GUIDE

P425/2
APPLIED
MATHEMATICS
PAPER 2
Jul/Aug 2018

3 hours

MUKONO KAYUNGA JOINT MOCK EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

APPLIED MATHEMATICS

Paper 2

3 hours

INSTRUCTIONS TO CANDIDATES:

Answer all the eight questions in section A and five questions from section B.

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

All working must be shown clearly.

Begin each answer on afresh sheet ofpaper.

Graph paper is provided.

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

 Turn over

SECTION A

1. Events A and B are such that P $A/B) = 3/8$, P(A' n B')- 14 and $P(A)+P(B)$ =-2324 • Find;

   (ii) p(B/A')

(05 marks)

2. The table below shows the values of x and their corresponding values offix).

x	1.8	2.3	3.1	3.9
fix)	3.352	5.587	14.571	32.899

   Use linear interpolation or extrapolation to obtain the value of;

   (i) f(2.9)
   (ii) 1(35.154)

(05 marks)

3. A particle is acted upon by two forces Fl —3i_ +4j)N and F2 = 75N in the direction 24i_ — 7j. Find the magnitude and direction of the resultant force. (05 marks)

4. A continuous random variable X is uniformly distributed in the interval (30, 45). Calculate the;

   (i) Mean of X
   (ii) > 39)

(05 marks)

5. A body of weight W is held in limiting equilibrium on a rough slope inclined at 60^0 to the horizontal by a force P at angle of 30^0 to the slope. The coefficient of friction being , show that P W. (05 marks)

6. Show graphically that the root of the equation $2x^3$ —4x—5 = 0 exist in the interval (1, 2). (05 marks)

7. A particle moving with simple harmonic motion has a speed of 2ms- when it is AVE m from its mean position. Given that the amplitude of its motion is 1.5m, calculate its; (i) velocity as it goes through the mean position.

   (ii) Time taken when it is of its amplitude from the maximum displacement.

(05 marks)

8. The marks of 6 students in French and Biology were as follows:

French	0	6	0	544		.70
Biolou	8	2	60	78	5	

Calculate the rank correlation coefficient for the scores in the two tests. Comment on your results.
(05 marks)

14. The probability density function of a continuous random variable x is represented by the equation below:

$$f(x)\begin{cases}\frac{2}{13}(x+1) & ; \\ \frac{2}{13}(5-x) & ; \\ 0 & ; \text{ elsewhere}\end{cases}$$

Calculate the;

a) the value of a. (07 marks)
b) $P(x<2.5)$ (05 marks)

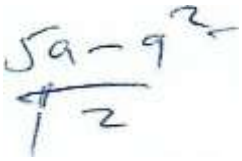
15. A biased coin is thrice as likely to show heads as tails. If it is tossed 48 times, find the probability of obtaining;
a) between 30 and 40 heads.
b) at least 28 but less than 42 heads.

(12 marks)

16. A car of mass 800kg tows a trailer of mass 200kg. The constant resistance acting on the car and the trailer are 450N and R respectively. If the car has maximum speed of 54kmhon the level road, with the engine at steady rate of 9.75kW, find the;
(i) Tension in the tow bar
(ii) The value of R
(iii) Acceleration of the car at a speed of 72kmlf [1].

(12 marks)

END



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SECTION B

9. The lengths (h) in inches of 40 nails were as follows.

Lengths (h)	Frequency
3.002<3.5	8
3.5 sh<4.O	5
4. 0K h < 5. 5	12
$5.5 \le h < 6.0$	9
$6.0 \le h < 6.5$	6

a) Calculate;

(i) The mean

(ii) The standard deviation.

b) Display the data on a histogram and use it to estimate the mode.

(12 marks)

10. a) Use the trapezium rule with 6 ordinates to estimate, to 3 decimal places the value of the integral f^3—4dx .

b) Obtain the exact value of the integral in a) above. Hence calculate the percentage error in your estimation.

(12 marks)

11. A ball is projected from the top of a vertical cliff 36m high with a speed of 40ms- at an angle of elevation 0. The ball passing the highest point, P which is 12m above the point of projection after 2 seconds.

a) Find the value of 0.

b) The horizontal from the foot of the cliff where the ball lands.

c) Find the speed and direction of the ball as it hits the ground.

(12 marks)

12. a) The mass M and velocity V of a car were estimated with error AM and AV respectively. Show that the maximum relative error in the kinetic energy is $\left|\frac{AM}{M}\right| + \left|\frac{AV}{V}\right|$ (07 marks)

b) Find the range with in which the exact value of $\frac{4.25}{3.152-2.4}$ lies. (05 marks)

13. A square ABCD of side 4m has forces of magnitude 8N, 3N, 4N and 2N/5N acting along AB, CB, DA, CD and BD respectively. Taking AB and AD as x and y axes respectively,

a) Find the distance from A where the line of action of the resultant crosses AB. (07 marks) b) When a force P is introduced, the system reduces to a couple. Find the magnitude of (05 marks)

1. $P(A|B) = \frac{1}{4}$ GOIDE APPLIED MATHS

$P(A' \cap B') = \frac{1}{4}$

$P(A) + P(B) = \frac{23}{24}$

from $P(A' \cap B') = P(A \cup B)'$

$P(A \cup B) =$

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$\frac{3}{4} - \frac{23}{24} = -P(A \cap B)$

$-\frac{5}{24} = -P(A \cap B)$

$P(A \cap B) =$

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

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

$\frac{5}{24} / \frac{3}{8} = \frac{5}{24} \times \frac{8}{3} = \frac{5}{9}$

$\frac{23}{24} - \frac{5}{9} = \frac{69-40}{72} = \frac{29}{72}$

-11

$P(A \cap$

$\frac{\frac{5}{9} - \frac{2}{24}}{\frac{43}{72}} = \frac{25}{72} \times \frac{72}{43}$ B

-25

0 S

B

$\frac{y_0 - 5.587}{2.9 - 2.3}$ 。、。二 $\frac{14.571 - y_0}{3.1 - 2.9}$

当 $= \frac{14.571 - y_0}{}$ 。~、ンキ

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0=

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32.899　つ　ろ&　　ハ日

3j・い当一3 a &望9　$\frac{32.899 - 14.571}{3.9 - 3.1}$

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$x_0 - 3.9$

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$-3i+4j$

$\frac{75}{|24i-7j|}(24i-7j) = \frac{75}{25}(24i-7j) = 3(24i-7j)$

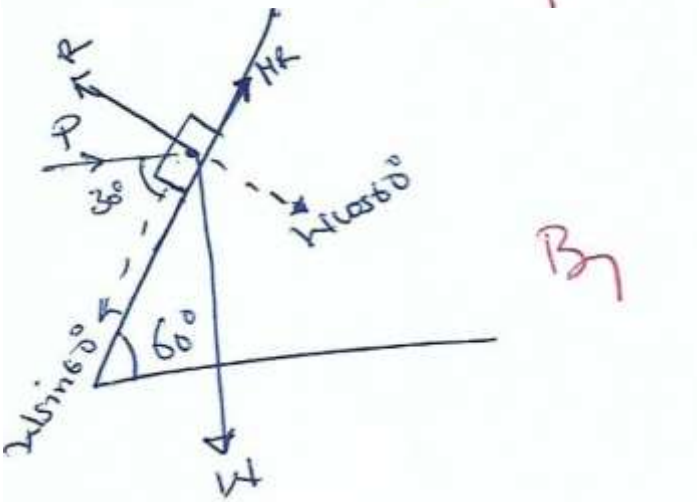
$= F_1 + F_2$　　一3 し十一

$X \sim R(30, 45)$

$$f(x) = \begin{cases} \frac{1}{15}, & 30 \le x \le 45 \\ 0, & \text{otherwise} \end{cases}$$

$$= \int_{30}^{45} \frac{1}{15} x \, dx = \frac{x^2}{30}\Big|_{30}^{45} = \frac{45^2 - 30^2}{30}$$

$$P(X > 39) = \int_{39}^{45} \frac{1}{15} dx = \frac{x}{15}\Big|_{39}^{45} = \frac{45 - }{15}$$



$\rightarrow \quad P\cos 30 + \mu R = W \sin 60$

$\uparrow \quad R = W\cos 60 + P\sin 30$

$$P\cos 30 + \frac{1}{2}(W\cos 60 + P\sin 30) = W\sin 60$$

$$\frac{\sqrt{3}}{2}P + \frac{1}{2}\left(W\left(\frac{1}{2}\right) + \frac{1}{2}P\right) = \frac{\sqrt{3}}{2}W$$

$\frac{\sqrt{3}}{2}(W-P)$

$(2+4\sqrt{3})P = (k\text{っ})い$

$= (4\sqrt{3}-2)^2 W$

$f(1)\cdot f(2) = -\text{又}0.$

$S = \sqrt{2m}$

$A = 1.5m$

S、Ho、へ

$V = max.$

$V_{max} = \omega A = \frac{2\pi}{T} A = \left(\frac{2\pi}{T}\right) 1.5$ By

$V^2 = 7(A^2 - x^2)$

$3 = \sqrt{\frac{4}{2.25-2}}$

3 $= \sqrt{\frac{4}{0.25}}$

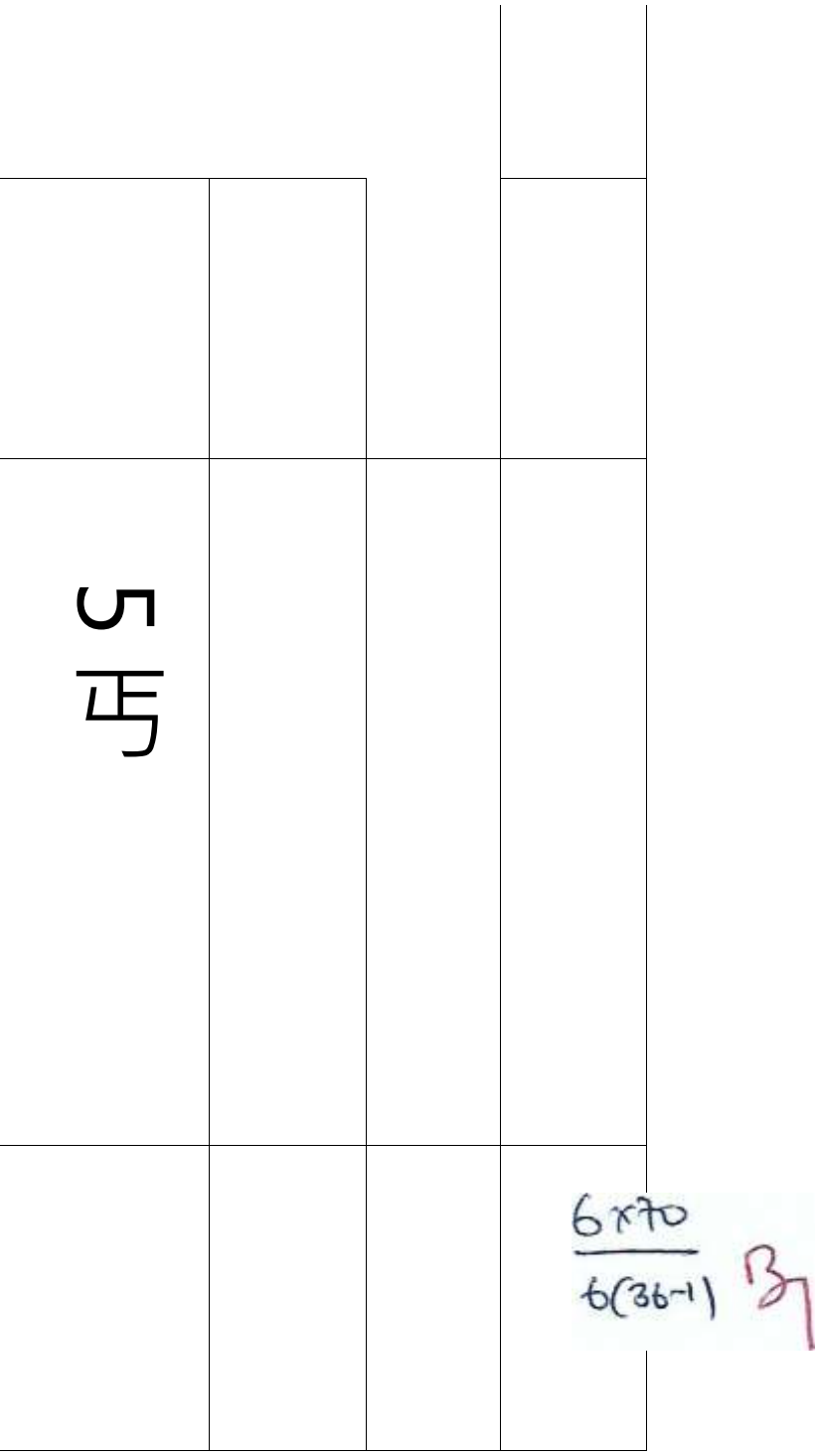
3 $= \sqrt{\frac{400}{25}}$ 3

$= \frac{20}{5} = 4$ B

下- $4 \times 1.5 = 6 \text{ m/s}$ A

Asmwt

$\frac{1}{4}(1.5) = 1.5 \sin \omega t$.



Significant correlation

c	f-A	x	fx	fx^2
0.5	16	3.25	26	84.5
0.5	10	3.75	18.75	70.3125
1.5	8	4.75	57	270.75
0.5	18	5.75	51.75	297.562
0.5	12	6.25	37.5	234.375
	B1	B1	B1	B1
			Σfx = 191	Σfx^2 = 9575

= 4.775 Inches B1

$$-\left(\frac{191}{40}\right)^2$$ B1

6875

05 on

nches' #7

$\frac{12}{12}$

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on the

3

$$\int_{1}^{3} \frac{x}{1+x^2}\, dx$$

$$h = \frac{3-1}{6-1} = \frac{2}{5} = 0.4$$ B1

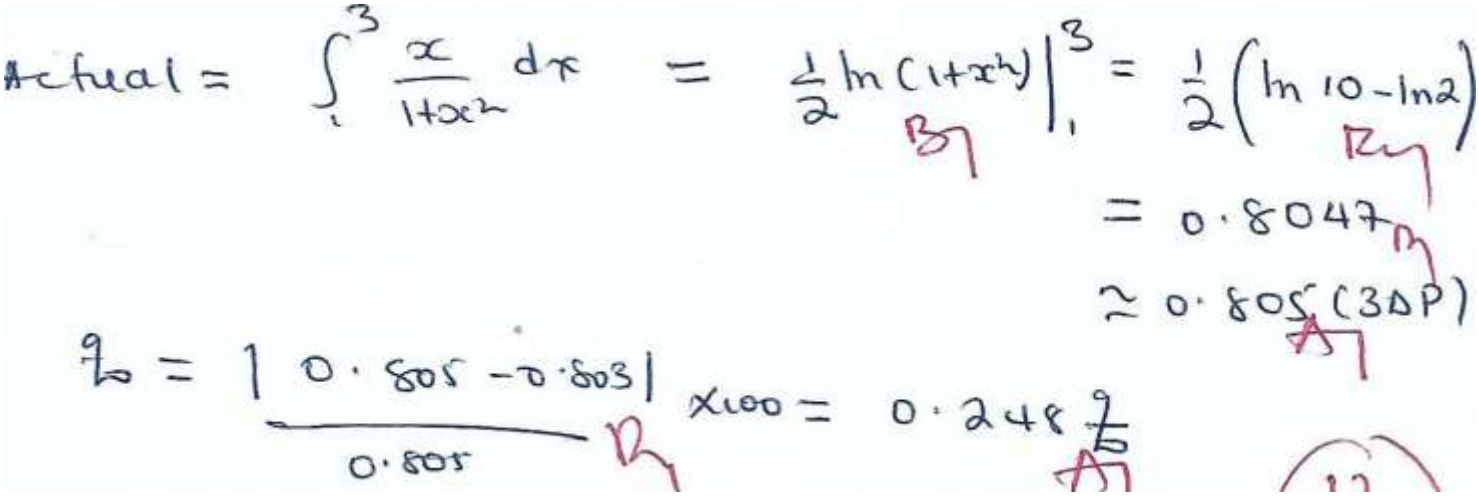
n	x_n	$y_n = \frac{x_n}{x_n^2+1}$
0	1	0.5000
1	1.4	0.4730
2	1.8	0.4245
3	2.2	0.3767
4	2.6	0.3351
5	3.0	0.3000 B1
6		0.8000 1.6093 B1

$$\int_1^3 \frac{x}{1+x^2}\,dx = \frac{1}{2}(0.4)(0.8000 + 2(1.6093)]$$ B1

$$= 0.8030$$ A1

0

$$0.803 \text{ (3DP)}$$ A1



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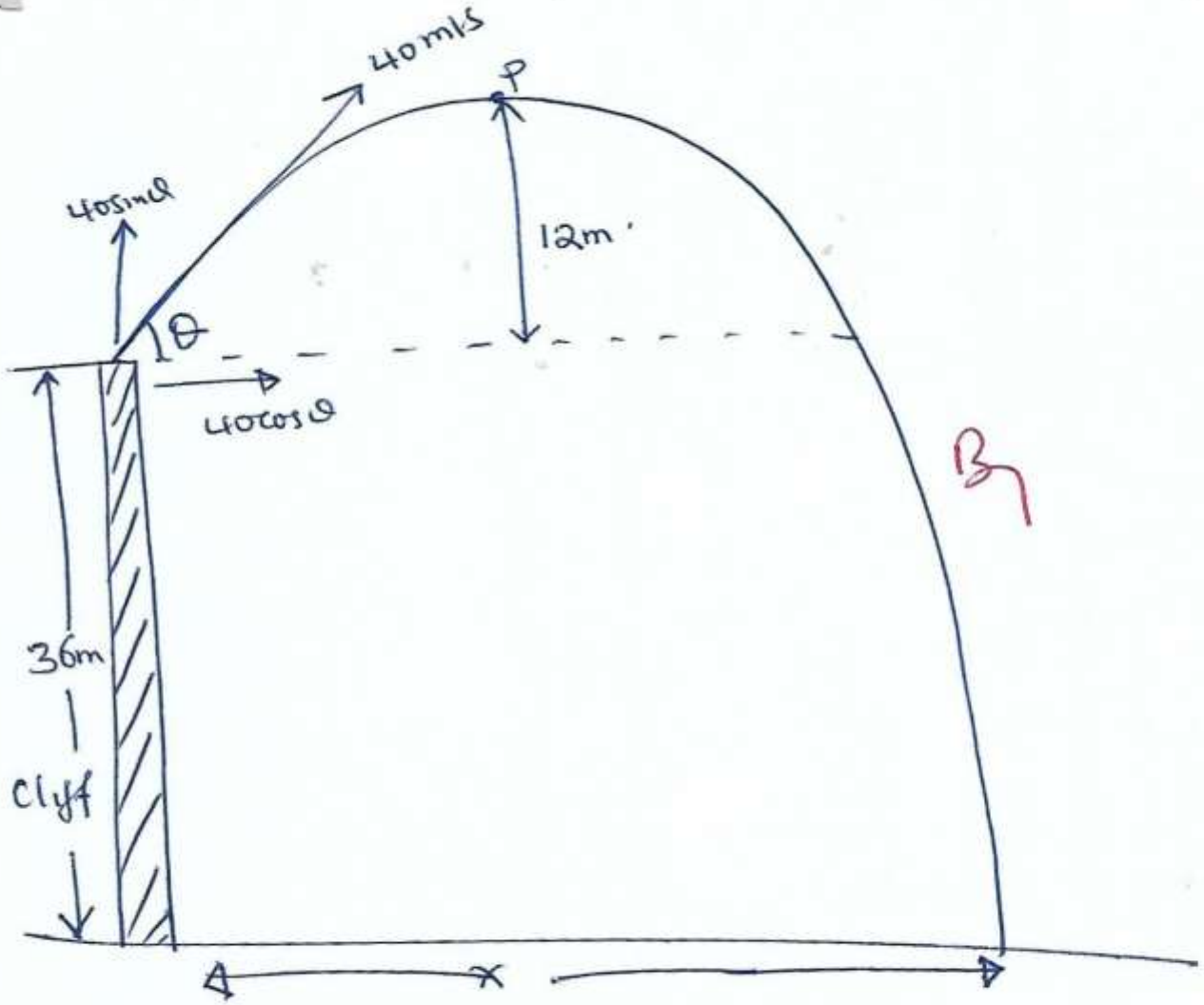

B1

$$H = \frac{U^2 \sin^2\theta}{2g}$$

$$12 = \frac{40^2 \sin^2\theta}{2g}$$

B1

$$\sin^2\theta = \frac{12 \times 2g}{40^2}$$

$$\sin^2\theta = 0.147$$

$$\theta = 22.5^\circ \quad A1$$

$$12 = (40\sin\theta)(2) - \tfrac{1}{2} \times 9.8 \times 4$$

$$\sin\theta = 0.395$$

$$\theta = 23.3^\circ.$$

12/12

$$-36 = (U\sin\theta)\,t - \tfrac{1}{2} g t^2$$

$$4.9t^2 - 15.3t - 36 = 0 \quad B1$$

$$t = \frac{15.3 \pm \sqrt{15.3^2 \; [illegible]}}{[illegible]}$$

h 0℃ら、ゞ乂H，も $q = 173.3m$ B1 A1

$V_x =$ 40 て心多よ、て $= 36.955\ m/s$ B1 405m22.5 一午8（64）

$-30.655\ m/s$

$\sqrt{36.955^2 + (-30.655)^2}$ M1

$48.01\ m/s$ A1

$\theta = 39.7°$ B1 below the horizontal.

$K.E = \frac{1}{2}mv^2$ B1

$E + \Delta E = \frac{1}{2}(m+\Delta m)(v+\Delta v)^2$ B1

$\Delta E = \frac{1}{2}(m+\Delta m)(v^2 + 2v\Delta v + (\Delta v)^2) - \frac{1}{2}mv^2$ B1

$\Delta E = \frac{1}{2}(mv^2 + 2mv\Delta v + m(\Delta v)^2 + v^2\Delta m + 2v\Delta m\Delta v + \Delta m(\Delta v)^2 - \frac{1}{2}$

$(\Delta v)^2 \approx 0,\ \Delta m\Delta v = 0$ B1

$\Delta E = \frac{1}{2}(2mv\Delta v + v^2\Delta m)$ B1

$\frac{\Delta E}{E} = \frac{mv\Delta v}{\frac{1}{2}mv^2} + \frac{\frac{1}{2}v^2\Delta m}{\frac{1}{2}mv^2}$ B1

$$= \left|2\frac{\Delta v}{v} + \frac{\Delta m}{m}\right| \leq \left|2\frac{\Delta v}{v}\right| + \left|\frac{\Delta m}{m}\right|$$

$$\frac{4 \cdot 25}{3 \cdot 152 - 2 \cdot 4}$$

$$\text{Max}(A) = \quad \text{H。}$$

2 5ヽ

$$= \frac{}{3 \cdot 1575 - 2 \cdot 45} \quad B$$

$$= 6 \cdot 0655\,7 \cdot A$$

$$\text{Min}(A) = \frac{4 \cdot 245}{3 \cdot 1525 - 2 \cdot 35} \quad B$$

$$= 5 \cdot 28971\,A$$

$\frac{12}{12}$

[5·28971 "006 賞 9」

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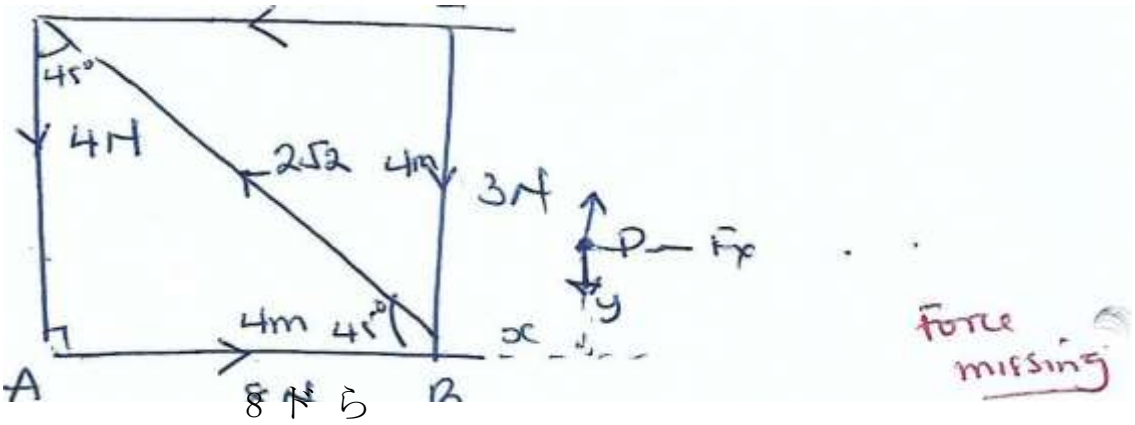


8 下 ら

0 4 十 $+\begin{pmatrix}0\\-4\end{pmatrix}+\begin{pmatrix}-2\sqrt{2}\sin 45\\2\sqrt{2}\sin 45\end{pmatrix}$

ーう

A'NJ トび下$=-(2\sqrt{2}\sin 45)4$

Jト 5 =一分

一し&料口上 0、tm し之、、改 4 .

a couple :

?十= 0 .

$$\sqrt{4^2+5^2} = \sqrt{16+25}$$

=会ヤ可 H.

$$f(x) = \begin{cases} \frac{2}{B}(x+h), & 0 \le \\ 2/13(5-x) & ; 9 \\ 0 & ; \text{Else where.} \end{cases}$$

oんェに気

, 蜃 久 3

$$f(9) = \quad a\ \frac{2}{3}(5-9).$$

=5_

Max(A) 4 , $\frac{}{3.1515-2.45}$ B7 S S

6.0655 7. A7

$$a = \frac{4}{2} = 2$$

or

$$\int_0^a \frac{2}{13}(x+h)\,dx + \int_a^3 \frac{2}{13}(5-x)\,dx =$$

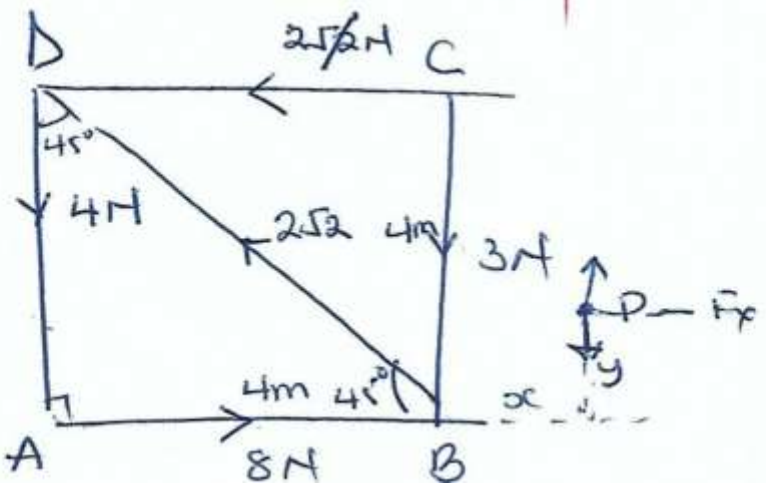
$$\frac{1}{3}\left[\frac{x^2}{2}+x\Big|_0^9 + 5x - \frac{x^2}{2}\Big|_a^3\right] =$$

$$\text{Min}(A) = \frac{4.245}{3.1525 - 2.35}$$ B

$$= 5.28971$$ A

12/12

$[5.28971 \cdot 6.06557]$. B



Force missing

4 $\begin{pmatrix}0\\-3\end{pmatrix} + \begin{pmatrix}-2\\0\end{pmatrix} + \begin{pmatrix}0\\-4\end{pmatrix} + \begin{pmatrix}-2\sqrt{2}\sin 45\\2\sqrt{2}\sin 45\end{pmatrix}$

$\begin{pmatrix}4\\-5\end{pmatrix}$

$4Y + 57Q = -(2\sqrt{2}\sin 45)4 + 3(4) - 2(4)$

$$\frac{2}{13}\left[\frac{a^2}{2}+a+(15-9/2)-(45a-a^2/2)\right]=1$$

$$a^2-44a+\frac{21}{2}=\frac{13}{2}$$

$$a^2-44a=-\frac{8}{2}$$

$$a^2-44a+4=0.$$

$$a=2.$$

$$P(X<2.5)=\int_0^2 \frac{2}{13}(x+1)\,dx+\int_{2.0}^{2.5}\frac{2}{13}(5-x)\,dx$$

$$=\frac{2}{13}\left[\frac{x^2}{2}+x\Big|_0^2+5x-\frac{x^2}{2}\Big|_2^{2.5}\right]$$

$$=\frac{2}{13}\left[4+(12.5-6.25)-(10-2)\right]$$

$$=\frac{2}{13}\left[-8+12.5-3.125\right]$$

= $\frac{11}{52}$ = ~~0.2115~~ B7

$\frac{43}{52}$ = 0.5269. B7

12/12

P(H) = 3/4

P(T) = 1/4 B7

p = 3/4

q = 1/4

n = 48

npq) B7

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0 斗.833<Z<1.167) = (B7

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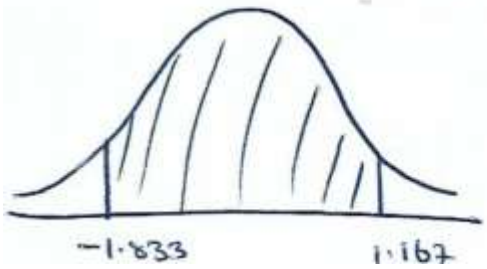

P(30 < X < 40) = P(30.5 28 ≤ X 4 食)=

By

P(30.5-36 / 3 < Z < 39.5-36 / 3) =

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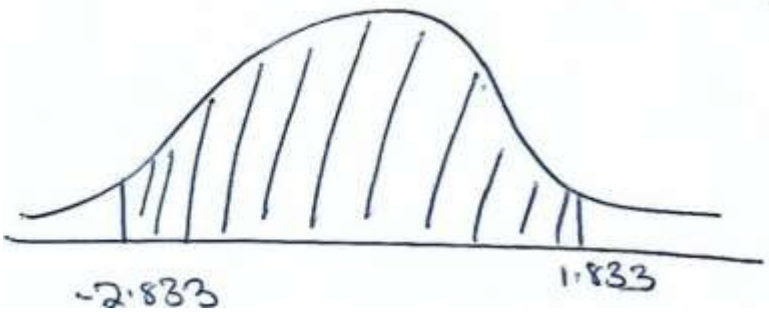

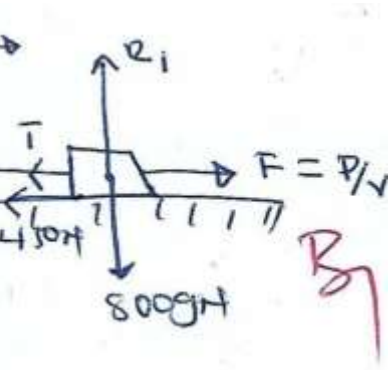

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