triangle ABC onto triangle $A^1B^1C^1$. (2 marks)
- (c) On the same grid draw triangle $A^{11}B^{11}C^{11}$ the image of triangle ABC under a reflection in line $Y = -x$. (2 marks)
- (d) Draw $\Delta A^{111}B^{111}C^{111}$ such that it can be mapped onto triangle ABC by a negative quarter turn about the origin. (2 marks)

SECTION I 50 MARKS (ANSWER ALL QUESTIONS IN SECTION I)

- Make h the subject of the formula $n = \sqrt[3]{\frac{yx^2h}{m-h}}$ (3 marks)
- A quantity M is partly constant and partly varies as the cube root of N. If M = 24.5 when N = 64 and M = 18.5 when N = 27; Find the constants and determine equation connecting M and N. (4 marks)
- Solve for x given: (3 marks)

$$\log_{27}(x + 7) - \log_{27}(x - 1) = \frac{2}{3}$$
- In finding the area of a rectangle whose dimensions are 7.28 by 5.49, a student truncated the measurement to 1d.p. Find the percentage error arising from this. (3marks)
- Simplify $\frac{3\sqrt{2}}{\sqrt{5} - \sqrt{2}}$, leaving the answer in the form $a + b\sqrt{c}$, where a, b and c are rational numbers (3 marks)
- The cost of maize flour and millet flour is Kshs 44 and Kshs 56 respectively. Calculate the ratio in which they were mixed if a profit of 20% was made by selling the mixture at Kshs. 54. (3marks)
- In the figure below, chord AB and CD are produced to meet at T. AB = 6cm, BT=5cm and CT=4cm. Find the length of DT. (3marks)



- The equation of a circle is given by $4x^2 + 4y^2 + 12x - 16y - 11 = 0$. Determine the radius and the co-ordinates of the centre of the circle. (3 marks)
- State the amplitude, period and phase angle of $y = 2 \sin\left(\frac{1}{2}x + 30^\circ\right)$
 - The amplitude (1mk)
 - The period (1mk)
 - Phase angle (1mk)
- The points P, Q and R lie on a straight line. The position vectors of P and R are $2i + 2j + 3k$ and $5i - 3j + 4k$, respectively. Q divides PR internally in the ratio 2:1. Find the position vector of Q and its magnitude. (3mks)
- The cash price of a music system is Kshs. 30,000. It can be bought under hire purchase terms by paying a deposit of Kshs. 10,000- and twelve-monthly installments of Kshs. 3,200 per month. Determine the percentage rate of interest per month. (3 marks)
- (a) Expand $(1-2x)^6$ in ascending powers of x upto the term in x^3 (2mks)
(b) Hence evaluate $(1.02)^6$ to 4 d.p (2mks)
- Given that $P = \begin{pmatrix} 3 & -1 \\ 2 & 4 \end{pmatrix}$ and $Q = \begin{pmatrix} 4 & 1 \\ -2 & 3 \end{pmatrix}$. Find PQ, hence the point of intersection of the lines $4x+y=9$ and $3y=2x-1$ (3Marks)
- Simplify completely : (3Marks)

$$\frac{12x^2 - ax - 6a^2}{9x^2 - 4a^2}$$
- The distance s metres moved by a particle along a straight line after t seconds in motion is given by

$s = 7 + 8t^2 - 2t^3$. Find the velocity at $t = 2$ sec.

(3mks)

16. Under a transformation presented by the matrix $\begin{pmatrix} -1 & 4 \\ 1 & 3 \end{pmatrix}$, an object whose area is 21cm^2 is mapped onto an image. Find the area of the image (3Marks)

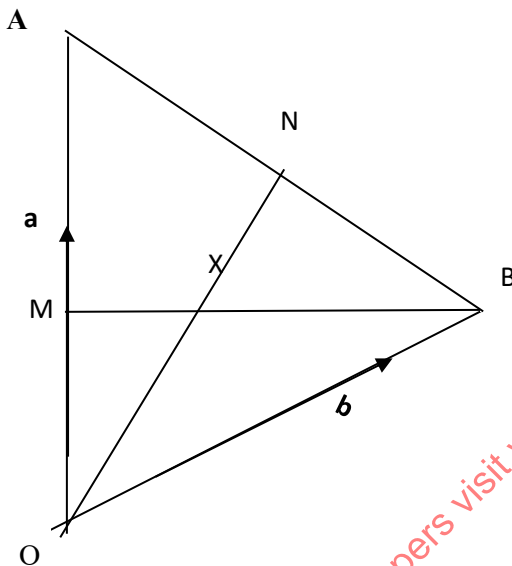
SECTION II (ANSWER ANY FIVE QUESTIONS FROM SECTION II 50 MKS)

17. The table below shows the distribution of ages in years of 50 adults who attended a clinic: -

| | | | | | | |
|-----------|-------|-------|-------|-------|-------|-------|
| Age | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | 71-80 |
| Frequency | 15 | 11 | 17 | 4 | 2 | 1 |

- (a) State the median class (1mark)
 (b) Using a working mean of 45.5, calculate: -
 (i) The mean age (3marks)
 (ii) The standard deviation (3marks)
 (iii) Calculate the 80th percentile. (3marks)

18. In the figure below $\mathbf{OA} = \mathbf{a}$ and $\mathbf{OB} = \mathbf{b}$, M is the mid-point of OA and $\mathbf{AN}:\mathbf{NB} = 2 : 1$.



- (a) Express in terms of \mathbf{a} and \mathbf{b} .
 (i) \mathbf{BA} (1 mark)
 (ii) \mathbf{BN} (1 mark)
 (iv) \mathbf{ON} (1 mark)
 (v) \mathbf{BM} (1 mark)
 (b) Given that $\mathbf{BX} = h\mathbf{BM}$ and $\mathbf{OX} = k\mathbf{ON}$, determine the values of h and k . (6 marks)

19. Triangle ABC is such that A (-5, 1), B(-1, 1) and C(-3, 4). Triangle A'B'C'.is the image of ΔABC under transformation $T = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$.

- (a) Determine the co-ordinates of $\Delta A'B'C'$. (2 marks)
 (b) On the grid provided draw ΔABC and $\Delta A'B'C'$. (2 marks)
 (c) Describe the transformation T fully. (1 mark)
 (d) $\Delta A''B''C''$ is a reflection of the $\Delta A'B'C'$ on the line $y = -x$. Construct $\Delta A''B''C''$. (3 marks)
 (e) Determine a single matrix that maps $\Delta A''B''C''$ onto ΔABC . (2 marks)

20. Two towns A (65°S , 35°E) and B (65°S , 145°W) are on the earth's surface. Two planes P and Q take off from A at the same time and at the same speed heading towards B. Plane P flies on the parallel of latitude while plane Q flies along the longitude. (Take radius of earth = 6360km , $\pi = \frac{22}{7}$)

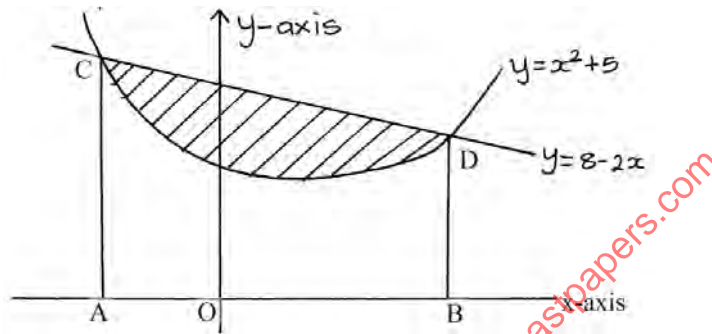
- a) Calculate the shortest distance between the two towns along the parallel of latitude. (3 marks)
 b) Calculate the shortest distance between the two towns along the longitude. (3 marks)
 c) Find the position of plane P when plane Q is landing at B. (4 marks)

21. (a) Complete the table below for the functions $y=\sin 2x$ and $y=2\cos(x+30)$ for $0 \leq x \leq 180$ 2 marks

| x | 0° | 15° | 30° | 45 | 60° | 75° | 90° | 105° | 120° | 135° | 150° | 165° | 180° |
|-----------------|-----------|------------|------------|------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| $Y=\sin 2x$ | 0.00 | | 0.87 | 1.00 | | | 0.00 | | | -1.00 | | -0.50 | |
| $Y=2\cos(x+30)$ | 1.73 | | | 0.52 | 0.00 | | | -1.41 | | -1.93 | | -1.93 | |

- b. On the grid provided draw the graphs of $y=\sin 2x$ and $y=2\cos(x+30^\circ)$ 5 marks for $0 \leq x \leq 180$
 c. State the amplitude and phase angle of the curve $y=2\cos(x+30)$ 2marks
 d. Use your graph in (b) above to solve the equation $\sin 2x-2\cos(x+30)=0$ 1mark

22. The diagram below, not drawn to scale shows part of the curve $y = x^2 + 5$ and the line $y = 8-2x$. The line intersects the curve at points C and D. Lines AC and BD are parallel to the y-axis.



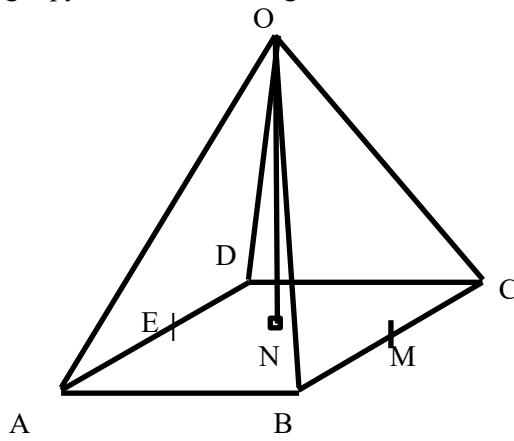
- (a) Determine the coordinates of C and D. (4marks)
 (b) Use integration to calculate the area bounded by the curve and the x-axis between the points C and D. (3marks)
 (c) Calculate the area enclosed by the lines CD, CA, BD and the x-axis. (2 marks)
 (d) Hence determine the area of the shaded region. (1 mark)

23. The probability of passing KCSE depends on performance in the school mock examination. If the candidate passes in mock, the probability of passing KCPE is $\frac{4}{5}$. If the candidate fails in mock, the probability of passing KCSE is $\frac{3}{5}$. If the candidate passes KCSE the probability of getting employed is $\frac{1}{3}$ otherwise the probability is $\frac{1}{5}$. The probability of passing the mock is $\frac{2}{3}$.

- a) Draw a well labeled tree diagram to represent the above information (2mks)
 b) Use the tree diagram in (a) above to find the probability that the candidate
 i. Passes KCSE exam (2mks)
 ii. Gets employed (2mks)
 iii. Passes KCSE and gets employed. (2mks)
 iv. Does not pass KCSE (2mks)

24. a) The first term of an arithmetic progression (AP) is 2. The sum of the first 8 terms of the AP is 156.
 i) Find the common difference of the AP (2mks)
 ii) Given that the sum of the first n terms of the AP is 416, find n (3mks)
 b). The 3rd, 5th and 8th terms of another AP form the first three terms of a Geometric Progression (GP). If the common difference of the AP is 3 find
 i) The first term of the GP (3mks)
 ii) The sum of the first 9 terms of the GP, to 4s.f (2mks)

25. OABCD is a right pyramid on a rectangular base with $AB=8\text{cm}$, $BC=6\text{cm}$, $OA=OB=OC=OD=13\text{cm}$



- | | | |
|------|--|---------|
| a. | The height of the pyramid | 3 marks |
| b. | State the projection of the line on the plane ABCD | 1 mark |
| c. | The angle between | |
| (i) | Plane OBC and plane ABCD | 2 marks |
| (ii) | Edge OB and the plane ABCD | 2 marks |
| (d) | The angle between edges OB and DC | 2 marks |

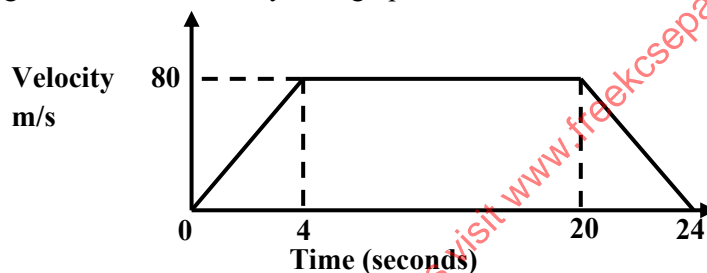
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- (a) Draw a labeled net of the pyramid. (2 Marks)
- (b) On the net drawn, measure the height of a triangular face from the top of the pyramid. (1 Mark)
11. A salesman is paid a salary of Sh. 10,000 per month. He is also paid a commission on sales above Sh. 100,000. In one month, he sold goods worth Sh. 500,000. If his total earning that month was Sh. 56,000. Calculate the rate of commission. (3 marks)
12. Solve the following inequality and state the integral solutions. (3 marks)
- $$\frac{1}{2}(24 - 4x) > 6(3x - \frac{4}{3}) \geq -\frac{2}{3}(42 + 3x)$$
13. A regular polygon is such that its exterior angle is one eighth the size of interior angle. Find the number of sides of the polygon. (3 marks)
14. The position vector of P is $\mathbf{OP} = 2\mathbf{i} - 3\mathbf{j}$ and M is the mid - point of PQ. Given $\mathbf{OM} = \mathbf{i} + 4\mathbf{j}$, Obtain the vector \mathbf{PQ} . (3 marks)
15. A liquid spray of mass 384 g is packed in a cylindrical container of internal radius 3.2 cm. Given that the density of the liquid is 0.6g/cm^3 , calculate to 2 decimal places the height of liquid in the container (3 marks)
16. Given that $\sin(2\theta + 30) = \cos(\theta - 60)$. Find the value of $\tan \theta$ to two decimal places. (2 marks)

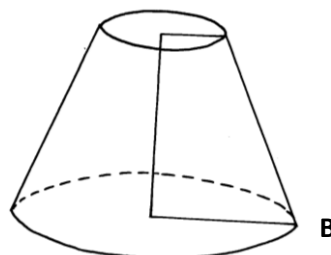
SECTION II (50 MARKS)

Answer any FIVE questions only in this section

17. Water flows through a circular pipe of cross-sectional area of 6.16cm^2 at a uniform speed of 10cm per second. At 6.00 a.m. water starts flowing through the pipe into an empty tank of base area 3m^2 .
- a) What will be the depth of the water at 8.30 a.m.? (5 marks)
- b) If the tank is 1.2m high and a hole at the bottom through which water leaks at a rate of 11.6cm^3 per second. Determine the time at which the tank will be filled. (5 marks)
18. (a) The figure below is a velocity time graph for a car.



- (i) Find the total distance travelled by the car. (2 marks)
- (ii) Calculate the deceleration of the car. (2 marks)
- (b) A car left Nairobi towards Eldoret at 7.12 a.m. at an average speed of 90km/h. At 8.22 a.m., a bus left Eldoret for Nairobi at an average speed of 72km/hr. The distance between the two towns is 348km. Calculate:
- i) the time when the two vehicles met. (4 marks)
- ii) the distance from Nairobi to the meeting place. (2 marks)
19. Using a ruler and a pair of compasses only.
- a) Construct a triangle ABC in which $AB=8\text{cm}$, $BC=7.5\text{ cm}$ and $\angle ABC = 112.5^\circ$. (3 marks)
- Measure length of AC. (1 mark)
- b) By shading the required region show the locus of P within triangle ABC such that
- i) $AP \leq BP$
- ii) $AP > 3$ (2 marks)
- c) Construct a normal line from C to meet AB at D. (1 mark)
- d) Locate the locus of R in the same diagram such that the area of the triangle ARB is $\frac{3}{4}$ area of triangle ABC. (3 marks)
20. The diagram below represents a solid consisting of a hemispherical bottom and a conical frustum at the top. $O_1O_2=4\text{cm}$, $O_2B=R=4.9\text{cm}$ $O_1A=r=2.1\text{cm}$



- a) Determine the height of the chopped off cone and hence the height of the bigger cone. (2 marks)
- b) Calculate the surface area of the solid. (4marks)
- c) Calculate the volume of the solid. (4marks)

21. a) Complete the table given below for the equation $y = -2x^2 + 3x + 3$ for the range $-2 \leq x \leq 3.5$ by filling in the blank spaces. (2 marks)

| | | | | | | | | | | | | |
|---|----|------|----|------|---|-----|---|-----|---|-----|---|-----|
| x | -2 | -1.5 | -1 | -0.5 | 0 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 3.5 |
| y | | -6 | | 1 | | | | | | -2 | | -11 |

- (b) Use the values from the table above to draw the graph of $y = -2x^2 + 3x + 3$. (3 marks)
- (c) Use your graph to:
 - (i) Determine the integral values of x in the graphs range which satisfy the inequality $2x^2 - 3x - 3 \geq 3$. (3 marks)
 - (ii) Solve $-2x^2 + 2x + 5 = 0$. (2 marks)

22. Triangle ABC has vertices A(3, 1), B(4, 4) and C(5, 2). The triangle is rotated through 90° about (1, 1) to give A'B'C'. Triangle A'B'C' is then reflected on the line $y - x = 0$ onto A''B''C''. triangle A''B''C'' then undergoes enlargement scale factor - 1 through the origin to give A'''B'''C'''.

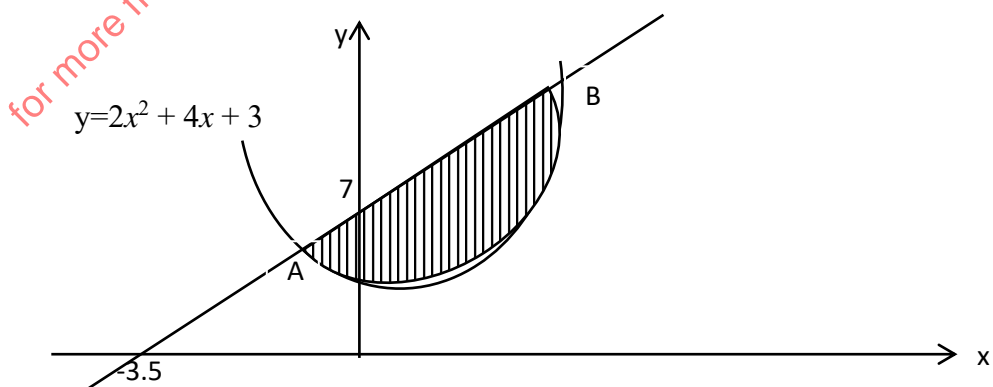
- (a) On the graph paper, draw triangles A'B'C', A''B''C'' and A'''B'''C''''. (8 marks)
- (b) Describe the type of congruence between:
 - i) ΔABC and $\Delta A'B'C'$
 - ii) $\Delta A'B'C'$ and $\Delta A''B''C''$ (2 marks)

23. The table below shows patients who attend a clinic in one week and were grouped by age as shown in the table below.

| | | | | | |
|--------------------|----------------|-----------------|------------------|------------------|------------------|
| Age x years | $0 \leq x < 5$ | $5 \leq x < 15$ | $15 \leq x < 25$ | $25 \leq x < 45$ | $45 \leq x < 75$ |
| Number of patients | 14 | 41 | 59 | 70 | 15 |

- (a) Estimate the mean age (4 marks)
- (b) On the grid provided draw a histogram to represent the distribution. (3 marks)
(Use the scales: 1cm to represent 5 units on the horizontal axis 2 cm to represent 5unit on the vertical axis)
- (c)
 - i) State the group in which the median mark lies (1 mark)
 - ii) A vertical line drawn through the median mark divides the total area of the histogram into two equals. Using this information estimate the median mark. (2 marks)

24. The figure below shows curve of $y=2x^2 + 4x + 3$ and a straight line intersecting the curves at A and B.



If the x - intercept is -3.5 and y - intercept as 7, find

- a) The Equation of the straight line. (2 marks)
- b) The coordinates of A and B. (4 marks)
- c) The area of the shaded region. (4 marks)

TRIAL 2 FORM FOUR COMMON EVALUATION TEST

Kenya Certificate of Secondary Education (K.C.S.E.)

121/2

MATHEMATICS

PAPER 2

TIME: 2½ HOURS

1. Simplify $(1 + \sqrt{2})(1 - \sqrt{2})$ (1 mk)
hence evaluate $\frac{1}{1 + \sqrt{2}}$ to 3 significant figure given that $\sqrt{2} = 1.4142$ (2 mks)
2. Mr. Ogingo Onur invested KSh. 100,000 at 11% simple interest for 3 years and KSh. 150,000 at x% simple interest for 3 years. If the total interest earned was KSh. 79,000, calculate the value of x. (3 mks)
3. Construct a circle centre P and radius 3cm, construct a tangent from point Q 7cm from the centre P to touch the circle at R. Measure the length of QR. (4 mks)
4. Matrix A is given by $\begin{pmatrix} p & 4 \\ -3 & q \end{pmatrix}$
(a) Determine A^2 (2 mks)
(b) If $A^2 = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$, determine the possible pairs of values of p and q (2 mks)
5. Find the range of values within which the difference of $3.492 - 2.141$ lies (3 mks)
6. Make x the subject of the formula in $a\sqrt{\frac{x^2 - m}{m}} = \frac{a^2}{b}$ (3 mks)
7. Three people Odago, Oronyi and Nyamohanga working together, take 30 min to do some work. Odago and Oronyi together would take 40 minutes, Odago and Nyamohanga together would take 45 minutes. How long would each take working alone. (3 mks)
8. In a transformation, an object with area 9cm^2 is mapped onto an image whose area is 54cm^2 , given that the matrix of transformation is $\begin{pmatrix} x & x - 1 \\ 2 & 4 \end{pmatrix}$ find the value of x. (3 mks)
9. Two variables m and n are such that m is directly proportional to x and n is inversely proportional to x. When $x = 2$ their sum is 8 and when $x = 3$ their sum is 7. Find the constants of proportionality. (4 mks)
10. Determine the quartile deviation for the following set of numbers (3 mks)
 $4, 9, 5, 4, 7, 6, 2, 1, 6, 7, 8$
11. Solve the equation (3 mks)
 $\text{Log}_{10}(6x - 2) - 1 = \text{Log}_{10}(x - 3)$
12. The points with co-ordinates (7,5) and (-3,-1) are the ends of a diameter of a circle centre M. Determine
(a) the co-ordinates of m. (1 mk)
(b) the equation of the circle, expressing it in the form $x^2 + y^2 + ax + by + c = 0$. Where a, b and c are constants. (3 mks)
13. Two places A and B are A ($36^\circ\text{N}, 125^\circ\text{E}$) and B ($36^\circ\text{N}, 55^\circ\text{W}$) respectively. Calculate the shortest distance in nautical miles between A and B. (3 mks)
14. Expand and simplify the expression. (3 mks)
 $\left(x + \frac{1}{2}\right)^4 + \left(x - \frac{1}{2}\right)^4$
15. A point Z is the mid-point of CD. Given that the position vectors of **c** and **d** are $\mathbf{i} - \mathbf{j} + \mathbf{k}$ and $2\mathbf{i} + \frac{3}{2}\mathbf{k}$ respectively, find the position vector of D in terms of **i**, **j** and **k**. (3 mks)
16. Solve the equation $\sin(3x + 30^\circ) = \frac{\sqrt{3}}{2}$ for $0^\circ \leq x \leq 90^\circ$ (4 mks)

SECTION B: 50 MARKS

Answer any FIVE questions in this section

17. Two bags A and B contain identical balls except for the colours. Bag A contains 4 red balls and two yellow ball s. Bag B contains 2 red balls and 3 yellow balls.
(a) If a ball is drawn at random, find the probability that the ball is red in colour. (4 mks)
(b) If two balls are drawn at random one ball at a time with replacement,
(i) draw the tree diagram (4 mks)
(ii) find the probability that the two balls drawn are both yellow
(iii) find the probability that the balls drawn are of different colours. (2 mks)

18. The table below shows monthly income tax rates for year 2016.

| Monthly taxable in KSh. | Tax rates (percentages) |
|-------------------------|-------------------------|
| 1 – 9680 | 10% |
| 9681-18800 | 15% |
| 18801-27920 | 20% |
| 27921-37040 | 25% |
| 37041 and above | 30% |

In the year 2016, Robi’s monthly earnings were as follows:

| | |
|----------------------------|-------------|
| Basic salary | KSh. 20,800 |
| Non taxable risk allowance | KSh. 2,500 |
| House allowance | KSh. 11,800 |
| Medical allowance | KSh. 2,800 |
| Transport | KSh. 540 |

Robi was entitled to a monthly tax relief of KSh. 1900. Calculate

- (i) his monthly taxable income (2 mks)
- (ii) the net tax paid by Robi per annum (6 mks)
- (iii) the monthly net salary earned by Robi (2 mks)

19. The product of the first three terms of a geometric progression is 64. If the first term is a and the common ratio is r.

- (a) Express r in terms of a. (3 mks)
- (b) Given that the sum of the three terms is 14.
 - (i) Find the values of a and r and hence write down two possible sequence each upto the fourth term. (5 mks)
 - (iii) Find the product of the 40th terms of the two sequences. (2 mks)

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

| | | | | | | | |
|----------------|---|----|-----|----|-----|-----|-----|
| x^0 | 0 | 30 | 60 | 90 | 120 | 150 | 180 |
| $2\sin x^0$ | 0 | 1 | | 2 | | | |
| $1 - \cos x^0$ | | | 0.5 | 1 | | | 2 |

(b) On the grid provided, using the same scale and axes draw the graphs of $y = 2\sin x^0$ and $y + \cos x = 1$ for $0^0 \leq x \leq 180^0$.

Take the scale: 2cm for 30⁰ on the x – axis
2cm for 1 unit on the y – axis

- (c) Use the graph in (b) above to
 - (i) Solve the equation $2 \sin x - 1 = -\cos x$ (1 mk)
 - (ii) determine the range of values of x for which $2 \sin x^0 \geq 1 - \cos x^0$ (1 mk)
 - (iii) State the amplitude of $2 \sin x$ (1 mk)

21. The table below shows the distribution of marks in a mathematical test done by 100 form fours at Mahando School in 2015 pre-mock.

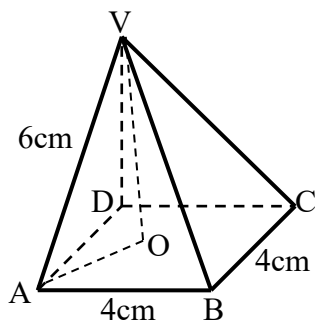
| Marks | 10-19 | 20-29 | 30-39 | 40-49 | 50-59 | 60-69 | 70-79 | 80-89 |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|
| No. of students | 12 | 25 | 20 | 15 | 8 | 7 | 11 | 2 |

- (a) State the modal class (1 mk)
- (b) Draw accumulative frequency curve to represent the above data. (4 mks)
- (c) Use the above graph to estimate
 - (i) the median (1 mk)
 - (ii) the quartile deviation (2 mks)
 - (iii) the pass mark if 60% of the students passed (2 mks)

22. (a) Draw the graph of the function given below on the grid provided in the range $0 \leq x \leq 6$ $y = 2x^2 - 7x - 2$ (5 mks)

- (b) Use the graph in (a) above to estimate the area under curve using the mid ordinate rule with six strips between the curve $y = 2x^2 - 7x - 2$, x – axis, $x = 0$ and $x = 6$ (5 mks)

23. ABCDV is a right pyramid on a square base ABCD of side 4cm, the slant edges of the pyramid are 6cm long.



- (a) Find the height VO (2 mks)
- (b) Find the angle
 - (i) that VA makes with the plane ABCD (3 mks)
 - (ii) between ABCD and VAD (3 mks)
 - (iii) between VA and BC. (2 mks)

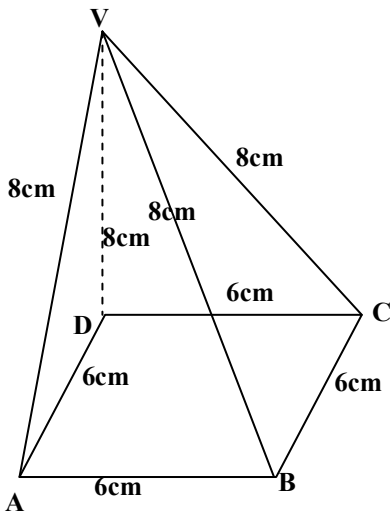
24. A building contractor has two lorries A and B, used to transport at least 420 tonnes of sand to a building site. Lorry A carries 8 tonnes of sand per trip while lorry B carries 12 tonnes of sand per trip. Lorry A uses 4 litres of fuel per trip while lorry B uses 8 litres of fuel per trip, the lorries are to use less than 320 litres of fuel. The number of trips made by lorry A should be less than 3 times the number of trips made by lorry B. Lorry A should make more than 20 trips.

- (a) Taking x to represent the number of trips made by lorry A and y to represent the number of trips made by lorry B. Write the inequalities that represent the above information. (4 mks)
- (b) On the grid provided, draw the inequalities. (4 mks)
- (c) Use the graph in (b) to determine the number of trips made by lorry A and by lorry B to deliver greatest amount of sand. (2 mks)

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(3 marks)

11. Using a ruler and pair of compasses only, construct triangle ABC in which $AB = 8\text{cm}$, $BC = 6\text{cm}$ and angle $ACB = 105^\circ$. Drop a perpendicular from A to BC to meet line BC at M. Measure AM. (4 marks)
12. In a book store, books packed in cartons are arranged in rows such that there are 50 cartons in the first row, 48 cartons in the next row, 46 in the next and so on.
- (a) How many cartons will there be in the 8th row? (2 marks)
- (b) If there are 20 rows in total, find the total number of cartons in the book store. (2 marks)
13. Draw the net of the solid below and calculate the total surface area of its slant faces. (3 marks)

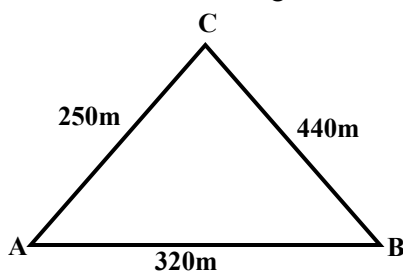


14. Town X is 20km in a bearing of 060° from Y, and Z is 30km in the direction 150° from Y. Using the scale 1cm represents 5km, find by scale drawing:
- (a) the bearing of Y from Z. (2 marks)
- (b) the distance of X from Z. (2 marks)
15. Solve for x in $2^{2x} + 18 \times 2^x = 40$ (3 marks)
16. Ekesa sells his car to Ebbyne and makes a profit of 20%. Ebbyne sells the same to Ivy at Sh. 480, 000, making a loss of 20%. Determine the price at which Ekesa bought the car. (3 marks)

Section II (50 Marks):

Answer ANY five questions in this section in the spaces provided.

17. The distance between towns A and B is 360km. A minibus left town A at 8.15 a.m. and traveled towards town B at an average speed of 90km/hr. A matatu left town B two and a third hours later on the same day and travelled towards A at average speed of 110km/hr.
- (a) (i) At what time did the two vehicles meet? (4 marks)
- (ii) How far from A did the two vehicles meet? (2 marks)
- (b) A motorist started from his home at 10.30 a.m. on the same day as the matatu and travelled at an average speed of 100km/h. He arrived at B at the same time as the minibus. Calculate the distance from A to his house. (4 marks)
18. Balongo owns a farm that is triangular in shape as shown below.

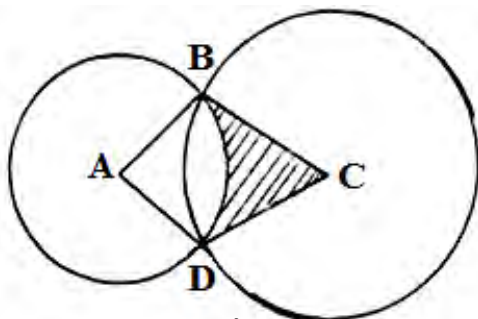


- (a) Calculate the size of angle BAC (2 marks)
- (b) Hence find the area of the farm in hectares (3 marks)
- (c) Balongo wishes to irrigate his farm using a sprinkler machine situated in the farm such that it is equidistant from points A, B and C.
- (i) Calculate the distance of the sprinkler from point C. (2 marks)

- (ii) The sprinkler rotates in a circular motion so that the maximum point reached by the water jets is the vertices A, B and C. Calculate the area outside his farm that will be irrigated. (3 marks)
19. A ship leaves port M and sails on a bearing of 050° heading towards island L. Two Navy destroyers sail from a naval base N to intercept the ship. Destroyer A sails such that it covers the shortest distance possible. Destroyer B sails on a bearing of 20° to L. The bearing of N from M is 100° and distance $NM = 300\text{km}$. Using a scale of 1cm to represent 50km, determine: -
- (i) the positions of M, N and L. (3 marks)
 - (ii) the distance travelled by destroyer A (3 marks)
 - (iii) the distance travelled by destroyer B. (2 marks)
 - (iv) the bearing of N from L. (2 marks)
20. A number of people agreed to contribute equally to buy books worth KSh. 120,000 for a school library. Five people pulled out and so the others agreed to contribute an extra Ksh. 100 each. Their contributions enabled them to buy books worth Shs. 2,000 more than they originally expected.
- (a) If the original numbers of people was x, write an expression of how much each was originally to contribute. (1 mark)
 - (b) Write down two expressions of how much each contributed after the five people pulled out. (2 marks)
 - (c) Calculate the number of people who made the contribution. (5 marks)
 - (d) Calculate how much each contributed. (2 marks)
21. Using a ruler and a pair of compasses only, draw a parallelogram ABCD, such that angle $DAB = 75^\circ$. Length $AB = 6.0\text{cm}$ and $BC = 4.0\text{cm}$. From point D, drop a perpendicular to meet line AB at N.
- (i) Measure length DN (1 mark)
 - (ii) Find the area of the parallelogram. (2 marks)
22. The following measurements were recorded in a field book of a farm in metres ($xy = 400\text{m}$)

| | | |
|------|-----|------|
| C60 | Y | |
| | 340 | |
| | 300 | 120D |
| | 240 | 100E |
| | 220 | 160F |
| B100 | 140 | |
| A120 | 80 | |
| | x | |

- (a) Using a scale of 1cm representing 4000cm, draw an accurate map of the farm. (3 marks)
 - (b) If the farm is on sale at Kshs. 80,000.00 per hectare, find how much it costs. (7 marks)
23. The table shows marks obtained by 100 candidates in a Mathematics examination.
- | | | | | | | | | |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|
| Marks | 15-24 | 25-34 | 35-44 | 45-54 | 55-64 | 65-74 | 75-84 | 85-94 |
| Frequency | 6 | 14 | 24 | 14 | x | 10 | 6 | 4 |
- (a) Determine the value of x (2 marks)
 - (b) State the modal class (1 mark)
 - (c) Calculate the mean mark (3 marks)
 - (d) Calculate the quartile deviation (4 marks)
24. In the diagram below, two circles, centres A and C and radii 7cm and 24cm respectively intersect at B and D. $AC = 25\text{cm}$.



- (a) Show that angle $ABC = 90^\circ$. (3 marks)
- (b) Calculate
 - (i) the size of obtuse angle BAD (3 marks)
 - (ii) the area of the shaded part (4 marks)

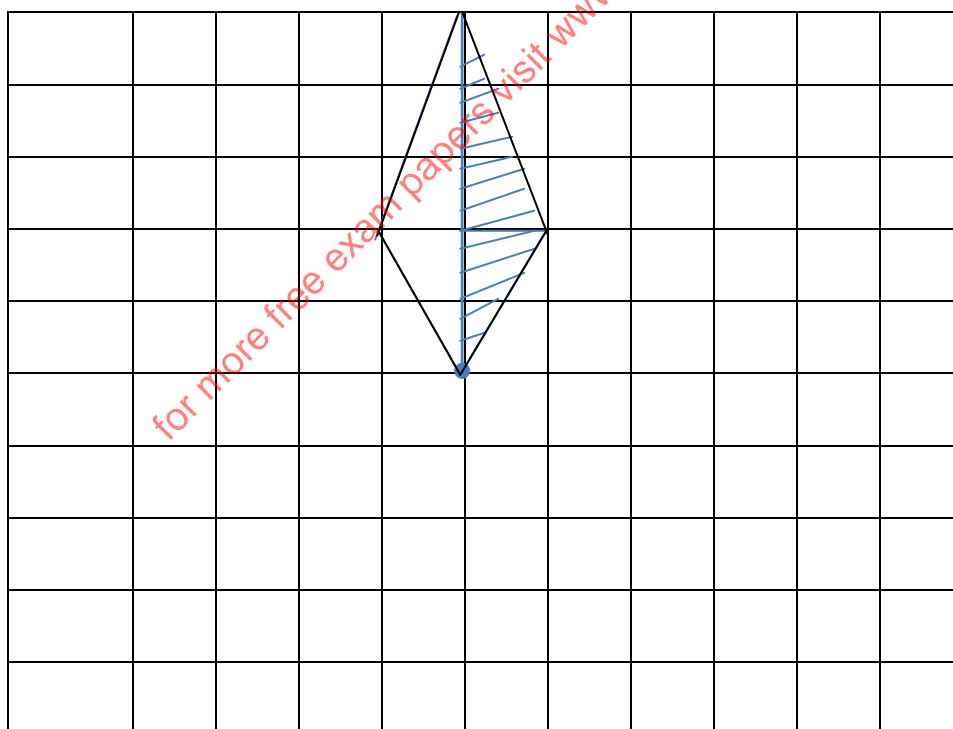
Section I (50 Marks):

Answer ALL questions in the section in the space provided.

1. Use logarithm tables to evaluate the following to four significant figures. (4 marks)

$$\sqrt{\frac{4.562^2 \times 0.038}{6.82 \times 35}}$$

2. The fifth term of an arithmetic progression is 11 and twenty fifth terms is 51. Find the first term and the common difference. (2 marks)
3. Given that matrices P, Q, R are such that $P = QR$ and $P = \begin{pmatrix} 2 & 3 \\ 1 & 2 \end{pmatrix}$ and $Q = \begin{pmatrix} 4 & 0 \\ 2 & 1 \end{pmatrix}$. Find matrix R. (3 marks)
4. Solve for x in the equation.
 $\text{Log}(x + 11) - 2\log 3 = \log(9 - x)$ (3 marks)
5. Given that the mean of 9, 8, 5, 5 and 8 is 7; find the standard deviation of the numbers to 2 d.p (3 marks)
6. Find the equation of a straight line passing through (2, 1) and is Parallel to line $2x - 3y + 6 = 0$ in the form $ax + b + c = 0$ (3 marks)
7. A bus travelling at 80km/h leave a station at 11.15pm. Another bus travelling at 75 km/h leaves the same station at 11.45 pm in the same direction as the first one. At what time will their distance apart be 55km? (3 marks)
8. The figure below shows part of a church badge which has a rotational symmetry of order 4 about the point marked with a dot. Draw the complete badge. (3 marks)

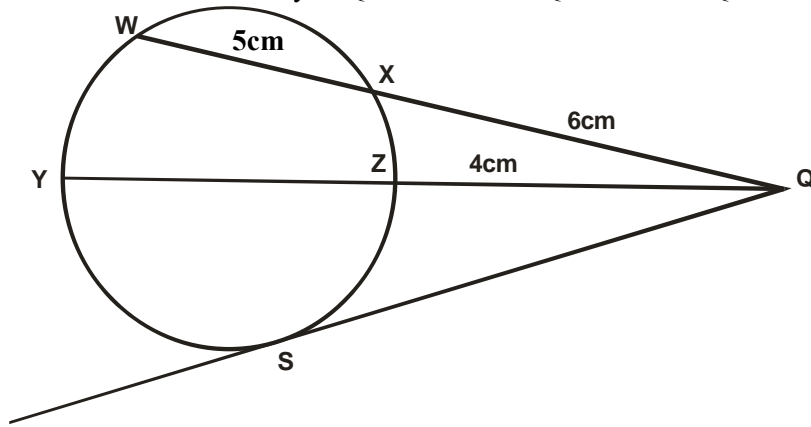


9. Simplify the expressions (3 marks)

$$\frac{15t^2y - 10ty^2}{3t^2 - 5ty + 2y^2}$$

10. a) Expand and simplify $(2 - x)^5$ in ascending powers of x up to and including the term in x^3 (2 marks)
 b) Hence approximate the value of $(1.98)^5$ to four significant figures. (2 marks)

11. Chord QX and YZ intersect externally at Q. The secant WQ = 11cm and QX = 6cm while ZQ = 4cm



- a) Calculate the length of chord YZ (2 marks)
- b) Use the answer in a) above to find the length of the tangent SQ (2 marks)

12. Make **n** the subject of the formula in

$$S = \frac{a(1-r^n)}{1-r} \quad (3 \text{ marks})$$

13. A man deposits some money in an investment which pays 12% per annum interest compounded quarterly. Find how many years it takes for the money to double. (3 marks)

14. A variable V varies jointly as the variables A and h. When A = 63 and h = 4, V = 84, find;

- (a) The value of V when A = 9 and h = 7 (2 marks)
- (b) The value of A when V = 4.5 and h = 0.5 (1 mark)

15. Rationalize and simplify

$$\frac{3\sqrt{5}}{\sqrt{45 + \sqrt{15}}} \quad (3 \text{ marks})$$

16. Given that x, y and z are integers and that $8 \leq x \leq 10, 5 \leq y \leq 7, 4 \leq z \leq 6$.

Find the percentage error in $\frac{x+y}{z}$ (3 marks)

Section II (50 Marks):

Answer ANY five questions in this section in the spaces provided.

- 17. (a.) Using the first principle and a small increment h, determine the derivative of $y = 3x^2 - 2$. (4 marks)
- b.) Find the equation of the normal to curve $3x^2 - y = 2$ at $x = 1$ in the form $ax + by + c = 0$. (4 marks)
- c.) Determine the stationary point of the curve and identify the nature of point. (2 marks)

18. The table below shows marks obtained by 56 students in Mathematics Examination

| | | | | | | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 32 | 64 | 68 | 55 | 52 | 68 | 37 | 46 | 65 | 26 | 23 | 76 | 74 | 91 | 28 | 33 | 27 | 48 | 92 |
| 45 | 87 | 44 | 58 | 39 | 54 | 21 | 44 | 76 | 23 | 45 | 56 | 98 | 21 | 34 | 31 | 83 | 65 | 95 |
| 65 | 42 | 82 | 87 | 75 | 44 | 47 | 48 | 52 | 32 | 66 | 76 | 56 | 77 | 56 | 77 | 86 | 21 | |

- (a.) Starting with 20 and using equal class intervals of 10, make a frequency distribution table. (2 marks)
- (b.) On grid provided, draw the cumulative frequency curve for the data. (3 marks)
- (c.) Using the graph (b.) above estimate:
 - (i.) The upper quartile (1 mark)
 - (ii.) The lower quartile (1 mark)
 - (iii.) Quartile deviation (1 mark)
 - (iv.) Pass mark if 28 students failed (2 marks)

19. Aphline's basic salary is Ksh.100,000. She is housed by her employer and pays a nominal rent of Ksh. 2,000 which is deducted from her salary. She is entitled to an entertainment allowance of Ksh.5, 000 and a responsibility allowance of Ksh.10, 000. She has a bank loan and hire purchase repayments which she repays at the rate of Ksh.15, 000 and Ksh.3, 000 per month. She also makes cooperative share contributions of Ksh.5, 000 per month. Calculate:

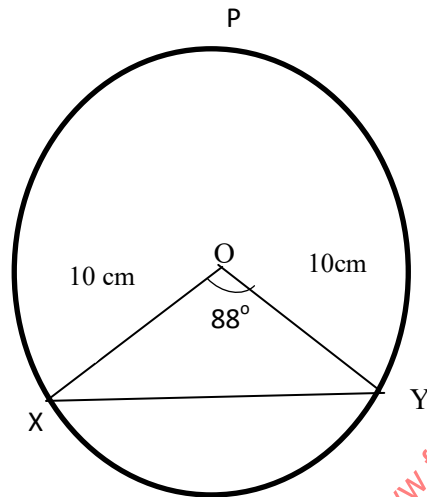
- (a) Her gross salary (1 mark)
- (b) Her taxable income in Ksh. (1 mark)

During that month, the table below was used to determine individual rate of income tax.

| Income K£ p.m. | | Rate (Ksh. per £) |
|----------------|---|-------------------|
| 1 | - | 484 |
| 485 | - | 940 |
| 941 | - | 1396 |
| 1397 | - | 1852 |
| Over 1852 | | 9 |

- (c) Use the table to determine;
- (i) Her monthly gross tax (4 marks)
 - (ii) Her net tax given that she is entitled to a tax relief of Ksh.1056 per month. (2 marks)
 - (iii) Her net salary. (2 marks)

20. The Chord XY subtends an angle of 88° at the centre O. If the radius of the circle is 10cm, calculate:



- (i) The area of the circle. (2 marks)
- (ii) The area of the major sector XPY, (3 marks)
- (iii) The area of triangle OXY (2 marks)
- (iv) The area of major segment (2 marks)
- (v) The area of the minor segment (1 mark)

21. a) Complete the table below for the curves $y = 3\cos 2x$ and $y = 2\sin(2x + 30)^\circ$ (2 marks)

| | | | | | | | | | | | | | |
|----------------------|---|----|-----|----|----|----|----|-----|------|-----|-----|-----|-----|
| x | 0 | 15 | 30 | 45 | 60 | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 |
| $3\cos 2x$ | 3 | | 1.5 | | | | | | -1.5 | | | | 3 |
| $2\sin(2x+30)^\circ$ | 1 | | 2 | | | | | | -2 | | | | 1 |

- b) On the grid, draw the graphs of $y = 3 \cos 2x$ and $y = 2 \sin (2x+30)^\circ$ for $0^\circ \leq x \leq 180^\circ$ (5 marks)
- a) State the amplitude, period and phase angle of the curve $y = 2 \sin (2x + 30)^\circ$ (1 mark)
 - b) Use your graph to:-
 - i) Estimate the value of x for which $3 \cos 2x - 2 \sin (2x+30)^\circ = 0$ (1 mark)
 - ii) Estimate the range of values of x for which $3 \cos 2x < 2 \sin (2x+30)^\circ$ (1 mark)

22. Kiplimo, Olendo and Kayoni are participating in an athletic competition. The probability that Kiplimo, Olendo, and Kayoni completes the race in $\frac{3}{5}$, $\frac{1}{6}$, and $\frac{4}{7}$ respectively. Find the probability that in a competition;

- (a) Only one of them completes the race. (3 marks)
- (b) All the three completes the race. (1 mark)
- (c) None of them completes the race. (1 mark)
- (d) Two of them complete the race. (3 marks)
- (e) At least one completes the race. (2 marks)

23. Using a **pair of compasses** and a **ruler** only;

- (a) Construct triangle ABC in which $AB = 5.8\text{cm}$, $AC = 4.2\text{cm}$ and $\angle BAC = 45^\circ$. Measure BC. (3 marks)
- (b) (i) Draw escribed circle of triangle ABC which touches BC. (3 marks)
- (ii) Draw P_1 the locus of points which move such that the area of triangle APB is half the area of triangle ABC. (3 marks)
- (iii) Mark P_1 and P_2 the points where P and the circle meet. Measure P_1P_2 . (1 mark)

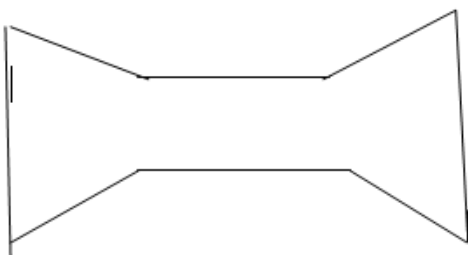
24. Mwanje wants to make and sell serving bowls and plates. A bowl uses 5 kg of clay. A plate uses 4 kg of clay. He has 40 kg of clay and wants to make at least 4 bowls. The profit a bowl is Ksh 35 and the profit on a plate is Ksh. 30.

- (a.) Form all the inequalities. (3 marks)
- (b.) On the grid provided draw the inequalities (4 marks)
- (c.) (i) How many bowls and how many plates should he make in order to maximize profit? (2 marks)
- (ii) Calculate the maximum profit (1 mark)

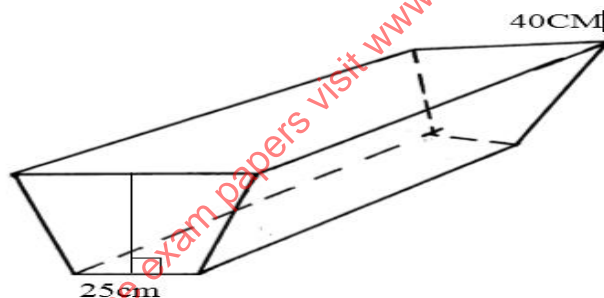
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Section 1: Answer all the questions in this section

1. Evaluate: $\frac{44 - (-28)}{12 \times -2} - \frac{8^2 \times -12 - 24}{96 \div -12 \times 9}$ (3 marks)
2. Solve the inequalities and represent the solution on number line.
 $3x - 9 < 5x + 3 \leq 2x - 6$ (3mks)
3. Solve for x in the equation $\left(\frac{1}{2}\right)^x x \left(\frac{1}{8}\right)^{1-x} = 32$ (3mks)
4. A piece of wood whose volume is 90cm^3 weighs 81 grams. Calculate the mass in kilograms of one cubic meter of the same wood. (3mks)
5. Find by calculation the sum of the interior angles in figure below (2mks)



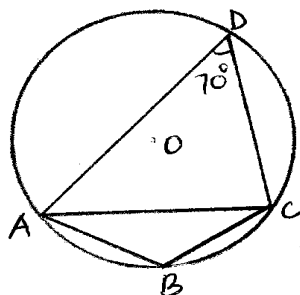
6. The figure below shows a trough which is 40 cm wide at the top and 25 cm wide at the bottom. The trough is 20cm deep and 4.5 m long. Calculate the capacity of the trough in litres. (3mks)



7. Given that $\tan \theta = 0.75$, find without using mathematical table or calculators.
 $2 \sin \theta + \cos \theta$ (3mks)
8. Evaluate using tables of reciprocals, squares and cubes roots (4mks)

$$\frac{\sqrt[3]{0.0008}}{0.375} - \frac{10}{37.5^2}$$

9. In the figure below O is the centre of circle ABCD. $\angle ADC = 70^\circ$. $AD = AC$.



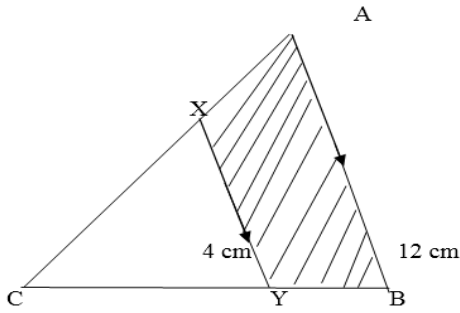
MATHEMATICS PAPER 1 & 2

Find the size of

- i) Angle ABC (1mk)
 - ii) Angle DAO (2mks)
10. Point $P^1(5,6)$ is the image of point $P(-1,-4)$ under a rotation of 180° about point $Q(x,y)$. Find the co-ordinates (x,y) (2mks)
11. Use logarithms to evaluate (4mks)

$$\frac{16.92^2 \times \sqrt{0.6318}}{327.5}$$

12. In the figure below, lines AB and XY are parallel.



- If the area of the shaded region is 36 cm^2 , find the area of triangle CXY. (3 marks)
13. Simplify the expression (3mks)

$$\frac{4t^2 - 25a^2}{6t^2 + 9at - 15a^2}$$

14. Solve the simultaneous equations (4mks)
- $$\begin{aligned} xy &= 4 \\ x + y &= 5 \end{aligned}$$

15. Calculate the area in hectares of a farm whose measurements are entered in a surveyor's field book as shown below. ($AD=37\text{m}$ and all measurements are in meters). (4mks)

| | | | |
|-----|----|-----|--|
| | D | | |
| | 37 | | |
| | 27 | 8E | |
| C6 | 21 | | |
| | 18 | 6F | |
| B12 | 16 | | |
| | 10 | 15G | |
| | A | | |

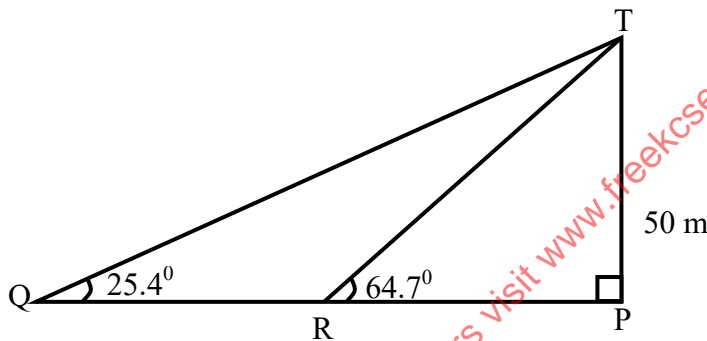
16. Four machines give out signals at interval of 24,27,30,50 seconds respectively. At 5.00 p.m. all the four machines gave out a signal simultaneously. Find the time this will happen again. (3mks)

SECTION 11 (50MRKS)

Answer only FIVE questions from this section

17. Chemelil Sugar Academy hall has 200 seats. During the District Drama Festival, tickets were sold at sh. 150 for adults and sh. 75 for students.
- (a) On day one of the festival 80% of the seats in the hall were occupied, and twenty of the seats were occupied by students. Calculate the total money collected from the sale of tickets this day. (3mrks)
 - (b) On the last day of the festival, x students occupied the seats and all seats were occupied. The money collected from the tickets sales was sh 25,350.
 - (i) Write down an equation of x . (2mrks)
 - (ii) Calculate the value of x . (2mrks)
 - (c) The money collected from the sale of tickets during the festival was divided among cost of hosting, allowances for adjudicators and electricity bill in the ratio 7: 3: 2. If the allowances amounted to sh. 126,000, calculate:
 - (i) the amount collected during the festival. (3mrks)

18. The figure below shows the position of a boat Q which is observed sailing directly towards the pier P at the base of a vertical cliff PT. The angle of elevation of the top of the cliff from Q is 25.4° . After 14 seconds the boat is at point R, and the angle for elevation of T is now 64.7° .



- If the cliff is 50m high, calculate
- (a) The distance PQ (2 Marks)
 - (b) The distance QR (4 Marks)
 - (c) The speed of the boat in km/h (4 Marks)
19. (a) Triangle **PQR** has vertices at **P(3,-1)**, **Q(5, 2)** and **R(2, 3)**. Plot and draw triangle **PQR** on the grid provided. (1mrk)
- (b) Given that triangle **P'Q'R'** is the image of **PQR** under positive quarter turn about the origin, plot and draw **P'Q'R'** on the same axes as **PQR** (3mrks)
- (c) **P''Q''R''** is the image of **P'Q'R'** after reflection in the line $y+x=0$. Plot and draw **P''Q''R''** on the same axes as **PQR** and **P'Q'R'** above. (3mrks)
- (d) State the pairs of triangles above that are:
 - (i) Oppositely congruent (2mrks)
 - (ii) Directly congruent (1mrk)
20. Three islands P, Q, R and S in an ocean are such that island Q is 400km on a bearing of 030° from island P. Island R is 520km and on a bearing of 120° from island Q. A port S is sighted 750km due south of island Q.
- (a) Taking a scale of 1cm to represent 100km, draw a scale drawing showing the relative positions of P, Q, R and S. (4 marks)
 - Use the scale drawing to
 - (b) Find the bearing of:
 - (i) Island R from island P (1 mark)
 - (ii) Port S from island R (1 mark)
 - (c) Find the distance between island P and R (2 marks)

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- (d) A warship T is such that it is equidistant from the islands P, S and R. By construction locate the position of T (2 marks)
21. A rectangular tank whose internal dimensions are 2.04m by 1.68m by 26.4 m is $\frac{7}{8}$ full of milk
- If the tank is made of metal of thickness 3mm. Calculate the external volume of the tank in m^3 when closed. (3 Marks)
 - Calculate the volume of milk in the tank in cubic metres. (2 marks)
- c) The milk is to be packed in small packets. Each packet is in the shape of a right- Pyramid on an equilateral triangular base of side 19.2cm. The height of each packet is 13.6 cm. Full packets obtained are sold at Kshs. 35 per packet. **Calculate;**
- The volume of milk, in cubic centimeters contained in each packet to 4 significance figures. Hence find the number of full packets. (4 marks)
 - The exact amount that will be realized from the sale of all the packets of milk. (3 marks)
22. The distance between town Nairobi and Mombasa is 560 km. A car and a lorry travel from Nairobi to Mombasa. The average speed of the Lorry is 20 km/h, less than that of the car. The Lorry takes $1\frac{1}{6}$ hours more than the car to travel from Nairobi to Mombasa.
- If the speed of lorry is x km/h, find x. (5mks)
 - The lorry left Nairobi town at 7:15 am. The car left Nairobi town later and overtook the lorry at 11:15 am.
 - Calculate the time the car left town Nairobi (3 marks)
 - Distance yet to be covered by lorry as the car arrives at Mombasa. (3 marks)
23. a) Find the equation of the perpendicular bisector of the line AB where A is (3,9) and B is (7,5) in the form $ax + by + c = 0$. (4 marks)
- b) The perpendicular bisector of line AB in (a) above intersects the line joining the points (2,4) and (-3,1) at C. Find the co-ordinates of C. (4mrks)
- c) The line through (2,4) and (-3,1) makes an angle θ with the positive X-axis. Find the value of angle θ (3mks)
24. The frequency table below shows the daily wages paid to casual workers by a certain company.

| Wages in shillings | 100 – 150 | 150 – 200 | 200 - 300 | 300 – 400 | 400 – 600 |
|--------------------|-----------|-----------|-----------|-----------|-----------|
| No. of workers | 160 | 120 | 380 | 240 | 100 |

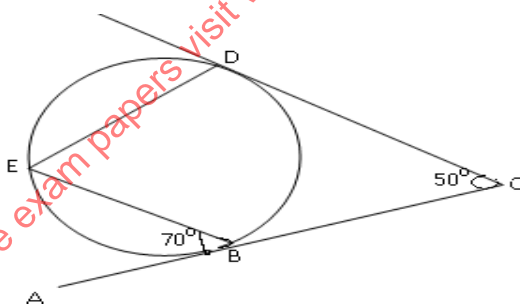
- Draw a histogram to represent the above information. (5 marks)
- state the class in which the median wage lies (1 mrk)
 - Draw a vertical line, in the histogram, showing where the median lies (1 mrk)
- Using the histogram, determine the number of workers who earn sh. 450 or less per day. (3 mrks)

SECTION 1 (50 MARKS)

Answer all questions in this section in the spaces provided.

1. Find x without using mathematical tables in (3mks)
 $\text{Log}_2(x+7) - \text{Log}_2(x-7) = 3$
2. Write in the simplest form as $a + b\sqrt{c}$ using a rational denominator. (2mks)

$$\frac{2\sqrt{3}}{\sqrt{3} + \sqrt{2}}$$
3. A ship sails due north from a point A for 62 Km to a point B. It changes its course to $N47^\circ E$ and sails up to a point C. Calculate the distance from C to A if C is $N25^\circ E$ of A. (3mks)
4. The height and radius of a cone are measured as 21cm and 14.0 cm respectively. Taking $\pi=3.142$, find the percentage error in the volume of the cone. (4mks)
5. a) Find the expansion in ascending powers of x of $\left(1 - \frac{x}{3}\right)^7$ up to the term in x^3 (2mks)
 b) Hence evaluate $(0.99)^7$ to four significant figures. (2mks)
6. Three people John, James and Peter can do a piece of work in 40 hours, 30 hours and 20 hours respectively. How long will James take to complete the work remaining after John and Peter have worked for 10 hours each. (3mks)
7. In the figure below, the tangents DC and BC meet at point C, angle $BCD=50^\circ$ while angle $ABE=70^\circ$



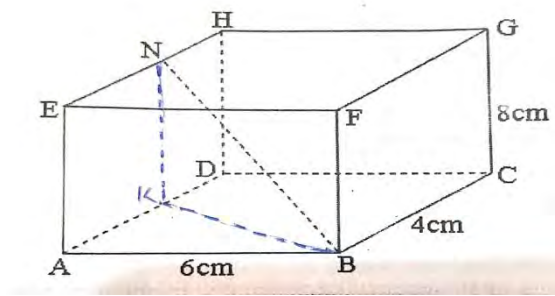
Calculate giving reasons the sizes of the angles below.

- i) $\angle BDE$ (2mks)
- ii) $\angle CDB$ (2mk)
8. Two matrices A and B are such that $A = \begin{bmatrix} k & 4 \\ 3 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$. Given that the determinant of $AB = 4$, find the value of k . (3mks)
9. Make d the subject in the given formula. (3mks)

$$m = \frac{hd^2}{2w + d^2}$$
10. (a) The 20th term of an A.P is 60 and the 16th term is 20. Find the first term and the common difference of the sequence. (3mks)
 (b) Find the sum of the first 9 terms of the G.P $8 + 24 + 72 + \dots$ (2mks)

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11. The figure below shows a cuboid ABCDEFGH. AB= 6 cm, BC= 4cm and CG=8cm, Given that N is the midpoint of EH and K is the midpoint of AD



- Calculate the angle between line BN and the base ABCD. (2mks)
- 12. A positive two digit number is such that the product of the digits is 20. When the digits are reversed, the number so formed is greater than the original number by 9. Find the number. (3mks)
- 13. A rectangle whose area is $96m^2$ is such that its length is 4m longer than its width. Find
 - a) Its dimensions (2mks)
 - b) Its perimeter (1mks)
- 14. Mrs. Ondiek invested Ksh 63,560 in a bank where the interest was compounded quarterly at the rate of 12% per month. Determine the amount of money she had after $2\frac{1}{2}$ years. (2mks)
- 15. A science club is made up of 5 boys and 7 girls. The club has three officials. Using a tree diagram or otherwise, find the probability that
 - a) The club officials are all boys (2mks)
 - b) Two of the officials are girls (1mks)
- 16. The diameter of a circle ,centre O has its end points M(-1, 6) and N(5, -2). Find the equation of the circle in form $x^2 + y^2 + ax + by = c$ where a, b and c are constants. (3mks)

SECTION II (50 MARKS)

Answer only 5 questions in this section in the spaces provided.

17. The table below shows marks scored by 42 students in a test.

| | | | | | | |
|----|----|----|----|----|----|----|
| 35 | 49 | 69 | 57 | 58 | 75 | 48 |
| 40 | 46 | 86 | 47 | 81 | 67 | 63 |
| 56 | 80 | 36 | 62 | 49 | 46 | 26 |
| 41 | 58 | 68 | 73 | 65 | 59 | 72 |
| 64 | 70 | 64 | 54 | 74 | 33 | 51 |
| 73 | 25 | 41 | 61 | 56 | 57 | 28 |

- a) Starting with a mark of 25 and using equal class intervals of 10, make a frequency distribution table. (3mks)
- b) Using an assumed mean of 62.5 calculate the mean, the variance and the standard deviation of the marks. (7mks)

18. a) Fill the table below for the function $y = \sin \theta$ and $y = 3 \sin \theta$ for $0^\circ \leq \theta \leq 360^\circ$ (2mks)

| | | | | | | | | | | | | | |
|---------------------|-----|------|----|----|-----|-----|-----|-----|-----|-----|-----|-------|-----|
| θ | 0 | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | 360 |
| $Y = \sin \theta$ | 0.0 | 0.50 | | | | | 0.0 | | | | | -0.50 | 0.0 |
| $Y = 3 \sin \theta$ | 0.0 | 1.50 | | | | | 0.0 | | | | | -1.50 | 0.0 |

- b) On the same axis draw the graphs of $y = \sin \theta$ and $Y = 3 \sin \theta$ (4mks)
- c) Solve the equation $\sin \theta - 3 \sin \theta = 0$ (2mks)
- d) State the amplitude and period of the graph $Y = 3 \sin \theta$ (2mks)
 - Amplitude _____
 - Period _____

19. a) i) On the grid (graph paper) plot and draw triangle ABC where A(4,3), B(4,6) and C(7,6). (1mk)
- ii) Triangle ABC is given a rotation of $+90^\circ$ about (0, 0) to map onto $A^I B^I C^I$. Plot $A^I B^I C^I$ and state its co-ordinates by using the matrix that represents $+90^\circ$ rotation about (0,0). (3mks)
- iii) Triangle $A^I B^I C^I$ is transformed by the matrix $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ to map onto $A^{II} B^{II} C^{II}$. Plot $A^{II} B^{II} C^{II}$ and state its co-ordinates. (3mks)
- b) (i) $A^{II} B^{II} C^{II}$ is further transformed by a reflection on the line $x=0$ to map onto $A^{III} B^{III} C^{III}$. Plot $A^{III} B^{III} C^{III}$ (1mks)
- (ii) What single transformation will map $A^{III} B^{III} C^{III}$ onto triangle ABC? (2mks)

20. An employee earns a basic salary of Ksh. 19,630 and a house allowance of Ksh. 6,200 per month. He claims a relief of Ksh 1080 per month, and is paid a transport allowance. The income taxation table used was shown.

| Monthly income (K£) | Rate per K£(Shs) |
|---------------------|------------------|
| 1-480 | 2 |
| 481-960 | 3 |
| 961-1440 | 5 |
| 1441-1920 | 7 |
| 1921-above | 9 |

- a) If he paid a PAYE of sh 3233 per month, calculate his transport allowance (5mks)
- b) If he pays shs 320 to NHIF, sh 500 to Co-op loan and shs 2,500 to Co-op shares, find his net monthly salary. (3mks)
- c) He decide to save $\frac{1}{6}$ of his basic salary to purchase a Motor bike. Calculate his saving per year. (2 marks)

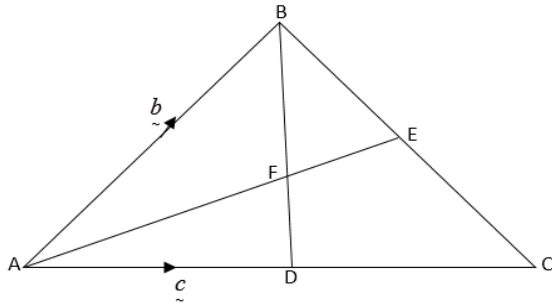
21. (a) Complete the table below for $y = x^3 + 4x^2 - 5x - 5$ (2mks)

| | | | | | | | | |
|---------------------------|----|----|----|----|----|----|---|---|
| x | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 |
| $y = x^3 + 4x^2 - 5x - 5$ | | | 19 | | | -5 | | |

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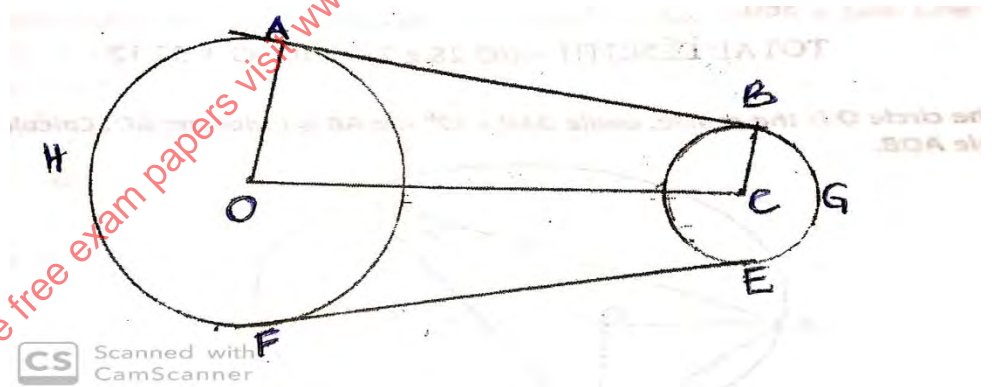
- (b) On the grid provided, draw the graph of $y = x^3 + 4x^2 - 5x - 5$ for $-5 \leq x \leq 2$ (3mks)
- (c) (i) Use the graph to solve the equation $x^3 + 4x^2 - 5x - 5 = 0$ (2mks)
- (ii) By drawing a suitable straight line on the graph, solve the equation $x^3 + 4x^2 - x - 4 = 0$ (3mks)

22. In the figure below, E is the midpoint of BC, AD: DC=3:2 and AE intersect with BD at F.



- a) Given that $\vec{AB} = \vec{b}$ and $\vec{AC} = \vec{c}$, express in terms of \vec{b} and \vec{c}
 - i) \vec{AE} (2mks)
 - ii) \vec{BD} (1mk)
- b) If $\vec{BF} = t\vec{BD}$ and $\vec{AF} = s\vec{AE}$, where t and s are scalars, find the values of t and s. (6mks)
- c) What is the ratio in which F divides \vec{AE} . (1mk)

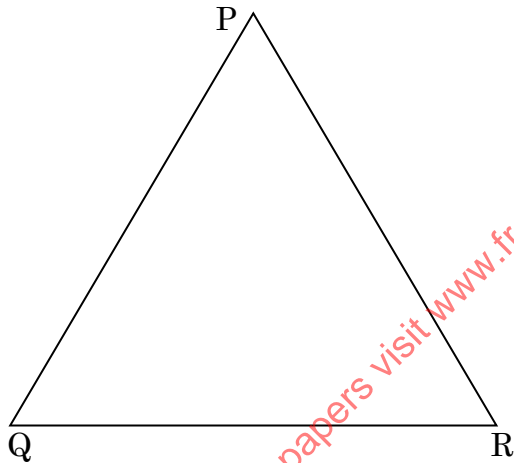
23. Two wheels have radii 20cm and 30cm. their centres are 70cm apart. A belt Passes tightly round the wheels as shown below.



- (i) Calculate the length AB and FE. (3mks)
 - (ii) Find the angles AOC and BCO (3mks)
 - (iii) Calculate the total length of the belt ABGEFH (4mks)
24. Construct triangle PQR such that PQ= 7cm, QR= 6cm and RP= 5cm. (2mks)
- a) Construct the locus of points x which is equidistant from Q and R. (2mks)
 - b) Construct the locus of m which is equidistant from PR and QR. Mark with letter M the point where locus m meets PQ. Measure QM. (2mks)
 - c) Construct the locus y such that PY=4cm. (2mks)
 - d) Shade the region in which T lies given that $QT \geq TR$, angle $PRT \geq$ angle QRT and $PT \leq 4$ cm (2mks)

MATHEMATICS PAPER 1 & 2

11. Using a pair of compasses and a ruler only construct a triangle ABC and such that $AB=4\text{cm}$, $BC=6\text{cm}$ and angle $ABC=135^\circ$. (2mks)
 (b) Construct the height of triangle ABC in (a) above taking AB as the base, hence Calculate the area of triangle ABC. (2 mks)
12. The external length width and height of an open rectangular container are 41cm, 21cm and 15.5cm respectively. The thickness of the materials making the container is 5mm. If the container has 8 litres of water. Calculate the internal height above the water level. (3mks)
13. A triangle P with vertices $x(2,4)$, $Y(6,2)$ and $z(4,8)$ is mapped onto triangle P^1 with vertices $X^1(10,0)$, $Y^1(8,-4)$ and $Z^1(14,-2)$ by a rotation.
 a) On the grid provided, draw triangle P and its image (2mks)
 b) Determine the centre and angle of rotation that maps P onto P^1 (2mks)
14. Solve the following inequalities and state the integral values (3mks)
 $2x - 2 \leq 3x + 1 < x + 11$
15. In the triangle PQR below, $PQ = 12\text{cm}$, $\angle PQR = 80^\circ$ and $\angle PRQ = 30^\circ$



- Calculate, to 4 s.f, the area of the triangle PQR (3mks)
16. A two digit number is such that the sum of digits is 13. When the digits are interchanged, the original number is increased by 9. Find the original number. (3mks)

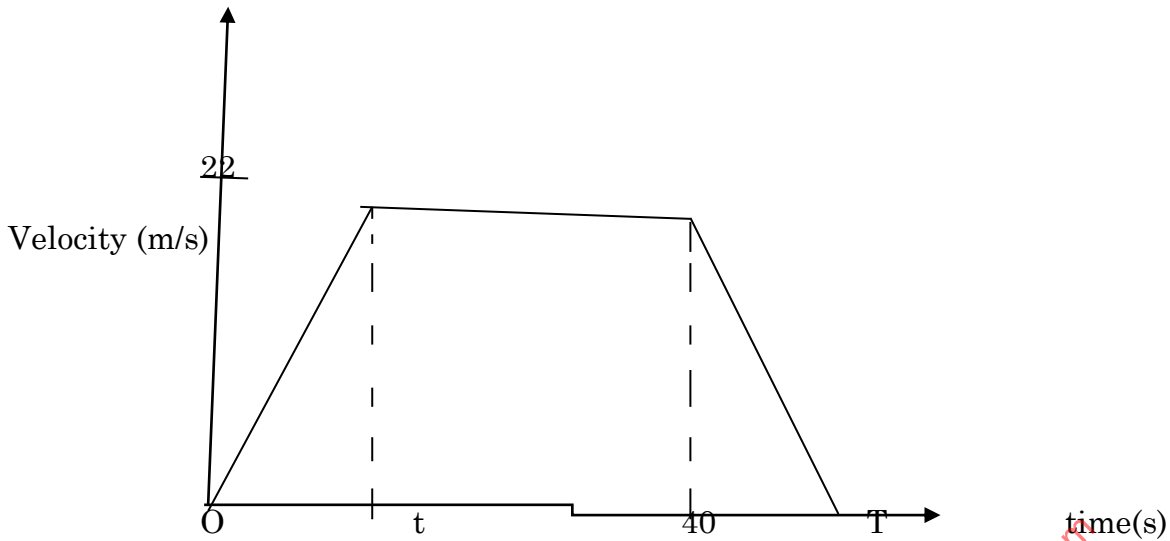
SECTION II (50 MARKS)

Answer only five questions in this section

17. A straight line L_1 has a gradient $-\frac{1}{2}$ and passes through point P (-1, 3). Another line L_2 passes through the points Q (1, -3) and R (3, 5). Find.
 (a) The equation of L_1 . (2mks)
 (b) The equation of L_2 in the form $ax+by+c=0$ (2mks)
 (c) The equation of a line passing through a point S (0, 1.5) and is perpendicular to L_2 . (3mks)
 (d) The point of intersection of a line passing through S and L_2 (3mks)

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18. The figure below shows a velocity – time graph of a car journey.

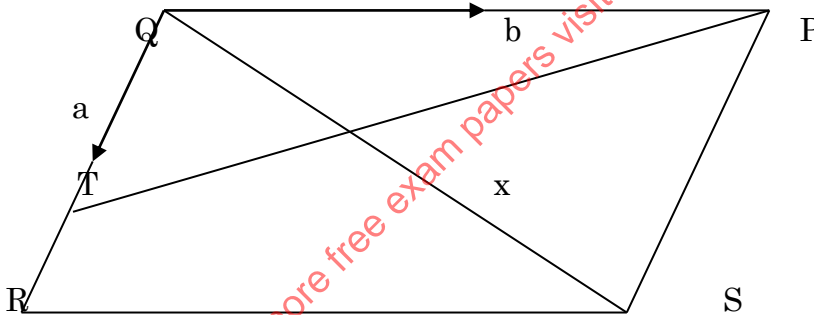


The car starts from rest and accelerates at 2.75m/s^2 for t seconds until its speed is 22m/s . It then travels at this velocity until 40 seconds after starting. Its brakes bring it uniformly to rest. The total journey is 847m long and takes T seconds.

Calculate the

- (i) Value of t (3mks)
- (ii) Distance travelled during the first t seconds (2mks)
- (iii) Value of T (3mks)
- (iv) Final deceleration (2mks)

19. In the figure below, $QT = a$ and $QP = b$.



- (a) Express the vector PT in terms of a and b . (1mk)
- (b) If $PX = kPT$, express QX in terms of a , b and k , where k is a scalar. (3mks)
- (c) If $QR = 3a$ and $RS = 2b$, write down an expression for QS in terms of a and b . (1mk)
- (d) If $QX = tQS$, use your result in (b) and (c) to find the value of k and t . (4mks)
- (e) Find the ratio $PX : XT$. (1mk)

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20. A triangle with $A(-4, 2)$, $B(-6, 6)$ and $C(-6, 2)$ is enlarged by a scale factor -1 and centre $(-2, 6)$ to produce triangle $A^1B^1C^1$.

- a) Draw triangle ABC and $A^1B^1C^1$ and state its coordinates 4mks
- b) Triangle $A^1B^1C^1$ is then reflected in the line $y = x$ to give triangle $A^{11}B^{11}C^{11}$. draw $A^{11}B^{11}C^{11}$ and state its coordinates 3mks
- c) If triangle $A^{11}B^{11}C^{11}$ is mapped onto $A^{111}B^{111}C^{111}$ whose co-ordinates are $A^{111}(0, -2)$, $B^{111}(4, -4)$ and $C^{111}(0, -4)$ by a rotation. Find the centre and angle of rotation. (3mks)

21. Four towns P, R, T and S are such that R is 80km directly to the north of P and T is on a bearing of 290° from P at a distance of 65km. S is on a bearing of 330° from T and a distance of 30 km. Using a scale of 1cm to represent 10km, make an accurate scale drawing to show the relative position of the towns. (4mks)

Find:

- (a) The distance and the bearing of R from T (3mks)
- (b) The distance and the bearing of S from R (2mks)
- (c) The bearing of P from S (1mk)

22. Four towns A, B, C and D are such that B is 80km directly North of A and C is on a bearing of 300° from A at a distance of 50km. D is on a bearing of 345° from C at a distance of 30km.

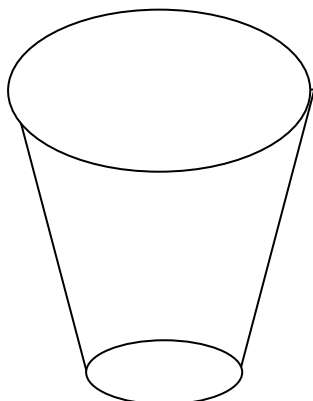
- a) Using a scale of 1cm rep 10km, draw the relative positions of the towns (4mks)
- b) Find:
 - (i) The distance and bearing of B from C (2mks)
 - (ii) The distance and bearing of B from D (2mks)
 - (iii) Calculate the distance of ABCD (2mks)

23. A school in Meru Central decided to buy x calculators for its students for a total cost of ksh. 16,200. The supplier agreed to offer a discount of ksh. 60 per calculator. The school was then able to get three extra calculators for the same amount of money.

- (a) Write an expression in terms of x , for the
 - (i) Original price of each calculator (1mk)
 - (ii) Price of each calculator after the discount (1mk)
- b) Form an equation in x and hence determine the number of calculators the school bought (5mks)
- c) Calculate the discount offered to the school as a percentage (3mks)

24. A solid is made up of a conical frustum and a hemispherical top. The slant height of the frustum is 8cm and its base radius is 3.5cm. If the radius of the hemispherical top is 4.2cm.

- (a) Find the area of:
 - (i) The circular base. (2 Marks)



- (ii) The curved surface of the frustum (3 Marks)
 - (iii) The hemispherical surface (3 Marks)
- (b) A similar solid has a total surface area of 81.51cm^2 . Determine the radius of its base. (2 Marks)

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MERU CENTRAL CLUSTER EXAMINATION
121/2
MATHEMATICS
PAPER 2
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SECTION 1 : 50 MARKS.

ANSWER ALL THE QUESTIONS

1. Evaluate without using Mathematical tables or a calculator. (3mks)

$$2\log 5 - \frac{1}{2}\log 16 + 2\log 40$$

2. The sum of K terms of sequence 3,9,15,21.....is 7500. Determine the value of K. (3mks)

3. Use matrix method to solve (3mks)

$$5x + 3y = 35$$

$$3x - 4y = -8$$

4. Calculate the percentage error in the volume of a cone whose radius is 9.0cm and slant length 15.0cm. (3mks)

5. Make y the subject the subject of the formula (3mks)

$$\frac{p}{w} = \frac{my-2}{ny+4}$$

6. Solve for x: $\tan^2 x - 2 \tan x = 3$ for the interval $0 \leq x \leq 180^\circ$ (3 marks)

7. The table below shows income tax rates in the year 2013.

| Monthly Income in Ksh | Tax rate in each shilling |
|-----------------------|---------------------------|
| Up to 9680 | 10% |
| 9681-18800 | 15% |
| 18801 – 27920 | 20% |
| 27921 – 37040 | 25% |
| Over 37040 | 30% |

In that year, a monthly personal tax relief of ksh 1056 was allowed. Calculate the monthly income tax by a constable who earned a monthly salary of ksh. 42500 (3mks)

8. Simplify $\frac{2\sqrt{2}}{1+\sqrt{2}} - \frac{\sqrt{2}}{1-\sqrt{2}} = a + b\sqrt{c}$ leaving your answer in the form $a + b\sqrt{c}$, where a, b and c are rational numbers. (3mks)

- 9 a) Expand $(1-n)^5$ (2mks)

b) Use the expansion in (a) up to the term in n^3 to approximate the value of $(0.98)^5$ (2mks)

- 10 The probability that three candidates; Anthony, Beatrice and Caleb will pass an examination are $\frac{3}{4}$, $\frac{2}{3}$ and $\frac{4}{5}$ respectfully. Find the probability that:-all the three candidates will not pass. (2mks)

11. The equation of a circle is $X^2 + Y^2 - 4x + 6y + 4 = 0$. On the graph provided draw the circle (4mks)

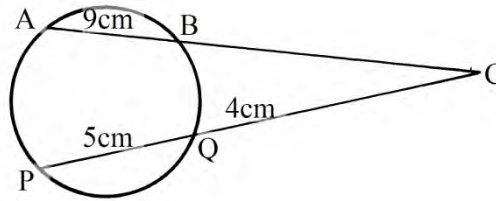
12. Find the shortest distance between points A(50°S,25°E) and B(50°S, 140°E) in KM (Take R=6370 Km) (3mks)

13. The mid-point of AB is (1,-1.5, 2) and the position vector of a point A is $-1 + j$. Find the magnitude of \vec{AB} correct to 1dp. (3mks)

14. Without using a calculator or mathematical tables. Express $\frac{3}{1-\cos 30^\circ}$ in surd form and simplify (3mks)

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15. The figure below shows a circle centre O. AB and PQ are chords intersecting externally at a point C. AB = 9cm, PQ = 5cm and QC = 4cm. Find the length of BC. (3mks)



16. Evaluate without using tables

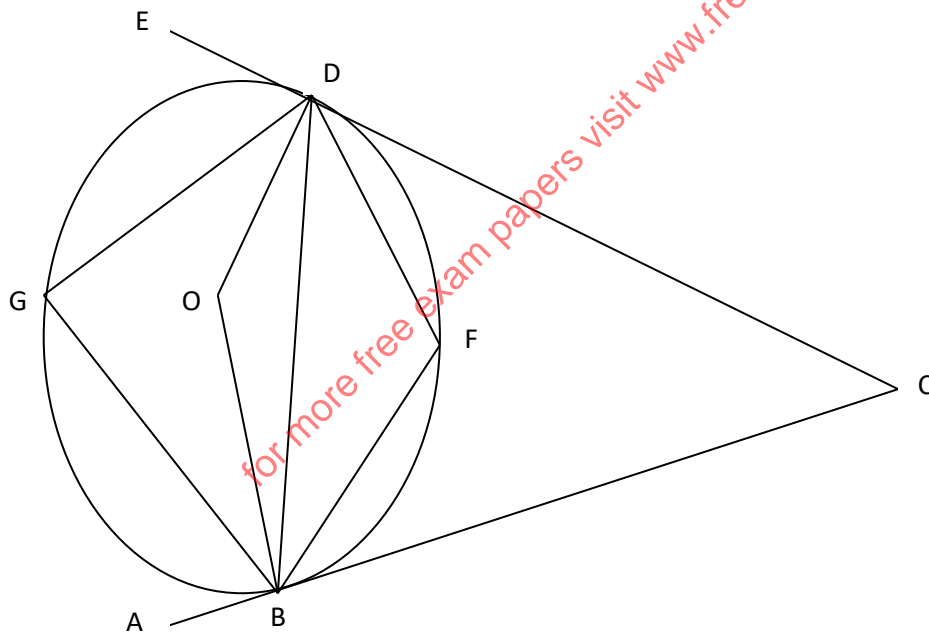
$$\log(3x+8) - 3\log 2 = \log(x-4)$$

(4mks)

SECTION II (50 MARKS)

Answer ONLY FIVE questions in this section

17. a) Use the trapezium rule with six trapezia to estimate the areas bounded by the curve $Y=2n^2 + 3n + 1$, the axis and the ordinate $x=0$ and $x=3$. (5mks)
 b) Calculate the exact area in (a) above by integration. (3mks)
 c) Assuming they are calculated in (a) above is an estimate, calculate the percentage error made when the trapezium rule is used leaving your answer to 2 decimal places. (2mks)
18. In the diagram below $\angle EDG=36^\circ$ and $\angle ABG=42^\circ$. Line EDC and ABC are tangents to the circle at D and B respectively.



Calculate by giving reason

- a) $\angle DGB$ (2mks)
 b) Obtuse $\angle DOB$ (2mks)
 c) $\angle GDB$ (2mks)
 d) $\angle DCB$ (2mks)
 e) $\angle DFB$ (2mks)

19. The table below shows the rate at which income tax is charged for all income earned in a month in 2015.

| Taxable Income p.m (Kenya pound) | Rate in % per Kenya pound |
|----------------------------------|---------------------------|
| 1 -236 | 10% |
| 237 -472 | 15% |
| 473 -708 | 20% |
| 709 – 944 | 25% |
| 945 and over | 30% |

Mrs.mumanyi earns a basic salary of 18000.She is entitled to a house allowance of Ksh. 6,000 a person relief of Ksh. 1064 month

Every month she pays the following.

- (i) Electricity bill shs.580
- (ii) Water bill shs. 360
- (iii) Co-operative shares shs. 800
- (iv) Loan repayment Ksh. 3000

- (a) Calculate her taxable income in k£ p.m (2Marks)
- (b) Calculate her P.A.Y.E (6Marks)
- (c) Calculate her net salary (2Marks)

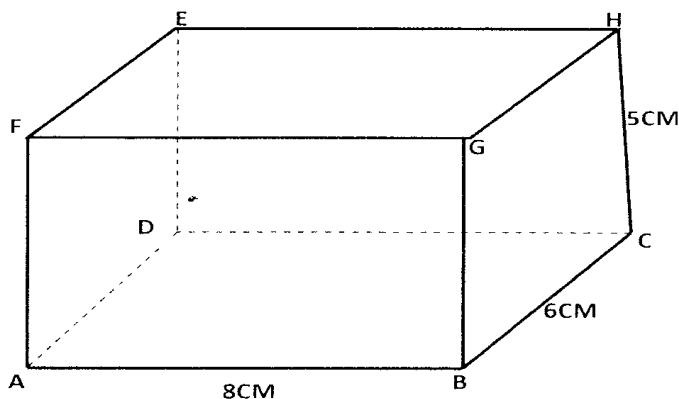
20. A flower garden is in the shape of a triangle ABC such that AB = 9M, AC=7.5M and angle ACB=75%. Using a rule and a pair of compass only.

- a) Construct $\triangle ABC$ (3mks)
- b) Construct a locus of P such that AP = pc (2mks)
- c) Construct locus of Q such that it is equal distance from AB and BC and locus of R which is 2M from AC. (2mks)
- d) Flowers are to be planted such that they are nearer AC than AB and less than 5m from a shade the portion with flowers. (3mks)

21. A tank has two water taps P and Q and another tap R. When empty the tank be filled by tap P alone in 5 hours or by tap Q in 3 hours .When full the tank can be emptied in 8 hours by tap R

- a) The tank is initially empty . Find how long it would take to fill up the tank
 - i) If tap R is closed and taps P and Q are opened at the same time (2mks)
 - ii) If all the three taps are opened at the same time .Giving your answer to the nearest minute (2mks)
- b) Assume the tank initially empty and the three taps are opened as follows
 - P at 8:00 am
 - Q at 9:00 am
 - R at 9:00 am
 - i) Find the fraction of the time that would be filled by 10:00 am (3mks)
 - ii) Find the time the tank would be fully filled up. Give your answer to the nearest minute (3mks)

22. The figure below shows a cuboid.

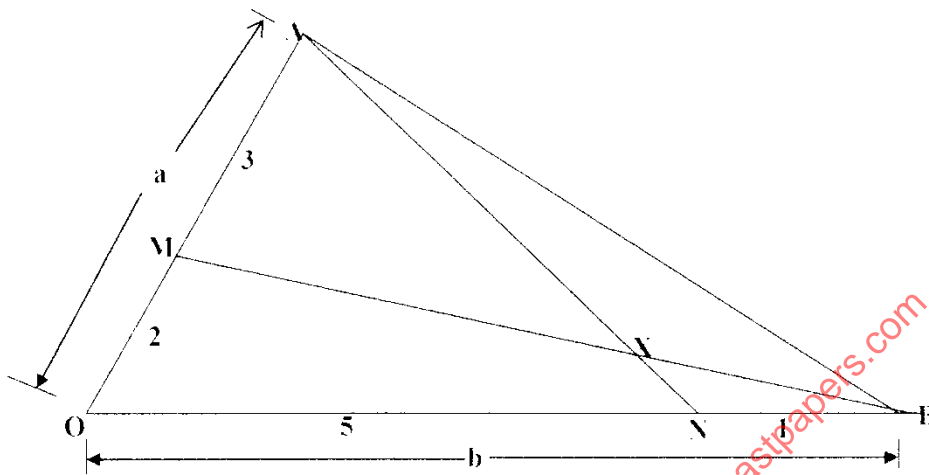


MATHEMATICS PAPER 1 & 2

Calculate

- (a) The length BE (2Mks)
- (b) The angle between BE and plane ABCD (3Mks)
- (c) The angle between FH and BC. (2Mks)
- (d) The angle between plane AGHD and plane ABCD. (3Mks)

23. In triangle OAB below OA = a, OB = b point M lies on OA such that OM : MA = 2:3 and point N lies on OB such that ON: NB = 5:1 line AN intersect line MB at X.



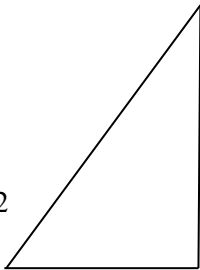
- (a) Express in terms of a and b
 - (i) AN (1mk)
 - (ii) BM (1mk)
- b) Given that $AX = kAN$ and $BX = rBM$ where k and r are scalars.
 - a. write down two different expressions for OX in terms of a, b, k and r. (2mks)
 - b. Find the value of k and r. (4mks)
 - c. Determine the ratio in which X divides line MB. (2mks)

24. (a) Complete the table below for the function $y = n^3 - 3n^2 - n + 2$ for $-2 \leq n \leq 4$. (2mks)

| | | | | | | |
|---|----|----|---|---|---|----|
| X | -2 | -1 | 0 | 1 | 3 | 4 |
| Y | 6 | | 2 | | | 14 |

- b) On the grid provided, draw the graph of $y = n^3 - 3n^2 - n + 2$. (3mks)
 - a) (i) Use the graph to solve the equation $n^3 - 3n^2 - n + 2 = 0$ (2mk)
 - (ii) By drawing a suitable line on the graph, solve the equation $n^3 - 3n^2 - 3n + 3 = 0$ (3mks)

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 TERM 2, 202 DECEMBER 2020
 MARKING SCHEME

| Q | | | | |
|----|--|--|-------------------------------|---|
| 1. | <p>Num</p> $\frac{7}{4} \times \frac{7}{3} = \frac{49}{12}$ $\frac{7}{5} \times \frac{12}{49} = \frac{12}{35}$ $\frac{3}{5} \times \frac{12}{5} = \frac{21-12}{35}$ $= \frac{9}{35}$ $\frac{Num}{Den} = \frac{9}{35} \times \frac{7}{5} = \frac{9}{25}$ | <p>Den</p> $\frac{5}{8} \times \frac{2}{3} = \frac{5}{12}$ $\frac{10}{7} - \frac{5}{12} = \frac{120-35}{84}$ $= \frac{85}{84}$ $\frac{12}{7} \times \frac{85}{84} = \frac{5}{7}$ | <p>M1</p> <p>M1</p> <p>A1</p> | <p>Numerator</p> <p>Denominator</p> <p>Accuracy</p> |
| 2. | <p>118 yens = ksh. 76</p> <p>$\therefore 2,950,000 \text{ yens} = \frac{2,950,000}{118} \times 76$</p> <p>=ksh. 1,900,000</p> <p>The duty paid $\frac{20}{100} \times 1,900,000$</p> <p>=Ksh. 380,000</p> | | <p>M1</p> <p>M1</p> <p>A1</p> | |
| 3. | <p>$2 + \frac{40}{60} = 2 \frac{2}{3}$ hours</p> <p>$2 \frac{2}{3} \times 120 = 320$ km</p> <p>$\frac{320}{4} = 80$ litres</p> <p>$80 \times 59 = 4720$ sh.</p> | | <p>B1</p> <p>M1A1</p> | |
| 4. | <p>$2\pi r l = 1980$</p> <p>$2 \times \frac{22}{7} \times 21 \times h = 1980$</p> <p>$h = \frac{1980}{132} = 15\text{cm}$</p> <p>$v = \pi r^2 h = \frac{22}{7} \times 21^2 \times 15$</p> <p>$= \frac{20790}{1000}$</p> <p>=20.81</p> | | <p>M1</p> <p>M1</p> <p>A1</p> | |
| 5. | <p>Adjacent = $\sqrt{13^2 - 5^2} = 12$</p> <p>Tan (90 - θ) = 12/5</p>  | <p>B1 for 12</p> <p>B1 - answer</p> | <p>B1</p> <p>A1</p> | |

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SECTION I (50 marks)

Answer all the questions in this section in the spaces provided.

- Without using mathematical tables or calculators, *evaluate* $\sqrt{\frac{1408 \times 0.594 \times 0.012}{6.05 \times 125}}$ leaving your answer as a simplified fraction (3mks)
- Two similar solids have surface areas 48cm^2 and 108cm^2 respectively. Find the volume of the smaller solid if the bigger one has a volume of 162cm^3 . (3mks)
- A triangle flower garden has an area of 28m^2 . Two of its edges are 14 metres and 8 metres. Find the angle between the two edges. (2mks)
- A watch which loses a half a minute every hour. It was set to read the correct time at 0445hr on Monday. Determine in twelve hour system the time the watch will show on Friday at 1845hr the same week. (3mks)
- Find the least whole number by which $2^5 \times 5^4 \times 7^3$ must be multiplied with to get a perfect cube. What is the cube root of the resulting number? (3mks)
- A woman went on a journey by walking, bus and matatu. She went by bus $\frac{4}{5}$ of the distance, then by matatu for $\frac{2}{3}$ of the rest of the distance. The distance by bus was 55km more than the distance walked. Find the total distance. (3mks).
- Simplify the expression: $\frac{9t^2 - 25a^2}{6t^2 + 19at + 15a^2}$ (3mks).
- Solve the simultaneous equations
 $xy = 4$ and $x + y = 5$ (4mks)
- The size of an interior angle of regular polygon is $3x^\circ$. While its exterior angle is $(x - 20)^\circ$. Find the number of sides of the polygon. (3mks)
- A Kenya company received US Dollars M. The money was converted into Kenya Shillings in a bank which buys and sells foreign currencies.

| | <u>Buying (in Ksh)</u> | <u>Selling (in Ksh)</u> |
|------------------|------------------------|-------------------------|
| 1 Sterling Pound | 125.78 | 126.64 |
| 1 Us Dollar | 75.66 | 75.86 |

 - If the company received Ksh.15, 132,000, calculate the amount, M received in US Dollar. (2mks)
 - The company exchanged the above Kenya shillings into Sterling pounds to buy a car in Britain. Calculate the cost of the car to the nearest Sterling pound. (2mks)
- A plot in a shape of rectangle measures 608m by 264m. Equidistance fencing posts are placed along its length and breadth as far apart as possible. Determine
 - The maximum distance between the posts. (1mk)
 - The number of posts used. (2mks)
- Given that $\sin(x - 30)^\circ - \cos(4x)^\circ$. Find the $\tan(2x + 30)^\circ$ (3mks)
- A trader sold a dress for Ksh 7200 allowing a discount of 10% on the marked price. If the discount had not been allowed the trader would have made a profit of 25% on the sale of the suit. Calculate the price at which the trader bought the dress. (3mks)

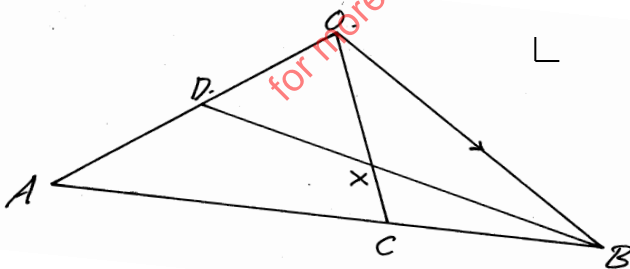
MATHEMATICS PAPER 1 & 2

14. In August, Joyce donated $\frac{1}{6}$ th of her salary to a children's home while Chui donated $\frac{1}{5}$ th of his salary to the same children's home. Their total donation for August was Kshs 14820. In September, Joyce donated $\frac{1}{8}$ th of her salary to the children's home while Chui donated $\frac{1}{12}$ th of his salary to the children's home. The total donation for September was Kshs 8675. Calculate Chui's monthly salary. (4mks)
15. Simplify completely $\frac{3^{n+3} - 3^{n+1}}{4 \times 3^{n+2}}$ (3mks)
16. In what ratio should grade **A** tea costing Sh. 180 per kg be mixed with grade **B** tea costing Sh. 300 per kg to produce Nganomu Tea which when sold at Kshs 270 a profit of 20% is realized? (3mks)

SECTION II (50 MARKS)

Answer any five questions from this section in the spaces provided

17. Atambo poured spirit into a test tube which has hemispherical bottom of inner radius 1.5cm. He noted that the spirit is 8cm high.
- What is the area of surface in contact with spirit? (4mks)
 - Calculate volume of spirit in the test tube. (4mks)
 - If Atambo obtained the mass of the spirit as 10g. Calculate the density of the spirit. (2mks).
18. A bus left Nairobi at 7.00 am and traveled towards Eldoret at an average speed of 80Km/hr. At 7.45am a car left Eldoret towards Nairobi at an average speed of 120Km/hr. The distance between Nairobi and Eldoret is 300 km. Calculate:
- The time the bus arrived at Eldoret. (2mks)
 - The time of the day the two met. (4mks)
 - The distance of the bus from Eldoret when the car arrived in Nairobi. (2mks)
 - The distance from Nairobi when the two met. (2mks)
19. The figure below C is a point on AB such that AC: CB=3:1 and D is the mid -point of OA. OC and BD intersect at X.



Given that $\mathbf{OA} = \mathbf{a}$ and $\mathbf{OB} = \mathbf{b}$

- Write the vectors below in terms of \mathbf{a} and \mathbf{b} .
 - \mathbf{AB} (1mk)
 - \mathbf{OC} (2mks)
 - \mathbf{BD} (1mk)
- If $\mathbf{BX} = h \mathbf{BD}$, express \mathbf{OX} in terms of \mathbf{a} , \mathbf{b} , and h . (1mk)
- If $\mathbf{OX} = k \mathbf{OL}$, find h and k . (4mks)
- Hence express \mathbf{OX} in terms of \mathbf{a} and \mathbf{b} only. (1mk).

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20. (a) Using a ruler and a pair of compasses only, draw a triangle ABC such that $AB = 5\text{cm}$, $BC = 8\text{cm}$ and $\angle ABC = 60^\circ$. Measure AC and $\angle CAB$. (4mks)
 (b) Find a point O in ΔABC such that $OA = OB = OC$. (2mks).
 (c) Construct a perpendicular from A to BC to meet BC at D. Measure AD. Hence calculate the area of the ΔABC (4mks)
21. A boy started walking due East from a dormitory 100m South of a bore-hole. He walked to the school library from which the bearing of the bore-hole is 315° . He then walked on a bearing of 030° to the water tank. From the water tank he went west to the bore-hole.
 (a) Using a scale of 1cm to represent 20m, construct a diagram to show the positions of the tank, borehole, dormitory and library. (5mks).
 (b) Find the distance and bearing of the bore-hole from the water tank. (3mks)
 (c) Calculate the total distance covered by the boy. (2mks).

22. The table below shows the amount in shillings of pocket money given to students in a particular school.

| Pocket Money (Ksh) | 210 – 219 | 220-229 | 230-239 | 240-249 | 250-259 | 260-269 | 270-279 | 280-289 | 290-299 |
|--------------------|-----------|---------|---------|---------|---------|---------|---------|---------|---------|
| No. of Students | 5 | 13 | 23 | 32 | 26 | 20 | 15 | 12 | 4 |

- (a) State the modal class. (1mk)
 (b) Calculate the mean amount of pocket money given to these students to the nearest shilling. (4mks).
 (c) Use the same axes to draw a histogram and a frequency polygon on the grid provided (5mks)
23. (a) Given that $y = 7 + 3\chi - \chi^2$, complete the table below. (2mks)

| | | | | | | | | | | |
|--------|-----|----|----|---|---|---|---|---|---|-----|
| χ | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| y | -11 | | | 7 | | | | | | -11 |

- (a) On the grid provided and using a suitable scale draw the graph of $y = 7 + 3\chi - \chi^2$. (3mks)
 (b) On the same grid draw the straight line and use your graph to solve the equation $\chi^2 - 4\chi - 3 = 0$. (3mks)
 (c) Determine the coordinates of the turning point of the curve. (2mks)
24. A straight line L_1 has a gradient $-\frac{1}{2}$ and passes through point P (-1, 3). Another line L_2 passes through the points Q (1, -3) and R (4, 5). Find.
 (a) The equation of L_1 . (2mks)
 (b) The gradient of L_2 . (1mk)
 (c) The equation of L_2 . (2mks)
 (d) The equation of a line passing through a point S (0, 5) and is perpendicular to L_2 . (3mks)
 (e) The equation of a line through R parallel to L_1 . (2mks)

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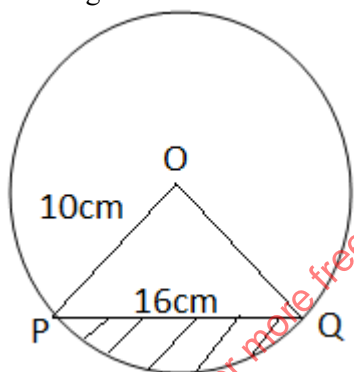
SECTION A: (50MARKS)

Answer all questions in this section in the spaces provided.

1. Use logarithms tables to evaluate. (4mks)

$$\sqrt[3]{\frac{36.72 \times (0.46)^2}{185.4}}$$

2. If $A = 2.3$, $B = 8.7$ and $C = 2.0$. Find the percentage error in calculating $\frac{A+B}{C}$ (3mks)
3. Given that $M = i - 3j + 4k$, $W = 6i + 3j - 5k$ and $Q = 2M + 5W$, find the magnitude of Q to 3 significant figures. (3mks)
4. Solve the following equation $2^{2x+3} - 2^{x+4} = 17(2^x) - 4$ (4mks)
5. If $\frac{1}{3-\sqrt{5}} - \frac{2+2\sqrt{5}}{3+\sqrt{5}} = a + b\sqrt{c}$, find the value of a , b and c (3mks)
6. Pipe A can fill an empty water tank in 3hrs while Pipe B can fill the same tank in 6hrs. When the tank is full it can be emptied by Pipe C in 8hrs. Pipe A and B are opened at the same time when the tank is empty. If one hour later Pipe C is also opened, find the total time taken to fill the tank. (3mks)
7. The figure below shows a circle center O , radius 10 cm . The chord $PQ = 16\text{ cm}$. Calculate the area of the unshaded region. (4mks)



8. The mean weight of 36 students is 45kg; two of the students leave and the mean weight increases by 0.5kg. If one of the students who left weighed 43kg, find the weight of the other one. (3mks)
9. Use the trapezium rule to estimate the area bounded by the curve $y + x^2 = 4$ and the lines $y = 0$, $x = -2$ and $x = 2$ using four strips. (3mks)
10. $4x^2 - 10x + 4y^2 + 12y - 1 = 0$ represents a circle centre $C(a, b)$ and of radius K . Find the values of a , b and K . (3mks)
11. Make x the subject of the equation (3mks)

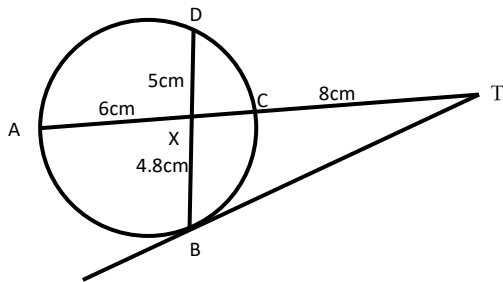
$$\frac{t}{s} = \frac{b}{\sqrt{x-4}}$$

12. Use reciprocal, square and cube root tables to evaluate to 4 significant figures, the expression. (3mks)

$$\sqrt[3]{\frac{9}{0.03746}} + 0.6042^2$$

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13. (a) Expand the expression $(1 + \frac{1}{2}x)^5$ in ascending powers of x, leaving the coefficients as fractions in their simplest form. (2mks)
 (b) Use the first three terms of the expansion in (a) above to estimate the value of $(1\frac{1}{20})^5$. (2mks)
14. In the diagram below, BT is a tangent to the circle at B. AXCT and BXD are straight lines. AX = 6cm, CT = 8cm, BX = 4.8cm and XD = 5cm.



Find the length of BT. (2mks)

15. Find x if $\cos x = \frac{\sqrt{3}}{2}$ for $-180^\circ \leq x \leq 180^\circ$. (2mks)
16. The following were recorded on a field note book by a surveyor. Taking the base line as 550m. Find the area in m². (3mks)

| | | | | | | |
|--|---|-----|-----|-----|----|---|
| | | | B | | | |
| | | | 550 | 120 | TO | A |
| | C | 150 | 450 | | | |
| | | | 250 | 90 | TO | D |
| | E | 60 | 40 | | | |
| | | | F | | | |

SECTION II (50mrks)

Attempt any FIVE questions from this section

17. Mr. Kobe is a civil servant who earns a monthly salary of Ksh. 21200. He has a house allowance of Ksh. 12000 per month, other taxable allowances are commuter Ksh. 1100, medical allowance Ksh. 2000. He is entitled to a personal relief of Ksh. 1240 per month.

Using the income rates below, solve the questions that follow.

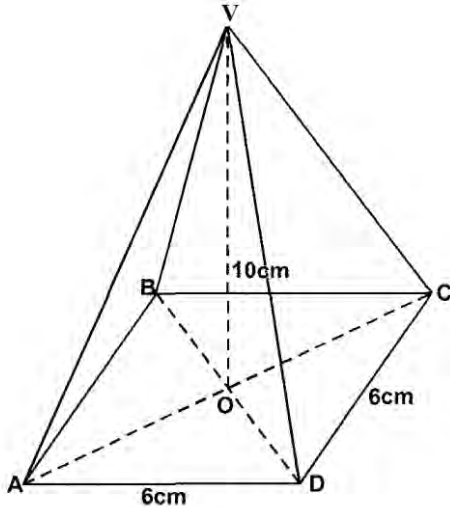
| Income in Ksh. per month | Rates in Ksh per sh 20 |
|--------------------------|------------------------|
| 1 – 8,400 | 2 |
| 8401 – 18,000 | 3 |
| 18001 – 30,000 | 4 |
| 30001 – 36,000 | 5 |
| 36001 – 48,000 | 6 |
| Above 48,000 | 7 |

Determine;

- a) i) His monthly taxable income. (2mks)
 ii) Net tax (PAYE) (5mks)
- b) In addition to the PAYE, the following deductions were made. Ksh. 250 for NHIF, Ksh. 120 service charges, he repays a loan at sh. 4500 and contributes towards savings at sh. 1800 every month. Calculate his net salary per month. (3mks)

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18. The figure below is a square based pyramid ABCDV with AD=DC = 6cm and height V = 10cm



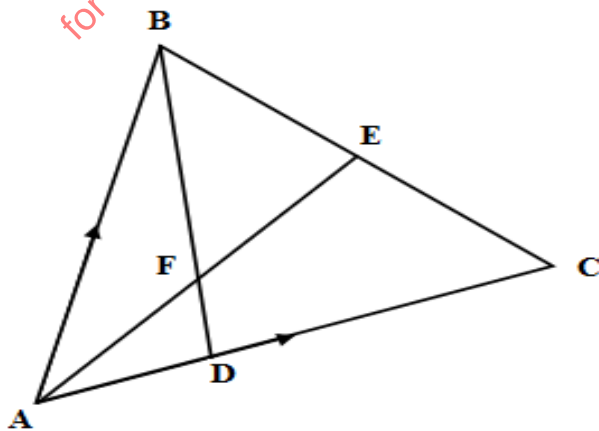
- a) State the projection of VA on the base ABCD. (1mk)
- b) Find:
 - i) The length of VA (3mks)
 - ii) The angle between VA and ABCD (2mks)
 - iii) The angle between the planes VDC and ABCD (2mks)
 - iv) Volume of the pyramid (2mks)

19.a) Complete the table below for $y = \sin 2x$ and $y = \sin (2x + 30)$ giving values to 2d.p.(2mks)

| | | | | | | | | | | | | | |
|---------------|----|---|---|---|-----|---|---|----|-----|----|----|----|----|
| X | | 5 | 0 | 5 | 0 | 5 | 0 | 05 | 20 | 35 | 50 | 65 | 80 |
| Sin 2x | | | | | .87 | | | | .87 | | | | |
| Sin (2x + 30) | .5 | | | | .5 | | | | 1 | | | | .5 |

- b) Draw the graphs of $y = \sin 2x$ and $y = \sin (2x + 30)$ on the axis. (4mks)
- c) Use the graph to solve $\sin (2x + 30) - \sin 2x = 0$ (1mk)
- d) Determine the transformation which maps $\sin 2x$ onto $\sin (2x + 30)$ (1mk)
- e) State the period and amplitude of $y = \sin (2x + 30)$ (2mks)

20. In the figure below E is the midpoint of BC. AD: DC 3:2 and F is the meeting point of BD and AE.



- a) If $AB = \mathbf{b}$ and $AC = \mathbf{c}$, find:
 - i) BD (2mks)
 - ii) AE (2mks)
- b) If $BF = t BD$ and $AF = n AE$. Find the value of t and n . (5mks)
- c) State the ratio of BD to BF . (1mk)

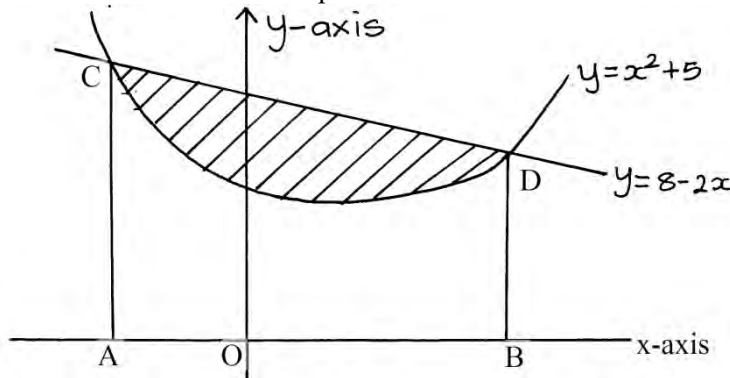
21. The position of two towns X and Y are given to the nearest degree as X (45° N, 110° W) and

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Y (45° N, 70° E). Take $\pi = 3.142$, $R = 6370\text{km}$. Find:

- (a) The distance between the two towns along the parallel of latitude in km. (3mks)
 - (b) The distance between the towns along a parallel of latitude in nautical miles. (3mks)
 - (c) A plane flew from X to Y taking the shortest distance possible. It took the plane 15hrs to move from X and Y. Calculate its speed in Knots. (4mks)
 - d) If the plane left town X on Monday 12:45PM. Find the local time it arrived at town Y. (3mks)
22. The 2nd and 5th terms of an arithmetic progression are 8 and 17 respectively. The 2nd, 10th and 42nd terms of the A.P. form the first three terms of a geometric progression. Find
- (a) The 1st term and the common difference. (3mks)
 - (b) The first three terms of the G.P and the 10th term of the G.P. (4mks)
 - (c) The sum of the first 10 terms of the G.P. (3mks)

23. The diagram below, not drawn to scale shows part of the curve $y = x^2 + 5$ and the line $y = 8 - 2x$. The line intersects the curve at points C and D. Lines AC and BD are parallel to the y-axis.



- (a) Determine the coordinates of C and D. (4mks)
 - (b) Use integration to calculate the area bounded by the curve and the x-axis between the points C and D. (3mks)
 - (c) Calculate the area enclosed by the lines CD, CA, BD and the x-axis. (3mks)
 - (d) Hence determine the area of the shaded region. (1mk)
24. Using a ruler and pair of compasses only
- a) Construct triangle ABC in which $AB = 9\text{cm}$, $AC = 8\text{cm}$ and angle $BAC = 60^\circ$. Measure BC (2mks)
 - b) On the same side of AB as C, draw the locus of a point such that angle $APB = 60^\circ$ (3mks)
 - c) A region T is within the triangle ABC such that $AT > 4\text{cm}$ and angle $ACT \geq$ angle BCT . Show the region T by shading it. (5mks)

SECTION I (50 MARKS)

Answer ALL the questions in this section

1. Without using a calculator or a mathematical table evaluate. (3 marks)

$$\frac{\frac{6}{7} \text{ of } \frac{14}{3} \div 8 \times \frac{-2}{3}}{-2 \times 3 + (14 \div 7) \times -3}$$

2. By using substitution $y = 3^x$ or otherwise solve, (4 marks)

$$9^{x+1} - 3^x = 3^{x+3} - 3$$

3. Simplify: $\frac{12x^2 - 27}{4 - (2x + 1)}$ (3 marks)

4. A line L_1 is perpendicular to the line $2x - 3y + 6 = 0$. Find the angle made by line L_1 and x axis. (3 marks)

5. Three – fifths of a certain work is done on the first day. On the second day, $\frac{3}{4}$ of the remainder is completed. If on the third day $\frac{7}{8}$ of what remained is done, what fraction of the work still remains to be done? (3 marks)

6. A bank in Kenya buys and sells foreign currency as shown in the table below.

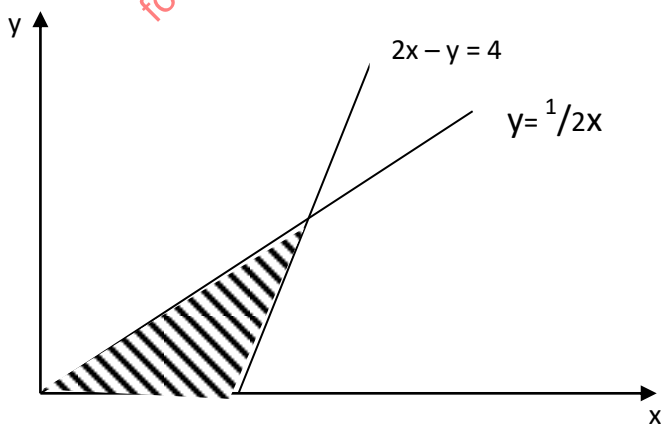
| | Buying | Selling |
|------------------|--------|---------|
| 1 US dollar | 100.87 | 100.97 |
| 1 Sterling pound | 147.27 | 147.43 |

An American tourist came to Kenya with 15000 US dollars and converted the whole of it into Ksh. He then spent Ksh. 650,000 and converted the remaining money to sterling pounds. Calculate to the nearest pound the amount of money he remained with. (3 marks)

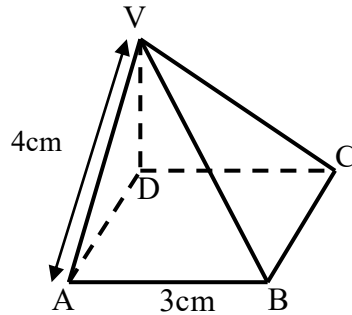
7. Use logarithm tables to evaluate $\frac{(0.07284)^2}{\sqrt[3]{0.06195}}$ (4 marks)

8. Under an enlargement scale factor -2, the image of A(2 ,4) is A'(-1 ,-2). Under the same enlargement, the image of D(x ,y) is D'(3, -2). Find the coordinates of the object D. (3 marks)

9. The figure below shows two lines $2x - y = 6$ and $y = \frac{1}{2}x$, intersecting. Calculate the area of shaded regions. (4 marks)



10. The diagram below represents a right pyramid on a square base of side 3cm. The slant edge of the pyramid is 4cm.



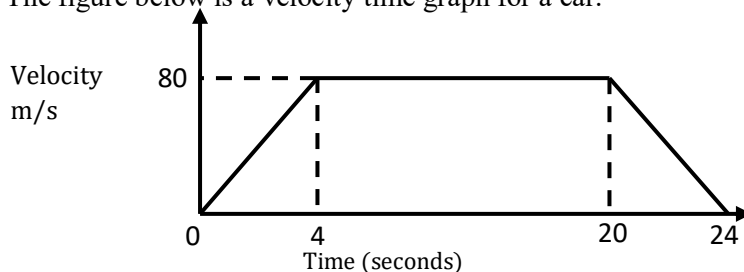
- (a) Draw a labeled net of the pyramid. (2 Marks)
 (b) On the net drawn, measure the height of a triangular face from the top of the pyramid. (1 Mark)
11. A salesman is paid a salary of Sh. 10,000 per month. He is also paid a commission on sales above Sh. 100,000. In one month he sold goods worth Sh. 500,000. If his total earning that month was Sh. 56,000. Calculate the rate of commission. (3 marks)
12. Solve the following inequality and state the integral solutions. (3 marks)
- $$\frac{1}{2}(24 - 4x) > 6\left(3x - \frac{4}{3}\right) \geq -\frac{2}{3}(42 + 3x)$$
13. A regular polygon is such that its exterior angle is one eighth the size of interior angle. Find the number of sides of the polygon. (3 marks)
14. The position vector of P is $\mathbf{OP} = 2\mathbf{i} - 3\mathbf{j}$ and M is the mid – point of PQ. Given $\mathbf{OM} = \mathbf{i} + 4\mathbf{j}$, Obtain the vector \mathbf{PQ} . (3 marks)
15. A liquid spray of mass 384 g is packed in a cylindrical container of internal radius 3.2 cm. Given that the density of the liquid is 0.6g/cm^3 , calculate to 2 decimal places the height of liquid in the container (3 marks)
16. Given that $\sin(2\theta + 30) = \cos(\theta - 60)$. Find the value of $\tan \theta$ to two decimal places. (2 marks)

SECTION II (50 MARKS)

Answer any FIVE questions only in this section

17. Water flows through a circular pipe of cross-sectional area of 6.16cm^2 at a uniform speed of 10cm per second. At 6.00 a.m. water starts flowing through the pipe into an empty tank of base area are 3m^2 .
- a) What will be the depth of the water at 8.30 a.m.? (5 marks)
 b) If the tank is 1.2m high and a hole at the bottom through which water leaks at a rate of 11.6cm^3 per second. Determine the time at which the tank will be filled. (5 marks)

18. (a) The figure below is a velocity time graph for a car.



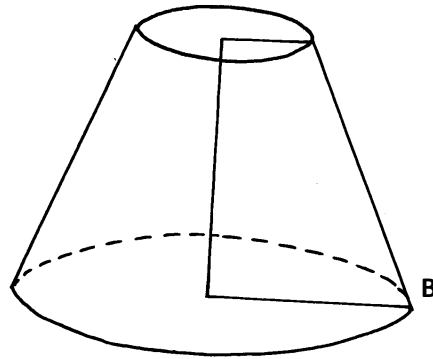
- (i) Find the total distance travelled by the car. (2 marks)
 (ii) Calculate the deceleration of the car. (2 marks)
- (b) A car left Nairobi towards Eldoret at 7.12 a.m. at an average speed of 90km/h. At 8.22 a.m., a bus left Eldoret for Nairobi at an average speed of 72km/hr. The distance between the two towns is 348km. Calculate:
- i) the time when the two vehicles met. (4 marks)
 ii) the distance from Nairobi to the meeting place. (2 marks)
19. Using a ruler and a pair of compass only.
- a) Construct a triangle ABC in which $AB=8\text{cm}$, $BC=7.5\text{ cm}$ and $\angle ABC = 112.5^\circ$. (3 marks)

MATHEMATICS PAPER 1 & 2

Measure length of AC. (1 mark)

- b) By shading the required region show the locus of P within triangle ABC such that
 - i) $AP \leq BP$
 - ii) $AP > 3$ (2 marks)
- c) Construct a normal line from C to meet AB at D. (1 mark)
- d) Locate the locus of R in the same diagram such that the area of the triangle ARB is $\frac{3}{4}$ area of triangle ABC. (3 marks)

20. The diagram below represents a solid consisting of a hemispherical bottom and a conical frustum at the top. $O_1O_2=4\text{cm}$, $O_2B=R=4.9\text{cm}$ $O_1A=r=2.1\text{cm}$



- a) Determine the height of the chopped off cone and hence the height of the bigger cone. (2 marks)
- b) Calculate the surface area of the solid. (4marks)
- c) Calculate the volume of the solid. (4mark)

21. a) Complete the table given below for the equation $y = -2x^2 + 3x + 3$ for the range $-2 \leq x \leq 3.5$ by filling in the blank spaces. (2 marks)

| | | | | | | | | | | | | |
|---|----|------|----|------|---|-----|---|-----|---|-----|---|-----|
| x | -2 | -1.5 | -1 | -0.5 | 0 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 3.5 |
| y | | -6 | | 1 | | | | | | -2 | | -11 |

- (b) Use the values from the table above to draw the graph of $y = -2x^2 + 3x + 3$. (3 marks)
- (c) Use your graph to:
 - (i) Determine the integral values of x in the graphs range which satisfy the inequality $2x^2 - 3x - 3 \geq 3$. (3 marks)
 - (ii) Solve $-2x^2 + 2x + 5 = 0$. (2 marks)

22. Triangle ABC has vertices A(3, 1), B(4, 4) and C(5, 2). The triangle is rotated through 90° about (1, 1) to give $A'B'C'$. Triangle $A'B'C'$ is then reflected on the line $y - x = 0$ onto $A''B''C''$. triangle $A''B''C''$ then undergoes enlargement scale factor $-\frac{1}{2}$ through the origin to give $A'''B'''C'''$.

- (a) On the graph paper, draw triangles $A'B'C'$, $A''B''C''$ and $A'''B'''C'''$. (8 marks)
- (b) Describe the type of congruence between:
 - i) ΔABC and $\Delta A'B'C'$
 - ii) $\Delta A'B'C'$ and $\Delta A''B''C''$ (2 marks)

23. The table below shows patients who attend a clinic in one week and were grouped by age as shown in the table below.

| | | | | | |
|--------------------|----------------|-----------------|------------------|------------------|------------------|
| Age x years | $0 \leq x < 5$ | $5 \leq x < 15$ | $15 \leq x < 25$ | $25 \leq x < 45$ | $45 \leq x < 75$ |
| Number of patients | 14 | 41 | 59 | 70 | 15 |

- (a) Estimate the mean age (4 marks)
 - (b) On the grid provided draw a histogram to represent the distribution. (3 marks)
- (Use the scales: 1cm to represent 5 units on the horizontal axis 2 cm to represent 5unit on the vertical axis)

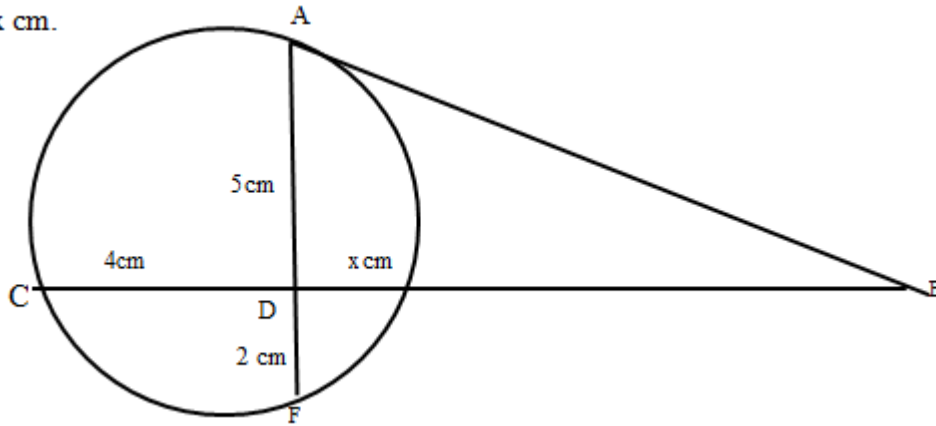
SECTION I (50 MARKS)

Answer all the questions in this section in the spaces provided below each question.

1. Using an assumed mean of 50, calculate the standard deviation of the marks obtained in a test recorded as follows: 50, 52, 45, 40, 55, 51, 56, 48, 55, 60 (2 marks)
2. Make x the subject of the formula $P = \frac{1}{2} \sqrt{\frac{x+2w}{4x+3R}}$ (3Marks)
3. Find the value of x in the equation $\text{Log}_3 X - 4\log_x 3 = -3$ (4 marks)
4. a) Expand the binomial $(2 - \frac{1}{4}x)^5$ (2 marks)
 b) Using the first 4 terms of the binomial above solve for 1.75^5 (2 marks)
5. a) Find the inverse of the matrix $\begin{pmatrix} 1 & 1 \\ 3 & 1 \end{pmatrix}$ (1 mark)
 b) Hence determine the point of intersection of the lines $x + y = 7$ and $3x + y = 15$ (2 marks)
6. Rationalise the denominator and simplify the answer completely. $\frac{\sqrt{3}}{1+\sqrt{2}} + \frac{2+5\sqrt{3}}{\sqrt{3}-\sqrt{2}}$ (3Marks)
7. Solve for x in the trigonometric equation $4\cos^2 x + 4\sin^2 x = 16\sin^2 x \cos^2 x$ in $0^\circ \leq x \leq 360^\circ$ (3 marks)
8. The mass of a cylinder of a small material varies jointly as the square of the radius and as the height. If the radius is increased by 20% and the height by 10%. Find the percentage increase in mass. (3 marks)
9. Given that the dimensions of a rectangle are 20.0cm and 25.0. Find the percentage error in calculating the area. (3 marks)
10. Maina bought a new laptop on hire purchase. The cash value of the laptop was Ksh. 56,000. He paid a deposit of Ksh. 14,000 followed by 24 equal monthly installments of Ksh. 3500 each. Calculate the monthly rate at which the compound interest was charged. (3marks)
11. Find the equation of tangent to a curve $x^2 = 4y+1$ at the point (2, 0.75) (3 marks)
12. Object A of area 12cm^2 is mapped onto its image B of area 72cm^2 by a transformation. Whose matrix is given by $P = \begin{pmatrix} x & 4 \\ 3 & x+3 \end{pmatrix}$. Find the positive values of x (3 marks)

13. In the figure below, AB is a tangent, meeting chord CDE at B. AD = 5cm, CD = 4cm, DF = 2cm, EB = 7.5cm and

DE = x cm.



Determine:

- (a) The value of x (1 mark)
- (b) The length of AB. (2 marks)

14. A ship covers 60km on a bearing of 230°. If then it changes course and heads due west for 80km, determine its direct distance from the starting point. (3 marks)

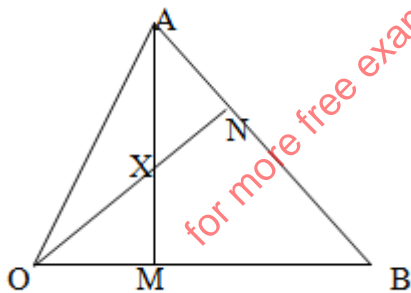
15 Find the centre and the radius of the circle whose equation is $x^2 + y^2 - 7x + 6 + 11y = 0$ (3marks)

16. The 2nd, 4th and 7th terms of A.P are the first 3 consecutive terms of a G.P. Find:
- (a) The common ratio (2Marks)
 - (b) The sum of the first eight terms of the G.P if the common difference of the A.P is 2. (2Marks)

SECTION II(50 MARKS)

Answer **ONLY FIVE** questions in this section in the spaces provided.

17.



In the figure above, M divides line OB in the ratio 1:2 and N divides AB in the ratio 2:3 AM and ON intersect at X. Given $\vec{OA} = 2a$ and $\vec{OM} = b$:

- a) Find in terms of a and b :
- (i) \vec{AB} (1 mark)

- (ii) \vec{AM} (1 mark)

- (iii) \vec{ON} (1 mark)

→ → →

b) If $AX = hAM$ and $OX = kON$ where h and k are scalars

- (i) Express \vec{OX} in two ways. (2 marks)

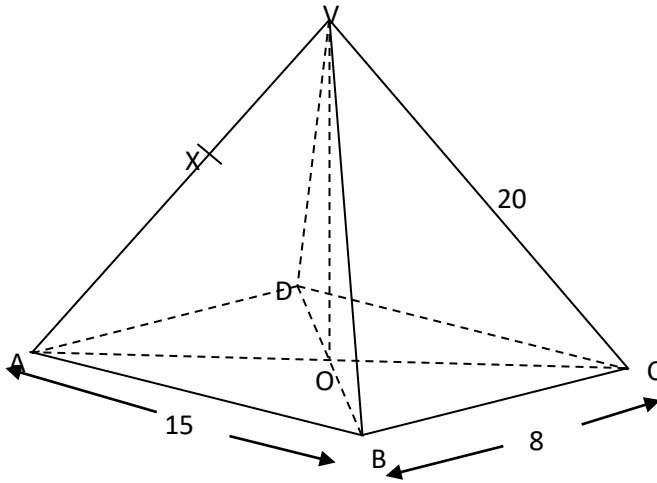
MATHEMATICS PAPER 1 & 2

Hence find the value of h and k

(4 marks)

c) Find the ratio of $\vec{AM} : \vec{MX}$ (1 mark)

18. The figure below shows a right pyramid with a rectangular base. The length of the rectangular base is 15cm and the width is 8cm. The slant edges are all equal to 20cm.



Calculate

- a) The volume of the pyramid. (3 marks)
- b) The angle VAB makes with ABCD (3 marks)
- c) The angle plane XBD makes with VBD given that point X lies on VA such that $VX : XA = 2 : 3$ (4 marks)

19. The number x is chosen at random from the set (0,3,6,9) and the number y is chosen at random from the set (0,2,4,6,8). Calculate the probability of each of the following separate events.

- (i) $x > 6$ (1 mark)
- (ii) $x + y = 11$ (2 marks)
- (iii) $x > y$ (3 marks)
- (iv) $xy = 0$ (2 marks)
- (v) $10x + y < 34$ (2 marks)

20. P and Q are two points on the same parallel of latitude $66^{\circ}25'$, whose longitudes differ by 120° . Calculate in kilometres. Radius of the earth = 6370.

- a) The radius of the parallel of latitude where P and Q lie. (2 marks)
- b) The distance of P and Q measured along the parallel of latitude. (2 marks)
- c) (i) find the length of the straight line joining PQ (2 marks)
- (ii) Find the distance between P and Q along the same latitude in nautical miles. (2 marks)
- (iii) If an aircraft took 30min to fly from P to Q, Calculate its speed in knots. (2 marks)

- 21. a) Use the trapezium rule to estimate the area between the curve $y = 3x^2 + 1$, lines $x=1$ and $x=3$ and x-axis. Use five ordinates. (5 marks)
- b) Using integration method find the exact area under a curve $y=3x^2 + 1$ (3 marks)
- c) Find the percentage error in estimating the area. (2 marks)

MATHEMATICS PAPER 1 & 2

22. The table below shows the rate at which income tax is charged for all income earned in a month in 2015.

| Taxable Income p.m (Kenya pound) | Rate in % per Kenya pound |
|----------------------------------|---------------------------|
| 1 -236 | 10% |
| 237 -472 | 15% |
| 473 -708 | 20% |
| 709 – 944 | 25% |
| 945 and over | 30% |

A total of Ksh. 14,500 is deducted from Mrs. Momanyi monthly salary .She is entitled to a house allowance of Ksh. 8,000 a person relief of Ksh. 1064 month and Monthly insurance relief at the rate of 15% of the premium paid.

Every month she pays the following.

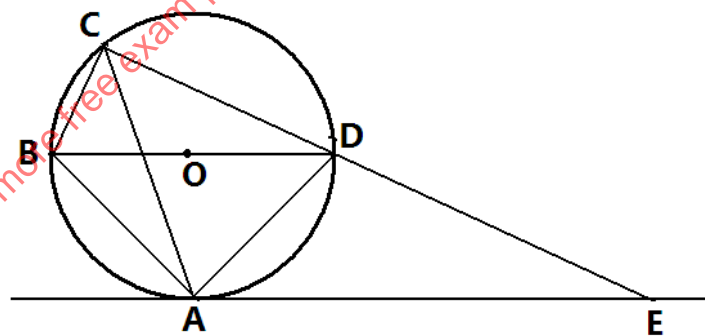
- (i) Electricity bill shs.780
- (ii) Water bill shs. 560
- (iii) Co-operative shares shs. 1200
- (iv) Loan repayment Ksh. 5000
- (v) Monthly insurance premiums of Ksh 1260

- (a) Calculate her P.A.Y.E (2Marks)
- (b) Calculate her monthly taxable income . (6Marks)
- (c) Calculate her basic salary per month (2Marks)

23. Mr. Wanyama wishes to take student from wonderful mixed secondary school for a tour. The total number of pupils to be taken should not exceed 60. Each girl must contribute sh.10,000 and each boy sh.15,000 and money to be contributed must not exceed sh.120,000. If this trip is to be successful the number of boys must conditionally be greater than girls.

- a) Write down five inequalities to represent this information taking the number of boys and girls to be x and y respectively. (4 marks)
- b) Represent the above information on the graph paper below. (4 marks)
- c) What is the optimum number of boys and girls to be taken in order to be minimise cost. (2 mark)

24. In the figure below, line BD is the diameter of the circle, centre O and AE is a tangent. Angle CBA = 110° and angle BAC = 26°.



Find the following angles, giving reasons for each answer.

- a) $\angle ABD$ (3marks)
- b) $\angle DAE$ (1mk)
- c) $\angle AED$ (3marks)
- d) $\angle AOD$ (3marks)

SECTION I

(Answer all question in this section in the spaces provided)

1. Evaluate $\frac{(2\frac{3}{7}-1\frac{5}{6})\div\frac{5}{6}}{\frac{2}{3}\text{ of }2\frac{1}{4}-1\frac{1}{7}}$ without using tables or a calculator. (3 marks)
2. Without using mathematical tables or calculator evaluate. (4 marks)

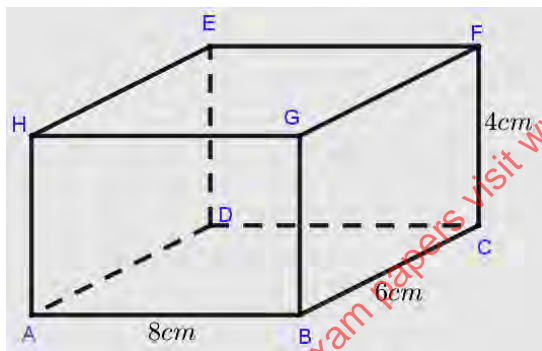
$$\frac{\sqrt[3]{0.729\times 0.125}}{\sqrt{110.25}}$$
3. A bus left Kisumu at 9:30 a.m. towards Nairobi at an average speed of 81 km/hr. At 10:10 a.m. a matatu left Nairobi for Kisumu at an average speed of 72 km/hr. The distance between Kisumu and Nairobi is 360 km. Determine the time taken before the two vehicles met. (3 marks)
4. Factorize the expression $x^2 - 1$. (2 marks)
5. Calculate the area of parallelogram PQRS in which $PR = 8\text{ cm}$, $QS = 6\text{ cm}$ and PR and QS cut at 60° (2 marks)
6. Solve for x in the equation $32^{(x-3)} \times 8^{(x+4)} = 64 \div 2^x$. (3 marks)
7. A map has a scale of 1: 40 000
 - a) Calculate the distance in metres between two points on the ground if the distance shown on the map is 3.25 cm. (2 marks)
 - b) Calculate the area on the map of woodland which occupies 36 metres by 36 metres on the ground. (2 marks)
8. Three bells ring at intervals of 9 minutes, 15 minutes and 21 minutes. The bells will next ring together at 11.00 pm. Find the time the bells had last rang together. (3 marks)
9. A bag whose marked price is sh. 800 is sold to a student after allowing her a discount of 25%. If the seller makes a profit of 20%, at what price did the seller buy the bag? (3 marks)
10. If $\cos \beta = \frac{15}{17}$, find without using tables or calculator
 - a) $\tan(90 - \beta)^\circ$ (2 marks)
 - b) $\sin \beta$ (1 mark)
11. The position vectors of A and B are $\begin{pmatrix} 2 \\ 5 \end{pmatrix}$ and $\begin{pmatrix} 8 \\ -7 \end{pmatrix}$ respectively. Find the coordinates of M which divides AB in the ratio 1: 2 (4 marks)
12. Using a pair of compass and ruler only,
 - a) Construct a triangle PQR such that $PQ = 6\text{ cm}$, $QR = 8\text{ cm}$ and $\angle PQR = 135^\circ$. (3 marks)
 - b) Construct the height of triangle PQR above taking QR as the base. (1 mark)
13. Solve the inequality and hence state the integral values. (3 marks)

$$4 - 3x > x + 12 \leq \frac{3x+29}{2}$$
14. Given that $\begin{pmatrix} x-1 & x+1 \\ 3 & 2 \end{pmatrix}$ is a singular matrix, find the value of x (3 marks)
15. Solve for x in; (3 marks)

$$\frac{6x-4}{3} - \frac{2x-1}{2} = \frac{6-5x}{6}$$
16. A practical session is expected to take 1 hour and 45 minutes. If the exam ended at 1255hrs, at what time did it start? Express the answer in 12 hr. clock system. (3 marks)

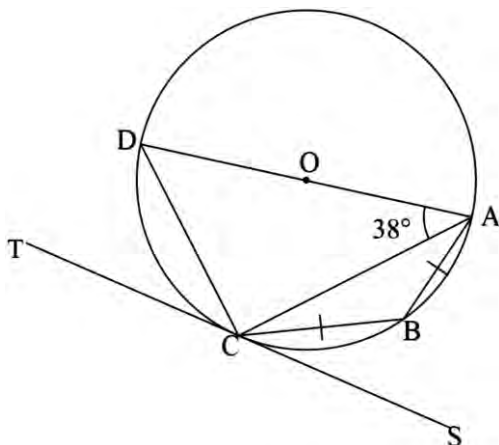
SECTION II (Answer any five questions in the spaces provided.)

17. Two tanks of equal volume are connected in such a way that one tank can be filled by pipe A in 1-hour 20minutes. Pipe B can drain one tank in 3 hours 36minutes but pipe C alone can drain both tanks in 9 hours. **Calculate:**
- The fraction of one tank that can be filled by pipe A in one hour. (2 marks)
 - The fraction of one tank that can be drained by both pipes B and C in one hour. (4 marks)
 - Pipe A closes automatically once both tanks are filled. Assuming that initially both tanks are empty and all pipes opened at once, calculate how long it takes before pipe A closes. (4 marks)
18. A straight line L_1 whose equation is $3y - 2x = -2$ passes through point $P (1, 0)$.
- Find the gradient of line L_1 . (2 marks)
 - A second line L_2 is perpendicular to line L_1 at P. find the equation of line L_2 in the form $y = mx + c$, where a, b and c are constants. (3 marks)
 - A third line L_3 passes through $(-4, 1)$ and is parallel to the line L_1 . Find the equation of line L_3 in the form $y = mx + c$ where a, b and c are constants. (2 marks)
 - Find the coordinates of point S at which L_2 intersects L_3 . (3 marks)
19. a) On the grid provided draw triangle QRS given $Q(0, 0)$, $R(2, 0)$ and $S(2, 1)$. (1 mark)
- Triangle QRS is reflected in the line $y = x$ to give triangle $Q'R'S'$. Draw $Q'R'S'$ on the same axes and state its coordinates. (3 marks)
 - Triangle $Q'R'S'$ is then rotated 180° centre $(0,0)$ to give triangle $Q''R''S''$. Find its coordinates and hence plot the image. (3 marks)
 - Find a single matrix of transformation that would map triangle $Q''R''S''$ onto triangle QRS. (3 marks)
20. The figure below is a cuboid ABCDEFGH such that $AB= 8\text{cm}$, $BC = 6\text{cm}$ and $CF 4\text{cm}$.



- Determine:
- The length
 - AC (2 marks)
 - AF (2 marks)
 - The angle AF makes with plane ABCD. (2 marks)
 - The angle plane AEFB makes with the plane ABCD (2 marks)
 - Find the angle between line EG and line DC (2 marks)
21. The weights of children were measured and recorded as follows;
- | Weight (Kg) | No. of children |
|-------------|-----------------|
| 11 – 20 | 3 |
| 21 – 30 | 9 |
| 31 – 40 | 15 |
| 41 – 50 | 14 |
| 51 – 60 | 7 |
| 61 – 70 | 2 |
- State the modal class. (1 mark)
 - Estimate the mean weight. (4 marks)
 - Calculate the median weight. (3 marks)
 - Calculate the difference between the mean weight and the median weight. (2 marks)

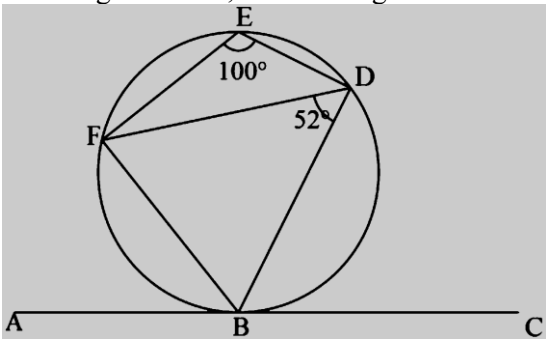
22. In the figure below, AD is a diameter of the circle ABCD centre O, radius 10 cm. TCS is a tangent to the circle at C. AB = BC and Angle DAC = 38°.



- a) Find the size of angle:
- (i) ACS (2 marks)
 - (ii) BCA (2 marks)
- b) Calculate, to 2 d.p, the length of:
- (i) AC (3 marks)
 - (ii) AB (3 marks)
23. a) Use the trapezium rule to estimate the area between the curve $y = 3x^2 + 1$, lines $x = 1$ and $x = 3$ and x-axis. Use five ordinates. (5 marks)
- b) Using integration method find the exact area under a curve $y = 3x^2 + 1$ (3 marks)
- c) Find the percentage error in estimating the area. (2 marks)
24. The displacement S metres of a moving particle after t seconds is given by $S = 2t^3 - 5t^2 + 4t + 2$. Determine;
- a) The velocity of the particle when $t = 2$. (3 marks)
 - b) The value(s) of t when the particle is momentarily at rest. (3 marks)
 - c) The displacement when the particle is momentarily at rest. (2 marks)
 - d) The acceleration of the particle when $t = 5$. (2 marks)

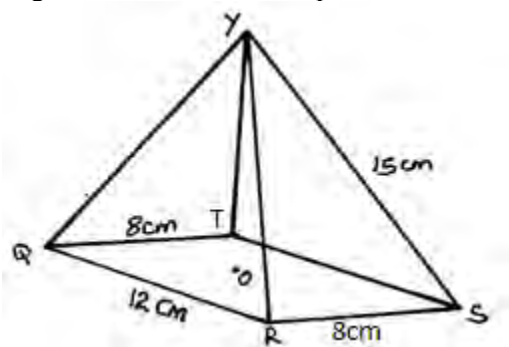
SECTION I (50 Marks)

- Simplify the expression $\frac{\sqrt{48}}{\sqrt{5+\sqrt{3}}}$, leaving your answer in the form $a + b\sqrt{c}$ where a, b and c are integers. (2 marks)
- A tea blender buys two grades of tea at sh 60 and sh 80 per packet. Find the ratio in which he should mix them so that by selling the mixture at sh 90, a profit of 25% is realized.
- A variable point varies partly as x and partly inversely as x . Given that $y = 17$ when $x = 4$ and $y = 13$ when $x = 6$, determine the law connecting y and x (3 marks)
- In the figure below, ABC is tangent to the circle at B and $\angle BDF = 52^\circ, \angle FED = 100^\circ$.



Calculate:

- $\angle FBA$ (1 mark)
 - $\angle DBC$ (1 mark)
- Solve the equation $6a^2 = 5a + 4$, using the completing square method. (4 marks)
 - A bag contains 36 balls all of the same size and shape. If y of the balls are red, 19 are white balls and the rest are blue, A ball is picked from the box at random If the probability that this ball is red is $\frac{1}{3}$, Find
 - The value of y (1 mark)
 - The probability that the ball picked is blue (2 marks)
 - The distance, S , metres covered by a particle moving horizontally from a point A after t , seconds is given by the equation $S = \frac{2}{3}t^3 + 4t^2 - 7$. Determine the acceleration of the particle after 4 seconds. (3 marks)
 - Calculate the area of a sector of a circle of radius is 8cm and subtends an angle 0.5 radians. (2 marks)
 - In a mathematics test, the scores of eight form four students are as follows 45,52,54,55, 57,57,62 and 66. Calculate the standard deviation of the scores correct to one decimal place. (4 marks)
 - State the amplitude and the period of the curve $y = 2 \sin(2x + 30)^\circ$ (2 marks)
 - The figure below shows a right pyramid with a rectangular base measuring 12cm by 8cm. The length of the slant edge is 15cm. X is the midpoint of RS and OY is the perpendicular height of the pyramid.



Determine

- The length of XY (2mk)
 - The angle between RSY and TQRS. (2mks)
- The cost of land was sh 950000. It appreciated in value by 5% per year for the first 2 years and 15% per year for the subsequent years. Calculate the value of the land after 5 years (3 marks)

13. The curve $y = ax^2 + bx + c$ passes through the origin and has a minimum point at $(-2, -4)$. Determine the values of a, b and c . (3 marks)
14. Triangle $A'B'C'$ is the image of triangle ABC when transformed under the matrix $\begin{pmatrix} 3 & -1 \\ 2 & 4 \end{pmatrix}$. If the area of triangle $A'B'C'$ is 770 cm^2 , find the area of triangle ABC. (4 marks)
15. Solve the equation $\log 3 + \log(4x + 4) = 1 + \log(2x - 2)$ (4 marks)
16. Calculate the length of the tangent from a point $(-9, 9)$ to the circle whose equation is $x^2 + y^2 + 6x - 10y - 2 = 0$. (4 marks)

SECTION B (50 MARKS) Answer ONLY five questions in this section.

17. An arithmetic progression of 41 terms is such that the sum of the first five terms is 560 and the sum of the last five terms is -250. Find:
 (a) The first term and the common difference (5 marks)
 (b) The last term (2 marks)
 (c) The sum of the progression (3 marks)
18. The table below shows a monthly income tax rate for the year 2015

| Monthly taxable income in kshs | Tax rate in percentage |
|--------------------------------|------------------------|
| 1-9680 | 10% |
| 9681-18800 | 15% |
| 18801-27920 | 20% |
| 27921-37040 | 25% |
| 37041 and above | 30% |

Peters monthly earning in 2015 were as follows

Basic Salary Kshs 35,600

House Allowance Kshs 12000

Medical allowance Kshs 2800

Transport allowance Kshs 3400

Peter was entitled to a monthly tax relief of Kshs 1056.

Calculate

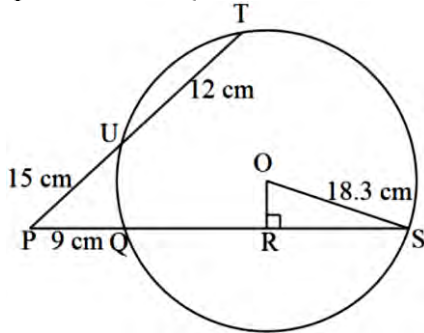
- a) His monthly taxable income (2 marks)
- b) The monthly tax paid by Peter (5 Marks)
- c) In addition to tax, the following deductions were made on Peter's monthly income
 Service charge Ksh 100
 Health insurance fund ksh 320
 2% of his basic salary as widow and children pension fund
 Calculate Peters net pay that month. (3 marks)
19. (a) Using a ruler and a pair of compasses only, construct a parallelogram PQRS in which $PQ = 9\text{cm}$, $PS = 5\text{cm}$ and angle $QPS = 60^\circ$ (4 marks)
 (b) Measure the length PR (2 marks)
 (c) Construct
 (i) The locus of a point A which moves such that A is equidistant from P and R. (1 marks)
 (ii) The locus of a point B which moves such that angle $SBQ = 90^\circ$ (2 marks)
 d) Shade the region inside the parallelogram such that $PM > MR$ and angle $QMS \geq 90^\circ$. (1 mark)
20. Two towns A and B lie on the same parallel of latitude 60°N if the longitudes of A and B are 42°W and 29°E respectively.
 (a) Find the distance between A and B in nautical miles along the parallel of latitude. (2 marks)
 (b) Find the local time at A if at B is 1.00pm. (2 marks).
 (c) Find the shortest distance between A and B along the earth's surface in km. (2 marks)

(Take $\pi = \frac{22}{7}$ and $R = 6370 \text{ km}$)

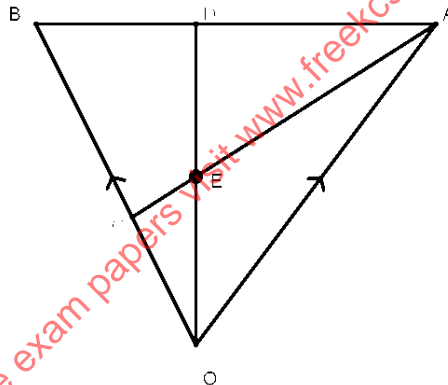
- (d) If C is another town due south of A and 10010km away from A, find the coordinate C. (3 marks)
21. Water is drawn to fill an empty tank whose capacity is 1200 litres using two types of buckets. It requires at least 30 type A buckets and 50 type B buckets to fill the tank. Two type A buckets are required to fill at most three type B buckets. Each type B bucket has a capacity of not more than 20 litres

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- a) Taking x litres and y litres to be the capacity of each type A and type B buckets respectively, write down three inequalities to represent the information above (3 marks)
- b) On the grid provided, draw the inequalities in (a) above (3 marks)
- c) Use the graph in (b) above to determine
- i) Minimum capacity of each type of bucket (2 marks)
- ii) Maximum capacity of each type of bucket (2 marks)
22. In the figure below, OS is the radius of the circle centre O. Chords SQ and TU are extended to meet at P and OR is perpendicular to QS at R. OS = 18.3 cm, PU = 15 cm, UT = 12 cm and PQ = 9 cm.



- a) Calculate the length of:
- (i) QS (3 marks)
- (ii) OR (2 marks)
- b) Calculate, correct to 1 decimal place:
- (i) The size of angle ROS (3 marks)
- (ii) The length of the minor arc QS (2 marks)
23. The figure below shows $\triangle OAB$ in which $BD:DA = 1:2$, $OE:ED = 3:2$ and C is the midpoint of OB.

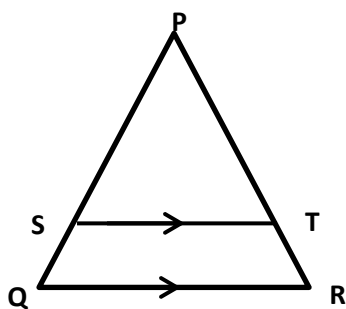


- (a) Given that $OA = \vec{a}$ and $OB = \vec{b}$, express the following vectors in terms of \vec{a} and \vec{b}
- (i) \vec{AB} (1 mark)
- (ii) \vec{OD} (1 mark)
- (iii) \vec{AE} (3 marks)
- (b) Show that points A, E and C lie on a straight line. Hence determine the ratio of CE:EA (5 marks)
24. A parallelogram has vertices $A(0,0)$, $B(-3,1)$, $C(1,3)$ and $D(4,2)$. $A'B'C'D'$ is the image of ABCD under a transformation $\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$
- a) i) Find the coordinates of $A'B'C'D'$ (2 marks)
- ii) On the grid provided draw the parallelogram ABCD and $A'B'C'D'$ (2 marks)
- b) i) Find the coordinates of $A''B''C''D''$ the image of ABCD under transformation matrix $\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$ (2 marks)
- ii) On the same grid draw $A''B''C''D''$ (1 mark)
- c) i) Find the single matrix that maps $A'B'C'D'$ onto $A''B''C''D''$ (2 marks)
- ii) Describe the transformation fully (1 mark)

SECTION 1 (50 MARKS) COMPULSORY

1. Evaluate without using a calculator (3 mks)

$$\frac{2/3 (1^{3/7} - 5/7)}{3/4 + 1^{5/7} \div 4/7 \text{ of } 2^{1/3}}$$
2. The exterior angle of a regular polygon is 24° . Determine the sum of the interior angle of the polygon (3 mks)
3. Solve for m in the equation. (3 mks)
 $3^{4(m+1)} + 3^{4m} = 246$
4. The angle subtended by the major arc at the centre of the circle is twice the angle subtended by the minor arc at the centre. If the radius of the circle is 3.5cm, find the length of the minor arc
 Take $\pi = 22/7$ (3 mks)
5. Given n that $\text{Log}_{10}7 = 0.8451$, $\text{Log}_{10}6 = 0.7782$. Find $\text{Log}_{10}25.2$ (4 mks)
6. The figure below shows triangle PQR in which PR = 12cm, T is a point on PR such that TR = 4cm. Line ST is parallel to QR
 If the area of triangle PQR is 336cm^2 , find the area of the quadrilateral STRQ. (3 mks)



7. Simplify the expression (3 mks)

$$\frac{5x^2 + 8x + 3}{x^2 - 1}$$
8. A translation maps a point P(3, 2) onto P¹(6, -4)
 - a) Determine the translation vector (1 mk)
 - b) A point Q¹(4,5) is the image of point Q under the same translation, find the co-ordinate of Q (2 mks)
9. A tourist arrived in Kenya with sterling pound (£) 4680 all of which he exchanged into Kenyan money. He spent Ksh. 51,790 while in Kenya and converted the rest of the money into US dollars. Calculate the amount he received in US dollars. The exchange rates were as follows (4 mks)

| | Buying | Selling |
|---------------------|---------------|----------------|
| US \$ | 65.20 | 69.10 |
| Sterling Pounds (£) | 123.40 | 131.80 |
10. The gradient of a straight line L₁ passing through the points P(3,4) and Q(a, b) is $-3/2$. A line L₂ is perpendicular to line L₁ and passes through the points Q and R(2, -1). Determine the values of a and b. (4 mks)
11. Determine the quartile deviation of the set of numbers below. (2 mks)
 8, 2, 3, 7, 5, 11, 2, 6, 9, 4
12. Given that $\text{Sin } \theta = 2/3$ and θ is an acute angle, find without using tables or calculators
 - (a) $\tan \theta$, giving your answer in surd form (2 mks)
 - (b) $\text{Cos}(90 - \theta)$ (1 mk)

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13. Four machines give out signals at intervals of 24, 27, 30 and 50 seconds respectively. At 5.00pm all the four machines give out a signal simultaneously. Find the time this will happen again. (3 mks)
14. Two pipes **A** and **B** can fill an empty tank in 3hrs and 5hrs respectively. Pipe **C** can empty the full tank in 4hrs. If the three pipes **A**, **B** and **C** are opened at the same time, find how long it will take for the tank to be full. (3 mks)
15. The density of liquid **X** is 2.6g/cm^3 and that of liquid **Y** is 1.8g/cm^3 . Liquid **X** is 0.89kg and liquid **Y** is 0.5kg. If **X** and **Y** are mixed together, find the density of the mixture in g/cm^3 (3 mks)
16. Use tables of reciprocals to work out (3 mks)

$$\frac{3}{0.6375} + \frac{14}{0.56}$$

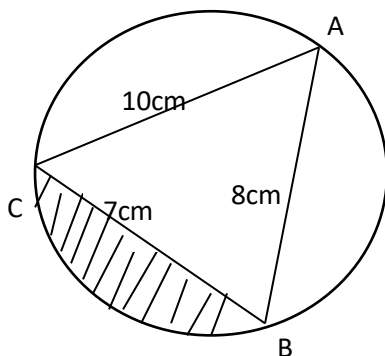
SECTION II (50 MARKS)

Attempt any 5 questions from this section

17. (a) Complete the table below (2 mks)

| | | | | | | | | | | |
|-------|----|-----|----|----|----|----|----|----|----|----|
| X | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 |
| X^2 | 25 | 16 | 9 | 4 | | 0 | 1 | 4 | 9 | 16 |
| 3x | | -12 | -9 | | -3 | 0 | | 6 | 9 | |
| +1 | +1 | +1 | +1 | +1 | +1 | +1 | +1 | +1 | +1 | +1 |
| Y | 11 | | 1 | | | 1 | | 1 | | 29 |

- (b) Draw the graph of $y = x^2 + 3x + 1$ on the grid provided (4 mks)
- (c) Use your graph to solve
- (i) $X^2 + 2x - 2 = 0$ (2 mks)
- (ii) $X^2 + 3x - 4 = 0$ (2 mks)
18. A bus set off from town A to town B 540km away at 7.00am at an average speed of 60km/h. Two hours later a car left town A towards B at an average speed of 100km/h.
- (a) Find the distance and the time from A when the car catches up with the bus. (3 mks)
- (b) After catching up with the bus the speed of the bus and car reduces due to bad state of the road. The car travels at 20km/h more than the bus, if the car arrives 2 hours earlier than the bus, find the speed of the bus. (4 mks)
- (c) After overtaking the bus the car meets with a train of length 217m travelling at 50km/h along a parallel way. If the car is 3m long, find the time in seconds it will take for the two to bypass each other. (3 mks)
19. The figure below shows a triangle **ABC** inscribed in a circle. **AC** = 10cm, **BC** = 7cm and **AB** = 10cm

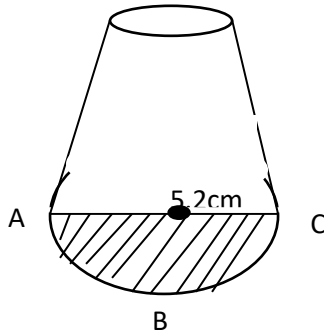


- (a) Find the size of angle **BAC**. (2 mks)

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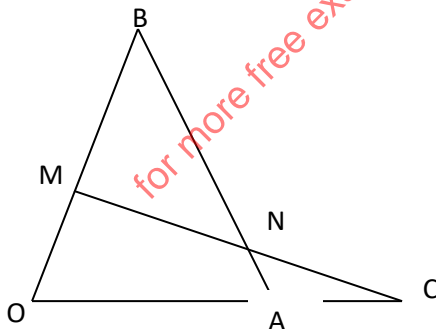
- (b) Find the radius of the circle (2 mks)
 (c) Hence calculate the area of the shaded region (6 mks)

20. The figure below shows a cross-section of a bottle. The lower part ABC is a hemisphere of radius 5.2cm and the upper part is a frustrum of a cone. The top radius of the frustrum is one third of the radius of the hemisphere. The hemispherical part is completely filled with water as shown.



When the container is inverted, the water now completely fills only the frustrum part.

- (a) Determine the height of the frustrum (6 mks)
 (b) Find the external surface area of the bottle (4 mks)
21. Every Sunday, Chalo drives a distance of 800km on a bearing of 074° to pick his brother Ben to go to church. The church is 75 km from Ben's house on a bearing of $S50^\circ E$. After church they drive a distance of 100km on a bearing of 260° to check on their father before Chalo drives to ben's home to drop him off then proceeds to his house.
- (a) Using a scale of 1 cm represent 10km show the relative positions of these places. (4 mks)
 (b) Use your diagram to determine
- (i) The true bearing of Charo's (1 mk)
 - (ii) The compass of bearing of the father's from Ben's home (1 mk)
 - (iii) The shortest distance between Ben's home and father's home (2 mks)
 - (iv) The total Charo travels' every Sunday (2 mks)
22. In the triangle OAB below $OA = a$ $OB = b$ and $OC = 3/2OA$. M divides OB in the ratio 3:2



- (a) Express in terms of **a** and **b** the vectors
- (i) **AB** (1mk)
 - (ii) **MC** (1 mk)
- (b) Given that $MN = hMC$ and $BN = kBA$, express vector **MN** in two different ways and hence find the values of h and k (6 mks)
- (c) Show that points M, N and C are collinear (2 mks)
23. A particle **p** moves in a straight line such that **t** seconds after passing a fixed point **Q**, its velocity **vm/s** is given by the equation.
 $V = t^2 - 7t + 12$.
 Find:-

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- (a) The value of t when p is instantaneously at rest. (2 mks)
 (b) An expression for the distance s meters, moved by p after t seconds (1 mk)
 (c) The total distance traveled by p in the first 3 seconds after passing point Q (3 mks)
 (d) The distance of p from Q when acceleration is zero (4 mks)
24. On the grid below;
- (a) (i) Draw the figure ABCD where $A(1,2)$, $B(7,2)$, $C(5,4)$ and $D(3,4)$ (1 mk)
 (ii) Draw on the same grid $A^1B^1C^1D^1$ the image of ABCD under rotation of -90° about the origin. (2 mks)
 (iii) On the same grid draw the image $A^{11}B^{11}C^{11}D^{11}$ of ABCD under the reflection in line $y = 0$. State the co-ordinates of $A^{11}B^{11}C^{11}D^{11}$ (3 mks)
- (b) $A^{111}B^{111}C^{111}D^{111}$ is the image of $A^{11}B^{11}C^{11}D^{11}$ under the reflection in the line $x = 0$
 Draw the image $A^{111}B^{111}C^{111}D^{111}$ and state its co-ordinates (2 mks)
- (c) Describe a single transformation that maps $A^{111}B^{111}C^{111}D^{111}$ onto ABCD (2 mks)

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FORM FOUR
MATHEMATICS PAPER 2

SECTION 1 (50 MARKS) COMPULSORY

1. Use logarithm tables to evaluate

$$\sqrt[3]{\frac{58.32 \times (0.9823)^2}{693.5}}$$

(4 mks)

2. Make t the subject of the formula

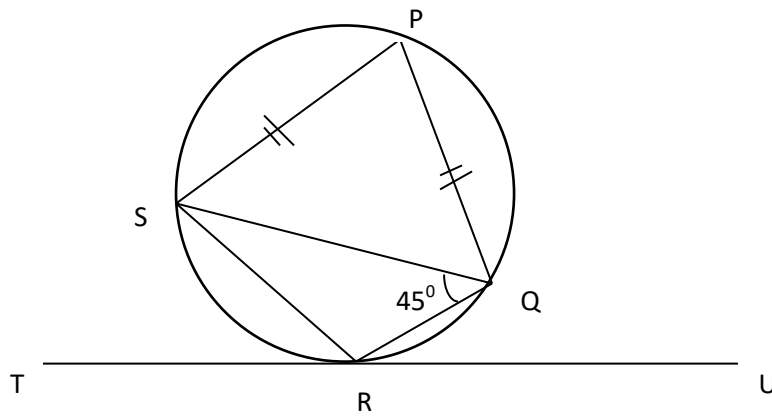
$$x = 3 \sqrt{\frac{3h(t-h)}{t}}$$

(3 mks)

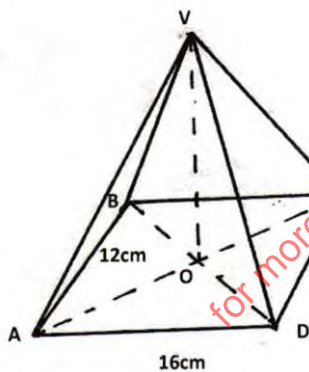
3. Simplify and rationalize the expression giving your answer in the form of $a + b\sqrt{c}$, where a , b and c are constants (3 mks)

$$\frac{11}{7 - \sqrt{3}} - \frac{5}{7 + \sqrt{3}}$$

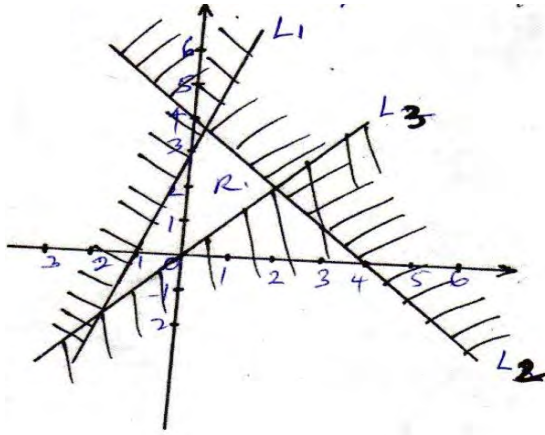
4. The measurements of the radius and height of a cylinder are given as 8cm and 9.5cm respectively. Calculate the percentage error in the volume of the cylinder (3 mks)
5. (a) Expand $(1 - 2x)^6$ in ascending powers of x upto x^3 (2 mks)
 (b) Hence evaluate $(1.02)^6$ to 4 d.p. (2 mks)
6. A hot water tap H can fill a bathtub in 5 minutes while a cold water tap C can fill the same bathtub in 3 minutes. The drain pipe D can empty the full bathtub in $3\frac{3}{4}$ minutes.
 Given that the bathtub is empty and that the two taps and the drain pipe are fully open for $1\frac{1}{2}$ minutes after which the drain pipe is closed, how much longer it will take to fill the bathtub? (3 mks)
7. P varies partly as Q and partly inversely as the square of Q . Given that $P = 7$ when Q is either 1 or 2. Find the value of P when $Q = \frac{2}{3}$ (3 mks)
8. In the figure below TRU is a tangent to the circle at point R and points P, Q, R and S lie on the circle that $PS = PQ$, $\angle QRU = 30^\circ$ and $\angle RQS = 45^\circ$. Determine the size of angle; (3 mks)



- (a) $\angle SRQ$ (1 mk)
 - (b) $\angle TRS$ (1 mk)
 - (c) $\angle SPQ$ (1 mk)
9. A point **P** divides the line **RT** in the ratio $-2 : 5$. Find the coordinates of **P** given **R**(3,1) and **T**(6,-5) (3 mks)
10. Two straight lines $x + 2y = -1$ and $2x + 3y = 3$ intersect at a point **R**. Find the equation of the circle, centre **R**, Radius 5 units, giving your answer in form $x^2 + y^2 + ax + by + c = 0$ (4 mks)
11. In what ratio should grape **P** of a tea costing sh. 450 per kg be mixed with grade **Q** of tea costing sh. 350 per kg so that a profit of 10% is made by selling the mixture at sh. 451 per kg. (3 mks)
12. Find the values of θ between 0° and 180° such that $2\cos 3\theta = 3\sin 3\theta$ (2 mks)
13. Solve $8^x = 4^{2y+1}$ and $27^{2x} = 9^{y-3}$ giving your answers as an exact fraction (3 mks)
14. The figure below represents a rectangular based pyramid **VABCD**. $AB = 12\text{cm}$ and $AD = 16\text{cm}$. Point **O** vertically below **V** and $VA = VC = VB = VD = 26\text{cm}$



- Calculate the angle between edge **VD** and the base **ABCD** (3 mks)
15. Form three inequalities that satisfy region **R** (3 mks)



16. Find without using mathematical tables or a calculator the value of x which satisfy the equation $\log_2(x^2 - 9) = 3\log_2 2 + 1$ (3 mks)

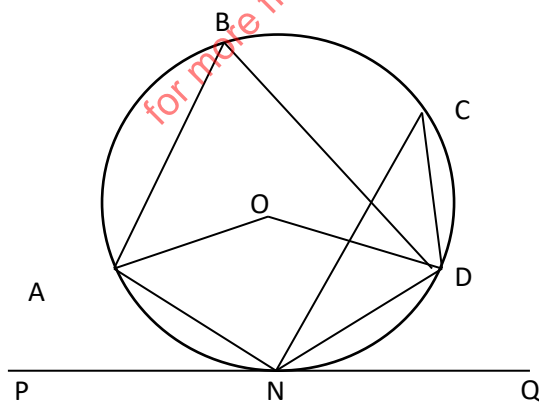
SECTION II (50 MARKS)

Answer any **FIVE** questions from this section in the spaces.

17. The table below shows the distribution of marks of 40 candidates in a test

| Marks | 1-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | 71-80 | 81-90 | 91-100 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Frequency | 2 | 2 | 3 | X | 12 | 5 | 2 | 3 | 1 | 1 |

- (a) (i) Find the value of x (1 mk)
 (ii) State the modal class (1 mk)
 (b) (i) Calculate the median (2 mks)
 (ii) Using an assumed mean of 55.5 and $d = \frac{x-A}{10}$ find the actual mean (3 mks)
 (c) Calculate the standard deviation (3 mks)
18. In the figure below, O is the centre of the circle. PQ is a tangent of the circle at N . Angle NCD is 10° and angle ANP is 30°



Giving reason find:-

- (a) Angle DON (2 mks)

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- (b) Angle DNQ (2 mks)
- (c) Angle ONA (2 mks)
- (d) Angle DBA (2 mks)
- (e) Angle ODN (2 mks)

19. The probability of three dart players Githongo, Mwai and Kanyoro hitting the bull eye in a competition of 0.4, 0.7 and 0.5 respectively

- (a) Draw a probability tree diagrams to show the possible outcomes (2 mks)
- (b) Find the probability
 - (i) All hit the bulls eye (2 mks)
 - (ii) Only one of them hit the bulls eye (3 mks)
 - (iii) Atmost one missed the bulls eye (3 mks)

20. Two variables qualities x and y are believed to follow the rule $y = mx + nx^2$. The following table gives their corresponding values in an experiment

| | | | | | | | | |
|---|---|---|---|---|-----|-----|-----|-----|
| x | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| y | 6 | 8 | 6 | 0 | -10 | -24 | -42 | -64 |

- (a) Use the given table and suitable straight line graph to find the value of the constants m and n (7 mks)
- (b) Use the graph to find the law connecting x and y (1 mk)
- (c) Hence calculate the value of y when $x = 3\frac{1}{2}$ (2 mks)

21. An aeroplane leaves point A (40°N , 78°W) and flies due west at 900km/hr . If it travels for 3 hours 20 minutes, (taking radius of the earth as 6370km)

- (a) How far has it traveled (3 mks)
- (b) What is the longitude of its position (3 mks)
- (c) A weather forecaster reports that, On Wednesday at 6.20am, a cyclone cited at (30°N , 120°W) is moving due North at 30knots . When will it reach a point (45°N , 120°W) (4 mks)

22. Given that $y = 2\sin 2x$ and $y = 3\cos (x + 45^{\circ})$

- (a) Complete the table below (2 mks)

| | | | | | | | | | | |
|-----------------------|-------------|--------------|--------------|--------------|--------------|---------------|---------------|---------------|---------------|---------------|
| x | 0° | 20° | 40° | 60° | 80° | 100° | 120° | 140° | 160° | 180° |
| $2\sin x$ | 0 | | 1.97 | | 0.68 | -0.68 | -1.73 | | -1.28 | 0.00 |
| $3\cos(x+45^{\circ})$ | 2.12 | 1.27 | | -0.78 | | -2.46 | | | -2.72 | -2.12 |

(b) Use the data to draw the graph $y = 2\sin 2x$ and $y = 3\cos (x + 45^{\circ})$ for $0^{\circ} \leq x \leq 180^{\circ}$ on the same axes

- (c) State the amplitude and period of each curve. (5 mks)
- (d) Use the graph to solve the equation $2\sin 2x - 3\cos (x + 45^{\circ}) = 0$ for $0^{\circ} \leq x \leq 180^{\circ}$ (2 mks)

23. (a) A triangular garden ABC is such that $AB = 8\text{cm}$, $\angle BAC = 45^{\circ}$ and $\angle ABC = 75^{\circ}$. Using an appropriate scale draw the garden using a ruler and a pair of compasses only. (1 mk)

(b) A water tap A is to be mounted in the garden that is equal in distance from A, B and C. on the diagram in (a) above show position of P. (3 mks)

(c) A section of the plot is enclosed such that a region R is formed under the following conditions

- (i) $CR \geq 1.5\text{cm}$ (1 mk)
- (ii) R is more than 2m from line AB (1 mk)
- (iii) R is nearer to CB than CA. shade the region R (2 mks)

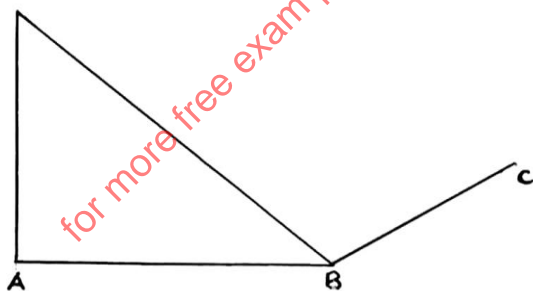
24. A cinema has seats for 400 people. The seats are in two categories; A and B which are charged at Sh. 200 and Sh. 500 per show respectively. The number of category B booked per show does not exceed that of category A. For the hall expenses to be covered, at least 70 category B seats must be booked and they must be more than a quarter of the total number of seats booked.

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MECS II CLUSTER JOINT EXAMINATION
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PAPER 1

SECTION I (50 marks)

Answer **all** the questions in this section in the spaces provided.

- Without using Mathematical tables or a calculator, evaluate
$$\frac{(-8) \times 4 + 156 \div 2 \text{ of } (-43 + 30)}{(-3) - (-8) \times 2 + 6}$$
 (3 marks)
- Antony spent one quarter of his net January salary on school fees. He spent a quarter of the remainder on electricity and water bills. He then spent one ninth of what was left on transport. If he finally had sh. 3 400, calculate his net January salary. (3 marks)
- A residential estate is to be developed on a 6 hectares piece of land. 1 500 m² is taken up by the roads while the rest is divided into 40 equal plots. Calculate the area of each plot. (3 marks)
- The equation of a straight line L_1 is $3y + 4x - 6 = 0$. Another straight line L_2 is perpendicular to L_1 and passes through point P (-3, 6). Determine the equation of L_2 in the form $y = mx + c$, where m and c are constants. (3 marks)
- A shopkeeper bought a number of eggs for which he paid a total of Ksh. 1000. Four eggs were broken. He sold the rest at $13\frac{1}{3}\%$ profit, thereby making a cash profit of Ksh. 100. Calculate the number of eggs that he had bought at the first place. (3 marks)
- Without using Mathematical tables a calculator evaluate
$$\frac{243^{\frac{2}{5}} \times 125^{\frac{2}{3}}}{9^{-\frac{3}{2}}}$$
 (3 marks)
- The longest side of a right-angled triangle is $(2x)$ cm. The other sides are $(x + 3)$ cm and $(2x - 4)$ cm. Find the value of x and hence the lengths of the sides of the triangle. (4 marks)
- Below is part of sketch of a wedge ABCDEF. Complete the sketch of the solid, showing the hidden edges with broken lines. (3 marks)



- If x is a positive integer, solve the inequality $2 < \frac{2x^2}{3} < 11$ and hence list the integral values that satisfy the inequality. (3 marks)
- The matrix $M = \begin{pmatrix} k & k + 3 \\ 1 & 2k \end{pmatrix}$ has no inverse. Determine the possible values of k . (3 marks)

MATHEMATICS PAPER 1 & 2

11. A Kenyan Bank buys and sells foreign currencies at the exchange rates shown below

| | Buying | selling |
|-------------|--------|---------|
| | Kshs | Kshs |
| 1 Euro | 147.86 | 148.00 |
| 1 US Dollar | 74.22 | 74.50 |

An American arrived in Kenya with 20000 Euros. He converted all the Euros to Kenya shillings at the Bank. He spent kshs.2,512, 000 while in Kenya and converted the remaining Kenya shillings into US Dollars at the bank. Find the amount in Dollars that he received. (3 marks)

12. Given that $\tan(\theta + 20)^\circ = -0.7660$, find θ , to the nearest degree, in the range $0^\circ \leq \theta \leq 360^\circ$. (3 marks)
13. The area of an island on a map of scale 1:100 000 is 200 cm^2 . Calculate the actual area on the ground in square kilometers. (3 marks)
14. P(2, 1), Q(8, 11) and R(12, 19) are three points on a Cartesian plane. Show that P, Q and R are collinear. (3 marks)
15. A bus leaves Nairobi travelling towards Mombasa at a speed of 70 kmh^{-1} . Half an hour later, a car leaves Nairobi travelling in the same direction at a speed of 90 kmh^{-1} . Calculate the distance travelled by the car when it overtook the bus. (3 marks)
16. Use a ruler and a pair of compasses in this question.
- (a) Construct a quadrilateral PQRS in which $PQ = 4 \text{ cm}$, $QR = 6 \text{ cm}$, $PS = 3 \text{ cm}$, angle $PQR = 135^\circ$ and angle $SPQ = 60^\circ$. (3 marks)
- (b) Measure the length of RS. (1 mark)

SECTION II

Answer five questions only in this section.

17. (a) Aisha sold 180 bags of rice in September 2017. The cost of each bag was sh. 2800. Calculate the amount of money that he received from the sale of rice that month. (1 mark)
- (b) (i) In October that year, the price of a bag of rice decreased by 24% and the number of bags that she sold increased by 30%. Determine the percentage decrease in the amount of money she received from the sale of rice. (3 marks)
- (ii) In November that year, the price of a bag of rice changed in the ratio of 7:8. Find the price of each bag in November. (2 marks)
- (c) The amount that he received from the sale of rice in September was sh. 1260 more than what was received in November. If the number of bags that were sold in November were $t\%$ more than those sold in September, find t . (4 marks)
18. (a) Complete the table below for the function $y = 2x^2 - 3x - 4$ for $-4 \leq x \leq 2$ (2 marks)

| | | | | | | |
|-----------|----|----|----|---|---|-----|
| x | -2 | -1 | 0 | 1 | 2 | 3 |
| $2x^2$ | | 2 | 0 | 2 | 8 | |
| $-3x - 4$ | 2 | | -4 | | | -13 |
| y | | | -4 | | | 5 |

- (b) On the grid below, draw the graph of $y = 2x^2 - 3x - 4 = 0$ for $-2 \leq x \leq 3$ (3 marks)
- (c) Use your graph to estimate the roots of $y = 2x^2 - 3x - 4 = 0$ (2 marks)
- (d) Use your graph to solve $4x^2 - 7x = 12$ (3 marks)

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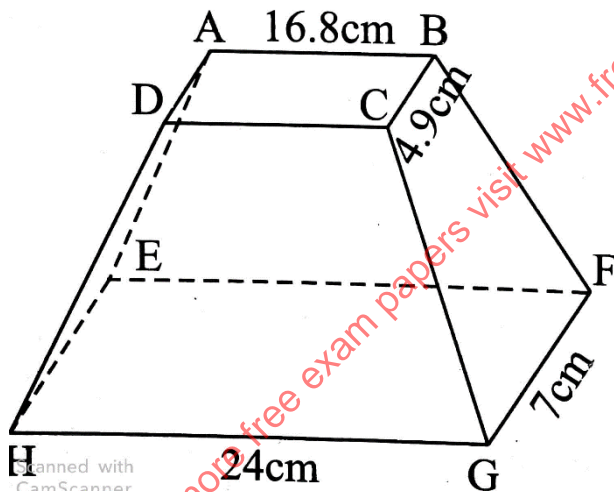
19. The marks scored by a certain number of students in a mathematics contest are as shown in the table below.

| Marks | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 |
|-----------------|-------|-------|-------|-------|-------|-------|-------|
| No. of students | 10 | 11 | 14 | 41 | 27 | 18 | 19 |

- (a) Calculate to 2d.p. the mean of the marks scored. (4 marks)
- (b) State the median class and hence calculate the median. (4 marks)
- (c) Calculate the difference between the mean and the median. (1 mark)
- (d) State the modal class. (1 mark)

20. The figure below shows a solid frustum of right pyramid with a rectangular base EFGH measuring 24cm by 7cm. The frustum was obtained by cutting off a small pyramid along plane ABCD that is parallel to base EFGH. Plane ABCD measures 16.8cm by 4.9cm, and is exactly seven tenths way up the vertical height of the original pyramid.

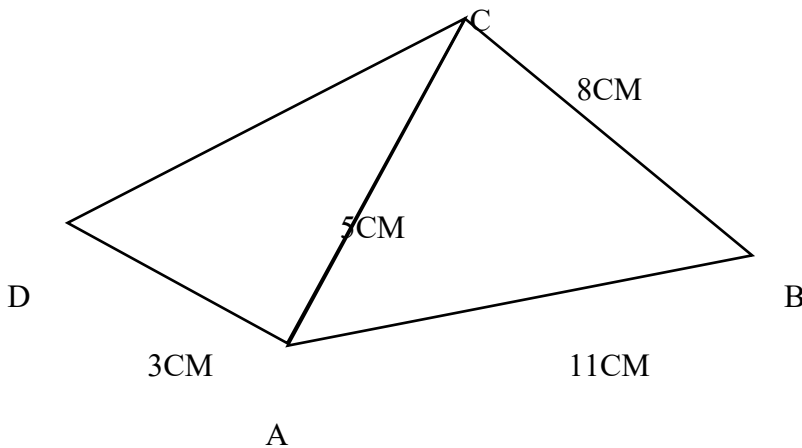
Given that the original pyramid had a slant edge of 32.5cm, find:



- (a) The altitude (perpendicular height) of the frustum. (4 marks)
 - (b) The volume of the frustum (3 marks)
 - (c) The surface area of the original pyramid. (3 marks)
21. Triangle ABC has vertices A(-6,5), B(0,1) and C(-2,-3). Triangle MNP is the image of triangle ABC under an enlargement. The vertices of triangle MNP are M(-4,6), N(-1,4) and P(-2,2). A reflection then maps triangle MNP onto triangle XYZ whose vertices are X(7,-5), Y(5,-2) and Z(3,-3).
- (a) Plot the three triangles on the grid below. (3 marks)
 - (b) Determine the centre and the scale factor of enlargement that maps ABC onto MNP. (3 marks)
 - (c) Find the equation of the mirror line of the reflection. (2 marks)
 - (d) Given that triangle XYZ has an area of $Q\text{cm}^2$, state the area of triangle ABC in terms of Q. (2 marks)

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22. In the figure below, $AB = 11\text{cm}$, $BC = 8\text{cm}$, $AD = 3\text{cm}$, $AC = 5\text{cm}$ and $\angle DAC$ is a right angle.



Calculate, correct to one decimal place:

- (a) The length DC (2 marks)
- (b) The size of $\angle ADC$ (2 marks)
- (c) The size of $\angle ACB$ (3 marks)
- (d) The area of the quadrilateral ABCD (3 marks)
23. Three warships P, Q and R are at sea such that ship Q is 400km on a bearing of 030° from ship P. Ship R is 750km from ship Q and on a bearing of 120° from ship Q. An enemy warship S is sighted 1000km due south of ship Q.
- (a) Taking a scale of 1cm to represent 100km locate the relative positions of ships P, Q, R and S. (4 Marks)
- (b) Find the compass bearing of
- (i) P from S (1 mark)
- (ii) S from R (1 mark)
- (c) Use the scale drawing to determine the distance of;
- (i) S from P (1 mark)
- (ii) R from S (1 mark)
- (d) Find the bearing of;
- (i) Q from R (1 mark)
- (ii) P from R (1 mark)
24. A particle moving along a straight line passes through a fixed point P. Its displacement S metres from P after a period at t seconds is given $S = t^3 - 5t^2 + 3$.
- Find;
- (a) The particle's displacement from P at $t = 4$ (2 marks)
- (b) The particle's velocity at $t = 4$. (3 marks)
- (c) The possible Value(s) of t when the particle is momentarily at rest. (3 marks)
- (d) The acceleration of the particle at $t = 3$. (2 marks)

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15. In a transformation, an object with area 9cm^2 is mapped onto an image whose area is 54cm^2 . Given that the matrix of transformation is $\begin{bmatrix} x & x-1 \\ 2 & 4 \end{bmatrix}$ find the value of x (3 marks)
16. The cost per kg of two brand of tea x and y are Sh. 60 and Sh. 80. The two brands are mixed and sold at a profit of 20% above the cost. if 1kg mixture was sold at Sh. 78, determine the ratio in which the two brands were mixed. (2 marks)

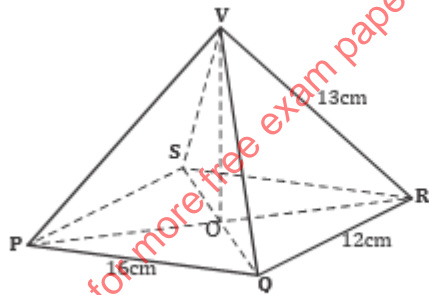
SECTION 11 (50 MARKS)

Answer ANY FIVE questions in this section.

17. The table below shows the distribution of marks of 50 students in an opener examination.

| Mark | 1 - 10 | 11 - 20 | 21 - 30 | 31 - 40 | 41 - 50 | 51 - 60 | 61 - 70 | 71 - 80 | 81 - 90 | 91 - 100 |
|-----------|--------|---------|---------|---------|---------|---------|---------|---------|---------|----------|
| Frequency | 4 | 7 | 6 | 6 | y | 8 | 4 | 3 | 2 | 1 |

- (a) (i) Find the value of y . (1 mark)
 (ii) State the modal class. (1 mark)
- (b) Using an assumed mean of 45.5 find the mean. (3 marks)
- (c) Calculate
 (i) Variance. (3 marks)
 (ii) Standard deviation. (2 marks)
18. Use a ruler and a pair of compass only in the constructions below:
 a) Construct a triangle ABC such that $AB = 4\text{cm}$, $BC = 5\text{cm}$ and $\angle ABC = 120^\circ$, measure AC . (3marks)
 b) On the same diagram
 (i) locate P the locus of a point equidistance from the three vertices of the triangle ABC and demonstrate this using a circle. Measure the radius of the circle. (3 marks)
 (ii) On the side of AC opposite point B construct R the locus of points 4cm from line AC . (2 marks)
 c) Calculate the area of the circle outside the triangle ABC (2 marks)
19. Figure below is a pyramid on a rectangular base. $PQ = 16\text{cm}$, $QR = 12\text{cm}$ and $VP = 13\text{cm}$.



Find

- a) the length of QS (2marks)
 b) the length of the height of the pyramid (2 marks)
 c) the angle between VQ and the base $PQRS$ (2 marks)
 d) the angle between plane VQR and the base $PQRS$ (2 marks)
 e) volume of the pyramid (2 marks)
20. Every evening before the end of preps, Eunice either reads a novel or solves a mathematical problem. The probability that she reads a novel is $\frac{4}{5}$. If she read a novel, there is a probability of $\frac{3}{4}$ that she will fall asleep. If she solves a mathematical problem, there is a probability of $\frac{1}{4}$ that she will fall asleep. Sometimes the teacher on duty enters Eunice's classroom. When Eunice is asked whether she had been asleep, there is a probability of only $\frac{1}{5}$ that she will admit that she had been asleep and a probability of $\frac{3}{5}$ that she will claim to have been asleep when she had not been asleep

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By use of a tree diagram, find the probability that

- a) She sleeps and admits (4 marks)
 - b) She sleeps and does not admit (2 marks)
 - c) She does not sleep but claims that she had been asleep (2 marks)
 - d) She does not sleep and says that she has not been asleep (2 marks)
21. (a) The first term of an arithmetic progression is 3 and the sum of its 8 terms is 164.
- i) Find the common difference of the arithmetic progression. (2 Marks)
 - ii) Given that the sum of the first n terms of AP is 570, find n. (3 Marks)
- b) The first, the fifth and the seventh terms of another Arithmetic sequence forms a decreasing geometric progression. If the first terms of the geometric progression is 64.
- (i) find the values of the common difference of AP. (3 Marks)
 - (ii) find the sum of the first ten terms of the G.P. (2 Marks)

22. The following table shows the rate at which income tax was charged during a certain year.

| Monthly taxable income in Ksh. | Tax rate % |
|--------------------------------|------------|
| 0 - 9860 | 10 |
| 9861 - 19720 | 15 |
| 19721 - 29580 | 20 |
| 29581 - 39440 | 25 |
| 39441 - 49300 | 30 |
| 49301 - 59160 | 35 |
| over 59160 | 40 |

A civil servant earns a basic salary of Ksh.35750 and a monthly house allowance of sh.12500. The civil servant is entitled to a personal relief of sh.1062 per month. Calculate:

- a) Taxable income (2 marks)
 - b) Calculate his net monthly tax (5 marks)
 - c) Apart from the salary the following deduction are also made from his monthly income.
 - WCPS at 2% of the basic salary
 - Loan repayment Ksh.1325
 - NHIF sh.480

Calculate his net monthly earning. (3 marks)
23. The points A (1,4), B(-2,0) and C(4,-2) of a triangle are mapped onto $A^1(7,4)$, $B^1(x,y)$ and $C^1(10,16)$ by a transformation $N = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$. Find
- a) (i) Matrix N of the transformation (4 Marks)
 - (ii) Coordinates of B^1 (2 Marks)
 - b) $A^{II}B^{II}C^{II}$ are the image of $A^1B^1C^1$ under transformation represented by matrix $M = \begin{pmatrix} 2 & -1 \\ 0 & 0 \end{pmatrix}$
 - Write down the co-ordinates of $A^{II}B^{II}C^{II}$ (2 Marks)
 - c) A transformation N followed by M can be represented by a single transformation K. Determine K (2 Marks)
24. A farmer has at least 50 acres of land on which he plans to plant potatoes and cabbages. Each acre of potatoes requires 6 men and each acre of cabbages requires 2 men. The farmer has 240 men available and he must plant at least 10 acres of potatoes. The profit on potatoes is Ksh. 1000 per acre and on cabbages is Ksh. 1200 per acre. If he plants x acres of potatoes and y acres of cabbages:
- a) Write down three inequalities in x and y to describe this information. (3marks)
 - b) Represent these inequalities graphically. (4marks)
 - c) Use your graph to determine the number of acres for each crop which will give maximum profit and hence find the maximum profit. (3marks)

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SECTION I (50 MKS)

Answer **ALL** the questions from this section.

1. Evaluate: (3mks)

$$\frac{-4 \text{ OF } [(-4 + -5 \div 15)] + -3 - 4 \div 6}{84 \div -7 + 3 - -5}$$

2. If $\log 2=0.30103$ and $\log 3=0.47712$ find the logarithm of 36 without using tables or calculators. (3mks)

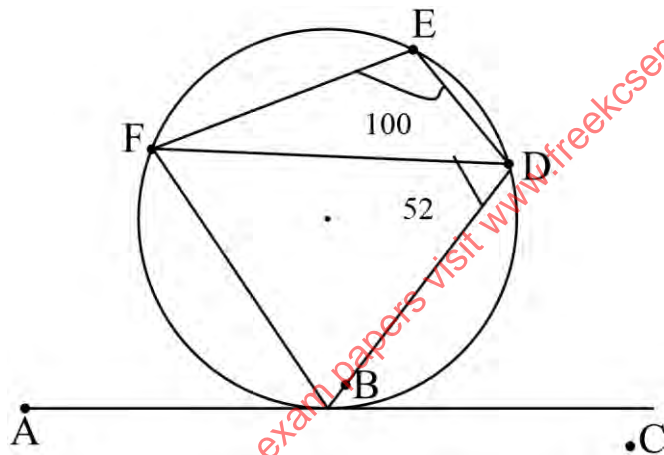
3. Find the equation of the perpendicular to the line below at its y-intercept. Leave your answer in the form of $y=mx +c$. (3mks)

$$\frac{4}{9}x - \frac{1}{3}y = 1$$

4. Simplify the expression given by $\frac{x}{x-3} - \frac{2x+3}{x^2-3x}$ (3mks)

5. Under an enlargement the images of the points A(3,1) and B(1,2) are A¹(3,7) and B¹(7,5). Find the centre and the scale factor of the enlargement. (3mks)

6. In the figure below, ABC is a tangent to the circle at B. find giving reasons angles:-



- i) $\angle FBA$ (1mk)
 ii) $\angle DBC$ (2mks)

7. Solve for x in the equation below without introducing logarithms

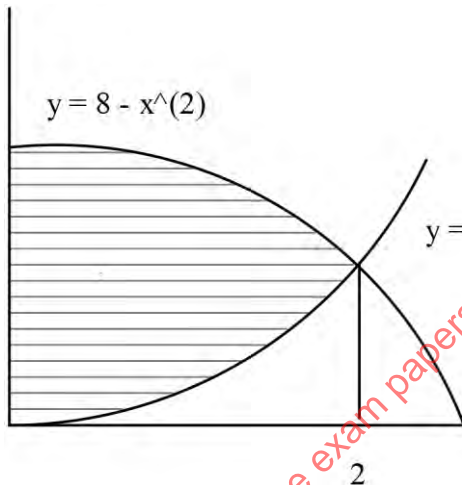
$$5^{2x-1} = 60^{2x-1} \quad \text{span style="float: right;">(3mks)}$$

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8. The table below shows masses of fifty students in a form one class.

| Mass (kg) | Frequency |
|-----------|-----------|
| 25-30 | 6 |
| 30-35 | 10 |
| 35-40 | 24 |
| 40-45 | 7 |
| 45-50 | 4 |

- a) State the modal class. (1mk)
- b) Calculate to 3 d.p the median mass. (2mks)
9. Solve the following pair of linear inequalities. Hence determine the integral values that satisfy the inequalities. $-5 - 2x < -3$ and $\frac{x}{5} + \frac{1}{3} \leq 1$. (3mks)
10. Given that the position vectors of points P and Q are $r = \begin{pmatrix} -4 \\ -2 \end{pmatrix}$ and $q = \begin{pmatrix} 5 \\ 4 \end{pmatrix}$. M is a point on PQ such that PM:MQ = 2:1. Find the coordinates of M. (3mks)
11. Calculate the area of the shaded region. (3mks)



12. Use square, squareroot and reciprocal tables only to evaluate the following giving your answer to 2 decimal places. (3mks)

$$\frac{2}{\sqrt{34.46}} + \frac{2}{(8.67)^2}$$

13. Solve the simultaneous equations. (4mks)

$$\frac{p}{q+1} = \frac{1}{4}, \frac{p-3}{p+q} = \frac{2}{3}$$

14. The angle of elevation of the top of the tower from the foot of a building is 63.51° . the angle of depression of the top of the building from the top of the tower is 18.43° . the building and the tower are 30 m apart. Find:
 a) The height of the tower. (1mk)
 b) The height of the building. (2mks)
15. Two towns M and N are 300km apart. A lorry left town M at 10.00a.m and travelled towards N at an average speed of 80km/h. At 10.45a.m a Nissan matatu left town N for town M at an average speed of 100km/h. calculate the distance covered by the lorry when it met the Nissan matatu. (3mks)

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16. A commercial bank in Kenya buys and sells Foreign currencies as shown below;

| Currency | Buying (Ksh) | Selling(Ksh) |
|------------------|--------------|--------------|
| 1 Euro | 102.15 | 102.26 |
| 100 Japanese Yen | 75.73 | 75.82 |

A Japanese travelling from Italy arrives in Kenya with 9000 Euros. He converts all the 9000 Euros to Kenya shillings at the bank. While in Kenya he spends Ksh.398,580 and then converts the remaining kshs to Japanese yen at the bank before leaving for Japan. Calculate the amount in Japanese yen that he receives.(4mks)

SECTION II (50 MKS)

Answer **only 5** questions from this section.

17. The attendance at a party consisted of 35 men, a number of women and some children. The number of women was one and a half that of the children present.

- a) If there are a total of 65 participants, how many women attended the party? (3mks)
- b) During the party, each child took one bottle of soda, the men took two bottles each while some women took two and others three. Given that five crates each containing 24 bottles of soda were consumed, how many women took two bottles of soda? (5mks)
- c) Each crate of soda was bought for sh.432 plus a deposit of sh.10 per bottle incase it broke. How much money did the party organizers pay at the soda depot? (2mks)

18. Three warships P, Q and R are at sea such that ship Q is 400km on a bearing of N30°E from ship P. Ship R is 750km from ship Q on a bearing of S60°E from ship Q. An enemy ship S is sighted 1000km due south of ship Q.

- a) Use scale drawing to locate the positions of ships P, Q, R and S. (4mks)
- b) Find the compass bearing of: (2mks)
 - i) Ship P from ship S.
 - ii) Ship S from ship R.
- c) Use the scale drawing to determine: (2mks)
 - i) The distance of S from P.
 - ii) The distance of R from S.
- d) Find the bearing of: (2mks)
 - i) Q from R.
 - ii) P from Q.

19. A bus and a matatu left vihiga for Moi's Bridge, 240 km away at 8.00a.m. They travelled at 90km/h and 120km/h respectively. After 20 minutes the matatu had a puncture which took 30 minutes to mend. It then continued with the journey.

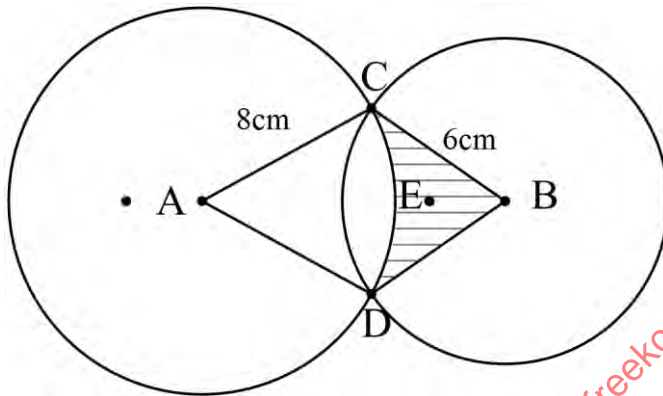
- a. How far from Vihiga did the matatu catch up with the bus? (6mks)
 - b. At what time did the matatu catch up with the bus? (2mks)
 - c. At what time did the bus reach Moi's Bridge? (2mks)
20. (a) Complete the table below. (2mks)

| θ | 0° | 30° | 60° | 90° | 120° | 150° | 180° | 210° | 240° | 270° | 300° | 330° | 360° |
|--------------------------|----|------|-----|-----|------|-------|------|-------|-------|------|-------|------|------|
| $\tan \frac{1}{2}\theta$ | 0 | 0.27 | | 1 | 1.73 | 3.73 | | -3.73 | -1.73 | | -0.58 | | 0 |
| $2\cos\theta$ | | 1.73 | 1 | | | -1.73 | | -1.73 | | 0 | 1 | 1.73 | 2 |

- b) Using the grid provided draw the graph of $y = \tan \frac{1}{2}\theta$ and $y = 2\cos\theta$. (5mks)
- c) Use your graph to solve;
 - i) $\tan \frac{1}{2}\theta - 2\cos\theta = 0$ (1mk)
 - ii) $2\cos\theta - 1.5 = 0$ (2mks)

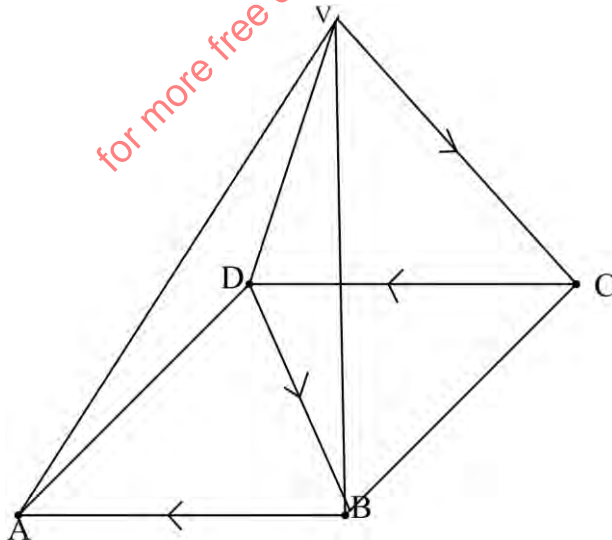
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21. (a) Express as a single fraction in its simplest form $\frac{200}{x} - \frac{200}{x+4}$ (2mks)
- (b) When driven in town, a car runs x km on each litre of petrol.
- i) Find in terms of x , the number of litres of petrol used when the car is driven 200km in town. (1mk)
- ii) When driven out of town, the car runs $x+4$ km on each litre of petrol. It uses 5 litres less petrol to go 200km out of town than to go the same distance in town. Use this information to write down an equation involving x , and show that it simplifies to $x^2 + 4x - 160 = 0$ (3mks)
- (c) Solve the equation $x^2 + 4x - 160 = 0$ (3mks)
- (d) Calculate the total volume of the petrol when the car is driven 40km in town. (1mk)
22. The figure below shows two circles intersecting at C and D. The centres are A and B with radii 8cm and 6cm respectively. $AB = 10$ cm.



Determine:

- i) Size of angle DAC. (4mks)
- ii) Size of angle DBC. (2mks)
- iii) Area of sector of ACMD. (2mks)
- iv) Area of the shaded region. (2mks)
23. The figure below shows a right pyramid standing on a square base ABCD and with a path marked on it.



- a. Sketch the net of the pyramid and label all the vertices. (2mks)
- b. On the sketch show the path marked on the diagram. (2mks)
- c. Given that the pyramid above has measurement $AB=BC=20\text{cm}$ and the slant height of the pyramid is 26 cm , calculate the surface area of the pyramid. (6mks)
24. As a car passes the point P on a straight road, its speed is 15m/s with a uniform acceleration of 0.25m/s^2 for 20 seconds until it reaches the point Q. the car travels for a further 10 seconds with a constant acceleration of 0.5m/s^2 until it reaches point S.
- a. Find;
- The speed at Q. (2mks)
 - The distance PQ. (2mks)
 - The speed at S. (2mks)
 - The total distance travelled. (2mks)
- b. Calculate the average speed of the car between P and S leaving your answer as a mixed number. (2mks)

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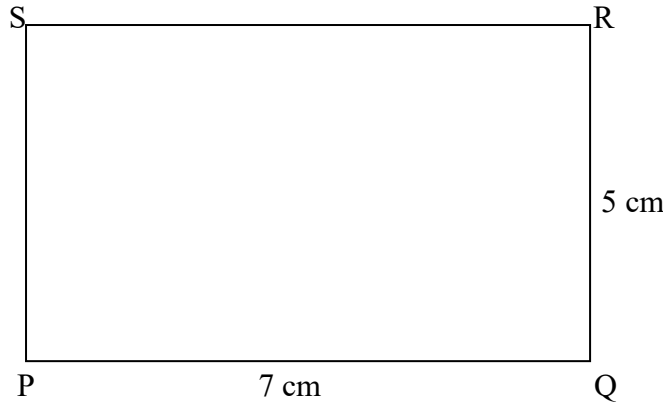
SECTION A 50 MARKS

1. Solve for x given: (3 marks)
 $\log_{27}(x + 7) - \log_{27}(x - 1) = \frac{2}{3}$
2. The equation of a circle is given by $2x^2 + 6x + 2y^2 + 8y = 0$. Find the centre and radius of the circle. (3 marks)
3. Solve for θ for values of $0^\circ \leq \theta \leq 360^\circ$ (3 marks)
 $3 - 3 \cos \theta = 2 \sin^2 \theta$
4. Find the equation of the tangent and the normal to the curve $y = x^2 - 3x + 5$ which is parallel to the line $y = 5x + 4$. (4 marks)
5. The triangle T has vertices at the points (1,K), (3,0) and (11,0) where K is a constant. Triangle T is transformed onto the triangle T^1 by the matrix $\begin{pmatrix} 6 & -2 \\ 1 & 2 \end{pmatrix}$. Given that the area of triangle T^1 is 364 square units, find the value of K. (4 marks)
6. Expand $(3x^2 + 2x^2)^6$. State the independent term. (2 marks)
7. Find the co-ordinates of the point A (-4,2) after a rotation of 60° about the origin followed by a reflection in the line $y = -x$, leaving your answer in surd form. (3 marks)
8. A curve passes through the points (-1,0) and (2,0). Find the equation of the curve in the form $y = ax^2 + bx + c$, where a, b, c are constants. (2 marks)
9. A point P divides **AB** with co-ordinates A (2, -1, 4) and B (6, -3, 5) externally in the ratio 3 : 1. Find the co-ordinates of P and the magnitude of **OP**. (4 marks)
10. XY and RS are parallel chords on opposite sides of the centre of a circle of radius 13cm. If $XY = 24\text{ cm}$ and $RS = 20\text{ cm}$, find the distance between the chords. Give your answer truncated to 4 s.f. (3 marks)
11. From a 35 metre high window, the angle of depression to the top of a nearby streetlight is 50° . The angle of depression to the base of the streetlight is 56.5° . How high is the streetlight correct to 3 d.p. (4 marks)
12. Simplify: (3 marks)

$$\frac{4}{\sqrt{5} + \sqrt{2}} - \frac{3}{\sqrt{5} - \sqrt{2}}$$

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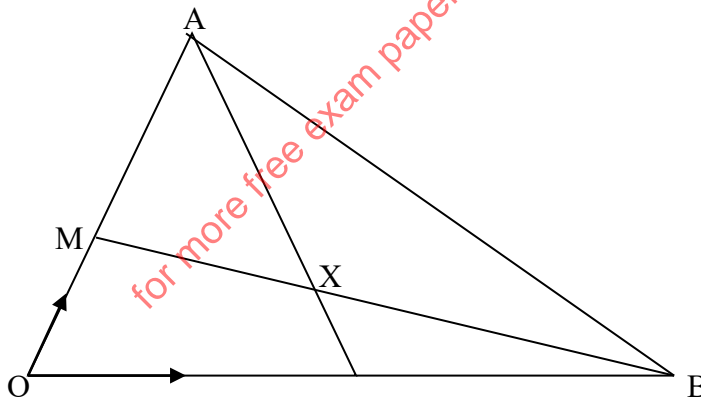
13. Two variables P and Q are such that P varies partly as the square root of Q and partly as Q. Determine the relationship between P and Q when $Q = 16, P = 500$ and when $Q = 25, P = 800$. (3 marks)
14. The 10th, 25th and the last term of an AP are 313, 193 and -7. Find the number of terms in the series. (3 marks)
15. The figure below shows a rectangle PQRS with $PQ = 7$ cm and $QR = 5$ cm. A variable point T inside the rectangle is such that $\angle PTQ \geq 90^\circ$ and $\angle STR \geq 90^\circ$. By shading the unwanted region locate the region in which T lies. (3 marks)



16. A lady bought a car on hire purchase terms. She paid a deposit of Sh 320,000. On the balance, compound interest was charged at 18% p.a. for 4 years. The interest charged and the balance were paid in 48 equal monthly installments of Sh 34,980. Calculate the price of the car to the nearest shilling. (3 marks)

SECTION II

17. The figure below shows a triangle OAB in which M divides OA in the ratio 2 : 5 and N divides OB in the ratio 5 : 3. AN and BM intersect at X.



- (a) Given that $OA = \mathbf{a}$ and $OB = \mathbf{b}$, express in terms of \mathbf{a} and \mathbf{b} .
- (i) \mathbf{AN} (1 mark)
- (ii) \mathbf{BM} (1 mark)
- (b) If $AX = kAN$ and $BX = hBM$ where k and h are constant, write two expressions for OX in terms of $\mathbf{a}, \mathbf{b}, k$ and h . Find the values of k and h. (8 marks)
18. The age distribution of workers in a factory is given in the following table.

| | | | | | | | | |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|
| Age yrs | 16-20 | 21-25 | 26-30 | 31-35 | 36-40 | 41-45 | 46-50 | 51-55 |
| Frequency | 2 | 10 | 12 | 23 | 10 | 8 | 2 | 3 |

- (a) Using a suitable assumed mean, calculate the mean and the standard deviation. (4 marks)

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(b) Draw an Ogive for the above distribution and use it to find the median, interquartile range and quartile deviation. (6 marks)

19. Mueni earns a basic salary of Ksh 55,000. She is housed by the employer and is given taxable allowances amounting to Ksh 10,580. The table below shows income tax rates.

| Monthly taxable pay Kf | Rate of tax Ksh / £ |
|------------------------|---------------------|
| 1 – 435 | 2 |
| 436 – 970 | 3 |
| 971 – 1505 | 4 |
| 1506 – 2040 | 5 |
| Excess over 2040 | 6 |

(a) If taxable income is gross salary plus $\frac{15}{100}$ of basic salary calculate her total monthly tax in Ksh per month. (5 marks)

(b) Mueni is entitled to personal relief of Ksh 1200 per month. Determine her net tax in Ksh per month. (2 marks)

(c) If she pays NHIF Sh 320, and contributes Sh 5,000 as shares to cooperative society. In addition she contributes Ksh 13,000 towards her loan repayment, calculate her net salary. (3 marks)

20. Four towns P, Q, R and S are located on the earth's surface at the following co-ordinates P (0° , 15° W), Q (0° , 15° E), R (45° N, 15° E), S (45° N, 15° W). At noon, two aircrafts A and B each flying at a speed of 350 km/h start simultaneously from P and S and flew towards Q and R respectively. Each aircraft files along the parallel of latitude.

(a) Determine the distance from:

- (i) P to Q (2 marks)
 (ii) S to R (2 marks)

(b) Calculate the time taken by:

- (i) A from P to Q (2 marks)
 (ii) B from R to S. (2 marks)

(c) Determine at what time of the day each aircraft arrives at its destination. (2 marks)

21. (a) Two variables x and y are connected by the law $y = \left(\frac{m}{x} + n\right)^{\frac{1}{2}}$ for all positive values of x.

- (i) Convert the equation above into linear form.
 (ii) State the variables to be plotted against each other to give a straight line graph. (1 mark)

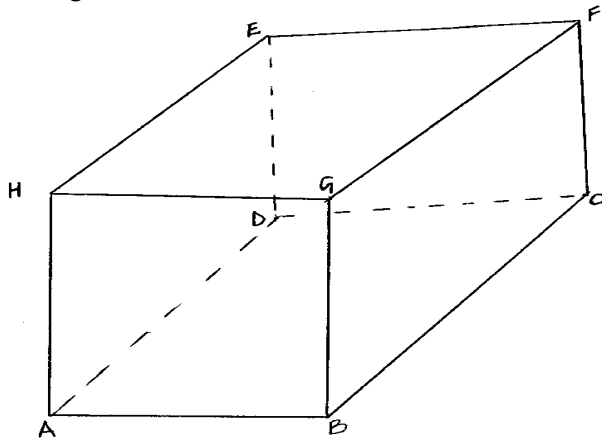
(b) The table below gives corresponding values of x and y. Complete the table by filling the blank boxes.

| | | | | | | |
|---|-------------|-------------|--------------|---|---------------|------------|
| x | 1.5 | 2 | 2.5 | 3 | 3.5 | 4 |
| y | $\sqrt{13}$ | $\sqrt{11}$ | $\sqrt{9.8}$ | 3 | $\sqrt{8.43}$ | $\sqrt{8}$ |
| | | | | | | |
| | | | | | | |

(c) By drawing a suitable linear graph, determine:

- (i) the values of m and n. (5 marks)
 (ii) the law connecting y and x. (1 mark)

22. The diagram below shows a cube of sides 20cm. calculate to one decimal place:



- (a) The length of AF (2 marks)
 - (b) The length of BF (2 marks)
 - (c) The size of the angle between plane BFD and the base ABCD. (2 marks)
 - (d) The shortest distance between point B and the plane ACF. (2 marks)
 - (e) Find the angle θ made by the line HF and its skew line BC. (2 marks)
23. For a mathematics contest examination, at least 4 but not more than nine students are to be chosen to make a group. The ratio of the number of boys to the number of girls must be less than 2 : 1 and there must be more boys than girls. If x and y represent the number of boys and girls respectively:
- (a) Write down in their simplest form all the inequalities in x and y. (4 marks)
 - (b) On the grid provided, graph the inequalities in (a) above, by shading the unwanted region and clearly indicate the region that satisfy the inequalities by letter R. (4 marks)
 - (c) By use of a search line, or otherwise find the composition of the contest group of:
 - (i) Largest size (1 mark)
 - (ii) Smallest size (1 mark)
24. Draw on the same set of axes, the graph of $y = \sin x$ and $y = 2\sin(x + 30^\circ)$ in the range $-240^\circ \leq x \leq 240^\circ$. Using a scale of x axis 1 cm rep 30° , y axis 1 cm rep 0.5 units.
- (a) Find the period and the amplitude of the functions.
 - (b) What transformation maps the graph of $y = \sin x$ onto the graph of $y = 2 \sin(x + 30^\circ)$.
 - (c) State the phase angle of $y = 2 \sin(x + 30^\circ)$

MATHEMATICS PAPER 1 & 2
KIRINYAGA WEST
121/1
MATHEMATICS
PAPER 1
DECEMBER 2020

Section I (50 Marks)

Answer ALL questions in the section in the space provided.

1. Without using mathematical tables or calculator, evaluate. (3 mks)

$$\frac{0.18 \times 4}{\sqrt{3.24 \times 4}}$$

2. Express 1764 and 2744 in terms of their prime factors. Hence evaluate. (3mks)

$$\frac{\sqrt{1764}}{\sqrt[3]{2744}}$$

3. A train moving at an average speed of 144 km/h takes 30 secs to completely cross a bridge that is 100 metres long.

i) Express 144km/h in metres per second. (1mk)

ii) Find the length of the train. (2mks)

4. Express and simplify (2mks)

$$6(x + 7) - 4(x - 3)$$

5. When the price of an item was increased by Sh. 5, I bought 2 items fewer with Sh. 200. What was the original price of the item, (3mks)

6. A line which joins the points A(3, k) and B(-2, 5) is parallel to another line whose equation is $5y + 2x = 10$

Find the value of k. (3mks)

7. Solve the equation. (4mks)

$$\sin(3x + 30^\circ) = \frac{\sqrt{3}}{2}, \text{ for } 0^\circ \leq x \leq 90^\circ$$

8. Find the integral values of x which satisfies the inequalities. (3mks)

$$2x - 1 < 7 + x \leq 3x + 1$$

9. The exterior angle of a regular polygon is equal to one third of the interior angle. Calculate the number of sides of the polygon and give its name. (4mks)

10. A boy and a girl working together can do a piece of work in 6 days. A boy, working alone takes 5 days longer than the girl. Determine the number of days that each will take to do the work. (4mks)

11. Simplify (3mks)
- $$\frac{x^2 - 9y^2}{2x^2 - 7xy + 3y^2}$$

12. If $\begin{pmatrix} -2 \\ 5 \end{pmatrix} + 3\tilde{r} = \begin{pmatrix} 4 \\ 4 \end{pmatrix}$ where \tilde{r} is the position vector of a point R. Find the co-ordinates of R. (3mks)

13. John sold a mobile phone costing Kshs 3800 at a profit of 20%. He earned a commission of $22\frac{1}{2}\%$ on the profit. Find the commission earned. (3mks)

14. Maina withdrew some money from a bank. He spent $\frac{3}{8}$ of the money to pay for Jane's school fees and $\frac{2}{5}$ to pay for John's school fees. If he remained with Kshs. 12,330. Calculate the amount of money he paid for John's school fees. (4mks)

15. Without using mathematical tables or a calculator, evaluate.

(3mks)

$$(27)^{\frac{2}{3}} \times \left(\frac{81}{16}\right)^{\frac{-1}{2}}$$

16. A watch which loses a half-minute every hour was set to read the correct time at 05:45h on Monday. Determine the time in the 12-hour system, the watch will show on the following Friday at 1945h.

(3mks)

SECTION II (50 Marks) :

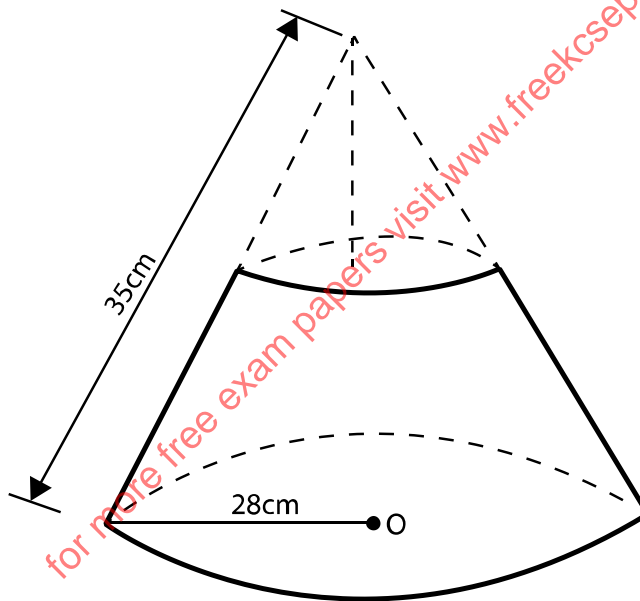
Answer ANY five questions in this section in the spaces provided.

17. A bus left Nairobi at 9.00am and travelled towards Eldoret at an average speed of 80km/h at 9.30am, a car left Kitale towards Nairobi at an average speed of 120km/h. Given that the distance between Nairobi and Kitale is 400km.

Calculate

- a) The time the car arrived in Nairobi. (2mks)
- b) The time the two vehicles met. (4mks)
- c) The distance from Nairobi to the meeting point. (2mks)
- d) The distance of the bus from Kitale when the car arrived in Nairobi. (2mks)

18. The figure below shows a closed frustum which was made by cutting off a smaller cone from a larger cone at point C, 14cm below the vertex. Given that the curved surface area of the small cone is 23.33cm^2 and the slant cone height and radius of the larger cone is 35cm and 28cm respectively.

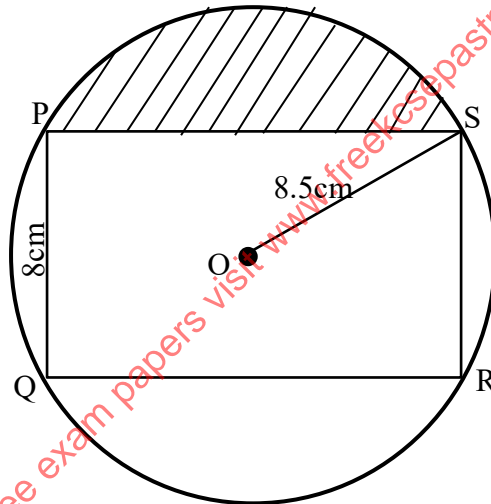


Calculate

- a) Radius of the smaller cone. (3mks)
 - b) Curved surface area of the larger cone. (3mks)
 - c) Total surface area of the frustum (4mks)
19. a) Given that matrix $P = \begin{pmatrix} 15 & 20 \\ 14 & 24 \end{pmatrix}$, find P^{-1} the inverse of P. (2mks)
- b) Two traders, Maina and Owino bought goats and sheep at Sh g per goat and Sh s per sheep. Maina paid a total of Sh 60 000 for 15 goats and 20 sheep while Owino paid a total of Sh 64000 for 14 goats and 24 sheep.
 - i) Form a matrix equation to represent this information. (1mk)
 - ii) Use the inverse matrix P^{-1} in (a) above to find the cost of a sheep and a goat. (3mks)

MATHEMATICS PAPER 1 & 2

- c) Maina sold all his animals at a profit of 20% per goat and 25% per sheep. Owino sold all his animals at a profit of 25% per goat and 20% per sheep. Calculate the profit each trader made. (4mks)
20. a) A point P divides line AB internally in the ratio 2:1. Given that the coordinates of A and B are (3,-6) and (6,9) respectively, find the coordinates of P. (3mks)
- b) A point Q is on the y-axis such that PQ is perpendicular to AB. Find
- i) The gradient of PQ (2mks)
- ii) The equation of PQ in the form $y = mx + C$. (2mks)
- d) Determine the coordinates of Q and hence calculate to one decimal place the length of PQ. (3mks)
21. Using a pair of compass and ruler only construct;
- a) Triangle PQR in which $PQ = 5\text{cm}$, $\angle QPR = 30^\circ$ and $\angle PQR = 105^\circ$. (3mks)
- b) A circle that passes through the vertices of the triangle PQR. Measure its radius. (3mks)
- c) The height of triangle PQR with PQ as the base. Measure the height. (2mks)
- d) Determine the area of the circle that is outside the triangle correct to 2 decimal places. (2mks)
22. a) Using the trapezoidal rule, estimate the area under the curve $y = \frac{1}{2}x^2 - 2$ between $x = 0$ and $x = 6$. Use six strips. (4mks)
- b) i) Use integration to evaluate the exact area under the curve. (4mks)
- ii) Hence, evaluate the percentage error in calculating the area using trapezoidal rule. (2mks)
- 23.



- The figure above represents a rectangle PQRS inscribed in a circle centre O and radius 8.5cm. Calculate
- a) the length PS of the rectangle. (3mks)
- b) the angle POS (3mks)
- c) the area of the shaded region. (4mks)
24. The displacement x metres of a particle after t seconds is given by $x = 3t^3 - 2t^2 + 6$, $t > 0$
- a) Calculate the velocity of the particle in m/s when $t = 2$ seconds. (3mks)
- b) When the velocity of the particle is zero, calculate its
- i) displacement (4mks)
- ii) acceleration (3mks)

MATHEMATICS PAPER 1 & 2
KIRINYAGA WEST
121/2
MATHEMATICS
PAPER 2
DECEMBER 2020

Section I: (50 Marks)

Answer ALL questions in the section in the space provided.

- The length and width of a rectangle to the nearest millimetres are 7.5cm and 5.2cm respectively. Find to 4 S.F, the percentage error in the area of the rectangle. (3mks)
- A shopkeeper mixes sugar costing Sh. 50 per kg with another type which costs Sh. 80 per kg. Find ratio in which the two must be mixed so that a kilogram of the mixture is sold at Ksh. 66 a profit of 10% is realized. (3 mks)
- T is a transformation represented by the matrix $\begin{pmatrix} 5x & 2 \\ -3 & x \end{pmatrix}$ under T, a square of area 10cm^2 is mapped onto a square of area 110cm^2 . Find the value of x. (2 mks)
- Points P(40°S , 45°E) and point Q(40°S , 60°W) are on the surface of the earth. Calculate the shortest distance along a circle of latitude between the two points in nautical mile. (3mks)
- Expand and simplify $(3x - y)^4$. Hence use the first three terms of the expansion to approximate the value of $(6 - 0.2)^4$ (4mks)
- The sum of the first four terms of an arithmetic sequence is 18. If the 10th term is 42 find;
 - The first term of the sequence. (2mks)
 - The sum of the first ten terms of the sequence. (2mks)
- Make h the subject of the formula. (3mks)

$$V = \sqrt[3]{\frac{ax^2h}{b-h}}$$

- The equation of a curve is $y = 4 + 3x - x^2$. Find the equation of normal to the curve at the point P(3, -5). Leave your answer in the form $y = mx + c$. (3mks)
- The table below shows the number of children per family in a housing estate.

| | | | | | | | |
|-----------------|---|---|----|----|----|---|---|
| No. of children | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| No. of families | 1 | 5 | 11 | 27 | 10 | 4 | 2 |

- Calculate the standard deviation of the data above to 4 s.f. (4mks)
- Draw a line of best fit for the graph of y against x using the values in the table below. Hence determine the equation connecting y and x. (3mks)

| | | | | | |
|---|-----|-----|-----|-----|-----|
| X | 0.4 | 1.0 | 1.4 | 2.0 | 2.5 |
| Y | 0.5 | 1.0 | 1.2 | 1.5 | 2.0 |

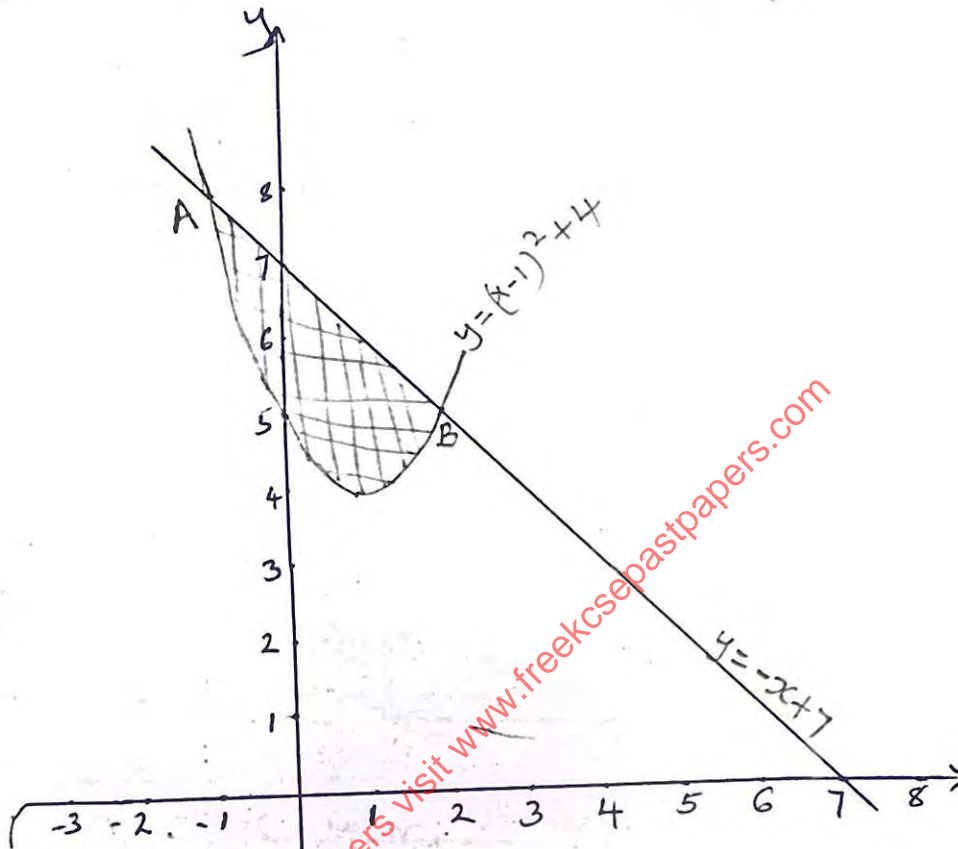
- Find the value of x in the equation.
 $\text{Log}(15-5x) - \text{log}(3x - 2) - 2 = 0$ (2mks)

→ →

- If $OA = 3i + 2j - 4k$ and $OB = 4i + 5j - 2k$, P divides AB into the ratio 3:-2. Determine the modulus of OP leaving your answer to 2 d.p. Given that O is the origin. (3mks)
- The equation of a circle centre (a, b) is $x^2 + y^2 - 6x - 10y + 30 = 0$. Find the values of a and b. (3mks)

MATHEMATICS PAPER 1 & 2

14. Draw a line $PQ = 7.2$ cm and on one side of the line, use a ruler and a pair of compasses only to draw the locus of a variable point A such that $\angle PAQ \geq 60^\circ$ and on it mark the region A such that $PA < QA$. (3mks)
15. Find the compound interest on Ksh. 21,000 in 3 years at a rate of 20% p.a compounded semi annually. (3mks)
16. The diagram below shows a straight line $y = -x + 7$ intersecting the curve $y = (x - 1)^2 + 4$ at the point A and B .



- a) Find the co-ordinates A and B (2mks)
- b) Calculate the area of the shaded region. (2mks)

SECTION II (50 Marks):

Answer ANY FIVE questions in this section in the spaces provided.

17. In a certain year, the income tax rates were as follows.

| Monthly taxable income (Ksh) | Rate per Sh. |
|------------------------------|--------------|
| 0 – 9680 | 10% |
| 9681 – 18800 | 15% |
| 18801 – 27920 | 20% |
| 27921 - 37040 | 25% |
| 37041 and above | 30% |

In this year, Wamalwa’s monthly earning were as follows.

| | |
|---------------------|-----------|
| House allowance | Ksh 1500 |
| Medical allowance | Ksh 3200 |
| Basic salary | Ksh 28600 |
| Transport allowance | Ksh 540 |

MATHEMATICS PAPER 1 & 2

He had a monthly tax relief of Ksh. 1056.

- a) Determine Wamalwa's monthly tax. (6mks)
- b) Apart from the tax, the following deductions are also made from Wamalwa's monthly pay.
 - Health Insurance Fund Ksh 500
 - Education Insurance Ksh 1200
 - Widows and children pension Scheme 2% of basic salary

Find Wamalwa's net monthly income. (4mks)

18. a) Complete the table below for the function $y = x^3 + 6x^2 + 8x$. (2mks)

| | | | | | | | |
|---|----|----|----|----|----|---|---|
| x | -5 | -4 | -3 | -2 | -1 | 0 | 1 |
| y | | | 3 | | | | |

- b) Draw the graph of the function $y = x^3 + 6x^2 + 8x$ for $-5 \leq x \leq 1$
Use a scale of 1cm to represent 1 unit on the x axis and 1cm to represent 5 units on the y axis. (3mks)
- c) Use your graph to estimate the roots of the equations
 - i) $x^3 + 6x^2 + 8x = 0$ (2mks)
 - ii) $x^3 + 6x^2 + 7x + 1 = 0$ (3mks)

19. The cost C of producing n items varies partly as n and partly as the inverse of n. To produce two items it cost Ksh. 135 and to produce three items it costs Ksh. 140. Find

- a) the constants of proportionality and hence write the equation connecting C and n. (5mks)
- b) the cost of producing 10 items. (2mks)
- c) the number of items produced at a cost of Ksh. 756. (3mks)

20. a) Complete the table below giving your values correct to 2 d.p. (2mks)

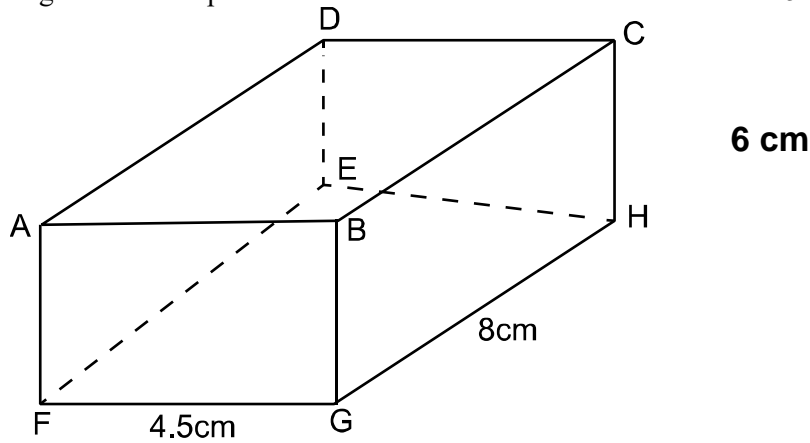
| | | | | | | | | | | | | | |
|------------------|-------|--------|--------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|
| x^0 | 0^0 | 15^0 | 30^0 | 45^0 | 60^0 | 75^0 | 90^0 | 105^0 | 120^0 | 135^0 | 150^0 | 165^0 | 180^0 |
| $\cos 2x^0$ | 1 | | | 0 | | | | | -0.5 | | | | |
| $\sin(x + 30)^0$ | | | 0.87 | | | | | 0.71 | | | | | -0.50 |

- b) Using the grid provided draw on the same axes, the graphs of $y = \cos 2x$ and $y = \sin(x + 30)^0$ for $0^0 \leq x \leq 180^0$. Take the scales 1cm for 15^0 on the x-axis and 4cm for 1 unit on the y-axis. (5mks)
- c) Using the graph in (b) above
 - i) Determine the period of the graph $y = \sin(x + 30)^0$ (1mk)
 - ii) Solve the equation $\cos 2x - \sin(x + 30)^0 = 0$ (2mks)

21. The probability that a school team will win a match is 0.6. The probability that the team will lose the match is 0.3 and the probability that the team will draw in the match is 0.1 Given that the team will play two matches.

- a) Draw a tree diagram to represent the above information. (2mks)
- b) What is the probability that the team will
 - i) win the two matches. (2mks)
 - ii) Either wins all the matches or lose all the matches. (2mks)
 - iii) Win one match and lose one. (2mks)
 - iv) Draw in one match. (2mks)

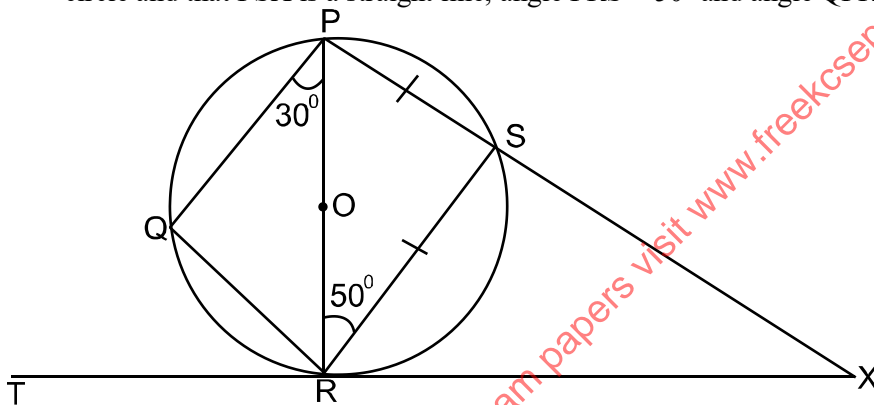
22. The diagram below represents a cuboid ABCDEFGH in which $FG = 4.5\text{cm}$, $GH = 8\text{cm}$ and $HC = 6\text{cm}$.



Calculate to 2 d.p.

- a) The length of FC (3mks)
- b) i) The size of the angle between the lines FC and FH. (2mks)
- ii) The size of the angle between the lines AB and FH. (2mks)
- c) The size of the angle between the planes ABHE and the plane FGHE. (3mks)

23. The figure below is a cyclic quadrilateral PQRS. Given that TRX is a tangent at R and O is the centre of the circle and that PSX is a straight line, angle PRS = 50° and angle QPR = 30° and chord RS = PS.



- a) Giving reason in each case, find;
 - i) Angle SRX (2mks)
 - ii) Angle RXS (2mks)
 - iii) Angle PQR (2mks)
 - iv) Reflex angle QOR (2mks)
 - b) Given that $RX = 12\text{cm}$, $SX = 8\text{cm}$, Find the length of Chord PS. (2mks)
24. Mueni makes two types of wedding cakes. Type A and B. Type A requires 200g of flour and 80g of cooking oil. Type B requires 400g of flour and 50g of cooking oil. On a particular day, they had 1600g of flour and 400g of cooking oil.
- a) If they make x cakes of type A and y cakes of type B. Write down inequalities in x and y to represent the above conditions. (4mks)
 - b) On the grid provided represent the above inequalities. (4mks)
 - c) If the profit on type A is Ksh. 30 and the profit on type B cake is Ksh. 40. Determine the number of cakes of each type he should make to maximize profit. (2mks)