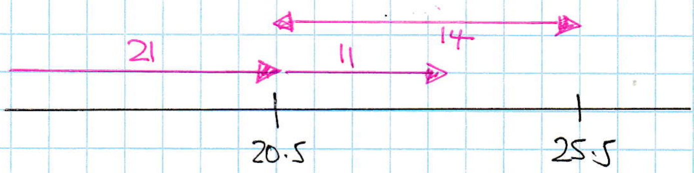
IYGB – MMS PAPER V – QUESTION 1

HOURS (NEAREST HOUR)	MIDPOINTS	FREQUENCY
1 – 10	5.5	5 (5)
11 – 20	15.5	16 (21)
21 – 25	23	14 (35)
26 – 30	28	17
31 – 40	35.5	10
41 – 59	50	2

a) $Q_2 = \frac{1}{2} \times 64 = 32^{\text{ND}}$ OBS WHICH LIES IN 21 – 25



$$Q_2 \simeq 20.5 + \frac{11}{14} \times 5 \simeq 24.4$$

b) USING A STATISTICAL CALCULATOR

$\sum x = 1528.5$ $\qquad \sum x^2 = 42331.75$ $\qquad n = 64$

- $\bar{x} = \frac{\sum x}{n} = \frac{1528.5}{64} = 23.9$
- $\sigma = \sqrt{\frac{\sum x^2}{n} - \bar{x}^2} = \sqrt{\frac{42331.75}{64} - 23.9\ldots^2} \simeq 9.54$

c) MEAN < MEDIAN < (MODE) $\Longrightarrow$ NEGATIVE SKEW

23.9 $\qquad$ 24.4

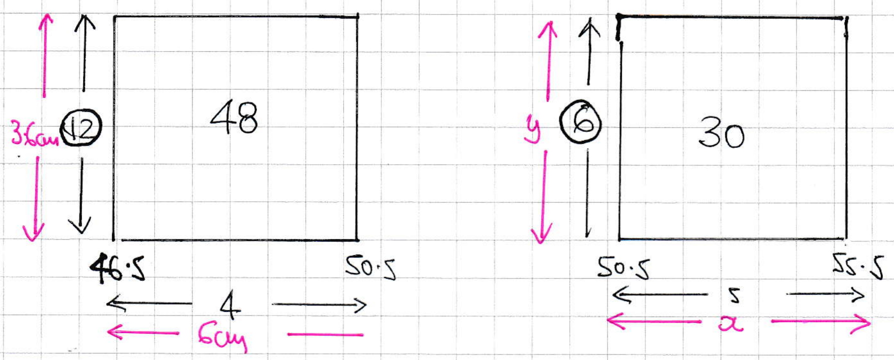
d) USING MEAN ± 2 STANDARD DEVIATIONS AS A MEASURE

"BOTTOM": $23.9 - 2 \times 9.54 \simeq 4.8$ (POSSIBLE OUTLIERS IN 1 – 10)

"TOP": $23.9 + 2 \times 9.54 \simeq 43$ (POSSIBLE OUTLIERS IN 41 – 59)

IYGB - MMS PAPER V - QUESTION 2

LOOKING AT THE DIAGRAM BELOW



WORK THE FREQUENCY DENSITIES FOR EACH RECTANGLE

i.e. $48 \div 4 = 12$

$30 \div 5 = 6$

THE SCALE IN "x" YIELDS

$$\frac{4}{6} = \frac{5}{x}$$

$$4x = 30$$

$$x = 7.5 \text{ cm}$$

(BASE)

THE SCALE IN "y" YIELDS

$$\frac{3.6}{12} = \frac{y}{6}$$

$$12y = 21.6$$

$$y = 1.8 \text{ cm}$$

HEIGHT

IYGB - MMS PAPER V - QUESTION 3

- BEST METHOD TO APPROACH THE PROBLEM IS BY A TWO WAY TABLE

	BIKE	NO BIKE	TOTAL
MALE	45	30	75
FEMALE	10	15	25
TOTAL	55	45	100

75% ARE MALE

25% ARE FEMALE

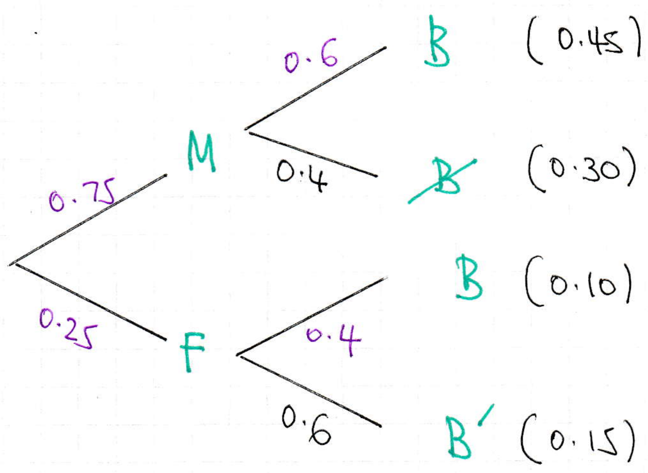
SAY THERE WERE 100 STUDENTS IN TOTAL

60% OF 75

40% OF 25

HENCE $P(\text{FEMALE} \mid \text{BIKE}) = \dfrac{10}{55} = \dfrac{2}{11}$ //

- BY TREE DIAGRAM



- $P(\text{FEMALE} \mid \text{BIKE})$

$= \dfrac{P(\text{FEMALE} \cap \text{BIKE})}{P(\text{BIKE})}$

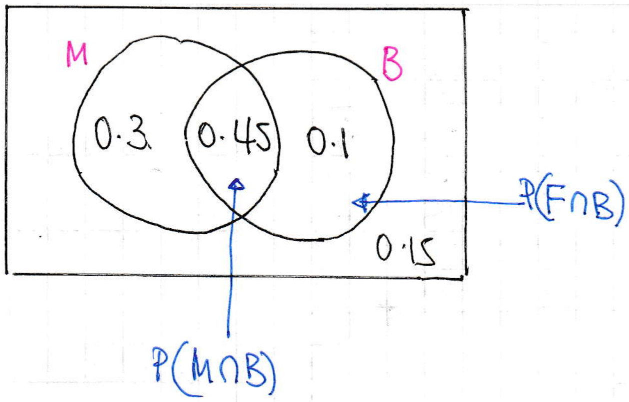
$= \dfrac{0.10}{0.10 + 0.45}$

$= \dfrac{0.10}{0.55} = \dfrac{2}{11}$ //

- BY A VENN DIAGRAM

- $P(M) = 0.75$
- $P(F) = 0.25$
- $P(B \mid M) = 0.6 \implies \dfrac{P(B \cap M)}{P(M)} = 0.6 \implies P(B \cap M) = 0.6 \times 0.75 = 0.45$
- $P(B \mid F) = 0.4 \implies \dfrac{P(B \cap F)}{P(F)} = 0.4 \implies P(B \cap F) = 0.4 \times 0.25 = 0.1$

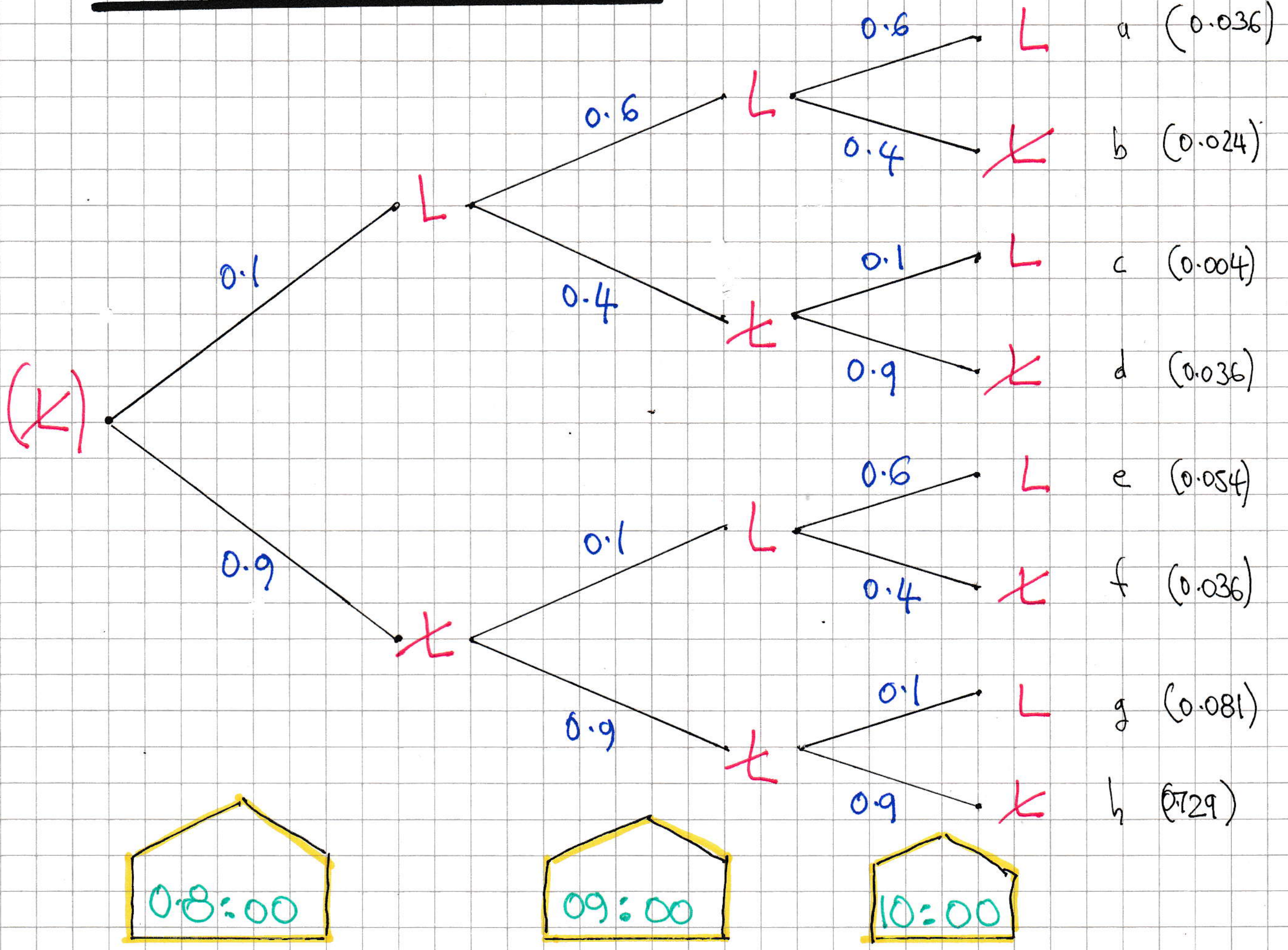
IYGB – MMS PAPER V – QUESTION 3



$$\therefore P(F|B) = \frac{P(F\cap B)}{P(B)} = \frac{0.1}{0.45+0.1} = \frac{0.1}{0.55} = \frac{2}{11}$$

IYGB – MMS PAPER V – QUESTION 4

DRAWING A TREE DIAGRAM



a) I) P(10 am train on time) = b + d + f + h

= 0.024 + 0.036 + 0.036 + 0.729

= **0.825**

II) P(only one arrives on time) = $L\,L\,\cancel{L}$ = b = 0.024

= $L\,\cancel{L}\,L$ = c = 0.004

= $\cancel{L}\,L\,L$ = e = 0.054

ADD **0.082**

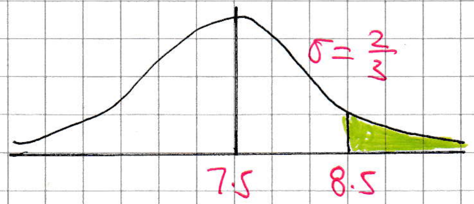
b) $$P(\text{8:00 was late} \mid \text{10:00 on time}) = \frac{P(\text{8:00 late} \cap \text{10:00 on time})}{P(\text{10:00 on time})}$$

$$= \frac{b+d}{b+d+f+h} = \frac{0.060}{0.825} = 0.0727$$

IYGB - MMS PAPER V - QUESTION 5

a)

$$\boxed{\begin{array}{l} X = \text{OUTWARD FLIGHT TIME} \\ X \sim N\left(7.5, \left(\tfrac{2}{3}\right)^2\right) \end{array}}$$

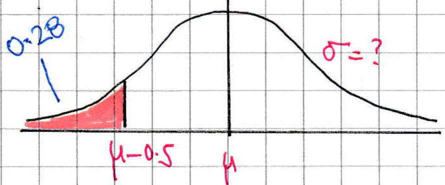


$$P(X>8.5) = 1 - P(X<8.5)$$
$$= 1 - P\left(Z < \frac{8.5-7.5}{\frac{2}{3}}\right)$$
$$= 1 - \Phi(1.5)$$
$$= 1 - 0.9332$$
$$= 0.0668$$

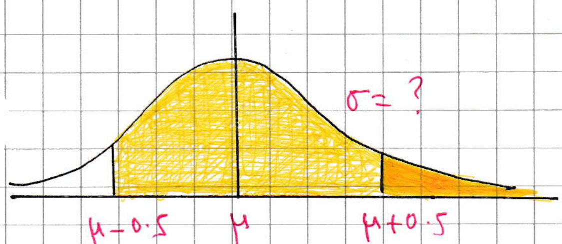
b)

Y = RETURN FLIGHT TIME

$Y \sim N(\mu, \sigma^2)$



$\Longrightarrow$



- $P(Y < \mu - 0.5) = 0.28$
- $P(Y > \mu - 0.5) = 0.72$
- $P(Y > \mu + 0.5) = 0.28$

$$P(Y > \mu+0.5 \mid Y > \mu - 0.5)$$
$$= \frac{0.28}{0.72}$$
$$= \frac{28}{72}$$
$$= \frac{7}{18}$$

IYGB - MMS PAPER V - QUESTION 6

a) PRODUCE A TABLE OF PROBABILITIES

x	0	1	2	3	4
$P(X=x)$	$4k$	$3k$	$2k$	k	$\frac{1}{2}$

$$4k+3k+2k+k+\tfrac{1}{2}=1$$
$$10k=0.5$$
$$k=\tfrac{1}{20}$$ AS REQUIRED

b) FORM A NEW TABLE

y	0	1	2	3	4	5	6	7	8
$P(Y=y)$	$\frac{16}{400}$	$\frac{24}{400}$	$\frac{25}{400}$	$\frac{20}{400}$	$\frac{90}{400}$	$\frac{64}{400}$	$\frac{41}{400}$	$\frac{20}{400}$	$\frac{100}{400}$
	↑	↑	↑	↑	↑	↑	↑	↑	↑
	0,0	0,1 1,0	1,1 2,0 0,2	3,0 0,3 1,2 2,1	4,0 0,4 3,1 1,3 2,2	4,1 1,4 2,3 3,2	3,3 4,2 2,4	3,4 4,3	4,4

c) $P(1.5 \leqslant Y \leqslant 4.5) = P(2 \leqslant Y \leqslant 4)$

$$= P(Y=2,3,4)$$
$$= \frac{25}{400}+\frac{20}{400}+\frac{90}{400}$$
$$= \frac{135}{400}$$
$$= \frac{27}{80}$$

IYGB – MMS PAPER V – QUESTION 7

a)

X = NUMBER OF VEGETARIAN ORDERS

$X \sim B(20, 0.25)$

$H_0 : p = 0.25$

$H_1 : p < 0.25$, WHERE p IS THE PROPORTION OF VEGETARIAN ORDERS IN GENERAL

TESTING AT 10% SIGNIFICANCE ON THE BASIS THAT $x = 2$

$$P(X \leqslant 2) = 0.09126\ldots$$
$$= 9.13\%$$
$$< 10\%$$

THERE IS SIGNIFICANT EVIDENCE THAT THE PROPORTION OF VEGETARIAN ORDERS IS LOWER THAN 25%

THERE IS SUFFICIENT EVIDENCE TO REJECT H_0

b) NOW SAMPLE IS 100

$H_0 : p = 0.25$

$H_1 : p \neq 0.25$, WHERE p IS THE PROPORTION OF VEGETARIAN ORDERS IN GENERAL

TESTING AT 5% SIGNIFICANCE, ON THE BASIS $x = 31$ (TWO TAILED)

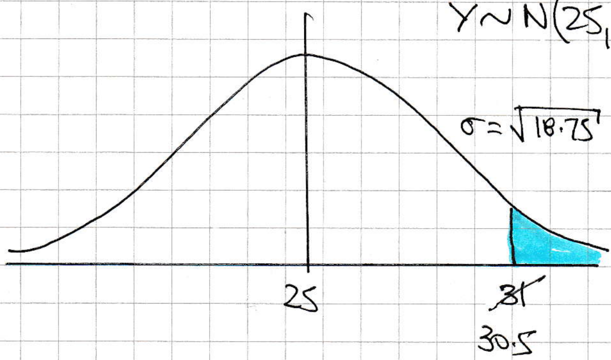
APPROXIMATE BY NORMAL

$$E(X) = \text{MEAN} = np = 100 \times 0.25 = 25$$
$$\text{Var}(X) = \text{VARIANCE} = np(1-p) = 25 \times 0.75 = 18.75$$

IYGB - MMS PAPER V - QUESTION 7

$P(X \geq 31)$

$Y \sim N(25, 18.75)$



$= P(Y > 30.5)$

$= 1 - P(Y < 30.5)$

$= 1 - P\left(Z < \frac{30.5 - 25}{\sqrt{18.75}}\right)$

$= 1 - \Phi(1.27017..)$

$= 1 - 0.897988...$

$= 0.1020...$

$= 10.2\%$

$> 2.5\%$

THERE IS NON SIGNIFICANT EVIDENCE TO SUPPORT THE WAITERS' CLAIM

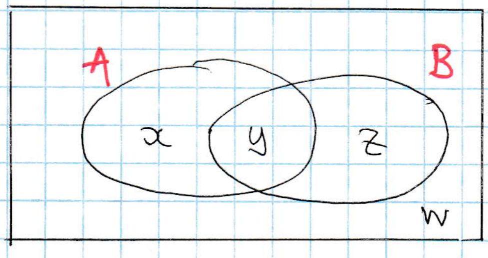
INSUFFICIENT EVIDENCE TO REJECT H_0

IYGB – MMS PAPER V – QUESTION 8

$$P(B|A) = \frac{3}{8} \qquad P(A|B) = \frac{4}{9} \qquad P(B|A') = \frac{15}{28}$$

$$① \ \frac{P(B \cap A)}{P(A)} = \frac{3}{8} \qquad ② \ \frac{P(A \cap B)}{P(B)} = \frac{4}{9} \qquad ③ \ \frac{P(B \cap A')}{P(A')} = \frac{15}{28}$$

FILL IN A VENN DIAGRAM



$$① \ \frac{y}{x+y} = \frac{3}{8} \qquad ② \ \frac{y}{y+z} = \frac{4}{9} \qquad ③ \ \frac{z}{z+w} = \frac{15}{28}$$

$$8y = 3x + 3y \qquad 9y = 4y + 4z \qquad 28z = 15z + 15w$$

$$5y = 3x \qquad 5y = 4z \qquad 13z = 15w$$

REWRITE EQUATIONS & TIDY

① $5y = 3x$

② $5y = 4z$ $\Longrightarrow$ $\boxed{y = \frac{3}{5}x}$ & SUB INTO THE OTHER 3

③ $13z = 15w$

④ $x + y + z + w = 1$

② $5 \times \frac{3}{5}x = 4z$

③ $13z = 15w$ } TIDY

④ $x + \frac{3}{5}x + z + w = 1$

② $3x = 4z$

③ $13z = 15w$

④ $\frac{8}{5}x + z + w = 1$

IYGB - MMS PAPER V - QUESTION 8

$\Longrightarrow x = \frac{4}{3}z$ & SUBSTITUTE INTO THE OTHER 2 EQUATIONS

$$\left.\begin{array}{ll} ③ & 13z = 15w \\ ④ & \frac{8}{5}\times\frac{4}{3}z + z + w = 1 \end{array}\right\} \Longrightarrow \text{TIDY} \quad \left.\begin{array}{l} 13z = 15w \\ \frac{47}{15}z + w = 1 \end{array}\right\}$$

$$\left.\begin{array}{ll} ③ & 13z = 15w \\ ④ & \frac{47}{15}z = 1 - w \end{array}\right\} \Longrightarrow \left.\begin{array}{l} 13z = 15w \\ 47z = 15 - 15w \end{array}\right\} \Longrightarrow \text{ADDING}$$

$$60z = 15$$

$$z = 0.25$$

HENCE

$$13z = 15w \qquad x = \frac{4}{3}z \qquad y = \frac{3}{5}x$$

$$\frac{13}{4} = 15w \qquad x = \frac{4}{3}\times\frac{1}{4} \qquad y = \frac{3}{5}\times\frac{1}{3}$$

$$w = \frac{13}{60} \qquad x = \frac{1}{3} \qquad y = \frac{1}{5}$$

(NOT ACTUALLY NEEDED)

FINALLY $P(A) = x + y = \frac{1}{3} + \frac{1}{5} = \frac{8}{15}$ //

IYGB - MMS PAPER V - QUESTION 9

THE CORRELATION MIGHT BE POSSIBLE BUT THE CONCLUSION NOT LIKELY TO BE CORRECT

CORRELATION $\not\Rightarrow$ CAUSE

THERE MAY BE "ANOTHER VARIABLE" WHICH CONNECTS THE TWO

E.g "SLEEPING WITH YOUR CLOTHES ON"

$\Downarrow$

MAYBE YOU DRANK HEAVILY THE NIGHT BEFORE?
MAYBE YOU TOOK DRUGS/MEDICINES?

$\Downarrow$

AS A RESULT YOU WOKE UP WITH A HEADACHE

IYGB - MMS PAPER V - QUESTION 10

- FORMING EXPRESSIONS FOR EACH PARTICLE, USING $\underline{r} = \underline{r}_0 + \underline{v}t$

$$\underline{r}_A = (1,-2,4) + (2,3,6)t = (2t+1,\ 3t-2,\ 6t+4)$$
$$\underline{r}_B = (-2,a,6) + (3,12,4)t = (3t-2,\ 12t+a,\ 4t+6)$$

$$|AB|^2 = |\underline{r}_B - \underline{r}_A|^2 = (t-3)^2 + (9t+a+2)^2 + (-2t+2)^2$$
$$= (t-3)^2 + (9t+a+2)^2 + 4(t-1)^2$$

- USING CALCULUS

LET $f(t) = (t-3)^2 + (9t+a+2)^2 + 4(t-1)^2$

$$f'(t) = 2(t-3) + 18(9t+a+2) + 8(t-1)$$

- NOW WE HAVE $f'(t) = 0$ WHEN $t = 5$

$$\Rightarrow 0 = (2\times2) + 18(47+a) + 8\times4$$
$$\Rightarrow 0 = 4 + 18(a+47) + 32$$
$$\Rightarrow -36 = 18(a+47)$$
$$\Rightarrow a+47 = -2$$
$$\Rightarrow a = -49$$

IYGB – MMS PAPER V – QUESTION 11

a) SIMPLY BY THE COSINE RULE ON $\overset{\triangle}{ABC}$

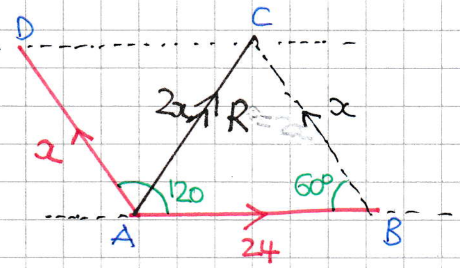
$$\Rightarrow |AC|^2 = |AB|^2 + |BC|^2 - 2|AB||BC|\cos 60^\circ$$

$$\Rightarrow (2x)^2 = 24^2 + x^2 - 2 \times 24 \times x \times \tfrac{1}{2}$$

$$\Rightarrow 4x^2 = 576 + x^2 - 24x$$

$$\Rightarrow 3x^2 + 24x - 576 = 0$$

$$\Rightarrow x^2 + 8x - 192 = 0$$



BY THE QUADRATIC FORMULA OR COMPLETING THE SQUARE

$$\Rightarrow (x+4)^2 - 16 - 192 = 0$$

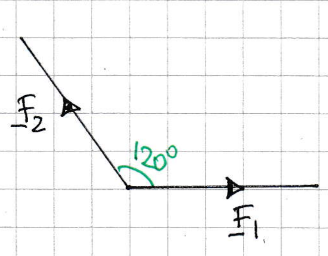
$$\Rightarrow (x+4)^2 = 208$$

$$\Rightarrow x + 4 = \pm\sqrt{208}$$

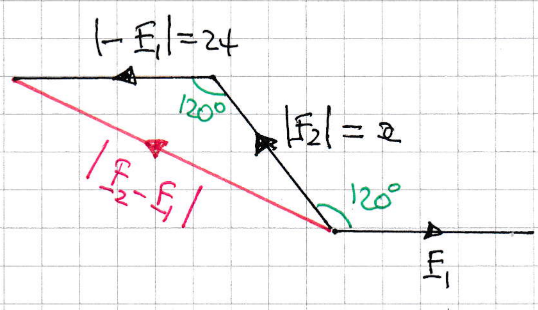
$$\Rightarrow x = \begin{cases} \cancel{-4 - \sqrt{208}} & (x > 0) \\ -4 + \sqrt{208} = -4 + 4\sqrt{13} \end{cases}$$

AS REQUIRED

b) LOOKING AT THE DIAGRAM BELOW



$\sim$



BY THE COSINE RULE AGAIN

$$|F_2 - F_1|^2 = |F_2|^2 + |-F_1|^2 - 2|F_2||-F_1|\cos 120$$

$$|F_2 - F_1|^2 = x^2 + 24^2 - 2x \times 24 \times -\tfrac{1}{2}$$

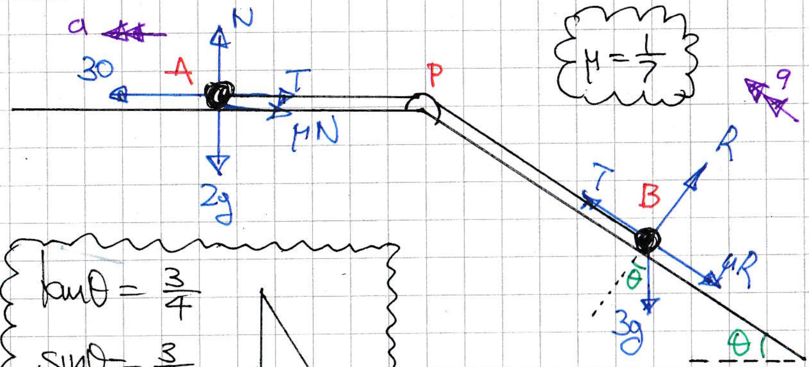
$$|F_2 - F_1|^2 = (-4 + 4\sqrt{13})^2 + 576 + 24(-4 + 4\sqrt{13})$$

$$|F_2 - F_1|^2 = 934.7552816\ldots$$

$$\therefore |F_2 - F_1| = 30.6 \quad (3\text{ s.f.})$$

IYGB - MMS PAPER V - QUESTION 12

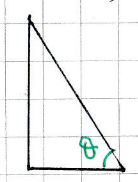
a) START WITH A DIAGRAM.



$\tan\theta = \frac{3}{4}$

$\sin\theta = \frac{3}{5}$

$\cos\theta = \frac{4}{5}$



LOOKING AT THE EQUATION OF MOTION FOR EACH PARTICLE

(A): $30 - T - \mu N = 2a$

(B): $T - \mu R - 3g\sin\theta = 3a$

ADDING GIVES

$\Rightarrow 30 - \mu N - \mu R - 3g\sin\theta = 5a$

$\Rightarrow 30 - \frac{1}{7}(2g) - \frac{1}{7}(3g\cos\theta) - 3g\sin\theta = 5a$

$\Rightarrow 30 - \frac{2}{7}g - \frac{3}{7}g \times \frac{4}{5} - 3g \times \frac{3}{5} = 5a$

$\Rightarrow 30 - 2.8 - 3.36 - 17.64 = 5a$

$\Rightarrow 5a = 6.2$

$\Rightarrow a = 1.24 \text{ ms}^{-2}$

USING FINALLY

$\Rightarrow 30 - T - \mu N = 2a$

$\Rightarrow 30 - T - \frac{1}{7}(2g) = 2 \times 1.24$

$\Rightarrow 30 - T - 2.8 = 2.48$

$\Rightarrow T = 24.72 \text{ N}$

b) USING KINEMATICS UNTIL THE STRING BREAKS

$u = 0$
$a = 1.24$
$s = ?$
$t = 1.5$
$v = ?$

• $v = \cancel{u} + at$

$v = 0 + 1.24 \times 1.5$

$v = 1.86 \text{ ms}^{-1}$

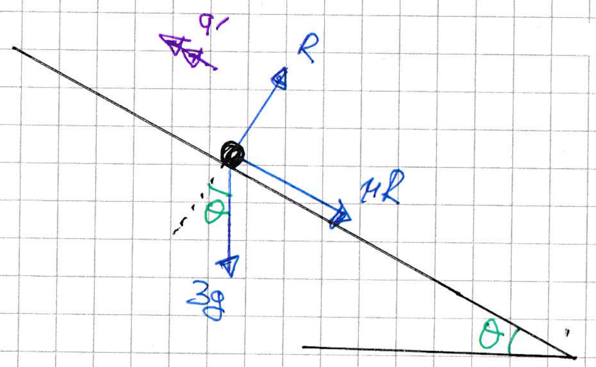
• $s = \cancel{ut} + \frac{1}{2}at^2$

$s = \frac{1}{2}(1.24)(1.5)^2$

$s = 1.395 \text{ m}$

IYGB - MMS PAPER V - QUESTION 12

RECALCULATE THE ACCELERATION (DECELERATION) OF B UP THE PLANE



STRING SNAPS ⟹ NO MORE TENSION

"$F = ma$"

$\Longrightarrow -\mu R - 3g\sin\theta = 3a'$

$\Longrightarrow -\frac{1}{7}(3g\cos\theta) - 3g\sin\theta = 3a'$

$\Longrightarrow -\frac{1}{7}g\cos\theta - g\sin\theta = a'$

$\Longrightarrow -\frac{1}{7}g \times \frac{4}{5} - g \times \frac{3}{5} = a'$

$\Longrightarrow \underline{\underline{a' = -7\ \text{ms}^{-2}}}$

FINAL KINEMATICS

$u = 1.86\ \text{ms}^{-1}$
$a = -7$
$s = ?$
$t =$
$v = 0$

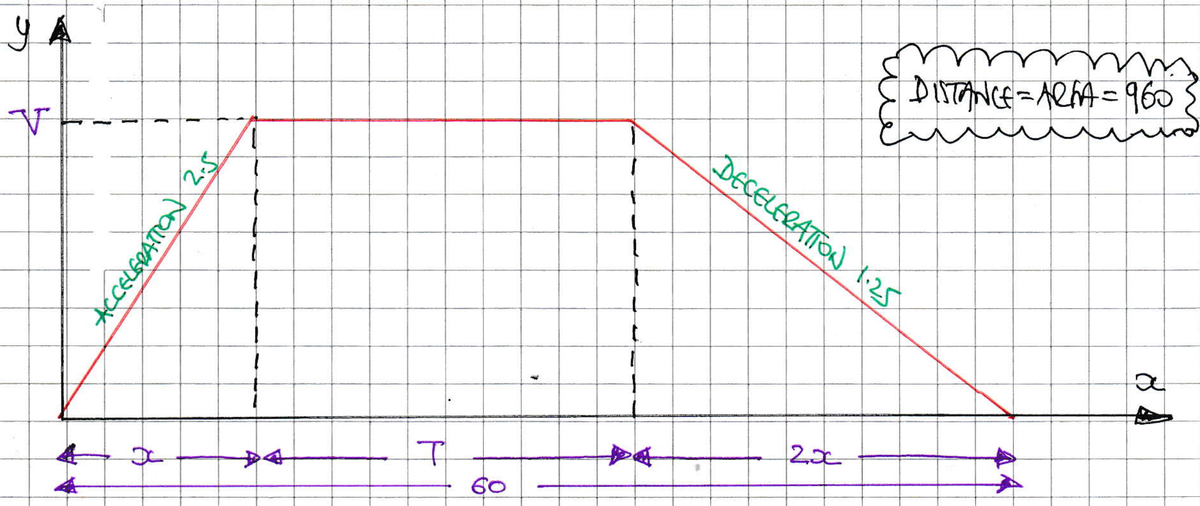
$v^2 = u^2 + 2as$
$0 = 1.86^2 + 2(-7)s'$
$14s' = 3.4596$
$\underline{\underline{s' = 0.24711\ldots}}$

∴ TOTAL DISTANCE

$1.395 + 0.24711\ldots \simeq 1.64\ \text{m}$

IYGB – MMS PAPER V – QUESTION 13

STARTING WITH A SPEED TIME GRAPH



NOTE AS THE MAGNITUDE OF THE DECELERATION IS "HALF" OF THAT OF THE ACCELERATION, THE DECELERATION TIME IS TWICE AS LONG AS THAT OF THE ACCELERATING TIME

FORMING SOME EQUATIONS

- GRADIENT = ACCELERATION

$$\frac{\Delta v}{\Delta t} = 2.5$$

$$\frac{V}{x} = 2.5$$

$$V = 2.5x$$

- $3x + T = 60$

$$T = 60 - 3x$$

- DISTANCE = AREA

$$960 = \frac{60+T}{2} \times V$$

$$1920 = (60+T)V$$

ELIMINATING x

$$\left.\begin{array}{l} 6V = 15x \\ 5T = 300 - 15x \end{array}\right\} \text{Adding yields} \quad 6V + 5T = 300$$

$$5T = 300 - 6V$$

FINALLY WE HAVE

$\Rightarrow (60+T)V = 1920$

$\Rightarrow (300+5T)V = 9600$

IYGB - MMS PAPER V - QUESTION 13

$$\Longrightarrow (300 + 300 - 6V) = 9600$$

$$\Longrightarrow (600 - 6V)V = 9600$$

$$\Longrightarrow (100 - V)V = 1600$$

$$\Longrightarrow 100V - V^2 = 1600$$

$$\Longrightarrow 0 = V^2 - 100V + 1600$$

FACTORIZE OR QUADRATIC FORMULA

$$\Longrightarrow (V - 20)(V - 80) = 0$$

$$\Longrightarrow V = \begin{cases} 20 \\ \cancel{80} \end{cases}$$

← THIS GIVES NEGATIVE TIME

IYOB - MMS PAPER V - QUESTION 14

a) INTEGRATE THE ACCELERATION SECTION BY SECTION

$\Rightarrow a_1 = 4 - \frac{1}{2}t \quad 0 \leq t \leq 8$

$\Rightarrow V_1 = \int 4 - \frac{1}{2}t$

$\Rightarrow V_1 = 4t - \frac{1}{4}t^2 + C$

$t=0,\ V_1=0 \Rightarrow C=0$

$\therefore \boxed{V_1 = 4t - \frac{1}{4}t^2,\ 0 \leq t \leq 8}$

$\Rightarrow a_2 = 0$

$\Rightarrow V_2 = $ CONSTANT, SAY D

USING V_1 WITH $t=8$

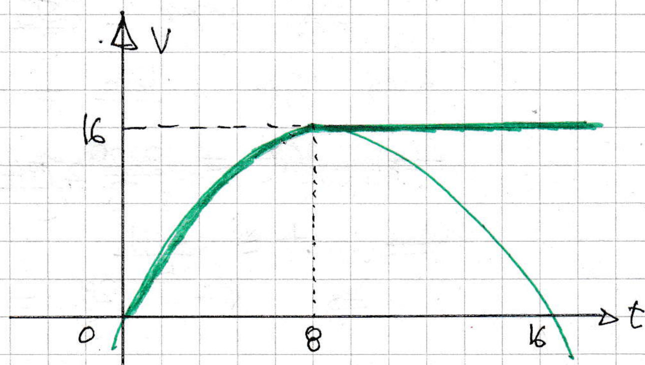
$V_1(8) = 4\times8 - \frac{1}{4}\times8^2$

$V_1(8) = 16$

$\therefore \boxed{V_2 = 16,\ t>8}$

b) THE TIME IS 8 SECONDS

(SEE SPEED TIME GRAPH OPPOSITE)



c) REPEAT THE PROCESS FOR DISPLACEMENT

$x_1 = \int 4t - \frac{1}{4}t^2\, dt \quad (0 \leq t \leq 8)$

$x_1 = 2t^2 - \frac{1}{12}t^3 + E$

$t=0,\ x=0,\ E=0$

$\therefore \boxed{x_1 = 2t^2 - \frac{1}{12}t^3 \quad 0 \leq t \leq 8}$

$x_2 = \int 16\, dt$

$x_2 = 16t + F$

USING x_1, WITH $t=8$

$x_1(8) = 2\times8^2 - \frac{1}{12}\times8^3$

$x_1(8) = \frac{256}{3}$

$\therefore x_2(8) = \frac{256}{3}$

$16\times8 + F = \frac{256}{3}$

$F = -\frac{128}{3}$

IYGB - MMS PAPER V - QUESTION 14

$$\therefore x_2 = 16t - \frac{128}{3}$$

$$\therefore x = \begin{cases} 2t^2 - \frac{1}{12}t^3 & 0 \leqslant t \leqslant 8 \\ 16t - \frac{128}{3} & t > 8 \end{cases}$$

d) FIRSTLY NOTE THAT $x(8) = \frac{256}{3} < 1000$

SET $x_2 = 1000$

$$\Rightarrow 16t - \frac{128}{3} = 1000$$

$$\Rightarrow 16t = \frac{3128}{3}$$

$$\Rightarrow t = \frac{391}{6}$$

$$\therefore t = 65\tfrac{1}{6}\text{ s}$$

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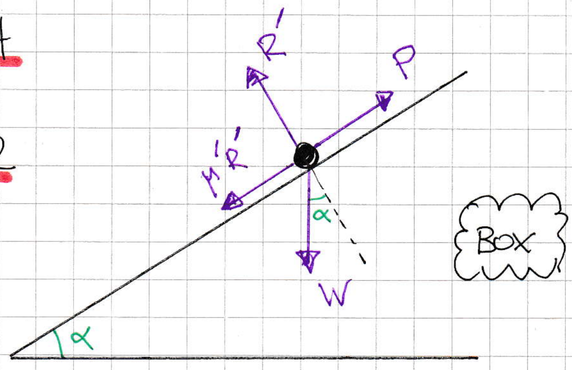
STARTING WITH A DIAGRAM FOR EACH

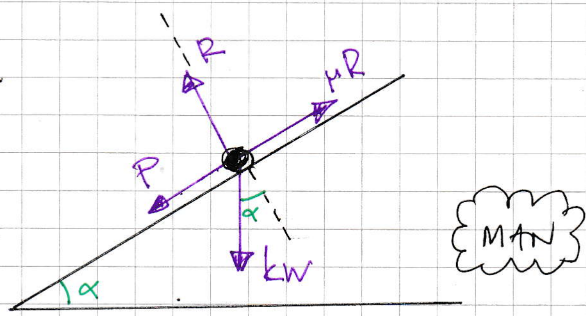
RESOLVING PARALLEL & PERPENDICULAR TO THE PLANE



- BOX

$(\parallel)$: $P = \mu' R' + W\sin\alpha$ (I)

$(\perp)$: $R' = W\cos\alpha$ (II)



- MAN

$(\parallel)$: $\mu R = P + kW\sin\alpha$ (III)

$(\perp)$: $R = kW\cos\alpha$ (IV)

SUBSTITUTE (II) INTO (I) AND (IV) INTO (III)

$$\Rightarrow \begin{pmatrix} P = \mu'(W\cos\alpha) + W\sin\alpha \\ \mu(kW\cos\alpha) = P + kW\sin\alpha \end{pmatrix} \begin{matrix} \text{— (I)} \\ \text{— (III)} \end{matrix}$$

NEXT SUBSTITUTE (I) INTO (III)

$$\Rightarrow \mu(kW\cos\alpha) = [\mu'(W\cos\alpha) + W\sin\alpha] + kW\sin\alpha$$

DIVIDE BY W

$$\Rightarrow \mu k\cos\alpha = \mu'\cos\alpha + \sin\alpha + k\sin\alpha$$

DIVIDE BY $\cos\alpha$ TO CREATE $\tan\alpha$

$$\Rightarrow \mu k = \mu' + \tan\alpha + k\tan\alpha$$

$$\Rightarrow \mu k - k\tan\alpha = \mu' + \tan\alpha$$

$$\Rightarrow k(\mu - \tan\alpha) = \mu' + \tan\alpha$$

$$\Rightarrow k = \frac{\mu' + \tan\alpha}{\mu - \tan\alpha}$$

$\therefore$ MINIMUM WEIGHT HAS TO BE

$$kW = \left(\frac{\mu' + \tan\alpha}{\mu - \tan\alpha}\right)W$$

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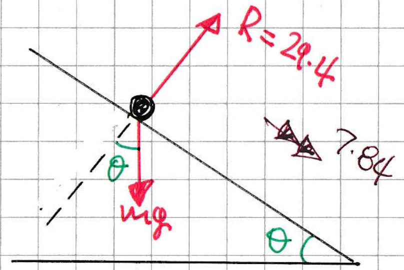
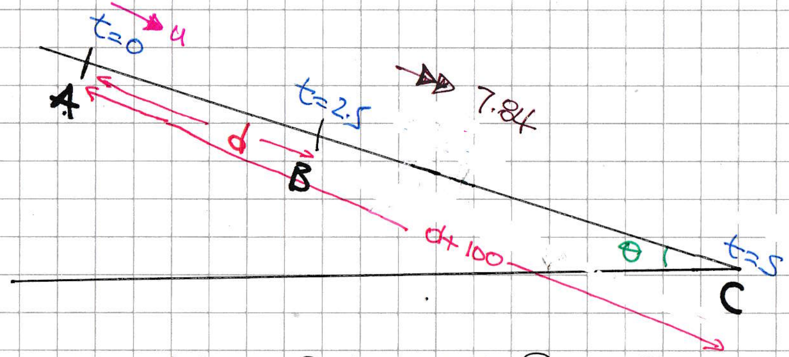




a) LOOKING AT THE FIRST DIAGRAM & RESOLVING FORCES

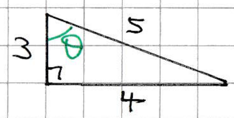
$(\perp)$: $R = mg\cos\theta$ (EQUILIBRIUM)

$(//)$: $\cancel{m}g\sin\theta = \cancel{m}a$ $(F = ma)$

$\Rightarrow a = g\sin\theta$

$\Rightarrow 7.84 = 9.8\sin\theta$

$\Rightarrow \sin\theta = \frac{4}{5}$



$\Rightarrow \cos\theta = \frac{3}{5}$

$\Rightarrow 29.4 = m \times 9.8 \times \frac{3}{5}$

$\Rightarrow m = 5\text{ kg}$

b) LOOKING AT THE 2ND DIAGRAM

CONSIDERING THE JOURNEY AB

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

$\Rightarrow d = u \times 2.5 + \frac{1}{2}(7.84)(2.5)^2$

$\Rightarrow \boxed{d = 2.5u + 24.5}$

CONSIDERING THE JOURNEY AC.

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

$\Rightarrow d + 100 = u \times 5 + \frac{1}{2}(7.84) \times 5^2$

$\Rightarrow d + 100 = 5u + 98$

$\Rightarrow \boxed{d = 5u - 2}$

SOLVING

$5u - 2 = 2.5u + 24.5$

$2.5u = 26.5$

$\therefore u = 10.6\text{ ms}^{-1}$ & $d = 51$