P425/2
APPLIED MATHEMATICS
Paper 2
July /Aug. 2025
3 hours

UGANDA TEACHERS' EDUCATION CONSULT (UTEC)

Uganda Advanced Certificate of Education

APPLIED MATHEMATICS

Paper 2

3 hours

INSTRUCTIONS TO CANDIDATES:

Answer **all** *questions in* ***section A*** *and any* **five** *from* ***section B.***

All necessary working must be shown clearly.

Silent non – programmable scientific calculators and mathematical tables may be used.

Any extra question(s) attempted in section ***B*** *will* **not** *be marked.*

SECTION A (40 MARKS)

1. Given that A and B are events in the same sample space such that $P(A \cap B) = {}^{3}/_{8}$ and $P(A' \cup B) = {}^{3}/_{4}$, find;

   (a) $P(A \cap B')$
   (b) $P(A)$

   (05 marks)

2. A body falls from rest from the top of a vertical tower, and in its last second it falls $\frac{9}{25}$ of the whole height of the tower. Calculate the height of the tower.

   (05 marks)

3. The marks of students in a Mathematics test are uniformly distributed between 40 and 80. The pass mark is 55.

   (a) Calculate their mean mark. ***(02 marks)***
   (b) Three students are picked at random, calculate the probability that all three failed to attain the pass mark. ***(03 marks)***

4. At a car hire service centre the amounts paid to travel to given distances (measured from the centre) are shown in the table above.

Distance (km)	10	15	25
Charge (shs)	30,000	40,000	60,000

   Use linear estimation to calculate the;

   (a) Distance travelled at a cost of 70,000 shillings. ***(03 marks)***
   (b) Basic fee each passenger pays before leaving the station. ***(02 marks)***

5. The position vector of a particle, t seconds into motion is;
   $\boldsymbol{r} = 4t^2\boldsymbol{i} + (6t + 10)\boldsymbol{j}$ metres.
   Calculate the average speed of the particle in the time interval $t = 0 \ to \ t = 2 \ seconds.$

   (05 marks)

6. Given that $x = 2.4, y = 1.80$ are corrected to the given number of decimal places; compute to maximum error in $x^2 - y$.

   (05 marks)

7. X is a discrete random variable. Study the table below;

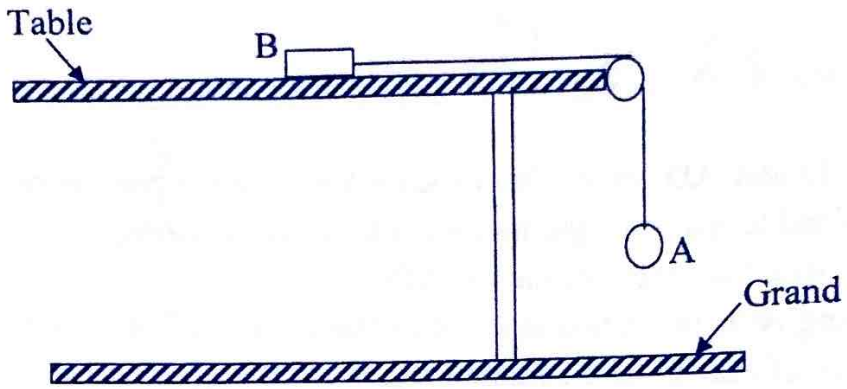
x	1	2	3	4	5
$P(X \leq x)$	0.1	0.25	0.55	0.7	1

Use the table to; *(04 marks)*

(a) Calculate the mean of X. *(01 mark)*

(b) Find the 80^{th} percentile.

8.



A and B are particle of mass 2kg and 3kg respectively.

(a) If particle B is in limiting equilibrium on a horizontal table. Calculate the coefficient of friction at the table and the tension in the string. *(05 marks)*

SECTION B

Answer FIVE questions only from this section

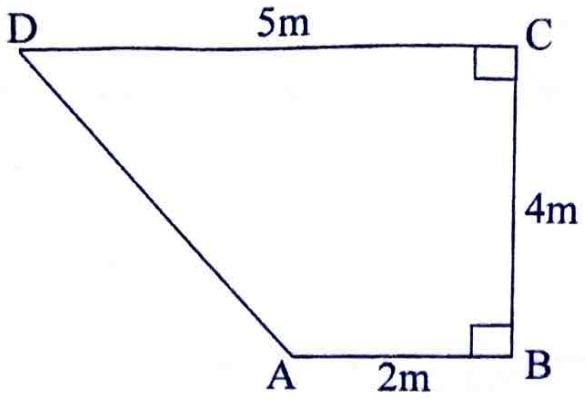
9. (a) Derive the iteration formula based on the Newton – Raphson Method for computing the root of the equation $2x = cosx$. *(04 marks)*

(b) Construct a flow chart for the process in (a) above.
Using $x_o = 0.2$; perform a dry run of your flow chart hence find the root correct to 3 dps. *(08 marks)*

10. In a certain school the ratio of boys to girls is 2:3. Students are picked at random, one at a time with replacement.

(a) Ten students are picked at random. Calculate the probability that at least 6 are boys. *(05 marks)*

(b) One hundred and fifty students are picked at random; calculate the probability that at least 78 but less than 96 are girls. *(07 marks)*



AB, BC, CD and AD are uniform rods whose weight per metre is 10N. the rods are joined to make a rigid frame work as shown above.

(a) Calculate the length of the rod AD. ***(02 marks)***

(b) Taking A as the origin and AB as the x – axis, find coordinates of the centre of gravity of the framework. ***(06 marks)***

(c) The framework is suspended from point B, calculate the angle rod AB will make with the vertical. ***(04 marks)***

12.

Number of cars	–10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
Number of days	2	10	6	10	4	0

The table represents the number of cars passing through a check point, recorded over a period of 32 days.

(a) Construct a histogram for this data, and use it to estimate the modal number of cars passing through the check point.

(b) Calculate the mean and the variance of the number of cars passing through the point in the given period. Construct a 95% confidence interval for the mean number of cars passing through this point.

13. (a) Calculate the exact value of the integral; ***(05 marks)***

$$\int_{-1.5}^{0} \frac{1}{\sqrt{4-2x}}\, dx$$

(b) Use the trapezium rule with 7 ordinates to evaluate $\int_{-1.5}^{0} \frac{1}{\sqrt{4-2x}}\, dx$ to 3 dpls.

Hence compute the absolute error in your answer. ***(07 marks)***

14. X is a continuous random variable whose C.D.F is given as;

$$F(x) = \begin{cases} 0 & ; \quad x \leq 0 \\ bx^2 & ; \quad 0 \leq x \leq 1 \\ c\,(10x - x^2 - 5) & ; \quad 1 \leq x \leq 5 \\ 1 & ; \quad x \geq 5 \end{cases}$$

(a) Find the constants **b** and **c** hence compute the median. ***(07 marks)***

(b) Calculate the expectation of X. ***(05 marks)***

15. (a) The forces $\begin{pmatrix} 6 \\ +5 \end{pmatrix}, \begin{pmatrix} -4 \\ 2 \end{pmatrix}, \begin{pmatrix} 5 \\ 0 \end{pmatrix}$ *and* $\begin{pmatrix} 1 \\ -1 \end{pmatrix} N$ act at the points (2,2), (-2, 2), (-2, -2) and (2, -2) respectively. Find the equation of the line of action of the resultant force. ***(06 marks)***

(b) To a cyclist travelling southwards at $6ms^{-1}$ a wind appears to blow in the direction S030°W; and when he doubles his speed the wind appears to blow in the direction S060°W. Calculate the actual velocity of the wind. ***(06 marks)***

16. A particle of mass 2kg initially at rest is acted upon by a force of $48t^2\boldsymbol{i} + (24 - 8t)\boldsymbol{j}\ N$ at any time t seconds. Calculate the;

(a) magnitude of the initial acceleration of the particle

(b) velocity after ts.

(c) work done by the force in the time interval $t = 0$ to $t = 2$ seconds. ***(12 marks)***

END

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UTEC 2025 APPLIED MATHEMATICS PROPOSED GUIDE:

BY TR. E. HENRY
0707443129

1(a) $P(A \cap B) = 3/8$, $P(A' \cup B) = 3/4$

$P(A \cap B')$:

from $P(A' \cup B) = P(A \cap B')'$ m1

$3/4 = 1 - P(A \cap B')$

$P(A \cap B') = 1 - 3/4$ B1

$= 1/4$ A1

(b) $P(A) = P(A \cap B) + P(A \cap B')$

$= \frac{3}{8} + \frac{1}{4}$ m1

$P(A) = 5/8$ A1

05

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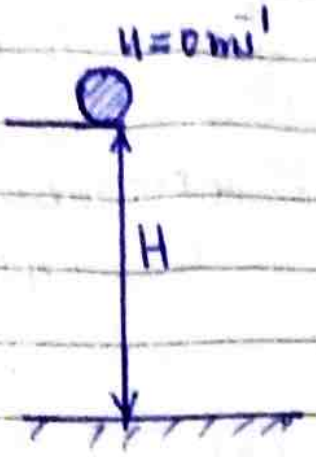

Distance fallen in n seconds: $S_n = \frac{1}{2}gn^2$

$\Rightarrow$ Total height, $H = \frac{1}{2}gn^2$

But distance fallen in last second $= S_n - S_{(n-1)}$

$= \frac{1}{2}gn^2 - \frac{1}{2}g(n-1)^2$ 1

$= \frac{1}{2}g\left(n^2 - (n-1)^2\right)$

$= g(n - \frac{1}{2})$ B_1

$\Rightarrow g(n-\frac{1}{2}) = \frac{9}{25} \times \frac{1}{2}gn^2$ M_1

$9n^2 - 50n + 25 = 0$ B_1

$n = \frac{50 \pm \sqrt{(-50)^2 - 4(9)(25)}}{2(9)}$

$n = 5s \quad n = 5/9$ B_1

But $n = 5s$

$\therefore H = \frac{1}{2} \times 9.8 \times 5^2$ or $H = \frac{1}{2} \times 10 \times 5^2$

$= 122.5m$ $(g = 9.8 ms^{-2})$ $= 125m$ (for $g = 10 ms^{-2}$) A1

65

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3. $[a,b] = [40, 80]$

(i) Mean, $E(x) = \frac{(80+40)}{2}$, from $E(x) = \frac{(b+a)}{2}$ m1

$= 60$ B1

(ii) $P(X < 55) = \int_{40}^{55} \frac{1}{40} dx$ m1

$= \frac{1}{40}\left[x\right]_{40}^{55} = \frac{1}{40}(55-40)$ B1

$= \frac{15}{40}$

$= \frac{3}{8}$ A1

05

4. (a)

D	15	25	d
shs	40,000	60,000	70,000

$\frac{25-15}{60,000-40,000} = \frac{d-15}{70,000-40,000}$ B1

$d = 30$ km A1

(b)

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(b) Let the charge take a linear form;

$C = mD + b$ (shs), where C - cost
D - distance
b - is the basic fee
m - gradient

Using points (D, C);

(10, 30,000) and (25, 60,000)

$$m = \frac{60,000 - 30,000}{25 - 10} \quad m_1$$

$m = 2000$ shs/km B_1

From $C = mD + b$, and point (10, 30,000)

$b = 30,000 - (2000 \times 10)$

$= 10,000$ shillings B_1

∴ The basic fee the passenger pays is 10,000 shillings

05

5 $\underline{r} = 4t^2\underline{i} + (6t+10)\underline{j}$

Average speed = $\frac{\text{change in displacement}}{\text{change in time}}$

$= \frac{|r(t=2)| - |r(t=0)|}{2-0}$ B1

$r(t=2) = 16\underline{i} + 22\underline{j}$

$r(t=0) = 0\underline{i} + 10\underline{j}$ B1

Average speed = $\frac{\sqrt{16^2+22^2} - \sqrt{10^2}}{2}$ B1 m1

$= 8.604\ ms^{-1}$ A1 A1

05

6 $x = 2.4$, $y = 1.80$

$e_x = 0.05$ $e_y = 0.005$

Let $H = x^2 - y$

$H_{max} = x^2_{max} - y_{min}$

$= (2.4+0.05)^2 - (1.80-0.005)$ m1

$= 4.2075$ B1

$H_{min} = x^2_{min} - y_{max}$

$= (2.4-0.05)^2 - (1.80+0.005)$ m1

$= 3.7175$ B1

Maximum error = $\frac{4.2075 - 3.7175}{2}$

$= 0.245$ A1

05

7.

x	$P(X \leq x)$	$P(X=x)$	$xP(X=x)$
1	0.1	0.1	0.1
2	0.25	0.15	0.3
3	0.55	0.3	0.9
4	0.7	0.15	0.6
5	1	0.3	1.5
			$\Sigma xP(X=x)$
			$= 3.4$

B1 B1

(a) Mean, $\bar{x} = 3.4$ A1

(b) $F(5) = 1 > 0.8$ B1

$\therefore 80^{th}$ Percentile $= 5$ A1

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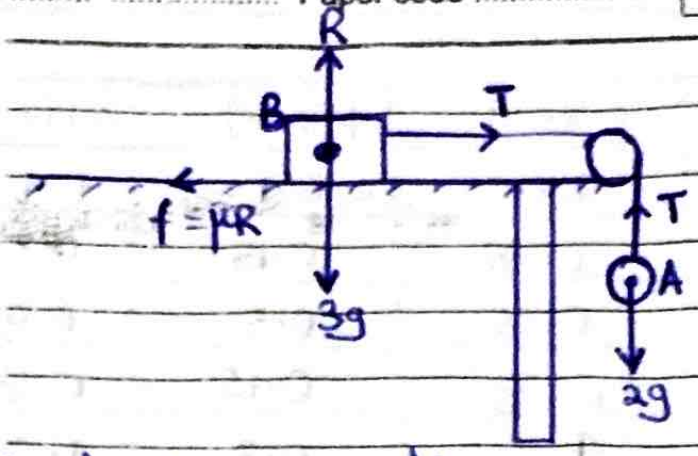

sketch — B1

At limiting equilbrium, $a = 0 ms^{-2}$

For the 3kg mass;

$T = \mu R$ —— (1), $R = 3g$ M1

For the 2kg mass;

$T = 2g$ M1

$T = 2 \times 9.8$

$T = 19.6N$ B1

$\Rightarrow 19.6 = 3 \times 9.8 \mu$

$\mu = 0.6667$ or $2/3$ B1

∴ The Tension in the string is 19.6N and the Coefficient of friction is $2/3$

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9 (a) Let $f(x) = 2x - \cos x$

$f'(x) = 2 + \sin x$ — B_1 – Correct Diff.

$$x_{n+1} = x_n - \frac{(2x_n - \cos x_n)}{2 + \sin x_n} \quad B_1$$

$$= \frac{x_n(2 + \sin x_n) - (2x_n - \cos x_n)}{(2 + \sin x_n)} \quad B_1$$

$$= \frac{2x_n + x_n \sin x_n - 2x_n + \cos x_n}{2 + \sin x_n}$$

$$= \frac{x_n \sin x_n + \cos x_n}{2 + \sin x_n}, \quad n = 0, 1, 2 \text{---} \quad B_1$$

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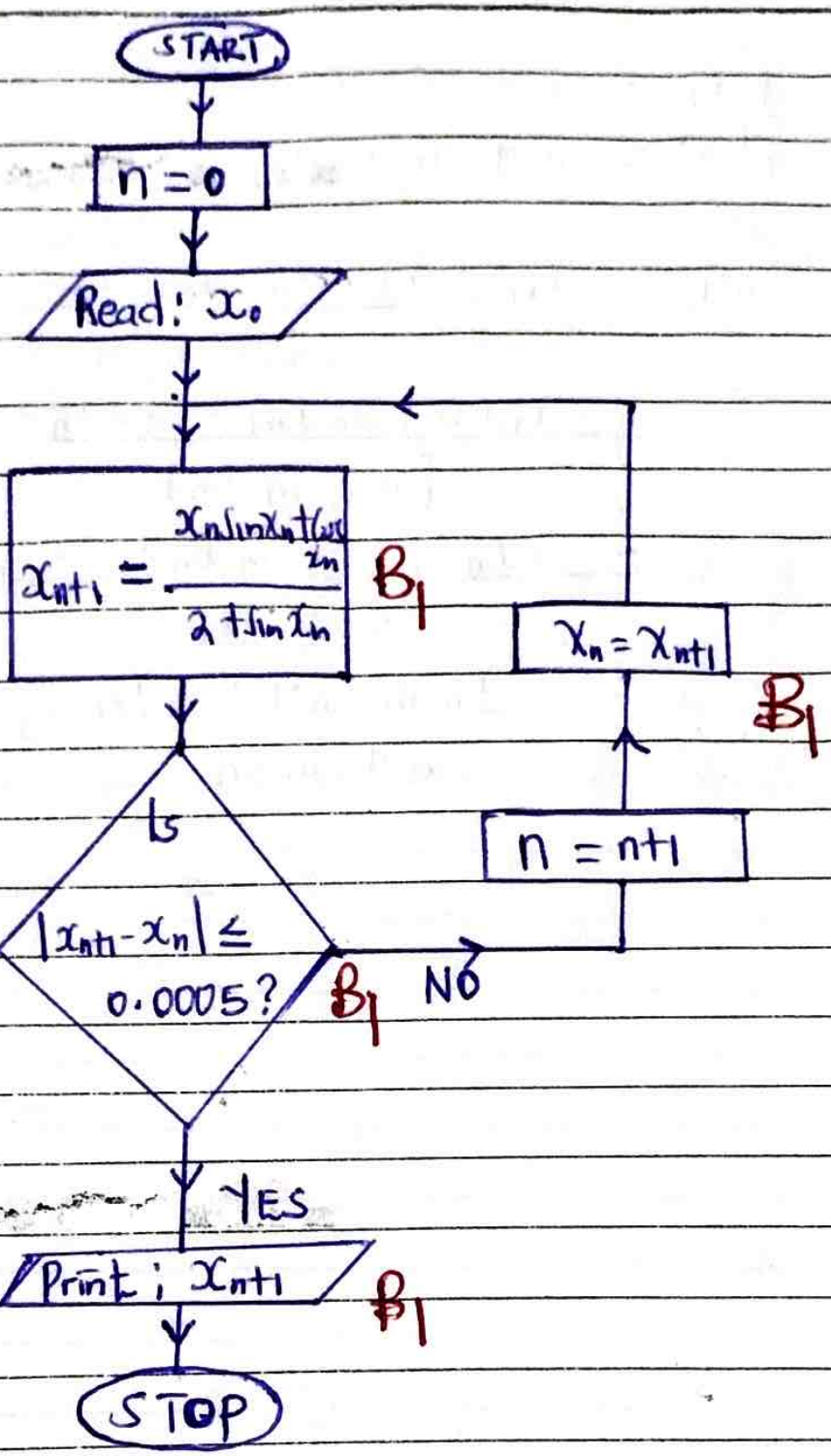
(b)



B1 B1 B1 B1 B1

Dry Run:

n	x_n	x_{n+1}	$\lvert x_{n+1} - x_n \rvert$
0	0.2	0.46383	0.26383
1	0.46383	0.45022	0.01361
2	0.45022	0.45018	0.00004 B1

∴ The root of the equation is 0.4501 A1 12

10 (a) Total ratio = 2+3
= 5 B1

P = probability of picking aboy
⇒ P = 2/5 B1
q = 3/5

let X- represent random variable for number of boy picked;

$P(X \geq 6) = \sum_{i \geq 6} P_i$

= 0.1662 B1 AJA

Any Alternative approach with Correct values:
B1 – for Correct P
B1 – for Correct Mean
B1 – for Correct S.D

(b) $n = 150$, $\mu = np = \frac{3}{5} \times 150$
$p = 3/5$, $q = 2/5$

$\mu = 90$

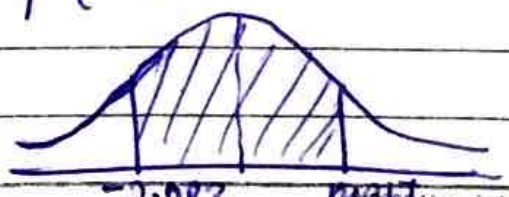
$\sigma = \sqrt{90 \times 2/5}$

$\sigma = 6$

$P(78 \leq X < 96) = P(77.5 \leq X < 95.5)$ B1

$= P\left(\frac{77.5 - 90}{6} \leq Z < \frac{95.5 - 90}{6}\right)$ B1

$= P(-2.083 < Z < 0.917)$ B1 → 3d.p



$= \Phi(2.083) + \Phi(0.917)$ B1 – Correct values

$= 0.4813 + 0.3203$

$= 0.8016$ A1

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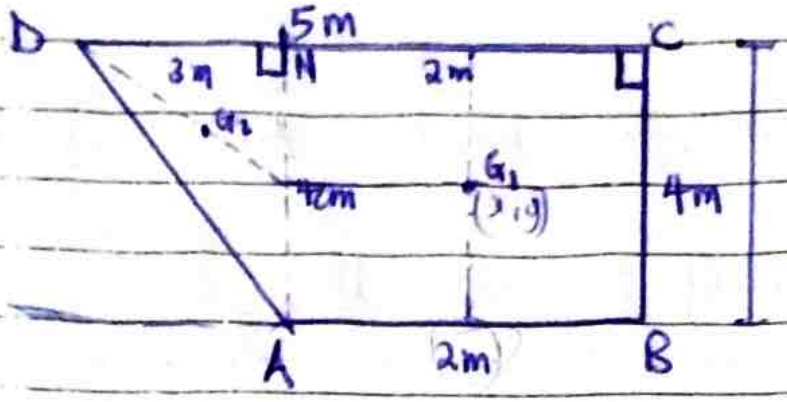
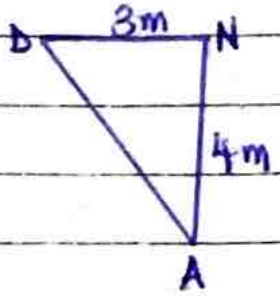


(a) Length $\overline{AD}$:



$\overline{AD}^2 = 3^2 + 4^2$ m_1

$\overline{AD} = \sqrt{25}$

$\overline{AD} = 5m$

Leng $AD = 5m$ A_1

$\overline{02}$

(b) Let P be the weight per unit area

Taking AB and BC

Figure	Area	Weight	x	y	
ABCN	$(4\times2) = 8$	8P	$\frac{1}{2}\times2 = 1$	$\frac{1}{2}\times4 = 2$	B_1
AND	$(\frac{1}{2}\times3\times4) = 6$	6P	$2+\frac{1}{3}(3) = 3$	$\frac{2}{6}\times4 = \frac{8}{3}$	B_1
Whole	$(8+6) = 14$	14P	$\bar{x}$	$\bar{y}$	B_1

Taking moments about AB and BC axes

$$8p\begin{pmatrix}1\\2\end{pmatrix} + 6p\begin{pmatrix}3\\8/3\end{pmatrix} = 14p\begin{pmatrix}\bar{x}\\\bar{y}\end{pmatrix}$$ M1

$$\begin{pmatrix}8\\16\end{pmatrix} + \begin{pmatrix}18\\16\end{pmatrix} = \begin{pmatrix}14\bar{x}\\14\bar{y}\end{pmatrix}$$

$$\begin{pmatrix}26\\32\end{pmatrix} = \begin{pmatrix}14\bar{x}\\14\bar{y}\end{pmatrix}$$

$26 = 14\bar{x}$

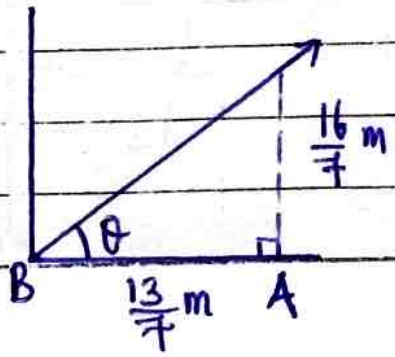
$\bar{x} = \frac{13}{7}$ m A1

$32 = 14\bar{y}$

$\bar{y} = \frac{16}{7}$ m A1

The Co-ordinates of C.O.G are $(13/7)$ m from BC and $16/7$ m from AB 06

(c) let θ be angle between AB with the vertical.



$\tan\theta = \left(\frac{16}{7} \times \frac{7}{13}\right)$ B1 – sketch

B_1B_1 – Substitution

$\theta = 50.91°$ A1 – Correct value

04

12.

Class	f	x	fx	fx^2
0-10	2	5	10	50
10-20	10	15	150	2,250
20-30	6	25	150	3,750
30-40	10	35	350	12,250
40-50	4	45	180	8100
	$\Sigma f = 32$		$\Sigma fx = 840$	$\Sigma fx^2 = 26,400$

$B_1 - \Sigma fx^2$
$B_1 - \Sigma fx$
$n_{\Sigma f}$ – substitution

(b) Mean, $\bar{x} = \frac{840}{32}$

$= 26.25$ A1

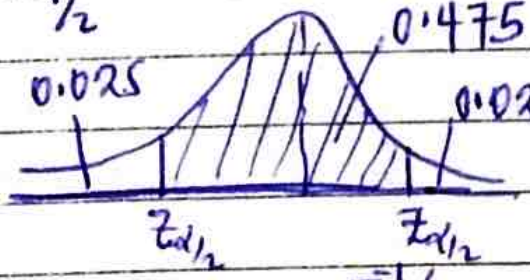
Variance, $\sigma^2 = \left(\frac{26400}{32}\right) - \left(\frac{840}{32}\right)^2$ $n_{\Sigma f}$

$= \frac{2175}{16}$ or 135.9375 A1

For 95% Confidence Interval;

$(1-\alpha) = 0.95$

$\alpha/2 = 0.025$



$z_{\alpha/2} = \Phi^{-1}(0.475)$

$z_{\alpha/2} = 1.96$ B1

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$$\mu = \bar{x} \pm Z_{\alpha/2} \cdot \frac{\sigma}{\sqrt{n}}$$

$$= 26.25 \pm 1.96 \cdot \frac{\sqrt{\frac{2175}{16}}}{\sqrt{32}} \quad M_1$$

$$\mu = 26.25 \pm 4.0397$$

Upper limit $= 26.25 + 4.0397$

$= 30.2897$

Lower limit $= 26.25 - 4.0397$

$= 22.2103$

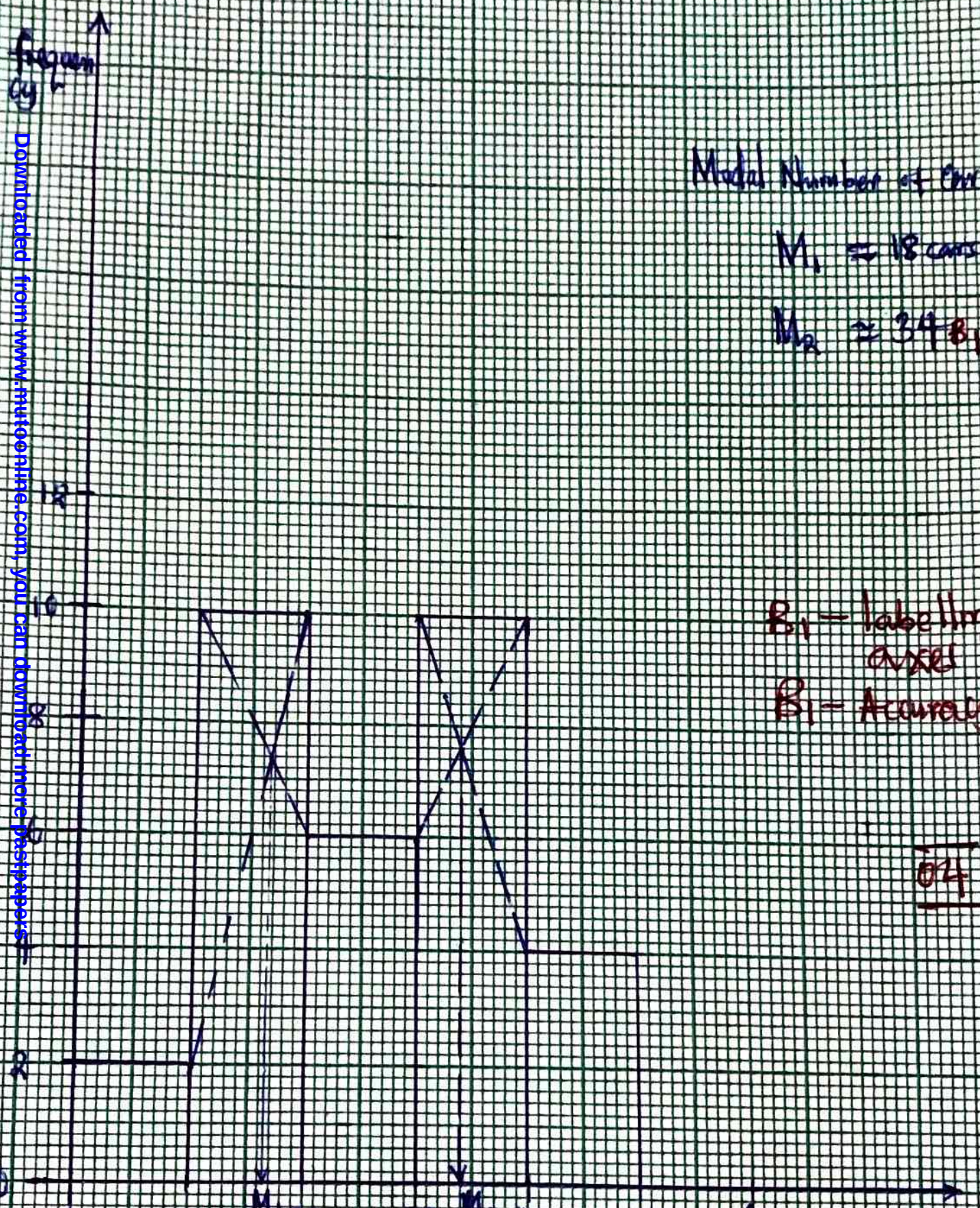
B_1 – for upper and lower limit (Correct)

Interval is $[22.2103, 30.2897]$ or A_1

$$22.2103 \leq \mu \leq 30.2897$$

12 (a)

A HISTOGRAM;



Modal Number of cars

$M_1 = 18$ cars B_1

$M_2 = 34$ B_1

B_1 = labelling axes

B_1 = Accuracy

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13(a) $\int_{-1.5}^{0} \frac{1}{\sqrt{4-2x}}\,dx$

Let $u = \sqrt{4-2x}$ M1

$u^2 = 4-2x$

$2u\,du = -2\,dx$

$dx = -u\,du$

Change of limits:

x	-1.5	0
u	$\sqrt{7}$	2

B1

$\int_{-1.5}^{0} \frac{1}{\sqrt{4-2x}}\,dx = \int_{\sqrt{7}}^{2} \frac{1}{u} \cdot -u\,du$ B1

$= -\int_{\sqrt{7}}^{2} du$

$= -u\Big|_{\sqrt{7}}^{2}$

$= -[2-\sqrt{7}]$ B1

$= 0.64575$

$= 0.6458$ (4dp) A1

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12(b) $h = \frac{1}{4}$ Let $y = \frac{1}{\sqrt{4-2x}}$

x	y	
-1.5	0.37796	
-1.25		0.39223
-1.00		0.40825
-0.75		0.42640
-0.5		0.44721
-0.25		0.47140
0	0.50000	
Sum	0.87796	2.14549
	B_1	B_1

B_1 – Correct value of h

$$\int_{-1.5}^{0} \frac{1}{\sqrt{4-2x}}\,dx \approx \frac{1}{8}\left(0.87796 + 2(2.14549)\right) \quad m_1$$

– strictly with $\approx$ signs

$$\approx 0.6461175$$

$$\approx 0.646 \quad (3\ d.p) \quad A_1$$

– Correct value to 3 d.p

Absolute error $= |0.6458 - 0.6461|$ m_1

$= 0.0003$ A_1

07

14 (a) for $0 \leq x \leq 1$

$F(1) = b$ ——— (i) B_1

for $1 \leq x \leq 5$

$F(1) = 4c$ ——— (ii) B_1

for $1 <$

$F(5) = 20c$ ——— (iii) B_1

for $x \geqslant 5$

$F(5) = 1$ ——— (iv) B_1

(iii) = (iv)

$20c = 1$

$c = \frac{1}{20}$ m_1

$\Rightarrow b = 4\left(\frac{1}{20}\right)$

$b = \frac{1}{5}$ m_1

$\therefore b = \frac{1}{5}$ $c = \frac{1}{20}$

Median;

$F(5) = 1 > 0.5$

$F(m) = 0.5$

$\frac{1}{20}(10m - m^2 - 5) = 0.5$ m_1

$m^2 - 10m + 15 = 0$

$m = \frac{10 \pm \sqrt{(-10)^2 - 4(1)(15)}}{2(1)}$ m_1

$m = 8.1623$ or $m = 1.8377$

But $m \neq 8.1623$;

$\therefore$ Median $= 1.8377$ A_1 07

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14 (b) for $0 \le x \le 1$

$$f(x) = \frac{d}{dx}\left(\frac{1}{5}x^2\right)$$

$$= \frac{2}{5}x \quad B1$$

$$f(x) = \frac{d}{dx}\left(\frac{1}{20}(10x - x^2 - 5)\right)$$

$$= \frac{1}{20}(10 - 2x)$$

$$= \frac{1}{10}(5 - x)$$

$$f(x) = \frac{d}{dx}(1) = 0 \quad B1$$

$$\text{Mean, } E(X) = \int_0^1 \frac{2}{5}x^2\,dx + \frac{1}{10}\int_1^5 (5x - x^2)\,dx$$

$$= \frac{2}{15}x^3\Big|_0^1 + \frac{1}{10}\left[\frac{5}{2}x^2 - \frac{x^3}{3}\right]_1^5 \quad B1$$

$$= \frac{2}{15}(1 - 0) + \frac{1}{10}\left(\left(\frac{50}{2} - \frac{125}{3}\right) - \left(\frac{5}{2} - \frac{1}{3}\right)\right) M1$$

$$= \frac{2}{15} + \frac{28}{15}$$

$$E(X) = 2 \quad A1$$

05

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15 (a) $F_R = \begin{pmatrix}6\\5\end{pmatrix} + \begin{pmatrix}-4\\2\end{pmatrix} + \begin{pmatrix}5\\0\end{pmatrix} + \begin{pmatrix}1\\-1\end{pmatrix}$ m_1

$= \begin{pmatrix}8\\6\end{pmatrix} N$ B_1

$G = \sum(r \times F)$

$= \sum \begin{vmatrix} x & y \\ F_x & F_y \end{vmatrix}$

$= \begin{vmatrix}2 & 2\\6 & 5\end{vmatrix} + \begin{vmatrix}-2 & 2\\-4 & 2\end{vmatrix} + \begin{vmatrix}-2 & -2\\5 & 0\end{vmatrix} + \begin{vmatrix}2 & -2\\1 & -1\end{vmatrix}$ m_1

$= (5\times2) - (6\times2) + (2\times-2) - (-4\times2) + [0 - (-2\times5)] + ((-1\times2) - (-2\times1))$

$= -2 + 4 + 10 + 0$

$= 12$ Nm B_1

Equation of line of action:

$G - xF_y + yF_x = 0$

$12 - x(6) + y(8) = 0$ m_1

$12 - 6x + 8y = 0$

$8y = 6x + -12$

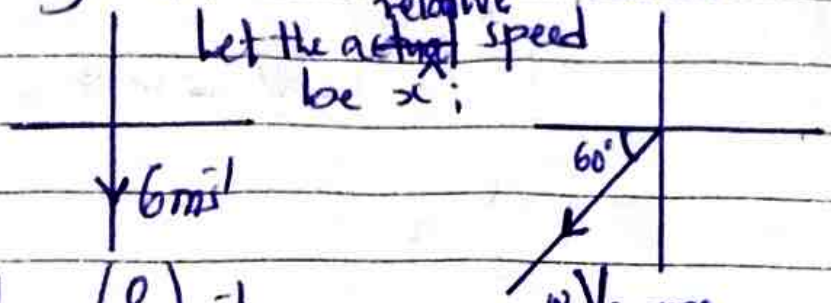
$4y = 3x - 6$ A_1

06

Case One:

(15) (b) Cyclist: Wind:

Let the ~~actual~~ relative speed be x;



$\underset{\sim}{V_c} = \begin{pmatrix} 0 \\ -6 \end{pmatrix} ms^{-1}$

$w\underset{\sim}{V_c}$ $w\underset{\sim}{V_c} = \begin{pmatrix} -x\cos 60 \\ -x\sin 60 \end{pmatrix}$

$w\underset{\sim}{V_c} = \underset{\sim}{V_w} - \underset{\sim}{V_c}$

$\underset{\sim}{V_w} = w\underset{\sim}{V_c} + \underset{\sim}{V_c}$

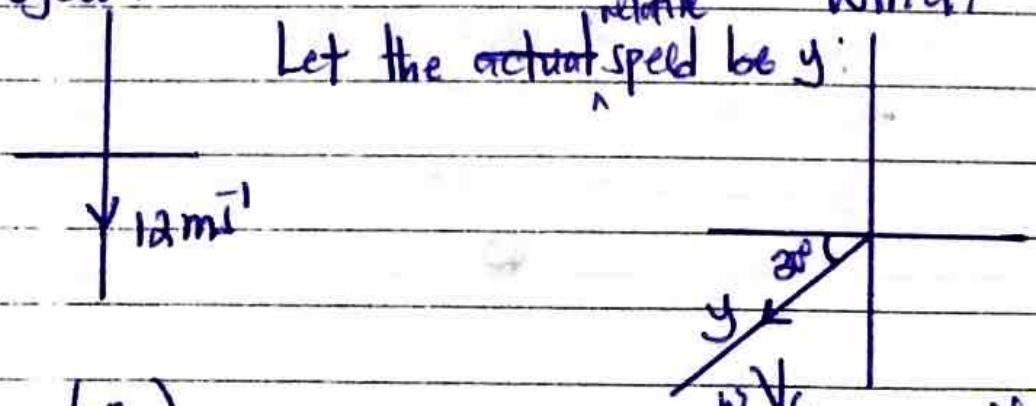
$= \begin{pmatrix} -x\cos 60 \\ -x\sin 60 \end{pmatrix} + \begin{pmatrix} 0 \\ -6 \end{pmatrix}$

$\underset{\sim}{V_w} = \begin{pmatrix} -x/2 \\ -\frac{\sqrt{3}}{2}x - 6 \end{pmatrix}$ ——— (1) $\$7$

Case two:

Cyclist Wind:

Let the ~~actual~~ relative speed be y:



$\underset{\sim}{V_c} = \begin{pmatrix} 0 \\ -12 \end{pmatrix}$ $w\underset{\sim}{V_c} = \begin{pmatrix} -y\cos 30 \\ -y\sin 30 \end{pmatrix}$

$$V_{iw} = \begin{pmatrix} -y\cos 30 \\ -y\sin 30 \end{pmatrix} + \begin{pmatrix} 0 \\ -12 \end{pmatrix}$$

$$= \begin{pmatrix} -\frac{\sqrt{3}}{2}y \\ -\frac{y}{2} - 12 \end{pmatrix} \quad \text{---(II)} \qquad B_1$$

eqn (I) = eqn (II)

$$\begin{pmatrix} -x/2 \\ -\frac{\sqrt{3}}{2}x - 6 \end{pmatrix} = \begin{pmatrix} -\frac{\sqrt{3}}{2}y \\ -y/2 - 12 \end{pmatrix}$$

$$x = \sqrt{3}y \quad \text{---(III)}$$

$$-\frac{\sqrt{3}x}{2} - 6 = -\frac{y}{2} - 12 \quad \text{---(IV)}$$

(III) into (IV) gives;

$$-\frac{3}{2}y + y/2 = -6$$

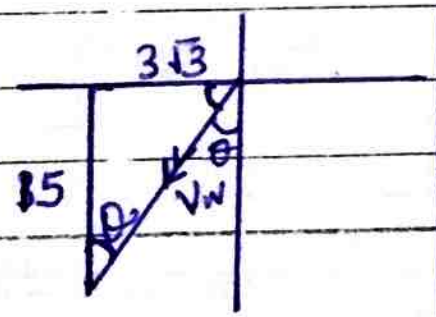
$$y = 6 \qquad m_1$$

From (II)

$$V_w = \begin{pmatrix} -\frac{\sqrt{3}}{2}(6) \\ -6/2 - 12 \end{pmatrix} = \begin{pmatrix} -3\sqrt{3} \\ -15 \end{pmatrix} ms^{-1} \qquad B_1$$

$$|V_w| = \sqrt{(-3\sqrt{3})^2 + (-15)^2}$$

$$= \sqrt{252}\, ms^{-1} \text{ or } 15.8745\, ms^{-1} \; B_1$$



$$\tan\theta = \left(\frac{3\sqrt{3}}{15}\right)$$

$$\theta = 53.30^\circ \; B_1$$

The true velocity of the wind is $\sqrt{252}\, ms^{-1}$ in the direction S53.30°W

06

(16) $\underset{\sim}{F} = 48t^2\underset{\sim}{i} + (24-8t)\underset{\sim}{j}$ N

$m = 2kg$

(a) $\underset{\sim}{a} = \frac{\underset{\sim}{F}}{m}$

$\underset{\sim}{a} = \frac{1}{2}\begin{pmatrix}48t^2\\24-8t\end{pmatrix} = \begin{pmatrix}24t^2\\12-4t\end{pmatrix} ms^{-2}$ m1

Initially, ~~at~~ $t = 0$

$\underset{\sim}{a} = \begin{pmatrix}0\\12\end{pmatrix} ms^{-1}$ B1

$|\underset{\sim}{a}| = \sqrt{0^2 + (12)^2}$ B1

$= 12ms^{-2}$ A1

(b) $\underset{\sim}{v} = \int \underset{\sim}{a}\, dt$

$\underset{\sim}{v} = \int \begin{pmatrix}24t^2\\12-4t\end{pmatrix} dt$ m1

$\underset{\sim}{v} = \begin{pmatrix}8t^3\\12t-2t^2\end{pmatrix} + c$ B1

at $t=0$, $\underset{\sim}{v} = \begin{pmatrix}0\\0\end{pmatrix} \Rightarrow c = \begin{pmatrix}0\\0\end{pmatrix}$

$\underset{\sim}{v}(t) = \begin{pmatrix}8t^3\\12t-2t^2\end{pmatrix} ms^{-1}$ A1

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16 (c) Work done $= \int_0^2 \underset{\sim}{F} \cdot \underset{\sim}{V}\, dt$

$$F \cdot V = \begin{pmatrix} 48t^2 \\ 24 - 8t \end{pmatrix} \cdot \begin{pmatrix} 8t^3 \\ 12t - 2t^2 \end{pmatrix} \quad M_1$$

$$= 384t^5 + (24 - 8t)(12t - 2t^2)$$

$$= 384t^5 + 288t - 144t^2 + 16t^3 \quad B_1$$

$$\text{Work done} = \int_0^2 (384t^5 + 16t^3 - 144t^2 + 288t)\, dt$$

$$= \left[64t^6 + 4t^4 - 48t^3 + 144t^2\right]_0^2 \quad B_1$$

$$= (4352) - 0$$

$$= 4352 \text{ J} \quad A_1$$

B_1 – Substitution

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