MATHEMATICS PAPER 2
MARKING SCHEME - 2009

1. 1 cow feeds on $\frac{480}{2\times4}$ in 1 day
$= 60$kg — M_1

No. of cows to feed on 20160 in 6wks
$= \frac{20160}{60\times6\times7}$ — M_1
$= 8$ cows — A_1
03

ALTERNATIVE METHOD

No. of cows that would feed on 20160 in 4 days
$= \frac{2\times20160}{480}$ M_1

No. of cows for 6 weeks
$= \frac{2\times20160}{480}\times\frac{4}{42}$ M_1
$= 8$ cows A_1

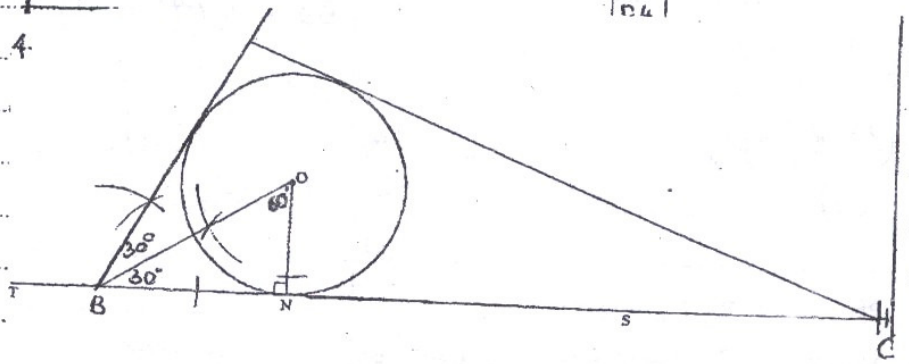
2. $(x-1.5-\sqrt{2})(x-1.5+\sqrt{2}) = 0$ — M_1
$x^2-1.5x+x\sqrt{2}-1.5x+2.25-1.5\sqrt{2}$
$-x\sqrt{2}+1.5\sqrt{2}-2 = 0$ — M_1
$x^2-3x+0.25 = 0$
$4x^2-12x+1 = 0$ — A_1
03

in $x^2+bx+c=0$
$b = -(1.5+\sqrt{2}+1.5-\sqrt{2})$ M_1
$= -3$
✓ For expansion
$c = (1.5+\sqrt{2})(1.5-\sqrt{2})$ M_1
$= 2.25-1.5\sqrt{2}+1.5\sqrt{2}$
$= -2$
$= 0.25$ (a,b,c) Must be integers.

3. $M = C+Kt^2$
$40 = C+4K$ — M_1
$65 = C+9K$
$25 = 5K$ $K=5$ — M_1
$40 = C+20$ $C=20$ — A_1
When $t=4$ $M = 20+5\times16$
$= 100$g — B_1
04

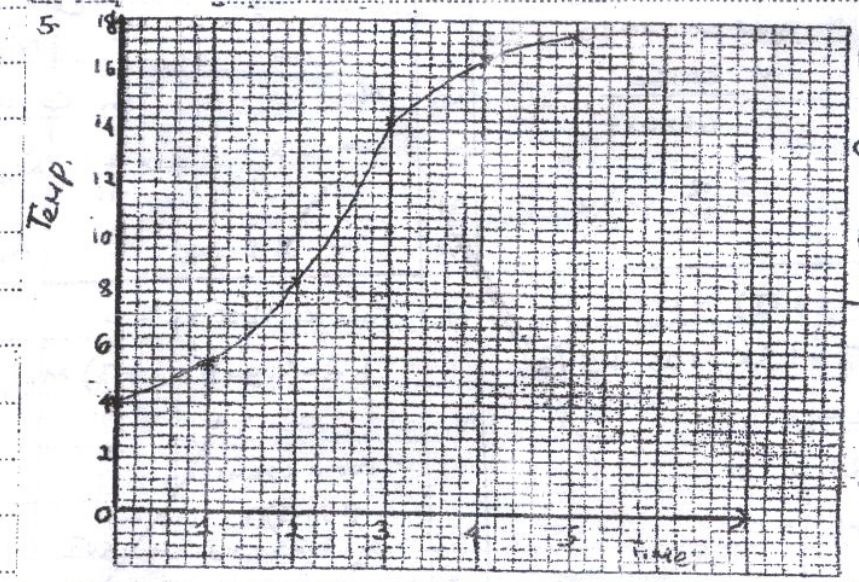
For any ✓ equation
attempt to eliminate one unknown
Allow elimination in practical variation
For both constants in P and T.

4.



B_1 For position of B
B_1 BC = 12cm
B_1 For 2 pts of contact
B_1 For ✓Δ

5



P_1 for plotting all six pts

C_1 for smooth curve

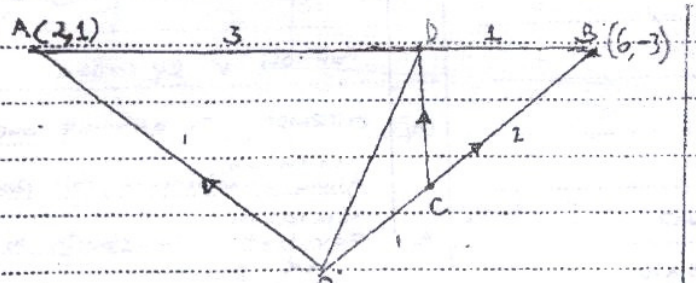
Rate of change

$\frac{15.5 - 7.6}{3.4 - 1.8} = 4.9375$ °C/min

M_1

4.9375 °C/min A_1

6



$\overrightarrow{CO} = \frac{1}{3}\begin{pmatrix}6\\-3\end{pmatrix} = \begin{pmatrix}-2\\1\end{pmatrix}$ or $\overrightarrow{OC} = \begin{pmatrix}2\\-1\end{pmatrix}$

$\overrightarrow{AD} = \frac{3}{4}\begin{pmatrix}4\\-4\end{pmatrix}$ or $\begin{pmatrix}3\\-3\end{pmatrix}$

$\overrightarrow{CD} = \overrightarrow{CO} + \overrightarrow{OA} + \overrightarrow{AD}$

$= \begin{pmatrix}2\\-1\end{pmatrix} + \begin{pmatrix}2\\1\end{pmatrix} + \begin{pmatrix}3\\-3\end{pmatrix}$

$= \begin{pmatrix}3\\-1\end{pmatrix}$

B_1 $\overrightarrow{CB} = \frac{2}{3}\begin{pmatrix}6\\-3\end{pmatrix} = \begin{pmatrix}4\\-2\end{pmatrix}$

Alt.

$\overrightarrow{BD} = \frac{1}{4}\begin{pmatrix}-4\\4\end{pmatrix} = \begin{pmatrix}-1\\1\end{pmatrix}$

$\overrightarrow{CD} = \overrightarrow{CB} + \overrightarrow{BD}$

M_1 $\rightarrow = \begin{pmatrix}4\\-2\end{pmatrix} + \begin{pmatrix}-1\\1\end{pmatrix}$

A_1 $\rightarrow = \begin{pmatrix}3\\-1\end{pmatrix}$

03

7 The LCM of 3 and 5 is 15 Min.

In 15 Minutes 8 Customers are served B_1 or equivalent

$\therefore$ Total time $= \frac{200 \times 15}{8}$ M_1 or equivalent

$= 375$ Minutes A_1 Accept 6h 15 Min or 6.25 hr

03

8.	$(2-x)^7 = 2^7 - 7\cdot 2^6 x + 21\cdot 2^5 x^2 - 35\cdot 2^4 x^3 + 35\cdot 2^3 x^4$		
	a) $- 21\cdot 2^2 x^5 + 7\cdot 2^1 x^6 - x^7$	B_1	Expansion or equivalent
	$= 128 - 448x + 672x^2 - 560x^3 + 280x^4 - 84x^5 +$		
	$14x^6 - x^7$	A_1	
	(b) $(1.97)^7 = (2 - 0.03)^7$		
	$= 128 - 448(0.03) + 672(0.03)^2 - 560(0.03)^3$	M_1	Allow Sub. in more than
	$= 128 - 13.44 + 0.6048 - 0.01512$		4 terms
	$= 115.14968$		
	$\simeq 115.1497$	A_1	Allow if 1st 4 terms of the
		04	expansion.
9.	Image area $= [(4\times 2) - (5\times 1)] \times 21$	M_1	
	$= 63\,cm^2$	A_1	
		02	
10.	$\frac{\sqrt{3}}{\sqrt{3}-\sqrt{2}} = \frac{\sqrt{3}(\sqrt{3}+\sqrt{2})}{(\sqrt{3}-\sqrt{2})(\sqrt{3}+\sqrt{2})} = \frac{3+\sqrt{3}\sqrt{2}}{3-2}$	M_1	
	$= 3 + \sqrt{6}$	A1	
		02	
11.	$(2-1)^2 + (5-k)^2 = 10$	M_1	
	$1 + 25 - 10k + k^2 - 10 = 0$		
	$k^2 - 10k + 16 = 0$		
	$(k-2)(k-8) = 0$; $K = 2$ or $K = 8$	M_1	or equivalent for factorisation
	Centre at $(1,2)$ and $(1,8)$	A_1	
		03	
12.	$(\frac{1}{7} \times \frac{3}{5}) + (\frac{6}{7} \times \frac{1}{6})$	M_1	
	$\frac{7}{35}$	A_1	
		02	
13.	longitude difference $= 45 + 60 = 105°$	B_1	Alt:
	Distance in km $= \frac{105}{360} \times 2 \times 3.142 \times 6370 \cos 40°$	M_1	$105 \times 60 \times \cos 40°$ nm
	$= 8943.7$ km	A_1	$= 4826$ nm
	$= 8946.12$ km when $22/7$ is		
	used for π	03	

14	$4 - 4\cos^2\alpha = 4\sin\alpha - 1$		
	$4 - 4(1-\sin^2\alpha) = 4\sin\alpha - 1$	M_1	for Sub. of $\cos^2\alpha$
	$4\sin^2\alpha - 4\sin\alpha + 1 = 0$		
	$(2\sin\alpha - 1)(2\sin\alpha - 1) = 0$	M_1	or equivalent
	$\sin\alpha = \frac{1}{2}$	A_1	
	$\therefore \alpha = \{30°, 150°\}$	B_1	for both
		04	
15	$AT^2 = 9 \times 4$	M_1	
	$= 36$		
	$AT = 6CM.$	A_1	
		02	
16	$\int (3t^2 - 6t - 9)\,dt = t^3 - 3t^2 - 9t + c$	B_1	allow if c is omitted
	$\left[t^3 - 3t^2 - 9t\right]_1^3 = [3^3 - 3(3^2) - 9(3)] -$	M_1	✓ Sub. of 1 and 3
	$[1^3 - 3(1)^2 - 9(1)]$		allow if two terms ✓
	$= -16$		
	$\left[t^3 - 3t^2 - 9t\right]_3^4 = [4^3 - 3(4)^2 - 9(4)] - [3^3 - 3(3^2) - 9(3)]$	M_1	Sub. of 3 and 4
	$= 7$		allow if two terms ✓
	Distance travelled $= 16 + 7 = 23M$	A_1	
		04	
17	Total rate of flow in litres $= 120 + 150 = 270 L/Min$	B_1	$\times$ 270,000 cm^3/ Min.
	Time taken $= \frac{18900}{270}$	M1	
	$= 70$ Min or 1 hr 10Min	A_1	
	b)(i) Part of tank filled in 25Min $= 270 \times 25$	M_1	Part of tank remaining 270×45
	$= 6750$		
	Time taken to fill remaing part $\frac{18900 - 6750}{270 - 20}$	M_1	$= \frac{270 \times 45}{250}$
	$= 48.6$Min.	A_1	
	Total time taken to fill tank $= 25 + 48.6 = 73.6$Min	B_1	
	(ii) Total inflow into tank $= 270 \times 73.6 = 19872$	M_1	
	Water Wasted $= 19872 - (542 \times 35 + 6300)$	M_1	
	$= 22$ Litres	A_1	
		10	

18 (a) Value after 9 years $= 1{,}240{,}000\left(1+\frac{12}{100}\right)^9$ — M_1

$= 3438617.659$ — A_1

$\simeq 3438618$

b) (i) $1240000(1.12)^n = 2{,}741{,}245$ — M_1

$n \log 1.12 = \log\left(\frac{2741245}{1240000}\right)$ — M_1 for log equation

$n = \frac{\log 2.210681452}{\log 1.12}$ — M_1 Make n the subject

$n = 7$ — A_1

(ii) $1{,}240{,}000\left(1+\frac{r}{100}\right)^7 = 2917231$ — M_1

$1+\frac{r}{100} = \left(\frac{2917231}{1240000}\right)^{1/7}$ — M_1

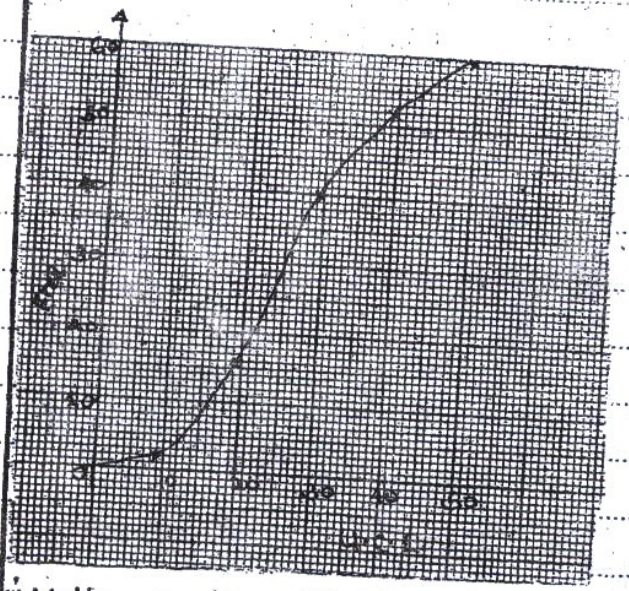
$= 1.130000011$ — M_1

$r = 13\%$ — A_1

10

19. 2 16 40 52 60 c.f

9.5 19.5 29.5 39.5 49.5 U.C.L. — B_1 B_1 ✓ May be implied.



S_1 scale

P_1 Plotting

C_1 Smooth curve

(i) Median goals $= 25.5 \pm 0.5$ — B_1

(ii) Number of matches in which scores were between 0 and 37 $= 49$ — B_1 Accept 50

(iii) $Q_1 = 19 \pm 0.5$ — B_1

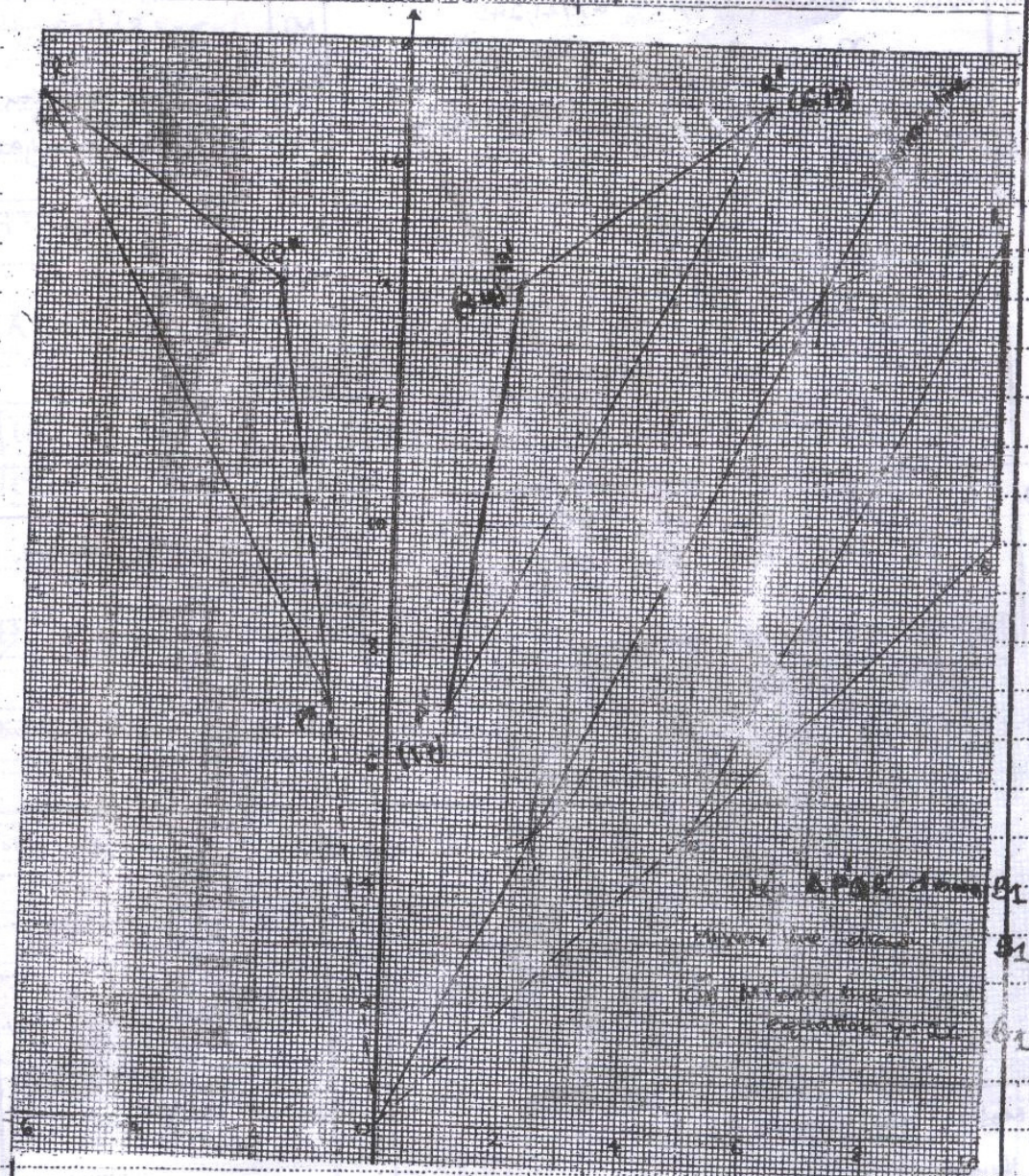
$Q_3 = 33 \pm 0.5$ — B_1

Interquartile range $= 33 - 19 = 14$ — B_1

10

20. $\begin{pmatrix} -0.6 & 0.8 \\ 0.8 & 0.6 \end{pmatrix}\begin{pmatrix} P & Q & R \\ 5 & 10 & 10 \\ 5 & 10 & 15 \end{pmatrix} = \begin{pmatrix} P' & Q' & R' \\ 1 & 2 & 6 \\ 7 & 14 & 17 \end{pmatrix}$ M1 A1 For L.H.S of the equation

P'(1,7) Q'(2,14) R'(6,17)



(i) Δ P''Q''R'' drawn B1

$\begin{pmatrix} a & b \\ c & d \end{pmatrix}\begin{pmatrix} P & Q & R \\ 5 & 10 & 10 \\ 5 & 10 & 15 \end{pmatrix} = \begin{pmatrix} -1 & -2 & 6 \\ 7 & 14 & 17 \end{pmatrix}$ M1 $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} -0.6 & 0.8 \\ 0.8 & 0.6 \end{pmatrix}$

$\begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} 0.6 & -0.8 \\ 0.8 & 0.6 \end{pmatrix}$ A1

Rotation about (0,0) B1

Through angle 53° or -307° B1

10

21 Tax on 1st Ksh 9680 = $9680 \times \frac{10}{100}$ = 968 M1

Tax on next (18800 − 9680) = $9120 \times \frac{15}{100}$ = 1368 M1

Tax on next (24,200 − 18800) = $5400 \times \frac{20}{100}$ = 1080 M1

Total tax = ksh (968 + 1368 + 1080)

= 3416 A1

b) Tax paid = $3416 - \left(1056 + 2400 \times \frac{15}{100}\right)$ M1

= Ksh. 2000 A1

c) Increase in tax paid = $2000 \times \frac{36.3}{100}$ M1

= 726

∴ Increase in earnings = ...

$= 726 \times \frac{100}{20}$ M1

= 3630

% increase = $\frac{3630}{24000} \times 100$ M1

= 15% A1

10

22 $AC = \sqrt{(15\sqrt{2})^2 + (15\sqrt{2})^2}$ = 30 cm B1

b) Identification of θ B1

$\tan \theta = \frac{15}{30}$ or equivalent M1

$\theta = 14.93°$ A1

c) Pyramids height = $\sqrt{(17\sqrt{2})^2 - 15^2}$ M1

= 18.79 cm.

VO = 18.79 + 8 M1

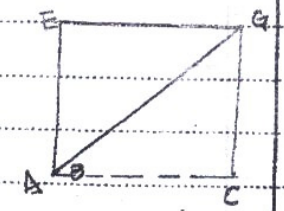
= 26.79 cm A1

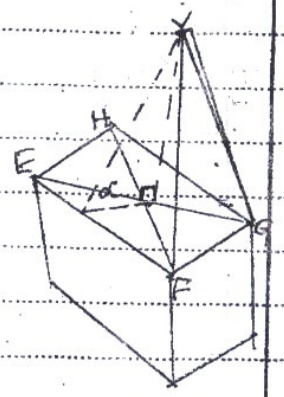
c) Identification of α B1

$\tan \alpha = \frac{18.79}{7.5\sqrt{2}}$ or equivalent. M1

$\alpha = 60.55°$ A1

10





23. (i) $\frac{8}{2}\{2\times 2+(8-1)d\}=156$ — M_1

$4(4+7d)=156$ $\quad d=5$ — A_1

(ii) $\frac{n}{2}\{4+(n-1)5\}=416$

$\frac{n}{2}\{4+5n-5\}=416$ — M_1

$5n^2-n=832$

$5n^2-n-832=0$

$n=13$ — A_1

b (i) 1st three terms of GP are

$a+2d,\ a+4d,\ a+7d$. $\frac{a+12}{a+6}=\frac{a+21}{a+12}=r$ — B_1 For terms

$(a+12)^2=(a+6)(a+21)$ — M_1 for r

$a^2+24a+144=a^2+27a+126$ — M_1

$a=6$

$\therefore$ 1st term $=6+6=12$ — A_1

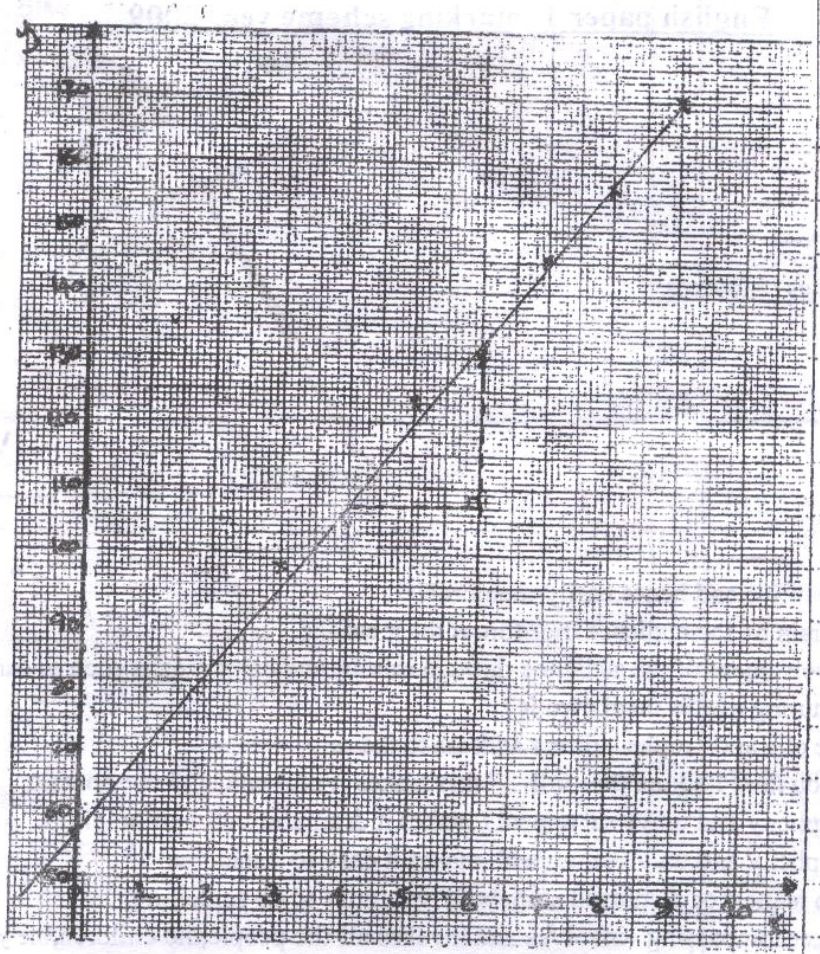
$r=\frac{6+12}{12}=\frac{3}{2}$

(ii) $S_9=\frac{12\left[\left(\frac{3}{2}\right)^9-1\right]}{\frac{3}{2}-1}$ — M_1

$=898.6$ to 4 S.f. — A_1

10

24.



✓ scale	S_1	
✓ plotting	P_2	allow P_1 for 4 ✓'y plotted.
line of best fit	L_1	
(bi) Average volume of ball bearing $= \frac{133-108}{6-4}$	M_1	
$= 12.5$	A_1	
(ii) $\frac{y-133}{x-6} = 12.5$	M_1	
$y = 12.5x + 58$	A_1	
(c) Volume of liquid in the cylinder is the value of y when $x=0$		
$y = 12.5(0) + 58$	M_1	
$= 58$	A_1	
	10	