IYGB – MMS PAPER G – QUESTION 1

a)

4	7	(1)
5	2 3 8	(3)
6	0 3 4 a b	(5)
7	3 6 c d 8	(5)
8	1 9	(2)

TOTAL OF 16 OBSERVATIONS

Q_1 IS THE 4^{TH} / 5^{TH} OBS

$\therefore Q_1 = \frac{58+60}{2} = 59$

b) MEDIAN IS 8^{TH} / 9^{TH} OBSERVATION

IF $Q_2 = \frac{"6a" + "6b"}{2} = 68$

$\therefore a = 7$ & $b = 9$

~~68 – 68~~ $a \neq b$

67 – 69

~~66 – 70~~

ETC

c) Q_3 IS 12^{TH} / 13^{TH} OBSERVATION

IF $Q_3 = \frac{"7c" + "7d"}{2}$

~~76 – 76~~ $c \neq d$

76 – 77 $\Rightarrow Q_3 = 76.5$

76 – 78 $\Rightarrow Q_3 = 77$

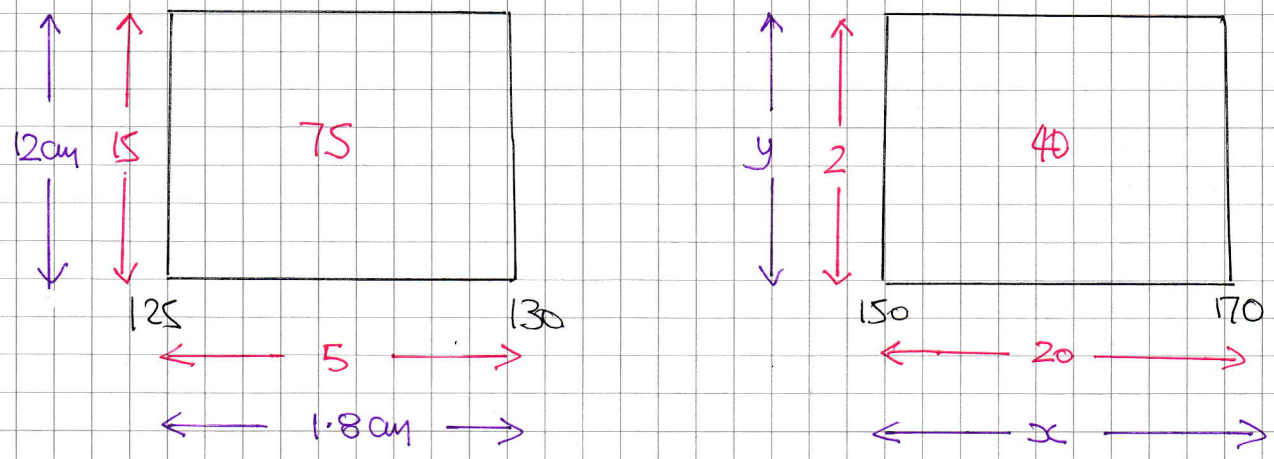
~~77 – 77~~ $c \neq d$

77 – 78 $\Rightarrow Q_3 = 77.5$

$\therefore$ POSSIBLE VALUES OF Q_3 ARE 76.5, 77 & 77.5

IYGB — MMS PAPER G — QUESTION 2

DRAWING TWO RECTANGLES TO INPUT INFORMATION (NOT TO SCALE)



USING RATIOS/PROPORTION

- $\frac{5}{1.8} = \frac{20}{x}$

$\Rightarrow 5x = 36$

$\Rightarrow x = 7.2$

- $\frac{12}{15} = \frac{y}{2}$

$15y = 24$

$y = 1.6$

$\therefore$ BASE 7.2 cm AND HEIGHT 1.6 cm.

IYGB - MMS PAPER G - QUESTION 3

USING THE CALCULATOR IN STATISTIC MODE, THE P.M.C.C IS

$$r = 0.816579\ldots \approx 0.817$$

SETTING HYPOTHESES

- $H_0 : \rho = 0$
- $H_1 : \rho \neq 0$

WHERE ρ IS THE P.M.C.C FOR "ALL DATA", IE POPULATION

THE CRITICAL VALUES AT 10%, TWO TAILED, FOR $n = 10$ ARE ± 0.5494

AS $0.817 > 0.5494$ THERE IS EVIDENCE OF (POSITIVE) CORRELATION, SO SUFFICIENT EVIDENCE TO REJECT H_0 //

CONCLUSION DRAWN

AS THERE IS EVIDENCE OF POSITIVE CORRELATION, SO PLACING ADS IN THE LOCAL RADIO APPEARS TO HAVE THE DESIRED EFFECT. //

IYGB – MMS PAPER 6 – QUESTION 4

a) X = NUMBER OF SUCCESFUL APPLICANTS AMONGST MATHS GRADUATES

$X \sim B(25, 0.2)$

$H_0 : p = 0.2$

$H_1 : p > 0.2$, WHERE p IS THE PROPORTION OF SUCCESSFUL APPLICANTS IN GENERAL

CRITICAL REGION REQUIRED AT 5% SIGNIFICANCE

$P(X \geqslant 8) = 1 - P(X \leqslant 7) = 1 - 0.8908 = 0.1092 = 10.92\% > 5\%$

$P(X \geqslant 9) = 1 - P(X \leqslant \ ) = 1 - 0.9532 = 0.0468 = 4.68\% < 5\%$

$\therefore$ CRITICAL REGION $= \{9, 10, 11, \ldots, 25\}$

b) ACTUAL SIGNIFICANCE IS 4.68 %

c) TEN IS IN THE CRITICAL REGION

THERE IS SUFFICIENT EVIDENCE TO SUPPORT THE DIRECTOR'S BELIEF

IYGB - MMS PAPER G - QUESTION 5

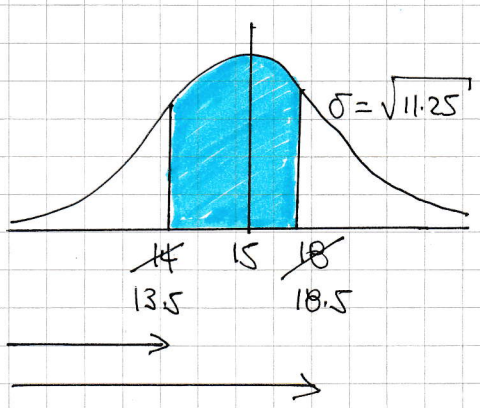
X = NUMBER OF BUSHES, EXCEEDING 2 METRES IN HEIGHT

$X \sim B(60, 0.25)$

- MEAN $= E(X) = np = 60 \times 0.25 = 15$
- Variance $= Var(X) = np(1-p) = 15 \times 0.75 = 11.25 > 5$

APPROXIMATE BY NORMAL $Y \sim N(15, 11.25)$

$$
\begin{aligned}
& P(13 < X \leqslant 18) \\
= \; & P(14 \leqslant X \leqslant 18) \\
= \; & P(13.5 < Y < 18.5) \\
= \; & P(Y < 18.5) - P(Y < 13.5) \\
= \; & P(Y < 18.5) - \left[1 - P(Y > 13.5)\right] \\
= \; & P(Y < 18.5) + P(Y > 13.5) - 1 \\
= \; & P\left(Z < \frac{18.5-15}{\sqrt{11.25}}\right) + P\left(Z > \frac{13.5-15}{\sqrt{11.25}}\right) - 1 \\
= \; & \Phi(1.043498\ldots) + \Phi(-0.4472135\ldots) - 1 \\
= \; & 0.85164\ldots + 0.67264\ldots - 1 \\
= \; & 0.5243
\end{aligned}
$$

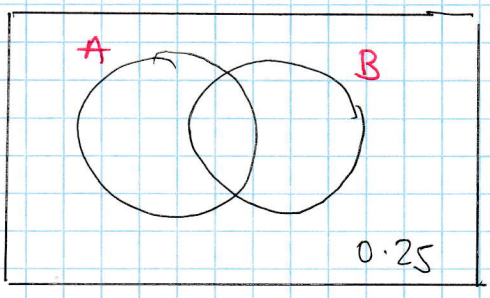


IYGB – MMS PAPER G – QUESTION 6

$P(A)=0.2 \qquad P(B)=0.6 \qquad P(A'\cap B')=0.25$

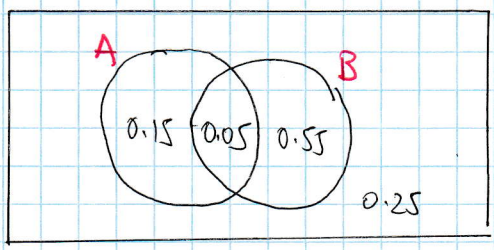
FROM "UNFILLED" VENN DIAGRAM $P(A\cup B)=1-0.25=0.75$

$$\Rightarrow P(A\cup B)=P(A)+P(B)-P(A\cap B)$$
$$\Rightarrow 0.75=0.2+0.6-P(A\cap B)$$
$$\Rightarrow P(A\cap B)=0.05$$



FILLING A VENN DIAGRAM

$P(A\cap B')\cup P(A'\cap B')=0.15+0.25$
$=0.4$



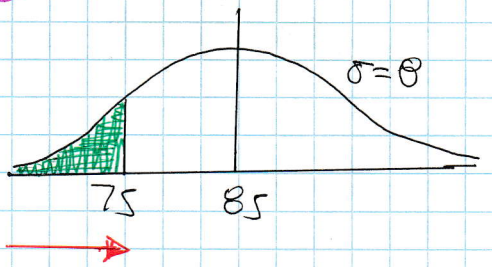
USING STANDARD FORMULA

$$\Rightarrow P(A\cup B)=P(A)+P(B)-P(A\cap B)$$
$$\Rightarrow P(A'\cup B)=P(A')+P(B)-P(A'\cap B)$$
$$\Rightarrow P(A'\cup B)=0.8+0.6-0.55$$
$$\Rightarrow P(A'\cup B)=0.85$$

IYGB - MMS PAPER G - QUESTION 7

a) T = flight time (min)

$T \sim N(85, 8^2)$

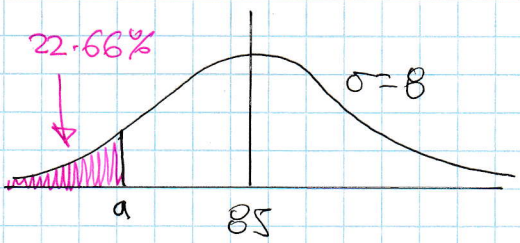


$$P(T<75) = 1 - P(T>75)$$
$$= 1 - P\left(Z > \frac{75-85}{8}\right)$$
$$= 1 - \Phi(1.25)$$
$$= 1 - 0.8944$$
$$= 0.1056$$

b) DRAWING A DIAGRAM

"NOT EXCEEDED BY 22.66%"

~ "EXCEEDED BY 77.34%"



$\Rightarrow P(T<a) = 22.66\%$

$\Rightarrow P(T>a) = 77.34\%$

$\Rightarrow P\left(T > \frac{a-85}{8}\right) = 0.7734$

↓ INVERTING

$\Rightarrow \frac{a-85}{8} = -\Phi^{-1}(0.7734)$

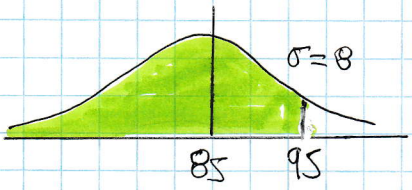
$\Rightarrow \frac{a-85}{8} = -0.75$

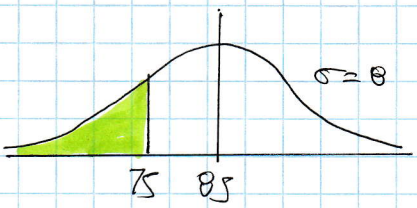
$\Rightarrow a - 85 = -6$

$\Rightarrow a = 79$

IYGB - MMS PAPER A - QUESTION 7

c) DEALING WITH THE CONDITIONAL PROBABILITY WITH 2 DIAGRAMS





"IF LESS THAN 95" $\Rightarrow$ "THEN LESS THAN 75"

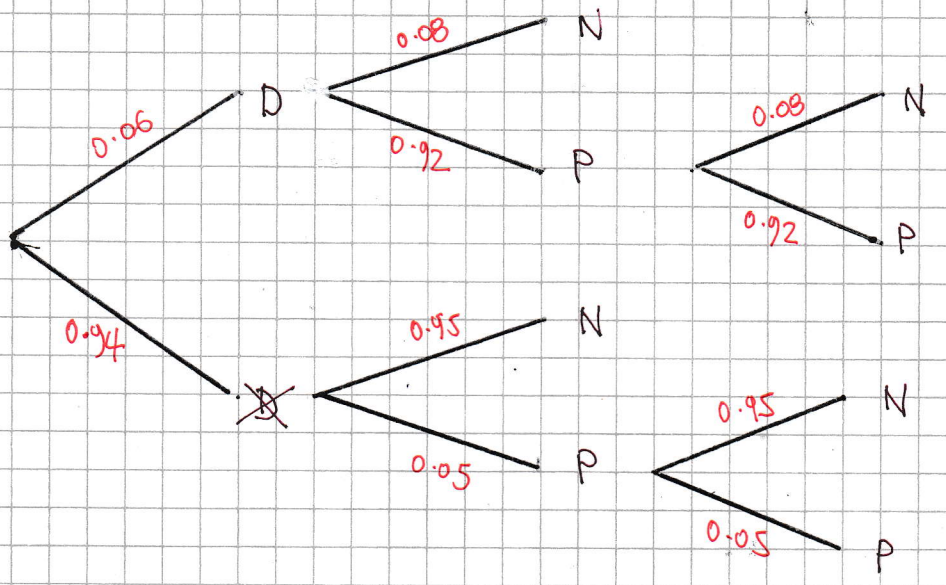
$\downarrow$ $\downarrow$

$1-0.1056=0.8944$ (SYMMETRY 75, 85, 95) $\quad$ 0.1056 (part a)

$\therefore$ REQUIRED PROBABILITY $= \dfrac{0.1056}{0.8944} = 0.118$

IYGB - MMS PAPER G - QUESTION 8

STARTING BY DRAWING A TREE DIAGRAM, EXTENDING IT TO CATER FOR PARTS c & d



a) $P(\text{FIRST TEST POSITIVE}) = (0.06 \times 0.92) + (0.94 \times 0.05) = 0.1022$

b) $P(\text{NO DISEASE} \mid \text{FIRST TEST POSITIVE}) = \dfrac{P(\text{NO DISEASE} \cap \text{POSITIVE})}{P(\text{POSITIVE})}$

$$= \frac{0.94 \times 0.05}{0.1022} = 0.4599$$

c) $P(\text{SECOND TEST +} \mid \text{FIRST TEST POSITIVE}) = \dfrac{P(\text{FIRST} \cap \text{SECOND TEST POSITIVE})}{P(\text{FIRST TEST POSITIVE})}$

$$= \frac{(0.06 \times 0.92 \times 0.92) + (0.94 \times 0.05 \times 0.05)}{0.1022}$$

$$= 0.5199$$

d) $P(\text{DISEASE} \mid \text{SECOND TEST POSITIVE}) = \dfrac{P(\text{DISEASE} \cap \text{SECOND TEST POSITIVE})}{P(\text{SECOND TEST POSITIVE})}$

$$= \frac{0.06 \times 0.92 \times 0.92}{(0.06 \times 0.92 \times 0.92) + (0.94 \times 0.05 \times 0.05)}$$

$$= 0.9558$$

IYGB – MMS PAPER G – QUESTION 9

a) I) X = NUMBER OF RED COLLARS

$X \sim B(50, 0.175)$

$P(X=6) = \binom{50}{6}(0.175)^6(0.825)^{44} = 0.0962$

II) Y = NUMBER OF BLUE CAT COLLARS

$Y \sim B(50, 0.4)$

$P(15 \leq Y < 25) = P(15 \leq Y \leq 24) = P(Y \leq 24) - P(Y \leq 14)$

$= 0.9022 - 0.0540 = 0.8482$

b) I) IRRELEVANT FOR THIS PART THE 50 FLUORESCENT COLLARS

W = NUMBER OF NON BLACK COLLARS

$W \sim B(50, 0.9)$

OR

W = NUMBER OF BLACK COLLARS

$W \sim B(50, 0.1)$

$P(W=50) = \binom{50}{50}(0.9)^{50}(0.1)^0$ OR $P(W=0) = \binom{50}{0}(0.1)^0(0.9)^{50}$

$= 0.0052$ $= 0.0052$

II) U = NUMBER OF BLUE OR BLACK COLLARS

$U \sim B(50, 0.5)$

V = NUMBER OF YELLOW OR ORANGE COLLARS

$V \sim B(50, 0.45)$

$P(U < 20) = P(U \leq 19)$

$= 0.1013$

$P(V > 30) = P(V \geq 31)$

$= 1 - P(V \leq 30)$

$= 1 - 0.9884$

$= 0.0116$

$\therefore$ REQUIRED PROBABILITY $= 0.1013 \times 0.0116 = 0.0012$

IYGB – MMS PAPER G – QUESTION 9

c) T = NUMBER OF NON-PINK COLLARS

$T \sim B(50, 0.6)$

$$P(25 \leq T < 33) = P(25 \leq T \leq 32)$$

CANNOT USE THE TABLES

REMODEL AS

S = NUMBER OF PINK COLLARS

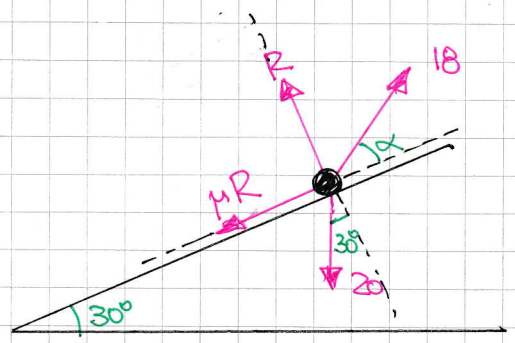
$S \sim B(50, 0.4)$

T:	25	26	27	28	29	30	31	32
S:	25	24	23	22	21	20	19	18

$$\Rightarrow P(25 \leq T < 33) = P(18 \leq S \leq 25)$$
$$= P(S \leq 25) - P(S \leq 17)$$
$$= 0.9427 - 0.2369$$
$$= 0.7058$$

IYGB – MMS PAPER G – QUESTION 10

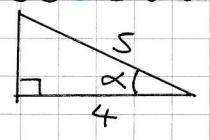
STARTING WITH A DIAGRAM



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

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

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



RESOLVING PARALLEL & PERPENDICULAR TO THE PLANE

$$(\parallel): \quad 18\cos\alpha = \mu R + 20\sin 30 \quad -(I)$$
$$(\perp): \quad R + 18\sin\alpha = 20\cos 30 \quad -(II)$$
$$\Rightarrow$$

$$18\times\frac{4}{5} = \mu R + 10$$
$$R + 18\times\frac{3}{5} = 10\sqrt{3}$$
$$\Rightarrow$$

$$\mu R = 4.4$$
$$R = 10\sqrt{3} - 10.8$$

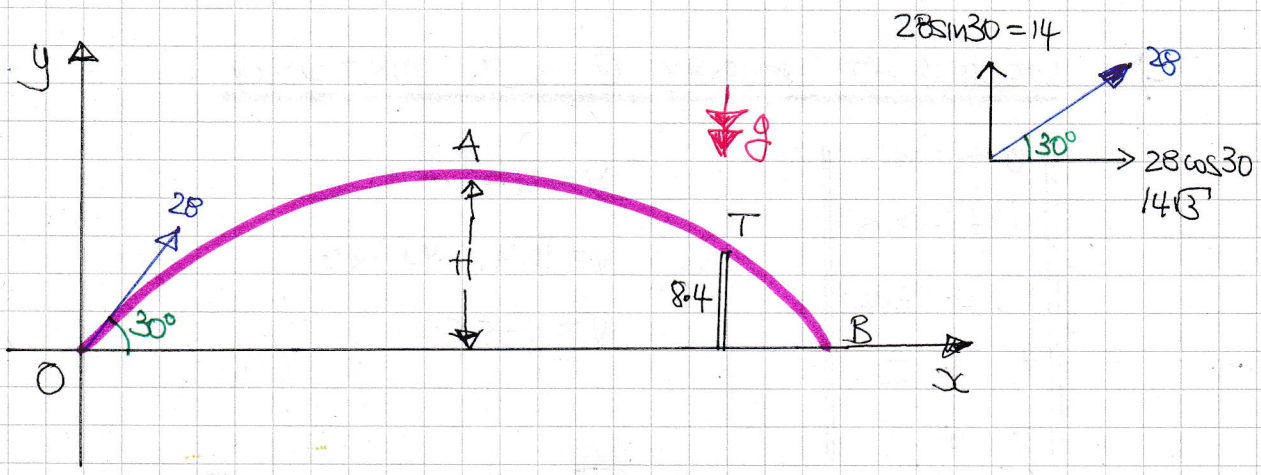
DIVIDING THE EQUATIONS ELIMINATES R

$$\frac{\mu R}{R} = \frac{4.4}{10\sqrt{3} - 10.8}$$

$$\mu = 0.67479\ldots$$

$$\mu \approx 0.675$$

IYGB – MMS PAPER G – QUESTION 11



LOOKING AT THE VERTICAL MOTION FROM O TO A

u	14
a	-9.8
s	H
t	
v	0

$$v^2 = u^2 + 2as$$
$$0^2 = 14^2 + 2(-9.8)H$$
$$19.6H = 196$$
$$H = 10 \text{ m}$$

LOOKING AT VERTICAL MOTION FROM O TO T

u	14
a	-9.8
s	8.4
t	$?$
v	

$$s = ut + \tfrac{1}{2}at^2$$
$$8.4 = 14t + \tfrac{1}{2}(-9.8)t^2$$
$$8.4 = 14t - 4.9t^2$$
$$4.9t^2 - 14t + 8.4 = 0$$
$$49t^2 - 140t + 84 = 0$$
$$7t^2 - 20t + 12 = 0$$
$$(7t - 6)(t - 2) = 0$$

$t =$ 2, ~~$\frac{6}{7}$~~ "ON THE WAY UP"

IYGB – MMS PAPER G – QUESTION 11

c) LOOKING AT JOURNEY O TO T VERTICALLY

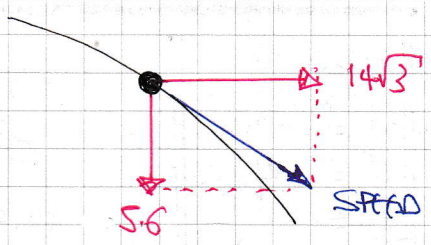
$$\begin{Vmatrix} u = 14 \\ a = -9.8 \\ s = 8.4 \\ t = 2 \\ v = ? \end{Vmatrix}$$

$v = u + at$

$v = 14 + (-9.8) \times 2$

$v = -5.6$

THUS THE SPEED AT T IS



$$\text{SPEED} = \sqrt{(14\sqrt{3})^2 + (5.6)^2}$$

$$= \frac{14}{5}\sqrt{79} \approx 24.89 \text{ ms}^{-1}$$

ALTERNATIVE BY ENERGIES – TAKING THE GROUND AS THE ZERO GRAVITATIONAL POTENTIAL LEVEL

$$KE_O + PE_O = KE_T + P.E_T$$

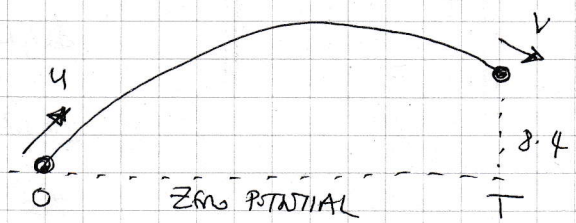
$$\tfrac{1}{2}mu^2 = \tfrac{1}{2}mv^2 + mgh$$

$$u^2 = v^2 + 2gh$$

$$28^2 = v^2 + 2(9.8)(8.4)$$

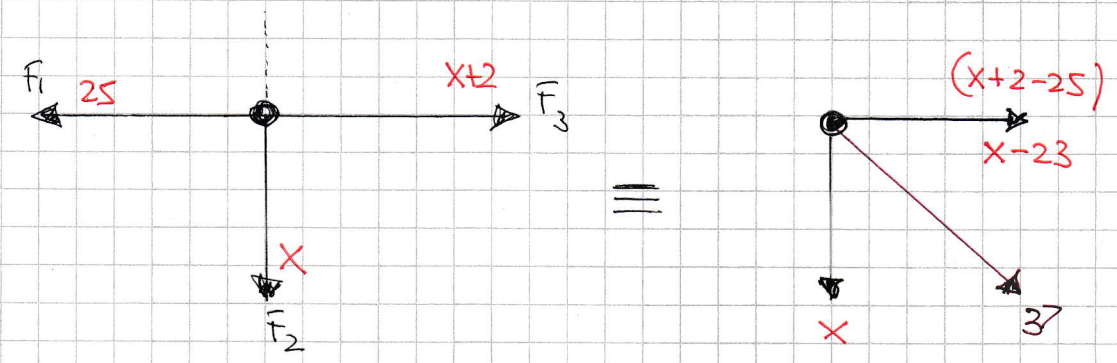
$$v^2 = 619.36$$

$$v = 24.89 \text{ ms}^{-1}$$



IYGB - MMS PAPER G - QUESTION 12

START WITH A DIAGRAM AND REDUCE IT TO TWO FORCES



BY PYTHAGORAS WE HAVE

$$\Rightarrow X^2 + (X-23)^2 = 37^2$$

$$\Rightarrow X^2 + X^2 - 46X + 529 = 1369$$

$$\Rightarrow 2X^2 + 46X - 840 = 0$$

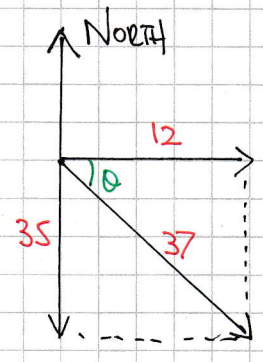
$$\Rightarrow X^2 - 23X - 420 = 0$$

$$\Rightarrow (X-35)(X+12) = 0$$

$$\Rightarrow X = \begin{cases} 35 \\ \cancel{-12} \end{cases}$$

OTHERWISE THE BEARING OF F_2 WILL NOT BE 180°

FINALLY WE HAVE



$$\tan\theta = \frac{35}{12}$$

$$\theta = 71.07\ldots$$

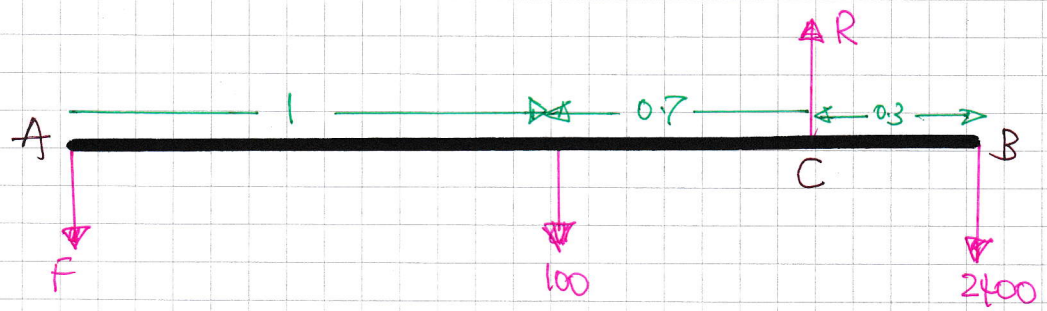
$\therefore$ BEARING OF RESULTANT IS

$$90 + 71.07\ldots$$

$$\simeq 161^\circ$$

IYGB - MMS PAPER G - QUESTION 13

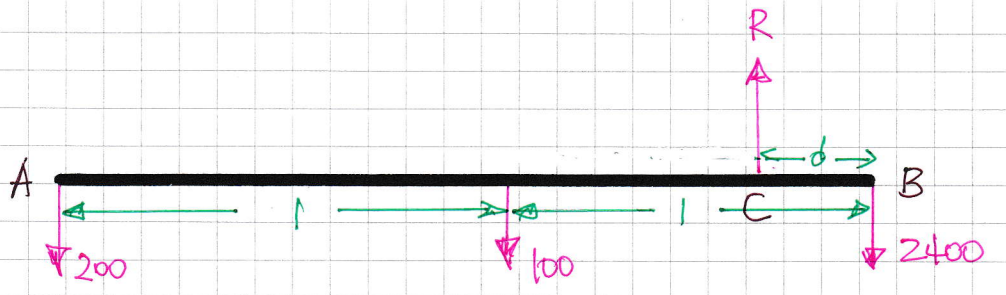
a) START WITH A DIAGRAM



TAKING MOMENTS ABOUT C.

$$\Rightarrow (F \times 1.7) + (100 \times 0.7) = 2400 \times 0.3$$
$$\Rightarrow 1.7F + 70 = 720$$
$$\Rightarrow 1.7F = 650$$
$$\Rightarrow F \approx 382\text{N}$$

b) REDRAW THE DIAGRAM

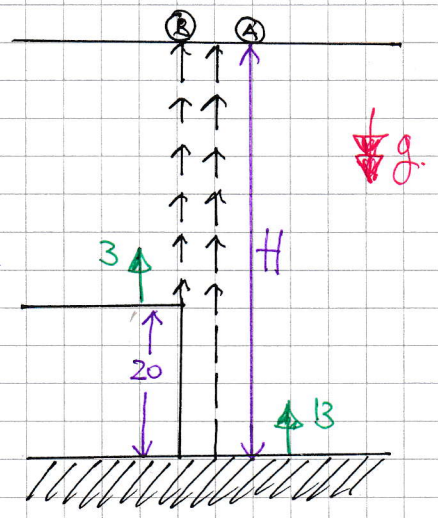


TAKING MOMENTS ABOUT B & NOTING THAT R = 2700 N

$$\Rightarrow (200 \times 2) + (100 \times 1) = R \times d$$
$$\Rightarrow 500 = 2700d$$
$$\Rightarrow d = \frac{5}{27}$$
$$\Rightarrow d \approx 0.185\text{ m}$$

IYGB – MMS PAPER 6 – QUESTION 14

a) LOOKING AT THE DIAGRAM, TAKING THE GROUND AS THE ZERO LEVEL FOR DISPLACEMENT



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

$$s_A = 13t + \tfrac{1}{2}(-9.8)t^2$$
$$s_A = 13t - 4.9t^2$$

$$s_B = 20 + 3t - \tfrac{1}{2}(-9.8)t^2$$
$$s_B = 20 + 3t - 4.9t^2$$

SAME HEIGHT ABOVE GROUND $\Rightarrow s_A = s_B$

$$13t - 4.9t^2 = 20 + 3t - 4.9t^2$$
$$10t = 20$$
$$t = 2$$

i.e. $T = 2$

b) USING $s_A = 13t - 4.9t^2$

$$s_A = 13\times 2 - 4.9\times 2^2$$
$$s_A = 26 - 19.6$$
$$s_A = 6.4 \text{ m}$$

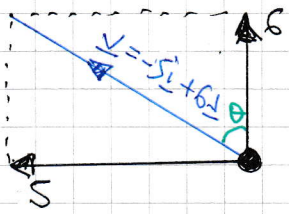
IE $H = 6.4$

IYGB – MMS PAPER G – QUESTION 15

a) When $t=0$ $\quv{v} = 3\quv{i} - 6\quv{j}$

$$\text{SPEED} = |\quv{v}| = |3\quv{i} - 6\quv{j}| = \sqrt{3^2+(-6)^2} = \sqrt{9+36}$$
$$= \sqrt{45} \simeq 6.71 \text{ ms}^{-1}$$

b) When $t=4$, $\quv{v} = (3-2\times 4)\quv{i} + (3\times 4 - 6)\quv{j} = -9\quv{i} + 6\quv{j}$



$$\tan\theta = \frac{5}{6}$$
$$\theta \simeq 39.8^\circ$$

$\therefore$ BEARING OF $360 - 39.8^\circ$
$\simeq 320^\circ$

c) LOOKING AT GENERAL EXPRESSION FOR THE VELOCITY VECTOR AT TIME t

$$\quv{v} = (3-2t)\quv{i} + (3t-6)\quv{j}$$

I) When moving parallel to $\quv{i}$ the $\quv{j}$ component must be zero

$$\Rightarrow 3t-6=0$$
$$\Rightarrow 3t=6$$
$$\Rightarrow t=2$$

II) When moving parallel to $5\quv{i}-7\quv{j}$, then $\quv{v} = \lambda(5\quv{i}-7\quv{j})$

$$\Rightarrow (3-2t)\quv{i} + (3t-6)\quv{j} = \lambda(5\quv{i}-7\quv{j})$$

$$\Rightarrow \begin{cases} 3-2t = 5\lambda \\ 3t-6 = -7\lambda \end{cases}$$

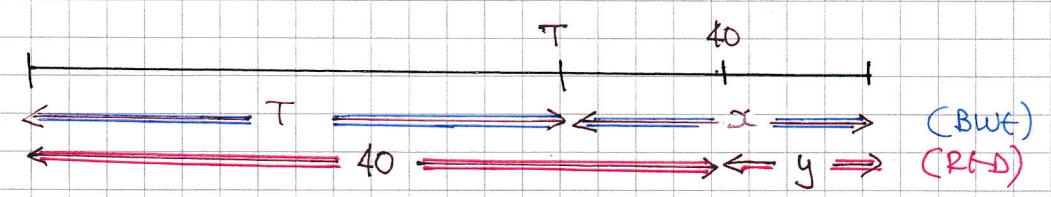
Dividing gives $\quad \dfrac{3-2t}{3t-6} = -\dfrac{5}{7} \Rightarrow 21-14t = -15t+30$

$$\Rightarrow t = 9$$

IYGB- MMS PAPER G- QUESTION 16

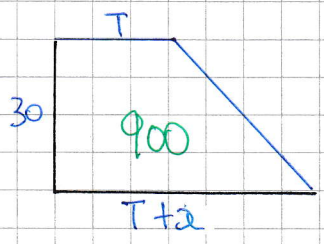
a) DRAWING A STANDARD SPEED TIME GRAPH

b) REPARAMETRISING THE t AXIS



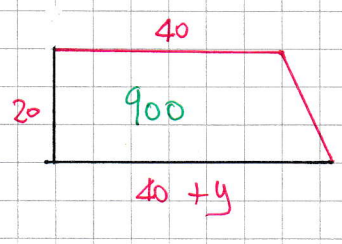
$$T+x = 40+y$$

NOW BOTH TRAPEZIA ARE 900



$$\frac{T+T+x}{2} \times 30 = 900$$

$$2T+x = 60$$



$$\frac{40+40+y}{2} \times 20 = 900$$

$$80+y = 90$$

$$y = 10$$

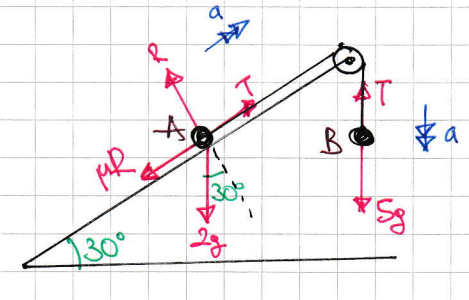
$$T = 10$$

FROM ABOVE WE HAVE $\Rightarrow T+x = 40+y$

$$\Rightarrow \boxed{T+x = 50}$$

IYGB MMS PAPER 6 - QUESTION 17

STARTING WITH A DETAILED DIAGRAM & CONSIDERING THE EQUATION OF MOTION FOR EACH PARTICLE SEPARATELY



(A): $T - \mu R - 2g\sin 30 = 2a$

(B): $5g - T = 5a$

ADDING THE EQUATIONS

$$\Rightarrow 5g - \mu R - 2g\sin 30 = 7a$$

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

$\mu = \frac{1}{2}\sqrt{3}$

$R = 2g\cos 30$, EQUILIBRIUM PERPENDICULAR TO THE PLANE

$$\Rightarrow 5g - \tfrac{3}{2}g - g = 7a$$

$$\Rightarrow 7a = \tfrac{5}{2}g$$

$$\Rightarrow a = 3.5\ ms^{-2}$$

FINALLY THE TENSION CAN BE FOUND

$$\Rightarrow 5g - T = 5a$$

$$\Rightarrow 49 - T = 5\times 3.5$$

$$\Rightarrow T = 31.5\ N$$