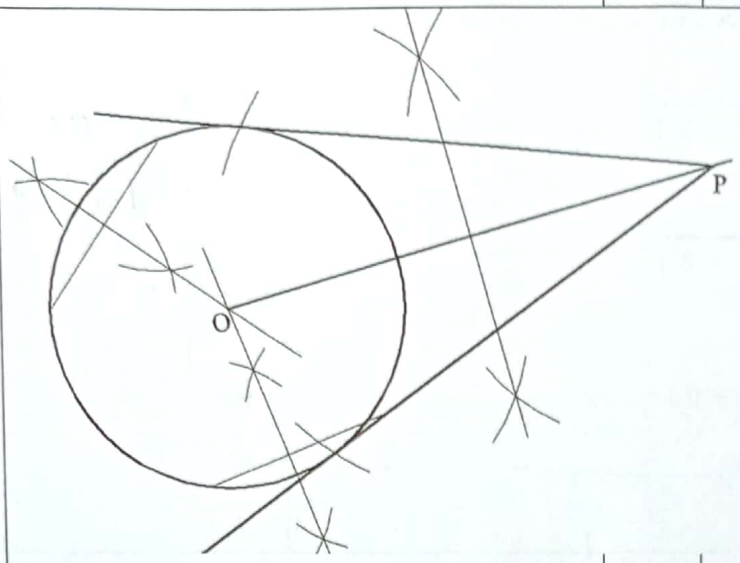
SECTION I

No.	Marking scheme	Marks	Comments
1.	Vol. of water geting to the tank in 1sec $= \frac{22}{7} \times 0.014^2 \times 2$ ✓ $= 0.001232\ m^3$ Time needed to fill tank $= \frac{18.48}{0.001232}$ ✓ $= 15{,}000$ sec $= 4\frac{1}{6}$ hours ✓	M1 M1 A1 3	Units must be compatible. C.A.O
(1)	n^{th} term $= 2 \times 2^{n-1}$ $(n-1)^{th}$ term $= 2 \times 2^{n-2}$	B1	Follow through when first
(2)	$2 \times 2^{n-1} \times 2 \times 2^{n-2} = 512$ $2^{2n-1} = 2^9$ $2n-1 = 9$ $n = 5$	M1 A1 3	
3.	$4 \times a \times 9 = (-30)^2$ $a = \frac{900}{36}$ $= 25$	M1 A1 2	also allow $(30)^2$ $b^2 - 4ac = 0$
4.	$y^2 = \frac{b^2x^2}{cx^2 - a}$ $cx^2y^2 - ay^2 = b^2x^2$ $cx^2y^2 - b^2x^2 = ay^2$ $x^2(cy^2 - b^2) = ay^2$ $x = \pm\sqrt{\frac{ay^2}{cy^2 - b^2}}$	M1 M1 A1 3	Be keen on the powers

No.	Marking scheme	Marks	Comments
5.			
	✓1 evidence of two chords bisected	B1 B1 B1	Locating centre O ⊥ bisector of OP Arc showing the correct position of point of contact of circle and tangent
		B1	√ tangent drawn
		4	
6.	$P = k\frac{\sqrt{Q}}{(R-S)^2}$	B1	
	New value of P after changes in Q, R and S		
	$= k\frac{\sqrt{1.44\,Q}}{(0.9\,R - 0.9\,S)^2}$	M1	
	$= k\frac{1.2\sqrt{Q}}{0.9^2(R-S)^2}$		
	$= 1.481\,k\frac{\sqrt{Q}}{(R-S)^2}$	~~A1~~	
	~~$= 1.481k\,P$~~	~~B1~~	
	Thus, P increases by 48.1%	A1	
		4	

One tangent is enough.

There must be k

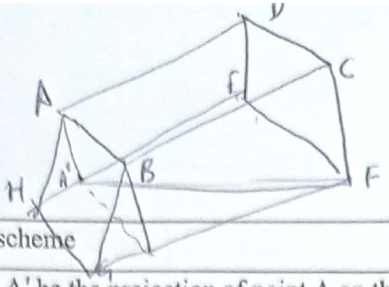
$\frac{(1.481P - P)}{P} \times 100$

$= 48.1\%$

$(1.481 - 1)100$ M1

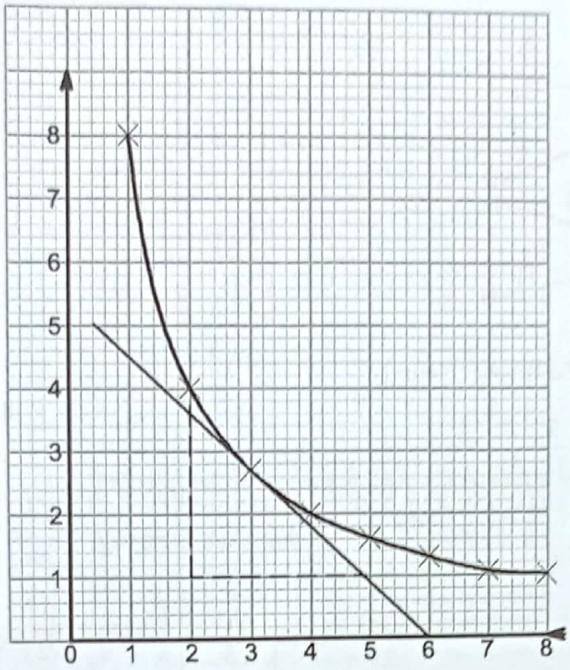
or 48.2%

The word increase is not necessary.

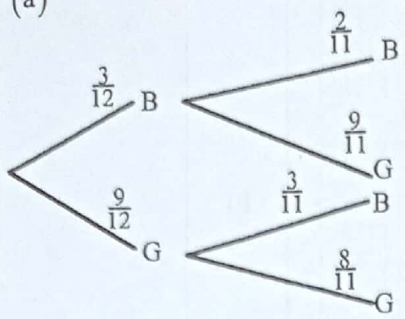
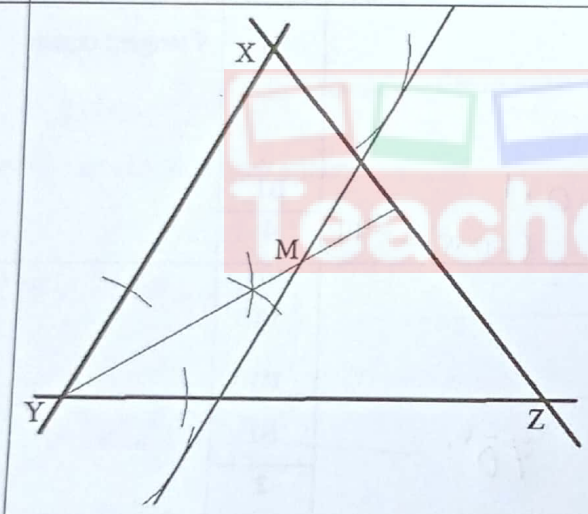


No.	Marking scheme	Marks	Comments
7.	Let point A′ be the projection of point A on the plane GFEH		
	$AA' = \sqrt{(5^2 - 3^2)}$	M1	Any of AA' or FA' *Allow 4 & 10 if you see them (automatic)
	$= 4$		
	$FA' = \sqrt{(6^2 + 8^2)}$		
	$= 10$		
	$\text{Tan}\,\theta = \frac{4}{10} = 0.4$	M1	
	$\theta = 21.8°$	A1	
		3	
8.	Balance upon paying deposit :		
	$= 20000 - 10000$		
	$= 10000$		
	Amount Repaid		
	$= 900 \times 18$		
	$= 16200$	B1	
	Let r = rate of interest per annum		
	$16200 = 10000\left(1 + \frac{\left(\frac{r}{4}\right)}{100}\right)^6$	M1	
	$= 10000\left(1 + \frac{r}{400}\right)^6$		
	$1 + \frac{r}{400} = \sqrt[6]{1.62} = 1.084$	M1	
	$r = (1.084 - 1) \times 400$		
	$= 33.6\%$ or 33.5%.	A1	
		4	

t	1	2	3	4	5	6	7	8
h	8	4	2.7	2	1.6	1.3	1.1	1

No.	Marking scheme	Marks	Comments
9.	(a) 	P1 C1	+ solid and smooth
	(b) Gradient $= \frac{0-2.7}{6-3}$ $= -0.9$	B1 B1 4	√ tangent drawn ± 0.1 (−0.8 to −1.0)
10.	(a) $\frac{360}{a} = 180$ $a = 2$	B1	
	(b) Phase Angle = +70	B1 2	70°
11.	Let θ = longitude difference between P and Q $\theta \times 60 \cos 40 = 2000$	M1	
	$\theta = \frac{2000}{60 \cos 40}$ $= 43.51^0$	M1	
	$155 + 43.5 = 198.51^0$		
	Longitude of Q $= 360° - 198.51^0$ $= 161.49^0$ E	M1 A1 3	161° E

180 − 18.51 — M1
= 161° E — A1

No.	Marking scheme	Marks	Comments
12.	(a) 	B1	
	(b) P(Balls picked are of different colours) $= \frac{3}{12} \times \frac{9}{11} + \frac{9}{12} \times \frac{3}{11}$	M1	
	$= \frac{27}{132} + \frac{27}{132}$ $= \frac{54}{132}$	A1 3	(Accept $\frac{9}{22}$) or equivalent fraction
13.		B1	Angle bisector of $\angle XYZ$
		B1	√ construction of a straight line 2 cm from and parallel to line XY
	$YM = (4 \pm 0.1)$ cm	B1	OW −1 if point M is not marked
		3	

M → must be there to get B1

No.	Marking scheme	Marks	Comments
14.	$\mathbf{PQ} = \begin{pmatrix}12\\-5\\6\end{pmatrix} - \begin{pmatrix}6\\-2\\3\end{pmatrix} = \begin{pmatrix}6\\-3\\3\end{pmatrix}$ .....(i) $\mathbf{PR} = \begin{pmatrix}8\\-3\\4\end{pmatrix} - \begin{pmatrix}6\\-2\\3\end{pmatrix} = \begin{pmatrix}2\\-1\\1\end{pmatrix}$ .....(ii) If PQ and PR are parallel, then PQ = kPR $\begin{pmatrix}6\\-3\\3\end{pmatrix} = k\begin{pmatrix}2\\-1\\1\end{pmatrix}$ $k = \frac{1}{3}\ 3$ $\therefore$ PQ = $3\frac{1}{3}$PR Parallels must come out. P is a common point Points P, Q and R are collinear	B1 B1 B1 3	For either (i) and (ii) allow for their equivalents. Parallelism The candidate must have P scale to parallelism
15.	$3x^2 - 7(x-1) = \frac{13x}{x} = 13$ $3x^2 - 7x - 6 = 0$ $(3x+2)(x-3) = 0$ $x = -\frac{2}{3}$ or $x = 3$ for both answers.	M1 M1 A1 3	allow for other methods used Correct Earned when values are correctly substituted.
16.	$\int_1^3 (x^2 + 2x) = \left[\frac{x^3}{3} + x^2\right]_1^3$ $= \left(\frac{3^3}{3} + 9\right) - \left(\frac{1}{3} + 1\right)$ $= 18 - 1\frac{1}{3}$ $= 16\frac{2}{3}$ sq. units	M1 M1 A1 3	Correct integration with limits Correct substitution C.A.O

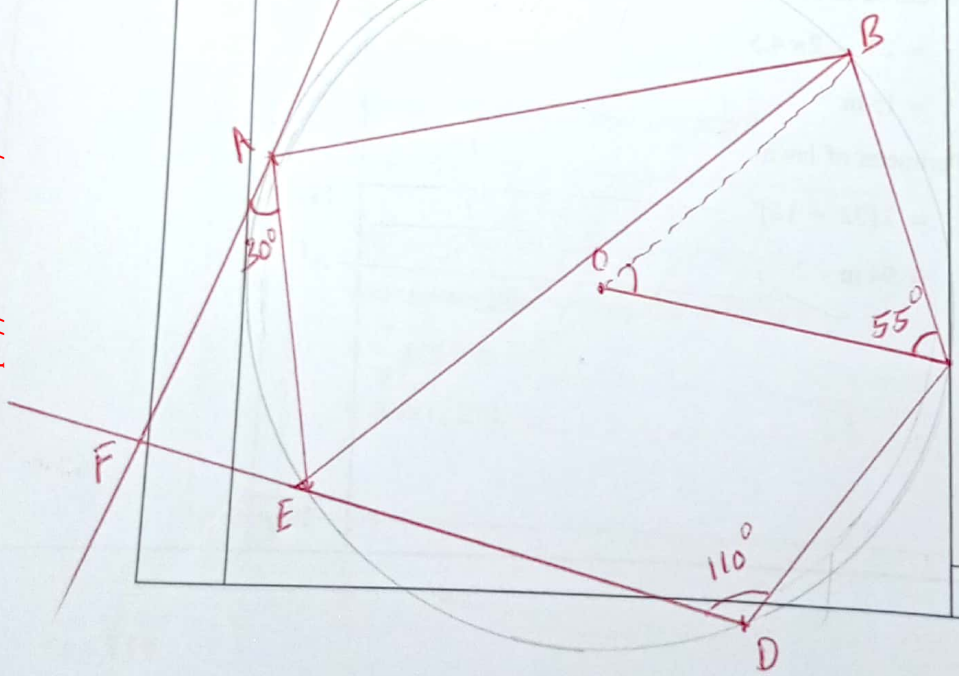
SECTION II (50 MARKS)

No.	Marking scheme	Mark	Comments
17.	(a) Fraction of tank filled by pumps P and Q in 1 hr $= \frac{1}{7\frac{1}{2}} + \frac{1}{11\frac{1}{4}} = \frac{2}{15} + \frac{4}{45}$ $= \frac{2}{9}$	M1	
	Fraction of tank filled by pumps P and Q in $2\frac{1}{2}$ hrs $= \frac{2}{9} \times \frac{5}{2}$ $= \frac{5}{9}$	M1	
	Fraction of tank still empty $= 1 - \frac{5}{9}$ $= \frac{4}{9}$	M1 A1	
	(b) Time taken by pump P alone to fill $\frac{4}{9}$ of the tank $= \frac{4}{9} \div \frac{2}{15}$ $= \frac{4}{9} \times \frac{15}{2}$ $= 3\frac{1}{3}$ hrs	M1 A1	
	(c) Total time Pump P has pumped $= 2\frac{1}{2} + 3\frac{1}{3}$ $= 5\frac{5}{6}$ hours		
	Fraction of tank delivered by pump P $= \frac{2}{15} \times 5\frac{5}{6}$ $= \frac{7}{9}$	M1 A1	
	Amount received by propriator of Pump P $= \frac{7}{9} \times 15\,750$ = Ksh 12 250	M1 A1	
		10	

M1A1 to be used if 1-5/9 is missing.

No.	Marking scheme	Mark	Comments
18.	(a) (i) Area of lawn		
	$= (50 - 4x)(24 - 2x)$	M1	
	$= 1200 - 100x - 96x + 8x^2$		
	$= 1200 - 196x + 8x^2$	A1	
	(ii) Area of path		
	$= 50 \times 24 - (1200 - 196x + 8x^2)$		
	$= 1200 - 1200 + 196x - 8x^2$		
	$= 196x - 8x^2$	B1	
	(b) (i) $196x - 8x^2 = \frac{3}{2}(1200 - 196x + 8x^2)$	M1	Allow quadratic formula
	$= 1800 - 294x + 12x^2$		
	$20x^2 - 490x + 1800 = 0$	M1	
	$2x^2 - 49x + 180 = 0$		
	$(2x - 9)(x - 20) = 0$	M1	
	$x = 4.5$ or $x = 20$	A1	for both values of x.
	(ii) Length of lawn		
	$= 50 - 4 \times 4.5$		
	$= 32$ m	B1	For √ length or width (any)
	or Width of lawn		B1 for either width or length.
	$= 24 - 2 \times 4.5$		
	$= 15$ m		
	Perimeter of lawn		
	$= 2(32 + 15)$	M1	
	$= 94$ m	A1	
		10	

No.	Marking scheme	Mark	Comments
19.	(a) (i) Size of $\angle AEC$		
	$\angle ABE = 30°$	B1	
	(Angle in alternate segment)		
	$\angle CBE = 70°$	B1	
	(Opposite angle of a cyclic quadrilateral)		
	$\angle AEC = [180 - (30+70)] = 80°$	B1	
	(Opposite angle of a cyclic quadrilateral)		
	(ii) $\angle BOC = 180 - 2\times55 = 70°$	B1	
	$\angle BEC = 35°$	B1	
	(Angle at the circumference is half angle at centre)		
	$\angle AEB = 80 - 35° = 45°$	B1	
	(b) (i) Let radius of circle = R		
	$2R = \frac{5}{\sin 45°}$	M1	
	$R = 3.5$ cm	A1	
	(ii) $AF^2 = 2.5\times(2.5 + 4.4)$	M1	
	$AF = \sqrt{17.25}$		
	$= 4.2$ cm	A1	
		10	



No.	Marking scheme	Mark	Comments
20.	(a) Taxable income		
	$= 64\,500 + 12\,000 - \frac{7.5}{100} \times 64\,500$	M1	
	= Ksh 71 662.50	A1	
	(b) Tax payable by Kanini		
	1st slab $= 12298 \times \frac{10}{100} = 1\,229.80$	M1	1229.80 Not Con
	2nd slab $= 11587 \times \frac{15}{100} = 1\,738.05$	M1	
	3rd slab $= 11587 \times \frac{20}{100} = 2\,317.4$		
	4th slab $= 11587 \times \frac{25}{100} = 2\,896.75$		
	5th slab $= 24603 \times \frac{30}{100} = 7\,381.05$	M1	
	Total tax = 15563.05	A1	
	Tax less relief		
	= Ksh 15 563.05 − 1408	M1	
	= Ksh 14 155.05	A1	
	(c) Total deductions		
	$= 14\,155.05 + \frac{7.5}{100} \times 64\,500$		
	= 18 992.55		
	Net income = (64 500 + 12000) − 18 992.55	M1	
	= 57 507.45	A1	
		10	

Net income

71662.50 − 14 155.05 = 57 507.45

alternative

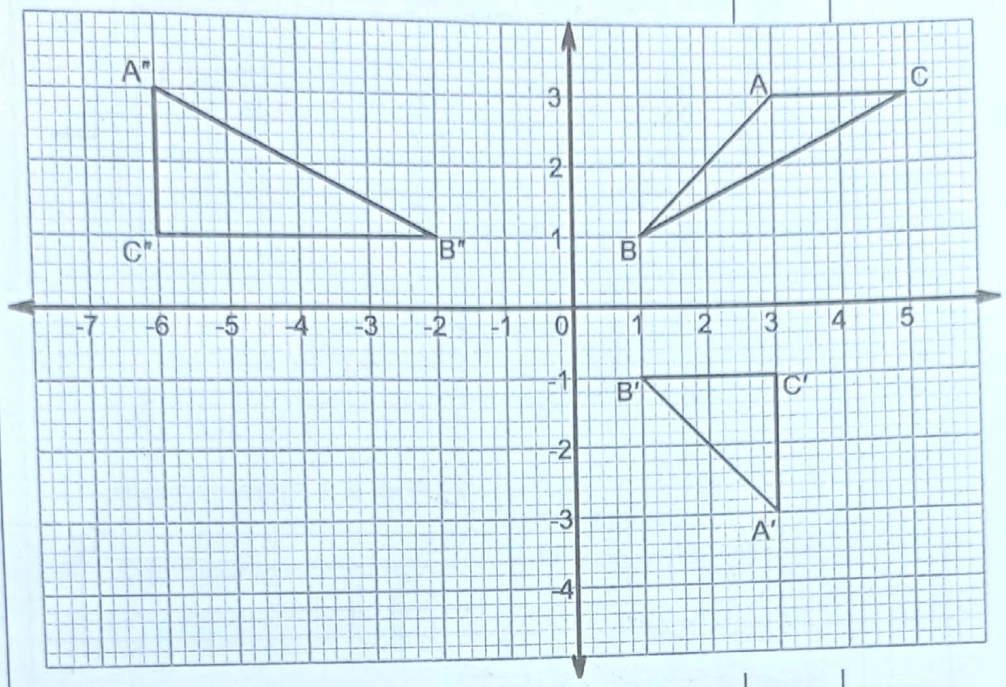
$$\begin{pmatrix}0 & 1\\ 1 & -2\end{pmatrix}\begin{pmatrix}a & b & c\\ d & e & f\end{pmatrix}=\begin{pmatrix}3 & 1 & 3\\ -3 & -1 & -1\end{pmatrix}$$ — M_1

$d = 3$
$e = 1$
$f = 3$ } A_1

for two correct } M_1
Const attempt in 3rd
any pair for
~~a b c~~
a b c

Co-ordinates A_1

No.	Marking scheme	Mark	Comments
21.	(a) Inverse of transformation matrix		
	$= \frac{1}{(0\ -1)}\begin{pmatrix}-2 & -1\\ -1 & 0\end{pmatrix}$	M1	
	$= \begin{pmatrix}2 & 1\\ 1 & 0\end{pmatrix}$	A1	
	Coordinates of triangle ABC		
	$= \begin{pmatrix}2 & 1\\ 1 & 0\end{pmatrix}\times\begin{pmatrix}3 & 1 & 3\\ -3 & -1 & -1\end{pmatrix}$	M1	
	$= \begin{pmatrix}3 & 1 & 5\\ 3 & 1 & 3\end{pmatrix}$		
	Coordinates of triangle ABC are $A(3, 3)$, $B(1, 1)$ and $C(5, 3)$	A1	
	(b) Coordinates of triangle $A''B''C''$		
	$= \begin{pmatrix}-2 & 0\\ 0 & -1\end{pmatrix}\times\begin{pmatrix}3 & 1 & 3\\ -3 & -1 & -1\end{pmatrix}$	M1	
	$= \begin{pmatrix}-6 & -2 & -6\\ 3 & 1 & 1\end{pmatrix}$		
	Coordinates of triangle $A''B''C''$ are $A''(-6, 3)$, $B''(-2, 1)$ and $C''(-6, 1)$	A1	

No.	Marking scheme	Mark	Comments
	(c) 		
		B1	√ Δ ABC drawn
		B1	√ Δ A″B″C″ drawn
	(d) Single matrix to map ABC onto A″B″C″ $= \begin{pmatrix} -2 & 0 \\ 0 & -1 \end{pmatrix}\begin{pmatrix} 0 & 1 \\ 1 & -2 \end{pmatrix}$	M1	
	$= \begin{pmatrix} 0 & -2 \\ -1 & 2 \end{pmatrix}$	A1	
		10	

Only solid lines are allowed. NO BROKEN LINES

No.	Marking scheme	Mark	Comments
22.	(a)		

Mid point x	f	xf	x^2f
3	3	9	27
8	6	48	284 384
13	t	13t	1352
18	7	126	2268
23	4	92	2116
28	2	56	1568
	$\sum f = 22 + t$	$\sum xf = 331 + 13t$	$\sum x^2 f = 7715$

B1 fx (with t)

~~B1 fx^2(without t)~~

$\frac{331 + 13t}{22 + t} = 14.5$ M1

$t = 8$ A1

~~Variance~~ Std. $= \sqrt{\frac{7715}{30} - 14.5^2}$ B1 → fx^2 (without t)

M1

$= 46.92$

~~Standard deviation~~ $= \sqrt{46.92}$

$= 6.85$ A1

(b)

UCB	5.5	10.5	15.5	20.5	25.5	30.5
C.F	3	9	17	24	28	30

B1 C.f.

$Q_3 = 15.5 + \frac{5.5}{7} \times 5$

$= 19.43$ M1 Any

$Q_1 = 5.5 + \frac{4.5}{6} \times 5$

$= 9.25$

Interquartile range

$Q3 - Q1 = 19.43 - 9.25$ M1

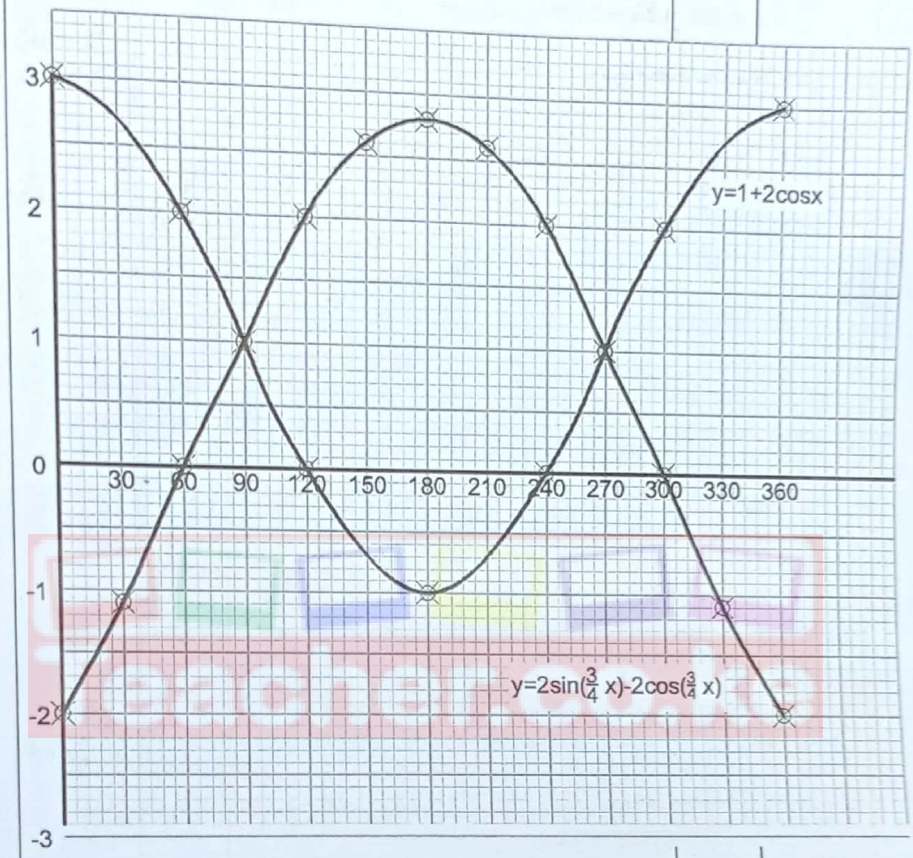
$= 10.18$ A1

10

No.	Marking scheme	Mark	Comments
23.	(a)		

x	30°	90°	150°	210°	300°	330°
$2\sin\left(\frac{3}{4}x\right) - 2\cos\left(\frac{3}{4}x\right)$		1.1	2.6	2.6		-1.1
1+2cosx	2.7			-0.7	2	

B2 — All 7 √
Allow B1 for any 5 √



- Points must be correctly plotted. otherwise Po Co — P1 C1
- Ignore extensions to the curve — P1 C1

No.	Marking scheme	Mark	Comments
	(c) (i) When $y=2$	B1	
	$2\sin\left(\frac{3}{4}x\right) - 2\sin\left(\frac{3}{4}x\right) = 2$ then		
	$\sin\left(\frac{3}{4}x\right) = 1 + \sin\left(\frac{3}{4}x\right)$		
	$x = 120°$ and $x = 240°$	B1	for both
	(ii) $90° < x < 270°$	B2	Allow B1 for one inequality √
		10	

B1B1 if $y=2$ is missing (implied).

$87° < x < 273$

$\pm 2°$

If $0 < x < 273$ or $87 < x$ give B1

No.	Marking scheme	Mark	Comments
24.	(a) $v = \int (4t - 13)\,dt$		
	$= 2t^2 - 13t + c$	M1	c must be th
	when $t = 0, v = 18$		
	$18 = 2\times0 - 13\times0 + c$		
	$c = 18$		
	$v = 2t^2 - 13t + 18$	A1	
	When $v = 0$		
	$2t^2 - 13t + 18 = 0$	M1	
	$(2t - 9)(t - 2) = 0$	M1	
	$t = 4.5$ or $t = 2$	A1	C.A.O
	(b) Distance covered by particle		
	Area above x axis		
	$\int_1^2 (2t^2 - 13t + 18)\,dt$		
	$= \left[\frac{2}{3}t^3 - \frac{13}{2}t^2 + 18t\right]_1^2$	M1	ignore limits.
	$= \left[\frac{2}{3}\times2^3 - \frac{13}{2}\times2^2 + 18\times2\right] - \left[\frac{2}{3}\times1^3 - \frac{13}{2}\times1^2 + 18\times1\right]$	M1	for 3
	$= \left[\frac{16}{3} - 26 + 36\right] - \left[\frac{2}{3} - \frac{13}{2} + 18\right]$		
	$= 15\frac{1}{3} - 12\frac{1}{6}$		
	$= 3\frac{1}{6}$	A1	also allow 19/6
	Area below x axis		
	$= \left[\frac{2}{3}\times3^3 - \frac{13}{2}\times3^2 + 18\times3\right] - 15\frac{1}{3}$	M1	
	$= \left[18 - \frac{117}{2} + 54\right] - 15\frac{1}{3}$		
	$= -1\frac{5}{6}$		
	$= 1\frac{5}{6}$	A1	allow 11/6.
	Total area		
	$= 3\frac{1}{6} + 1\frac{5}{6}$	B1	
	$= 5$ m		
		10	