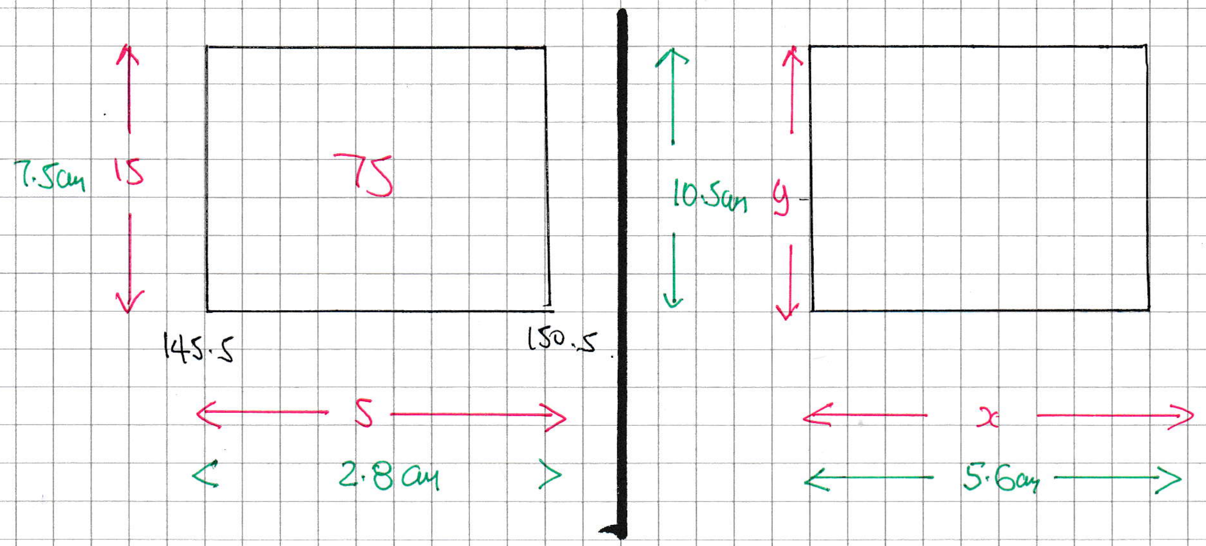
IYGB - MMS PAPER D - QUESTION 1

DRAWING TWO RECTANGLES NOT TO SCALE



BY RATIO / PROPORTION

- $\dfrac{7.5}{15} = \dfrac{10.5}{y}$

  $7.5y = 157.5$

  $y = 21$

- $\dfrac{5}{2.8} = \dfrac{x}{5.6}$

  $2.8x = 28$

  $x = 10$

$\therefore$ REQUIRED FREQUENCY $= xy = 10 \times 21 = 210$

ALTERNATIVE APPROACH

- AREA OF RECTANGLE 1 $= 7.5\text{ cm} \times 2.8\text{ cm} = 21\text{ cm}^2$
- AREA OF RECTANGLE 2 $= 5.6\text{ cm} \times 10.5\text{ cm} = 58.8\text{ cm}^2$

$$\times 2.8 \left(\begin{array}{ccc} 21\text{ cm}^2 & : & 75 \\ 58.8\text{ cm}^2 & : & 210 \end{array} \right) \times 2.8$$

IYGB - MMS PAPER D - QUESTION 2

a) $Y \sim N(122, 14^2)$

$P(125 < Y < 139)$

$= P(Y < 139) - P(Y < 125)$

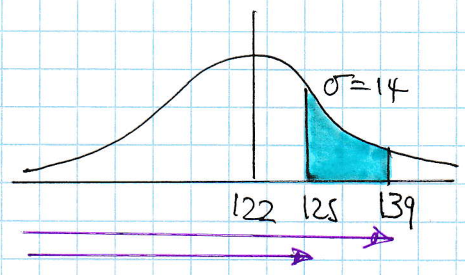
$= P\left(Z < \frac{139-122}{14}\right) - P\left(Z < \frac{125-122}{14}\right)$

$= \Phi(1.2143) - \Phi(0.2143)$

... USING CALCULATOR ...

$= 0.88768 - 0.58484$

$= \underline{0.30284}$



b) PROCEED BY INPUTING THE INFORMATION IN A NEW DIAGRAM

$\Rightarrow P(101 < Y < a) = 0.8276$

$\Rightarrow P(Y<a) - P(Y<101) = 0.8276$

$\Rightarrow P(Y<a) - [1 - P(Y>101)] = 0.8276$

$\Rightarrow P(Y<a) - 1 + P(Y>101) = 0.8276$

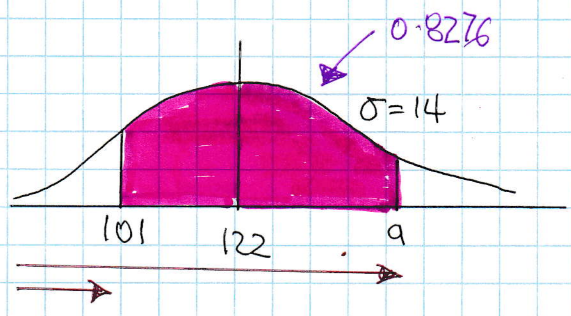
$\Rightarrow P(Y<a) + P(Y>101) = 1.8276$

$\Rightarrow P(Y<a) + P\left(Z > \frac{101-122}{14}\right) = 1.8276$

$\Rightarrow P(Y<a) + \Phi(-1.5) = 1.8276$

$\Rightarrow P(Y<a) + 0.9332 = 1.8276$

$\Rightarrow P(Y<a) = 0.8944$



IYGB - MMS PAPER D - QUESTION 2

FINISH OFF BY INVERTING

$$\Rightarrow \quad P\left(z < \frac{a-122}{14}\right) = 0.8944$$

$$\Rightarrow \quad \frac{a-122}{14} = +\Phi^{-1}(0.8944)$$

$$\Rightarrow \quad \frac{a-122}{14} = 1.25$$

$$\Rightarrow \quad a-122 = 17.5$$

$$\Rightarrow \quad a = 139.5$$

IYGB - MMS PAPER D - QUESTION 3

a) IF THE EVENTS ARE MUTUALLY EXCLUSIVE $P(A \cap B) = 0$

$$\Longrightarrow P(A \cup B) = P(A) + P(B) - \cancel{P(A \cap B)}$$
$$\Longrightarrow 0.79 = 0.4 + P(B)$$
$$\Longrightarrow P(B) = 0.39$$

b) IF THE EVENTS ARE INDEPENDENT $P(A \cap B) = P(A) \times P(B)$

$$\Longrightarrow P(A \cup B) = P(A) + P(B) - P(A \cap B)$$
$$\Longrightarrow P(A \cup B) = P(A) + P(B) - P(A)P(B)$$
$$\Longrightarrow 0.79 = 0.4 + P(B) - 0.4P(B)$$
$$\Longrightarrow 0.39 = 0.6P(B)$$
$$\Longrightarrow P(B) = 0.65$$

IYGB - MMS PAPER D - QUESTION 4

x	ARNOLD ST		BENEDICT ST	y
(1)	5	0		
(4)	5 5 3 3	1		
(3)	9 9 1	2	5	(1)
(11)	9 8 6 5 5 4 3 2 2 2 1	3	6 7 8	(3)
(7)	6 4 1 0 0 0 0	4	1 2 2 3 4 8	(6)
(1)	9	5	1 4 4 4 4 5 8 8	(8)
		6	1 3 4 4 5 9 9	(7)
		7	2 6 9	(3)
27				28

$13 = 1|3|6 = 36$

a)

ARNOLD STREET

MODE = 40

$Q_1 = \frac{1}{4}(27+1) = 7^{TH}$ OBS

$Q_1 = 29$

$Q_2 = \frac{1}{2}(27+1) = 14^{TH}$ OBS

$Q_2 = 34$

$Q_3 = \frac{3}{4}(27+1) = 21^{ST}$ OBS

$Q_3 = 40$

$\bar{x} = \frac{\Sigma x}{n} = \frac{866}{27} = 32.07$

$\sigma_x = \sqrt{\frac{\Sigma x^2}{n} - \bar{x}^2} = 11.77$

BENEDICT STREET

MODE = 54

$Q_1 = 7^{TH}/8^{TH}$ OBS

$Q_1 = 42.5$

$Q_2 = 14^{TH}/15^{TH}$ OBS

$Q_2 = 54$

$Q_3 = 21^{ST}/22^{ND}$ OBS

$Q_3 = 64$

$\bar{y} = \frac{\Sigma y}{n} = \frac{1516}{28} = 54.14$

$\sigma_y = \sqrt{\frac{\Sigma y^2}{n} - \bar{y}^2} = 13.09$

IYGB - MMS PAPER D - QUESTION 4

b) USING THE FORMULA GIVEN

FOR ARNOLD STREET $= \dfrac{32.07 - 40}{11.77} = -0.67$

FOR BENEDICT STREET $= \dfrac{54.14 - 54}{13.09} = 0.01$

c)
- MEDIAN & MEAN IS HIGHER IN BENEDICT STREET, INDICATING OLDER PEOPLE LIVING THERE
- BENEDICT STREET AGES ARE SLIGHTLY MORE VARIED, AS INDICATED BY THE STANDARD DEVIATION
- DATA IN ARNOLD STREET IS NEGATIVELY SKEWED AS INDICATED BY PART (b), WHILE DATA IN BENEDICT STREET IS PRACTICALLY SYMMETRICAL (SLIGHT POSITIVE SKEW) AS INDICATED BY (b)

IYGB - MMS PAPER D - QUESTION 5

USING THE CALCULATOR IN STATISTICAL MODE

$$\text{P.M.C.C} = r = 0.5814\ldots$$

SETTING HYPOTHESES

$H_0 : \rho = 0$

$H_1 : \rho > 0$

WHERE ρ IS THE P.M.C.C. OF THE ENTIRE POPULATION

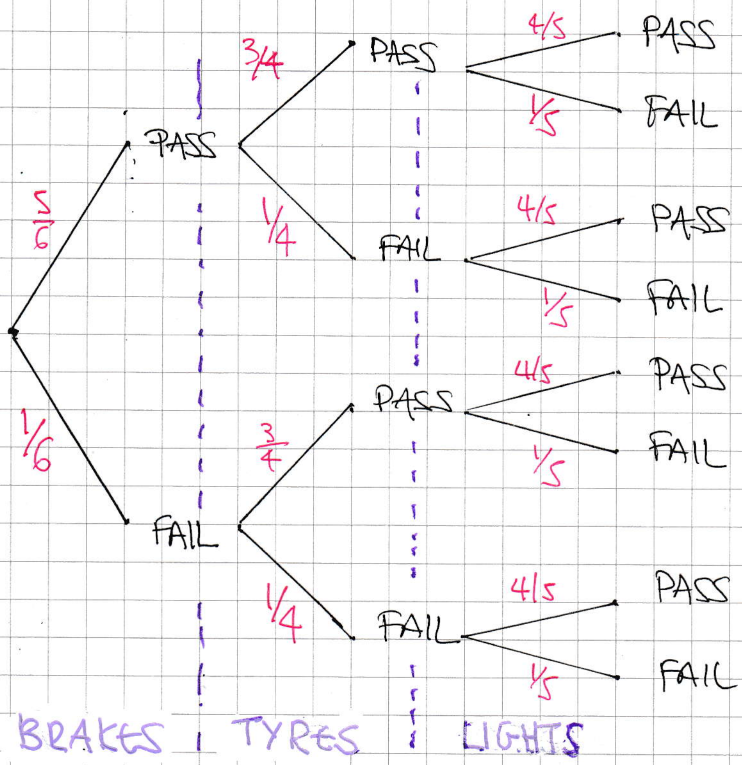
THE CRITICAL VALUE AT $n=8$ AT 5% SIGNIFICANCE IS 0.6215

AS $0.5814 < 0.6215$ THERE IS NO SIGNIFICANT EVIDENCE OF POSITIVE CORRELATION BETWEEN THE TEST MARKS IN PHYSICS & CHEMISTRY

INSUFFICIENT EVIDENCE TO REJECT H_0

IYGB – MMS PAPER D – QUESTION 6

a) USING A TREE DIAGRAM



P(FAIL EXACTLY ONE) = "F P P" $= \frac{1}{6} \times \frac{3}{4} \times \frac{4}{5} = \frac{12}{120}$

P F P $= \frac{5}{6} \times \frac{1}{4} \times \frac{4}{5} = \frac{20}{120}$

P P F $= \frac{5}{6} \times \frac{3}{4} \times \frac{1}{5} = \frac{15}{120}$

$\frac{47}{120}$

b) USING THE TREE DIAGRAM, NOTING THAT BRANCHES TERMINATE IF THEY END UP IN A FAIL

$$P(\text{FAIL}) = \frac{1}{6} + \frac{5}{6} \times \frac{1}{4} + \frac{5}{6} \times \frac{3}{4} \times \frac{1}{5} = \frac{1}{2}$$

FAILED BRAKES

FAILED TYRES.

FAILED LIGHTS

IYGB - MMS PAPER D - QUESTION 6

ALTERNATIVE APPROACH

$$P(\text{FAIL}) = 1 - P(\text{PASSES}) = 1 - \frac{5}{6} \times \frac{3}{4} \times \frac{4}{5} = \frac{1}{2}$$

c) $$P(\text{FAILED LIGHTS} \mid \text{FAILED}) = \frac{P(\text{FAILED LIGHTS} \cap \text{FAILED})}{P(\text{FAILED})}$$

$$= \frac{\frac{5}{6} \times \frac{3}{4} \times \frac{1}{5}}{\frac{1}{2}} \leftarrow \text{FOUND IN (b)}$$

$$= \frac{\frac{1}{8}}{\frac{1}{2}}$$

$$= \frac{1}{4}$$

IYGB – MMS PAPER D – QUESTION 7

COLLECTING OUTCOMES GREATER OR EQUAL TO 4

$0, 1, 3$ GIVES 4 : $\frac{1}{6} \times \frac{1}{3} \times \frac{1}{2} \times 3$ WAYS $= \frac{1}{12}$

$1, 1, 3$ GIVES 5 : $\frac{1}{6} \times \frac{1}{6} \times \frac{1}{2} \times 3$ WAYS $= \frac{1}{24}$

$1, 3, 3$ GIVES 7 : $\frac{1}{3} \times \frac{1}{2} \times \frac{1}{2} \times 3$ WAYS $= \frac{1}{4}$

$0, 3, 3$ GIVES 6 : $\frac{1}{6} \times \frac{1}{2} \times \frac{1}{2} \times 3$ WAYS $= \frac{1}{8}$

$3, 3, 3$ GIVES 9 : $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$

$$\therefore P(X_1 + X_2 + X_3 \geq 4) = \frac{5}{8} = 0.625$$

IYGB - MMS PAPER D - QUESTION 8

X = NUMBER OF BUSHES WITH PINK FLOWERS, $X \sim B(20, 0.2)$

a) $P(X>4) = P(X \geq 5) = 1 - P(X \leq 4)$

$= \ldots$ tables $\ldots$

$= 1 - 0.6296$

$= 0.3704$

b) $P(X \geq 1) > 0.975$

$\Rightarrow 1 - P(X=0) > 0.975$

$\Rightarrow 0.025 < P(X=0)$

$\Rightarrow \binom{n}{0}(0.2)^0(0.8)^n > 0.025$

$\Rightarrow 0.8^n < 0.025$

$\Rightarrow \log(0.8^n) < \log(0.025)$

$\Rightarrow n\log(0.8) < \log(0.025)$

$\Rightarrow n > \dfrac{\log(0.025)}{\log(0.8)}$

[log 0.8 IS NEGATIVE]

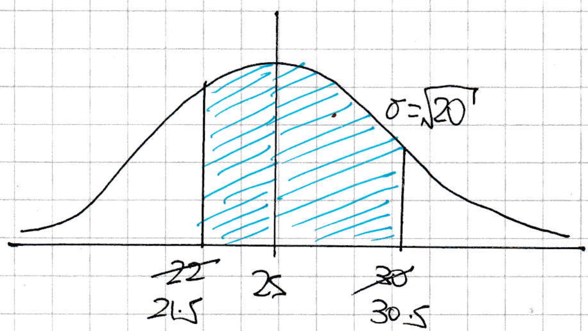
$\Rightarrow n > 16.53\ldots$

$\therefore n = 17$

c) APPROXIMATE BY NORMAL

$X \sim B(125, 0.2)$

- MEAN $= 125 \times 0.2 = 25$
- VARIANCE $= 25 \times 0.8 = 20$



$Y \sim N(25, 20)$

$P(21 < X \leq 30)$

$= P(22 \leq X \leq 30)$

$= P(21.5 < Y < 30.5)$

$= P(Y < 30.5) - P(Y < 21.5)$

$= P(Y < 30.5) - [1 - P(Y > 21.5)]$

$= P(Y < 30.5) + P(Y > 21.5) - 1$

IYGB - MMS PAPER D - QUESTION 8

$$= P\left(Z < \frac{30.5-25}{\sqrt{20}}\right) + P\left(Z > \frac{21.5-25}{\sqrt{20}}\right) - 1$$

$$= \Phi(1.23) + (-0.78) - 1$$

$$= 0.8907 + 0.7823 - 1$$

$$\simeq 0.673$$

d) SETTING HYPOTHESES FOR $X \sim B(25, 0.2)$

$H_0: p = 0.2$

$H_1: p > 0.2$

WITH p THE PROPORTION OF PINK FLOWERING BUSHES IN GENERAL

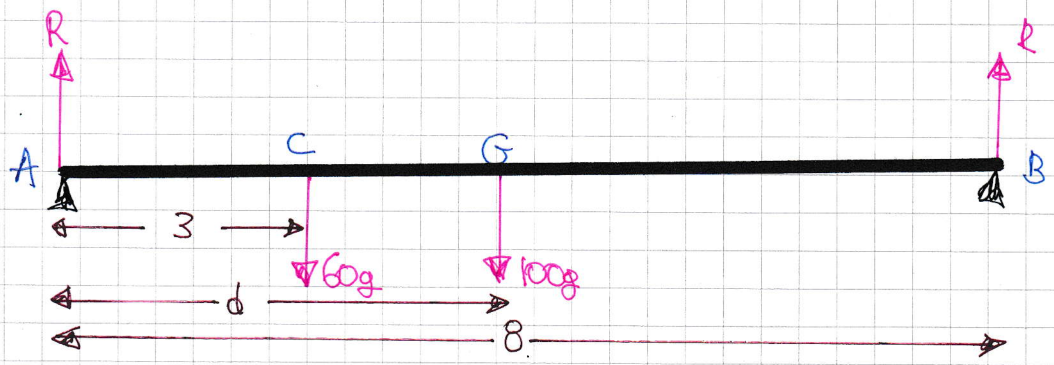
TESTING AT 1% SIGNIFICANCE ON THE BASIS $X = 10$

$$P(X \geqslant 10) = 1 - P(X \leqslant 9)$$
$$= 1 - 0.9827$$
$$= 0.0173$$
$$= 1.73\% > 1\%$$

THERE IS NO SIGNIFICANT EVIDENCE AT 1% THAT THE PROPORTION IS GREATER THAN 0.2 — INSUFFICIENT EVIDENCE TO REJECT H_0

IYGB - MMS PAPER D - QUESTION 9

a) START WITH A DIAGRAM



RESOLVING VERTICALLY

$R + R = 60g + 100g$

$2R = 160g$

$R = 80g$

TAKING MOMENTS ABOUT A

$\overset{\curvearrowright}{A}: (60g \times 3) + (100g \times d) = R \times 8$

$180g + 100gd = 8R$

$180g + 100gd = 640g$

$100gd = 460g$

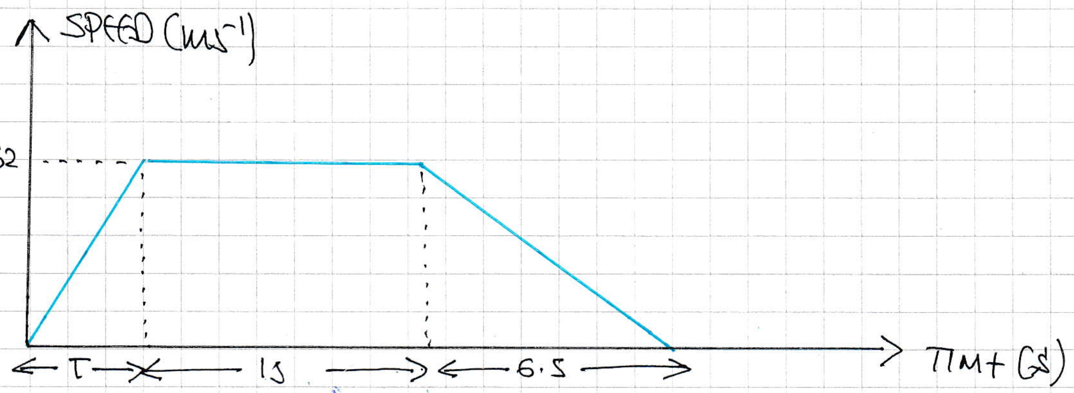
$d = 4.6 \text{ m}$

b) "ROD" IMPLIES AN OBJECT WHICH IS RIGID & ITS DIMENSIONS, COMPARED TO ITS LENGTH ARE NEGLIGIBLE, SO IT IS TREATED AS A RIGID, ONE DIMENSIONAL OBJECT

"PARTICLE" MEANS CAN BE TREATED AS A "POINT MASS" SO ITS CENTRE OF MASS CAN BE PLACED EXACTLY 3 METRES FROM A

IYGB - MMS PAPER D - QUESTION 10

a) FILL IN A SPEED TIME GRAPH FROM THE INFORMATION GIVEN



b) USING GRADIENT = ACCELERATION OR DECELERATION

$$\text{"}a = \frac{\Delta v}{\Delta t}\text{"} \implies 0.36 = \frac{1.62}{T}$$

$$\implies T = 4.5$$

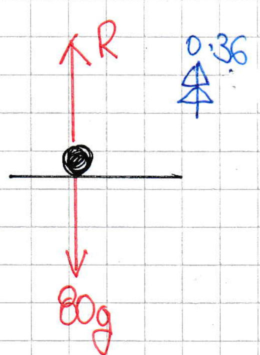
NOW "DISTANCE = AREA"

$$\text{DISTANCE} = \tfrac{1}{2}(T + 15 + 6.5 + 15) \times 1.62$$

$$= \tfrac{1}{2} \times 41 \times 1.62$$

$$= 33.21 \text{ m}$$

c) MAXIMUM REACTION OCCURS DURING "UPWARD" ACCELERATION



"F = ma"

$$R - 80g = 80 \times 0.36$$

$$R - 80g = 28.8$$

$$R = 812.8 \text{ N}$$

IYGB – MMS PAPER D – QUESTION 11

a) USING $\underline{r} = \underline{r}_0 + \underline{u}t + \frac{1}{2}\underline{a}t^2$

$$\underline{r} = \left(-20\underline{i} - \tfrac{15}{2}\underline{j}\right) + (4\underline{i} + 2\underline{j})t + \tfrac{1}{2}\left(\tfrac{1}{10}\underline{i} - \tfrac{1}{5}\underline{j}\right)t^2$$

$$\underline{r} = \left(-20 + 4t + \tfrac{1}{20}t^2\right)\underline{i} + \left(-\tfrac{15}{2} + 2t - \tfrac{1}{10}t^2\right)\underline{j}$$

b) DUE EAST IN POSITION, IMPLIES $\underline{j}$ COMPONENT ZERO & $\underline{i}$ COMPONENT POSITIVE (IN THE POSITION VECTOR)

$$-\tfrac{15}{2} + 2t - \tfrac{1}{10}t^2 = 0$$

$$-75 + 20t - t^2 = 0$$

$$t^2 - 20t + 75 = 0$$

$$(t-5)(t-15) = 0$$

$$t = \begin{cases} 5 \\ 15 \end{cases}$$

CHECK $\underline{i}$ FOR BEING POSITIVE

$t=5 \Rightarrow -20 + 4\times5 + \frac{1}{20}\times5^2 = \frac{5}{4} > 0$

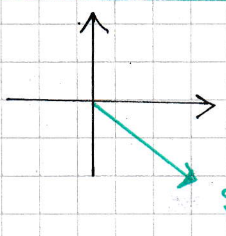
$t=15 \Rightarrow -20 + 4\times15 + \frac{1}{20}\times15^2 = \frac{205}{4} > 0$

c) USING $\underline{v} = \underline{u} + \underline{a}t$

$$\underline{v} = 4\underline{i} + 2\underline{j} + \left(\tfrac{1}{10}\underline{i} - \tfrac{1}{5}\underline{j}\right)t$$

$$\underline{v} = \left(4 + \tfrac{1}{10}t\right)\underline{i} + \left(2 - \tfrac{1}{5}t\right)\underline{j}$$

"SOUTH EAST" DIRECTION OF MOTION, IMPLIES PARALLEL TO $\underline{i} - \underline{j}$



$$\Rightarrow \left(4 + \tfrac{1}{10}t\right)\underline{i} + \left(2 - \tfrac{1}{5}t\right)\underline{j} = \lambda(\underline{i} - \underline{j})$$

$$\Rightarrow \begin{cases} 4 + \tfrac{1}{10}t = \lambda \\ 2 - \tfrac{1}{5}t = -\lambda \end{cases}$$

$$\Rightarrow 2 - \tfrac{1}{5}t = -4 - \tfrac{1}{10}t$$

$$\Rightarrow 6 = \tfrac{1}{10}t$$

$$\Rightarrow t = 60$$

IYGB - MMS PAPER D - QUESTION 11

WHEN $t=60$

$$\underline{v} = \left(4+\tfrac{1}{10}\times 60\right)\underline{i} + \left(2-\tfrac{1}{5}\times 60\right)$$

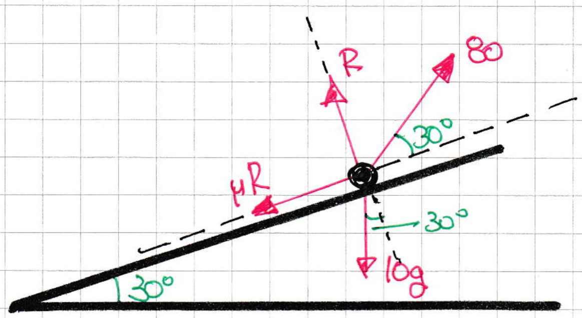
$$\underline{v} = 10\underline{i} - 10\underline{j}$$

$$\text{SPEED} = |\underline{v}| = |10\underline{i} - 10\underline{j}| = \sqrt{10^2+(-10)^2}$$

$$= \sqrt{100+100} = \sqrt{200} = 10\sqrt{2} \simeq 14.14 \text{ ms}^{-1}$$

IYGB - MMS PAPER D - QUESTION 12

STARTING WITH A DIAGRAM



CONSTANT SPEED, IMPLIES EQUILIBRIUM

RESOLVING PARALLEL & PERPENDICULAR TO THE PLANE

$(\parallel)$: $\mu R + 10g\sin 30 = 80\cos 30$ — (I)

$(\perp)$: $R + 80\sin 30 = 10g\cos 30$ — (II)

SOLVING SIMULTANEOUSLY BY SUBSTITUTION

(II) — $R = 10g\cos 30 - 80\sin 30$

$\Rightarrow \mu(10g\cos 30 - 80\sin 30) + 10g\sin 30 = 80\cos 30$ — (I)

$\Rightarrow \mu(10g\cos 30 - 80\sin 30) = 80\cos 30 - 10g\sin 30$

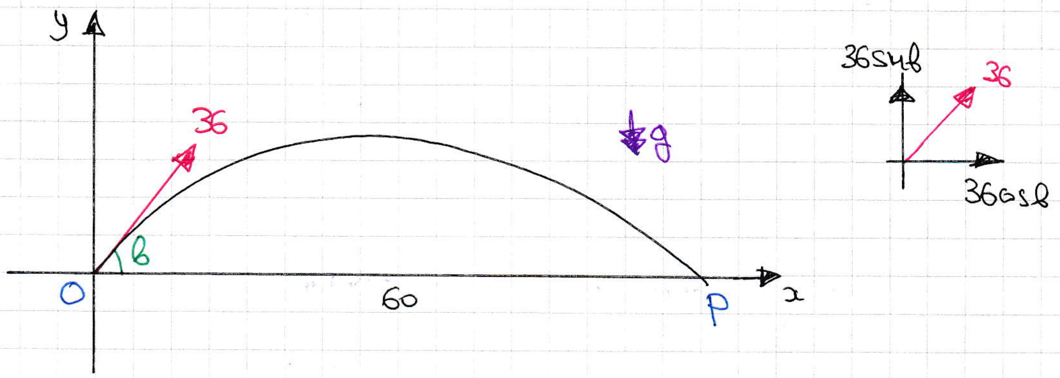
$\Rightarrow \mu = \dfrac{80\cos 30 - 10g\sin 30}{10g\cos 30 - 80\sin 30}$

$\Rightarrow \mu = \dfrac{40\sqrt{3} - 5g}{5g\sqrt{3} - 40}$

$\Rightarrow \mu \simeq 0.452$

IYGB – MMS PAPER D – QUESTION 13

a) STARTING WITH A STANDARD DIAGRAM



DETERMINE THE FLIGHT TIME, FROM THE VERTICAL MOTION

$u = 36\sin\theta$
$a = -9.8$
$s = 0$
$t = ?$
$v =$

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

$0 = (36\sin\theta)t + \frac{1}{2}(-9.8)t^2$

$0 = 36\sin\theta - 4.9t \qquad (t \neq 0)$

$t = \frac{36\sin\theta}{4.9}$

LOOKING AT THE HORIZONTAL MOTION

$\Rightarrow$ "DISTANCE = SPEED × TIME"

$\Rightarrow 60 = 36\cos\theta \times \frac{36\sin\theta}{4.9}$

$\Rightarrow 294 = 1296\cos\theta\sin\theta$

$\Rightarrow 294 = 648(2\sin\theta\cos\theta)$

$\Rightarrow 294 = 648\sin 2\theta$

$\Rightarrow \sin 2\theta = \frac{49}{108}$

$\begin{cases} 2\theta = 26.98... \pm 360n \\ 2\theta = 153.02... \pm 360n \end{cases} \quad n = 0, 1, 2, 3, ...$

$\begin{cases} \theta = 13.5° \pm 180n \\ \theta = 76.5° \pm 180n \end{cases}$

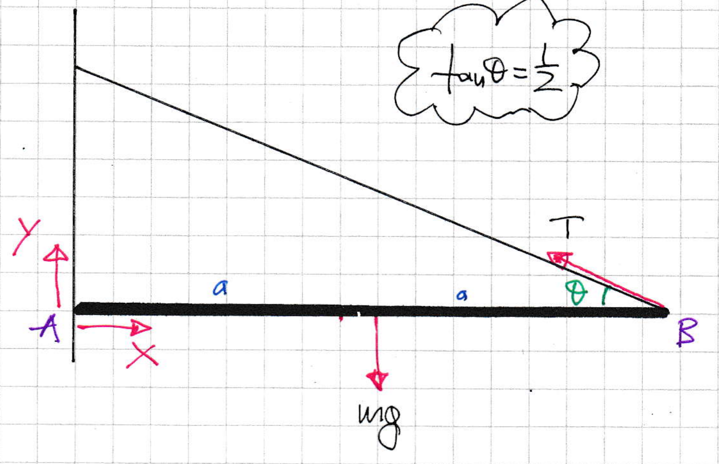
$\therefore \theta = 13.5°, 76.5°$

b) USING THE ANSWER FROM EARLIER WITH $\theta = 13.5$, AS THIS GIVES THE LEAST SIN

$t = \frac{36\sin\theta}{4.9} = \frac{36\sin(13.5°)}{4.9} \simeq 1.71\text{ s}$

IYGB - MMS PAPER D - QUESTION 14

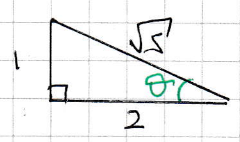
a) LOOKING AT THE DIAGRAM BELOW



$\tan\theta = \frac{1}{2}$

$(\uparrow): Y = T\sin\theta$

$(\rightarrow): X = T\cos\theta$



$\sin\theta = \frac{1}{\sqrt{5}}$

$\cos\theta = \frac{2}{\sqrt{5}}$

TAKING MOMENTS ABOUT A

$\overset{\curvearrowleft}{A}$: $mg \times \cancel{a} = T\sin\theta \times 2\cancel{a}$

$mg = 2T \times \frac{1}{\sqrt{5}}$

$T = \frac{\sqrt{5}}{2}mg$ // AS REQUIRED

b) LOOKING AT THE "RESOLVING" EQUATIONS

- $X = T\cos\theta$
  $X = \frac{\sqrt{5}}{2}mg \times \frac{2}{\sqrt{5}}$
  $X = mg$

- $Y = T\sin\theta$
  $Y = \frac{\sqrt{5}}{2}mg \times \frac{1}{\sqrt{5}}$
  $Y = \frac{1}{2}mg$

REACTION $= \sqrt{X^2+Y^2} = \sqrt{(mg)^2 + \left(\frac{1}{2}mg\right)^2} = \sqrt{\frac{5}{4}m^2g^2} = \frac{\sqrt{5}}{2}mg = T$ //

ALTERNATIVE

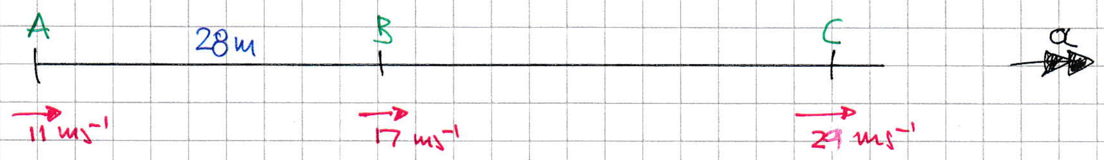
$X = T\sin\theta$
$Y = T\cos\theta$

$X^2+Y^2 = T^2\sin^2\theta + T^2\cos^2\theta = T^2(\cancel{\sin^2\theta+\cos^2\theta})$

$\therefore \sqrt{X^2+Y^2} = T$ //

IYGB - MMS PAPER D - QUESTION 15

a) POTTING THE INFORMATION INTO A DIAGRAM



LOOKING AT THE JOURNEY AB

$u = 11 \text{ ms}^{-1}$
$a = ?$
$s = 28 \text{ m}$
t
$v = 17 \text{ ms}^{-1}$

$$v^2 = u^2 + 2as$$
$$17^2 = 11^2 + 2a \times 28$$
$$289 = 121 + 56a$$
$$168 = 56a$$
$$a = 3 \text{ ms}^{-2}$$

NOW LOOKING AT AC

$u = 11 \text{ ms}^{-1}$
$a = 3 \text{ ms}^{-2}$
$s =$
$t =$
$v = 29 \text{ ms}^{-1}$

$$v^2 = u^2 + 2as$$
$$29^2 = 11^2 + 2 \times 3 \times s$$
$$841 = 121 + 6s$$
$$720 = 6s$$
$$s = 120 \text{ m}$$

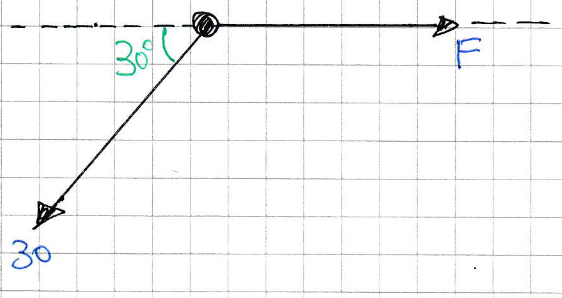
b) USING THE INFORMATION FROM ABOVE

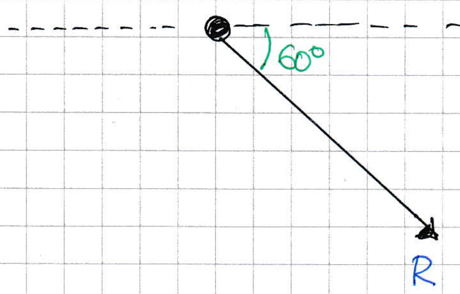
$$v = u + at$$
$$29 = 11 + 3t$$
$$18 = 3t$$
$$t = 6 \text{ s}$$

IYGB - MMS PAPER D - QUESTION 16

METHOD A - BY RESOLVING

LOOKING AT THE DIAGRAM BELOW





- "BALANCING TO THE RIGHT" (→) $F - 30\cos 30 = R\cos 60$
- BALANCING "DOWNWARDS" (↓) $30\sin 30 = R\sin 60$

THUS WE OBTAIN

$\Rightarrow 30\sin 30 = R\sin 60$ AND $F - 30\cos 30 = R\cos 60$

$\Rightarrow 30 \times \frac{1}{2} = R \times \frac{\sqrt{3}}{2}$ $F - 30 \times \frac{\sqrt{3}}{2} = 10\sqrt{3} \times \frac{1}{2}$

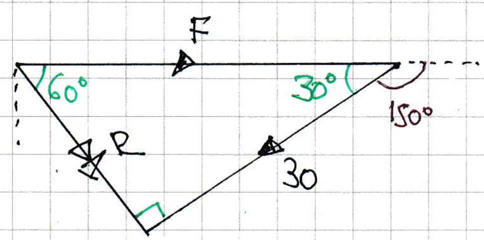
$\Rightarrow 30 = R\sqrt{3}$ $F - 15\sqrt{3} = 5\sqrt{3}$

$\Rightarrow 30\sqrt{3} = 3R$ $F = 20\sqrt{3}$ $\simeq 34.6\text{N}$

$\Rightarrow R = 10\sqrt{3}$ $\simeq 17.3\text{N}$

METHOD B - BY TRIANGLE OF FORCES

LOOKING AT THE DIAGRAM OPPOSITE



- $\tan 30° = \frac{R}{30}$

  $R = 30\tan 30$

  $R = 10\sqrt{3}$

- $\cos 30° = \frac{30}{F}$

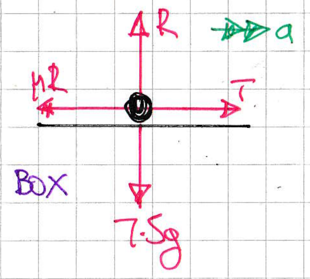
  $F = \frac{30}{\cos 30}$

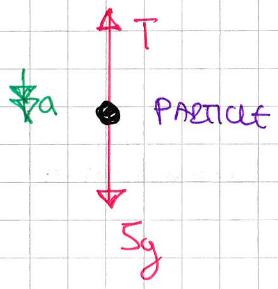
  $F = 20\sqrt{3}$

AS ABOVE

IYGB - MMS PAPER D - QUESTION 17

a) LOOKING AT THE EQUATION OF MOTION FOR EACH PARTICLE SEPARATELY





"$F = ma$"

$T - \mu R = 7.5a$

$T - \mu(7.5g) = 7.5a$

$T - 0.2(7.5g) = 7.5a$

$\underline{T - 1.5g = 7.5a}$

"$F = ma$"

$\underline{5g - T = 5a}$

ADDING THE EQUATIONS YIELDS

$T - 1.5g = 7.5a$

$-T + 5g = 5a$

$3.5g = 12.5a$

$\Rightarrow a = 2.744 \text{ ms}^{-2}$ //

& $T - 1.5g = 7.5a$

$T - 1.5g = 7.5(2.744)$

$T = 35.28 \text{ N}$ //

b) FIRSTLY CALCULATE THE COMMON SPEED, WHEN THE STRING BREAKS

$u = 0 \text{ ms}^{-1}$
$a = 2.744 \text{ ms}^{-2}$
$s = 2.8 \text{ m}$
$t =$
$v = ?$

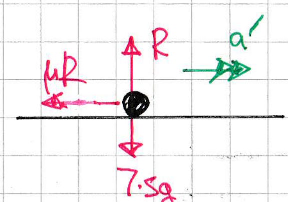
$v^2 = \cancel{u^2} + 2as$

$v^2 = 2(2.744)(2.8)$

$v^2 = 15.3664$

$v = 3.92 \text{ ms}^{-1}$

RECALCULATE THE DECELERATION OF THE BOX ONCE THE STRING BREAKS (NO TENSION)



$\Rightarrow -\mu R = 7.5a'$

$\Rightarrow -\mu(7.5g) = 7.5a'$

IYGB - MMS PAPER D - QUESTION 17

$$\Rightarrow a' = -\mu g$$

$$\Rightarrow a' = -0.2(9.8)$$

$$\Rightarrow \underline{\underline{a' = -1.96 \text{ ms}^{-2}}}$$

FINALLY KINEMATICS AGAIN WITH CONSTANT DECELERATION 1.96 ms^{-2}

$u =$	3.92 ms^{-1}
$a =$	-1.96 ms^{-2}
$s =$	$?$
t	
$v =$	0

$$v^2 = u^2 + 2as$$

$$0 = 3.92^2 + 2(-1.96)s$$

$$3.92s = 3.92^2$$

$$\underline{\underline{s = 3.92}}$$

$$\therefore d = 2.8 + 3.92 = 6.72 \text{ m}$$