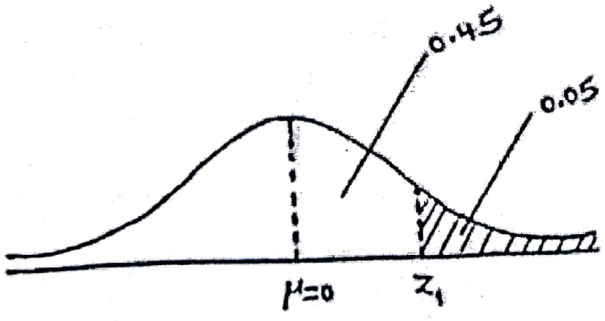
JJEB S473/1 SOLUTIONS 2020

No.	Solution		Comment
1.	$\log(x^2+6) = 1 + \log(x-1)$		
	$\log(x^2+6) = \log 10 + \log(x-1)$	M1	
	$\log(x^2+6) = \log(10(x-1))$	M1	
	$x^2+6 = 10(x-1)$		
	$x^2+6 = 10x-10$		
	$x^2-10x+6+10 = 0$		
	$x^2-10x+16 = 0$	B1	
	$(-8,-2)$		
	$x^2-8x-2x+16 = 0$		
	$x(x-8)-2(x-8) = 0$		
	$(x-2)(x-8) = 0$	M1	
	$x = 2$ *or* $x = 8$	A1	05
2.	Let x denote the marks obtained by teachers		
	$P(X \geq x) = \frac{5}{100}$		
	$p\left(z \geq \frac{x-45}{\sqrt{400}}\right) = 0.05$		
		B1	
	$P(O < Z < Z_0) = 0.45$	M1	
	$Z_0 = 1.645$	A1	
	$\frac{x-45}{20} = 1.645$		
	$x - 45 = 32.9$	M1	
	$x = 32.9 + 45$		
	$x = 77.9$	A1	05

3. $(2y+1)\frac{dy}{dx} = 4x+3$ M1

$\int(2y+1)dy = \int(4x+3)dx$ M1 A1

$y^2 + y = 2x^2 + 3x + c$

$when\ y = 2, x = 1$

$2^2 + 2 = 2(1)^2 + 3(1) + C$ M1

$4 + 2 = 2 + 3 + C$

$6 = 5 + C$

$C = 1$

$y^2 + y = 2x^2 + 3x + 1$ A1 [05]

4. $P = 1/5$ B1

$q = 4/5$

$P(x \geq 2) = 1 - [p(x=0) + p(x=1)]$ M1

$but P(X=0) = \binom{10}{0}\left(\frac{1}{5}\right)^0\left(\frac{4}{5}\right)^{10}$

$= 0.1074$ M1

$P(x=1) = \binom{10}{1}\left(\frac{1}{5}\right)^1\left(\frac{4}{5}\right)^9 = 0.0014$ M1

$p(x \geq 2) = 1 - [0.1074 + 0.0014]$

$p(x \geq 2) = 0.8912$ A1 [05]

5. $\alpha + \beta = 21$ B1

$\alpha\beta = 4$ B1

$\alpha^2 + \alpha\beta + \beta^2$

$= \alpha^2 + \beta^2 + \alpha\beta$

$= (\alpha+\beta)^2 - 2\alpha\beta + \alpha\beta$ M1

$= (\alpha+\beta)^2 - \alpha\beta$

$= (21)^2 - 4$ M1

$= 437$ A1 [05]

6.

Region	Distance(km)	Transport (000ugx	R_D	R_T	d	d^2
A	150	15	1	1	0	0
B	85	7	5	5	0	0
C	110	9	4	35	0.5	0.25
D	50	4	7	7	0	0
E	70	6	6	6	0	0
F	130	11	2	2	0	0
G	125	9	3	3.5	0.5	0.25
						$\sum d^2 = 0.5$

B1

B1

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

M1

$$= 1 - \frac{6 \times 0.5}{7(7^2-1)}$$

$$= 1 - \frac{3}{7(48)}$$

A1

$$= 1 - \frac{3}{336}$$

$$= 0.9911 (4dp)$$

There is a very high positive correlation between the distance ad transport charges.

B1

05

7.

$a = 7$.....(1)

$ar^3 = 189$.....(11)

$a_n = 137781$.....(111)

B1

From eqns. (1) and (11)

i) $ar^3 = 189$ and $a = 7$

M1

$$\frac{7r^3}{7} = \frac{189}{7}$$

$$r^3 = 27$$

$$r = \sqrt[3]{27}$$

$$r = 3$$

A1

ii) from an = 137781

$a_n = ar^{n-1}$

$ar^{n-1} = 137781$ M1

$7(3)^{n-1} = 137781$

$3^{n-1} = 19683$

$(n-1)\log 3 = \log 19683$

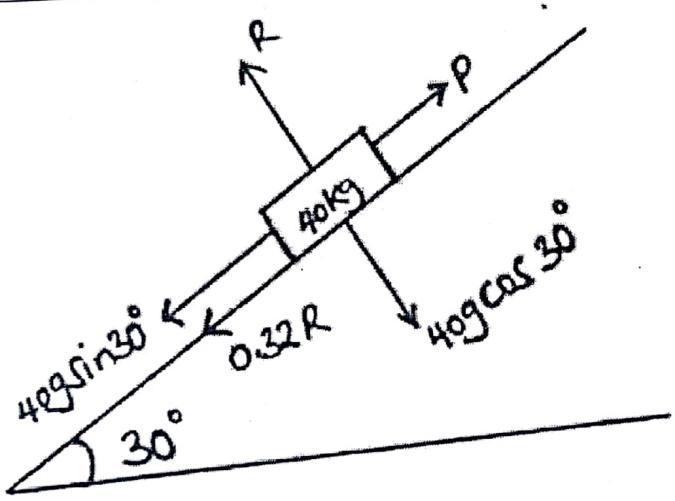
$n-1 = \dfrac{\log 19683}{\log 3}$

$n = 1 + \dfrac{\log 19683}{\log 3}$ A1 [05]

$n = 1+9$

$n = 10 terms$

8.



B1

$R = 40g\cos 30^0$ B1

$p = 40g\sin 30^0 + 0.32R$ M1

$P = 40g\sin 30^0 + 0.32(40g\cos 30^o)$ M1

$p = 40g(\sin 30^o + 0.32\cos 30^o)$

$p = 304.63N$ A1 [05]

9. a) Price relative $= \dfrac{P2019}{P2018} X100$ M1

for rice $= \dfrac{3300}{2700} \times 100$

$= 122.22$ A1

For Posho $= \frac{2200}{1800} \times 100$ A1

$= 115.79$

For beans $= \frac{3100}{2800} \times 100$ A1

$= 110.71$

For cowpeas $= \frac{2800}{3000} \times 100$ A1

$= 93.33$

For salt $= \frac{1400}{1200} \times 100$ A1

$= \underline{116.67}$

b) Simple aggregate price index $= \frac{\sum P2019}{\sum P2018} \times 100$ M1

$= \frac{3300+2200+3100+2800+1400}{2700+1900+2800+3000+1200} \times 100$ M1

$= \frac{12800}{11600} \times 100$ A1

$= 110.34$

The simple aggregate price index increased by 10.34% B1

c) Cost of living index $= \frac{\sum P2019X\,W2019}{\sum P2018\,XW\,2018} \times 100$ M1

$= \frac{(3300\times96)+(2200\times110)+(3100\times45)+(2800\times55)+(1400\times16)}{(2700\times100)+(1900\times80)+(2800\times50)+(3000\times40)+(1200\times15)} \times 100$ M1

$= \frac{874,700}{700,000} \times 100$ M1 A1

$= \underline{124.961}$

The cost of living index increased by 24.96% B1

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10.a)

$S = 2t^3 - 9t^2 + 12t$

$v = \frac{ds}{dt} = 6t^2 - 18t + 12$ M1

$for..v = 0$

$6t^2 - 18t + 12 = 0$ M1

$t^2 - 3t + 2 = 0$

$(-2,-1)$

$t^2 - 2t - t + 2 = 0$

$t(t-2) - 1(i-2) = 0$

$(t-1)(t-2) = 0$ M1

$t = 1 second$

t=1 second or t = 2 seconds A1

$at\ t = 1$

$s = 2(1)^3 - 9(1)^2 + 12(1)$ M1

$s = 2 - 9 + 12$

$s = 14 - 9$

$s = 5m$ B1

$t = 2 seconds$

$S = 2(2)^3 - 9(2)^2 + 12(2)$ M1

$s = 16 - 36 + 24$

$s = 40 - 36$

$\underline{\underline{s = 4m}}$ A1

b)

$a = \frac{dv}{dt}$

$but V = 6t^2 - 18t + 12$

$a = \frac{d}{dt}(6t^2 - 18t + 12)$ M1

$a = 12t - 18$

$when\ t = 1 second$ M1

$a = 12(1) - 18$

$a = 12 - 18$ A1

$a = -6ms^{-2}$

When t = 2 seconds

$a = 12(2) - 18$

$a + 24 - 18$

$a = 6ms^{-2}$ A1

c)

$a = 0$ *then*

$12t - 18 = 0$

$6(2t - 3) = 0$ M1

$2t - 3 = 0$

$t = \frac{3}{2}$ seconds

from $V = 6t^2 - 18t + 12$ M1

at $t = 3/2\ s$

$V = 6\left(3/2\right)^2 - 18\left(3/2\right) + 12$

$V = 6\left(9/4\right) - 9(3) - 12$ A1 [15]

$V = -3/2\ ms^{-1}$

11

i) M1

$A + 0.21 + B + 0.29 + 0.12 + 0.05 = 1$

$A + B = 1 - 0.67$ B1

$A + B = 0.33$.....(*i*)

$2^2 A + 3^2(0.21) + 4^2(B) + 5^2(0.29) + 6^2(0.12) + 7^2(0.05) = 19.51$ M1

$4A + 1.89 + 16B + 7.25 + 4.32 + 2.45 = 19.51$

$4A + 16B = 19.51 - 15.91$

$4A + 16B = 3.6$ B1

$A + 4B = 0.9$.....(*ii*)

Solving eqn(*i*) & (*ii*) *simulteneously* M1

$A + B = 0.33$

$-A + 4B = 0.9$

$\frac{-3B}{-3} = \frac{-0.57}{-3}$ A1

$B = \underline{0.19}$

$A = 0.33 - B$

$A = 0.33 - 0.19$ A1

$A = \underline{0.14}$

X	2	3	4	5	6	7
P(X=x)	0.14	0.21	0.19	0.29	0.12	0.05

ii)

Variance = $E(x^2)-[(E(x))]^2$

But $E(x)=\sum_{x=2}^{7} xP(X=x)$

$E(x)=2\times0.14+3\times0.21+4\times0.19+5\times0.29+6\times0.12+7\times0.05$ M1

$=4.19$ M1

Variance $=19.51-(4.19)^2$ A1

$=\underline{\underline{1.9539}}$

iii)

$P(x\le4)=P(x=4)+P(x=3)+P(x=2)$ M1

$=0.19+0.21+0.14$

$=\underline{\underline{0.54}}$ A1

iv)

$P(x<6/x\geq4)=\dfrac{P(x<6\cap x\geq4)}{P(x\geq4)}$ M1

for $x<6,\ x=2,3,4,5$

for $x\geq4$, $x=4,5,6,7$

$x<6\cap x\geq4\{x=4,x=5\}$

$p(x<6\cap\geq4)=p(x=4)+p(x=5)$

$=0.19+0.29$

$=0.48$

$P(x\geq4)=P(x=4)+P(x=5)+P(x=6)+P(x=7)$

$0.19+0.29+0.12+0.05$

$=0.65$

$P(x<6/x\geq4)=\dfrac{0.48}{0.65}$ M1

$=\underline{\underline{0.7385}}$ A1

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12. PQ:SR:2:1

$$\frac{PQ}{SR} = \frac{2}{1}$$

$$PQ = 2SR$$ M1

$$OQ - OP = 2[OR - OS]$$

$$\begin{pmatrix}4\\9\end{pmatrix} - \begin{pmatrix}0\\3\end{pmatrix} = 2\left[\begin{pmatrix}9\\1\end{pmatrix} - \begin{pmatrix}x\\y\end{pmatrix}\right]$$ M1

$$\begin{pmatrix}4\\6\end{pmatrix} = 2\begin{bmatrix}9-x\\1-y\end{bmatrix}$$

$$2\begin{pmatrix}2\\3\end{pmatrix} = 2\begin{pmatrix}9-x\\1-y\end{pmatrix}$$ M1

$$2 = 9 - x$$

$$x = 9 - 2$$

$$x = 7$$ M1

$$3 = 1 - y$$

$$y = 1 - 3$$

$$y = -2$$ A1

$$\therefore S(7,-2)$$

ii)

PR=QR-OP M1

$$= \begin{pmatrix}9\\1\end{pmatrix} - \begin{pmatrix}0\\3\end{pmatrix}$$

$$= \begin{pmatrix}9\\-2\end{pmatrix}$$ A1

$$= QS = OS - OD$$

$$= \begin{pmatrix}7\\-2\end{pmatrix} - \begin{pmatrix}4\\9\end{pmatrix}$$ M1

$$QS = \begin{pmatrix}3\\-11\end{pmatrix}$$ A1

iii)

$$PR \bullet QS = \begin{pmatrix} 9 \\ -2 \end{pmatrix} \bullet \begin{pmatrix} 3 \\ -11 \end{pmatrix}$$

$= 9(3) + -2(-11)$

$27 + 22$

$= 49$

iv)

$$PR \bullet QS = |PR||QS|\cos\theta$$

$$49 = \sqrt{(9)^2 + (-2)^2}\sqrt{(3)^2 + (11)^2}\cos\theta$$

$$49 = \sqrt{81+4}\sqrt{9+121}\cos\theta$$

$$49 = \sqrt{85}\sqrt{130}\cos\theta$$

$$49 = \sqrt{85(130)}\cos\theta$$

$$49 = \sqrt{11050}\cos\theta$$

$$\cos\theta = \frac{49}{\sqrt{11050}}$$

$$\theta = \cos^{-1}\left(\frac{49}{11050}\right)$$

$$\theta = \underline{\underline{62.22^{\circ}}}$$

13.

Time(minutes)	f	x	fx	fx^2	Cf
60-65	1	62.5	62.5	3906.25	1
65-70	4	67.5	270	18225	5
70-75	9	72.5	652.5	47306.25	14
75-80	7	77.5	542.5	42043.75	21
80-85	13	82.5	1072.5	88481.25	34
85-90	6	87.5	525	45937.5	40
90-95	8	92.5	740	68450	48
95-100	2	97.5	195	19012.5	50
	$\sum f = 50$		$\sum fx = 4060$	$\sum fx^2 = 333362.5$	

B1 B1 B1

a) $mean = \frac{\sum fx}{\sum f}$

M1

$= \frac{4060}{50}$

$= \underline{\underline{81.2}}$

A1

$s\tan darddeviation = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$

M1

$= \sqrt{\frac{333362.5}{50} - (81.2)^2}$

$= \underline{\underline{8.5913}}$

A1

b) Refer to the Ogive/cumulative frequency curve

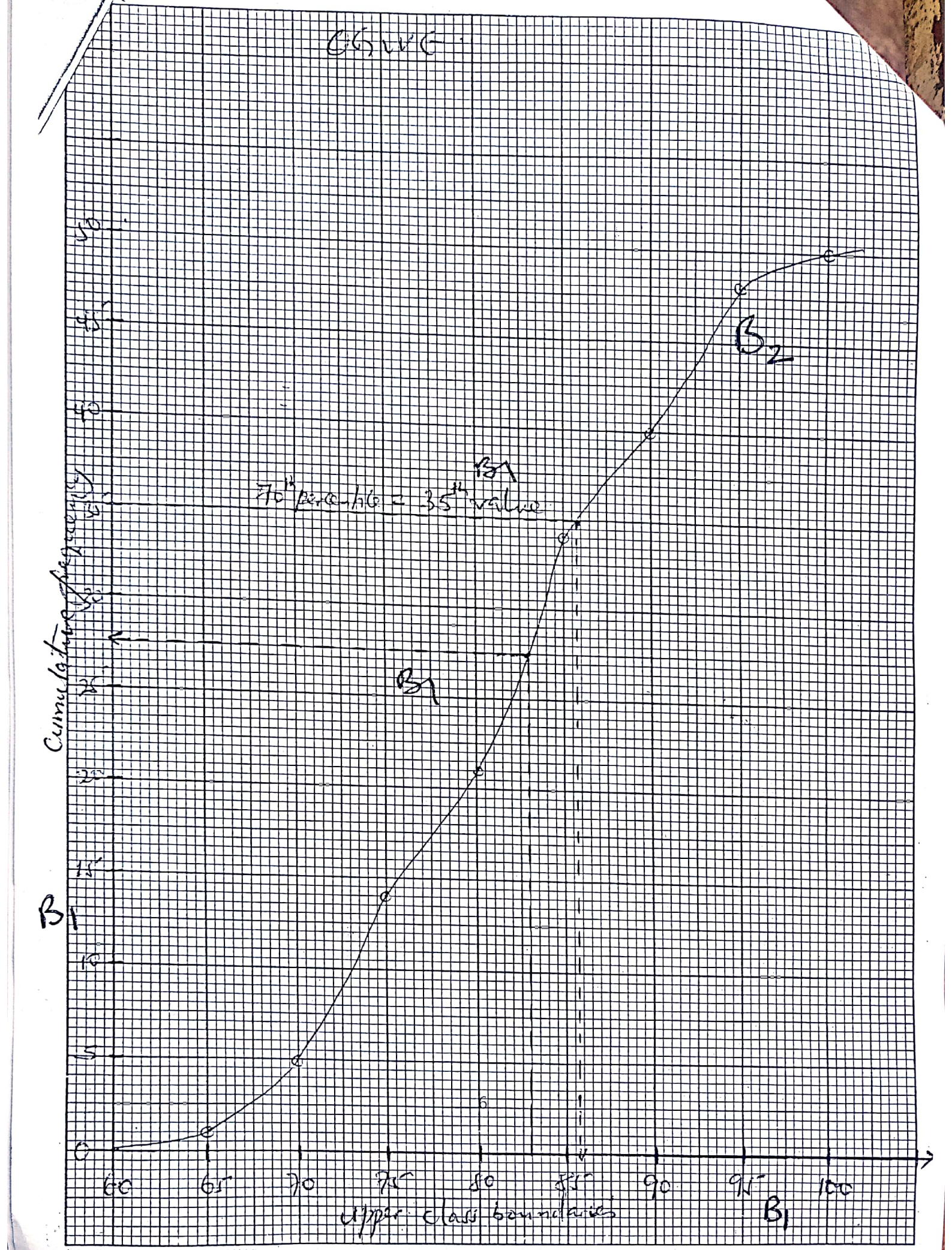
i) =85.75

B1

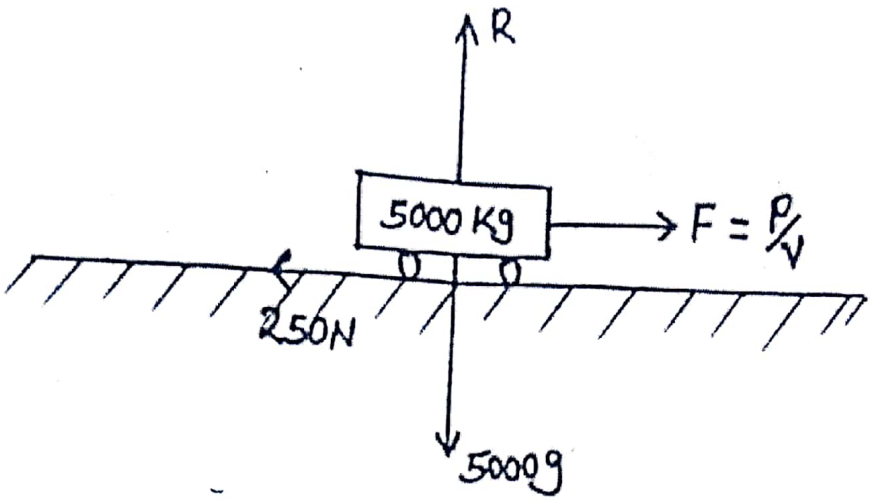
ii)27.5

= <u>28 carpenters</u>

B1



14 i)



B1

$P/V = 250$

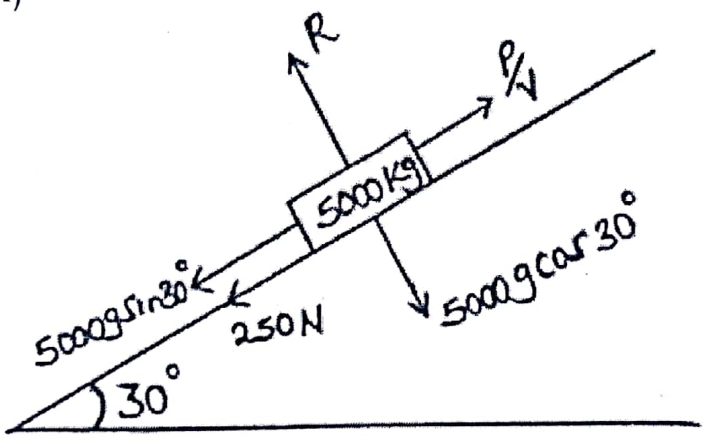
$P = 250V$ M1

$but\ V = 10ms^{-1}$

$P = 250 \times 10$ M1

$P = \underline{\underline{2500W}}$ A1

ii)



B1

$P/v = 5000g\sin 30^0 + 250$ M1

$P/v = 24750$

$\frac{2500}{v} = 24750$ M1

$\frac{v}{2500} = \frac{1}{24750}$ M1

$V = \frac{2500}{24750}$ A1

$V = 0.101ms^{-1}$

b) $Work\ done = Fs$

$F = mg$ B1

$F = 50\ x\ 9.8$ M1

$F = 490N$ M1

$S = 30m$ A1

$Work\ done = 490\ X\ 30$ M1

$= \underline{\underline{14700J}}$ A1

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END.