

FORM 4 MATHEMATICS PAPER 2
MARKING SCHEME

s/n	Working	Marks																
1	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>No.</th><th>Log.</th></tr> </thead> <tbody> <tr> <td>$10^{0.8043}$</td><td>0.8043</td></tr> <tr> <td>$\log 4.948 = 0.6944$</td><td>0.8043 + 0.6944</td></tr> <tr> <td></td><td>1.4987</td></tr> <tr> <td>4.636×10^{-2}</td><td>0.6459 $\rightarrow$ 0.6459</td></tr> <tr> <td></td><td>$(3.6661) \times \frac{1}{2}$</td></tr> <tr> <td></td><td>$\frac{4}{2} + \frac{1.6661}{2} \rightarrow 2.8331$</td></tr> <tr> <td></td><td>1.8128</td></tr> </tbody> </table> $10^{0.7124} \times 10^1 = 6.498 \times 10^1$ $= 64.98$	No.	Log.	$10^{0.8043}$	0.8043	$\log 4.948 = 0.6944$	0.8043 + 0.6944		1.4987	4.636×10^{-2}	0.6459 $\rightarrow$ 0.6459		$(3.6661) \times \frac{1}{2}$		$\frac{4}{2} + \frac{1.6661}{2} \rightarrow 2.8331$		1.8128	M1 All correct logs M1 Addition and Subtraction M1 Division A1
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2.	$x^2 - 6x + y^2 + 8y = 11$ $x^2 - 6x + (3)^2 + y^2 + 8y + (4)^2 = 11 + (-3)^2 + (4)^2$ $(x-3)^2 + (y+4)^2 = 36$ $(x-3)^2 + (y+4)^2 = 6^2$ Centre $\Rightarrow (3, -4)$ radius	M1 M1 A1																
3	$\frac{m+n}{m-n} = \frac{8}{3}$ $3m + 3n = 8m - 8n$ $11n = 5m$ $\frac{n}{m} = \frac{5}{11} \Rightarrow m:n = 11:5$	M1 M1 A1																

S/P	Working	MKS
4.	$\log(x+5) = \log 4 - \log(x+2)$ $\log(x+5) = \log\left(\frac{4}{x+2}\right)$ $\Rightarrow x+5 = \frac{4}{x+2}$ $(x+5)(x+2) = 4$ $x^2 + 2x + 5x + 10 = 4$ $x^2 + 7x + 6 = 0$ $x^2 + x + 6x + 6 = 0$ $x(x+1) + 6(x+1) = 0$ $(x+6)(x+1) = 0$ Either $x+6=0 \Rightarrow x=-6$ or $x+1=0 \Rightarrow x=-1$	 M1 M1 A1
5	$\vec{OA} = \begin{pmatrix} 0 \\ 4 \end{pmatrix} \quad \vec{OB} = \begin{pmatrix} 2 \\ -1 \end{pmatrix} \quad \vec{OC} = \begin{pmatrix} 8 \\ 9 \end{pmatrix}$ $\vec{AB} = \vec{OB} - \vec{OA} \qquad \vec{BC} = \vec{OC} - \vec{OB}$ $= \begin{pmatrix} 2 \\ -1 \end{pmatrix} - \begin{pmatrix} 0 \\ 4 \end{pmatrix} = \begin{pmatrix} 2 \\ -5 \end{pmatrix} \qquad = \begin{pmatrix} 8 \\ 9 \end{pmatrix} - \begin{pmatrix} 2 \\ -1 \end{pmatrix} = \begin{pmatrix} 6 \\ 10 \end{pmatrix}$ $\vec{AB} = k \vec{BC}$ $\begin{pmatrix} 2 \\ -5 \end{pmatrix} = k \begin{pmatrix} 6 \\ 10 \end{pmatrix}$ $\begin{pmatrix} 2 \\ -5 \end{pmatrix} = \begin{pmatrix} 6k \\ 10k \end{pmatrix} \Rightarrow \begin{matrix} 2 = 6k & \text{and} & -5 = 10k \\ k = \frac{1}{3} & \checkmark & k = -\frac{1}{2} \end{matrix}$ $\vec{AB} = \frac{1}{3} \vec{BC}$ Hence A, B and C are collinear.	
6	$W = k \frac{x^2}{y}$ $80 = k \left(\frac{2^2}{5} \right)$ $\Rightarrow k = \frac{80 \times 5}{4} = 100$	$W = 100 \frac{x^2}{y}$

S/N	Working	Marker
7.	$\frac{2}{3-\sqrt{7}} - \frac{2}{3+\sqrt{7}} = \frac{2(3+\sqrt{7}) - 2(3-\sqrt{7})}{(3-\sqrt{7})(3+\sqrt{7})}$ $= \frac{6 + 2\sqrt{7} - 6 + 2\sqrt{7}}{9 + 3\sqrt{7} - 3\sqrt{7} - 7}$ $= \frac{4\sqrt{7}}{2}$	M1 M1 A1
8.	Coefficients $\rightarrow 1, 5, 10, 10 \rightarrow$ $(2+x)^5 = 1(2)^5(x)^0 + 5(2)^4(x)^1 + 10(2)^3(x)^2 + 10(2)^2(x)^3 + \dots$ $= 32 + 80x + 80x^2 + 40x^3 + \dots$ $2+x = 2.03$ $x = 2.03 - 2$ $x = 0.03$ $(2.03)^5 = 32 + 80(0.03) + 80(0.03)^2 + 40(0.03)^3 + \dots$ $= 32 + 2.4 + 0.072 + 0.00108$ $= 34.47$	M1 M1 A1
9.	$\begin{matrix} 3x + 2y = 840 \\ 4x + 5y = 1680 \end{matrix}$ $\begin{pmatrix} 3 & 2 \\ 4 & 5 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 840 \\ 1680 \end{pmatrix}$ $\det = (3 \times 5) - (4 \times 2)$ $= 7$ $\frac{1}{7} \begin{pmatrix} 5 & -2 \\ -4 & 3 \end{pmatrix} \begin{pmatrix} 3 & 2 \\ 4 & 5 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \frac{1}{7} \begin{pmatrix} 5 & -2 \\ -4 & 3 \end{pmatrix} \begin{pmatrix} 840 \\ 1680 \end{pmatrix}$ $\frac{1}{7} \begin{pmatrix} 7 & 0 \\ 0 & 7 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \frac{1}{7} \begin{pmatrix} 840 \\ 1680 \end{pmatrix}$ $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 120 \\ 240 \end{pmatrix} \Rightarrow \begin{matrix} x = 120 \\ y = 240 \end{matrix}$	M1 M1 A1

S/N	Working	Marks
10.	$\frac{42x + 21y}{x + y} = 56.39 \times \frac{100}{130}$ $\frac{42x + 21y}{x + y} = 30$ $42x + 21y = 30x + 30y$ $12x = 9y$ $\frac{x}{y} = \frac{9}{12} = \frac{3}{4} \Rightarrow x:y = 3:4$	M1 M1 A1
11.	Determinant = Area scale factor. $4x - (2(x-1)) = \frac{30 \text{ cm}^2}{5 \text{ cm}^2}$ $4x - 2x + 2 = 6$ $2x = 4 \Rightarrow x = 2$	M1 M1 A1
12.	(a) $n^{\text{th}} = a + (n-1)d$ 1st $a = -7$ 2nd $a + d = -4$ 3rd $a + 2d = -1$ 4th $a + 3d = 2$ 5th $a + 4d = 5$ 6th $a + 5d = 8$ (b) $S_n = \frac{n}{2} [2a + (n-1)d]$ $S_{50} = \frac{50}{2} [2(-7) + (50-1)3]$ $= 25(-14 + 147)$ $= 25 \times 133$ $= 3325$	M1 for all the values M1 A1

S/N	Working	Marks
13.	Rate of work. Pipe A = $\frac{1}{3}$ per hr. Pipe B = $\frac{1}{5}$ per hr. Pipe C = $\frac{1}{15}$ per hr. Rate of work of A and B = $\frac{1}{3} + \frac{1}{5}$ $= \frac{8}{15}$ per hr. Work done by A and B is 1 hour. Work = Rate $\times$ Time $= \frac{8}{15} \times 1 = \frac{8}{15}$ Remaining Value = $1 - \frac{8}{15} = \frac{7}{15}$ ✓ Rate of work of all pipes = $\frac{1}{3} + \frac{1}{5} - \frac{1}{15} = \frac{7}{15}$ per hr. Time taken = $\frac{7}{15} \div \frac{7}{15}$ $= 1$ hr. Total time taken to fill = $1\text{ hr.} + 1\text{ hr.}$ $= 2\text{ hr.}$	M1 M1 M1 A1
14.	$\frac{r}{\sqrt{p^2 - t^2}} = \frac{p}{t}$ $\left(\frac{r}{\sqrt{p^2 - t^2}} \right)^2 = \left(\frac{p}{t} \right)^2$ $\frac{r^2}{p^2 - t^2} = \frac{p^2}{t^2}$ $r^2 t^2 = p^4 - p^2 t^2$ $r^2 t^2 + p^2 t^2 = p^4$ $t^2 (r^2 + p^2) = p^4$ $t^2 = \frac{p^4}{r^2 + p^2} \Rightarrow t = \sqrt{\frac{p^4}{r^2 + p^2}}$	M1 M1 A1

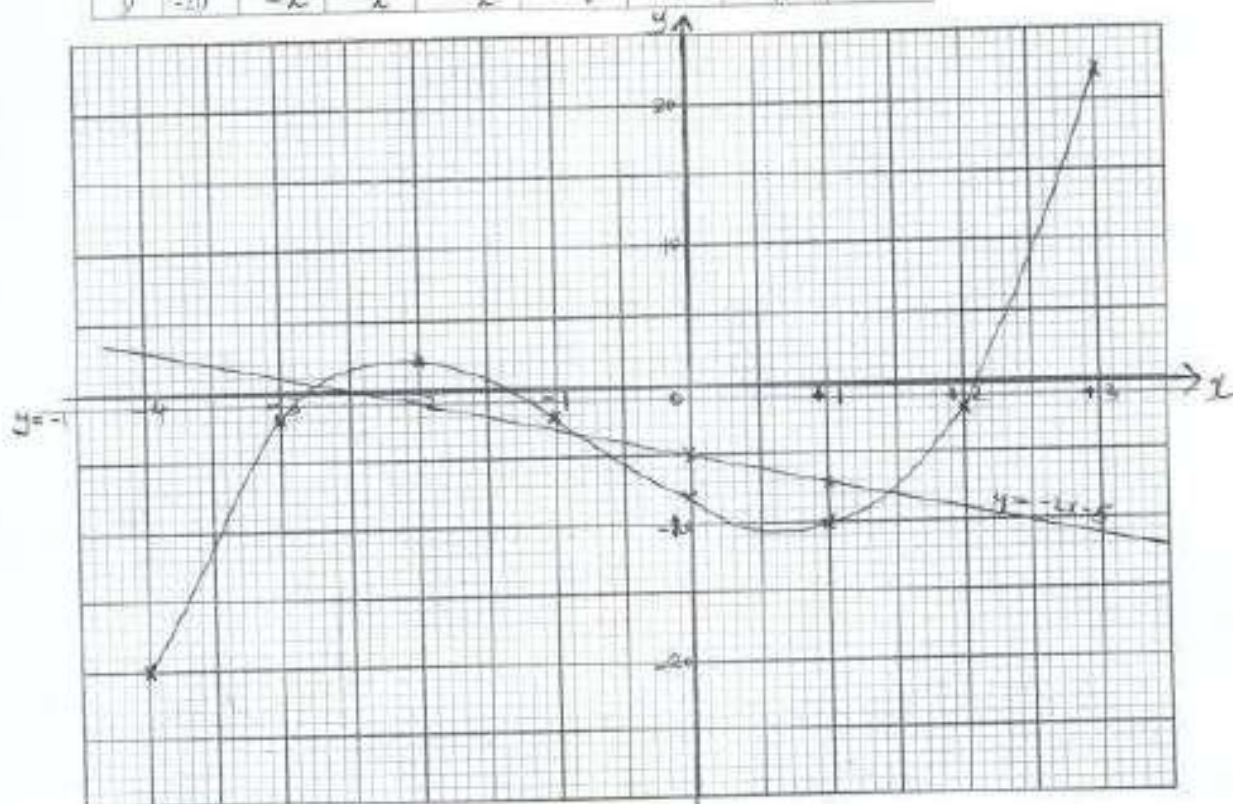
S/N	Working	
15	$AC \cdot BC = PC \cdot QC$ $(9+x)x = 9 \times 4$ $x^2 + 9x = 36$ $x^2 + 9x - 36 = 0$ $x^2 + 12x - 3x - 36 = 0$ $x(x+12) - 3(x+12) = 0$ $(x-3)(x+12) = 0$ Either $x-3=0 \Rightarrow x=3\text{cm} \checkmark$ or $x+12=0 \Rightarrow x=-12 \text{ N/A}$	 M1 M1 A1
16	$\frac{1}{25.36} = \frac{1}{2.536 \times 10}$ $= 0.3943 \times 10^{-1}$ $= 0.03943 \checkmark$ $\frac{1}{1.382} = 0.7680 \checkmark$ $x = 0.03943 + 3(0.7680)$ $= 2.343$	 M1 M1 A1

S/N	Working	Marks
17.	(a) (i) $\vec{AB} = \vec{OB} - \vec{OA}$ $= \underline{b - a}$ ----- A1	
	(ii) $\vec{ON} = \vec{OA} + \vec{AN}$ $= \underline{a + \frac{1}{3}(b - a)}$ M1 $= \underline{a + \frac{1}{3}b - \frac{1}{3}a}$ $= \underline{\frac{2}{3}a + \frac{1}{3}b}$ ----- A1	
	(iii) $\vec{BM} = \vec{OM} - \vec{OB}$ $= \underline{\frac{2}{5}a - b}$ ----- A1	
	(b) $\vec{OX} = k\vec{ON}$ $= k(\frac{2}{3}a + \frac{1}{3}b)$ $= \underline{\frac{2}{3}ka + \frac{1}{3}kb}$ ----- (i) M1	
	$\vec{OX} = \vec{OB} + b\vec{X}$ $= \underline{b + h(\frac{2}{3}a - b)}$ $= \underline{b + \frac{2}{3}ha - hb}$ $= \underline{\frac{2}{3}ha + (1-h)b}$ ----- (ii) M1	
	$\Rightarrow \underline{\frac{2}{3}ka + \frac{1}{3}kb = \frac{2}{3}ha + (1-h)b}$ M1	
	$\frac{2}{3}k = \frac{2}{3}h$ $10k = 6h \Rightarrow \begin{matrix} 10k - 6h = 0 \\ 5k - 3h = 0 \end{matrix}$ ----- (iii) M1	
	$\frac{1}{3}k = 1-h$ $k = 3 - 3h \Rightarrow k + 3h = 3$ ----- (iv)	
	$\begin{matrix} 5k - 3h = 0 \\ k + 3h = 3 \\ \hline 6k = 3 \end{matrix} \Rightarrow k = \frac{1}{2}$ A1	
	$5k = 3h$	

18. Draw the graph of $y = x^3 + 2x^2 - 5x - 8$ for values of x in the range $-4 \leq x \leq 3$

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

(5 mks)



By drawing suitable straight line on the same axis, solve the equations.

i) $x^3 + 2x^2 - 5x - 8 = 0$

(1 mks)

Line $y = 0$

$x = -2.8$

$x = 2.1$

$x = -1.4$

ii) $x^3 + 2x^2 - 5x - 7 = 0$

(2 mks)

$y = x^3 + 2x^2 - 5x - 7$

$x = -2.9$

$x = 2.05$

$0 = x^3 + 2x^2 - 5x - 7$

$x = -1.2$

$y = -1$

iii) $3 + 3x - 2x^2 - x^3 = 0$

(2 mks)

$y = x^3 + 2x^2 - 5x - 8$

$0 = x^3 + 2x^2 + 3x + 3$

$y = -2x - 5$

Roots

$x = -2.8$

$x = -0.9$

$x = 1.4$

17. (c) $k = \frac{1}{2}$

$$\vec{OX} = \frac{1}{2} \vec{OH}$$

$$\vec{OX} : \vec{XH} = 1:1$$

A1

19. (e)

$$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix} = \begin{pmatrix} 0 & 2 \\ 2 & 0 \end{pmatrix}$$

Inverse of $\begin{pmatrix} 0 & 2 \\ 2 & 0 \end{pmatrix}$

$$\det = 0 - 4$$

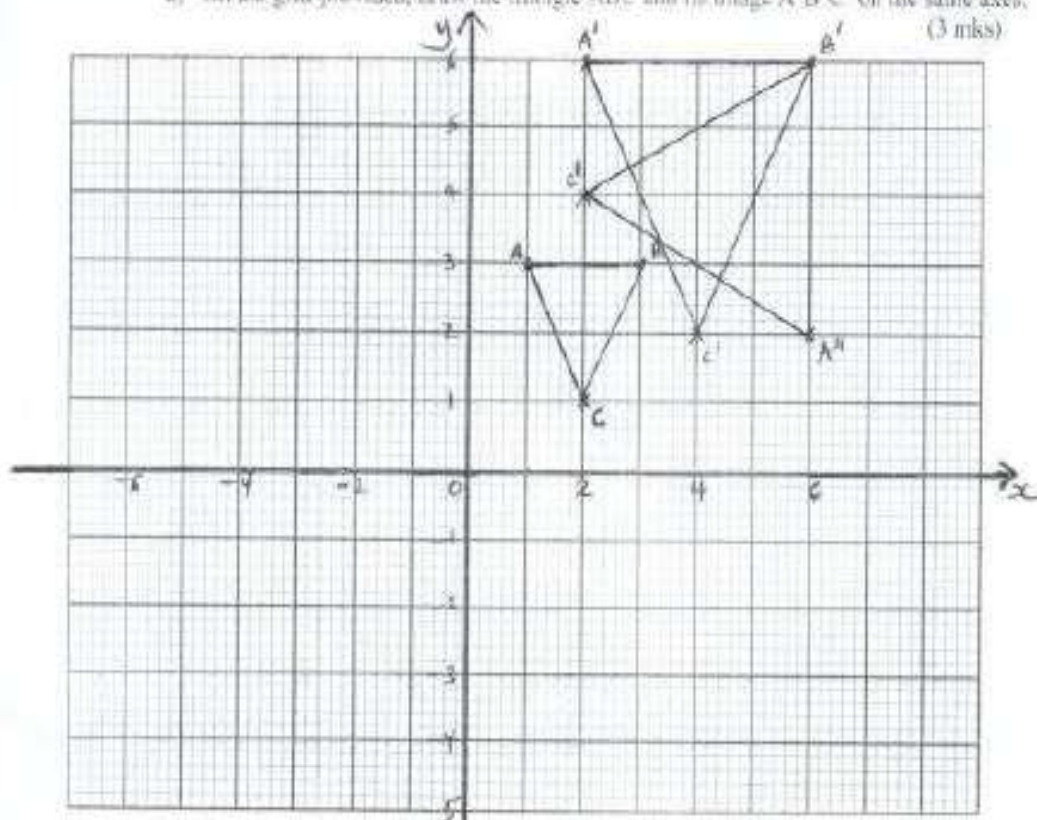
$$= -4$$

$$\frac{1}{-4} \begin{pmatrix} 0 & -2 \\ -2 & 0 \end{pmatrix} = \begin{pmatrix} 0 & \frac{1}{2} \\ \frac{1}{2} & 0 \end{pmatrix}$$

19. A transformation represented by the matrix $\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$ maps $A(1, 3)$, $B(3, 3)$ and $C(2, 1)$ onto

$A'B'$ and C' respectively.

a) On the grid provided, draw the triangle ABC and its image $A'B'C'$ on the same axes. (3 mks)



b) Hence or otherwise determine the area of the triangle $A'B'C'$. (2 mks)

$$\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix} \begin{pmatrix} A & B & C \\ 1 & 3 & 2 \\ 3 & 3 & 1 \end{pmatrix} = \begin{pmatrix} A' & B' & C' \\ 2 & 6 & 4 \\ 6 & 6 & 2 \end{pmatrix} \quad \text{Area of } A'B'C' = \frac{1}{2} \times 4 \times 4 = 8 \text{ square units}$$

c) Another transformation represented by the matrix $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ maps $A'B'C'$ onto

$A''B''C''$. Plot triangle $A''B''C''$ on the same axes. (2 mks)

$$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} A' & B' & C' \\ 2 & 6 & 4 \\ 6 & 6 & 2 \end{pmatrix} = \begin{pmatrix} A'' & B'' & C'' \\ 6 & 6 & 2 \\ 2 & 6 & 4 \end{pmatrix} \quad A''(6, 2) \quad C''(2, 4) \quad B''(6, 6)$$

d) Describe the transformation represented by the matrix $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$. (1 mk)

Reflection on the mirror line $y = x$.

s/n	Working	Mks.
20	(a) <pre> graph LR A[Written Exam] -- 6/11 --> B[Pass] A -- 5/11 --> C[Fail] B -- 3/5 --> D[Pass] B -- 2/5 --> E[Fail] C -- 2/5 --> F[Pass] C -- 3/5 --> G[Fail] </pre> (b) Passes both tests $\frac{6}{11} \times \frac{3}{5} = \frac{18}{55}$ (c) Passes Written Exam only. $\frac{6}{11} \times \frac{2}{5} = \frac{12}{55}$ (d) Passes practical Exam only. $\frac{5}{11} \times \frac{2}{5} = \frac{10}{55}$ (e) Fails all tests $\frac{5}{11} \times \frac{3}{5} = \frac{15}{55}$	M2 (All branches indicated correctly) 2 2 2 2

slw	Working	Mks.
21.	a) Total fare for 1 trip = 14 x sh. 250 = sh. 3500 Total Amount for two round trips. sh 3500 x 4 = sh. 14,000 Net profit = sh. 14000 - sh. 6000 = sh. 8,000 ✓	
	b) Total Amount for the whole month of June sh 8000 x 25 = sh. 200,000 ✓ Profit = sh. 200,000 - sh. 10,000 = sh. 190,000 ✓	
	(c) Amount shared equally = $\frac{40}{100} \times 190,000$ = 76,000 ✓ Each got = $\frac{76,000}{3} = \text{sh. } 25,333 \frac{1}{3}$ ✓ Amount shared in ratio of Contribution $\frac{60}{100} \times 190,000 = 114,000 \text{ K}$ Ratio of Contributor Mathu; Mathika; Munkeli 6 : 4 : 8 Mathika = $\frac{4}{18} \times 114,000 = 25,333 \frac{1}{3}$ Mathika share = 25,333 + 25,333 = sh. 50,667	
	(d) Total amount amount received = 475,000 x 3 = 1,425,000	

Soln	Working	Marks
22.	$\sin \theta = \frac{8}{7}$ $\theta = \sin^{-1}\left(\frac{8}{7}\right)$ $= 56.44^\circ$ $2\theta = 112.89^\circ \checkmark$ $\sin x = \frac{5}{7}$ $x = \sin^{-1}\left(\frac{5}{7}\right)$ $= 45.58^\circ$ $2x = 91.17^\circ \checkmark$	 M1 A1 M1 A1
	$\text{Area of Segment 1} = \frac{\theta}{360} \pi r^2 - \frac{1}{2} r^2 \sin \theta$ $= \left(\frac{112.89}{360} \times \frac{22}{7} \times 6^2 \right) - \left(\frac{1}{2} \times 6^2 \times \sin 112.89^\circ \right) \quad \text{M1 M1}$ $= 35.49 \text{ cm}^2 - 16.58$ $= 18.9 \text{ cm}^2$	A1
	$\text{Area of Segment 2} = \frac{\alpha}{360} \pi r^2 - \frac{1}{2} r^2 \sin \alpha$ $= \left(\frac{91.17}{360} \times \frac{22}{7} \times 7^2 \right) - \left(\frac{1}{2} \times 7^2 \times \sin 91.17^\circ \right) \quad \text{M1 M1}$ $= 39.0 - 24.49 \text{ cm}^2$ $= 14.51 \text{ cm}^2$	A1
	$\text{Area of the shaded R} = 18.9 + 14.51$ $= \underline{\underline{33.41 \text{ cm}^2}}$	A1

$$23.(a) AC = \sqrt{5^2 + 7^2}$$

$$(b) VO = \sqrt{13^2 - 4.301^2}$$

$$= 12.27$$

$$(c) BD = AC = 8.602$$

$$BO = \frac{1}{2} \times 8.602 = 4.301$$

$$\angle VBO = \theta$$

$$\cos \theta = \frac{4.301}{13} = 0.3308$$

$$\theta = \cos^{-1}(0.3308) = 70.68$$

$$(d) VM = \sqrt{MO^2 - VO^2} = \sqrt{2.5^2 + 12.27^2}$$

$$= \sqrt{156.8029}$$

$$= 12.52$$

$$\angle VMO = d$$

$$\cos d = \frac{2.5}{12.52} = 0.1997$$

$$d = \cos^{-1}(0.1997) = 78.48^\circ$$

$$24.(a) DCE = EDF (\angle s \text{ in alternate segment})$$

$$= 42^\circ$$

$$(a) BCE = BDF (\angle s \text{ in the same segment})$$

$$\frac{180-48}{2} = 42^\circ$$

$$= 24^\circ$$

$$(b) DCB = DBF (\angle s \text{ in alternate segment})$$

$$DBF = \frac{180-48}{2} (AB = D)$$

$$= 66^\circ$$

$$(c) CED = CBD (\angle s \text{ in the same segment})$$

$$CBD = 180 - (60 + 60) (\angle s \text{ on straight line})$$

$$CED = 54^\circ$$

$$(d) BEF = BCD (\text{ext. angle} = \text{opp. interior angle})$$

$$= 24 + 42$$

$$= 66^\circ$$