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UGANDA ADVANCED CERTIFICATE OF EDUCATION
NOVEMBER - DECEMBER, 2023

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Candidate's Name UACE 2024 APPLIED MATHS P425/2

Signature PROPOSED GUIDE

Subject ..... Paper code ...../.....

(1)

Random No.					
Personal Number					

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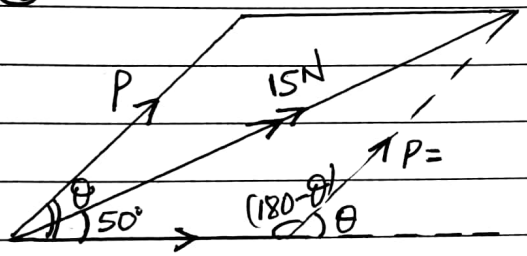
(1)

$$P(A'|B') = \frac{P(A' \cap B')}{P(B')} = \frac{1-\{P(A)+P(B)-P(A \cap B)\}}{1-P(B)}$$

$$= \frac{1-(0.4+0.7-0.35)}{1-0.7}$$

$$= 5/6 \text{ or } 0.8333$$

(2)



$$P^2 = 15^2 + 12^2 - 2 \times 15 \times 12 \cos 50°$$

$$P = 11.7302 N$$

$$15^2 = 11.7302^2 + 12^2 - 2 \times 12 \times 11.7302 \cos(180-\theta)$$

$$\cos(180-\theta) = 0.201035$$

$$180-\theta = 78.40°$$

$$\theta = 101.60°$$

∴ direction of P is 101.60° to 12N force.

(3) a)

t(s)	0	1	1.5
V(ms⁻¹)	0	2	V

$$\frac{V-2}{1.5-1} = \frac{2-0}{1-0}$$

$$V = 3 ms^{-1}$$

b)

t(s)	3	4	t
V(ms⁻¹)	8	10	13

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

$$t = 5.5 s$$

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NOVEMBER - DECEMBER, 2023

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Subject ..... Paper code ...../.....

Random No.					
Personal Number					

(2)

(4) a)

$$W\cdot A\cdot P\cdot I = \left(\frac{3500\times25+7000\times10+2000\times50+8000\times5+1200\times50}{2500\times25+5000\times10+1500\times50+5000\times5+800\times50}\right)\times100$$

$$= 141.58$$

b) prices increased by 41.58% in 2010.

(5) $\underset{\sim}{v} = \frac{d\underset{\sim}{r}}{dt} = \begin{pmatrix}3t^2\\ \cos t\end{pmatrix}$; $\underset{\sim}{a} = \frac{d\underset{\sim}{v}}{dt} = \begin{pmatrix}6t\\ -\sin t\end{pmatrix}$

$\underset{\sim}{F}(t) = 4\begin{pmatrix}6t\\ -\sin t\end{pmatrix}$; $\underset{\sim}{F}(t=\frac{\pi}{3}) = \begin{pmatrix}24\cdot\frac{\pi}{3}\\ -4\sin\pi/3\end{pmatrix} = \begin{pmatrix}8\pi\\ -2\sqrt{3}\end{pmatrix}$

(6)

$$V_{min} = (2.7-0.05)(4.80-0.005)(3.281-0.0005)$$

$$= 41.68449$$

$$V_{max} = (2.7+0.05)(4.80+0.005)(3.281+0.0005)$$

$$= 43.36092$$

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

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

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

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

$$n^2+n-20 = 0$$

$$n = \frac{-1+\sqrt{1^2-4(1)(-20)}}{2}$$

$n = -5$ or 4

$\therefore n = 4$

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Subject ..... Paper code ...../.....

Random No.					
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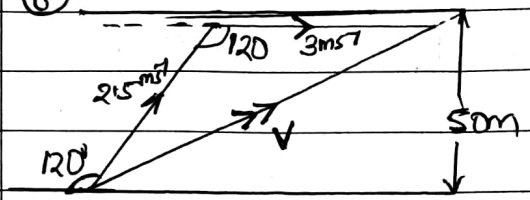
(3)

(8)



a) $t = \frac{50}{2.5 \sin 60^\circ}$

$= 23.0940\ s$

b)

$V^2 = 2.5^2 + 3^2 - 2 \times 2.5 \times 3 \cos 120$

$= 4.769696\ ms^{-1}$

(9) (a)

C.b	f	x	fx	c	fd
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	70.0	4200	20	3
80–90	10	85.0	850	10	1
	$\Sigma f = 293$		$\Sigma fx = 12607.5$		

$\bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{12607.5}{293}$

$= 43.0273$ minutes

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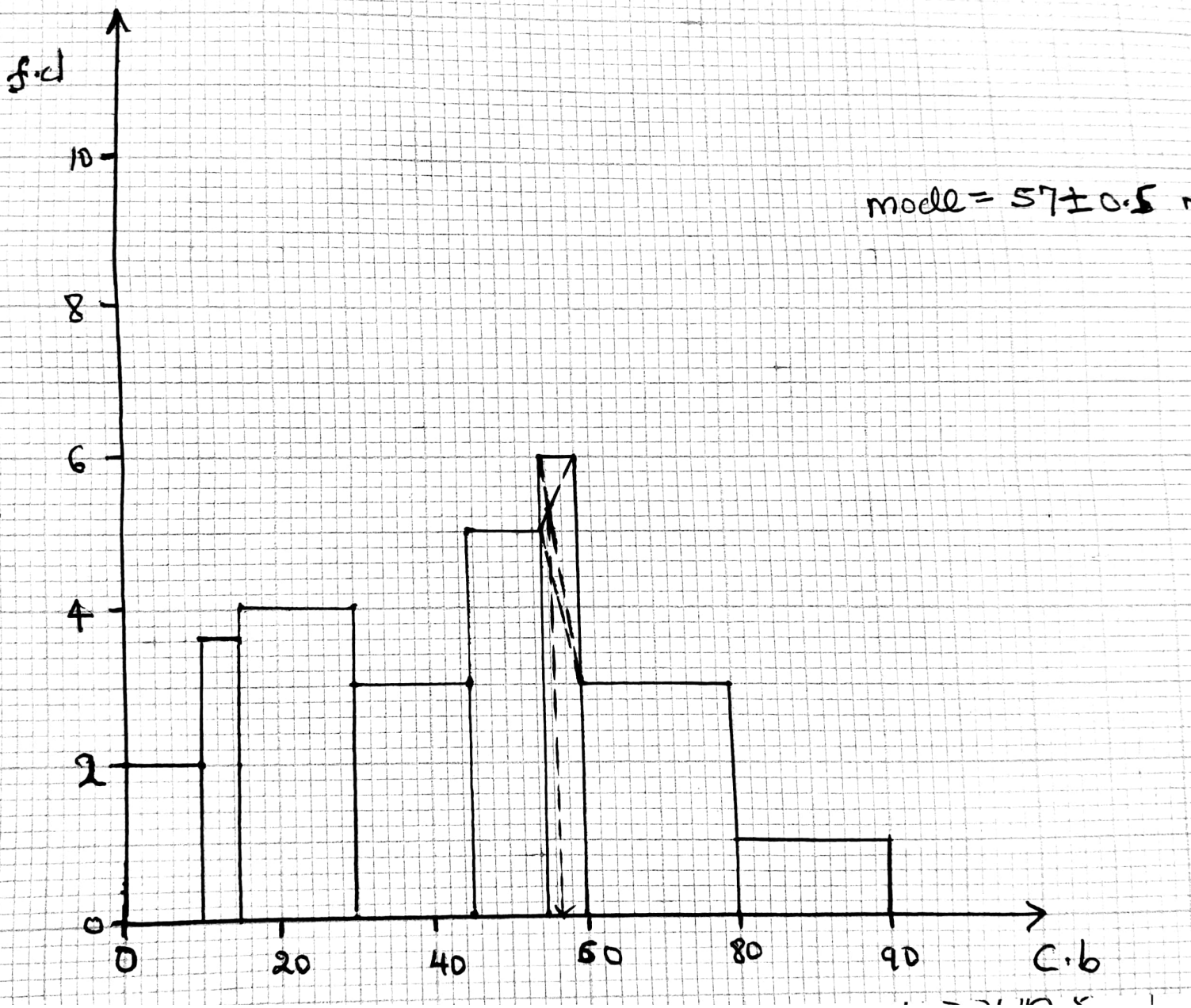
(4)

9 b (i), (ii)

A histogram



mode = 57 ± 0.5

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Subject ..... Paper code ...../.....

(5)

Random No.						
Personal Number						

(10) (a)(i) upward motion

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

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

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

$t = \frac{-(-15) \pm \sqrt{(-15)^2 - 4(49)(9)}}{2 \times 4.9}$

$= 0.8192$ or 2.2420

$\therefore t = 2.2420$ s

ALT 2) Downward motion

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

$-9 = -15t + \frac{1}{2} \times 9.8t^2$

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

$t = \frac{-(-15) \pm \sqrt{(-15)^2 - 4(49)(9)}}{2 \times 4.9}$

$= 0.8192$ or 2.2420

$\therefore t = 2.2420$ s

~~ALT (i)~~ upward motion

$V = u + at$

$-V = 15 - 9.8 \times 2.2420$

$V = 6.9716 \text{ ms}^{-1}$

ALT 2) Downward motion

$V = u + at$

$V = -15 + 9.8 \times 2.2420$

$V = 6.9716 \text{ ms}^{-1}$

(a) (i)

ALT 3:

maximum height;

$H_{max} = \frac{u^2}{2g} = \frac{15^2}{2 \times 9.8} = 11.47959$ m

Distance covered before catching it from max. height $= 11.47959 - 9$

$= 2.47959$

Time taken to be caught from max. height;

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

$2.47959 = 0 + \frac{1}{2} \times 9.8t^2$

Time taken to reach max. height

$= \frac{u}{g} = \frac{15}{9.8}$

$= 1.5306$ s

Candidate's Name .....

Signature .....

Subject ..... Paper code ...../.....

(6)

Random No.					
Personal Number					

$t = 0.71136\ s$

∴ Total time taken before it is caught

$= 1.5306 + 0.71136$

$= 2.2420\ s$

a(ii) ALT 3:

$V = u + at$

$= 0 + 9.8 \times 0.71136$

$= 6.971328\ ms^{-1}$

ALT 4:

$V^2 = u^2 + 2as$

$V^2 = 0 + 2 \times 9.8 \times 2.47959$

$V = 6.971367\ ms^{-1}$

b i)

$\underset{\sim}{s} = \underset{\sim}{u}t + \frac{1}{2}\underset{\sim}{a}t^2$

$= \begin{pmatrix} 11 \\ -8 \\ 3 \end{pmatrix} + \frac{1}{2} \cdot \frac{1}{5} \begin{pmatrix} 2 \\ 3 \\ -4 \end{pmatrix} \times 5^2 = \begin{pmatrix} 60 \\ -32.5 \\ 5 \end{pmatrix} m$

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

$= \begin{pmatrix} -2 \\ 1 \\ 0 \end{pmatrix} + \begin{pmatrix} 60 \\ -32.5 \\ 5 \end{pmatrix} = \begin{pmatrix} 58 \\ -31.5 \\ 5 \end{pmatrix} m$

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

$= 66.191011\ m.$

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NOVEMBER - DECEMBER, 2023

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Candidate's Name .....

Signature .....

Subject ..... Paper code ...../.....

Random No.					
Personal Number					

(11) (a)

let $y = xe^{x^2+1}$; $h = \frac{1-0}{6-1} = 0.2$

x	y	
0	0	
0·2		0·5658
0·4		1·2760
0·6		2·3377
0·8		4·1241
1·0	7·3891	
SUM	7·3891	8·3036

$$\int_0^1 xe^{x^2+1}\,dx \approx \frac{1}{2}\times 0.2\{7.3891 + 2(8.3036)\}$$

$$\approx 2.400$$

b) $P.E = \frac{A.E}{E.V} \times 100$

$$= \frac{|2.335 - 2.400|}{2.335} \times 100$$

$$= 2.78\%$$

(c) – By increasing number of strips

12 (a) (i)

$x \leq -1$; $F(x) = 0$

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

$\frac{F(x)-0}{x+1} = \frac{\frac{1}{8}-0}{0-(-1)}$; $F(x) = \frac{1}{8}(x+1)$

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

$\frac{F(x)-\frac{1}{8}}{x-0} = \frac{\frac{7}{8}-\frac{1}{8}}{2-0}$; $F(x) = \frac{1}{8}(3x+1)$

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

$\frac{F(x)-\frac{7}{8}}{x-2} = \frac{1-\frac{7}{8}}{3-2}$; $F(x) = \frac{1}{8}(x+5)$

$x \geq 3$; $F(x) = 1$

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

(ii)

$P(1 < X < 2.5) = F(2.5) - F(1)$

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

$= 7/16$ or 0.4375

b(i)

$-1 \leq x \leq 0$;

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

$0 \leq x \leq 2$;

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

$2 \leq x \leq 3$;

$f(x) = \frac{d}{dx}\{\frac{1}{8}(x+5)\} = \frac{1}{8}$

$x \geq 3, x \leq 1, f(x) = 0$

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

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Signature .....

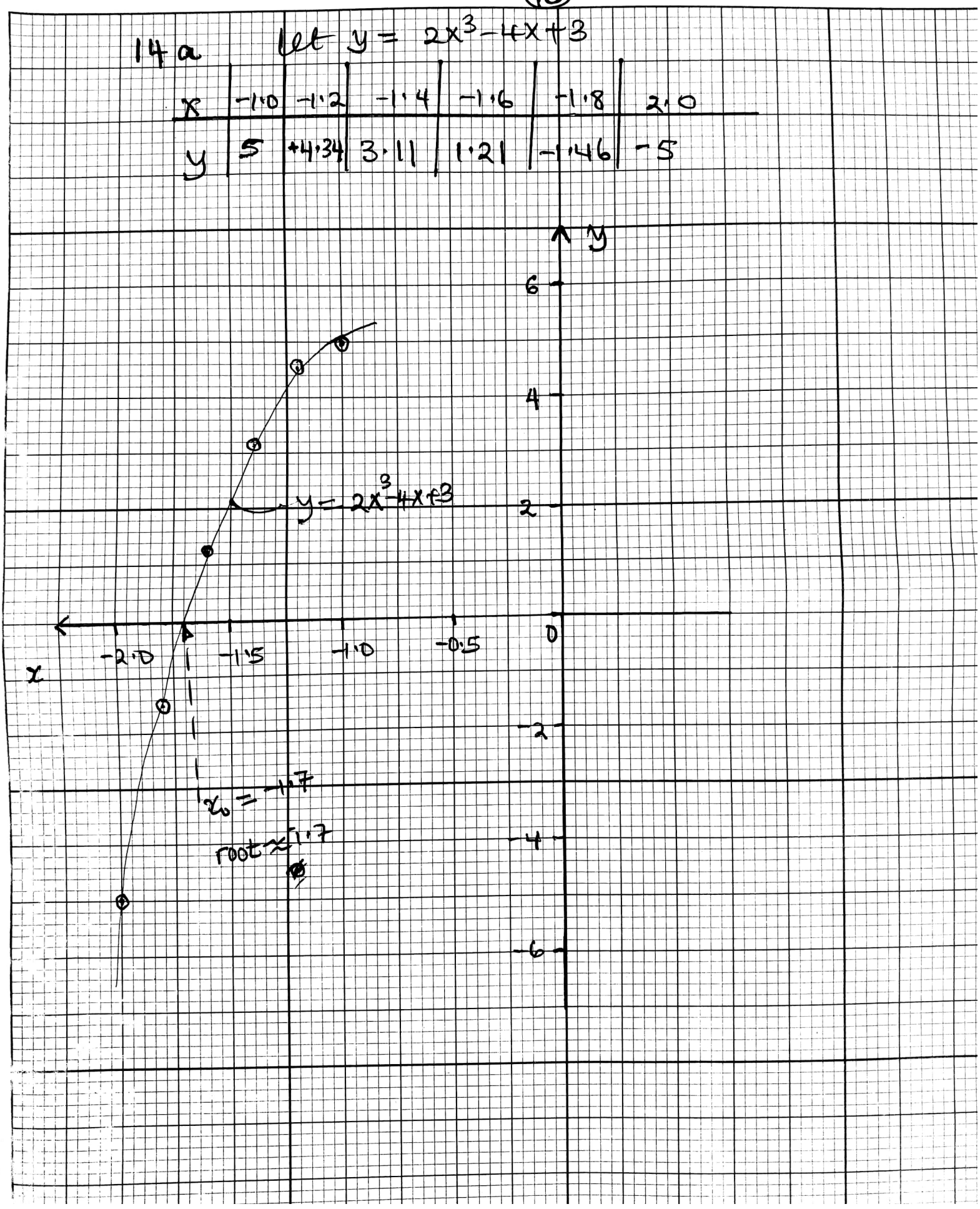
Subject Name ..... Paper code ...../.....

Random No.			
Personal Number			

(10)

14 a let $y = 2x^3 - 4x + 3$

x	-1·0	-1·2	-1·4	-1·6	-1·8	2·0
y	5	+4·34	3·11	1·21	-1·46	-5



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UGANDA ADVANCED CERTIFICATE OF EDUCATION
NOVEMBER - DECEMBER, 2023

Candidate's Name .....

Signature .....

Subject ..... Paper code ...../.....

Random No.					
Personal Number					

(11)

14(b)

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

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

$\Rightarrow f(x_n) = 2x_n^3 - 4x_n + 3 \; ; \; f'(x_n) = 6x_n^2 - 4$

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

$x_0 = -1.7$

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

$= -1.69805$

$|-1.69805 - 1.7| = 0.00195 > TOL = 0.0005$

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

$= -1.69805$

$|-1.69805 - 1.69805| = 0.0000 < TOL$

$\therefore$ root ≈ -1.698

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UGANDA ADVANCED CERTIFICATE OF EDUCATION
NOVEMBER - DECEMBER, 2023

Candidate's Name .....

Signature .....

Subject ..... Paper code ...../.....

Random No.					
Personal Number					

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(12)

15(a)(i)

$n = 120,\ p = 0.25,\ q = 0.75$

$\mu = np = 120 \times 0.25 = 30$

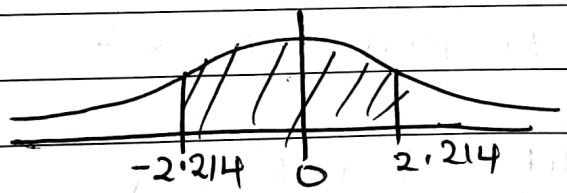
$\sigma^2 = npq = 120 \times 0.25 \times 0.75 = 22.5$

$X \sim N(np, npq)$

$$P(20 \leq X \leq 40) = P\left(\frac{20-0.5-30}{\sqrt{22.5}} < Z < \frac{40.5-30}{\sqrt{22.5}}\right)$$

$$= P(-2.214 < Z < 2.214)$$

$$= 2 \times P(0 \leq Z < 2.214)$$



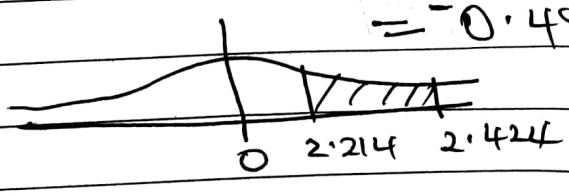
$$P(20 \leq x \leq 40) = 2 \times 0.4865 = 0.9730$$

(ii) $P(X = 41) = P(40.5 \leq X \leq 41.5)$

$$= P\left(\frac{40.5-30}{\sqrt{22.5}} < Z < \frac{41.5-30}{\sqrt{22.5}}\right)$$

$$= P(2.214 < Z < 2.424)$$

$$= 0.4923 - 0.4865$$



$\therefore P(X = 41) = 0.0058$

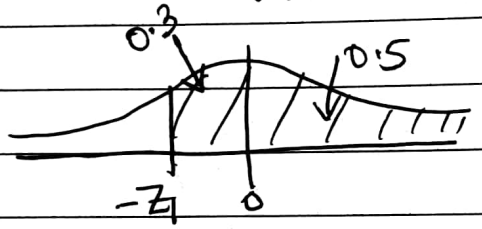
Candidate's Name ..... (13)
Signature .....
Subject ..... Paper code ...../.....

Random No.					
Personal Number					

x_1 = pass mark

b) $P(X > x_1) = 0.8$; $P(Z > z_1) = 0.8$

$P\left(Z > \frac{x_1 - 0.5 - 30}{\sqrt{22.5}}\right) = 0.8$; $z_1 = \frac{x_1 - 30.5}{\sqrt{22.5}}$ — (1)



$z_1 = -0.842$ — (2)

(1) = (2)

$\frac{x_1 - 30.5}{\sqrt{22.5}} = -0.842$; $x_1 = 26.5060$

∴ pass mark 27

16 (a) let W = Weight per unit area

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

$9W\begin{pmatrix}\bar{x}\\ \bar{y}\end{pmatrix} = 6W\begin{pmatrix}2.5\\ 0.6\end{pmatrix} + 3W\begin{pmatrix}2.5\\ 2.7\end{pmatrix}$

$\begin{pmatrix}\bar{x}\\ \bar{y}\end{pmatrix} = \begin{pmatrix}2.5\\ 1.3\end{pmatrix}$ m.

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

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UGANDA ADVANCED CERTIFICATE OF EDUCATION
NOVEMBER - DECEMBER, 2023

Candidate's Name .....

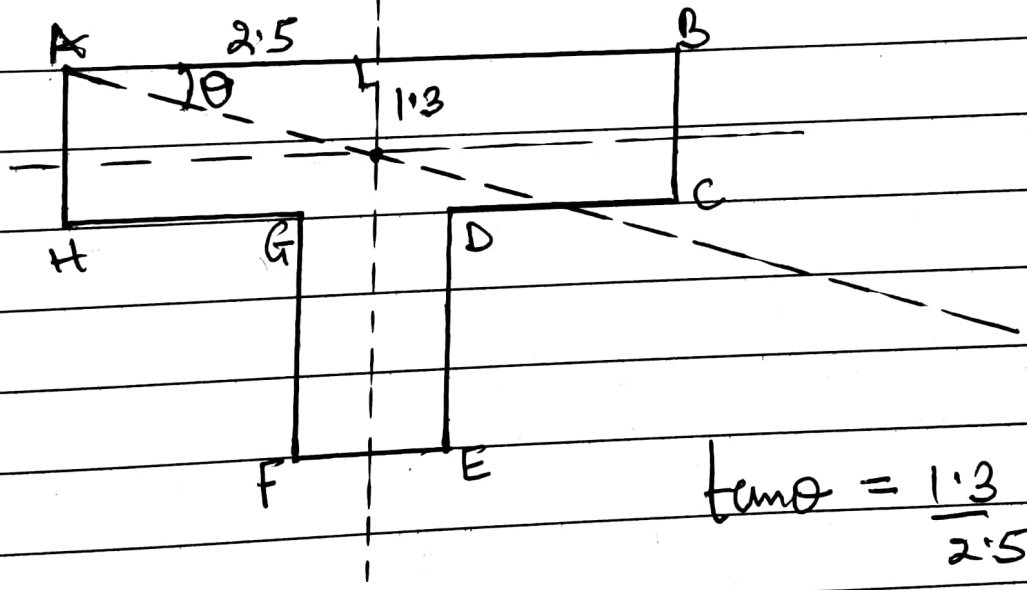
Signature .....

Subject ..... Paper code ...../.....

Random No.					
Personal Number					

(14)

(b)



$\tan\theta = \frac{1·3}{2·5}$

$\theta = 27·47°$