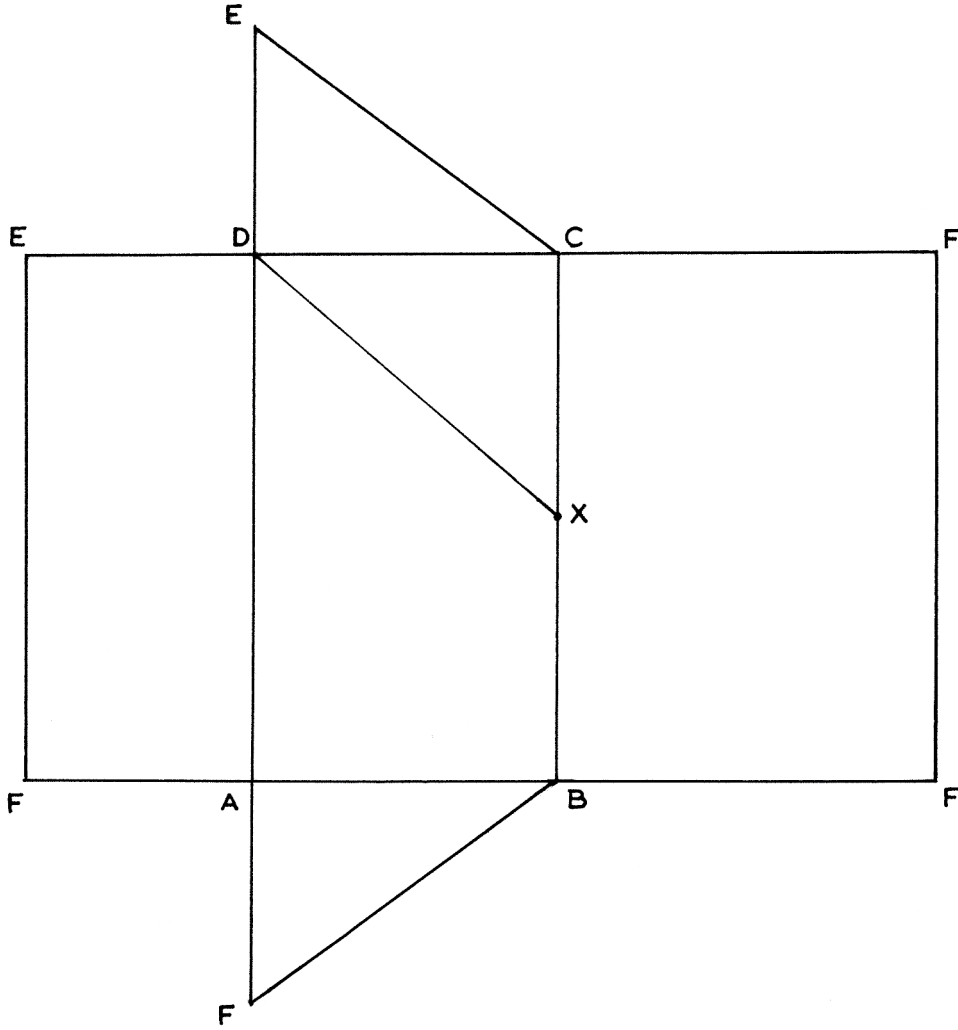


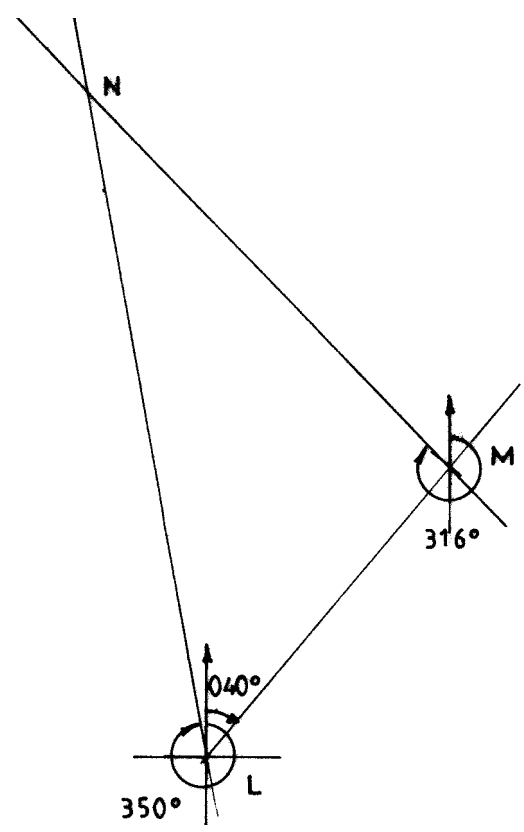
### 4.3 MATHEMATICS (121 AND 122)

#### 4.3.1 Mathematics Alternative A Paper 1 (121/1)

1.	Cows = 32 Sheep = $32 \times 12$ = 384 Goats = $384 + 1344$ = 1728 Number of goats that remained = $\frac{1}{4} \times 1728$ = 432	M1  M1  M1 A1 4	
2.	$\frac{\sqrt{1764}}{\sqrt[3]{2744}} = \frac{\sqrt{2^2 \times 3^2 \times 7^2}}{\sqrt[3]{2^3 \times 7^3}}$ $= \frac{2 \times 3 \times 7}{2 \times 7}$ $= 3$	M1 M1 A1 3	For prime factors of both  $\sqrt{\quad}$ and $\sqrt[3]{\quad}$
3.	Volume = $\frac{1}{3} \times \frac{22}{7} \times (14)^2 \times 18$ = $3696 \text{ cm}^3$  Density = $\frac{4.62 \times 1000}{3696}$ = $1.25 \text{ g/cm}^3$	M1  M1 A1 3	

4.	 <p>DX = 5.3 ± 0.1</p>	<table border="1"> <tbody> <tr> <td>B1</td> <td rowspan="3">✓ measurements and angles ✓ complete net (labelled)</td> </tr> <tr> <td>B1</td> </tr> <tr> <td>B1</td> </tr> <tr> <td>3</td> <td></td> </tr> </tbody> </table>	B1	✓ measurements and angles ✓ complete net (labelled)	B1	B1	3		
B1	✓ measurements and angles ✓ complete net (labelled)								
B1									
B1									
3									
5.	<p>C.P. for carpet</p> $= \frac{36000 \times 100}{120}$ $= 30000$ <p>% profit made during trade fair</p> $= \frac{33600 - 30000}{30000} \times 100$ $= 12\%$	<table border="1"> <tbody> <tr> <td>M1</td> <td rowspan="3"></td> </tr> <tr> <td>M1</td> </tr> <tr> <td>A1</td> </tr> <tr> <td>3</td> <td></td> </tr> </tbody> </table>	M1		M1	A1	3		
M1									
M1									
A1									
3									

6.	$= \frac{243^{-\frac{2}{5}} \times 125^{\frac{2}{3}}}{9^{-\frac{3}{2}}}$ $= \frac{27 \times 25}{9}$ $= 75$	M1 M1 A1 3	√ manipulation of all indices or equivalent simplification
7.	$= \frac{\theta}{2\pi} \times \pi \times 2.1 \times 2.1 = 2.31$ $\theta = \frac{2.31 \times 2}{2.1 \times 2.1}$ $= 1.05^\circ$	M1   A1 2	
8.	$(x + 2y)^2 - (2y - 3)^2$ $= (x^2 + 4xy + 4y^2) - (4y^2 - 12y + 9)$ $= x^2 + 4xy + 12y - 9$	M1  A1 2	

9.	 <p>Distance MN = <math>6.8 \times 100</math> = 680 km</p>	<p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>4</p>	<p>✓ location of M</p> <p>✓ location of N</p> <p>MN = <math>6.8 \pm 0.1</math> cm</p>
10.	$(2n - 4) \times 90 = 1800$ $180n = 2160$ $n = 12$ <p>size of each exterior angle</p> $= \frac{360}{12} = 30^\circ$	<p>M1</p> <p>M1</p> <p>A1</p> <p>3</p>	
11.	<p>let age of cow be <math>x</math> years</p> $\therefore x \left( x - 4\frac{2}{3} \right) = 8$ $3x^2 - 14x - 24 = 0$ $(3x + 4)(x - 6) = 0$ $x = 6 \text{ or } -\frac{4}{3}$ <p>Age of cow = 6 years</p> <p>Age of heifer = <math>1\frac{1}{3}</math> years</p>	<p>M1</p> <p>M1</p> <p>A1</p> <p>B1</p> <p>4</p>	

12.	$4 \leq 3x - 2 < 9 + x$ $4 \leq 3x - 2 \quad 3x - 2 < 9 + x$ $6 \leq 3x \quad 2x < 11$ $x \geq 2 \quad x < 5\frac{1}{2}$ $\therefore 2 \leq x < 5\frac{1}{2}$ <p>Integral values 2, 3, 4, 5</p>	M1  A1  B1 3	
13.	<p>Volume of water in container</p> $= \frac{80}{100} \times 90(40 \times 25 - \pi \times 7.5^2)$ $= 59276.54975$ $\frac{59276.54975}{1000}$ $= 59.3$	M1  M1  M1  A1 3	for $\frac{80}{100} \times 90$  difference in volumes  conversion into litres
14.	<p>Angle for major arc = <math>360 - 105</math> = <math>255^\circ</math></p> <p>Length of arc = <math>\frac{255}{360} \times 2 \times 8.4 \times \frac{22}{7}</math> = 37.4 cm</p>	B1  M1  A1 3	
15.	<p>Amount of work = <math>25 \times 16 \times 9</math> Machines required</p> $= \frac{25 \times 16 \times 9}{12 \times 10}$ $= 30$	M1  M1  A1 3	<div style="text-align: right;">÷ by <math>12 \times 10</math></div>
16.	$ AB  = \sqrt{(-3 + 2)^2 + (7 - 2)^2} = \sqrt{26}$ $ A'B'  = \sqrt{4^2 + (-20)^2} = \sqrt{416}$ <p>Scale factor = <math>\frac{ A'B' }{ AB } = \frac{\sqrt{416}}{\sqrt{26}}</math> = 4</p>	M1  M1  A1 3	for $ AB $ and $ A'B' $

17.	(a) Equation of L		
	gradient = $\frac{6-3}{-1-2}$	M1	
	= 3		
	equation = $\frac{y-6}{x+1} = 3$		
	$\Rightarrow y - 3x = 9$	A1	
	(b) equation of P		
	= $\frac{y-6}{x+1} = -\frac{1}{3}$	M1	
	$3y + x = 17$	A1	
	(c) equation of Q		
	= $\frac{y-2}{x-1} = 3$		
$y = 3x - 1$	B1		
$x$ intercept			
when $y = 0 \Rightarrow x = \frac{1}{3}$	B1		
$y$ intercept			
when $x = 0 \Rightarrow y = -1$	B1		
(d) Intersection of lines P and Q			
$3y + x = 17..(i)$			
$y - 3x = -1..(ii)$	M1		
$3y + x = 17$			
$3y - 9x = -3$			
$10x = 20 \Rightarrow x = 2$	A1	for both $x = 2$ and $y = 5$	
subset $3y + 2 = 17 \Rightarrow y = 5$			
$\therefore$ point of intersection $(2, 5)$	B1		
	10		

18.

(a)

Class	3-5	6-8	9-11	12-14	15-17	18-20
Frequency	3	8	13	10	4	2

B1

B1

(b) (i) mean length =  $\frac{\sum fx}{\sum f}$

$$= \frac{4 \times 3 + 7 \times 8 + 10 \times 13 + 13 \times 10 + 16 \times 4 + 19 \times 2}{40}$$

$$= 10.75$$

B1

M1

A1

for all  $\sqrt{\phantom{x}}$  mid points - i.e 4, 7, 10, 13, 16, and 19

(ii)

$$= \frac{23}{40} \times 100$$

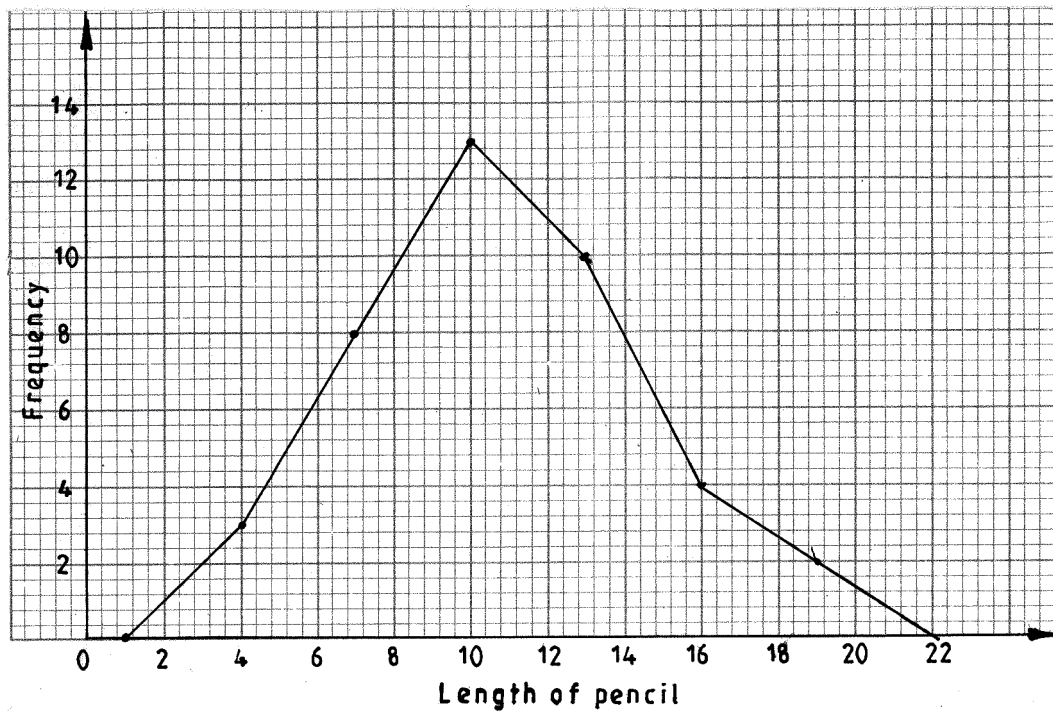
$$= 57.5\%$$

B1

for 23

B1

(c)



S1

P1

C1

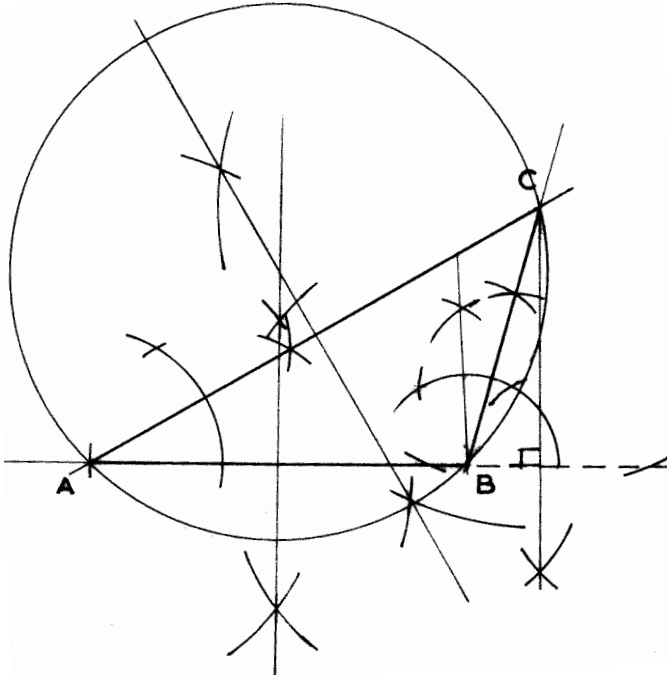
10

19.	(a)	15 m/s	B1		
	(b)	maximum speed			
		$\frac{1}{2}(15 + h) \times 10 + \frac{1}{2}(10 + 30)h = 825$	M1		
		$75 + 5h + 20h = 825$	M1		
		$25h = 750$			
		$h = 30 \text{ m/s}$	A1		
	(c)	(i)	$= \frac{30 - 15}{10}$		M1
			$= 1.5 \text{ m/s}^2$		A1
		(ii)	$= \frac{0 - 30}{20} = -1.5 \text{ m/s}^2$		B1
	(d)	$\left[ \frac{1}{2}(15 + 30) \times 10 + 10 \times 30 \right] \div 20$	M1		for distance covered in first 20 seconds
	$= (225 + 300) \div 20$	M1			
	$= 26.25 \text{ m/s}$	B1			
		10			



20.	(a) base area $= \frac{1}{2} \times 15 \times 15 \sin 72 \times 5$  $= 534.97$	B1 M1  A1	use of $72^\circ$
	(b) Length AV $= \sqrt{36^2 + 15^2} = 39$	B1	
	(c) Area of triangular faces: $\frac{AB}{\sin 72} = \frac{15}{\sin 54}$  $AB = \frac{15 \sin 72}{\sin 54}$  $= 17.63$  $\therefore$ area $= \sqrt{\left\{ \frac{1}{2} (39 + 39 + 17.63)(30.185)(8.815^2) \right\}}$  $= 334.89$	M1     M1 A1	$\checkmark$ application of Herons formula
	Total area = $334.89 \times 5 + 534.97$ $= 2209.42$	M1 A1	
	(d) volume of pyramid $= \frac{1}{3} \times 534.97 \times 36$  $= 6419.63 \text{ cm}^2$ $\simeq 6420 \text{ (4 s.f.)}$	M1  A1 10	

21.	(a)																									
	<table border="1"> <tr> <td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td> </tr> <tr> <td>y</td><td>16</td><td>10</td><td>6</td><td>4</td><td>4</td><td>6</td><td>10</td><td>16</td><td>24</td><td>34</td><td>46</td> </tr> </table>	x	-2	-1	0	1	2	3	4	5	6	7	8	y	16	10	6	4	4	6	10	16	24	34	46	B2
x	-2	-1	0	1	2	3	4	5	6	7	8															
y	16	10	6	4	4	6	10	16	24	34	46															
	(b) Area using trapezium rule																									
	$= \frac{1}{2} \times 1 [16 + 46 + 2(10 + 6 + 4 + 4 + 6 + 10 + 16 + 24 + 34)]$	M1																								
	$= \frac{1}{2} [62 + 2(114)]$	M1	simplification																							
	$= 145$	A1																								
	(c) Area using mid-ordinate rule																									
	$= 2 \times (10 + 4 + 6 + 16 + 34)$	M1																								
	$= 140$	A1																								
	(d) Area using integration method																									
	$\int_{-2}^8 (x^2 - 3x + 6) dx = \frac{x^3}{3} - \frac{3x^2}{2} + 6x \Big _{-2}^8$	M1	✓ integration																							
	$= \left[ \frac{512}{3} - \frac{192}{2} + 48 \right] - \left[ \frac{-8}{3} - \frac{3 \times 4}{2} - 12 \right]$	M1																								
	$= 122 \frac{2}{3} + 20 \frac{2}{3}$	A1																								
	$= 143 \frac{1}{3}$	10																								

22.	<p>(a) (i)</p> 	B1	construction of 30°
		B1	construction of 105°
		B1	completion of $\triangle ABC$
	<p>(ii)</p> <p>radius = <math>3.5 \pm 0.1</math></p> <p>(iii) height construction height = <math>3.4 \pm 0.1</math></p>	B1	$\perp$ bisectors
		B1	circle
		B1	
		B1	height constructed
		B1	
	<p>(b) area of circle outside triangle = <math>\pi \times 3.5^2 - \frac{1}{2} \times 3.4 \times 5</math> <math>\simeq 29.98</math></p>	M1	
		A1	
		10	

23.	(a) $\tan \theta = \frac{70}{240}$	M1	
	$= 0.2917$		
	$\theta = 16.26^\circ$	A1	
	(b) $AC = \sqrt{70^2 + 240^2}$		
	$= 250 \text{ m}$	B1	
	$\angle ACD = 150^\circ - (90^\circ - 16.26^\circ)$	M1	
	$= 76.26^\circ$		
	$AD^2 = 200^2 + 250^2 - 2 \times 200 \times 250 \cos 76.26$	M1	
	$AD = \sqrt{40000 + 62500 - 100000 \cos 76.26^\circ}$	A1	
	$= 280.6$		
(c) Area of plot			
$= \frac{1}{2} \times 240 \times 70 + \frac{1}{2} \times 250 \times 200 \sin 76.26^\circ$	M1		
$= 8400 + 24284.59$	M1		
$= 32684.59 \text{ m}^2$			
$= \frac{32684.59}{10000}$	M1		
$= 3.27 \text{ ha}$	A1		
	10		

24.	<p>(a) Value of <math>y</math> when <math>x = -1</math>  <math>y = -1 - 4 + 3 = -2</math></p> <p>(b) Stationary points  <math>\frac{dy}{dx} = 3x^2 - 8x - 3</math>  for stationary points  <math>3x^2 - 8x - 3 = 0</math>  <math>(3x + 1)(x - 3) = 0</math>  <math>x = -\frac{1}{3}</math> or <math>x = 3</math>  when <math>x = -\frac{1}{3}</math>, <math>y = \frac{14}{27}</math>  when <math>x = 3</math>, <math>y = -18</math>  <math>\therefore</math> stationary points  <math>(-\frac{1}{3}, \frac{14}{27})</math>  and <math>(3, -18)</math></p> <p>(c) Equation of normal to curve:  gradient of tangent at <math>x = 1</math>  <math>\frac{dy}{dx} = 3 - 8 - 3 = -8</math>  gradient of normal  <math>= \frac{1}{8}</math>  <math>\therefore</math> equation of normal at <math>x = 1</math>  <math>\frac{y + 6}{x - 1} = \frac{1}{8}</math>  <math>y + 6 = \frac{1}{8}x - \frac{1}{8}</math>  <math>y = \frac{1}{8}x - 6\frac{1}{8}</math></p>	<p>B1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>10</p>	
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### 4.3.2 Mathematics Alternative A Paper 2 (121/2)

1.	Limits: $12.5 \pm 0.05$ m and $9.23 \pm 0.005$ m Maximum difference $= 12.55 - 9.225$ $= 3.325$ m	B1  M1 A1 3																			
2.	a) First 6 terms $-7, -4, -1, 2, 5, 8$  b) Sum of 1 <sup>st</sup> 50 terms $S_{50} = \frac{50}{2} \{2 \times -7 + 49 \times 3\}$  $= 3325$	B1  M1 A1 3																			
3.	a) $\angle BAC = 70^\circ - 30^\circ = 40^\circ$  Reflex $\angle BOC = 360^\circ - 80^\circ$ $= 280^\circ$ b) $\angle ACO = 40^\circ - 30^\circ = 10^\circ$	B1  B1 B1 3																			
4.	$L = \frac{kM}{N^2}$  $2 = \frac{k \times 12}{36}$  $k = 6$ $\therefore$ equation $L = \frac{6M}{N^2}$	B1  M1  A1 3																			
5.	<table border="1"> <thead> <tr> <th>Marks</th> <th>Frequency</th> <th>c.f</th> </tr> </thead> <tbody> <tr> <td>1 - 10</td> <td>2</td> <td>2</td> </tr> <tr> <td>11 - 20</td> <td>4</td> <td>6</td> </tr> <tr> <td>21 - 30</td> <td>11</td> <td>17</td> </tr> <tr> <td>31 - 40</td> <td>5</td> <td>22</td> </tr> <tr> <td>41 - 50</td> <td>3</td> <td>25</td> </tr> </tbody> </table> Median $= 20.5 + \frac{12.5 - 6}{11} \times 10$  $= 20.5 + 5.91$ $= 26.41$ $\approx 26$	Marks	Frequency	c.f	1 - 10	2	2	11 - 20	4	6	21 - 30	11	17	31 - 40	5	22	41 - 50	3	25	B1  M1 M1  A1 4	for c.f
Marks	Frequency	c.f																			
1 - 10	2	2																			
11 - 20	4	6																			
21 - 30	11	17																			
31 - 40	5	22																			
41 - 50	3	25																			

6.	Amplitude = 2 Period = $\frac{360}{3} = 120^\circ$	B1	
		B1	
		2	
7.	Area scale factor = $\frac{30}{5} = 6$  $4x - 2x + 2 = 6$ $2x = 4$ $x = 2$	B1	
		M1	
		A1	
		3	
8.	$(3 - x)^7 = 3^7 - 7(3)^6x + 21(3)^5x^2 - 35(3)^4x^3 + 35(3)^3x^4 + \dots$  $= 2187 - 5103x + 5103x^2 - 2835x^3 + 945x^4$ $(2.8)^7 = (3 - 0.2)^7$ $= 2187 - 5103(0.2) + 5103(0.2)^2 - 2835(0.2)^3 + 945(0.2)^4$ $= 1349.352$	B1	
		M1	
		A1	
		3	
9.	$\text{Log} \frac{15^2}{x} = \log 5(x - 4)$  $\frac{15^2}{x} = 5(x - 4)$  $x^2 - 4x - 45 = 0$ $(x - 9)(x + 5) = 0$ $x = 9 \text{ or } -5$ $x = 9$	M1	
		M1	
		M1	
		A1	
		4	
10.	$PR = \sqrt{60^2 + 11^2} = 61$ $\text{Tan } \theta = \frac{10}{61}$ $\theta = 9.31^\circ$	B1	
		M1	
		A1	
		3	

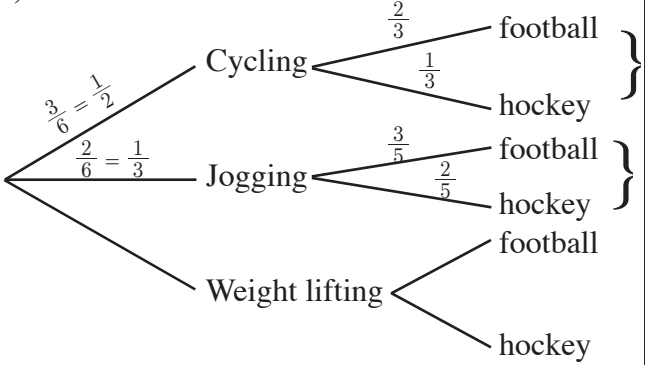
11.	$3x - y = 9 \quad \dots\dots\dots \times x$ $x^2 - xy = 4$ $3x^2 - xy = 9x$ $\frac{x^2 - xy = 4}{2x^2} = 9x - 4$ $2x^2 - 9x + 4 = 0$ $(2x - 1)(x - 4) = 0$ $x = \frac{1}{2} \quad \text{or } x = 4$ $y = 3\left(\frac{1}{2}\right) - 9 \quad \text{or } 3(4) - 9$ $= -7\frac{1}{2} \quad \text{or } 3$	M1            B1	Attempt to solve            Factors
4			
12.	$\left(1 + \frac{r}{100}\right)^4 = \frac{495000}{280000}$ $1 + \frac{r}{100} = 1.153$ $r = 15.3$	M1    A1	
3			
13.	$8008 = \frac{40 + \theta}{360} \times 2 \times \frac{22}{7} \times 6370$ $40 + \theta = \frac{8008 \times 360 \times 7}{2 \times 22 \times 6370} = 72$ $\theta = 72^\circ - 40^\circ$ $= 32^\circ$ <p>Position of B(32° S, 20°W)</p>	M1       A1	or 32° seen
3			
14.	$\underline{r} + \underline{s} = (7\underline{i} + 2\underline{j} - \underline{k}) + (-\underline{i} + \underline{j} - \underline{k})$ $= 6\underline{i} + 3\underline{j} - 2\underline{k}$ $ \underline{r} + \underline{s}  = \sqrt{6^2 + 3^2 + (-2)^2}$ $= 7$	B1    A1	
3			



15.	$y = \int (x^2 - 4x + 3) dx$ $= \frac{1}{3}x^3 - 2x^2 + 3x + c$ $0 = \frac{1}{3} - 2 + 3 + c$ $\therefore c = -\frac{4}{3}$ $\therefore y = \frac{1}{3}x^3 - 2x^2 + 3x - \frac{4}{3}$	M1	
		M1	
		A1	
		3	
16.	Temperature at the 2nd minute = 60° Temperature at the 11th minute = 18°  Average rate of cooling  $= \frac{60 - 18}{2 - 11}$ $= \frac{42}{ 9 }$ $= 4\frac{2}{3} \text{ C/min}$	B1	for both ✓
		M1	
		A1	
		3	
17.	a) $A = \frac{3}{4}B, C = 2B$ $\Rightarrow A:B:C = \frac{3}{4}B:B:2B$ $= 3:4:8$  b) $\left(\frac{168}{8} \times 4\right)$ litres $= 84 \text{ l}$  c) (i) $\frac{3 \times 160 + 4 \times 205 + 8 \times 100}{3 + 4 + 8}$ $= \text{Ksh } 140$  (ii) $\frac{182 - 140}{140} \times 100\%$ $= 30\%$  (iii) $\text{Ksh } 140 \times \frac{125}{100}$ $= \text{Ksh } 175$	M1	
		A1	
		M1	
		A1	
		M1	
		A1	
		M1	
		A1	
		M1	
		A1	
		M1	
		A1	
		10	

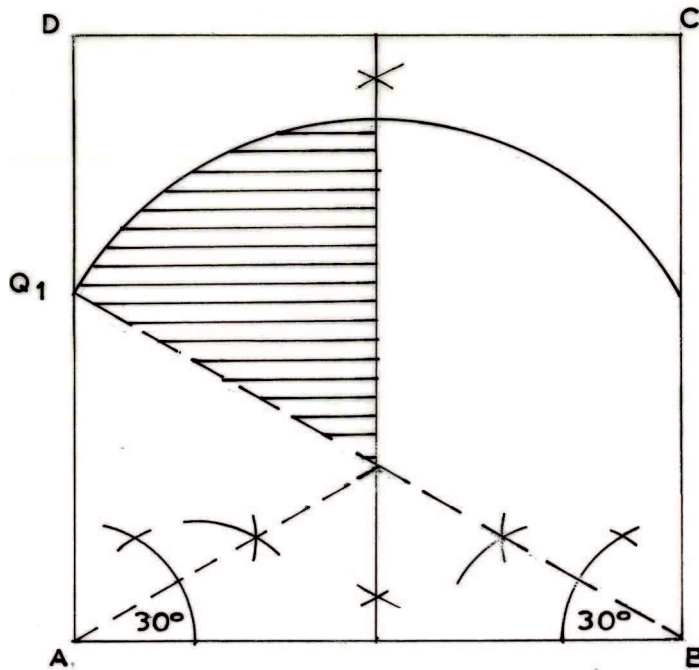
18.	<p>a) (i) <math>(50 + 40)(50) = 30(30 + x)</math>  <math>4500 = 900 + 30x</math>  <math>30x = 3600</math>  <math>QS = x = 120 \text{ cm}</math></p> <p>(ii) <math>RS = \frac{1}{2}QS</math>  <math>= \frac{1}{2}(120) = 60 \text{ cm}</math>  OR <math>= \sqrt{61^2 - 60^2}</math>  <math>= 11 \text{ cm}</math></p>	M1 A1 B1 M1 A1	or equivalent
	<p>b) (i) <math>\sin \theta = \frac{60}{61}</math>  <math>\theta = 79.6^\circ</math></p> <p>(ii) Angle at the centre  <math>= 2 \times 79.6</math>  <math>= 159.2^\circ</math></p> <p>Length of minor arc QS  <math>= \frac{159.2}{360} \times 2\pi \times 61</math>  <math>= 169.5 \text{ cm}</math></p>	M1 A1 M1 M1 A1	
		10	
19.	<p>a) (i) <math>38392 + 2108</math>  <math>= \text{Ksh } 41000</math></p> <p>(ii) <math>10164 \times 0.1 + 9576 \times 0.15 + 9576 \times 0.2</math>  <math>+ 9576 \times 0.25 + 2108 \times 0.3</math>  <math>= 1016.4 + 1436.4 + 1915.2 + 2394 + 632.4</math>  <math>= \text{Ksh } 7394.4</math></p> <p>monthly income tax  <math>= 7394.4 - 1162</math>  <math>= \text{Ksh } 6232.4</math></p>	M1 A1 M1 M1 M1 A1	$\sqrt{1^{\text{st}}}$ band $\sqrt{3}$ middle bands $\sqrt{\text{last } (5^{\text{th}})}$ band
	<p>b) Amount saved in coop society  <math>= \frac{5}{100} \times (41000 - 15000)</math>  <math>= \text{Ksh } 1300</math></p> <p>Nett pay  <math>41000 - (6232.4 + 1300)</math>  <math>= \text{Ksh } 33467.6</math></p>	M1 M1 A1	
		10	

20.	<p>a) <math>y &gt; x</math>  <math>y \leq 2x</math></p> <p><math>x + y &lt; 20</math>  <math>x + y &gt; 8</math></p> <p>b) (i)</p>	<p>B1  B1</p> <p>B1  B1</p>	
		<p>B1  B1  B1  B1</p> <p>M1  A1</p> <p>10</p>	<p>line <math>y = 2x</math> and <math>\sqrt{\quad}</math> shading  broken line <math>x + y = 20</math> and <math>\sqrt{\quad}</math> shading  broken line <math>x + y = 8</math> and <math>\sqrt{\quad}</math> shading  broken line <math>y = x</math> and <math>\sqrt{\quad}</math> shading</p>
<p>(ii) Maximum area:</p> $9 \times 10$ $= 90 \text{ m}^2$			

21.	<p>a) (i) <math>\frac{3}{6} + \frac{1}{6}</math>  <math>= \frac{2}{3}</math></p> <p>(ii) <math>\frac{2}{6} \times \frac{2}{6}</math>  <math>= \frac{1}{9}</math></p> <p>b)</p>  <p>c) (i) P(Gataro plays football)  <math>= \frac{1}{2} \times \frac{2}{3} + \frac{1}{3} \times \frac{3}{5} + \frac{1}{6} \times \frac{1}{2}</math>  <math>= \frac{37}{60}</math></p> <p>(ii) P(neither jogs nor plays football)  <math>= \frac{1}{2} \times \frac{1}{3} + \frac{1}{6} \times \frac{1}{2}</math>  <math>= \frac{1}{4}</math></p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>10</p>	
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22.	a) (i) $\underline{BA} = \underline{a} - \underline{b}$	B1	
	(ii) $\underline{BN} = \frac{1}{3}\underline{BA} = \frac{1}{3}(\underline{a} - \underline{b})$	B1	
	(iii) $\underline{ON} = \underline{b} + \frac{1}{3}(\underline{a} - \underline{b})$	M1	
	$= \frac{1}{3}\underline{a} + \frac{2}{3}\underline{b}$	A1	
	b) $\underline{BX} = h\underline{BM} = h\left(\frac{1}{2}\underline{a} - \underline{b}\right)$		
	$\underline{OX} = k\underline{ON} = k\left(\frac{1}{3}\underline{a} + \frac{2}{3}\underline{b}\right)$	B1	
	also		
	$\underline{OX} = \underline{OB} + \underline{BX}$	B1	
	$= \underline{b} + h\left(\frac{1}{2}\underline{a} - \underline{b}\right)$		
	$k\left(\frac{1}{3}\underline{a} + \frac{2}{3}\underline{b}\right) = \underline{b} + h\left(\frac{1}{2}\underline{a} - \underline{b}\right)$	M1	
	$\frac{1}{3}k\underline{a} = \frac{1}{2}h\underline{a}$		
	$\frac{1}{3}k = \frac{1}{2}h \implies k = \frac{3}{2}h \dots\dots\dots (i)$	M1	
	$\frac{2}{3}k\underline{b} = \underline{b} - h\underline{b}$		
	$\frac{2}{3}k = 1 - h \dots\dots\dots (ii)$		
	Substituting $k = \frac{3}{2}h$ in (ii)		
	$\frac{2}{3}\left(\frac{3}{2}h\right) = 1 - h \implies h = \frac{1}{2}$	M1	
	Substituting $h = \frac{1}{2}$ in (i)		
	$k = \frac{3}{2}\left(\frac{1}{2}\right) = \frac{3}{4}$	A1	
			for $h = \frac{1}{2}$ and $k = \frac{3}{4}$
		10	

23.

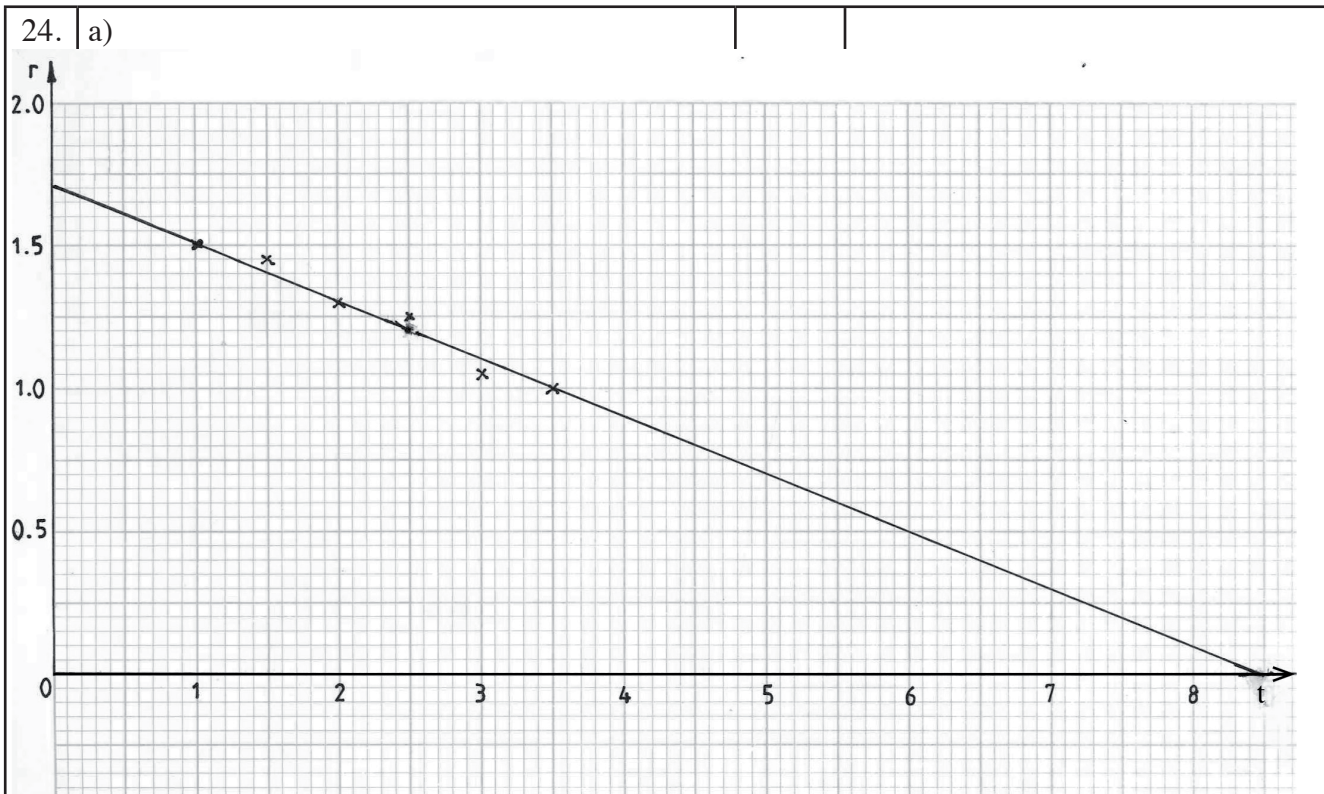


- (i)
- (ii)

b) (i)  $9.2 \times 10 = 92 \text{ m}$

(ii) area of region bounded by locus of P,  
 locus of Q and line  $BQ_1$   
 angle =  $60^\circ$  radius = 46 m  
 $= \pi \times 46^2 \times \frac{60}{360}$   
 $= 1107.94$   
 $\approx 1108 \text{ m}^2$

B2	locus of P
B1	construction of $30^\circ$
B1	identification of centre
B1	drawing of arc
B1	
B1	Identifying region
B1	for radius and angle of sector
M1	
A1	
10	



b) (i) value of a

$$= \frac{-0.7}{3.5}$$

$$= -0.2$$

value of k = 1.7

(ii) equation:  $r = -0.2t + 1.7$

(iii) value of t when  $r = 0$

$$\therefore 0 = -0.2t + 1.7$$

$$0.2t = 1.7$$

$$t = \frac{1.7}{0.2} = 8.5$$

S1  $\sqrt$  scale  
 P2 (P1 for 4 points  $\sqrt$  plotted)  
 L1  $\sqrt$  line  
 M1

A1  
 B1

B1

M1

A1

10