F3 M/S

SECTION 1 (50 Marks)

Answer all questions in this section in the spaces provided.

1\. Without using mathematical tables or calculators, evaluate: (3 Marks)

$$\frac{0.38 \times 0.23 \times 2.7 \times 10^7}{0.114 \times 0.0575 \times 10^7}$$

$$\frac{38 \times 23 \times 27 \times 1000}{114 \times 575} = 9 \times 4 \quad \text{M1 M1}$$

$$= 36 \quad \text{A1}$$

2\. Determine the equation of the line through the point A(5, 3) and parallel to the line $y = 2x + 3$. (3 Marks)

Let L_1 be $y = 2x + 3$

Gradient $L_1 = 2$

$\therefore$ Gradient $L_2 = 2$

$\frac{y-3}{x-5} = 2$

$y - 3 = 2x - 10$

$y = 2x - 7$

or

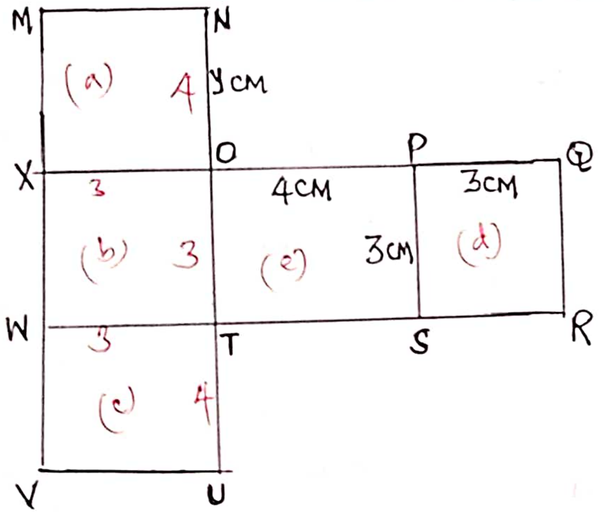
$y - 2x + 7 = 0$

M1 – g2

M1 – eqn.

A1

3\. The figure below is a sketch of the net of an open box. The dimensions are in centimetres.



(a) $y = 4$ cm B1

(b) Area of faces a, c, e

$3 \times 4 \times 3 = 36$

Area of faces b, d

$3 \times 3 \times 2 = 18$ M1

$\therefore SA = 36 + 18$

$= 54\,cm^2$ A1

(a) State the value of y (1 Mark)

(b) Calculate the surface area of the box (3 Marks)

4\. Given that $\frac{3}{m} - 4m = 2 - \frac{9}{m}$, find the value of m (4 Marks)

$\frac{3 - 4m^2}{m} = \frac{2m - 9}{m}$

$4m^2 + 2m - 12 = 0$

$\Rightarrow 2m^2 + m - 6 = 0$

(4, −3)

$2m^2 + 4m - 3m - 6 = 0$

$2m(m+2) - 3(m+2) = 0$

$(2m-3)(m+2) = 0$

$\therefore 2m = 3$

$m = 1\frac{1}{2}$

or

$m = -2$

M1

M1 – quad. eq.

M1 – solving

A1 (both)

5\. The table below shows speeds of vehicles measured to the nearest 10 kph. as they passed a certain point:

Speed (kph.)	30	40	50	60	70	80	90	100	110	
Frequency	1	4	9	14	38	47	51	32	4	$\Sigma f = 200$
fx	30	160	450	840	2660	3760	4590	3200	440	$\Sigma fx = 16130$

$\bar{x} = \frac{16130}{200} = 80.65$

M1

B1 – for fx

A1

(i) Calculate the mean speed of the vehicle. (3 Marks)

(ii) State the Modal speed. (1 Mark).

90 Kph. — B_1

6. Given that $A=\begin{pmatrix}4 & 3\\-1 & 2\end{pmatrix}$ and $C=\begin{pmatrix}14 & 7\\-4 & 2\end{pmatrix}$, find B if (3 Marks)

$2A+B=C$

$2\begin{pmatrix}4 & 3\\-1 & 2\end{pmatrix}+B=\begin{pmatrix}14 & 7\\-4 & 2\end{pmatrix}$

$\begin{pmatrix}8 & 6\\-2 & 4\end{pmatrix}+B=\begin{pmatrix}14 & 7\\-4 & 2\end{pmatrix}$

$\therefore B=\begin{pmatrix}14 & 7\\-4 & 2\end{pmatrix}-\begin{pmatrix}8 & 6\\-2 & 4\end{pmatrix}$ M_1

$\begin{pmatrix}6 & 1\\-2 & -2\end{pmatrix}$

M_1 – equation
M_1
A_1

7. A container M_1 is in the form of a frustrum of a right Pyramid 4M square at the bottom, 2.5M square at the top and 3M deep. calculate the capacity of the container. (4 Marks)

$\frac{h}{3+h}=\frac{2.5}{4}$ M_1

$4h=7.5+2.5h$

$1.5h=7.5$

$\therefore h=5$

$V=\frac{1}{3}\times16\times8-\frac{1}{3}\times6.25\times5$

$42.67-10.42$

$=32.25\ m^3$

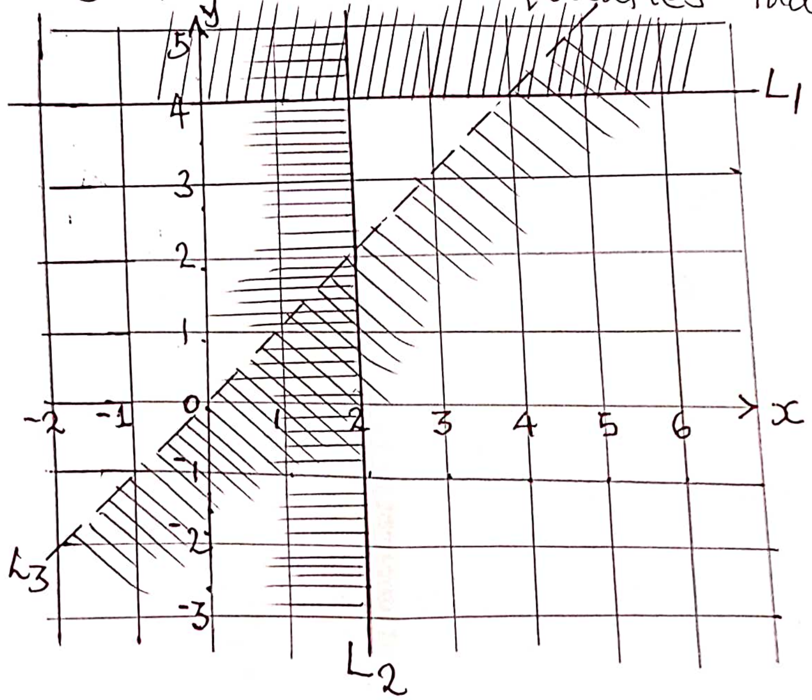
$1m^3 \to 1000L$

$32.25m^3 \to ?$

$=32{,}250\ L$

M_1 – L
M_1 – Vol
M_1
A_1

8. The unshaded region in the figure below is bounded by lines L_1, L_2 and L_3. State the three inequalities that define the region. (3 Marks)



L_1 equation
$y=4$
$\therefore y\le4$ ✓ B_1

L_2 equation
$x=2$
$\therefore x\ge2$ ✓ B_1

L_3 – Gradient
$4/4=1$
at $(4,4)$
$\frac{y-4}{x-4}=1$
$y-4=x-4$
$y=x$
$y\ge x$ ✓ B_1

9. The Mass (M) of a certain rod varies jointly as its Length (L) and the square of its radius (R). A rod 40 cm Long and radius 5cm has a mass of 6 kg. Find the mass of a similar rod of Length 25 cm and radius 8 cm. (4 Marks)

$M\propto LR^2$

$\therefore M=KLR^2$

$6=K40\times5^2$

$6=1000K$

$M=\frac{6}{1000}\times25\times8\times8$

$\frac{48}{5}$

9. Simplify $\frac{\sqrt{54}+3\sqrt{3}}{\sqrt{3}}$ (3 Mks)

$\frac{(\sqrt{54}+3\sqrt{3})\times\sqrt{3}}{\sqrt{3}\ \sqrt{3}}$

$\frac{(\sqrt{9\times6}+3\sqrt{3})\sqrt{3}}{3}$

$\frac{3\sqrt{6}\times\sqrt{3}+3\sqrt{3}\times\sqrt{3}}{3}$

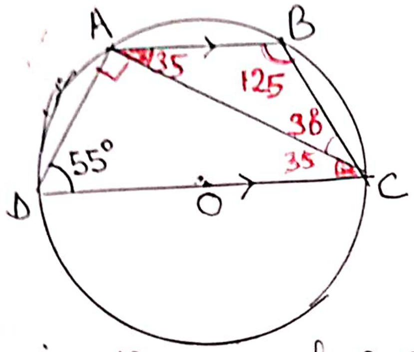
$\frac{3\times3\sqrt{2}+3\times3}{3} \Rightarrow 3\sqrt{2}+3$

M_1 – Conjugate

M_1 – simplifying

A_1

10. In the figure below, O is the centre of the circle. A, B, C and D are points on the circumference of the circle. Line AB is parallel to line DC and angle ADC = 55°.



Determine the size of angle ACB.

(3 marks)

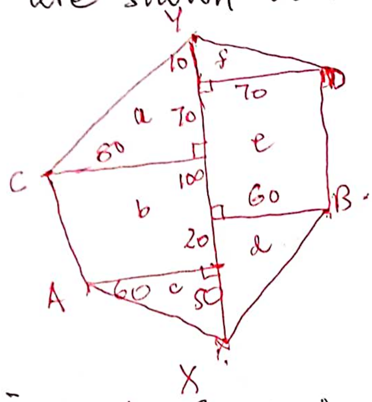
$\angle ABC = 180 - 55$ (opp. ∠s of cyc. quad.)
$= 125$
$\angle ACD = 180 - (90+55) = 35°$

∴ $\angle BAC = 35$ (alt. ∠s)
∴ $\angle ACB = 180 - (125+35)$
$= 30°$

B_1 – for ∠BAC
B_1 – for ∠ACB

11. The results of a survey activity are shown in the field book below.

	Y	
	250	
	240	70 D
C 80	170	
	70	60 B
A 60	50	
	X	

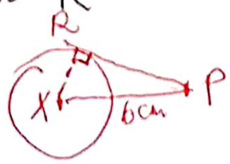


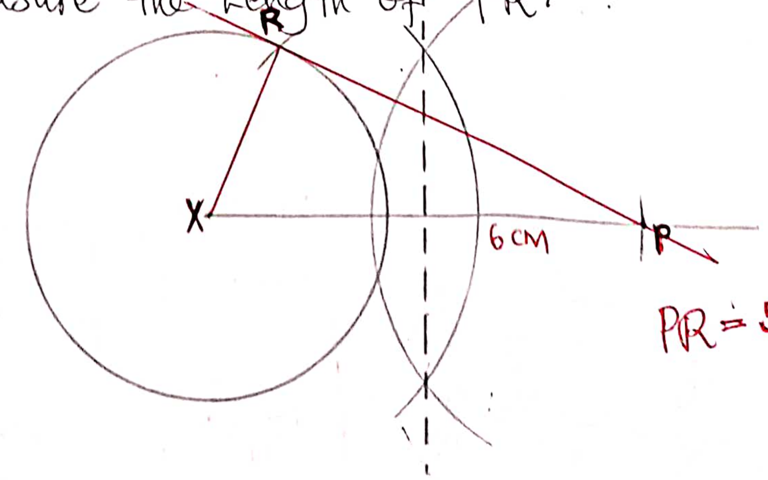
If all the measurements are in metres, calculate the area of the field in: (i) M^2 (3 marks)
(ii) Ha. (1 Mark)

Area (a) $= \frac{1}{2} \times 80 \times 80 = 3200$
(b) $= \frac{1}{2} \times 120(80+60) = 8400$
(c) $\frac{1}{2} \times 50 \times 60 = 1500$
(d) $\frac{1}{2} \times 70 \times 60 = 2100$
(e) $\frac{1}{2} \times 170(60+70) = 11050$
(f) $= \frac{1}{2} \times 10 \times 70 = 350$
Total area
$= 26{,}600\ m^2$
1 ha → 10000 m²
→ 26600 m²
= 2.66 ha

M_1 – Area
A_1
M_1
A_1

12. Construct a circle centre X and radius 2.5 cm. Construct a tangent from point P, 6 cm from X to touch the circle at R. Measure the length of PR. (3 Marks)





PR = 5.5

B_1 – ⊥ bisector of PX
B_1 – Tangent drawn
B_1 PR = 5.5 ± 0.1

13. Given that $\underset{\sim}{a}=\begin{pmatrix}2\\-3\end{pmatrix}$, $\underset{\sim}{b}=\begin{pmatrix}-5\\4\end{pmatrix}$ and $\underset{\sim}{c}=\begin{pmatrix}0\\-2\end{pmatrix}$, find

$|\underset{\sim}{a}+\underset{\sim}{b}+\underset{\sim}{c}|$ to four significant figures. (3 Marks)

$\begin{pmatrix}2\\-3\end{pmatrix}+\begin{pmatrix}-5\\4\end{pmatrix}+\begin{pmatrix}0\\-2\end{pmatrix}=\begin{pmatrix}-3\\-1\end{pmatrix} \Rightarrow \sqrt{-3^2+-1^2}$

$=\sqrt{10} = 3.162$ units

M1 - addition
M1
A1

14. Two matrices A and B are such that $A=\begin{pmatrix}K & 4\\3 & 2\end{pmatrix}$ and $B=\begin{pmatrix}1 & 2\\3 & 4\end{pmatrix}$. Given that the determinant of $AB=4$, find the value of K. (3 Marks)

$AB=\begin{pmatrix}K & 4\\3 & 2\end{pmatrix}\times\begin{pmatrix}1 & 2\\3 & 4\end{pmatrix}=\begin{pmatrix}K+12 & 2K+16\\3+6 & 6+8\end{pmatrix}$

$=\begin{pmatrix}K+12 & 2K+16\\9 & 14\end{pmatrix}$

Det: $=14(K+12)-9(2K+16)$

$14K+168-18K-144$

$-4K+24$

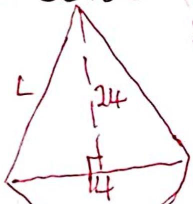
$\Rightarrow 24-4K=4$

$-4K=-20$

$\therefore K=5$

M1 - Product AB
M1 - Eqn.
A1

15. A solid metal cone has a diameter of 14 cm and a height of 24 cm. Calculate the surface area of the cone. (2 Marks)



$SA=\pi rL+\pi r^2$

$L=\sqrt{24^2+7^2}$

$=\sqrt{576+49}$

$=\sqrt{625}$

$=25$

$\Rightarrow SA=\pi\times7\times25+\pi\times7^2$

$=550+154$

$=704\ cm^2$

M1
A1

16. ~~Two taps A and B can each fill an empty tank in 3 hours and 2 hours respectively. A drainage tap R can empty the full tank in 6 hours. Taps A and R are opened for 5 hours then closed. Determine the fraction of the tank that is still empty. (2 Marks)~~

~~A in 1 hr $\rightarrow \frac{1}{3}$~~

~~B " " $\rightarrow \frac{1}{2}$~~

~~R " " $\rightarrow -\frac{1}{6}$~~

~~A and R $=\frac{1}{3}-\frac{1}{6}=\frac{1}{6}\rightarrow$ 1 hr~~

~~$\therefore$ in 5 hrs $=5\times\frac{1}{6}=\frac{5}{6}$ full~~

Empty $=1-\frac{5}{6}$

$=\frac{1}{6}$

M1 - for both.
A1

16. Evaluate $\dfrac{2\frac{1}{2}-1\frac{1}{5}\text{ of }2}{\frac{1}{4}-\left(-\frac{1}{2}\right)^3}$

Num:
$2\frac{1}{2}-\left(\frac{6}{5}\times2\right)$

$2\frac{1}{2}-\frac{12}{5}=\frac{5}{2}-\frac{12}{5}=\frac{25-24}{10}=\frac{1}{10}$

Den:
$\frac{1}{4}-\left(-\frac{1}{2}\times3\right)$

$\frac{1}{4}-\left(-\frac{3}{2}\right)$

$\frac{1}{4}+\frac{3}{2}$

$\frac{1+6}{4}=\frac{7}{4}$

$\Rightarrow\frac{1}{10}\div\frac{7}{4}$

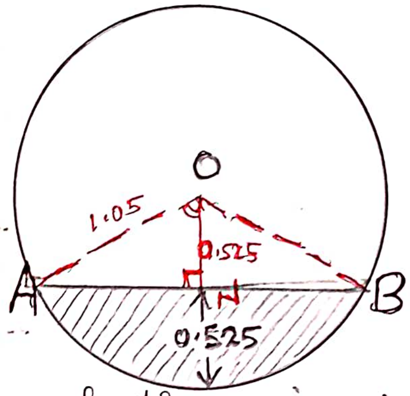
$=\frac{1}{10}\times\frac{4}{7}$

$=\frac{2}{35}$

SECTION II (50 MARKS)

Answer any five questions from this section.

17. The figure below shows the cross section of a cylinder of a petrol tanker. Its length is 7M and internal diameter 2.1 M. The depth of the petrol it contains is 0.525 M, AB being the horizontal level of the petrol,



Calculate:

(a) $\angle AOB$ where O is the centre of the circular section (3 Marks)

$1.05 - 0.525 = 0.525$ $\cos\theta = \frac{0.525}{1.05} = 0.5$ $\therefore \theta = 60^\circ$ $\angle AOB = 60 \times 2 = 120^\circ$

1.05 0.525

B1 – ON got
M1
A1

(b) The area of sector AOB. (2 Marks)

$\frac{\theta}{360}\pi r^2 = \frac{120}{360} \times \pi \times 1.05^2 = 1.1\ m^2$

M1
A1

(c) The shaded area. (3 Marks)

$\frac{\theta}{360}\pi r^2 - \frac{1}{2}ab\sin C = 1.1 - \frac{1}{2} \times 1.05^2 \sin 120^\circ$
$= 0.68\ m^2$

M1 M1
A1

(d) The mass of the petrol in the tanker, given that one cubic metre of petrol has a mass of 700 kg. (2 Marks)

Volume $= 0.68 \times 7$
$= 4.76\ m^3$

$1\ m^3 \to 700\ kg$
$4.76\ m^3 \to$

4.76×700
$= 3332\ kg$

M1
A1

18. (a) On the grid provided draw the graph of $y = 2x^2 + 3x + 1$ for $-4 \le x \le 3$ (6 Marks)

x	-4	-3	-2	-1	0	1	2	3
y	21	10	3	0	1	6	15	28

B2 – table
S1 – scale
C1 – smooth curve
P1 – plotting
B1 – axes/labelling

18
32
-12
21

(b) Use your graph to solve the equation

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

$y = 2x^2 + 3x + 1$
$- \quad 0 = 2x^2 + 4x - 3$
$y = -x + 4$

Line

x	-2	0	2
y	6	4	2

$x = 1.6$ and -2.6

L1
A1

(ii) $x^2 - x - 45 = 0$ (2 Marks)

$y = 2x^2 + 3x + 1$
$- \quad 0 = x^2 - x - 4.5$
$y = 4x + 5.5$

Line –

x	-1	0	1
y	1.5	5.5	9.5

$x = -1.4$ and 1.8

L1
A1

19. Atieno and Muthoni invested in a Matatu business. They bought a mini bus whose carrying capacity was 26 passengers 25 of whom would be paying. They put the mini bus on a route connecting two towns A and B, where the fare was sh.120 one way. Every day the Matatu made 3 round trips between the two towns. On each day, fuel used was sh.2500. The driver and conductor were paid sh.450 and sh.250 respectively. A further sh.3,500 was set aside daily for maintainance, insurance and loan repayment.

Collection for 1 round trip = sh. 120 × 25 × 2 = sh. 6000 M1

∴ Total days collection = sh. 6000 × 3 = sh. 18000 A1

(a) How much was (i) The amount of the day's collections (2 marks)

(ii) The net profit (2 marks)

Days expenditure = sh(2500 + 450 + 250 + 3500) = sh. 6700 M1

∴ Net profit = sh. (18000 − 6700) = sh. 11,300 A1

(b) The agreement between Atieno and Muthoni was that they would be sharing each day's profits in the ratio 3 : 4. Calculate how much each got on a day when the mini bus was 75% full per round trip. (6 marks)

Days collections $= \frac{75}{100} \times 18000$ M1

$= sh.\ 13,500$ A1

∴ Day's net profit = sh.(13,500 − 6700) B1

= sh. 6,800

Atieno's share $= \frac{3}{7} \times 6800 = sh.\ 2914.30$ M1 ~~A1~~

Muthoni's share $= \frac{4}{7} \times 6800 = sh.\ 3885.70$ M1 A1

20. The length of 40 athletes in a country athletics competition were as shown in the table below:

Height (cm)	Frequency (f)	Mid (x)	fx
150 − 159	2	154.5	309
160 − 169	8	164.5	1316
170 − 179	10	174.5	1745
180 − 189	y	184.5	2214
190 − 199	6	194.5	1167
200 − 209	2	204.5	409
	$\Sigma f = 40$		$\Sigma fx = 7160$

B1 − x column

B1 − fx column

$\bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{7160}{40}$ M1

$= 179$ cm A1

(a) Find the value of y (2 marks) M1 − eqn. A1

2 + 8 + 10 + y + 6 + 2 = 40   28 + y = 40 ∴ y = 12

(b) State the modal class (1 mark) B1

180 − 189

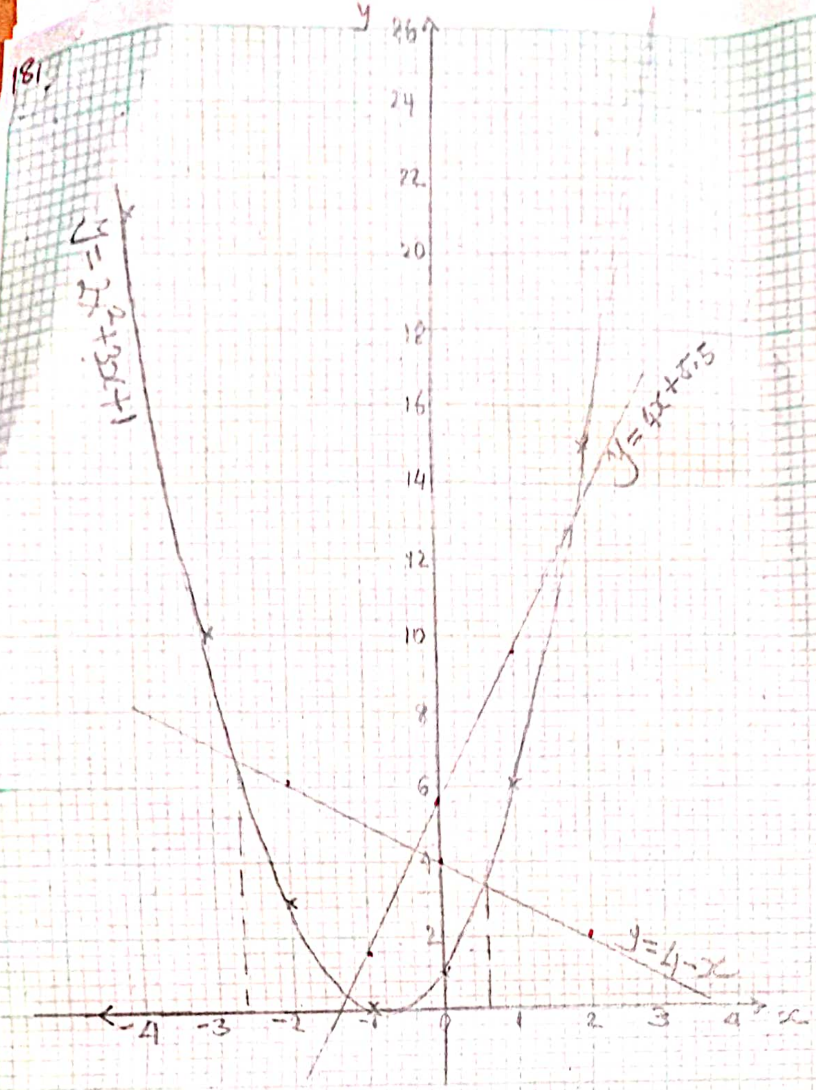
(c) Calculate the mean height of the athletes. (4 marks)

(d) On the grid provided below, draw a histogram to represent the information shown above. (3 marks)

S1 − scale

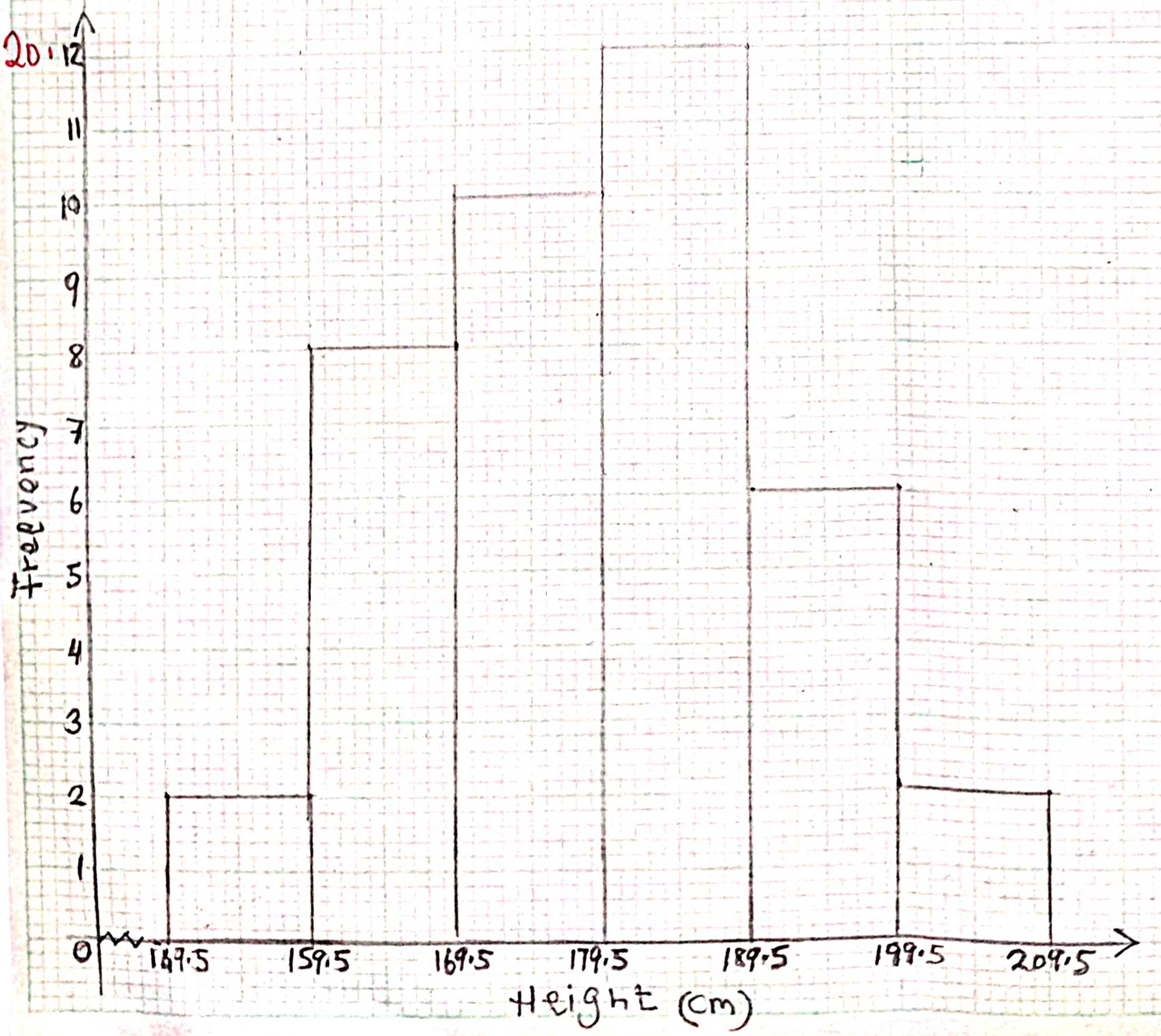
B2 − all bars

18.



$y = 2x^2 + 3x + 1$
$y = 4x + 5.5$
$y = 4 - x$
y
x

20.



Frequency
Height (cm)
149.5
159.5
169.5
179.5
189.5
199.5
209.5

21\. A line L passes through points (−2, 3) and (−1, 6). It is perpendicular to a line p at (−1, 6).

(a) Find the equation of L (2 Marks)

Gradient L $= \frac{6-3}{-1--2} = 3$

$y = mx + c$

$y = 3x + c$

$3 = -6 + c$

$\therefore c = 9$

$y = 3x + 9$

M1 – Gradient

A1 – Eqn.

(b) Find the equation of P in the form $y = mx + c$ (2 Marks).

Gradient p $= -\frac{1}{3}$

let $y = mx + c$

$y = -\frac{1}{3}x + c$

$\therefore$ at (−1, 6)

$6 = \frac{1}{3} + c$

$c = \frac{17}{3}$

$\therefore y = \frac{17}{3} - \frac{1}{3}x$

M1 – Gradient

A1 – Eqn.

$6 - \frac{1}{3}$

(c) Another line Q is parallel to L and passes through point (1, 2). Find the equation of Q. (3 Marks)

Gradient Q = 3

$\frac{y-2}{x-1} = 3$

$y - 2 = 3x - 3$

$\therefore y = 3x - 1$

M1 – Gradient

M1 – Eqn.

A1 – Eqn.

(d) Find the point of intersection of lines P and Q (3 Marks)

$P = Q$

$\Rightarrow 3x - 1 = \frac{17}{3} - \frac{1}{3}x$

$3\frac{1}{3}x = \frac{20}{3}$

$\therefore x = \frac{20}{3} \times \frac{3}{10}$

$= 2$

$\therefore y = 3 \times 2 - 1$

$= 5$

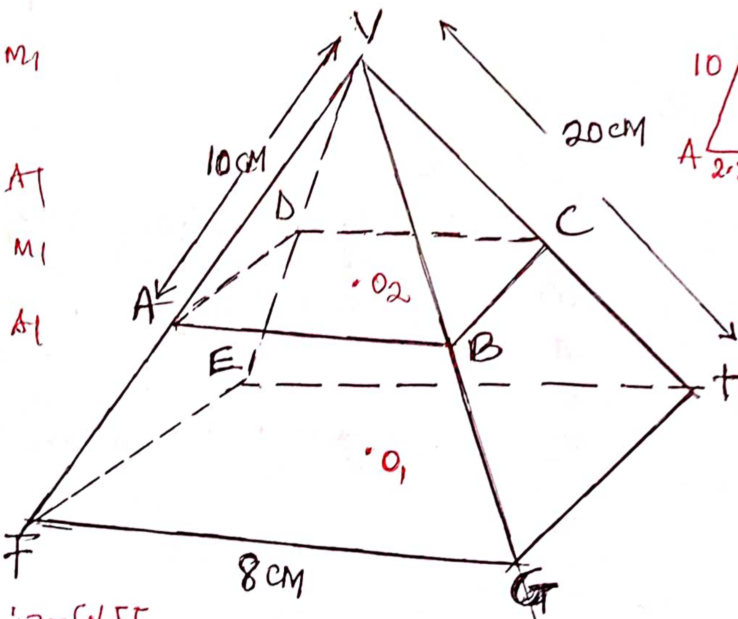
Point (2, 5)

M1 – Equation

M1 – Simplifying

A1

22\. The figure below is a right pyramid VEFGH with a square base of 8cm and a slant edge of 20cm. Points A, B, C and D lie on the slant edges of the pyramid such that VA = VB = VC = VD = 10 cm and plane ABCD is parallel to the base EFGH.



(a) $\frac{AB}{FG} = \frac{10}{20}$ M1

$\therefore AB = \frac{10 \times 8}{20}$

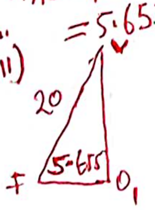
$= 4$CM A1

(b)(i) $AC^2 = 4^2 + 4^2$ M1

$\therefore AC = \sqrt{32}$

$= 5.657$CM A1

(ii)



$FH = \sqrt{8^2 + 8^2}$

$= \sqrt{128} = 11.31$

$FO_1 = 11.31 \div 2 = 5.655$

$VO_2 = \sqrt{10^2 - 2.829^2}$

$= \sqrt{100 - 8.009}$

$= 9.591$

(a) Find the length of AB (2 Marks)

(b) Calculate to 2 decimal places

(i) The length of AC (2 Marks)

(ii) The perpendicular height of the pyramid VABCD (2 Marks)

$\sqrt{20^2 - 5.655^2} = \sqrt{400 - 31.98} = \sqrt{368.02} = 19.18$ CM

M1 A1

(c) The pyramid VABCD was cut off. Find the volume of the frustrum ABCDEFGH correct to 2 decimal places (4 Marks)

$\frac{1}{3} \times 8^2 \times 19.18 - \frac{1}{3} \times 4^2 \times 9.591 = 358.02 \text{ CM}^3$

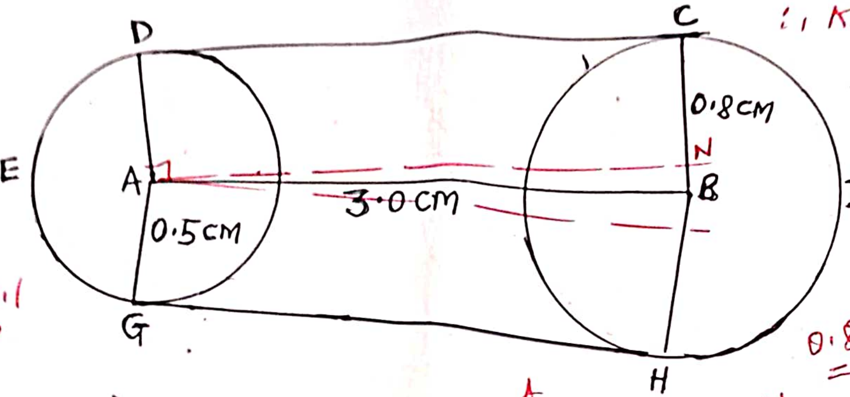
$409.17 - 51.153$

M1 M1 (both volumes)

M1 A1

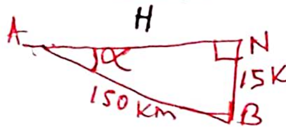
23. The diagram below shows a design model of a race course drawn to scale of 1cm represents 50 Km. It consists of two circles centre A and B radii 0.5 cm and 0.8 cm respectively. The distance between their centres is 3.0 cm.

1cm → 50Km
∴ AB = 3×50
= 150 Km
Radius 1
0.8×50
40 Km
Radius 2
0.5×50
25Km



$\sin\alpha = \frac{15}{150} = 0.1$
$\alpha = 5.8°$

0.8 − 0.5
= 0.3



Calculate in Km:

(i) The length of CD (2 Marks)

CD = AN
$\therefore = \sqrt{150^2 - 15^2} = \sqrt{22275} = 149.2$ Km
M1
A1

(ii) The length of DEG (Take π = 3.142) (2 Marks)

Reflex ∠DAG = 90×2 + 5.8×2
= 191.6°
∴ obt. ∠DAG = 360 − 191.6
= 168.8°
Length DEG = $\frac{168.8}{360} \times 2\pi \times 25 = 73.66$ Km
M1
A1

(iii) The length of HIC (Take π = 3.142) (2 marks)

Reflex ∠HBC = 191.6° ∴ Length HIC = $\frac{191.6}{360} \times 2 \times \pi \times 40 = 133.8$ Km
M1
A1

(iv) During a race, the course is managed by race officials placed 500M apart and each is paid Ksh. 2300 per day. How much is needed to pay race officials for one day's event. (4 Marks)

Total length = 149.2 × 2 + 73.66 + 133.8
= 505.9 Km
No. of officials = $\frac{505.9}{0.5}$
500 M = 0.5Km
= 1012
1012 × 2300
= Sh 2,327,600

24. A bus left Nairobi at 6.00 a.m. and travelled towards Kapsabet Boys at an average speed of 100 Km/hr. At 6.30 a.m. a van left Kapsabet Boys and travelled towards Nairobi to receive the bus with a number of students moving at an average speed of 125 Km/hr. Given that the distance between Nairobi and Kapsabet is 500 km.

Calculate:

Distance by bus in ½ hr
100 × ½ = 50 Km,
500 − 50
= 450 Km
M1

(a) The time the two vehicles met (4 Marks)

R.S. = 100 + 125
= 225 Km/hr.
RD = 450 Km
Time to meet = $\frac{450}{225}$ = 2hrs
∴ Time to meet = 6.30 + 2
8.30 a.m
M1
M1
A1

(b) On meeting the bus proceeded with its journey but the van had a break of 30 minutes before proceeding for Kapsabet Boys. Calculate:

(i) The time the bus arrived at Kapsabet Boys. (3 Marks)

Distance in 2hrs = 100Km/hr × 2
= 200 Km
Remaining distance = 450 − 200
= 250 Km
Time taken = $\frac{250}{100}$
= $2\frac{1}{2}$ hrs
8.30
+ 2.30
11.00 am

(ii) The time the van arrived at Kapsabet (3 Marks)

Time by van = $\frac{250}{125}$ + 0.5 hr = $2\frac{1}{2}$ hrs
= 8.30 + $2\frac{1}{2}$ hrs = 11.00 am.
M1
M1
A1

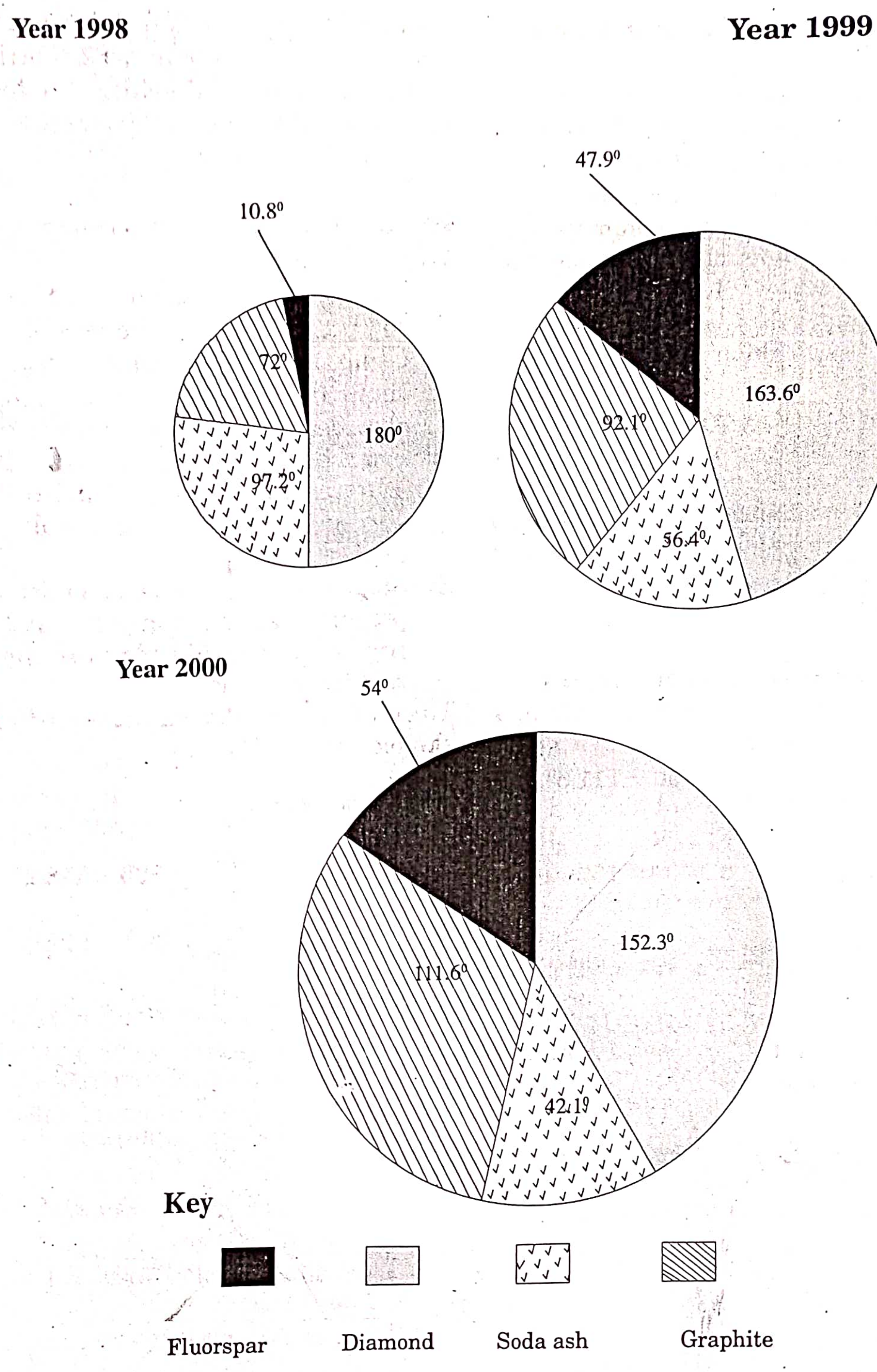


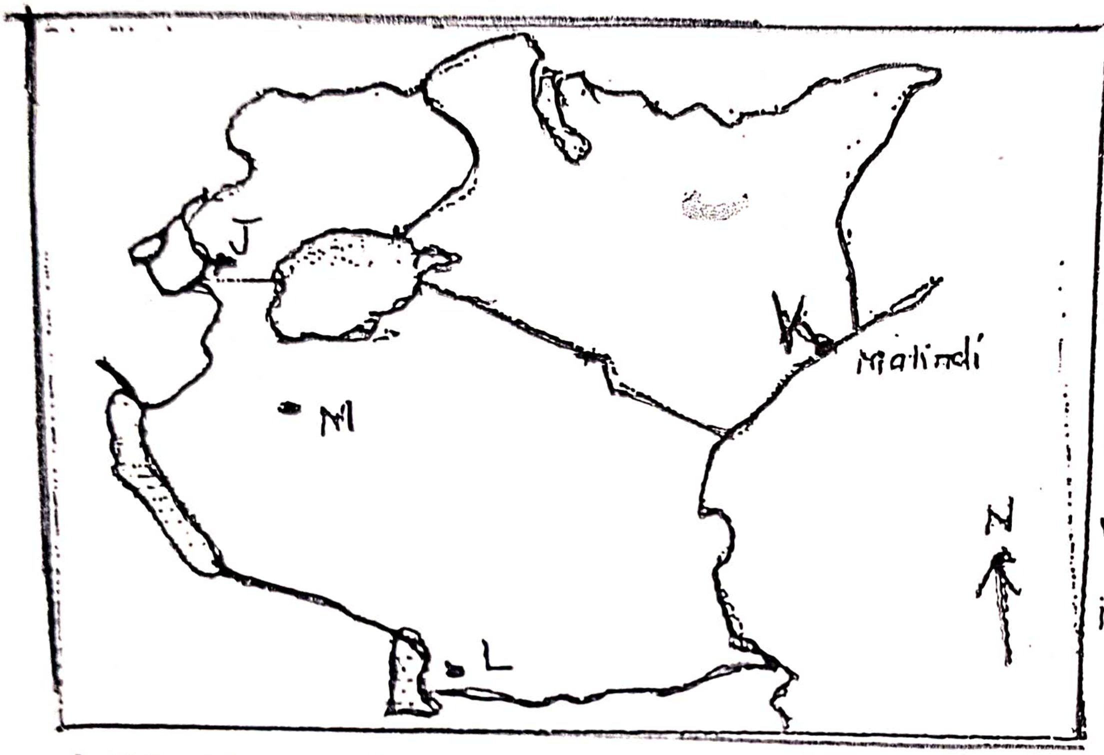
Fig. 1.2: Mineral production in Tanzania in 1998, 1999 and 2000 in tonnes.

ii. State four factors that influence the occurrence of minerals

b. Describe the open cast method of mining

c. The map below shows location of minerals in East Africa. Use it to answ

question(c) (i)



i. Name the mineral

area marked J, K,L a

ii. Describe the proc

Trona in Lake Magadi

d. Explain here ways

which mining promot

industrialization in ker

Fieldwork question

7. i. What is forestry

ii. Apart from tropical hardwood forests, name two other types of natural for

iii. State the problems experienced in exploitation of tropical hardwood fores

b. List the characteristics of planted forests in Kenya

c. Explain three factors that favour forestry in Canada

d. Give five measures that the government has taken to conserve and mange

forests in kenya — A Field work Question

8. a. Explain each of the following methods of land rehabilitation

i. Mulching

ii. Bunds and gabions

b. Give three ways in which the government is trying to rehabilitate overgradec

lands in Kenya

c. i. Name four ty...