No.	WORKING	
1		

No.	Log	
0.52	$\bar{1}.7160$	
0.312	$\bar{1}.4942$	
	$\bar{1}.2102$	$\rightarrow \bar{1}.2102$
2.12^2	$(0.3263)\times 2$	$\rightarrow 0.6526^{+}$
		$(\bar{2}.5576) \div 3$
		$\frac{\bar{3}+1.5576}{3}$
		$\bar{1}+0.5192$

M1 Logs

M1 (Add & Sub

M1 (Divi

$10^{0.5192} \times 10^{-1} \Rightarrow 3.305 \times 10^{-1}$

$\Rightarrow 0.3305$ A1

2. Mass of acid $= 200cm^3 \times 1.08g/cm^3$

$= 216g.$ M1

Mass of alcohol $= 300cm^3 \times 0.8g/cm^3$

$= 240g.$

Total Volume of the mixture $= 200 + 300$

$= 500cm^3$ M1

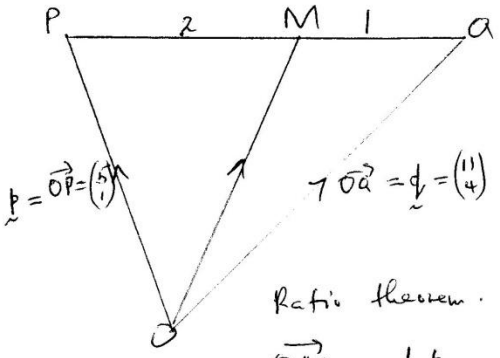
Density of the mixture $= \frac{\text{Total Mass}}{\text{Total Volume}}$

$= \frac{216g + 240g}{500cm^3}$

$= \frac{456g}{500cm^3}$

$= 0.912g/cm^3$ M1

3.



Ratio theorem.

$\overrightarrow{OM} = \frac{1}{3}\underset{\sim}{p} + \frac{2}{3}\underset{\sim}{q}$

$= \frac{1}{3}\begin{pmatrix} 5 \\ 1 \end{pmatrix} + \frac{2}{3}\begin{pmatrix} 11 \\ 4 \end{pmatrix}$

$= \begin{pmatrix} 5/3 \\ 1/3 \end{pmatrix} + \begin{pmatrix} 22/3 \\ 8/3 \end{pmatrix}$

$= \begin{pmatrix} 9 \\ 3 \end{pmatrix}$

$|OM| = \sqrt{9^2 + 3^2}$

$= \sqrt{81+9}$

$= \sqrt{90}$

$= 9.486$ units

4. Taxable Income = Ksh. 32 520

Income	tax (Sh)
$9680 \times \frac{10}{100}$	$= 968$ +
$9120 \times \frac{15}{100}$	$= 1368$ +
$9120 \times \frac{20}{100}$	$= 1824$ +
$4580 \times \frac{25}{100}$	$= 1145$
Total tax payable	$= 5305$

Tax Due = Tax payable − Relief.

= Sh. 5305 − 1056

= Sh. 4249

5. $2x = \sqrt{\frac{2w+8}{3w-5}}$

$(2x)^2 = \frac{2w+8}{3w-5}$ ✓ (1)

$4x^2(3w-5) = 2w+8$

$12x^2w - 20x^2 = 2w+8$ (1)

$12x^2w - 2w = 8 + 20x^2$ ✓ (1)

$w(12x^2-2) = 8+20x^2$ (1)

$w = \frac{8+20x^2}{12x^2-2}$

---

6. (a) $\frac{y-5}{x-2} = 2$ ✓ (1)

$y-5 = 2x-4$ (1)

$y = 2x+1$ ✓

(b) $\theta = \tan^{-1}(\text{gradient})$

$= \tan^{-1}2$

$= 63.43^\circ$

---

7. $P = a + bQ^3$

$23 = a+b$ ---- (i) (1)

$-44 = a+8b$ ---- (ii)

$-21 = -7b$

$\Rightarrow b = 3$

$23 = a+3 \Rightarrow a = 20$ (1)

Equation

$P = 20 + 3Q^3$ ✓

When $Q = 5$

$P = 20 + 3(5)^3$ ✓ (1)

$= 395$

8. (a) $T + C = C'$

$T + \begin{pmatrix} 4 \\ 1 \end{pmatrix} = \begin{pmatrix} 6 \\ -2 \end{pmatrix}$

$T = \begin{pmatrix} 6 \\ -2 \end{pmatrix} - \begin{pmatrix} 4 \\ 1 \end{pmatrix}$

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

(b) $T + B = B'$

$\begin{pmatrix} 2 \\ -3 \end{pmatrix} + \begin{pmatrix} 3 \\ 5 \end{pmatrix} = \begin{pmatrix} 5 \\ 2 \end{pmatrix} \Rightarrow B'(5, 2)$ ✓

$T + A = A'$

$\begin{pmatrix} 2 \\ -3 \end{pmatrix} + \begin{pmatrix} 1 \\ 2 \end{pmatrix} = \begin{pmatrix} 3 \\ -1 \end{pmatrix} \Rightarrow A'(3, -1)$. ✓

9. $(1 - x)^4 = 1(1)^4(-x)^0 + 4(1)^3(-x)^1 + 6(1)^2(-x)^2 + 4(1)^1(-x)^3 + 1(1)^0(-x)^4$

$= 1 - 4x + 6x^2 - 4x^3 + x^4$ ✓ M1

~~$x - 1 = 0.98$~~

$1 - x = 0.98 \Rightarrow x = 0.02$

$(0.98)^4 = 1 - 4(0.02) + 6(0.02)^2 - 4(0.02)^3 + (0.02)^4$

$= 1 - 0.08 + 0.0024 - 0.000032$ ✓

$= 0.922$

$\simeq 0.92$ ✓

10. $x^2 + y^2 - 6x + 8y - 11 = 0$

$x^2 - 6x + \left(\frac{-6}{2}\right)^2 + y^2 + 8y + \left(\frac{8}{2}\right)^2 = 11 + (-3)^2 + (4)^2$ ✓

$(x - 3)^2 + (y + 4)^2 = 36$

$(x - 3)^2 + (y + 4)^2 = 6^2$ ✓

Centre $\Rightarrow (3, -4)$ Radius = 6 units ✓ Both Centre and radius.

11. Let the ratio be $x : y$ in kg respectively.

Cost of the mixture = sh. $(42x + 47y)$ ✓

Total Mass of mixture = $(x+y)$ kg. M1

Cost per kg of the mixture = $\frac{\text{Total Cost of the mixture}}{\text{Total Mass}}$

$$\text{sh. } 46 = \frac{42x + 47y}{x+y} \quad \text{✓} \qquad \text{M1}$$

$$46x + 46y = 42x + 47y.$$

$$4x = y \quad \text{✓}$$

$$\frac{x}{y} = \frac{1}{4} \Rightarrow \underline{x : y = 1 : 4} \qquad \text{A1}$$

12. Rate of work of each pipe.

$A = \frac{1}{3}$
$B = \frac{1}{5}$
$C = \frac{1}{15}$
} Per hr.

Rate of work of A & B = $\frac{1}{3} + \frac{1}{5} = \frac{8}{15}$ per hr. ✓

Work done in 1 hr. = $\frac{8}{15} \times 1 = \frac{8}{15}$ of the volume.

Volume still empty = $1 - \frac{8}{15}$

$= \frac{7}{15}$ ✓

Rate of work of A, B & C = $\frac{1}{3} + \frac{1}{5} - \frac{1}{15}$

$= \frac{7}{15}$. ✓

Time taken to fill = $\frac{7}{15} \div \frac{7}{15} = 1$ hr.

Total time = $1 + 1 = \underline{2 \text{ hrs}}$ ✓

13. Numerator.

$9t^2 - 25a^2 = (3t + 5a)(3t - 5a)$ ✓

Denominator.

$6t^2 + 19at + 15a^2$

$6t^2 + 10at + 9at + 15a^2$

$2t(3t + 5a) + 3a(3t + 5a)$

$(2t + 3a)(3t + 5a)$ ✓

Both Combined.

$$\frac{(3t + 5a)(3t - 5a)}{(2t + 3a)(3t + 5a)} = \frac{3t - 5a}{2t + 3a}$$ ✓

14. Buying Price = 300kg x sh 30 per kg.

= sh. 9,000

After the loss $\Rightarrow \frac{80}{100} \times 300kg = 240kg$.

9000 — 100%

SP — 120%

$SP = \frac{9000 \times 120}{100} = sh.\ 10800$

SP per kg $= \frac{10800}{240}$ ✓

= Ksh 45

15. $\log_6 216 + (\log 42 - \log 6) \div \log 49$.

$\log_6 216 + \left(\log\left(\frac{42}{6}\right) \div \log 49\right)$ ✓

$\log_6 216 + \log 7 \div \log 7^2$.

$\log_2 216 + \frac{1 \log 7}{2 \log 7}$

$\log_6 216 + \frac{1}{2}$.

$\log_6 216 = x$

$216 = 6^x$

$6^3 = 6^x$

$\Rightarrow x = 3$.

$3 + \frac{1}{2} = 3\frac{1}{2}$.

16. $x : y = 2 : 3$

$\frac{x}{2} = \frac{y}{3} = k.$

$\frac{x}{2} = k. \Rightarrow x = 2k.$

$\frac{y}{3} = k \Rightarrow y = 3k.$

$$\frac{5x - 2y}{x + y} = \frac{5(2k) - 2(3k)}{2k + 3k}$$

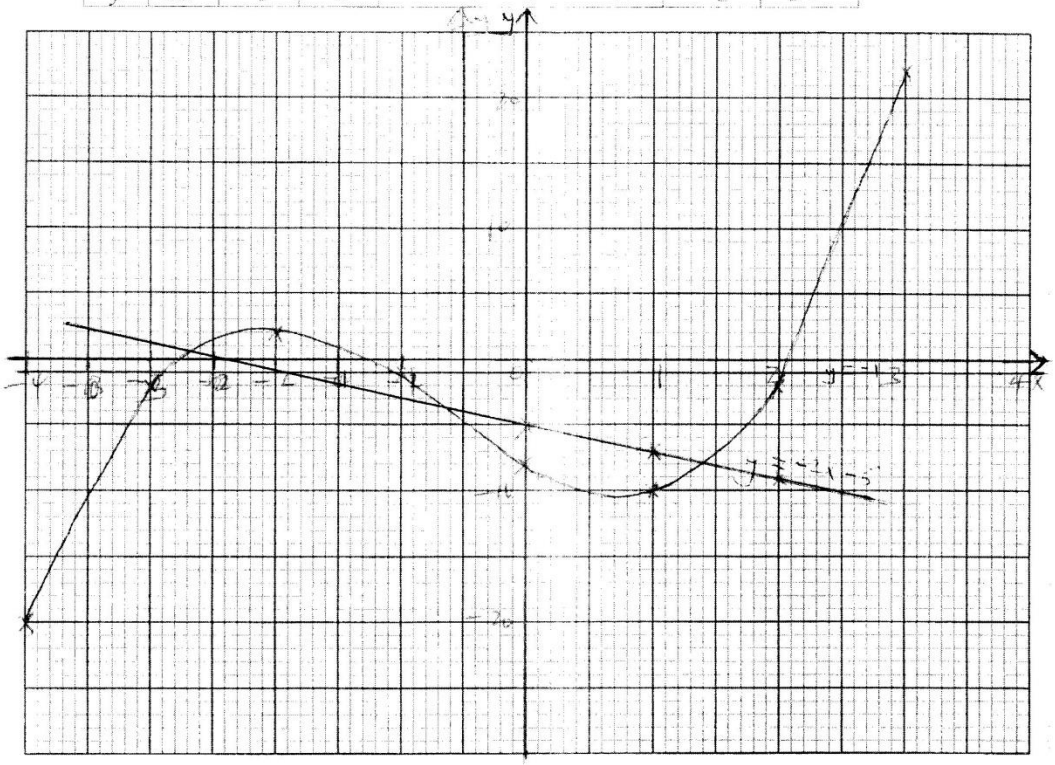
$$= \frac{10k - 6k}{5k.}$$

$$= \frac{4k}{5k}$$

$\Rightarrow \frac{5x - 2y}{x + y} = \frac{4}{5} \Rightarrow 5x - 2y : x + y = 4 : 5$

17

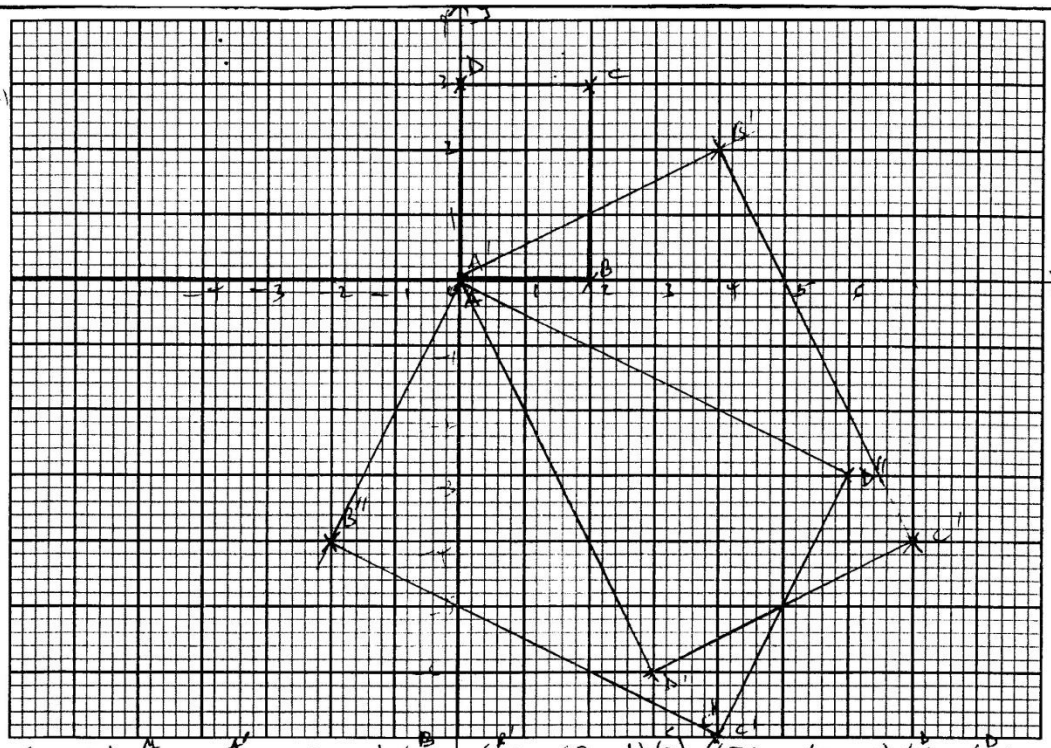
x	-4	-3	-2	-1	0	1	2	3
x^3	-64	-27	-8	-1	0	1	8	27
$2x^2$	32	18	8	2	0	2	8	18
$-5x$	20	15	10	5	0	-5	-10	-15
-8	-8	-8	-8	-8	-8	-8	-8	-8
y	-20	-2	2	-2	-8	-10	-2	22



(i) $y = x^3 + 2x^2 - 5x - 5$
$c = x^3 + 2x^2 - 5x - 5$
$y = 0$ ... roots ... $x = -2.5, -1.5, 2.1$

(ii) $y = x^3 + 2x^2 - 5x - 5$
$c = x^3 + 2x^2 - 5x - 7$
$y = -1$ ... roots ... $x = -2.1, -1.0, 2.1$

(iii) $y = x^3 + 2x^2 - 5x - 5$
$c = -x^3 - 2x^2 + 5x + 5$
$y = -2x - 5$ ... roots ... $x = -2.7, -0.2, 1.4$



$\begin{pmatrix} 2 & 1 \\ 1 & -2 \end{pmatrix}\begin{pmatrix} 0 \\ 0 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$ $\begin{pmatrix} 2 & 1 \\ 1 & -2 \end{pmatrix}\begin{pmatrix} 2 \\ 0 \end{pmatrix} = \begin{pmatrix} 4 \\ 2 \end{pmatrix}$ $\begin{pmatrix} 2 & 1 \\ 1 & -2 \end{pmatrix}\begin{pmatrix} 2 \\ 3 \end{pmatrix} = \begin{pmatrix} 7 \\ -4 \end{pmatrix}$ $\begin{pmatrix} 2 & 1 \\ 1 & -2 \end{pmatrix}\begin{pmatrix} 0 \\ 3 \end{pmatrix} = \begin{pmatrix} 3 \\ -6 \end{pmatrix}$

A'(0, 0) B'(4, 2) C'(7, −4) D'(3, −6)

Det = −4 − 1

= −5

(c) $\begin{pmatrix} 2 & -1 \\ -1 & 2 \end{pmatrix}$

A'(0, 0)

(d) $\begin{pmatrix} 2 & -1 \\ -1 & 2 \end{pmatrix}$

Det = (−1 × −1) − (2 × 2)

= 1 − (−4) = 5

$= \frac{1}{5}\begin{pmatrix} -1 & -2 \\ 2 & -1 \end{pmatrix}$

$= \begin{pmatrix} -\frac{1}{5} & -\frac{2}{5} \\ \frac{2}{5} & -\frac{1}{5} \end{pmatrix}$

19. (a) $a^2 = b^2 + c^2 - 2bc\cos A^\circ$

$a^2 = 6^2 + 8^2 - 2(6)(8)\cos 50^\circ$

$= 36 + 64 - 96(0.6428)$

$a = \sqrt{100 - 61.71}$

$= \sqrt{38.29}$

$a = 6.188\text{cm}$

(b) $\frac{b}{\sin B^\circ} = \frac{a}{\sin A^\circ}$

$\frac{6}{\sin B^\circ} = \frac{6.188}{\sin 50^\circ}$

$\sin B^\circ = \frac{6\sin 50^\circ}{6.188}$

$B^\circ = \sin^{-1}(0.7428)$

$= 47.97^\circ$

(c) $a^2 = d^2 + c^2 - 2dc\cos A^\circ$

$2.82^2 = 7^2 + 6^2 - 2(7)(6)\cos A^\circ$

$7.9524 = 85 - 84\cos A^\circ$

$\Rightarrow \cos A^\circ = \frac{85 - 7.9524}{84}$

$A^\circ = \cos^{-1}(0.9172)$

$= 23.48^\circ$

(d) Area $= \frac{1}{2}dc\sin A^\circ$

$= \frac{1}{2} \times 7 \times 6 \times \sin 23.48 = 8.367\text{cm}^2$

20. (a) $P \propto \frac{Q}{R^2}$.

$P = k\frac{Q}{R^2}$

$18 = k\frac{24}{4^2} \Rightarrow k = \frac{18 \times 4^2}{24}$

$k = 12$

When $Q = 30$ and $R = 10$

$P = 12\frac{Q}{R^2}$

$= 12 \times \frac{30}{10^2}$

$= 3.6$

(b) $P = 12\frac{Q}{R^2}$.

(c) $P = k\frac{120\%\,Q}{(90\%\,R)^2}$

$P = k\frac{1.2Q}{(0.9R)^2} \Rightarrow P = k\,1.48\frac{Q}{R^2}$.

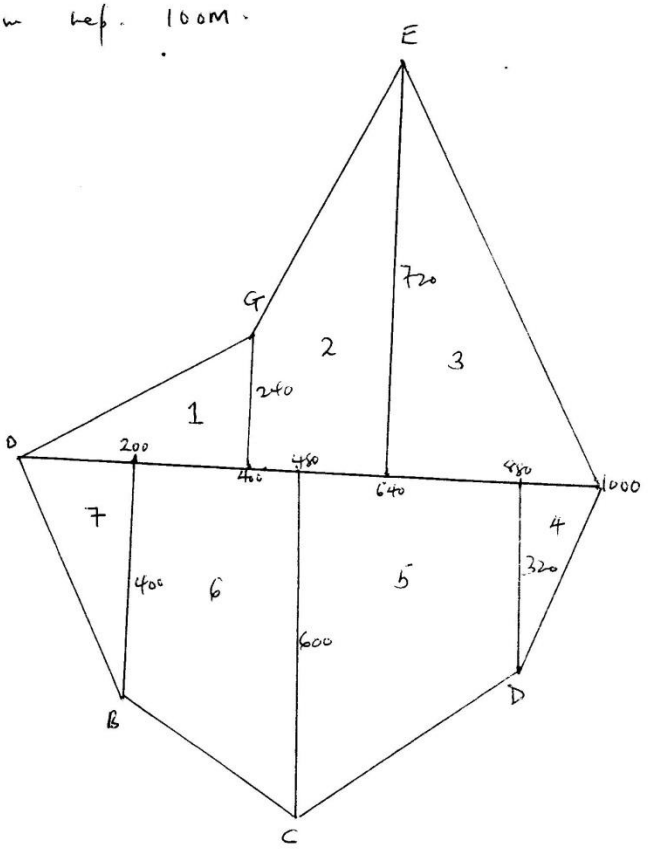
$P_{New} = 1.48P$.

(d) $P = 1.48\left(k\frac{Q}{R^2}\right)$

$P = \frac{148}{100}\left(k\frac{Q}{R^2}\right)$

P increases by 48%.

21. (a) 1 cm rep. 100m.



(b) Area 1 $= \frac{1}{2} \times 400 \times 240 = 48\,000 m^2$

Area 2 $= \frac{1}{2} \times 240 \times (240 + 720) = 115\,200 m^2$

Area 3 $= \frac{1}{2} \times 360 \times 720 = 129\,600 m^2$

Area 4 $= \frac{1}{2} \times 120 \times 320 = 19\,200 m^2$

Area 5 $= \frac{1}{2} \times 400 \times (600 + 320) = 184\,000 m^2$

Area 6 $= \frac{1}{2} \times 280 \times (400 + 600) = 140\,000 m^2$

Area 7 $= \frac{1}{2} \times 200 \times 400 = 40\,000 m^2$

Total Area $= 48000 + 115200 + 129600 + 19200 + 184000 + 140000 + 40000$

$= 676,000 m^2$

$= 67.6$ ha.

21. (a) Gradient of L

$$M = \frac{6-3}{-1-(-2)}$$

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

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

$$y - 3 = 3x + 6$$

$$y = 3x + 9$$

(b) Gradien of P $\times$ 3 $= -1$

Gradient of P $= \frac{-1}{3}$

$$\frac{y-6}{x+1} = -\frac{1}{3}$$

$$3y - 18 = -x - 1$$

$$x + 3y = 17$$

(c) Gradient of Q $= 3$

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

$$y - 2 = 3x - 3$$

$$y = 3x - 1$$

(d) Solve eq. P and Q

$$x + 3y = 17$$

$$-3x + y = -1$$

$$3x + 9y = 51$$

$$-3x + y = -1$$

$$10y = 50$$

$$y = 5$$

Simultaneously.

$$x + 3(5) = 17$$

$$x = 2$$

Point of Intersection $(2, 5)$

23 (a) $AC = \sqrt{10^2 + 10^2}$

$= \sqrt{200}$

$= 14.14 \text{ cm}$

(b) Height $= \sqrt{13^2 - 7.07^2}$

$= \sqrt{119.0151}$

$= 10.91 \text{ cm}$

(c) $\cos\theta = \frac{7.07}{13}$

$\theta = \cos^{-1}\left(\frac{7.07}{13}\right)$

$= 57.05^\circ$

(d) $\tan x^\circ = \left(\frac{10.91}{5}\right)$

$x^\circ = \tan^{-1}\left(\frac{10.91}{5}\right)$

$= 65.38^\circ$

(e) $\tan x^\circ = \frac{5}{10.91}$

$x^\circ = \tan^{-1}\left(\frac{5}{10.91}\right)$

$= 24.62^\circ$

$2x^\circ = 49.24^\circ$

24 (a) Volume of water $= \frac{1}{3} \times \frac{22}{7} \times 21^2 \times 30$

$= 13,860 \text{ cm}^3$

(b)

(i) $\frac{h}{H} = \frac{r}{R}$

$\frac{30}{36} = \frac{21}{R} \Rightarrow R = \frac{21 \times 36}{30}$

$= 25.2 \text{ cm}$

(ii) New Volume $= \frac{1}{3} \times \frac{22}{7} \times 25.2^2 \times 36$

$= 23\,958.08 \text{ cm}^3$

Vol of spher $= 23\,958.08 - 13\,860$

$= 10\,098.08 \text{ cm}^3$

(iii) $\frac{4}{3} \times \frac{22}{7} \times r^3 = 10\,098.08$

$r^3 = \frac{10\,098.08 \times 21}{88}$

$r = \sqrt{\frac{10\,098.08 \times 21}{88}}$

$= 13.40 \text{ cm}$