JJEB MARKING GUIDE MATHS Paper 2 P425/2 2020

1. $n = 120, \quad p = \frac{1}{10}, \quad q = \frac{9}{10}$

$\mu = 120 \times \frac{1}{10}, \quad \sigma = \sqrt{12 \times \frac{9}{10}}$

$= 12 \qquad = 3.2863$ B1

$P(x < 15) = P\left(Z < \frac{14.5 - 12}{3.2863}\right)$ B1 M1

$= P(Z < 0.7607)$

$= 0.5 + 0.2767$ M1

$= 0.7767$ A1

05

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2. $a = 3e^{-t}l + 5\cos tj - 4\sin tk$

$\mathbf{V}_t = \int \left(3e^{-t}\mathbf{i} + 5\cos + \mathbf{j} - 4\sin t\mathbf{k}\right) \, dt$

$= -3e^{-t}\mathbf{i} + 5\sin t\mathbf{j} + 4\cos t\mathbf{k} + \mathbf{c}$ M1

$\mathbf{V}t = 0{,}6\mathbf{i} - 2\mathbf{j} + 3\mathbf{k} = -3\mathbf{i} + 0\mathbf{j} + 4\mathbf{k} + \mathbf{c}$ M1

$\therefore \mathbf{C} = 9\mathbf{i} - 2\mathbf{j} - \mathbf{k}$ B1

$\therefore \mathbf{V}t = \left(-3e^{-t} + 9\right)\mathbf{i} + \left(5\sin t - 2\right)\mathbf{j} + \left(4\cos t - 1\right)\mathbf{k}$

$\therefore \mathbf{V}t = 2 = \left(-3e^{-2} + 9\right)\mathbf{i} + \left(5\sin 2 - 2\right)\mathbf{j} + \left(4\cos 2 - 1\right)\mathbf{k}$

Speed $= |\mathbf{V}t = 2| = \sqrt{\left(-3e^{-2} + 9\right)^2 + \left(5\sin 2 - 2\right)^2 + \left(4\cos 2 - 1\right)^2}$ M1

$= 9.351$ A1

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3. $x = 4.3, \quad z = 84.001, \quad D^e x = 0.0215, \quad D^e z = 0.042$ B1 B1

$$\text{evel } (x-z) = \frac{|D^e x| + |D^e z|}{|x-z|}$$

$$= \frac{0.0215 + 0.042}{|4.3 - 84.001|} \quad \text{M1}$$

$$= 0.0007967 \quad \text{B1}$$

$$= 0.000797 \quad \underline{\text{A1}}$$

$$\underline{\underline{05}}$$

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4. (i) Total momentum before collision $= 0.2\begin{pmatrix}5\\7\end{pmatrix} + 0.3\begin{pmatrix}2\\-3\end{pmatrix}$

$$= \begin{pmatrix}1.6\\0.5\end{pmatrix}$$

Total momentum after collision $= 0.5\mathbf{v}$

$$\therefore 0.5\mathbf{v} = 1.6\mathbf{i} + 0.5\mathbf{j} \quad \text{M1}$$

$$\mathbf{v} = 3.2\mathbf{i} + \mathbf{j}$$

$$\therefore \text{speed} = \sqrt{(3.2)^2 + 1^2} \quad \text{M1}$$

$$= 3.3526 ms^{-1}$$

(ii) K.E before $= \frac{1}{2}.0.2.(5\mathbf{i} + 7\mathbf{j}) \cdot (5\mathbf{i} + 7\mathbf{j}) + \frac{1}{2}.0.3.(2\mathbf{i} - 3\mathbf{j}) \cdot (2\mathbf{i} - 3\mathbf{j})$

$= 9.35J$

K.E after $= \frac{1}{2}.0.5.(3.2\mathbf{i} + \mathbf{j}) \cdot (3.2\mathbf{i} + \mathbf{j}) = 2.81J$ **B1**

$\therefore$ loss in K.E $= (2.81 - 9.35)\ J$ M1

$= 6.54J$ M1

$\underline{\underline{05}}$

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5. (i) $P(M) = P(N) = 2P\ (M \cap N)$

$P(M \cup N) = P(M) + P(N) - P(M \cap N)$

$0.6 = 3P(M \cap N)$ M1

$\therefore P(M \cap N) = 0.2)$ A1

(ii) $P(M \cap N') = P(M) - P(M \cap N)$

$= 2(0.2) - 0.2$ B1 for P(M) M1

$= 0.2$ A1

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6. $h = \frac{\pi/2 - 0}{5} = \pi/10$ B1

B1

x	y_0, y_4	$y_1 = y_4$
0		
$\pi/10$	1.0000	
$2\pi/10$		1.7999
$3\pi/10$		2.2457
$4\pi/10$		2.5884
$\pi/2$	2.7183	
sum	3.7183	6.6341

B1

$\therefore \int_0^{\pi/2} e^{\sin x}\,dx = \frac{1}{2} \times \frac{\pi}{10}(3.7183 + 2(6.6341))$ M1

$= 2.6682$

$= 2.66$ A1

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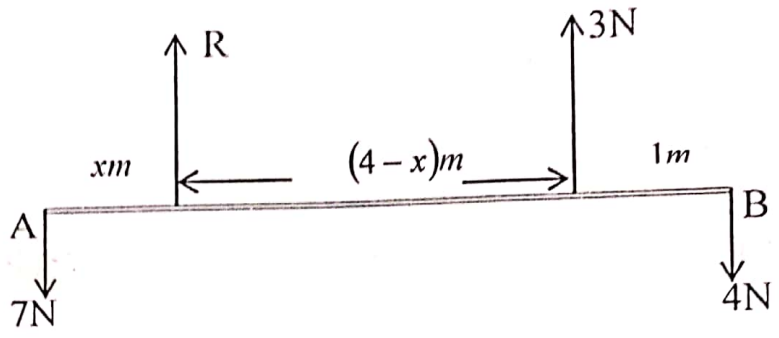
7.



(a) (I) : $R+3=7+4$ M1

$R=8N$ A1

$M(A)$: $8x+3\times4=4\times5$

$x=1m$

(b) If forces reduce to a couple then resultant = 0

$\therefore R+3-7-4=0$

$R=8N$ A1

And $8\times x+3\times4-4\times5=4$ M1

$x=3/2m$ A1

05

8.

Age	f	F
20 – 29	20	20
30 – 39	61	81
40 – 49	35	116
50 -- 59	29	145
60 – 69	5	150

B1
for C.f

(i) $\text{Mode} = 29.5 + \dfrac{(61-20)}{(61-20)+(61-35)} \times 10$ M1

$= 35.6194$ A1

(ii) $\text{Median} = 29.5 + \dfrac{(75-20)}{61} \times 10$ M1

$= 38.5164$ A1

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9. (a) $\mu = 17.2 \ , \ \sigma = 3.6$

$P(x > 20) = P\left(Z > \dfrac{20-17.2}{3.6}\right)$ M1

$= P(Z > 0.778)$

$= 0.5 - 0.2818$ B1 M1

$= 0.2182$ B1

$\therefore P = 0.2182 \ , \ q = 0.7818 \ , \ n = 5$ B1

$\therefore P(x = 3) = \binom{5}{3} (0.2182)^3 \ (0.7818)^2$ M1

$= 0.0635$ A1

(b) $\mu = 82.36$, $\sigma = 15$, $Z_{0.4875} = 2.24$, $n = 400$ B1

$$\therefore \bar{x} \pm Z\frac{\sigma}{\sqrt{n}} = 82.36 \pm 2.24 \times \frac{15}{\sqrt{400}}$$ M1 M1

(weight) upper = $84.04g$ A1

(weight) lower = $80.68g$ A1

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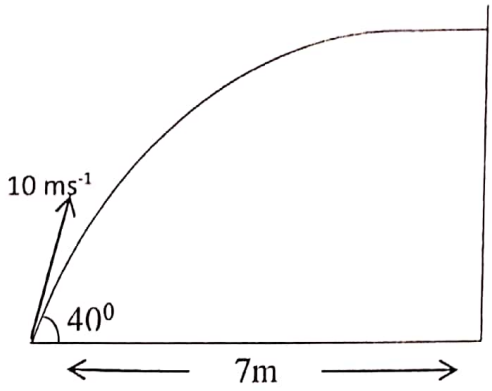
10.



$u = 10\cos 40\mathbf{i} + 10\sin 40\mathbf{j}$

$\mathbf{v} = (10\cos 40^0\,\mathbf{i} + 10\sin 40^0\,\mathbf{j}) - 9.8t\mathbf{j}$

$= 7.660\ \mathbf{i} + (6.428 - 9.8t)\ \mathbf{j}$

$\mathbf{r} = \boldsymbol{\mu}\, t + \frac{1}{2}\,\boldsymbol{a}\, t^2$

$\mathbf{r} = (10\cos 40\mathbf{i} + 10\sin 40\mathbf{j})\ t - \frac{1}{2}.9.8.t^2$ **M1**

$= 7.660t\ \mathbf{i} + (6.428t - 4.9t^2)\ \mathbf{j}$ **B1**

(i) $7.660\,t = 7$ M1

$t = 0.9138$ **B1**

Height of the ball at time t

$= 6.428 + -4.9\,t^2$

at $t = 0.9138$

$= 6.428(0.9138) - 4.9(0.9138)^2$ **M1**

$= 1.7823m$ **A1**

(ii) Velocity of ball when it hits the wall,

From $\mathbf{V} = 7.660\mathbf{i} + (6.428 - 9.8t)\ \mathbf{j}$

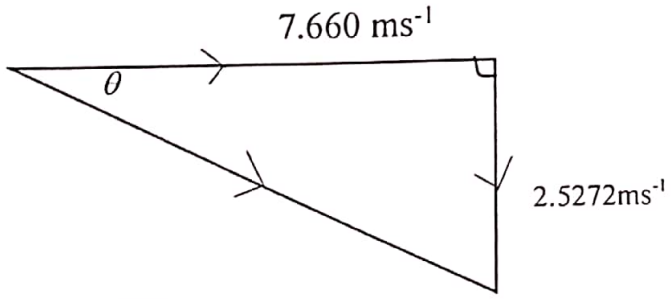
$t = 0.9138\,;\ \mathbf{V} = 7.660\mathbf{i} + (6.428 - 9.8 \times 0.9138)\ \mathbf{j}$

$= 7.660\mathbf{i} - 2.5272\mathbf{j}$ B1

$\therefore speed = \sqrt{(7.660)^2 + (-2.5272)^2}$ M1

$= 8.0661 ms^{-1}$ A1

(iii)



$\therefore \tan\theta = \dfrac{2.5272}{7.660}$ M1

$\theta = 18.3^0$ B1

A1

$\therefore$ Ball hits the wall in a direction 18.3^0 below the horizontal.

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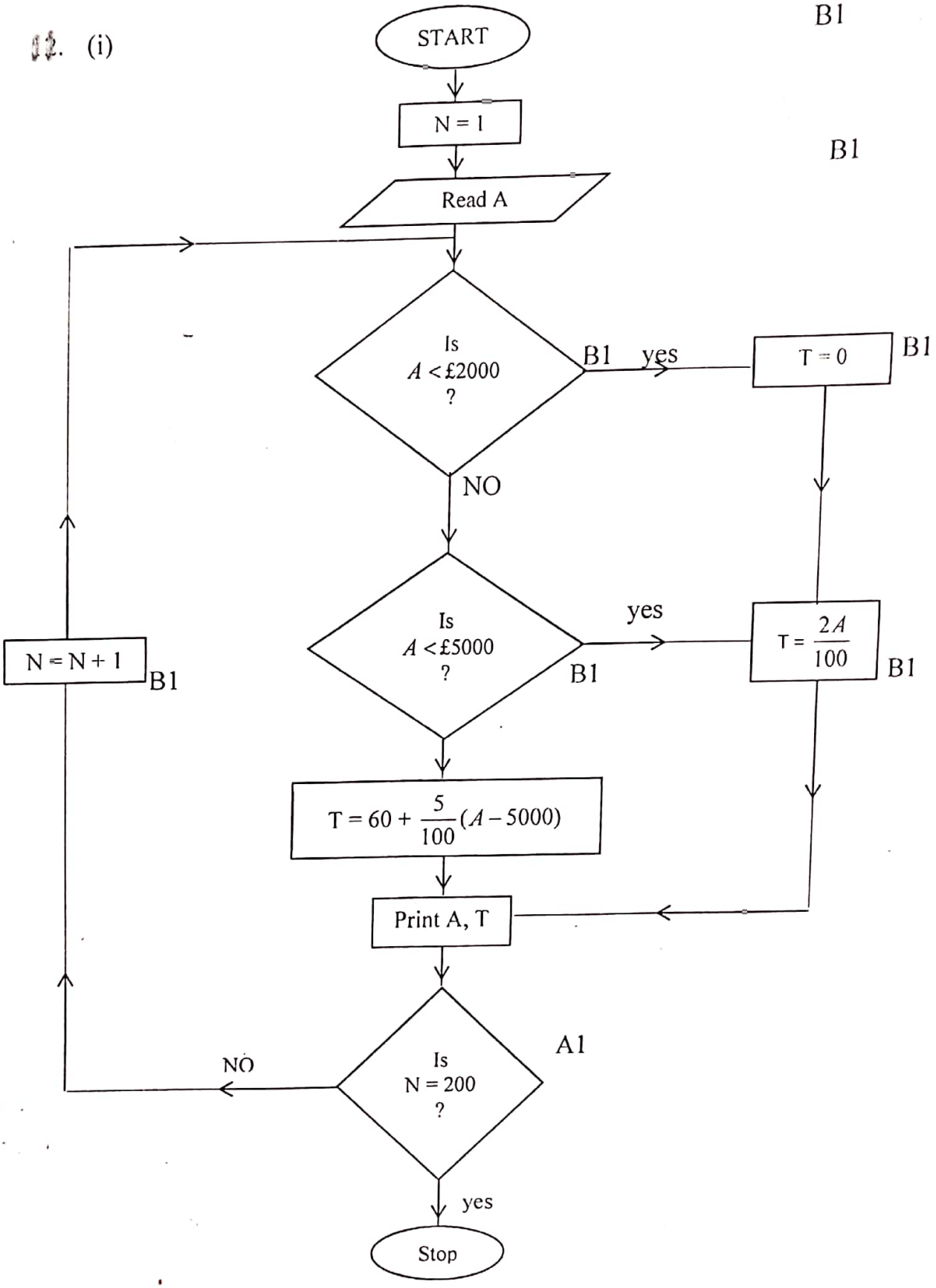
11.

12. (i)



(ii) $A = £6000. \implies A > £5000.$ B1

$$\therefore T = 60 + \frac{5}{100}(6000 - 5000)$$ M1

$$= 110$$

The man pays tax = £110 annually A1 12

12 (b) (i)

Students	A	B	C	D	E	F	G	H
R_2	4	3	5	1.5	7	6	1.5	8
R_3	1	4	6	3	8	6	2	6
d	3	−1	−1	−1.5	−1	0	−0.5	2
d^2	9	1	1	2.25	1	0	0.25	4

B1

B1

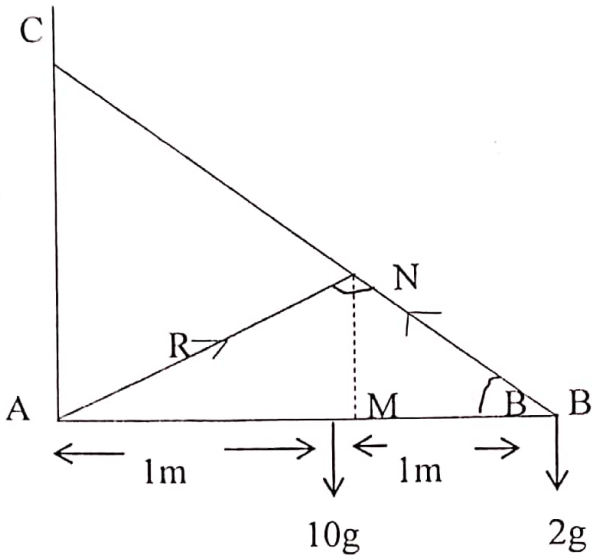
$\Sigma d^2 = 18.5$ B1

$r_2 = 1 - \frac{6 \times 18.5}{8 \times 63}$ M1

$= 0.78$ A1

(ii) At 5% level, correlation is significant A1 12

13.



B1

$NB = 2(1)\cos\theta$; $MB = \dfrac{10g \times (1)}{10g + 2g}$ B1 B1

$= 2\cos\theta$ $= 5/6$

$\therefore \cos\theta = \dfrac{MB}{NB} = \dfrac{5/6}{2\cos\theta}$ M1

$\therefore \cos^2\theta = 5/12$ B1

: But $\dfrac{AB}{BC} = \cos\theta$

$\therefore Bc = C = 2/\sqrt{5/12}$ M1

$= 3.098\text{m}$ A1

(b) M(A) : $T\sin\theta(2) = 10(1) + 2(2)$ M1 M1

But $\sin\theta = \sqrt{7/12}$ B1

$\therefore T = \dfrac{14}{2\sqrt{7/12}}$ M1

$= 9.1652N$ A1 **12**

14. (a)

(b) $f(x) = e^x - x^2 - 2$

$f^1(x) = e^x - 2x$ M1

$x_0 = 1.2$ B1

$$x_1 = 1.2 - \frac{\left(e^{1.2} - (1.2)^2 - 2\right)}{e^{1.2} - 2(1.2)}$$

$= 1.3303$ M1

$$x_2 = 1.3303 - \frac{\left(e^{1.3303} - (1.3303)^2 - 2\right)}{e^{1.3303} - 2(1.3303)}$$

$= 1.3189$ M1

$$x_3 = 1.3189 - \frac{\left(e^{1.3189} - (1.3189)^2 - 2\right)}{e^{1.3189} - 2(1.3189)}$$

$= 1.3191$ M1

$\therefore$ root $= 1.32$ B1 A1

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15.(a) (i) $P(A/B) = 5/11$, $P(A \cup B) = {}^9/_{10}$, $P(B) = x$

$$\frac{P(A \cap B)}{P(B)} = \frac{5}{11}$$

$$\therefore P(A \cap B) = \frac{5}{11^x}$$ B1

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

$$\frac{9}{10} = P(A) + x - \frac{5}{11^x}$$ M1

$$P(A) = \frac{9}{10} - \frac{6}{11^x}$$ B1

(ii) $P(A \cap B) = 2[P(A) - P(A \cap B)]$

$$\therefore P(A) = \frac{3}{2} P(A \cap B)$$

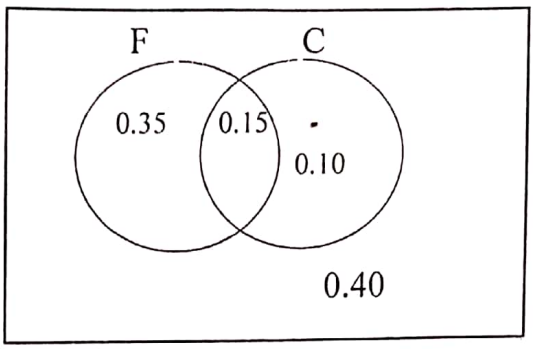
$$= \frac{3}{2} \times \frac{5}{11} x$$

$$= \frac{15}{22} x$$ B1

$$\Rightarrow \frac{15}{22} x = \frac{9}{10} - \frac{6x}{11}$$ M1

$$x = \frac{22}{27}$$ A1

(b)



B1

(i) $P(F/C) = \dfrac{P(F \cap C)}{P(C)}$

$\dfrac{0.15}{0.25} = 0.6$ M1 A1

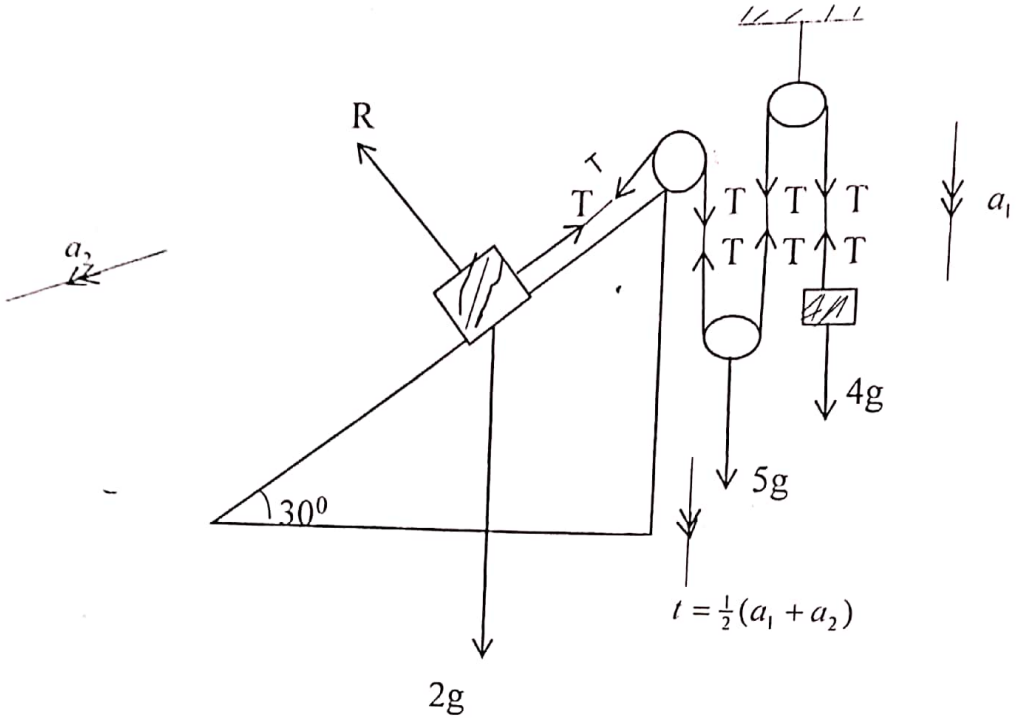
(ii) $P(F/C') = \dfrac{P(F \cap C')}{P(C')}$

$= \dfrac{0.35}{0.75}$ M1 A1

$= 7/15$ A1

12

16. (a)



$25\sin 30^0 - T = 2a_2$ - - - ---------- (1) M1

$2T - 5g = 5.\frac{1}{2}(a_1 + a_2)$ ----- (2) M1

$4g - T = 4a_1$ ----------(3) M1

From (1) $a_2 - \frac{g-T}{2}$ - - - - (4)

From (3) $a_1 = \frac{4g-T}{4}$ - - - - (5)

Substituting into (2)

$\Rightarrow 4T - 10g = 5\left[\frac{4g-T}{4} + \frac{g-T}{2}\right]$ M1

$T = \frac{70g}{31}$

$= \frac{70 \times 9.8}{31}$

$\therefore T = 22.129N.$ A1

(b) from equation (4)

$$a_2 = \frac{g - T}{2}$$

$$= \frac{g - \frac{70g}{31}}{2} \qquad \text{M1}$$

$$= \frac{-39g}{62} = \frac{39 \times 9.8}{62}$$

$$= -6.1645$$

$\therefore 2kg$ mass moves with $6.1645 ms^{-2}$ upwards A1

And from equation (5)

$$a_1 = \frac{4g - \frac{70g}{31}}{4} \qquad \text{M1}$$

$$= \frac{54g}{124}$$

$$= \frac{54 \times 9.8}{124}$$

$$a_1 = 4.2677 ms^{-2} \qquad \text{A1}$$

$\therefore$ acceleration for movable pulley

$$= ½ (a_1 + a_2)$$

$$= ½ (4.2677 + 6.1645) \qquad \text{M1}$$

$$= 5.2161 \text{ ms}^{-2} \qquad \text{A1}$$

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END