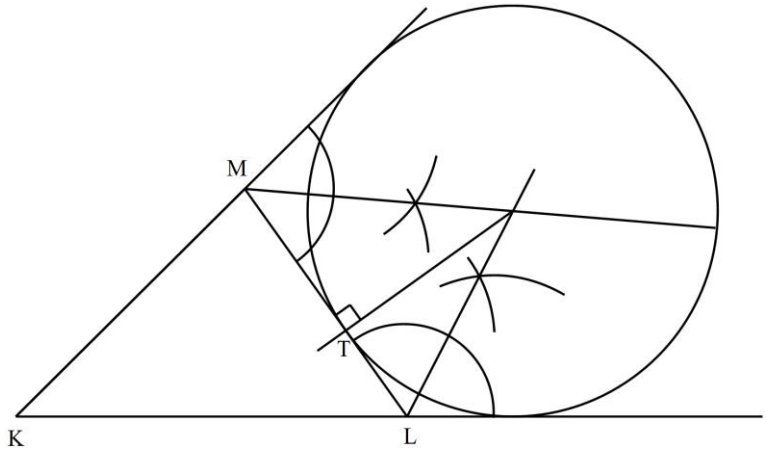
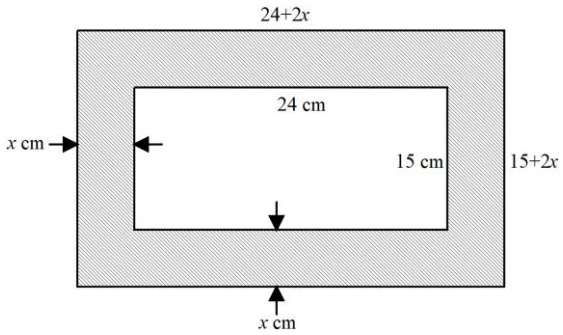
TERM 2 – 2023 (JULY)
MATHEMATICS PAPER 1 (121/1)
MARKING SCHEME

NO.	WORKING	MARKS	REMARKS
1.	$3.2 \times 1000 = 3{,}200$ kg $8 \times 1000 = 8{,}000$ kg $10 \times 1000 = 10{,}000$ kg $3{,}200 = 2^7 \times 5^2$ $8{,}000 = 2^6 \times 5^3$ $10{,}000 = 2^4 \times 5^4$ $\text{LCM} = \frac{2^7 \times 5^4}{1000} = \frac{2^7 \times 5^4}{2^3 \times 5^3} = 2^4 \times 5$ $= 80$ tonnes	 M1 M1 A1	 Attempt to get LCM of 3,200, 8,000 and 10,000 or equivalent Division by 1000 or equivalent
	Total	**3**	
2.	$\frac{3}{0.5217} = 3\left(\frac{1}{5.217} \times 10\right) = 3(0.1916 \times 10) = 5.748$ $\sqrt{0.4036} = \sqrt{40.36 \times \frac{1}{100}} = 6.3529 \times \frac{1}{10} = 0.63529$ $5.748 - 0.63529 = 5.11271$	M1 M1 A1	5.748 seen 0.63529 seen 5.11271 seen
	Total	**3**	
3.	Let the gradient of the line be m $\tan 53.13010235^0 = m \Rightarrow m = 1.33333\ldots$ $m = \frac{4}{3}$ $5 = \frac{4}{3} \times -3 + c$ $15 = -4 + 3c$ $3c = 15 + 4 = 19$ $c = \frac{19}{3}$ Hence $y = \frac{4}{3}x + \frac{19}{3}$	M1 M1 A1	Gradient of the line seen ✓ attempt to get c $y = \frac{4}{3}x + \frac{19}{3}$ seen
	Total	**3**	
4.	(a) (i) $\begin{pmatrix}12{,}500\\15{,}200\\8{,}750\end{pmatrix}$ (ii) $(20 \quad 30 \quad 45)$ (b) $(20 \quad 30 \quad 45)\begin{pmatrix}12{,}500\\15{,}200\\8{,}750\end{pmatrix}$ $= (250{,}000) + (456{,}000) + (393{,}750)$ $= (1{,}099{,}750)$ $=$ Ksh 1,099,750	B1 B1 M1 A1	
	Total	**4**	

NO.	WORKING	MARKS	REMARKS
5.	Arc length = circumference of the base $C = 2 \times \frac{22}{7} \times 10.5$ $C = 66$ The slant height = radius of the arc $66 = \frac{225}{360} \times 2 \times \frac{22}{7} \times r$ $r = \frac{66 \times 360 \times 7}{225 \times 2 \times 22}$ $r = 16.8$ cm	M1 A1	
	Total	**2**	
6.	**OR** $= \frac{-2}{3+(-2)}\begin{pmatrix}2\\-1\end{pmatrix} + \frac{3}{3+(-2)}\begin{pmatrix}-4\\3\end{pmatrix}$ **OR** $= -2\begin{pmatrix}2\\-1\end{pmatrix} + 3\begin{pmatrix}-4\\3\end{pmatrix} = \begin{pmatrix}-4\\2\end{pmatrix} + \begin{pmatrix}-12\\9\end{pmatrix}$ **OR** $= \begin{pmatrix}-16\\11\end{pmatrix}$ $\|\mathbf{OR}\| = \sqrt{(-16)^2 + 11^2}$ $\|\mathbf{OR}\| = \sqrt{377} = 19.42$	M1 A1 M1 A1	Application of ratio theorem or otherwise Vector OR M0 if $\sqrt{16^2 + 11^2}$ used
	Total	**4**	
7.	$\frac{15}{16} \times \frac{24}{20} \times 8$ $= 9$ hours	M1, M1 A1	
	Total	**3**	
8.	Change in height $= 9 - 5 = 4$ cm $\pi \times 5^2 \times 4 = \frac{4}{3} \times \pi \times r^3$ $100 = \frac{4}{3}r^3 \Rightarrow 4r^3 = 3 \times 100$ $r = \sqrt[3]{\frac{300}{4}} = 4.217$ cm	M1 M1 A1	
	Total	**3**	
9.	$(2n-4) \times 90^0 = 2 \times 90^0 + 150^0(n-2)$ $180n - 360 = 180 + 150n - 300$ $180n - 150n = 180 - 300 + 360$ $30n = 240 \rightarrow n = 8$ Hence sum$= (2 \times 8 - 4) \times 90^0 = 1080^0$	M1 A1 B1	
	Total	**3**	
10.	Let the length of the train be x metres long Total distance train covers to completely cross the bridge $= x + 50 + 120 = (x + 170)$ metres $120\text{km/h} = \frac{120 \times 1{,}000}{3{,}600} = 33\frac{1}{3}\text{m/s}$ $\frac{100}{3} = \frac{x+170}{9}$ $900 = 3(x + 170)$ $300 = x + 170 \Rightarrow x = 300 - 170$ $x = 130$ metres	M1 M1 A1	Total distance to be covered to completely cross the bridge Expression of speed
	Total	**3**	

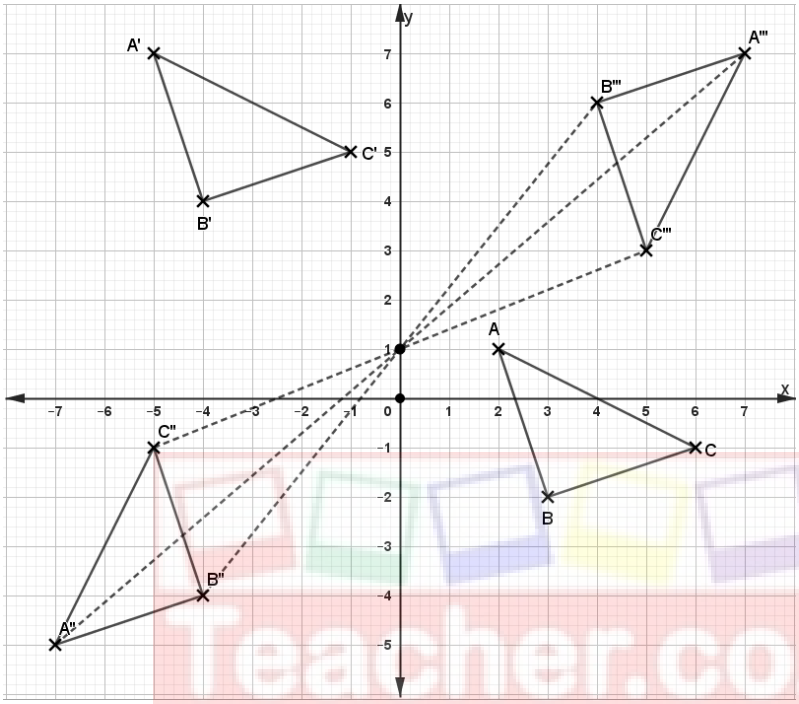
NO.	WORKING	MARKS	REMARKS
11.	Commission$= 48{,}700 - 25{,}000$ $= 23{,}700$ Let the value of sales be Ksh. A $23{,}700 = \frac{7.5}{100} \times A \Rightarrow A = \frac{23{,}700 \times 100}{7.5} = 316{,}000$ Total Sales$= 316{,}000 + 100{,}000 =$ Ksh $416{,}000$	M1 M1, A1	
	Total	**3**	
12.		B1 B1 B1	Dropping perpendicular form centre of escribed circle to LM Location of T Radius $= 3.1\text{cm} \pm 0.1\text{cm}$
	Total	**3**	
13.	$\frac{(a+b)(a-b)}{a(a+b)-1(a+b)}$ $\frac{(a+b)(a-b)}{(a-1)(a+b)}$ $\frac{\cancel{(a+b)}(a-b)}{(a-1)\cancel{(a+b)}}$ $\frac{a-b}{a-1}$	M1 M1 A1	Factorization of numerator Factorization of denominator
	Total	**3**	
14.	Rent $\rightarrow \frac{1}{10}$ Plot $\rightarrow \frac{1}{3} \times \frac{9}{10} = \frac{3}{10}$ Mother, shopping & remainder $= 1 - \left(\frac{1}{10} + \frac{3}{10}\right) = \frac{3}{5}$ Also mother, shopping and remainder $= 2{,}500 + 7{,}500 + 12{,}500 = 22{,}500$ $\frac{3}{5} \rightarrow 22{,}500$ $\frac{3}{10} = \frac{3}{10} \times 22{,}500 \times \frac{5}{3}$ $=$ Ksh $11{,}250$	M1 M1 A1	Remainder fraction $\frac{3}{5}$ obtained
	Total	**3**	

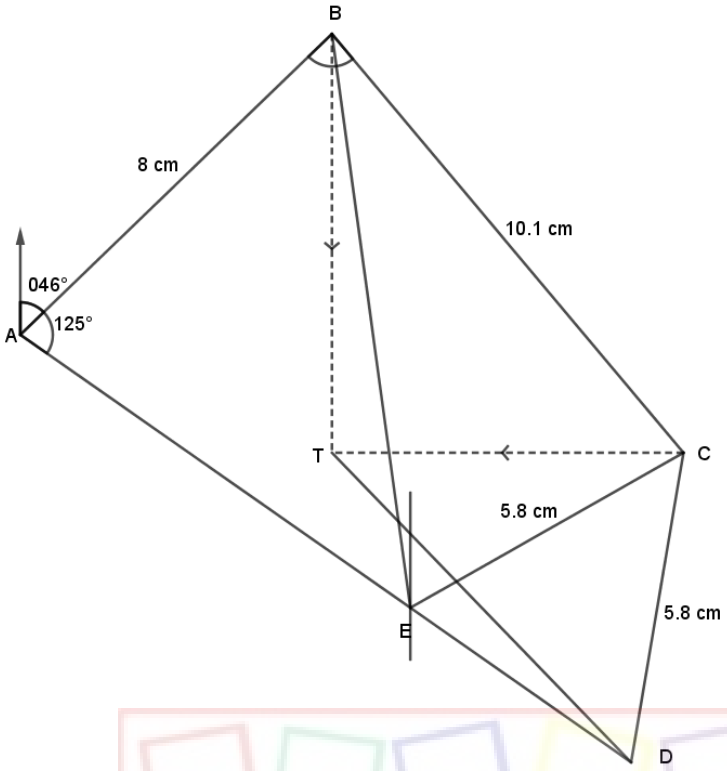
NO.	WORKING	MARKS	REMARKS
15.			
	$(24+2x)(15+2x)-(24\times 15)=270$	M1	Equating area of path to difference of areas of the two rectangles
	$360+78x+4x^2-360=270$		
	$4x^2+78x-270=0$		
	$\Rightarrow 2x^2+39x-135=0$	M1	Formation of quadratic equation
	$x=\dfrac{-39\pm\sqrt{39^2-(4\times 2\times -135)}}{2\times 2}$		
	$x=\dfrac{-39\pm 51}{4}$		
	Either $x=\dfrac{-39-51}{4}=-22.5$ (discriminate)	M1	✓ attempt to solve the quadratic equation
	Or $x=\dfrac{-39+51}{4}=3$	A1	
	Total	**4**	
16.	$49^{(x-3)}\times 2401^{(1-x)}=\dfrac{1}{343^x}$		
	$7^{2(x-3)}\times 7^4=7^{-3x}$	M1	Expressing both sides to base 7
	$2x-6+4=-3x$		
	$2x+3x=6-4$	M1	Adding and equating the indices
	$5x=2$		
	$x=\dfrac{2}{5}$	A1	
	Total	**3**	

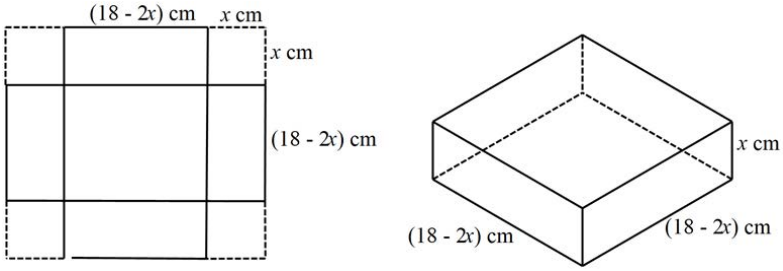
NO.	WORKING	MARKS	REMARKS
17.	(a) Volume $= 225 \times 0.4 \times 1{,}000$ $= 90{,}000\ cm^3$	M1	Volume of concrete
	Mass $= \frac{90{,}000 \times 2.4}{1{,}000}$ $= 216$ tonnes	M1	Mass of court
	Cement $\rightarrow \frac{1}{10} \times 216$ $= 21.6$ tonnes	M1 A1	Mass of cement
	(b) Number of bags $= \frac{21.6 \times 1{,}000}{50}$ $= 432$ bags	B1	
	(c) (i) Mass of ballast $= \frac{4}{10} \times 216{,}000$ $= 864{,}000$ kg	M1 A1	
	(ii) Number of trips $= \frac{864{,}000}{25{,}000}$ $= 34.56 \approx 35$ trips	M1	
	Cost $= 35 \times 43{,}500$ $=$ Ksh. $1{,}522{,}500$	M1 A1	
	Total	**10**	

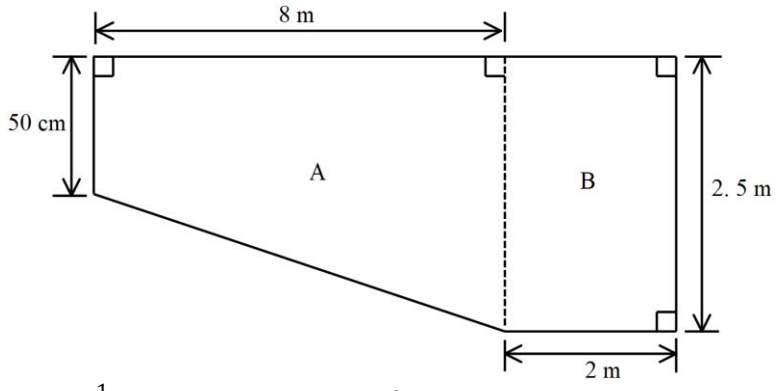
NO.	WORKING	MARKS	REMARKS
18.	(a) Frequency distribution table		
		B1	All classes ✓
		B1	Multiplication of class interval by frequency density
		B1	All f ✓
	(b) Total frequency$= 10 + 35 + 30 + 5 = 80$	B1	80 seen/award if shown in table
	(c) (i) Mean		
	$\overline{X} = \frac{1572.5}{80}$	B1	All x and fx ✓
	$= 19.65625$	M1, A1	Mean mark
	(ii) median from histogram		
	$\text{Midpoint} = \frac{80}{2} = 40$		
	$40 - 10 = 30$		
	$30 = 3.5 \times h$	M1	For $30 = 3.5 \times h$
	$h = \frac{30}{3.5} = 8\frac{4}{7}$		
	$\text{Median} = 10 + 8\frac{4}{7}$	M1	Addition
	$= 18\frac{4}{7}$	A1	Accept 18.5714
	Total	**10**	

Marks	f	x	fx
5 – 9	$5 \times 2.0 = 10$	7	70
10 – 19	$10 \times 3.5 = 35$	14.5	507.5
20 – 34	$15 \times 2.0 = 30$	27	810
35 – 39	$5 \times 1.0 = 5$	37	185
	$\Sigma f = 80$		$\Sigma f = 1572.5$

NO.	WORKING	MARKS	REMARKS
19.	(a) M – Translation Consider the position vectors of A and A′ Let the position vector be T $T = \begin{pmatrix}-5\\7\end{pmatrix} - \begin{pmatrix}2\\1\end{pmatrix} = \begin{pmatrix}-7\\6\end{pmatrix}$	B1 M1, A1	Translation Vector
	(b) Successive transformation	B1	Rotation
	(c) $A'''(7,7), B'''(4,6), C'''(5,3)$	B1	$\Delta A''B''C''$ drawn
	 	B1 B1	Enlargement $\Delta A'''B'''C'''$ drawn
		B1	Coordinates
	(d) (i) Directly	B1	
	(ii) Oppositely/Indirectly	B1	
	Total	**10**	

NO.	WORKING	MARKS	REMARKS
20.	(a) Scale drawing  	S1 B1 B1 B1	Given scale used Location of B Location of C Location of D and E
	(b) (i) Distance AD= 13.8 cm $\pm$ 0.1 cm $13.8 \times 10 = 138$ km $\pm$ 1km	B1 B1	AD in cm Conversion to km
	(ii) $N008^0W \pm 1^0$	B1	bearing
	(c) (i) T located – due west of C and due south of B	B1, B1	
	(ii) DT = 8.0 cm $\pm$ 0.1 cm	B1	
	Total	**10**	

NO.	WORKING	MARKS	REMARKS
21.	(a) Sketch  	B1 B1	✓ sketch ✓ dimensions in terms of x
	(b) (i) height of the box $V = x(18 - 2x)^2$ $V = x(324 - 72x + 4x^2) = 324x - 72x^2 + 4x^3$ $V = 4x^3 - 72x^2 + 324x$ $\frac{dV}{dx} = 12x^2 - 144x + 324$ For maximum volume $12x^2 - 144x + 324 = 0$ $x^2 - 12x + 27 = 0$ $x^2 - 3x - 9x + 27 = 0$ $x(x - 3) - 9(x - 3) = 0$ $(x - 9)(x - 3) = 0$ Either $x = 9$ or $x = 3$ Second derivative $\frac{d^2V}{dx^2} = 24x - 144 = x - 6$ At $x = 9$ $\frac{d^2V}{dx^2} = 9 - 6 = 3$ (positive) Volume will be minimum at $x = 9$ At $x = 3$ $\frac{d^2V}{dx^2} = 3 - 6 = -3$ (negative) Volume will be maximum at $x = 3$	M1 M1 A1 B1	
	(ii) maximum volume $V = (18 - 2 \times 3)(18 - 2 \times 3)(3)$ $V = 12 \times 12 \times 3 = 432\ cm^3$	M1 A1	
	(c) GCD of 12, 12 and 3 = 3 Least number of cubes $= \frac{432}{3 \times 3 \times 3}$ $= 16$ cubes	M1 A1	
	Total	**10**	

NO.	WORKING	MARKS	REMARKS
22.	(a) Capacity of the pool Cross sectional area		
			
	$A = \frac{1}{2} \times 8(0.5 + 2.5) = 12m^3$ $B = 2 \times 2.5 = 5m^3$ $Total = 12 + 5 = 17m^3$	M1	Cross-sectional area
	$Capacity = 17 \times 20 \times 1000$	M1, M1	Volume, multiply by 1000
	$= 340{,}000$ litres	A1	Capacity in litres
	(b) Volume drained in 1 minute $V = \frac{22}{7} \times 20^2 \times 35 + \frac{22}{7} \times 25^2 \times 42$	M1	Volume of both
	$= 44{,}000 + 82{,}500$	M1	Addition
	$= 126{,}500\ cm^3$	A1	
	(c) Capacity drained in 1 minute by A and B together $= \frac{126{,}500}{1000}$ $= 126.5$ litres	M1	Volume or capacity in 1 minute for A and B
	Time to drain $= \frac{340{,}000}{126.5 \times 60}$ $= 44.796$ hours $\cong 45$ hours	M1 A1	
	Total	**10**	

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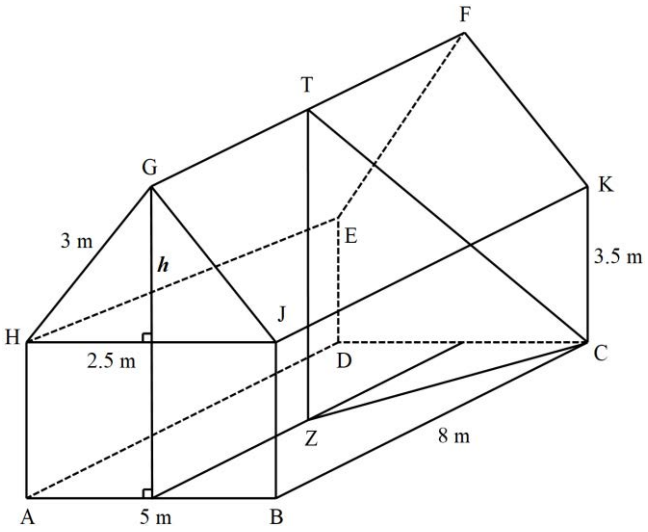
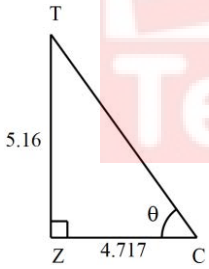
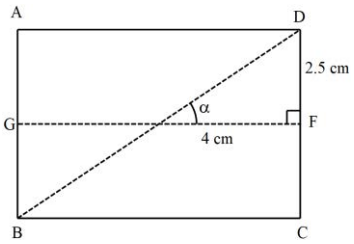
23.			
	(a) $h = \sqrt{3^2 - 2.5^2}$ $h = 1.658$ cm height of tent $= 3.5 + 1.658$ $= 5.158 \approx 5.16$ m	M1 M1 A1	Pythagorean expression for height of ΔGHJ Sum of both heights
	(b) $CZ = \sqrt{4^2 + 2.5^2}$ $= 4.717$ m Consider ΔTZC and let the angle of elevation be θ	M1	CZ obtained
			
	$\tan\theta = \frac{5.16}{4.717}$ $\theta = \tan^{-1}\left(\frac{5.16}{4.717}\right) \Rightarrow \theta = 47.57^0$	M1 A1	
	(c) Consider the figure below $\tan\alpha = \frac{2.5}{4}$ $\alpha = \tan^{-1}\left(\frac{2.5}{4}\right) = 32.00^0$ Obtuse angle $= 180^0 - 32^0 = 148^0$	M1 A1	
			
	(d) Volume $= \left\{(5 \times 3.5) + \left(\frac{1}{2} \times 1.658 \times 5\right)\right\} \times 8$ $= 173.16\ m^3$	M1 A1	
	Total	**10**	

NO.	WORKING	MARKS	REMARKS
24.	(a) (i) Consider ΔOQS $\angle OQS = \angle OSQ = 46^0$ - base angles of isosceles ΔOQS are equal $\angle QOS = 180^0 - (2 \times 46^0) = 88^0$ Sum of angles in ΔOQS is 180^0 (ii) $\angle STQ = 90^0 - 46^0 = 44^0$ Diameter TQ subtends 90^0 at S (iii) $\angle QOS$ reflex $= 360^0 - 88^0 = 272^0$ $\angle QRS = \frac{1}{2} \times 272^0 = 136^0$ angle at the centre twice angle at the circumference (b) Consider ΔQTS $\cos 46^0 = \frac{QS}{9}$ $QS = 9 \cos 46 = 6.252$ cm Area $= \frac{1}{2} \times 6.252 \times 9 \cos 46^0$ $= 19.54$ cm^2	B1 B1 B1 B1 B1 B1 B1 M1 M1 A1	
	Total	**10**	