MATHEMATICS PAPER 2
MARKING SCHEME - 2009

1. 1 cow feeds on $\frac{480}{2\times 4}$ in 1 day — M1
$= 60\text{kg}$

No. of cows to feed on 20160 in 6wks
$= \frac{20160}{60\times 6\times 7}$ — M1
$= 8$ cows — A1

03

ALTERNATIVE METHOD

No. of cows that would feed on 20160 in 4 days
$= \frac{2\times 20160}{480}$ M1

No. of cows for 6 weeks
$= \frac{2\times 20160}{480}\times\frac{4}{42}$ M1
$= 8$ cows A1

2. $(x-1.5-\sqrt{2})(x-1.5+\sqrt{2}) = 0$ — M1
$x^2 - 1.5x + x\sqrt{2} - 1.5x + 2.25 - 1.5\sqrt{2}$
$- x\sqrt{2} + 1.5\sqrt{2} - 2 = 0$ — M1
$x^2 - 3x + 0.25 = 0$
$4x^2 - 12x + 1 = 0$ — A1

03

ALTERNATIVE METHOD

in $x^2 + bx + c = 0$

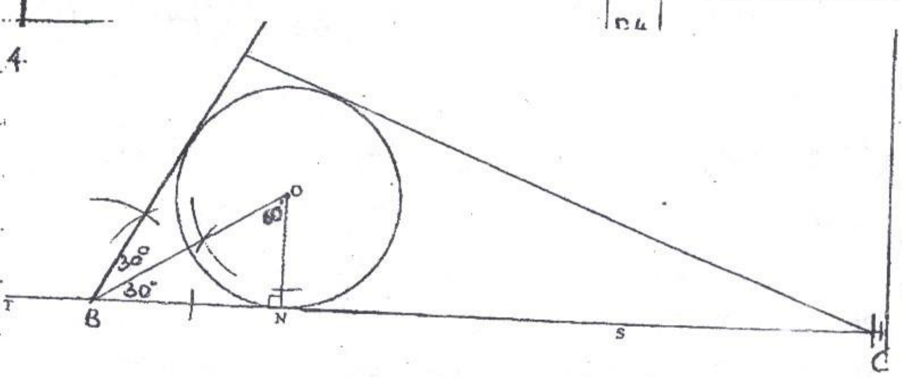
$b = -(1.5+\sqrt{2}+1.5-\sqrt{2})$ M1
$= -3$
✓ For expansion
$c = (1.5+\sqrt{2})(1.5-\sqrt{2})$ M1
$= 2.25 - 1.5\sqrt{2} + 1.5\sqrt{2}$
$= -2$
$= 0.25$ (a, b, c) Must be integers.

3. $M = c + kt^2$
$40 = c + 4k$ — M1
$65 = c + 9k$
$25 = 5k \quad k = 5$ — M1
$40 = c + 20 \quad c = 20$
when $t = 4 \quad m = 20 + 5\times 16$ — A1
$= 100g$ — B1

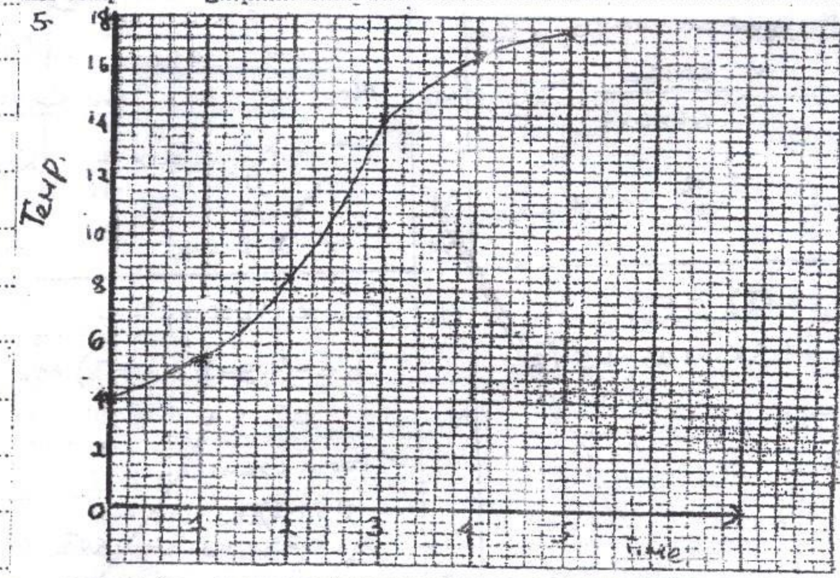
04

For only ✓ equation
attempt to eliminate one unknown
Allow elimination in partial variation
For both constants in 5 and 20.

4.



B1 For position of B
B1 BC = 12cm
B1 For 2 points of contact
B1 For ✓ Δ

5. 

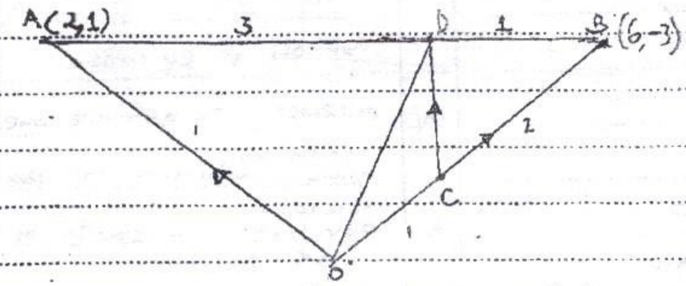
P_1 for plotting all six pt

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. 

$\underset{\sim}{CO} = \frac{1}{3}\begin{pmatrix}6\\-3\end{pmatrix} = \begin{pmatrix}-2\\1\end{pmatrix}$ or $OC = \begin{pmatrix}2\\-1\end{pmatrix}$	B_1	Alt. $CB = \frac{2}{3}\begin{pmatrix}6\\-3\end{pmatrix} = \begin{pmatrix}4\\-2\end{pmatrix}$
$\underset{\sim}{AD} = \frac{3}{4}\begin{pmatrix}4\\-4\end{pmatrix}$ or $\begin{pmatrix}3\\-3\end{pmatrix}$		$BD = \frac{1}{4}\begin{pmatrix}-4\\4\end{pmatrix} = \begin{pmatrix}-1\\1\end{pmatrix}$
$\underset{\sim}{CD} = \underset{\sim}{CO} + \underset{\sim}{OA} + \underset{\sim}{AD}$		$CD = CB + BD$
$= \begin{pmatrix}2\\-1\end{pmatrix} + \begin{pmatrix}2\\1\end{pmatrix} + \begin{pmatrix}3\\-3\end{pmatrix}$	M_1	$\rightarrow = \begin{pmatrix}4\\-2\end{pmatrix} + \begin{pmatrix}-1\\1\end{pmatrix}$
$= \begin{pmatrix}3\\-1\end{pmatrix}$	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
∴ total time $= \frac{200 \times 15}{8}$	M_1	or equivalent
$= 375$ Minutes	A_1	Accept 6h 15 Min or 6.25hr
	03	

8.	$(2-x)^7 = 2^7 - 7\cdot 2^6 x + 21\cdot 2^5 x^2 - 35\cdot 2^4\cdot x^3 + 35\cdot 2^3\cdot x^4$		
a)	$- 21\cdot 2^2\cdot x^5 + 7\cdot 2^1\cdot x^6 - x^7$	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 4 terms
	$= 128 - 13.44 + 0.6048 - 0.01512$		
	$= 115.14968$		
	$\simeq 115.1497$	A_1	Allow if 1st 4 terms of the expansion.
		04	
9.	Image area $= [(4\times 2) - (5\times 1)] \times 21$	M_1	
	$= 63\text{cm}^2$	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	
	$= 3+\sqrt{6}$	A_1	
		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	$\left(\frac{1}{7}\times\frac{3}{5}\right) + \left(\frac{6}{7}\times\frac{1}{6}\right)$	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	$4 - 4\cos^2\alpha = 4\sin\alpha - 1$		
	$4 - 4(1-\sin^2\alpha) = 4\sin\alpha - 1$	M1	for sub. of $\cos^2\alpha$
	$4\sin^2\alpha - 4\sin\alpha + 1 = 0$		
	$(2\sin\alpha - 1)(2\sin\alpha - 1) = 0$	M1	or equivalent
	$\sin\alpha = \frac{1}{2}$	A1	
	$\therefore \alpha = \{30^\circ, 150^\circ\}$	B1	for both
		04	
15	$AT^2 = 9 \times 4$	M1	
	$= 36$		
	$AT = 6$ cm.	A1	
		02	
16	$\int (3t^2 - 6t - 9)\,dt = t^3 - 3t^2 - 9t + c$	B1	allow if c is omitted
	$[t^3 - 3t^2 - 9t]_1^3 = [3^3 - 3(3^2) - 9(3)] - [1^3 - 3(1)^2 - 9(1)]$	M1	✓ sub. of 1 and 3 allow if two terms ✓
	$= -16$		
	$[t^3 - 3t^2 - 9t]_3^4 = [4^3 - 3(4)^2 - 9(4)] - [3^3 - 3(3^2) - 9(3)]$	M1	sub. of 3 and 4 allow if two terms ✓
	$= 7$		
	Distance travelled $= 16 + 7 = 23$ m	A1	
		04	
17	Total rate of flow in litres $= 120 + 150 = 270$ l/min	B1	or $270{,}000$ cm³/min.
	Time taken $= \frac{18900}{270}$	M1	
	$= 70$ min or 1 hr 10 min	A1	
	b)(i) Part of tank filled in 25 min $= 270 \times 25$ $= 6750$	M1	Part of tank remaining 270×45
	Time taken to fill remaining part $\frac{18900 - 6750}{270 - 20}$	M1	$= \frac{270 \times 45}{250}$
	$= 48.6$ min.	A1	
	Total time taken to fill tank $= 25 + 48.6 = 73.6$ min	B1	
	(ii) Total inflow into tank $= 270 \times 73.6 = 19872$	M1	
	Water wasted $= 19872 - (542 \times 25 + 6300)$	M1	
	$= 22$ litres	A1	
		10	

18 (a) Value after 9 years $= 1{,}240{,}000\left(1+\frac{12}{100}\right)^9$ — M1

$= 3438617.659$ — A1

$\simeq 3438618$

b) (i) $1240000(1.12)^n = 2{,}741{,}245$ — M1

$n \log 1.12 = \log\left(\frac{2741245}{1{,}240000}\right)$ — M1 for log equation

$n = \frac{\log 2.210681452}{\log 1.12}$ — M1 Make n the subject

$n = 7$ — A1

(ii) $1{,}240{,}000\left(1+\frac{r}{100}\right)^7 = 2{,}917{,}231$ — M1

$1 + r/100 = \left(\frac{2917231}{1{,}240{,}000}\right)^{1/7}$ — M1

$= 1.130000011$ — M1

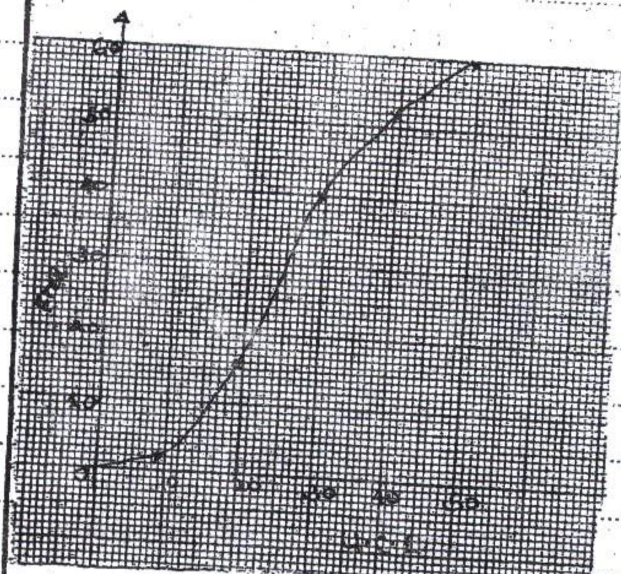
$r = 13\%$ — A1

10

19.

2	16	40	52	60	c.f.
9.5	19.5	29.5	39.5	49.5	U.C.L.

B1, B1 } May be implied.



S1 Scale

P1 Plotting

C1 Smooth curve

(i) Median goals $= 25.5 \pm 0.5$ — B1

(ii) Number of matches in which scores were between 0 and 37 $= 49$ — B1 Accept 50

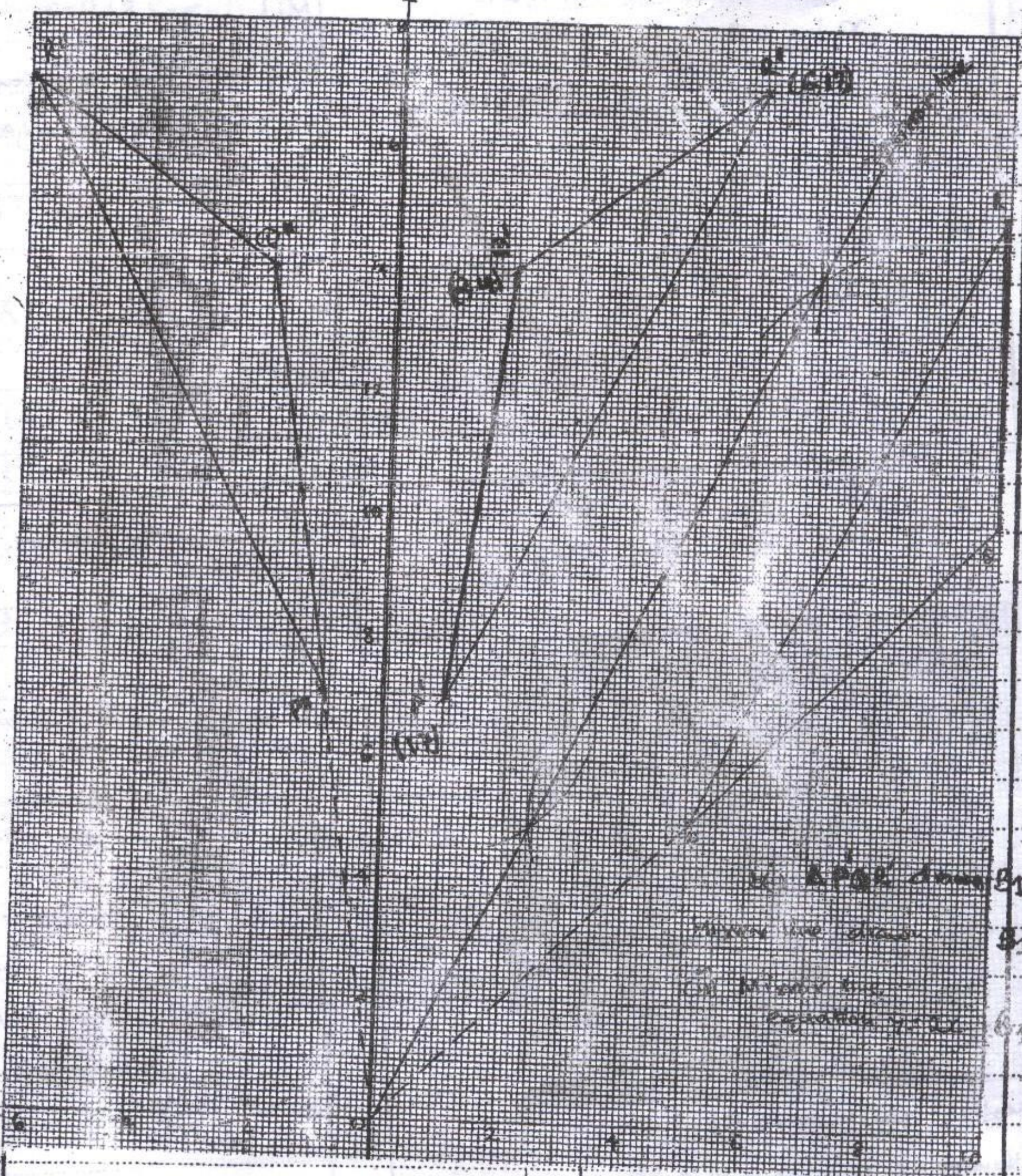
(iii) $Q_1 = 19 \pm 0.5$ — B1

$Q_3 = 33 \pm 0.5$ — B1

Interquartile range $= 33 - 19 = 14$ — B1

10

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



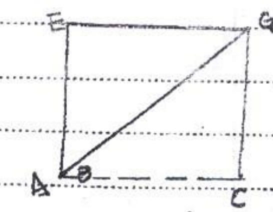
(a) $\Delta P'Q'R'$ drawn B1

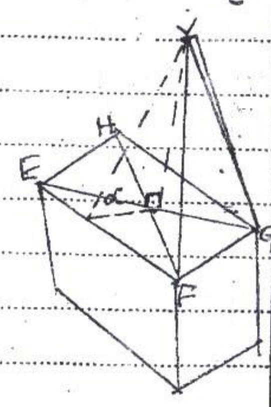
Mirror line drawn B1

(b) Mirror line equation $y = 2x$ B1

(c)(i) $\Delta P''Q''R''$ drawn	B1	$\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 0.6 & 0.8 \\ 0.8 & 0.6 \end{pmatrix}$
$\begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{array}{c} \begin{array}{ccc} P & Q & R \end{array} \\ \begin{pmatrix} 5 & 10 & 10 \\ 5 & 10 & 15 \end{pmatrix} \end{array} = \begin{pmatrix} -1 & -2 & -6 \\ 7 & 14 & 17 \end{pmatrix}$	M1	
$\begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} 0.6 & -0.8 \\ 0.8 & 0.6 \end{pmatrix}$	A1	
Rotation about (0,0)	B1	
Through angle $53°$ or $-307°$	B1	
	10	

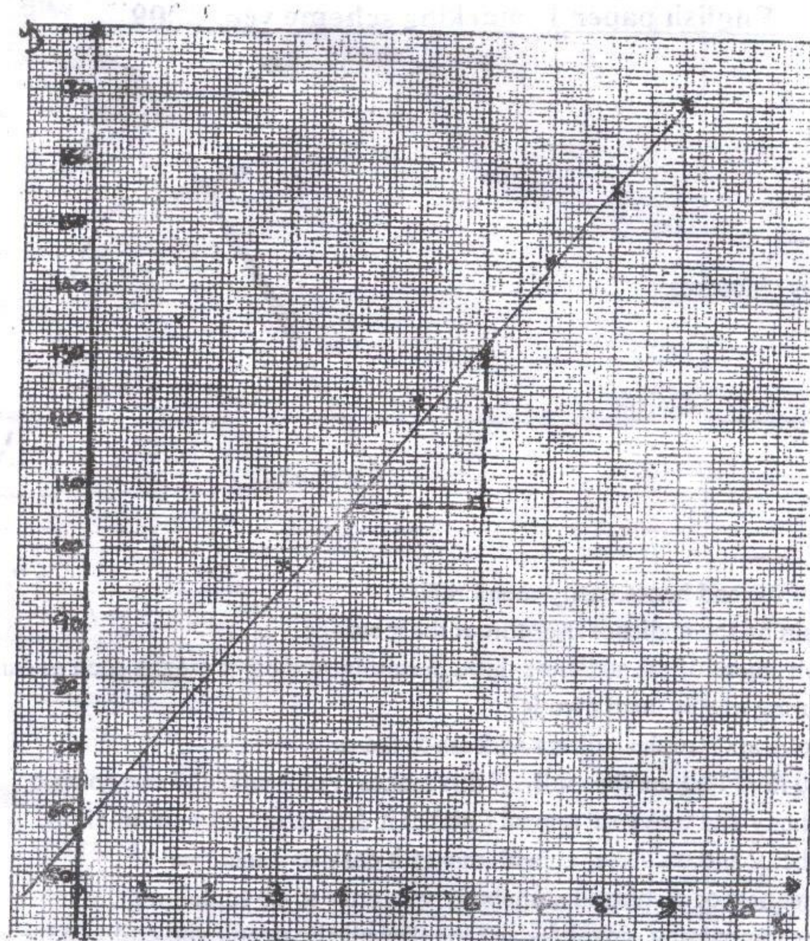
21	Tax on 1st Ksh 9680 = $9680 \times \frac{10}{100}$ = 968	M1
	Tax on next (18800 − 9680) = $9120 \times \frac{15}{100}$ = 1368	M1
	Tax on next (24,200 − 18800) = $\frac{5400 \times 20}{100}$ = 1080	M1
	Total tax = ksh (968 + 1368 + 1080)	
	= 3416	A1
	b) Tax paid = $3416 - \left(1056 + \frac{2400 \times 15}{100}\right)$	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 = $\frac{3630}{2400} \times 100$	M1
	= 15%	A1
		10
22	AC = $\sqrt{(15\sqrt{2})^2 + (15\sqrt{2})^2}$ = 30 cm	B1
	b) Identification of θ	B1
	Tan θ = 8/30 or equivalent	M1
	θ = 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 α = $\frac{18.79}{7.5\sqrt{2}}$ or equivalent.	M1
	α = 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		
$a+2d,\ a+4d,\ a+7d$ $\therefore$ $\frac{a+12}{a+6}=\frac{a+21}{a+12}=r$	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 ✓ly plotted.

line of best fit — L_1

b)i) 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 water in the cylinder is the value of y when $x=0$

$y = 12.5(0) + 58$ — M_1

$= 58$ — A_1

10