KITABI SEMINARY

MID TERM TWO EXAMINATIONS 2023

S.5 APPLIED MATHEMATICS

MTC TWO

Time: 3 Hours

Instructions:

Section **A** has **40** marks while section **B** has **60** marks

Attempt **all** questions in section **B**

Where necessary, take acceleration due to gravity as $9.8m/s^2$

Be neat in your working.

SECTION A

1. Forces $\begin{pmatrix}-3\\1\end{pmatrix}$N, $\begin{pmatrix}2\\9\end{pmatrix}$N, and $\begin{pmatrix}4\\-6\end{pmatrix}$N act on a body of mass 2kg. Find the magnitude of the acceleration.

2 (i) Use the trapezium rule with equal strips of width $\frac{\pi}{6}$ to find an approximate for $\int_0^{\pi} xsinxdx$. Give your answer to 4 s.f.

(ii) Comment on how you could obtain a better approximation to the value of the integral using the trapezium rule. (05 marks)

3. The table below shows variation of temperature of cooling water with time.

Time (s)	0	120	240	360	450	600
Temperature (°C)	100	80	75	69	54	46

Use linear interpolation or extrapolation to find the;

(i) Temperature of water after 300 seconds. (03 marks)

(ii) Time at which the temperature is $42°C$. (02 marks)

4.

Ranks							
Height	1	2	3	4	5	6	7
Mass	2	1	4	3	7	5	6

The heights and corresponding masses of 7 tourists were taken and ranked as shown. Calculate the spearman's rank correlation coefficient for the data. Comment on your results. (05 marks)

5. A body moving with a velocity of $[b\underset{\sim}{i} + (b+7)\underset{\sim}{j}]$m/s has a speed of 17m/s. Find the two possible values of b. (05 marks)

6. A particle is projected from a point on a horizontal plane and has an initial velocity $28\sqrt{3}$m/s at an angle of elevation of 60°. Find the greatest height reached by the particle and the time taken to reach this point. (05 marks)

7. The table below shows the time to the nearest second taken by 100 students to solve a problem.

Time (s)	30-49	50-64	65-69	70-74	75-79
No. of students	10	30	25	20	15

Calculate the variance of the distribution correct to 2dp. (05 marks)

8. A bag contains 4 green marble and 5 white marble. Two marbles are chosen at random one after the other without replacement. Find the probability of;

(i) Two marbles of different colours. (03 marks)

(ii) A white marble first followed by a green marble. (02 marks)

SECTION B.

9. The height (in cm) of a certain tree plantation were recorded as follows.

Height (cm)	120 – 124	125- 12	130 – 134	135 – 139	140 – 144	145 – 149	150 - 154
No. of trees	5	17	20	25	15	6	2

(a) Estimate the

(i) Mean height and

(ii) Standard deviation of trees. (06 marks)

(b) Plot a cumulative frequency curve (ogive). (03 marks)

(c) Use your graph in (b) above to estimate

(i) Median height (01 mark)

(ii) Middle 60% height range. (02 marks)

10. The numbers A and B are rounded off to a and b with errors Δa and Δb respectively.

(a) Show that the absolute relative error in the product ab is given by $\left|\frac{\Delta a}{a}\right| + \left|\frac{\Delta b}{b}\right|$. (05 marks)

(b) Given that A = 6.43 and B = 37.2 are rounded off to the given number of decimal places indicated.

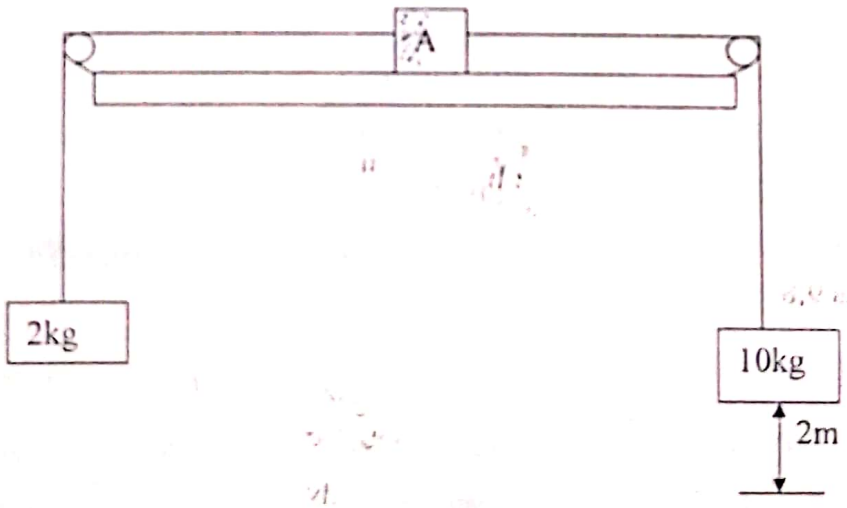
(i) State the maximum possible errors in A and B.

(ii) Determine the absolute error in AB.

(iii) Find the limits within which the product AB lies. Give your answer to 4d.p

(07 marks)

11. A body A of mass 27.2kg rests on a horizontal smooth table. Two bodies of mass 2kg and 10kg hanging freely are attached to A by strings which pass over smooth pulleys at the edges of the table. The two strings are taut. The system is then released form rest.



Calculate the;

(i) Acceleration, a of body A.

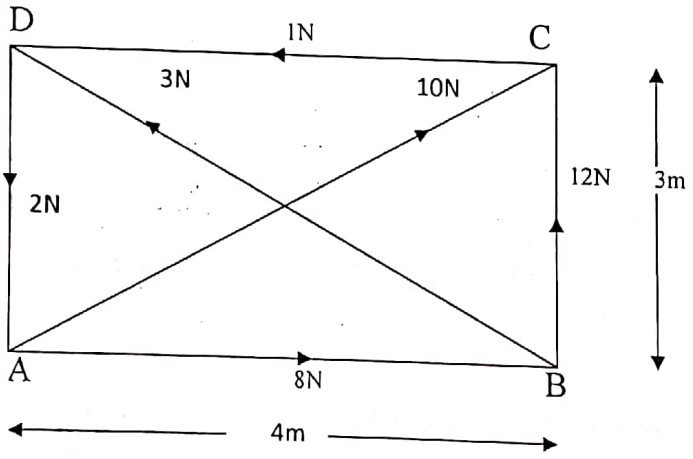
(ii) Tension in the strings

(iii) The velocity with which the 10kg mass hits the ground. (12 marks)

12(a) Forces of $(10\underset{\sim}{i} + 2\underset{\sim}{j})$N and $(a\underset{\sim}{i} + b\underset{\sim}{j})$N acting on a particular of mass 500g cause it to accelerate at $(24\underset{\sim}{i} + 3\underset{\sim}{j})$m/s^2. Find the constants a and b. (05 marks)

(b) A train of mass 100 tonnes, starts from rest at station A and accelerates uniformly at 1m/s^2 until it attain a speed of 30m/s. It maintains this speed for further 90s and the brakes are applied producing a resultant braking force of 50KN. If the train comes to rest at station B, find the distance between the two stations. (07 marks)

13(a) Find the magnitude and direction of resultant the following system of force on a rectangle ABCD.



(08mks)

(b) The resultant of force $(p\underset{\sim}{i} + \underset{\sim}{j})$ N, $(2q\underset{\sim}{i} + 3p\underset{\sim}{j})$ N and $(\underset{\sim}{i} + q\underset{\sim}{j})$ N is $-6\underset{\sim}{i}$. Find the values of P and q. (04 marks)

14(a) Use trapezium rule with 6 sub intervals to estimate the value of $\int_{0.5}^{1.0} \frac{x^2}{1+x^2} dx$. Correct to 4d.p. (06 marks)

(b) The kinetic energy of a body of mass m and velocity v, is given as $k = \frac{1}{2}mv^2$. Show that the maximum relative error in the kinetic energy of the body is $\left|\frac{\Delta m}{m}\right| + 2\left|\frac{\Delta v}{v}\right|$ where Δm and Δv are the errors in the mass m and velocity, v respectively of the body. (06 marks)

15. The table below shows the marks scored by 8 students in UNEB final examination and mock examinations.

UNEB	79	67	52	71	97	55	41	86
MOCK	75	60	45	55	85	43	30	70

(a)i) Draw a scatter diagram for the data.

(ii) On the same diagram, draw a line of the best fit.

(iii) Use the line of best fit to estimate the mark that a student who scored 68 in mock will score in UNEB.

(b) Calculate the spearman's rank correlation coefficient for the marks in mock and UNEB and comment on your result. (12 marks)

16(a) The length and width of a rectangle are measured as 4.5m and 2.4m with percentage errors of 5% and 2% respectively.

Determine the;

(i) Range within which its area lies.

(ii) Maximum possible error made in estimating its perimeter. (07 marks)

(b) Show that the equation $x^3 + 2x^2 - 4x - 4 = 0$ has three roots in the interval $x = -3$ and $x = 2$. Hence use linear interpolation once to find the positive root correct to 1d.p. (05 marks)

END

Tentative Guide.

No 1

$$R = \begin{pmatrix} -3 \\ 1 \end{pmatrix} + \begin{pmatrix} 2 \\ 9 \end{pmatrix} + \begin{pmatrix} 4 \\ -6 \end{pmatrix} = \begin{pmatrix} 3 \\ 4 \end{pmatrix} N \cdot M_1$$
$$\cdot M_1$$

$$|R| = \sqrt{3^2 + 4^2} = 5N \cdot B_1$$ (05)

$$a = \frac{|R|}{m} = \frac{5}{2} = 2.5 m/s^2 \cdot A_1$$

No 2

$$\int_0^{\pi} x \sin x \, dx \cdot ; \quad \text{width}, d = \frac{\pi}{6} \cdot M_1$$

x	$x \sin x$	
0	0.00000	
$\pi/6$		0.26180
$\pi/3$		0.90690
$\pi/2$		1.57080
$2\pi/3$		1.81380
$5\pi/6$		1.30900
π	0.00000	
	0.00000 B0	5.86230 B1

(05)

$$\int_0^{\pi} x \sin x \, dx \approx \frac{1}{2} \times \frac{\pi}{6} \left[0.00000 + 2(5.86230) \right].$$

$$\approx 3.069493102.$$

$$= 3.069 \ (4 s.f) \ A_1$$

By increasing the number of strips btn the interval $0 \le x \le \pi$. B1

No 3

Time (s)	240	300	360
θ (°C)	75	8	69

(i) $\frac{360-240}{69-75} = \frac{360-300}{69-8}$ My

$\frac{120}{-6} = \frac{60}{69-8}$ By

$120(69-8) = -36$.

$8280 - 120 = -36$.

$120 = 8280 + 36$.

$t = \frac{7785}{12} = 648.75$ s. $\frac{864}{12} = 72$ °C Ay

03

(ii)

Time (s)	450	600	t
θ (°C)	54	46	42

$\frac{t-600}{42-46} = \frac{600-450}{46-54}$ My

$\frac{t-600}{-4} \quad \frac{150}{-8}$,

$t - 600 = \frac{150}{8} \times 4$

$t = 600 + 75 = 675$ s. Ay

02

No 4.

R_h	R_m	$d = R_h - R_m$	d^2
1	2	-1	1
2	1	1	1
3	4	-1	1
4	3	1	1
5	7	-2	4
6	5	1	1
7	6	1	1 By
			$\Sigma d^2 = 10$

05

$\rho = 1 - \frac{6\Sigma d^2}{n(n^2-1)}$.

$= 1 - \frac{6 \times 10}{7(7^2-1)}$ My $1 - \frac{60}{336} = 0.821428571$

≈ 0.8214 Ay Comment: Very high positive correlation By

No 5.

Speed $\sqrt{b^2 + (b+7)^2} = 17$ M1

$b^2 + b^2 + 14b + 49 = 17^2$.

$2b^2 + 14b + 49 - 289 = 0$.

$2b^2 + 14b - 240 = 0$.

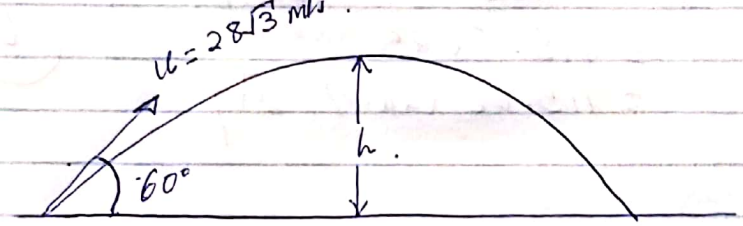
$b^2 + 7b - 120 = 0$ B1

$(b+15)(b-8) = 0$ M1

either $b = -15$ A1 or $b = 8$. A1

(05)

No 6.



Using $s_y = u_y t - \frac{1}{2} g t^2$.

$h = u \sin 60° t - \frac{1}{2} g t^2$ —①

$V_y = \frac{dh}{dt} = u \sin 60° - gt$.

at greatest height, $V_y = 0$.

$\Rightarrow u \sin 60° - gt = 0$.

$t = \frac{u \sin 60°}{g} = \frac{28\sqrt{3} \times \sin 60°}{9.8}$

$t = \frac{28\sqrt{3} \times \sqrt{3}}{98 \times 2} = 4.2857$ s. or $\frac{30}{7}$ s.

Sub t in ①.

$h = 28\sqrt{3} \sin 60° \times 4.2857 - \frac{1}{2} \times 9.8 \times 4.2857^2$

$= 14 \times 3 \times 4.287 - 4.9 \times 4.2857^2$

$= 90$m

OR

Using $V_y^2 = u_y^2 - 2gh$.

$0 = (28\sqrt{3} \sin 60°)^2 - 2 \times 9.8 \times h$ M1

$h = 90$m A1

Using $s_y = u_y t - \frac{1}{2} g t^2$.

$90 = 28\sqrt{3} \sin 60° t - \frac{1}{2} \times 9.8 t^2$ M1

$4.9t^2 - 42t + 90 = 0$ B1

$t = \frac{30}{7}$ s A1

(05)

No 7.

Time (t)	f	x	fx	fx^2
30–49	10	39.5	395	15,602.5
50–64	30	57	1,710	97,470
65–69	25	67	1,675	112,225
70–74	20	72	1,440	103,680
75–79	15	77	1,155	88,935
	$\Sigma f = 100$	B1	$\Sigma fx = 6375$ B1	$\Sigma fx^2 = 417,912.5$ B1

$$\text{Variance} = \frac{\Sigma fx^2}{\Sigma f} - \left(\frac{\Sigma fx}{\Sigma f}\right)^2$$

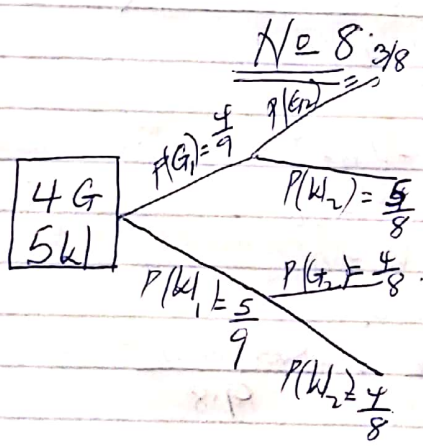
$$= \frac{417912.5}{100} - \left(\frac{6375}{100}\right)^2 \text{ M1}$$

$$= 115.0625$$

$$\approx 115.06 \text{ (2 d.p)}. \text{ A1}$$

05

No 8.



(i) P(Two marbles of different colours) = $P(G_1 W_2) + P(W_1 G_2)$

$$= \frac{4}{9} \times \frac{5}{8} + \frac{5}{9} \times \frac{4}{8} \text{ M1 B1}$$

$$= \frac{20}{72} \times \frac{1}{2}$$

$$= \frac{5}{9} \text{ A1}$$

03

(ii) P(a white marble followed by a green marble).

$$= P(W_1, G_2).$$

$$= \frac{5}{9} \times \frac{4}{8} \text{ M1} = \frac{5}{18} \text{ A1}$$

02

No 9.

Height (cm)	f	x	fx	fx^2	c.f	c.b
120 - 124	5	122	610	74420	5	119.5 - 124.5
125 - 129	17	127	2159	274193	22	124.5 - 129.5
130 - 134	20	132	2640	348480	42	129.5 - 134.5
135 - 139	25	137	3425	469225	67	134.5 - 139.5
140 - 144	15	142	2130	302460	82	139.5 - 144.5
145 - 149	6	147	882	129654	88	144.5 - 149.5
150 - 154	2	152	304	46208	90	149.5 - 154.5
Sum	$\Sigma f = 90$		$\Sigma fx = 12150$	$\Sigma fx^2 = 1644640$		

B1 B1

(a) Mean $\bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{12150}{90}$ my

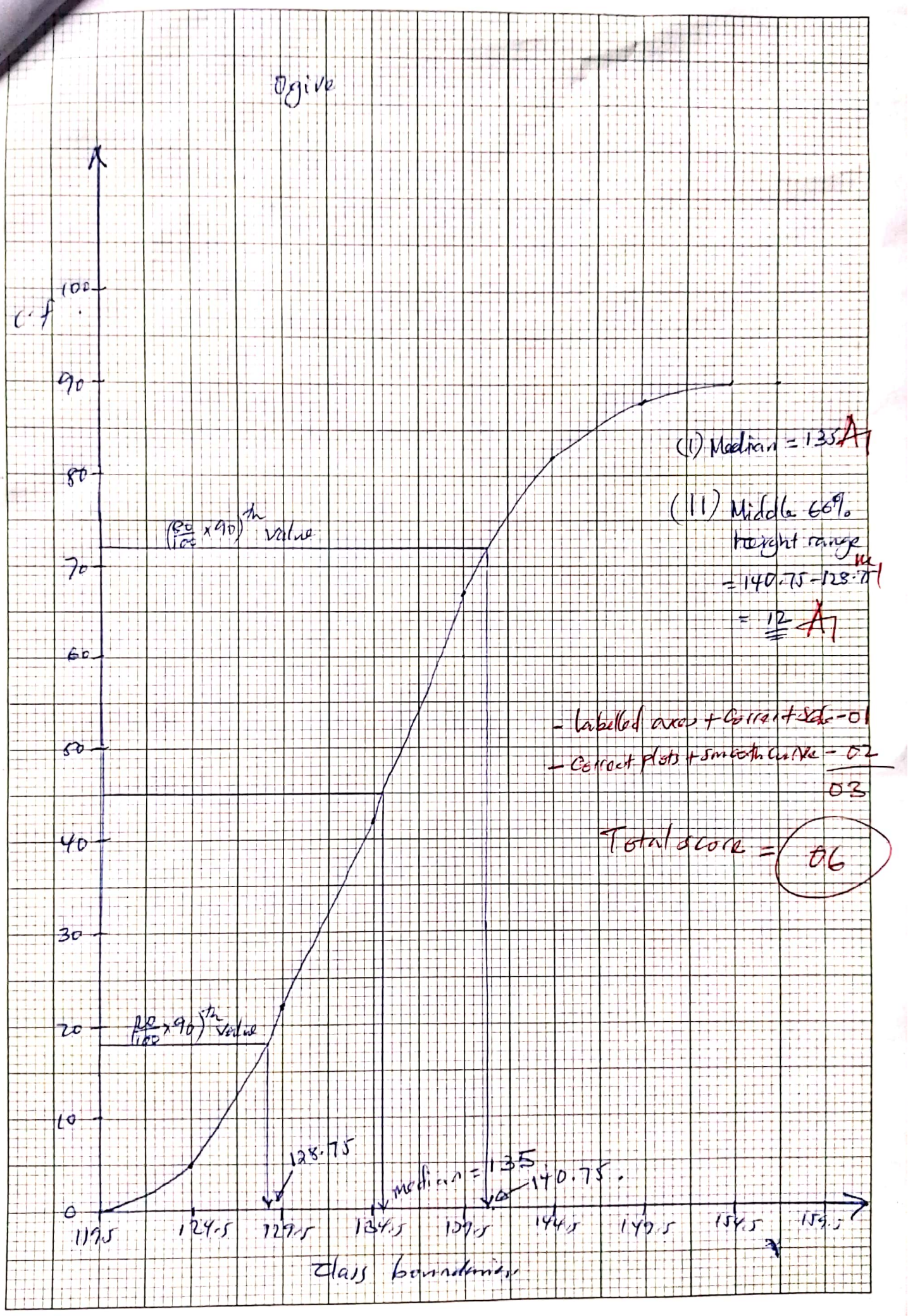
$= 135$ cm A1

06

(ii) $\sigma = \sqrt{\frac{\Sigma fx^2}{\Sigma f} - \bar{x}^2} = \sqrt{\frac{1644640}{90} - 135^2}$ my

$= 6.9841$ cm A1

(b) on graph paper.



(i) Median = 135 A1

(ii) Middle 66% height range
= 140.75 - 128.75 M1
= 12 A1

- Labelled axes + Correct Scale - 01
- Correct plots + Smooth Curve - 02

03

Total score = 06

N:10.

(a)

$AB = (a+\Delta a)(b+\Delta b)$. M_1

$= ab + b\Delta a + a\Delta b + \Delta a\Delta b$.

$AB - ab = b\Delta a + a\Delta b + \Delta a\Delta b$.

but Δa and Δb are very small, hence $\Delta a\Delta b \approx 0$ B_1

$\Rightarrow AB - ab \approx b\Delta a + a\Delta b$.

$|\Delta_{ab}| = |b\Delta a + a\Delta b|$ M_1

$|\Delta_{ab}| \leq b|\Delta a| + a|\Delta b|$ B_1

$\left|\frac{\Delta ab}{ab}\right|_{max} = \frac{b|\Delta a|}{ab} + \frac{a|\Delta b|}{ab}$

$\left|\frac{\Delta ab}{ab}\right|_{max} = \frac{|\Delta a|}{a} + \frac{|\Delta b|}{b}$

$\left|\frac{\Delta ab}{ab}\right|_{max} = \left|\frac{\Delta a}{a}\right| + \left|\frac{\Delta b}{b}\right|$ A_1

05

(b) $A = 6.43$, $B = 37.2$

(i) $|\Delta A|_{max} = 0.005$ A_1, $|\Delta B|_{max} = 0.05$. A_1

(ii) Absolute error in $AB = B|\Delta A| + A|\Delta B|$.

$= 37.2 \times 0.005 + 6.43 \times 0.05$ M_1

$= 0.5075$ A_1

(iii) Working value, $AB = 6.43 \times 37.2$.

$= 239.196$ B_1

$AB_{max} = 239.196 + 0.5075$.

$= 239.7035$. A_1

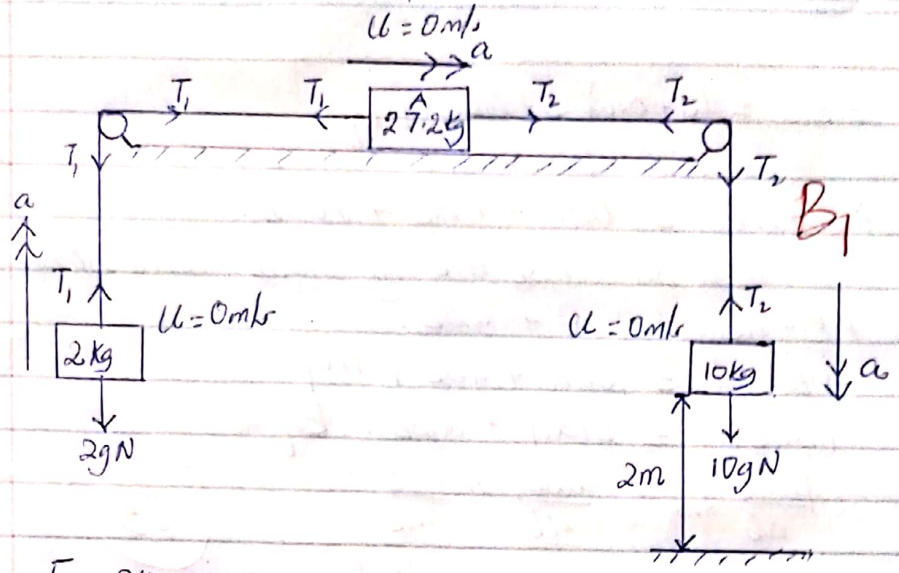
$AB_{min} = 239.196 - 0.5075$

$= 238.6885$ A_1

limits $= [238.6885, 239.7035]$.

07

No 11.



For 2kg mass

$T_1 - 2g = 2a$ — (i) my

For 27.2kg mass,

$T_2 - T_1 = 27.2a$ — (ii) my

For 10kg mass,

$10g - T_2 = 10a$ — (iii) my

adding (i) + (ii) + (iii)

$$\begin{array}{l} T_1 - 2g = 2a \\ + \quad T_2 - T_1 = 27.2a \\ \quad 10g - T_2 = 10a \end{array}$$ my

$10g - 2g = 39.2a$.

$a = \frac{8g}{39.2} = \frac{8 \times 9.8}{39.2}$

$a = 2 m/s^2$ A1

(ii) Sub a in (i),

$T_1 = 2 \times 2 + 2 \times 9.8 = 23.6 N$ my A1

sub a in (iii),

$T_2 = 10g - 10 \times 2$ my

$= 10 \times 9.8 - 10 \times 2$

$T_2 = 78 N$. A1

(iii) $u = 0 m/s$, $s = 2m$, $v = ?$, $a = 9.8 m/s$.

using $v^2 = u^2 + 2as$.

$v = \sqrt{2 \times 2 \times 2}$ my

$= \sqrt{8} m/s$.

$= 2.8284 m/s$ A1

12

N=12

(a) Net force = ma

$\begin{pmatrix}10\\2\end{pmatrix} + \begin{pmatrix}a\\b\end{pmatrix} = \frac{500}{1000} \times \begin{pmatrix}24\\3\end{pmatrix}$ M1

$\Rightarrow 10 + a = 12$ — (i) M1

$a = 12 - 10$

$= 2$ A1

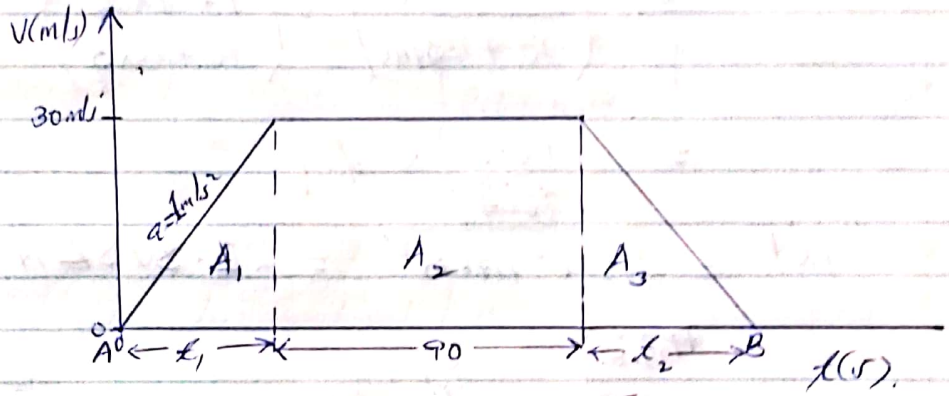
Also $2 + b = 1.5$ — (ii) M1

$b = 1.5 - 2$

$= -0.5$ A1

05

(b)



For t_1,

using $V = u + at$.

$30 = 0 + 1 \times t_1$ M1

$t_1 = 30s$ A1

For t_2,

using $V = u + at$.

$0 = 30 - \frac{f}{m} t_2$ MA

$30 = \frac{50 \times 1000}{100,000} \times t_2$ M1

$t_2 = 30 \times 2$

$t_2 = 60s$ A1

Total distance = Area(A1 + A2 + A3).

$= \frac{1}{2}bh + l \times w \times h + \frac{1}{2}bh$.

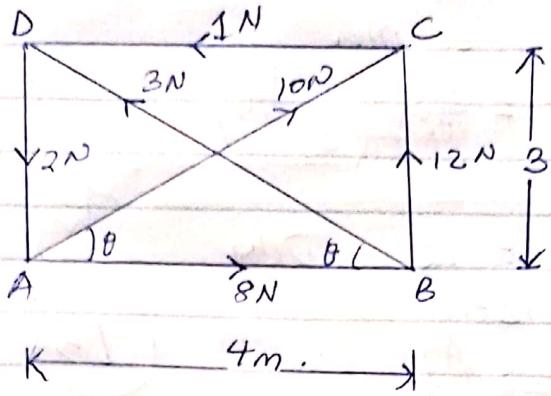
$= \frac{1}{2} \times 30 \times 30 + 90 \times 30 + \frac{1}{2} \times 60 \times 30$ M1 B1

$= 450 + 2700 + 900$ BA

$= 4050m$ A1

07

No 13.



$\overline{AC} = \sqrt{4^2+3^2}$

$= 5m.$

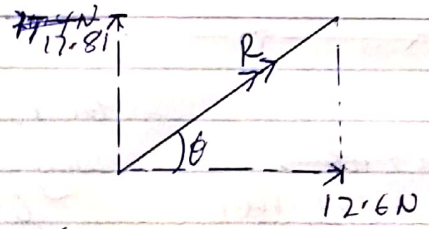
$\sin\theta = \frac{3}{5}$, $\cos\theta = \frac{4}{5}$.

Resultant force, $R = \begin{pmatrix}8\\0\end{pmatrix} + \begin{pmatrix}0\\12\end{pmatrix} + \begin{pmatrix}-1\\0\end{pmatrix} + \begin{pmatrix}0\\-2\end{pmatrix} + \begin{pmatrix}10\cos\theta\\10\sin\theta\end{pmatrix} + \begin{pmatrix}-3\cos\theta\\3\sin\theta\end{pmatrix}$ M1

$= \begin{pmatrix}7+7\cos\theta\\10+13\sin\theta\end{pmatrix} = \begin{pmatrix}7+7\times\frac{4}{5}\\10+13\times\frac{3}{5}\end{pmatrix}$

$= \begin{pmatrix}12.6\\17.8\end{pmatrix}$ N A1

$|R| = \sqrt{12.6^2+17.8^2} = 21.8088$ N A1



$\theta = \tan^{-1}\left(\frac{17.81}{12.6}\right) = 54.7^\circ$ A1

The resultant has magnitude 23.9775 N and acts at angle 58.3° above x-axis

(b) $\begin{pmatrix}p\\1\end{pmatrix} + \begin{pmatrix}2q\\3p\end{pmatrix} + \begin{pmatrix}1\\q\end{pmatrix} = \begin{pmatrix}-6\\0\end{pmatrix}$ M1

05

$\Rightarrow p + 2q + 1 = -6.$

$p + 2q = -7$ — (i) M1

Also

$1 + 3p + q = 0.$

$3p + q = -1$ — (ii) M1

$3\times(1) - (ii)$

$3p + 6q = -21$

$-\ 3p + q = -1$

$5q = -20$

$\Rightarrow q = -4$ A1

sub q in (i),

$p + 2(-4) = -7.$

$p = -7 + 8.$

$p = 1$ A1

$\therefore p = 1$ and $q = -4$ A1

N°14.

(a) $\int_{0.5}^{1.0} \frac{x^2}{1+x^2}\,dx$.

$d = \frac{1.0 - 0.5}{6}$

$= \frac{1}{12}$ B_1

x	$x^2/1+x^2$	
0.5	0.20000	
7/12		0.43523
2/3		0.46154
3/4		0.48000
5/6		0.49180
11/12		0.04528
1	0.50000	
sum	0.70000 B_1	1.91385 B_1

06

$\int_{0.5}^{1.0} \frac{x^2}{1+x^2}\,dx \approx \frac{1}{2} \times \frac{1}{12}\left[0.70000 + 2(1.91385)\right]$ M_1

$= 0.18865416$ B_1

≈ 0.1887 (4dp). A_1

(b) $K = \frac{1}{2}mV^2$.

$K + \Delta K = \frac{1}{2}(m+\Delta m)(V+\Delta V)^2$ M_1

$= \frac{1}{2}(m+\Delta m)(V^2 + 2V\Delta V + (\Delta V)^2)$

Since ΔV is very small, $(\Delta V)^2 \approx 0$ B_1

$\Rightarrow K + \Delta K \approx \frac{1}{2}(m+\Delta m)(V^2 + 2V\Delta V)$. B_1

$= \frac{1}{2}(mV^2 + 2mV\Delta V + V^2\Delta m + 2\Delta m\Delta V.V)$.

Since ΔV and Δm are very small, then $\Delta m\Delta V \approx 0$:

$\Rightarrow K + \Delta K \approx \frac{1}{2}(mV^2 + 2mV\Delta V + V^2\Delta m)$ B_1

$K + \Delta K = \frac{1}{2}mV^2 + \frac{2}{2}mV\Delta V + \frac{1}{2}V^2\Delta m$.

$\Delta K = \frac{1}{2}(2mV\Delta V + V^2\Delta m)$.

$\frac{\Delta K}{K} = \frac{\frac{1}{2}(2mV\Delta V + V^2\Delta m)}{\frac{1}{2}mV^2} = 2\frac{\Delta V}{V} + \frac{\Delta m}{m}$.

$$\left|\frac{\Delta K}{K}\right| = \left|2\frac{\Delta V}{V} + \frac{\Delta m}{m}\right| \text{ my}$$

$$\leq 2\left|\frac{\Delta V}{V}\right| + \left|\frac{\Delta m}{m}\right| \text{ my}$$

(06)

$$\left|\frac{\Delta K}{K}\right|_{max} = 2\left|\frac{\Delta V}{V}\right| + \left|\frac{\Delta m}{m}\right| \text{ Ans}$$

No 15.

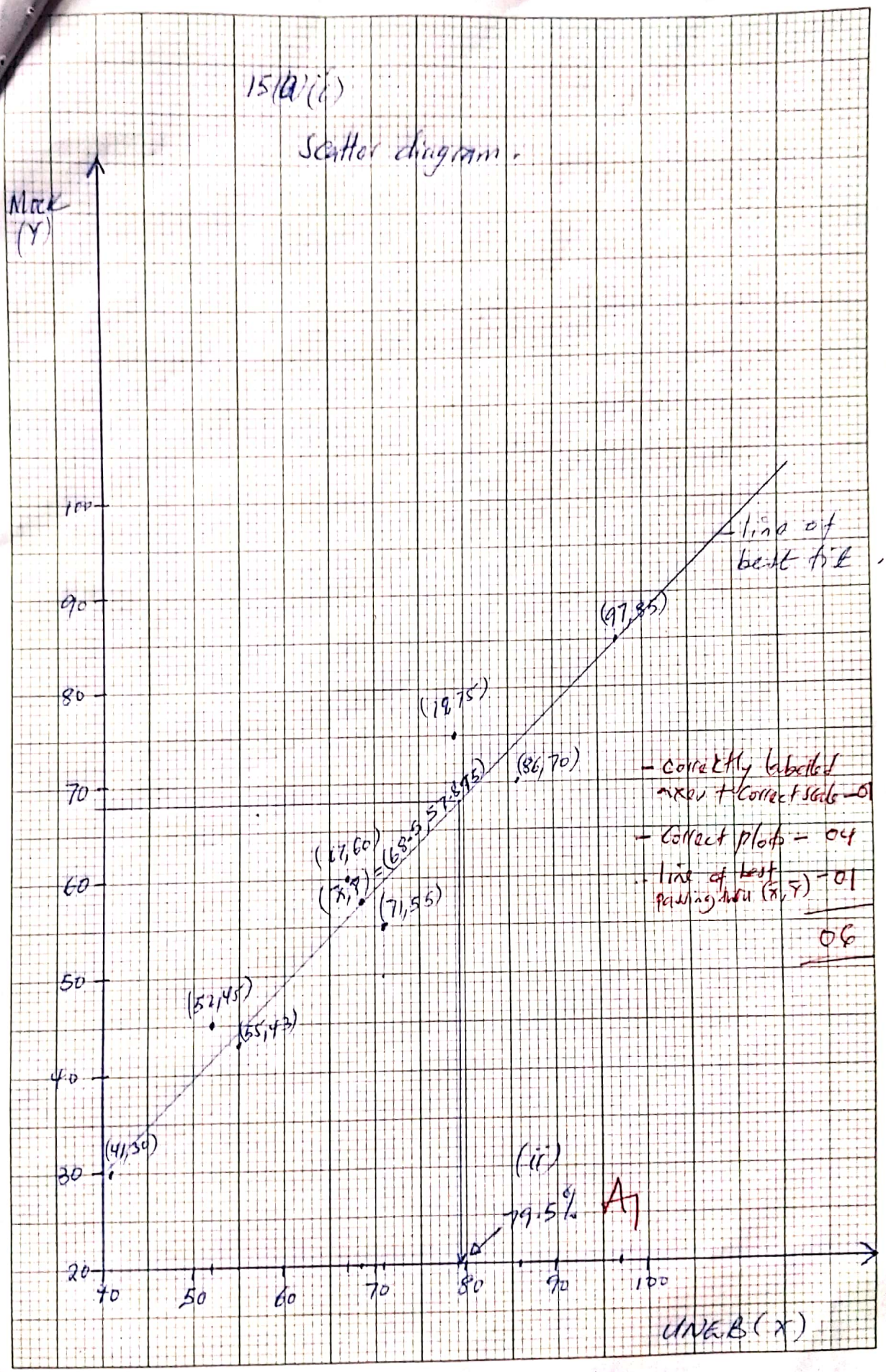
$$\begin{pmatrix}\bar{x}\\ \bar{y}\end{pmatrix} = \frac{1}{8}\left[\begin{pmatrix}79+67+52+71+97+55+41+86\\ 75+60+45+55+85+43+30+70\end{pmatrix}\right].$$

$$= \frac{1}{8}\begin{bmatrix}548\\ 463\end{bmatrix}.$$

$$\begin{pmatrix}\bar{x}\\ \bar{y}\end{pmatrix} = \begin{pmatrix}68.5\\ 57.875\end{pmatrix}$$

15(a)(i)

Scatter diagram.



- correctly labelled axes + correct scale - 01
- correct plots - 04
- line of best fit passing thru $(\bar{x}, \bar{y})$ - 01

06

R_u	R_m	d	d^2
3	2	1	1
5	4	1	1
7	6	1	1
4	5	-1	1
1	1	0	0
6	7	-1	1
8	8	0	0
2	3	-1	1
			$\Sigma d^2 = 6$

06

$$\rho = 1 - \frac{6\Sigma d^2}{n(n^2-1)}$$

$$= 1 - \frac{6 \times 6}{8(8^2-1)}$$

$$= 0.92857.$$

Very high positive rank correlation between the scores in mock and UNEB examinations.

No 16

(a) $l = 4.5m$, $W = 2.4m$.

(i) $\frac{\Delta l}{l} \times 100 = 5$. $\frac{\Delta W}{W} \times 100 = 2$

$\Delta l = 0.05 \times 4.5$ $\Delta W = 0.02 \times 2.4$

$= 0.225m$ B1 $= 0.048m$ B1

Area $= l \times W$.

Working value of area $= 4.5 \times 2.4$

$= 10.8m^2$.

Error in area $= l|\Delta W| + W|\Delta l|$

$= 4.5 \times 0.048 + 2.4 \times 0.225$.

$= 0.756m^2$

Range = Working value $\pm$ error. (07)

$= 10.8 \pm 0.756$ M1

$= 10.8 + 0.756, 10.8 - 0.756$

$= [11.5560, 10.0440]$ A1 A1

(ii) Perimeter, $P = 2(l + W)$.

error in perimeter $\Delta P = 2(\Delta l + \Delta W)$.

$|\Delta P|_{max} = 2(|\Delta l| + |\Delta W|)$

$= 2 \times (0.225 + 0.048)$ M1

$= 0.546m$. A1

(b) x lies $f(x) = x^3 + 2x^2 - 4x - 4 = 0$.

x	-3	-2	-1	0	1	2
$f(x)$	-1	4	1	-4	-5	4

M1 M1 A1

There is a change of sign in the ranges $(-3,-2)$, $(-1,0)$ and $(1,2)$ hence a roots exists in each of these ranges B1

x	1	x_0	2
$f(x)$	-5	0	4

(05)

$\frac{2-1}{4--5} = \frac{x_0 - 1}{0--5}$ M1

$\frac{1}{9} = \frac{x_0 - 1}{5}$

$x_0 - 1 = \frac{5}{9}$

$x_0 \approx 1.5556$. $x_0 = 1.6$ (1 d.p). A1