P425/2
APPLIED MATHEMATICS
Paper 2
Nov./Dec. 2024
3 hours

UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

APPLIED MATHEMATICS

Paper 2

3 hours

INSTRUCTIONS TO CANDIDATES:

This paper consists of **two** *Sections;* **A** *and* **B**.

Section **A** *is* **compulsory**.

Answer only **five** *questions from Section* **B**.

Any additional question(s) answered will **not** *be marked.*

All *necessary working* **must** *be shown clearly.*

Begin each answer on a fresh page.

Graph paper is provided.

Silent, non-programmable scientific calculators and mathematical tables with a list of formulae may be used.

In numerical work, take acceleration due to gravity g, to be 9.8 ms^{-2}.

SECTION A (40 MARKS)

Answer **all** *the questions in this section.*

1. Two events A and B are such that $P(A) = 0.4$, $P(B) = 0.7$ and $P(A \cap B) = 0.35$. Find $P(A'/B')$. *(05 marks)*

2. The resultant of two forces P and Q is a force of 15 N acting at an angle of 50° to force Q. Given that the magnitude of force Q is 12 N, determine the magnitude and direction of the force P. *(05 marks)*

3. The table below shows the velocity V at any instant t seconds of a particle moving in a straight line.

t (s)	0	1	2	3	4
V (ms^{-1})	0	2	7	8	10

Calculate;

(a) the velocity of the particle after 1.5 seconds. *(03 marks)*

(b) the time when the velocity is 13 ms^{-1}. *(02 marks)*

4. The table below shows the unit prices (Shs) and quantities of food items in the years 2005 and 2010.

FOOD ITEM	**QUANTITY**	**PRICE (SHS)**	
		2005	**2010**
Sugar	25 kg	2500	3500
Meat	10 kg	5000	7000
Beans	50 kg	1500	2000
Fish	5 pieces	5000	8000
Maize flour	50 kg	800	1200

(a) Calculate the weighted price index of 2010 using 2005 as the base year. *(04 marks)*

(b) Comment on your result. *(01 mark)*

5. A force $\boldsymbol{F}$ (N) is acting on a particle of mass 4 kg whose position vector at any time t is $\boldsymbol{r} = (t^3\boldsymbol{i} + \sin t\boldsymbol{j})$ m. Find $\boldsymbol{F}$ when $t = \frac{\pi}{3}$ (s). *(05 marks)*

6. A metallic container is in form of a cuboid. Its dimensions are 2.7 m, 4.80 m and 3.281 m correct to the given number of decimal places. Determine the possible minimum and maximum volumes of the container correct to **three** decimal places. *(05 marks)*

7. A discrete random variable X, has a probability function given by

$$P(X = x) = \begin{cases} \frac{1}{10}x; & 1, 2, \ldots, n \\ 0, & \text{elsewhere.} \end{cases}$$

Given that $E(X) = 3$, find the value of n. *(05 marks)*

8. A boy can swim in still water at a speed of 2.5 ms^{-1}. The boy wishes to cross a straight river which is 50 m wide and flowing at a speed of 3 ms^{-1}. He sets off at an angle of 60 ° to the bank of the river.

Determine;

(a) the time it takes him to cross the river. *(03 marks)*

(b) the boy's resultant velocity. *(02 marks)*

SECTION B (60 MARKS)

Answer any **five** *questions from this section.*
All *questions carry equal marks.*

9. The table below shows the distribution of time (minutes) spent by students revising for a test.

Time , T (minutes)	**Frequency**
$0 \le T < 10$	20
$10 \le T < 15$	18
$15 \le T < 30$	60
$30 \le T < 45$	45
$45 \le T < 55$	50
$55 \le T < 60$	30
$60 \le T < 80$	60
$80 \le T < 90$	10

(a) Calculate the mean revision time. *(05 marks)*

(b) (i) Draw a histogram for the data.
(ii) Use your histogram to estimate the modal revision time. *(07 marks)*

Turn Over

10. (a) A ball was thrown with a velocity of 15 ms^{-1} vertically upwards from the ground. A girl on a balcony of a building 9 metres high, leaned and caught the ball on its way down.

(i) Calculate the time taken before the ball is caught by the girl. *(04 marks)*

(ii) Find the speed with which the ball was travelling when it was caught. *(03 marks)*

(b) A particle travels with an initial velocity of $(11\boldsymbol{i} - 8\boldsymbol{j} + 3\boldsymbol{k})$ ms^{-1} from a point with a position vector of $(-2\boldsymbol{i} + \boldsymbol{j})$ m. The particle moves with an acceleration of $\frac{1}{5}(2\boldsymbol{i} + 3\boldsymbol{j} - 4\boldsymbol{k})$ ms^{-2}.

Determine;

(i) the position vector of the particle after 5 seconds. *(03 marks)*

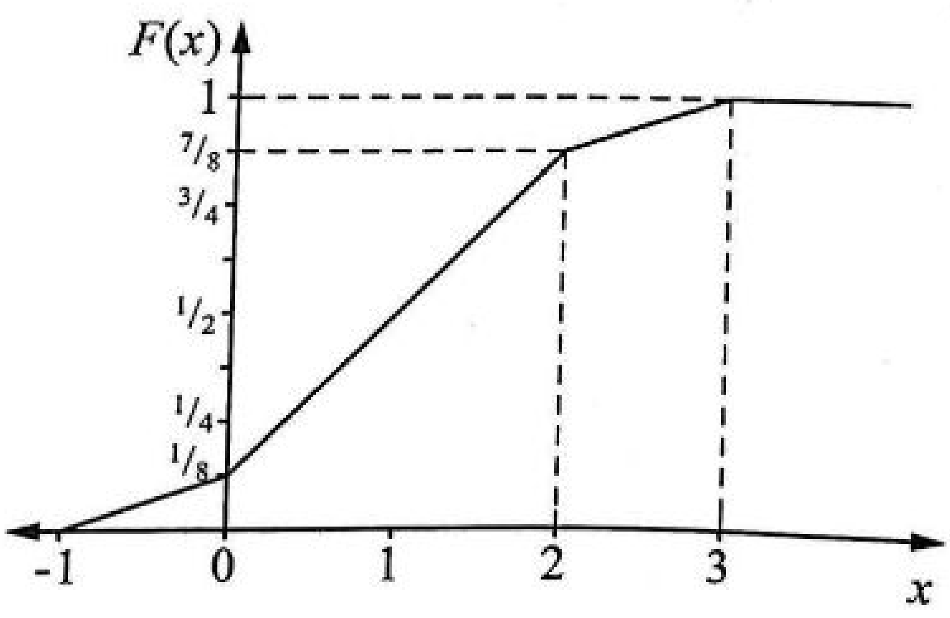
(ii) the distance covered in the 5 seconds. *(02 marks)*

11. (a) Using the trapezium rule with **six** ordinates, estimate $\int_0^1 xe^{(x^2+1)}\,dx$ giving your answer correct to **three** decimal places. *(07 marks)*

(b) Given that $\int_0^1 xe^{(x^2+1)}\,dx = 2.335$, find the percentage error for the estimate in (a). *(03 marks)*

(c) Suggest how the accuracy in (a) can be improved. *(02 marks)*

12. The cumulative distribution function $F(x)$ of a continuous random variable X is represented graphically as shown below.



Find:

(a) (i) $F(x)$. *(05 marks)*

(ii) $P(1 < X < 2.5)$. *(02 marks)*

(b) (i) the probability density function (pdf) $f(x)$. *(02 marks)*

(ii) $E(X)$. *(03 marks)*

13. A light inelastic string of length 80 cm is fixed at one end R and carries a particle of mass 0.1 kg at the other end S. The particle moves in a horizontal circle with angular speed 5 rads^{-1}. Determine;

(a) the tension in the string. *(08 marks)*

(b) the radius of the horizontal circle. *(04 marks)*

14. (a) Use the graphical method to estimate the root of the equation $2x^3 - 4x + 3 = 0$ in the interval $-2 \leq x \leq -1$. *(06 marks)*

(b) Using the Newton Raphson method, find the root of the equation $2x^3 - 4x + 3 = 0$ taking the approximate root obtained in (a) as the initial value of x_0. Give your answer correct to **three** decimal places. *(06 marks)*

15. An examination consists of 120 multiple choice questions. Each question has four options for which there is only one correct option.

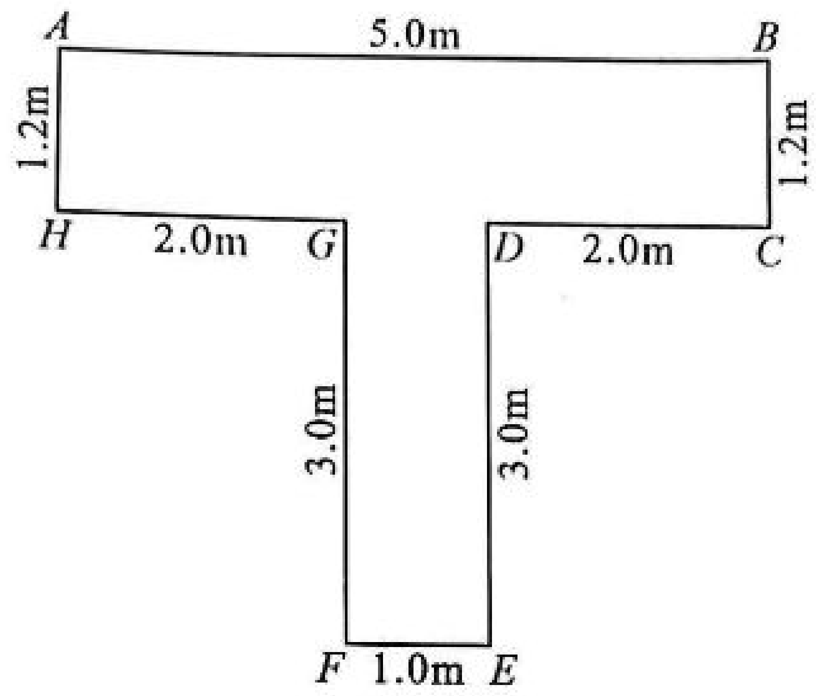
(a) If a candidate who sat for the examination is chosen at random, find the probability that the candidate obtained;

(i) between 20 and 40 (inclusive) correct options.

(ii) exactly 41 correct options. *(07 marks)*

(b) Determine the pass mark for 80 % of the candidates to pass the examination. *(05 marks)*

16. The diagram below shows a uniform lamina $ABCDEFGH$.



(a) Determine the distances of the centre of gravity of the lamina from the sides AB and AH. *(09 marks)*

(b) If the lamina is suspended from the vertex A and rests in equilibrium, calculate the angle which the side AB makes with the vertical. *(03 marks)*

END

UACE 2024 APPLIED MATHS P425/2 GUIDE
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SECTION A (40 marks)

Qn 1

$$P(A'/B') = \frac{P(A' \cap B')}{P(B')}$$

$$= \frac{1-P(A\cup B)}{1-P(B)}$$

$$P(A\cup B)' = 1 - P(A\cup B)$$

$$= 1 - \left(P(A)+P(B)-P(A\cap B)\right)$$

$$= 1 - \left((0.4+0.7) - 0.35\right)$$

$$= 1 - 0.75$$

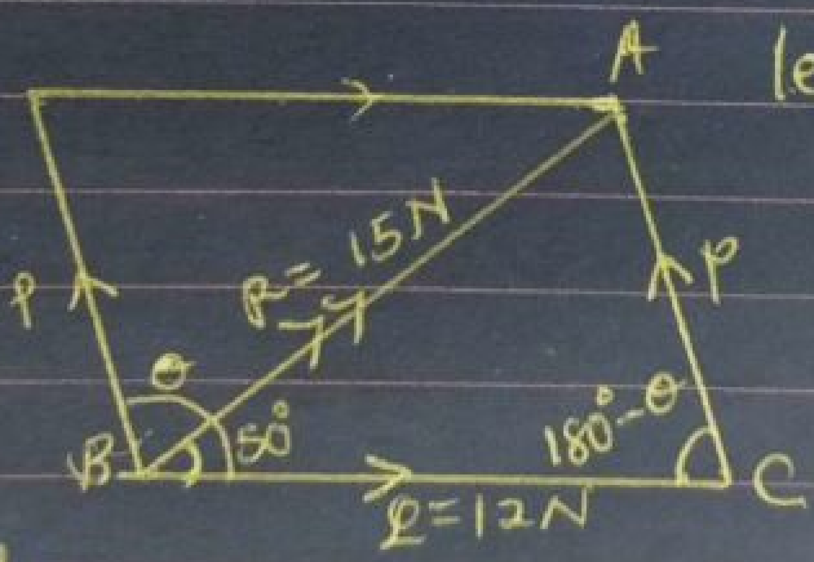
$$P(A\cup B)' = 0.25$$

$$\therefore P(A'/B') = \frac{0.25}{1-0.7}$$

$$= \frac{0.25}{0.3}$$

$$\therefore P(A'/B') = \underline{\underline{5/6}}$$

Qn 2



let θ be angle between force P and Q

considering triangle ABC
From cosine rule,

$$P^2 = 12^2 + 15^2 - 2(12)(15)\cos 50^\circ$$

$$\underline{P = 11.7302\,N}$$

from sine rule,

$$\frac{11.7302}{\sin 50^\circ} = \frac{15}{\sin(180^\circ-\theta)}$$

$$\sin(180^\circ-\theta) = \frac{15\sin 50^\circ}{11.7302}$$

$$180^\circ - \theta = 78.40^\circ$$

$$\underline{\underline{\theta = 101.6^\circ}}$$

$\therefore$ Force P is 11.7302N at an angle of 101.6° to the 12N force

Qn 3

(a) Let v_1 be the velocity after 1.5s

t(s)	1	1.5	2
$v(ms^{-1})$	2	v_1	7

$$\frac{7-2}{2-1} = \frac{v_1-2}{1.5-1}$$

$$\frac{5}{1} = \frac{v_1-2}{0.5}$$

$$v_1 = (0.5 \times 5) + 2$$

$$v_1 = 4.5\,ms^{-1}$$

(b) Let t_1 be time taken.

t(s)	3	4	t_1
$v(ms^{-1})$	8	10	13

$$\frac{13-8}{t_1-3} = \frac{10-8}{4-3}$$

$$\frac{5}{t_1-3} = \frac{2}{1}$$

$$t_1 = \left(\frac{5}{2}\right) + 3$$

$$t_1 = 5.5 \text{ Seconds.}$$

Qn 4 (a)

Food item	Quantity	P_0	$P_0 q$	P_1	$P_1 q$
Sugar	25kg	2500	62500	3500	87500
Meat	10kg	5000	50000	7000	70000
Beans	50kg	1500	75000	2000	100000
Fish	5pieces	5000	25000	8000	40000
Maize flour	50kg	800	40000	1200	60000
Total			252,500		357,500

$$\text{Weighted Price index (WAPI)} = \frac{\sum P_1 q}{\sum P_0 q} \times 100$$

$$= \frac{357500}{252500} \times 100$$

$$= 141.5842.$$

(b) The prices of the items increased by 41.5842% in 2010.

Qn 5. $r = t^3 i + \sin t j$

$\frac{dr}{dt} = 3t^2 i + \cos t j$

$\frac{d^2r}{dt^2} = 6t i - \sin t j$

$\frac{d^2r}{dt^2}$ = acceleration

$F = ma$

$F = 4(6t i - \sin t j)$

$F = (24t i - 4\sin t j)$ N

At $t = \frac{\pi}{3}$ s

$F = \frac{24\pi}{3} i - 4\sin\left(\frac{\pi}{3}\right) j$

$F = 8\pi i - 4\frac{\sqrt{3}}{2} j$

$F = (8\pi i - 2\sqrt{3} j)$ N

Qn 6 $L = 4.80$ m, $W = 2.7$ m, $H = 3.281$ m

$e_L = 0.005$ $e_W = 0.05$ $e_H = 0.0005$

Volume $= L \times W \times H$

$V_{minimum} = L_{min} \times W_{min} \times H_{min}$

$V_{min} = (4.80 - 0.005) \times (2.7 - 0.05) \times (3.281 - 0.0005)\ m^3$

$V_{min} = 4.795\ m \times 2.65\ m \times 3.2805\ m$

$V_{min} = 41.684\ m^3$

$V_{maximum} = L_{max} \times W_{max} \times H_{max}$

$V_{max} = (4.80 + 0.005)(2.7 + 0.05)(3.281 + 0.0005)\ m^3$

$V_{max} = 4.805 \times 2.75 \times 3.2815\ m^3$

$V_{max} = 43.361\ m^3$

Qn 7 $\sum_{all\,x} p(X=x) = 1$

$\frac{1}{10} + \frac{2}{10} + \dots + \frac{n}{10} = 1$

$1 + 2 + \dots + n = 10$

$\frac{n}{2}(n+1) = 10$

$n^2 + n = 20$

$n^2 + n - 20 = 0$

$n = \frac{-1 \pm \sqrt{1^2 - 2(1)(-20}}{2 \times 1}$

$n = \frac{-1 \pm \sqrt{81}}{2}$

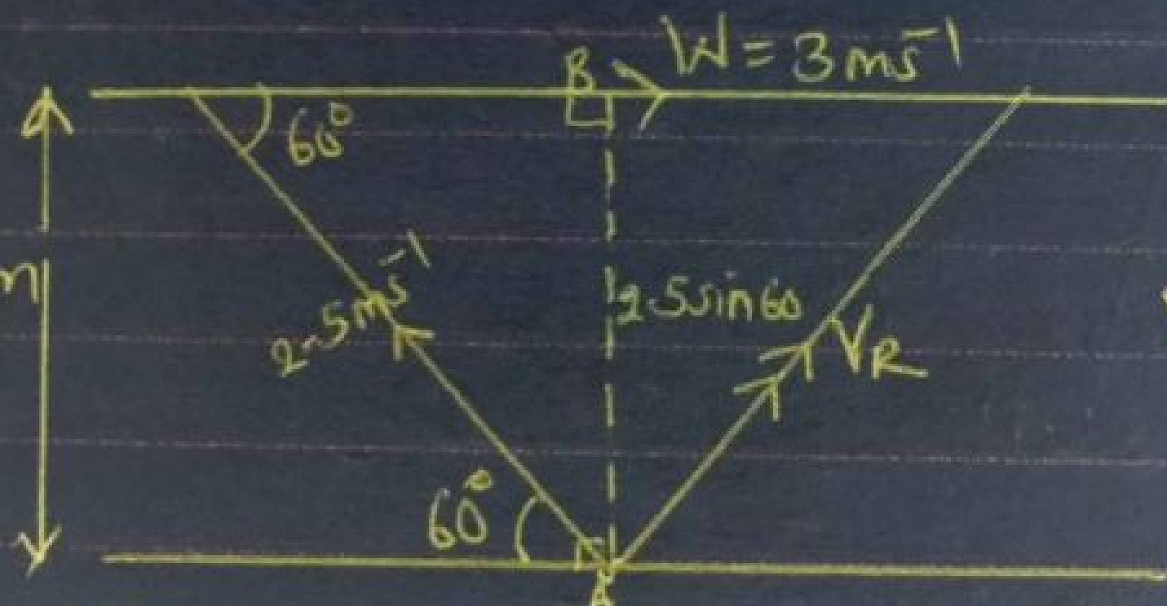
$n = \frac{-1 \pm 9}{2}$

$n = \frac{-1+9}{2}$ or $n = \frac{-1-9}{2}$

$n = 4$ $\qquad$ $n = -5$

$\therefore$ $n = 4$ since it cannot be negative.

Qn 8



$U = 2.5ms^{-1}$

$d = 50m$

V_R - Resultant velocity

(a) $t = \frac{AB}{2.5\sin 60}$

$t = \frac{50}{2.5\sin 60}$

$t = 23.094$ seconds.

(b) Let V_R be resultant velocity of the boy

$V_R^2 = 3^2 + 2.5^2 - 2(3)(2.5)\cos 60^\circ$

$V_R = \sqrt{7.75}$

$V_R = 2.7839 ms^{-1}$

Qn 9

C.b	f	x	fx	c	f.d
0 – 10	20	5	100	10	2
10 – 15	18	12.5	225	5	3.6
15 – 30	60	22.5	1350	15	4
30 – 45	45	37.5	1687.5	15	3
45 – 55	50	50	2500	10	5
55 – 60	30	57.5	1725	5	6
60 – 80	60	70	4200	20	3
80 – 90	10	85	850	10	1
	$\Sigma f = 293$		$\Sigma fx = 12637.5$		

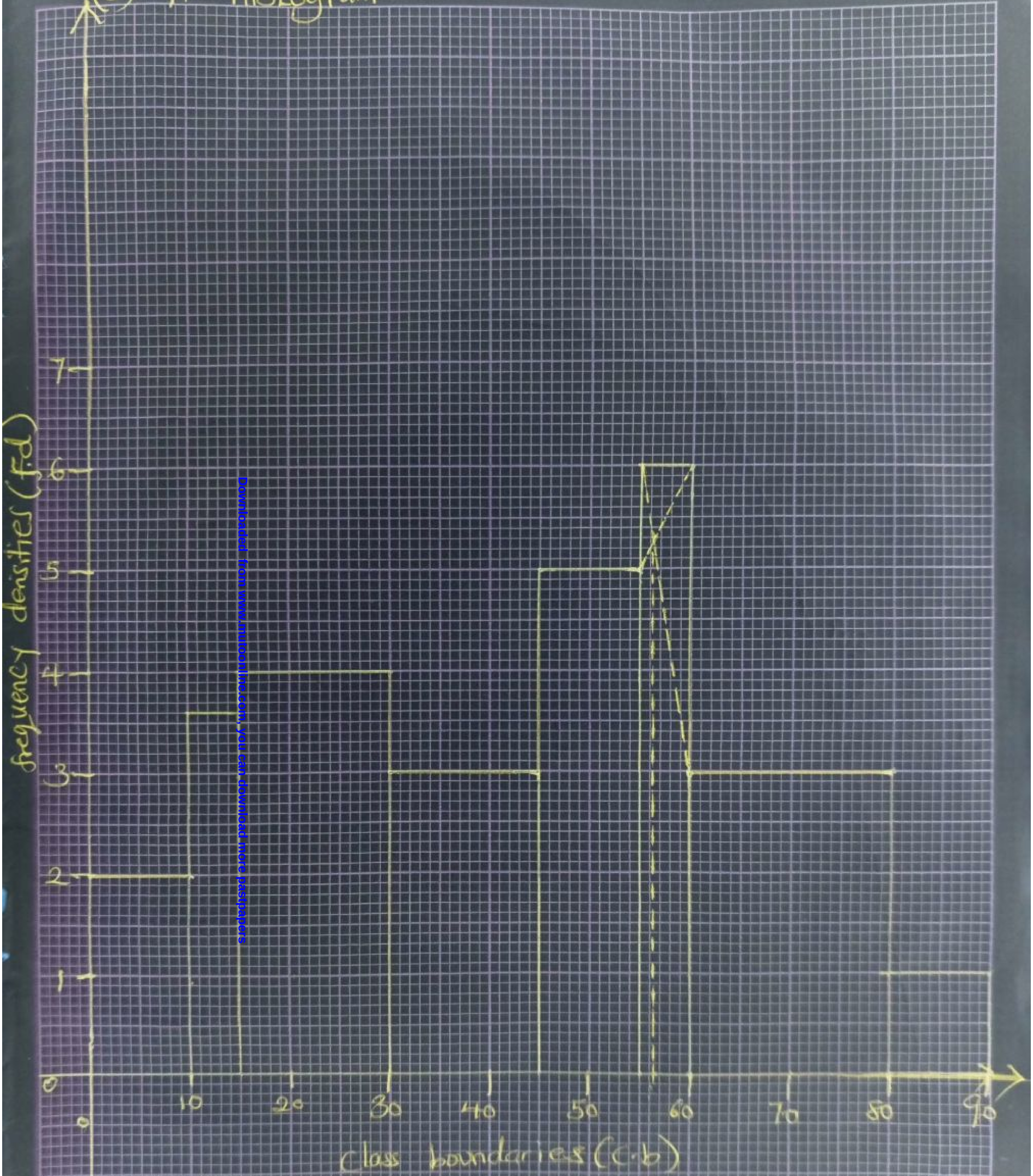
(a) Mean $= \dfrac{\Sigma fx}{\Sigma f}$

$= \dfrac{12637.5}{293}$

$= \underline{43.1314 \text{ minutes}}$.

(b) From the graph,
mode is 56.5minutes.

(b) A histogram.



Mode is 56.5 minutes

Qn 10(a)

(i) $s = ut - \frac{1}{2}gt^2$

$9 = 15t - \frac{1}{2}(9.8)t^2$

$-4.9t^2 + 15t - 9 = 0$

$t = \frac{-15 \pm \sqrt{15^2 - 4(-4.9 \times -9)}}{2 \times -4.9}$

$t = \frac{-15 \pm \sqrt{48.6}}{-9.8}$

$t = \frac{-15 \pm 6.9714}{-9.8}$

either

$t = \frac{-15 + 6.9714}{-9.8}$

$t = 0.8192\,s$

or $t = \frac{-15 - 6.9714}{-9.8}$

$t = 2.2420\,s$

$\therefore$ time ~~taken~~ taken, $t = 2.2420$ seconds.

(ii) $-v = u - gt$

$-v = 15 - 9.8 \times 2.2420$

$-v = -6.9716$

$v = 6.9716\,ms^{-1}$

(b) $r(t = 5s) = r_0 + \underset{\sim}{s}$

$r_0 = \begin{pmatrix} -2 \\ 1 \end{pmatrix}$

$s = ut + \frac{1}{2}at^2$

$s = \begin{pmatrix} 11 \\ -8 \\ 3 \end{pmatrix} \times 5 + \frac{5^2 \times 1}{25}\begin{pmatrix} 2 \\ 3 \\ -4 \end{pmatrix}$

$s = \begin{pmatrix} 55 \\ -40 \\ 15 \end{pmatrix} + \begin{pmatrix} 5 \\ 7.5 \\ -10 \end{pmatrix}$

$s = \begin{pmatrix} 60 \\ -32.5 \\ 5 \end{pmatrix} m$

$$r(t=5) = r_0 + \underset{\sim}{s}$$

$$= \begin{pmatrix} -2 \\ 1 \\ 0 \end{pmatrix} + \begin{pmatrix} 60 \\ -32.5 \\ 5 \end{pmatrix}$$

$$= \begin{pmatrix} 58 \\ -31.5 \\ 5 \end{pmatrix}$$

$$\underline{\underline{r = 58i - 31.5j + 5k.}}$$

(II) Distance covered $= |r|$

$$|r| = \sqrt{58^2 + (-31.5)^2 + 5^2}$$

$$|r| = \sqrt{4381.25}$$

$$\underline{\underline{|r| = 66.1910m.}}$$

Qn 11 (a) let $y = xe^{(x^2+1)}$

$h = \frac{1-0}{6-1}$

$h = 0.2$

x	$y_0 + y_n$	$y_1 + y_2 + \cdots + y_{n-1}$
0	0	
0.2		0.56584
0.4		1.27597
0.6		2.33772
0.8		4.12414
1.0	7.38906	
Sum	7.38906	8.30367

$$\int_0^1 xe^{(x^2+1)} = \frac{h}{2}\left(y_0 + y_n + 2(y_1 + y_2 + \cdots + y_{n-1})\right)$$

$$= \frac{0.2}{2}\left(7.38906 + 2(8.30367)\right)$$

$$= \underline{2.400} \text{ (3dp)}$$

(b) Exact value $= 2.335$

$|\text{error}| = |\text{Exact value} - \text{Inexact value}|$

$|\text{error}| = |2.335 - 2.400|$

$|\text{error}| = |-0.065|$

$|\text{error}| = 0.065$

$$P.E = \frac{|\text{error}|}{\text{Exact value}} \times 100$$

$$= \frac{0.065}{2.335} \times 100$$

$$P.E = 2.7837\%$$

(c) The accuracy in (a) can be improved by increasing on the number of sub-intervals/strips

Qn 12

(a) (i) for $(x \leq -1)$, $F(x) = 0$

for $-1 \leq x \leq 0$, $\frac{F(x) - 0}{x - -1} = \frac{\frac{1}{8} - 0}{0 - -1}$

$(-1, 0), (0, \frac{1}{8})$

$$\frac{F(x)}{x+1} = \frac{\frac{1}{8}}{1}$$

$$F(x) = \frac{1}{8}(x+1)$$

for $0 \leq x \leq 2$, $\frac{F(x) - \frac{1}{8}}{x - 0} = \frac{\frac{7}{8} - \frac{1}{8}}{2 - 0}$

$(0, \frac{1}{8}), (2, \frac{7}{8})$

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

$$\frac{F(x) - \frac{1}{8}}{x} = \frac{3}{8}$$

$$F(x) = \frac{3}{8}x + \frac{1}{8}$$

$$F(x) = \frac{1}{8}(3x+1)$$

for $2 \leq x \leq 3$, $\frac{F(x) - \frac{7}{8}}{x - 2} = \frac{1 - \frac{7}{8}}{3 - 2}$

$(2, \frac{7}{8}), (3, 1)$

$$\frac{F(x) - \frac{7}{8}}{x - 2} = \frac{1}{8}$$

$$F(x) = \frac{1}{8}(x-2) + \frac{7}{8}$$

$$F(x) = \frac{1}{8}(x - 2 + 7)$$

$$F(x) = \frac{1}{8}(x+5)$$

For $x \geq 3$, $F(x) = 1$

$$\therefore F(x) = \begin{cases} 0, & x \leq -1 \\ \frac{1}{8}(x+1), & -1 \leq x \leq 0 \\ \frac{1}{8}(3x+1), & 0 \leq x \leq 2 \\ \frac{1}{8}(x+5), & 2 \leq x \leq 3 \\ 1, & x \geq 3 \end{cases}$$

(ii) $P(1 < X < 2.5)$

$= F(2.5) - F(1)$

$= \left(\frac{2.5+5}{8}\right) - \left(\frac{3(1)+1}{8}\right)$

$= \frac{7.5}{8} - \frac{4}{8}$

$= \frac{3.5}{8}$

$\therefore P(1 < X < 2.5) = \underline{\underline{0.4375 \text{ or } 7/16}}$

(b)(ii) for $x < -1$ and $x > 3$, $f(x) = 0$.

for $-1 \leq x \leq 0$

$f(x) = \frac{d}{dx}\left(\frac{x+1}{8}\right)$

$f(x) = \frac{1}{8}$

for $0 \leq x \leq 2$

$f(x) = \frac{d}{dx}\left(\frac{1}{8}(3x+1)\right)$

$f(x) = 3/8$

for $2 \leq x \leq 3$

$f(x) = \frac{d}{dx}\left(\frac{x+5}{8}\right)$

$f(x) = \frac{1}{8}$

$$\therefore f(x) = \begin{cases} \frac{1}{8}, & -1 \leq x \leq 0 \\ 3/8, & 0 \leq x \leq 2 \\ \frac{1}{8}, & 2 \leq x \leq 3 \\ 0, & \text{elsewhere} \end{cases}$$

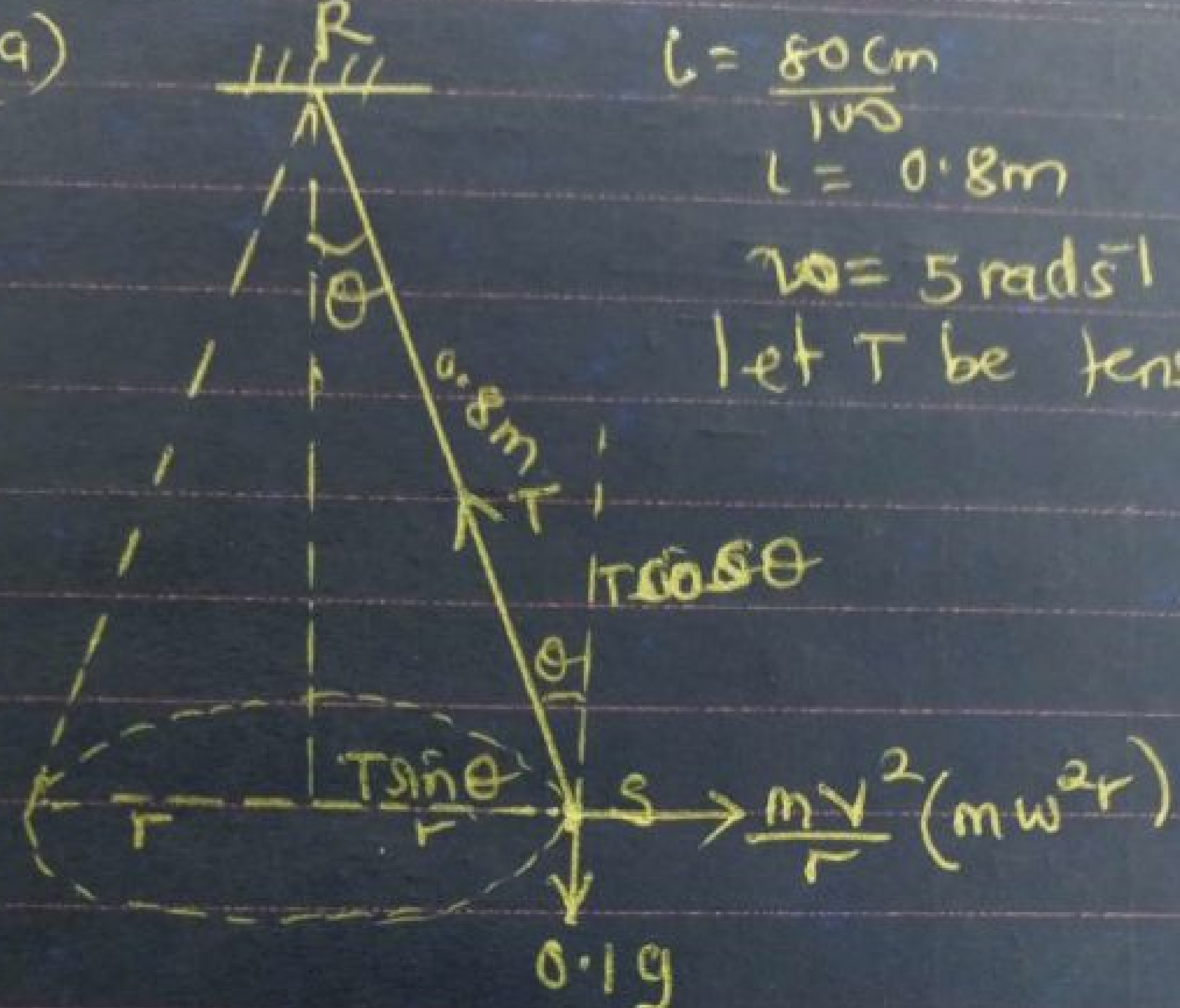
(ii) $E(x) = \int_{-1}^{0} \frac{x}{8} dx + \int_{0}^{2} \frac{3x}{8} dx + \int_{2}^{3} \frac{x}{8} dx$

$E(x) = \frac{x^2}{16}\Big|_{-1}^{0} + \frac{3x^2}{16}\Big|_{0}^{2} + \frac{x^2}{16}\Big|_{2}^{3}$

$E(x) = \frac{1}{16}(0-1) + \frac{1}{16}(12-0) + \frac{1}{16}(9-4)$

$E(x) = \underline{\underline{1}}$

Qn 13 (a)



$l = \frac{80cm}{100}$

$l = 0.8m$

$\omega = 5 rads^{-1}$

let T be tension in the string

$r = l\sin\theta$

$r = 0.8\sin\theta$

$R(\rightarrow)$, $T\sin\theta = m\omega^2 r$

$T\sin\theta = 0.1 \times 5^2 \times 0.8\sin\theta$

$T = 2N$.

∴ Tension in the string is 2N

(b) $R(\uparrow)$, $T\cos\theta = 0.1g$

$2\cos\theta = 0.1 \times 9.8$

$\cos\theta = \frac{0.98}{2}$

$\theta = \cos^{-1}(0.49)$

$\theta = 60.66^\circ$

but radius, $r = l\sin\theta$

$r = 0.8\sin 60.66^\circ$

$r = 0.6974m$

∴ radius = 0.6974m

Qn 14 (a)

Let $y = 2x^3 - 4x + 3$

x	-2	-1.8	-1.6	-1.4	-1.2	-1
y	-5	-1.46	1.21	3.11	4.31	5

$\therefore$ From the graph, the approximate root, $x_0 = -1.7$

(b) Let $f(x) = 2x^3 - 4x + 3$

$f(x_n) = 2x_n^3 - 4x_n + 3$

$f'(x_n) = 6x_n^2 - 4$

from NRM,

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

$$x_{n+1} = x_n - \frac{(2x_n^3 - 4x_n + 3)}{6x_n^2 - 4}$$

$$x_{n+1} = \frac{6x_n^3 - 4x_n - 2x_n^3 + 4x_n - 3}{6x_n^2 - 4}$$

$$x_{n+1} = \frac{4x_n^3 - 3}{6x_n^2 - 4}$$

Taking $x_0 = -1.7$

$$x_1 = \frac{4(-1.7)^3 - 3}{6(-1.7)^2 - 4}$$

$x_1 = -1.69805$

$|x_1 - x_0| = |-1.69805 - {}^-1.7|$

$= 1.95 \times 10^{-3} > 0.5 \times 10^{-3}$

$$x_2 = \frac{4(-1.69805)^3 - 3}{6(-1.69805)^2 - 4}$$

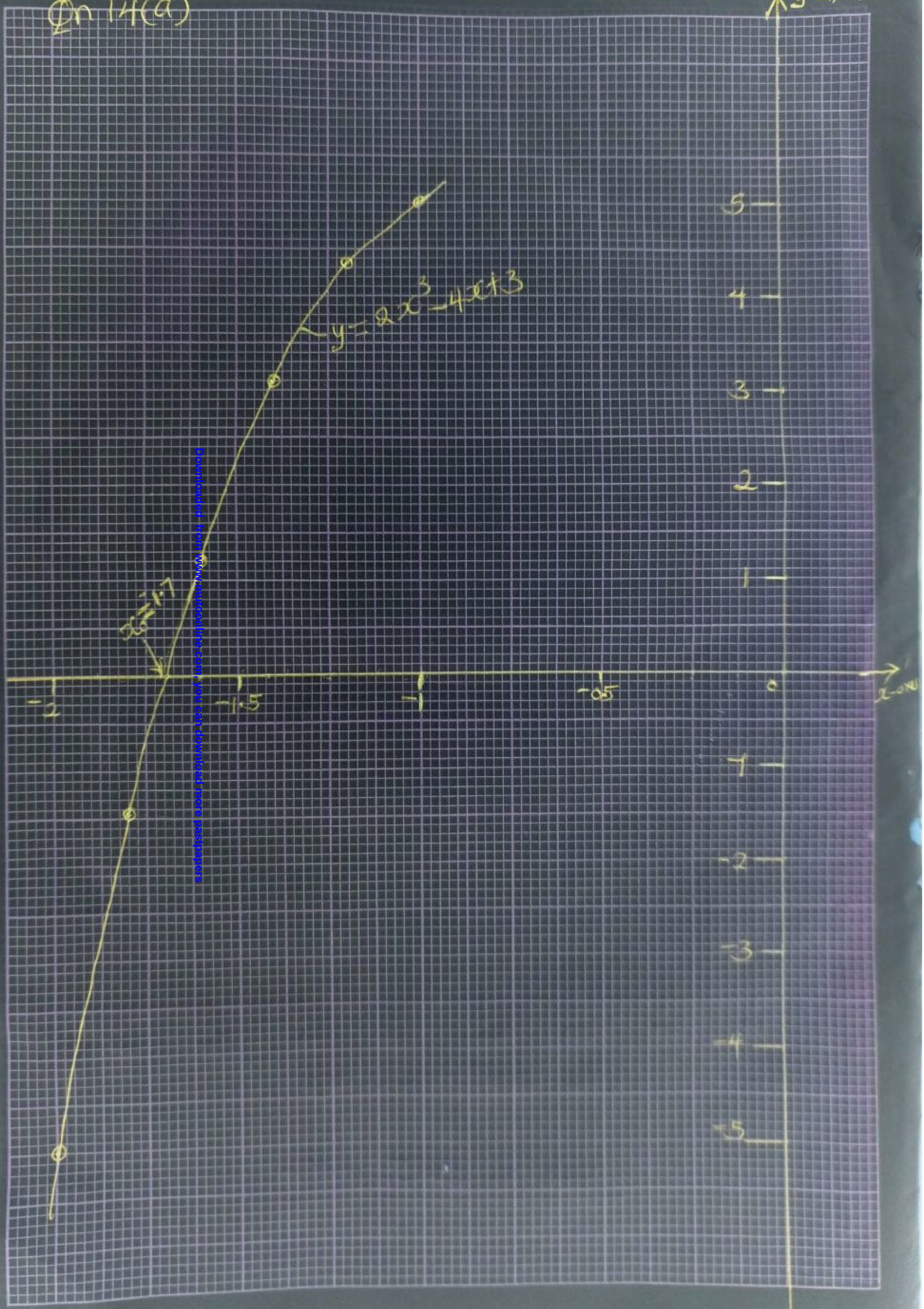
$x_2 = -1.69805$

$|x_2 - x_1| = |-1.69805 - {}^-1.69805|$

$= 0.00000 < 0.5 \times 10^{-3}$

$\therefore$ The root is -1.698 (3dp).

Qn 14(a)



Qn 15(a) Let X be a random variable for "number of correct options"

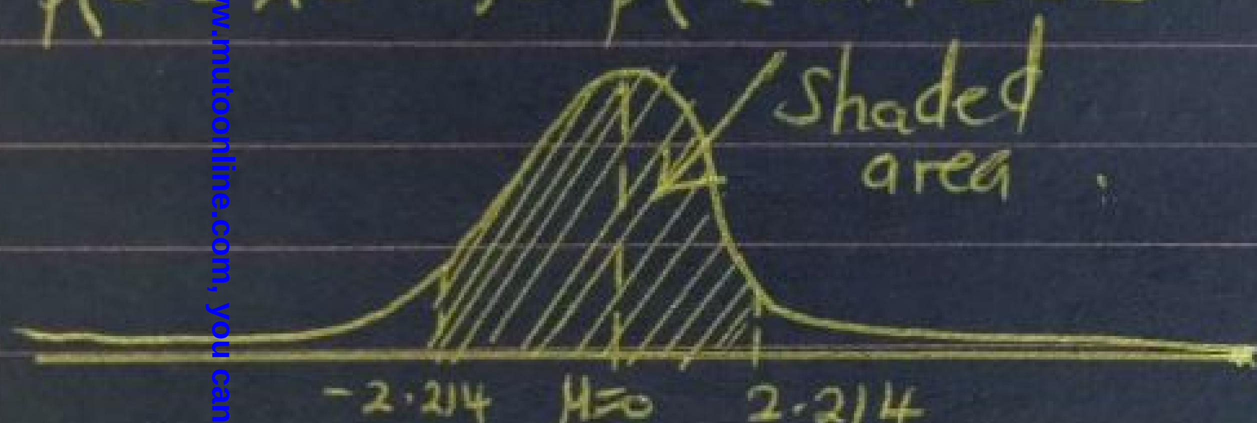
$n = 120,\ p = \frac{1}{4},\ q = \frac{3}{4}.$

$$\text{Mean}(\mu) = np$$
$$= 120 \times \frac{1}{4}$$
$$\underline{\underline{\mu = 30}}$$

$$\text{Standard Deviation } (\delta) = \sqrt{npq}$$
$$\delta = \sqrt{\left(30 \times \frac{3}{4}\right)}$$
$$\underline{\underline{\delta = \sqrt{22.5}}}$$

(i) $p(20 \leq X \leq 40) = p\left(\frac{19.5 - 30}{\sqrt{22.5}} \leq Z \leq \frac{40.5 - 30}{\sqrt{22.5}}\right)$

$p(20 \leq X \leq 40) = p(-2.214 \leq Z \leq 2.214)$



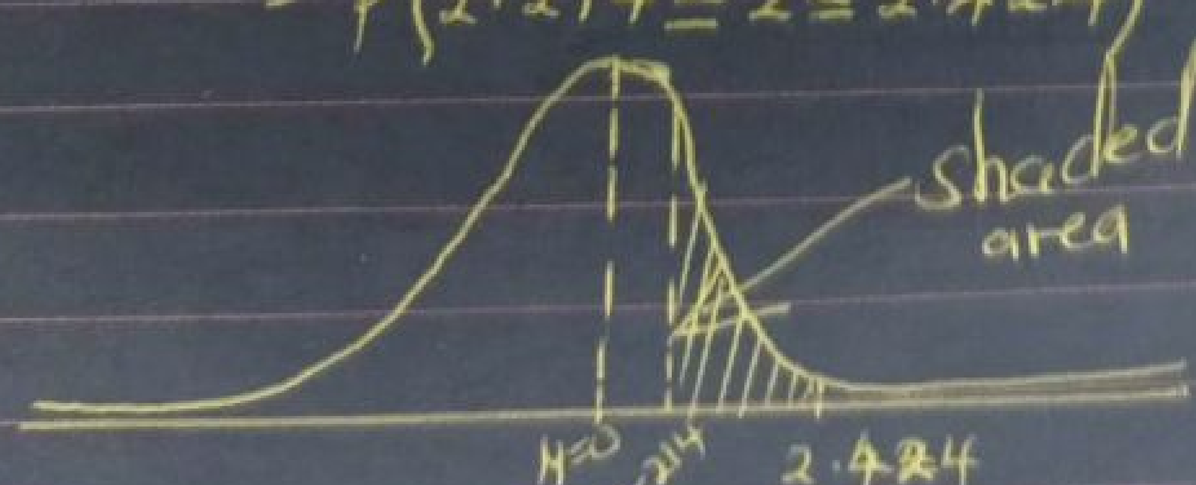
$p(20 \leq X \leq 40) = 2p(0 < Z < 2.214)$

$= 2 \times 0.4865$

$\therefore p(20 \leq X \leq 40) = \underline{0.9730}.$

(ii) $p(X = 41) = p\left(\frac{40.5 - 30}{\sqrt{22.5}} \leq Z \leq \frac{41.5 - 30}{\sqrt{22.5}}\right)$

$= p(2.214 \leq Z \leq 2.424)$



$p(X = 41) = p(0 < Z < 2.424) - p(0 < Z < 2.214)$

$= 0.4923 - 0.4865$

$\therefore \underline{\underline{p(X = 41) = 0.0058}}$

(b) Let x_0 be the pass mark

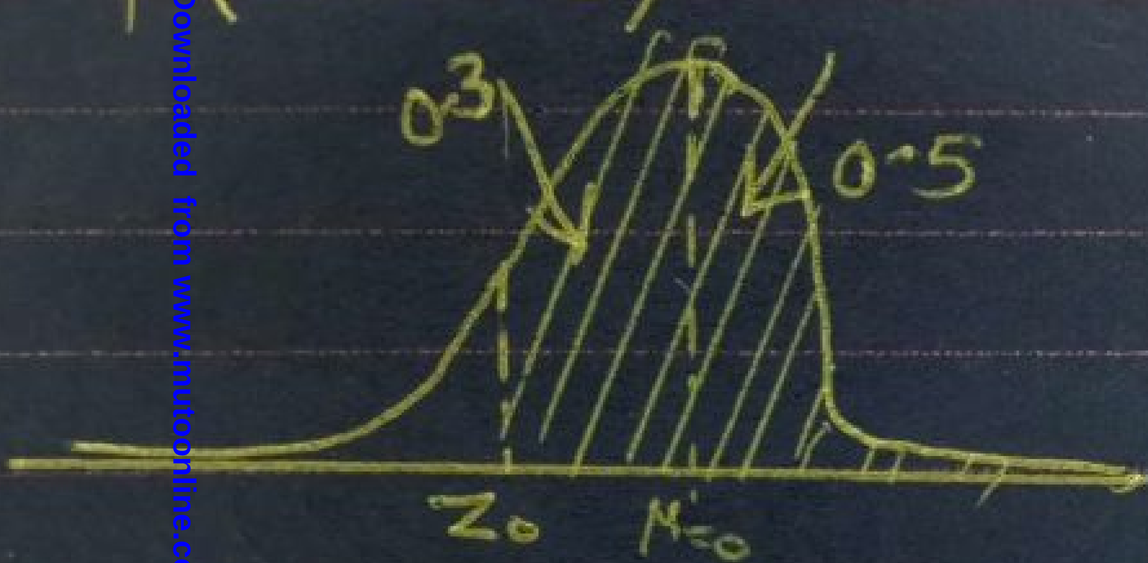
$$P(X \geq x_0) = 0.8$$

$$P\left(Z \geq \frac{x_0 - 0.5 - 30}{\sqrt{22.5}}\right) = 0.8$$

$$P\left(Z \geq \frac{x_0 - 30.5}{\sqrt{22.5}}\right) = 0.8$$

let $Z_0 = \dfrac{x_0 - 30.5}{\sqrt{22.5}}$

$$P(Z \geq Z_0) = 0.8$$



$$P(0 < Z < Z_0) = 0.3$$

$$Z_0 = -0.842$$

but $Z_0 = \dfrac{x_0 - 30.5}{\sqrt{22.5}}$

$$\cancel{-0.842} \quad -0.842 = \frac{x_0 - 30.5}{\sqrt{22.5}}$$

$$x_0 = 30.5 - \left(0.842\sqrt{22.5}\right)$$

$$\underline{x_0 = 26.506}$$

$$\underline{x_0 \simeq 27}$$

$\therefore$ The passmark is 27

Qn 16(a) let C.O.G be $(\bar{x}, \bar{y})$

Let W = weight per unit area.

Body	Area	Weight	Distance of C.O.G from AH	Distance of C.O.G from AB
ABCH	$6m^2$	6W	2.5	0.6
FEDG	$3m^2$	3W	2.5	2.7
Whole	$9m^2$	9W	$\bar{x}$	$\bar{y}$

Equating moments along AH,

$$9W\bar{x} = 2.5(3W) + 2.5(6W)$$

$$\bar{x} = \frac{9W(2.5)}{9W}$$

$$\bar{x} = 2.5$$

Equating moments along AB

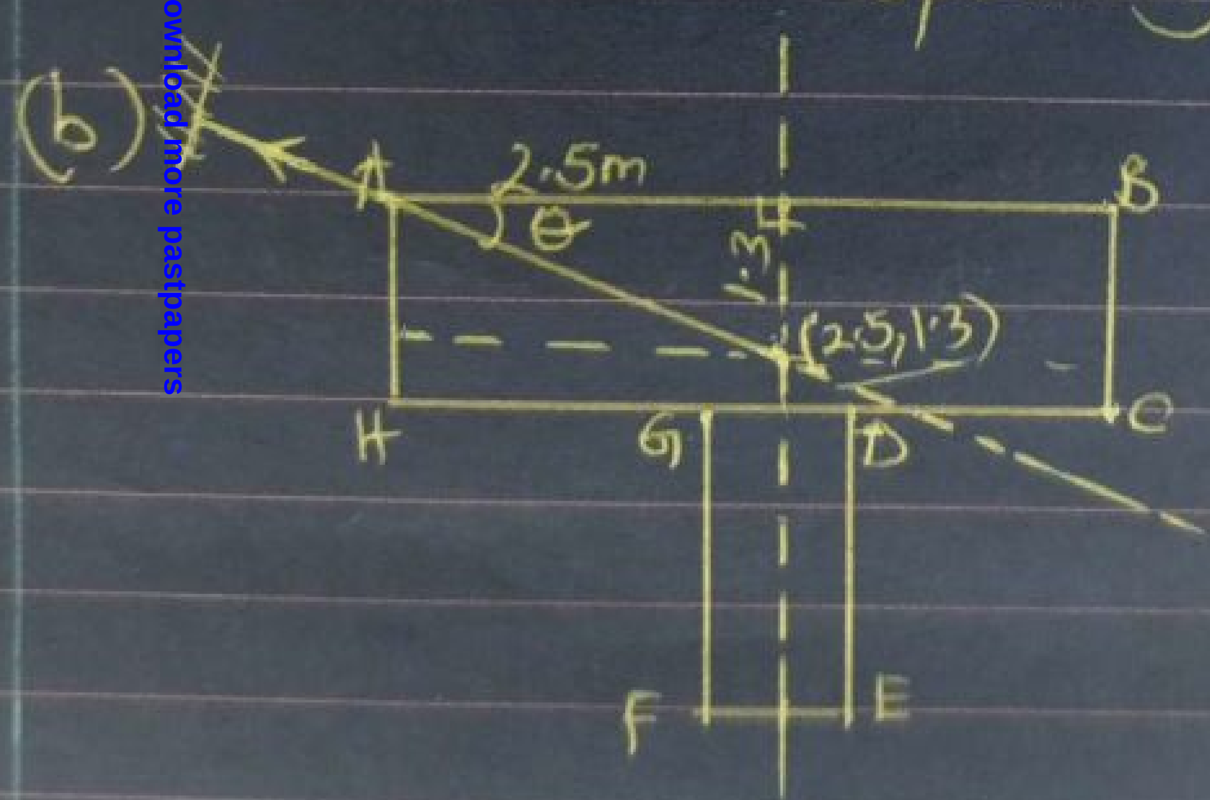
$$9W(\bar{y}) = 2.7(3W) + 0.6(6W)$$

$$\bar{Y} = \frac{2.7(3W) + 0.6(6W)}{9W}$$

$$\bar{y} = 1.3$$

∴ Distances of C.O.G from AH and AB are 2.5m and 1.3m respectively.

(b)



$$\tan\theta = \frac{opp}{Adj}$$

$$\tan\theta = \frac{1.3}{2.5}$$

$$\theta = \tan^{-1}\left(\frac{1.3}{2.5}\right)$$

$$\theta = 27.47^\circ$$

∴ AB makes an angle of 27.47° with the vertical.

– END –