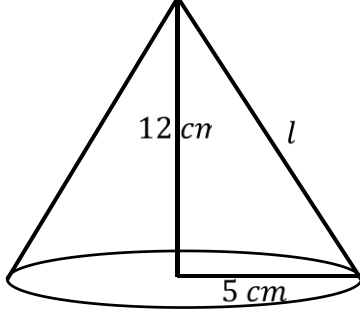
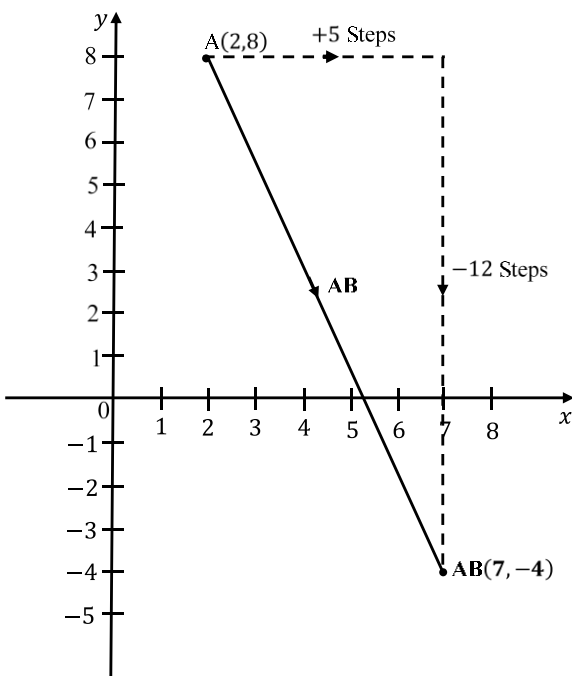


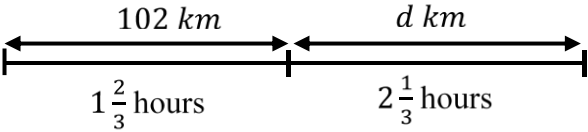
**PROPOSED  
MARKING GUIDE  
MATH 2 UMTA  
O LEVEL 2023**

NO	SOLUTION	Mks	Comments
1	$= \left( \frac{13}{8} \div \frac{13}{4} \right) \div \left( \frac{11}{4} - \frac{15}{8} \right)$ $= \left( \frac{13}{8} \times \frac{4}{13} \right) \div \left( \frac{22-15}{8} \right)$ $= \frac{1}{2} \div \frac{7}{8}$ $= \frac{1}{2} \times \frac{8}{7}$ $= \frac{4}{7}$		
		<b>04</b>	
2	$P = \{3, 6, 9, 12\}$ $Q = \{1, 3, 6, 10, 15\}$ $P \cap Q = \{3, 6\}$ $\therefore n(P \cap Q) = 2 \text{ elements}$		
		<b>04</b>	
3	<p>For perpendicular lines; <math>m_1 \times m_2 = -1</math></p> $-\frac{2}{3} \times m_2 = -1 \quad \therefore m_2 = 3/2$ $3/2 = \frac{h+4}{8-2}$ $2(h+4) = 3 \times 6$ $2h + 8 = 18$ $2h = 10 \quad \therefore h = 5$		
		<b>04</b>	
4	$\frac{4\sqrt{3}}{2\sqrt{3}-\sqrt{6}} = \frac{4\sqrt{3}(2\sqrt{3}+\sqrt{6})}{(2\sqrt{3}-\sqrt{6})(2\sqrt{3}+\sqrt{6})}$ $= \frac{8 \times 3 + 4\sqrt{18}}{(2\sqrt{3})^2 - (\sqrt{6})^2}$		

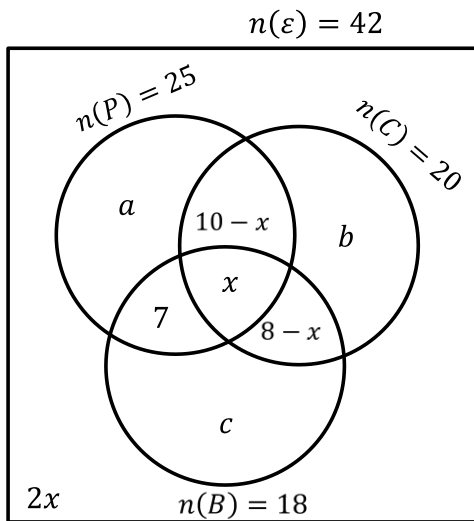
	$= \frac{24+4\sqrt{9 \times 2}}{4 \times 3 - 6}$ $= \frac{24+12\sqrt{2}}{6}$ $= 4 + 2\sqrt{3}$		
		<b>04</b>	
5	<p>From <math>A = P \left(1 + \frac{r}{100}\right)^n</math></p> $2,850,000 = 2,420,000 \left(1 + \frac{805}{100}\right)^n$ $(1.085)^n = 1.17768565$ <p>Taking log to base 10 on both sides</p> $\log_{10}(1.085)^n = \log_{10} 1.17768595$ $n = \frac{\log_{10} 1.17768595}{\log_{10} 1.085}$ $n = 2 \text{ years}$		
		<b>04</b>	
6	$1 - \frac{1}{3} \log_{10} 64 + 2 \log_{10} 20$ $= \log_{10} 10 - \log_{10} 64^{1/3} + \log_{10} 20^2$ $= \log_{10} 10 - \log_{10} 4 + \log_{10} 400$ $= \log_{10}(10 \times 400) - \log_{10} 4$ $= \log_{10} 4000 - \log_{10} 4$ $= \log_{10} \left(\frac{4000}{4}\right)$ $= \log_{10} 1000$ $= \log_{10} 10^3$ $= 3 \log_{10} 10$ $= 3 \times 1$ $= 3$		
		<b>04</b>	

7	 <p> <math>l^2 = 5^2 + 12^2</math>  <math>l^2 = 25 + 144</math>  <math>l^2 = 169</math>  <math>\sqrt{l^2} = \sqrt{169}</math>  <math>l = 13 \text{ cm}</math>  <math>S.A = \pi r l</math>  <math>= 3.142 \times 5 \times 13</math>  <math>= 204.23 \text{ cm}^2</math> </p>		
		04	
8	<p>From <math>\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA}</math></p> <p><math>\overrightarrow{OB} = \overrightarrow{OA} + \overrightarrow{AB}</math></p>		

	 <p> <math>OB = \begin{pmatrix} 5 \\ -12 \end{pmatrix}</math>  <math>\therefore (5,12)</math> are the coordinates of B </p>		
		04	
9	<p> <math>V.S.F = (L.S.F)^3</math>  <math>\frac{V_b}{V_s} = \left(\frac{H}{h}\right)^3</math>  <math>\frac{250}{54} = \left(\frac{10}{h}\right)^3</math>  <math>\frac{125}{27} = \left(\frac{10}{h}\right)^3</math>  <math>\left(\frac{10}{h}\right)^3 = \frac{5^3}{3^3}</math>  <math>\frac{10}{h} = \left(\frac{5^3}{3^3}\right)^{1/3}</math>  <math>\frac{10}{h} = \frac{5^{3 \times \frac{1}{3}}}{3^{3 \times \frac{1}{3}}}</math>  <math>\frac{10}{h} = \frac{5}{3}</math>  <math>5h = 30 \quad \therefore h = 6 \text{ cm}</math> </p>		

		<b>04</b>	
10	 $d = 54 \times \frac{7}{3} = 126 \text{ km}$ <p>Average speed = <math>\frac{\text{Total distance}}{\text{total time taken}}</math></p> $= \frac{102+126}{\frac{5}{3}+\frac{7}{3}}$ $= \frac{228}{4}$ $= 57 \text{ kmh}^{-1}$		
		<b>04</b>	
11	<p>(a) i) <math>f(-5) = \frac{5(-5)+1}{4}</math></p> $= \frac{-25+1}{4}$ $= \frac{-24}{4}$ $= -6$ <p>ii) let <math>f(x) = y</math></p> $y = \frac{5x+1}{4}$ $5x + 1 = 4y$ $5x = 4y - 1$ $x = \frac{4y-1}{5}$ $f^{-1}(x) = \frac{4x-1}{5}$ $\Rightarrow f^{-1}(4) = \frac{4(4)-1}{5}$ $= \frac{15}{5}$		

	$= 3$ <p>(b) <math>gh(x) = g[h(x)]</math></p> $= \frac{4\left(\frac{1+2x}{8}\right)+3}{3}$ $= \frac{\frac{1+2x}{2}+3}{3}$ $= \frac{1+2x+6}{6}$ $= \frac{2x+7}{6}$ $\Rightarrow \frac{2x+7}{6} = \frac{6-x^2}{4}$ $8x + 28 = 36 - 6x^2$ $6x^2 + 8x - 8 = 0$ $3x^2 + 4x - 4 = 0$ $3x^2 - 2x + 6x - 4 = 0$ $x(3x - 2) + 2(3x - 2) = 0$ $(x + 2)(3x - 2) = 0$ <p>Either <math>x + 2 = 0</math> or <math>3x - 2 = 0</math></p> $x = -2 \text{ or } 3x = 2$ $x = \frac{2}{3}$		
		<b>12</b>	
12	(a)		



**$n(P)$  only;**

$$a + 7 + x + 10 - x = 25$$

$$a + 17 = 25$$

$$a = 25 - 17 = 8$$

**$n(C)$  only;**

$$b + 10 - x + x + 8 - x = 20$$

$$b + 18 - x = 20$$

$$b = 20 - 18 + x$$

$$b = 2 + x$$

**$n(B)$  only;**

$$7 + x + 8 - x + c + 18$$

$$c + 15 = 18$$

$$c = 18 - 15 = 3$$

(b) i)  $8 + 7 + x + 10 - x + 2 + x + 8 - x + 3 + 2x = 42$

$$25 + 13 + 2x = 42$$

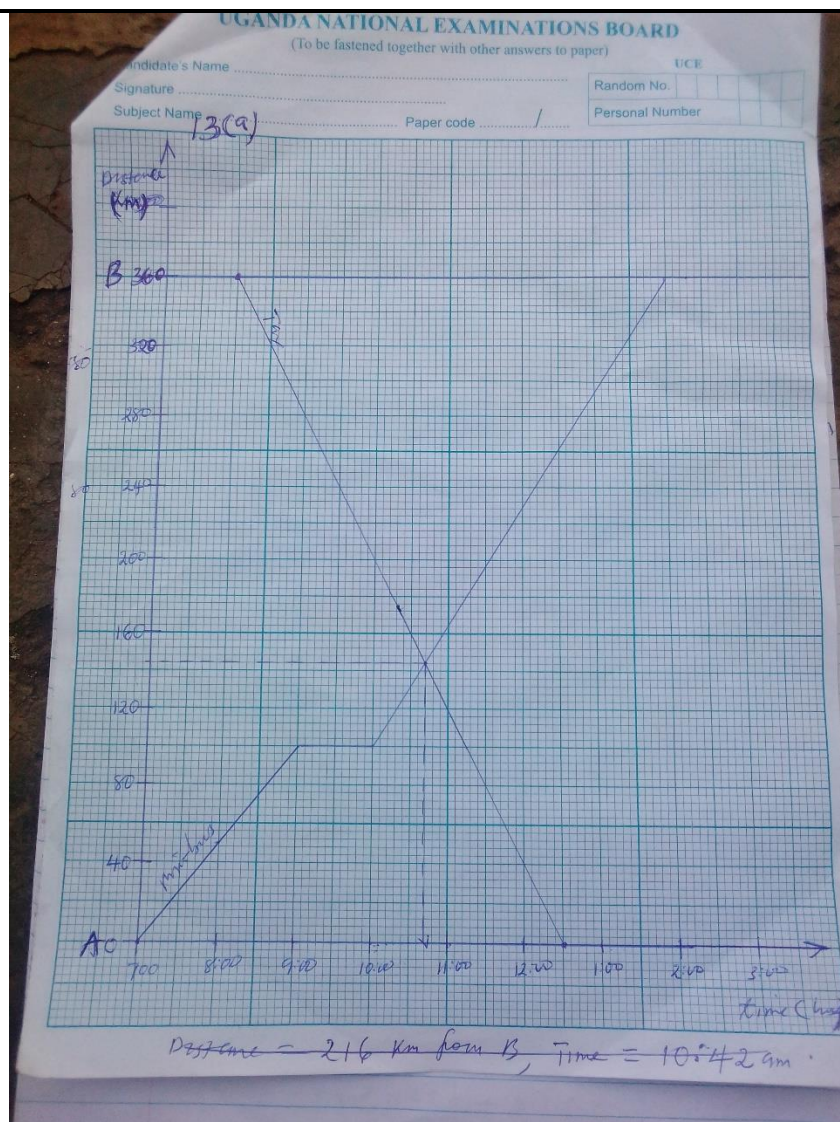
$$2x + 38 = 42$$

$$2x = 42 - 38$$

$$2x = 4 \quad \therefore x = 2$$

	<p>ii) At least two = <math>7 + (10 - 2) + (8 - 2) + 2</math></p> <p style="text-align: center;"><math>= 7 + 8 + 6 + 2</math></p> <p style="text-align: center;"><math>= 23</math> students</p> <p>(c) Probability = <math>\frac{n(E)}{n(s)}</math></p> <p style="text-align: center;"><math>= \frac{8+3+4}{42}</math></p> <p style="text-align: center;"><math>= \frac{15}{42}</math></p> <p style="text-align: center;"><math>= \frac{5}{14}</math> or 0.3571</p>		
		<b>12</b>	
13	(a)		





(b) i) Time of arrival of:

Mini-bus = 2:00 pm

Taxi = 12:30 pm

ii) Time = 10:42 am

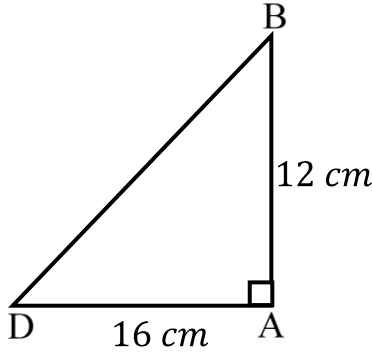
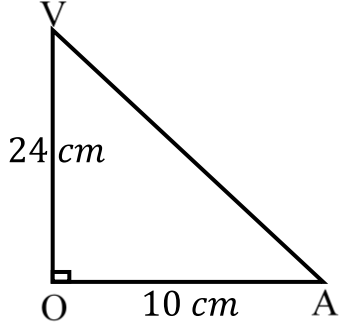
Distance = 216 km from B

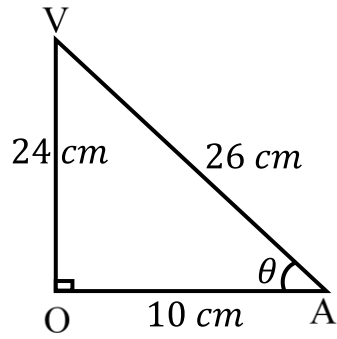
$$\begin{aligned} \text{(c) Average speed} &= \frac{\text{Total distance}}{\text{Total time taken}} \\ &= \frac{260}{4} \\ &= 65 \text{ kmhr}^{-1} \end{aligned}$$

		12																						
14	<p>(a) Allowances</p> <p>Housing     = <math>\frac{840,000}{12}</math> = Shs70,000</p> <p>Electricity                 =Shs60,000</p> <p>Medical                     =Shs100,000</p> <p>Children     = 15,000 + 9,000</p> <p>                      =Shs24,000</p> <p>Total allowances =Shs254,000</p> <p>⇒ Taxable income = 950,000 – 254,000</p> <p>                              =Shs696,000</p> <p>(b) <b>income tax</b></p> <table> <tr> <th>Taxable income</th> <th>Rate</th> <th>Income tax</th> </tr> <tr> <td>01-100,000</td> <td>5</td> <td><math>\frac{5}{100} (100,000 - 0)</math> =Shs5,000</td> </tr> <tr> <td>100,001-300,000</td> <td>7</td> <td><math>\frac{7}{100} (300,000 - 100,000)</math> =Shs14,000</td> </tr> <tr> <td>300,001-450,000</td> <td>10</td> <td><math>\frac{10}{100} (450,000 - 300,000)</math> =Shs15,000</td> </tr> <tr> <td>450,001-600,000</td> <td>14</td> <td><math>\frac{14}{100} (600,000 - 450,000)</math> =Shs21,000</td> </tr> <tr> <td>600,001-696,000</td> <td>25</td> <td><math>\frac{25}{100} (696,000 - 600,000)</math> =Shs24,000</td> </tr> <tr> <td><b>Total</b></td> <td></td> <td><b>=Shs79,000</b></td> </tr> </table> <p>∴Income tax =Shs79,000</p> <p>Net income = Gross -income tax</p> <p>                      = 950,000 – 79,000</p> <p>                      =Shs871,000</p>	Taxable income	Rate	Income tax	01-100,000	5	$\frac{5}{100} (100,000 - 0)$ =Shs5,000	100,001-300,000	7	$\frac{7}{100} (300,000 - 100,000)$ =Shs14,000	300,001-450,000	10	$\frac{10}{100} (450,000 - 300,000)$ =Shs15,000	450,001-600,000	14	$\frac{14}{100} (600,000 - 450,000)$ =Shs21,000	600,001-696,000	25	$\frac{25}{100} (696,000 - 600,000)$ =Shs24,000	<b>Total</b>		<b>=Shs79,000</b>		
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<b>Total</b>		<b>=Shs79,000</b>																						
		12																						
15	<p>(a) i) <b>QR</b> = <math>\frac{2}{3}</math> <b>QT</b></p>																							

	<p>but <math>QT = QO + OT</math></p> $= -q + \frac{1}{2}p$ $= \frac{1}{2}(p - 2q)$ $\therefore QR = \frac{2}{3} \times \frac{1}{2}(p - 2q) = \frac{1}{3}(p - 2q)$ <p>ii) <math>OR = OQ + QR</math></p> $= q + \frac{1}{3}(p - 2q)$ $= \frac{3q + p - 2q}{3}$ $= \frac{1}{3}(p + q)$ <p>iii) <math>QS = \frac{1}{2}QP</math></p> <p>but <math>QP = OP - OQ</math></p> $= p - q$ $\therefore QS = \frac{1}{2}(p - q)$ <p>iv) <math>TS = TQ + QS</math></p> $= -\frac{1}{2}(p - 2q) + \frac{1}{2}(p - q)$ $= \frac{-p + 2q + p - q}{2}$ $= \frac{1}{2}q$ <p>(b) <math>OS = OQ + QS</math></p> $= q + \frac{1}{2}(p - q)$ $= \frac{2q + p - q}{2}$ $= \frac{1}{2}(p + q)$		
--	---	--	--

	$\Rightarrow OS:OR = \frac{\frac{1}{2}(p+q)}{\frac{1}{3}(p+q)}$ $= \frac{1}{2} \times \frac{3}{2}$ $= 3/2$ <p><math>\therefore</math> Since <math>2OS = 3OR</math> and point O is common, then the points lie on a straight line.</p>		
		12	
16	<p>(a) <math>C = k_1 + \frac{k_2}{N}</math></p> <p>When <math>N = 200, C = \text{shs}850</math></p> $850 = k_1 + \frac{k_2}{200}$ $170,000 = 200k_1 + k_2 \dots\dots\dots(i)$ <p>When <math>N = 400, C = \text{shs}500</math></p> $500 = k_1 + \frac{k_2}{400}$ $200,000 = 400k_1 + k_2 \dots\dots\dots(ii)$ <p><math>(ii) - (i); 200k_1 = 30,000 \quad \therefore k_1 = 150</math></p> <p>From (i); <math>200(150) + k_2 = 170,000</math></p> $30,000 + k_2 = 170,000$ $k_2 = 170,000 - 30,000$ $k_2 = 140,000$ $\therefore C = 150 + \frac{140,000}{N}$ <p>(b) i) When <math>N = 560, C = ?</math></p> $C = 150 + \frac{140,000}{560}$ $= \text{shs}400$ <p>ii) When <math>C = \text{shs}950, N = ?</math></p>		

	$950 = 150 + \frac{140,000}{N}$ $800 = \frac{140,000}{N}$ $800N = 140,000$ $N = 175 \text{ copies}$		
		12	
17	<p>i) <b>VA</b></p>  $\overline{DB} = \sqrt{16^2 + 12^2}$ $= \sqrt{400}$ $= 20 \text{ cm}$  $\overline{VA} = \sqrt{24^2 + 10^2}$ $= \sqrt{676}$ $= 26 \text{ cm}$ <p>ii)</p>		



$$\tan \theta = \frac{24}{10}$$

$$\theta = \tan^{-1}\left(\frac{24}{10}\right)$$

$$\theta = 67.38^\circ$$

$$\sin \theta = \frac{24}{26}$$

$$\theta = \sin^{-1}\left(\frac{24}{26}\right)$$

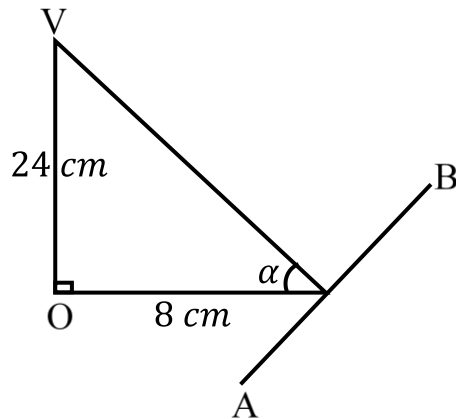
$$\theta = 67.38^\circ$$

$$\cos \theta = \frac{10}{26}$$

$$\theta = \cos^{-1}\left(\frac{10}{26}\right)$$

$$\theta = 67.38^\circ$$

iii)



$$\tan \alpha = \frac{24}{8}$$

$$\alpha = \tan^{-1}(3)$$

$$\alpha = 71.57^\circ$$

iv) volume =  $\frac{1}{3} \times \text{base area} \times \text{height}$

$$= \frac{1}{3} \times 16 \times 12 \times 24$$

$$= 1536 \text{ cm}^3$$