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P425/2 APPLIED MATHEMATICS
MARKING GUIDE

(1) (a) $u = 20ms^{-1}$, $v = 0ms^{-1}$, $s = 30m$, $a = a ms^{-2}$

$v^2 = u^2 + 2as$ (M1) – Correct Substitution

$(0)^2 = (20)^2 + 2a \times 30$

$a = -\frac{20}{3} ms^{-2} = -6.6667 ms^{-2}$ (B1) – For acceleration (Ignore the negative sign)

$\therefore$ deceleration $= \frac{20}{3} ms^{-2}$ (A1) → deceleration

(b) $v = u + at$, $t = t$ (M1) – correct sub for u

$0 = 20 - \frac{20}{3}t$ (A1) – Correct output with units

$t = 3.5$

(2)

c.f	i	f	x	fx	c.f
29.5 – 49.5	20	10	39.5	395	10
49.5 – 64.5	15	30	57	1,710	40
64.5 – 69.5	5	25	67	1,675	65
69.5 – 74.5	5	20	72	1,440	85
74.5 – 79.5	5	15	77	1,155	100
SUM		$\Sigma f = 100$		$\Sigma fx = 6,375$ (B1)	(B1) → For c.f or (40+30) without fx

(a) Mean $(\bar{x}) = \frac{\Sigma fx}{\Sigma f}$ (correct) Substitution correct output (extra)

$\bar{x} = 6,375 = 63.75$ (M1) (A1)

(b) $64.5 = 49.5 + \frac{(N_{64.5} - 40)}{30} 15$

$N_{64.5} = 40$ (A1)

→ correct Σfx

(3) (a) $P.E = \frac{A.E}{E.V} \times 100$, $A.E = \frac{P.E \times E.V}{100}$

$e_x = \frac{4.23 \times 2}{100} = 0.0846$ (B1) → Correct e_x

$e_y = \frac{3 \times 2.1}{100} = 0.063$ (B1) → correct e_y

$e_z = \frac{4 \times 3.2}{100} = 0.128$ (B1) → correct e_z

(b) $P_{max} = \frac{x_{max} \, y_{max}}{z_{min}} = \frac{4.3146 \times 2.163}{3.072}$ (M1) – correct substitution

$= 3.0379$ (A1) correct output (≥ 2 d.p.s)

ALT: $|e_p| = \left\{ \left|\frac{0.0846}{4.23}\right| + \left|\frac{0.063}{2.1}\right| + \left|\frac{0.128}{3.2}\right| \right\} \times \frac{4.23 \times 2.1}{3.2} = 0.2498$

W.V $= \frac{4.23 \times 2.1}{3.2} = 2.7759$ $P_{max} = 2.7759 + 0.2498$

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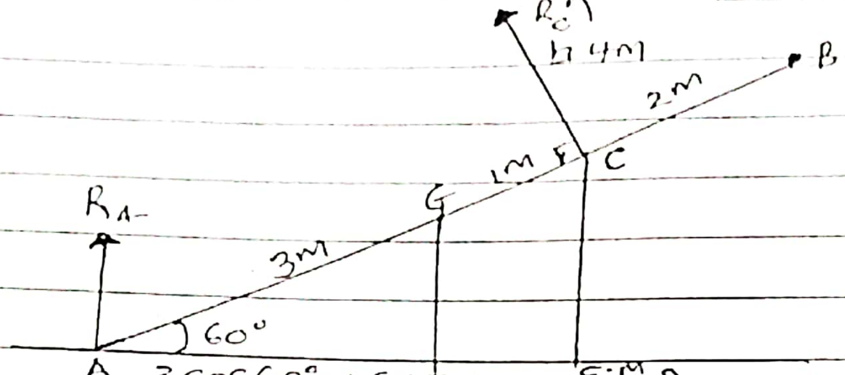

correct force (All forces ...) B_1

A $3\cos 60^\circ = 1.5m$ $5g\,N = 49N$ 1.5m A C.W M, C.W M

A: $4 \times R_c = 49 \times 1.5$ M_1 M_1 M_1 → Equating the m...

$R_c = 18.375N$ A_1 → correct output with units

(5) (a) $P(A|B) = \frac{P(A\cap B)}{P(B)}$, $P(A\cap B) = P(A|B)\cdot P(B) = 0.3 \times 0.4$

$= 0.12$ B_1 → For correct $P(A\cap B)$

$P(A\cup B) = P(A) + P(B) - P(A\cap B) = 0.7 + 0.4 - 0.12 = 0.98$ ... correct ... M_1 A_1

(b) $P(A|(A\cup B)) = \frac{P(A)}{P(A\cup B)} = \frac{0.7}{(0.7+0.4-0.12)} = \frac{5}{7}$ M_1 A_1 ...

or 0.7143

(6)

N = N+1	T = T+6A+1	A = A+N	PRINT N, T	IS N = 5?
0	0	0	0, 0	0
1	1	1	1, 1	1
2	8	3	2, 8	2
3	27	6	3, 27	3
4	64	10	4, 64	4
5	125	15	5, 125	5

For correct N B_1; All T correct B_1; All A's correct B_1; correct termination or decision B_1

EITHER $N^3 = T$ OR $N = \sqrt[3]{T}$ B_1 — correct relationship

(7) (a) $B.M_G = F.M_S$

$Mu = mv$

$2000 \times u = 5 \times 400$ M_1 → correct substitution of velocities and masses

$u = 1ms^{-1}$ A_1 → correct output with/without unit

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OR Retarding force = mass × deceleration
$4000 = 2000 \times$ deceleration $B_1 m_1$

(b) $-F = ma$ deceleration $= 2ms^{-2}$ A_1

$-4000 = 2000a$ (M_1) – correct substitution

$a = -2ms^{-2}$ (A_1) – correct output

$\therefore$ retardation $= 2ms^{-2}$. (B_1) → for conclusion

(8) T : H

1 : 2 = 3

$P(T) = \frac{1}{3}$, $P(H) = \frac{2}{3}$, $n = 6$ (B_1) → Both P(T) and P(H) correct.

(a) $P(X_H \geq 5) = P(X_H = 5) + P(X_H = 6)$ correct substitution

$= {}^6C_5\left(\frac{2}{3}\right)^5\left(\frac{1}{3}\right)^1 + {}^6C_6\left(\frac{2}{3}\right)^6\left(\frac{1}{3}\right) = \frac{256}{729} = 0.3512$ (M_1) (A_1) – correct but ≥ 4 d.p

(b) $P(1 < X_T < 3) = P(X_T = 2) = {}^5C_2\left(\frac{1}{3}\right)^2\left(\frac{2}{3}\right)^4 = \frac{80}{243} = 0.3292$ (M_1) correct substitution (A_1) correct but ≥ 4 d.p

(9) (a) $\underset{\sim}{v}_{(t=t)} = \begin{pmatrix} 2t^3 + 16 \\ \frac{9}{2}t^2 - 4t + 15 \\ -\frac{3}{2}t^2 - 8 \end{pmatrix} ms^{-1}$, $\underset{\sim}{a}_{(t=t)} = \frac{d\underset{\sim}{v}}{dt} = \begin{pmatrix} 6t^2 \\ 9t - 4 \\ -3t \end{pmatrix} ms^{-2}$ correct $\frac{dr}{dt}$ (M_1)

$\underset{\sim}{a}_{(t=3s)} = \begin{pmatrix} 6(3)^2 \\ 9(3) - 4 \\ -3(3) \end{pmatrix} = \begin{pmatrix} 54 \\ 23 \\ -9 \end{pmatrix} ms^{-2}$ (M_1) → correct substitution (B_1) → correct for $\underset{\sim}{a}$ in vector form

$|\underset{\sim}{a}_{(t=3s)}| = \sqrt{(54)^2 + (23)^2 + (-9)^2} = 59.3801 ms^{-2}$ (M_1) → attempt to find $|\underset{\sim}{a}|$

$= 59 ms^{-2}$ (A_1) → correct output ≥ 0 d.p

(b) $\underset{\sim}{r}_{(t=t)} = \int \underset{\sim}{v}\,dt = \int \begin{pmatrix} 2t^3 + 16 \\ \frac{9}{2}t^2 - 4t + 15 \\ -\frac{3}{2}t^2 - 8 \end{pmatrix} dt = \begin{pmatrix} \frac{1}{2}t^4 + 16t \\ \frac{3}{2}t^3 - 2t^2 + 15t \\ -\frac{1}{2}t^3 - 8t \end{pmatrix}$ (M_1) → correct integration with $+C$ with constant seen

at $t = 0$, $\underset{\sim}{r} = \begin{pmatrix} 3 \\ -1 \\ 4 \end{pmatrix}$, $\begin{pmatrix} 3 \\ -1 \\ 4 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} + \underset{\sim}{C}$, $\underset{\sim}{C} = \begin{pmatrix} 3 \\ -1 \\ 4 \end{pmatrix}$ (B_1) → attempt to find constant

$\underset{\sim}{r}_{(t=t)} = \begin{pmatrix} \frac{1}{2}t^4 + 16t + 3 \\ \frac{3}{2}t^3 - 2t^2 + 15t - 1 \\ -\frac{1}{2}t^3 - 8t + 4 \end{pmatrix}$ m (B_1) – Correct position vector

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correct substitution of $t=2$

$$\underset{\sim}{r}_{(t=2s)} = \begin{pmatrix} \frac{1}{2}(2)^4 + 16(2) + 3 \\ \frac{3}{2}(2)^3 - 2(2)^2 + 15(2) - 1 \\ \frac{1}{2}(2)^3 - 8(2) + 4 \end{pmatrix} m = \begin{pmatrix} 43 \\ 33 \\ -16 \end{pmatrix} m \quad (B_1)\ (B_1)$$

$$|\underset{\sim}{r}_{(t=2s)}| = \sqrt{(43)^2 + (33)^2 + (-16)^2} = 56.5155\ m \quad (M_1)\ (A_1)$$

(10) (b)

R_x	R_y	d^2
6.5	5	2.25
12	12	0
1	2	1
6.5	6	0.25
11	11	0
10	9	1
3	1	4
2	3	1
5	7.5	6.25
4	4	0
9	10	1
8	7.5	0.25
Sum	$\Sigma d^2 = 17$	

(B_1) correct rank of physics (B_1) correct R_{maths} (B_1) correct Σd^2

Correct substitution of correct formula

$$\rho_c = \left| 1 - \frac{6\Sigma d^2}{n(n^2-1)} \right| = \left| 1 - \frac{6 \times 17}{12 \times 143} \right| = 0.9406 \quad (M_1)\ (A_1)$$

Correct to $\geq$ 2 d.p.s

Since $\rho_c = 0.9406 > \rho_t = 0.58$, $\therefore$ Significant at 5%. (B_1)

Correct conclusion with relationship seen.

9 (b)

$$\underset{\sim}{v} = \begin{pmatrix} 2t^3 + 16 \\ \frac{9}{2}t^2 - 4t + 15 \\ -\frac{3}{2}t^2 - 8 \end{pmatrix}$$

Displacement $= \int_0^2 \begin{pmatrix} 2t^3 + 16 \\ \frac{9}{2}t^2 - 4t + 15 \\ -\frac{3}{2}t^2 - 8 \end{pmatrix} dt$

$$= \left[\begin{pmatrix} \frac{t^4}{2} + 16t \\ \frac{3}{2}t^3 - 2t^2 + 15t \\ -\frac{1}{2}t^3 - 8t \end{pmatrix} \right]_0^2$$

M_1 B_1 B_1 — correct integral, correct limits

$$= \begin{pmatrix} 40 \\ 34 \\ -20 \end{pmatrix} - \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

B_1 B_1 — correct substitution of $t=2$ and $t=0$

$$= \begin{pmatrix} 40 \\ 34 \\ -20 \end{pmatrix}$$

B_1 — correct vector displacement

distance $= \sqrt{40^2 + 34^2 + (-20)^2}$

M_1 — Attempt to find distance

$= 56.1783$

A_1 → correct output with/without units $\geq$ 0 d.p

11 (a) Alt:

x	1.2	1.4	1.6	1.8	2.0
$y = e^{-3x} - \cos x$	-0.33	-0.16	0.04	0.24	0.40
$y = \cos x - e^{-3x}$	0.33	0.16	-0.04	-0.24	-0.40

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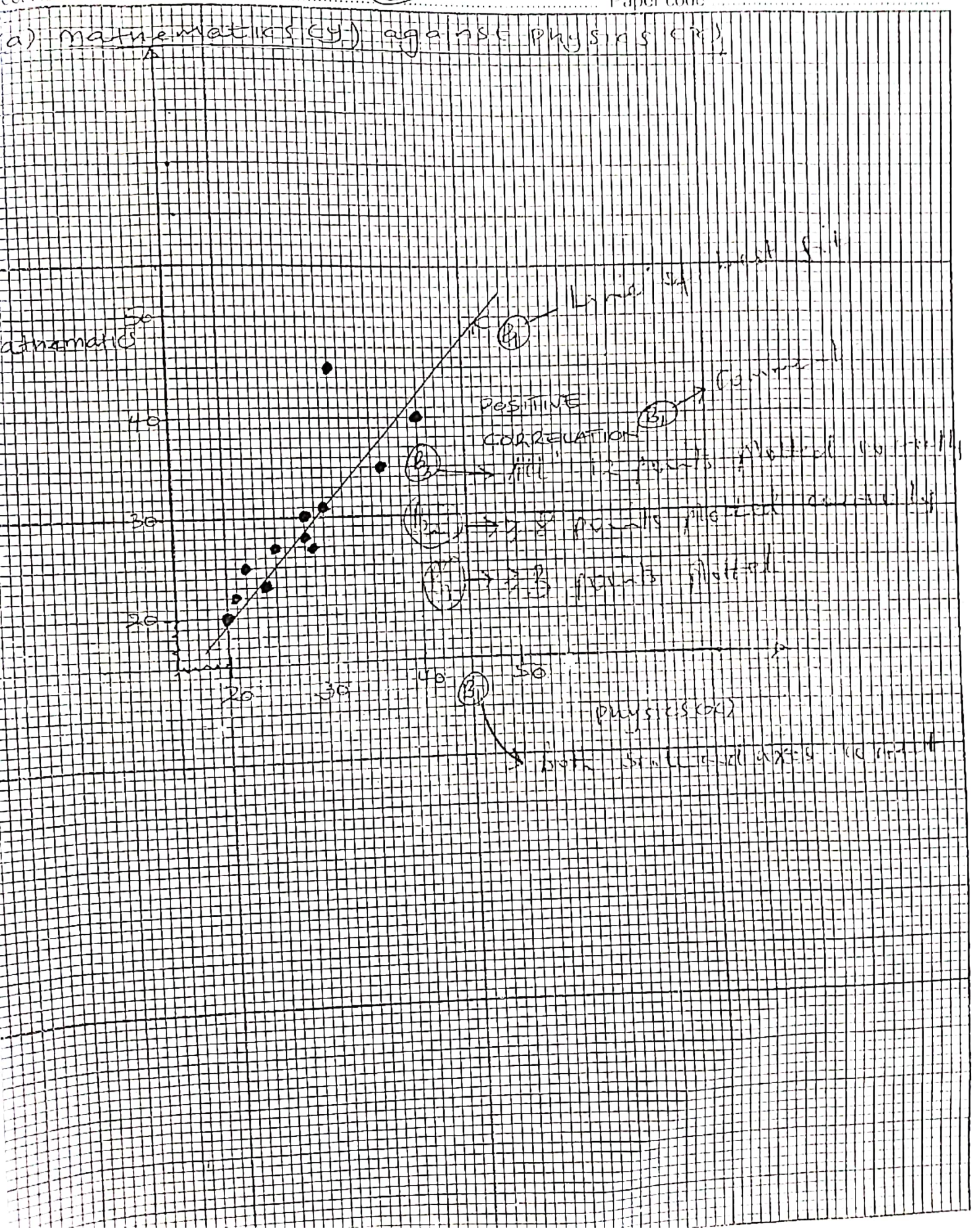
a) mathematics (y) against Physics (x)



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(11) (a)

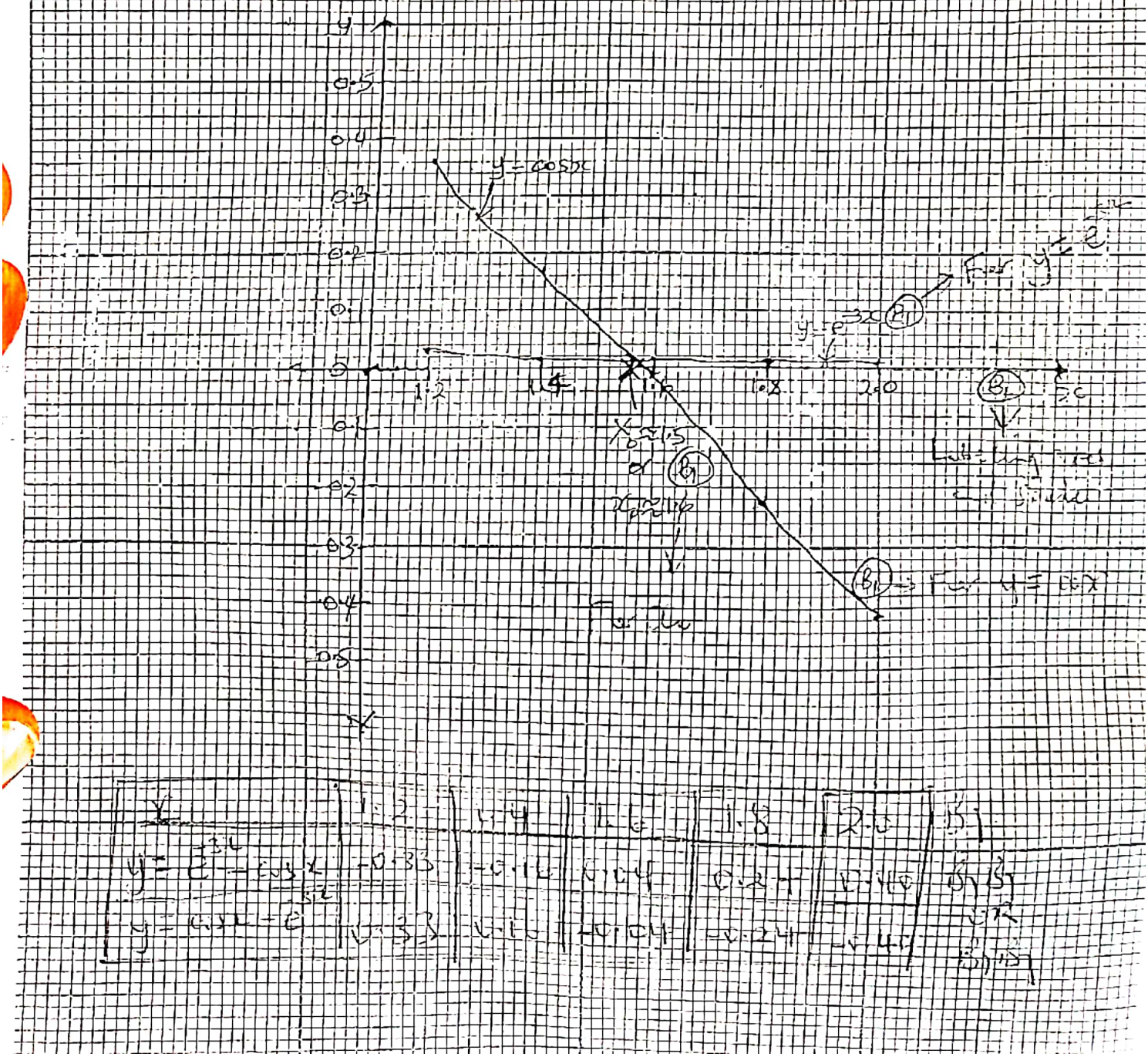
x	1·2	1·4	1·6	1·8	2·0
$y = e^{-3x}$	0·03	0·01	0·01	0·005	0·002
$y = \cos 2x$	−0·26	−0·14	−0·03	+0·23	+0·42

(B1)

(B1)

(B1)

Graphs of $y = \cos 2x$ and $y = e^{-3x}$ against x values



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(11) (b) $e^{-3x} = \cos x$, $\cos x - e^{-3x} = 0$, $f(x) = 0$

$f(x) = \cos x - e^{-3x}$ OR $\sin x - 3e^{-3x}$ correct derivative ← (M1)

$f'(x) = 3e^{-3x} - \sin x$

N.R.M $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)} = x_n - \left(\frac{\cos x_n - e^{-3x_n}}{3e^{-3x_n} - \sin x_n}\right)$

$x_0 = 1.5000$ OR $x_0 = 1.6000$

$x_1 = 1.5000 - \left(\frac{\cos(1.5000) - e^{-4.5000}}{3e^{-4.5000} - \sin(1.5000)}\right) = 1.5618$ (B1) For x_1 OR 1.561L

$x_2 = 1.5618 - \left(\frac{\cos(1.5618) - e^{-4.6854}}{3e^{-4.6854} - \sin(1.5618)}\right) = 1.5616$ (B1) → For x_2 OR 1.561L

$x_3 = 1.5616 - \left(\frac{\cos(1.5616) - e^{-4.6848}}{3e^{-4.6848} - \sin(1.5616)}\right) = 1.5616$ (B1) → For x_3

$|x_3 - x_2| \doteq 0$, root ≈ 1.562 (3 d.p.s) (A1) correct output 3 d.p.s

(12) let C.G $(\bar{x}, \bar{y})$ and ρ = weight / unit area.

lamina	Weight	L.o.C.G from AF	L.o.C.G from AB	
ABDF	$6\times6\rho = 36\rho$	$\frac{1}{2}\times6 = 3$ (B1)	$\frac{1}{2}\times6 = 3$	(B1)
DEF	$\frac{1}{2}\times6\times4\rho = 12\rho$	$\frac{2}{3}\times6 = 4$ (B1)	$6+\frac{1}{3}\times4 = \frac{22}{3}$	(B1)
BCD	$\frac{1}{2}\times6\times6\rho = 18\rho$	$6+\frac{1}{3}\times6 = 8$ (B1)	$\frac{1}{3}\times6 = 4$	(B1)
ABCDEF	66ρ	$\bar{x}$	$\bar{y}$	(B1)

M.O.W = M.O.P.

$\bar{y}$ $(66\bar{x}\rho = 36\times3\rho + 12\times\frac{22}{3}\rho + 18\times8\rho)\div\rho$ (M1)

$\bar{x} = \frac{50}{11} = 4.5455$ 4.3636 OR $\frac{48}{11}$ (A1)

$\bar{x}$ $(66\bar{y}\rho = 36\times3\rho + 12\times\frac{22}{3}\rho + 18\times4\rho)\div\rho$ (M1)

$\bar{y} = \frac{134}{33} = 4.0606$ 3.7879 OR $\frac{125}{33}$ (A1)

$(4.3636, 3.7879)$

$\therefore$ C.G $(\bar{x}, \bar{y}) = (4.5455, 4.0606)$ (B1)

OR $= \left(\frac{50}{11}, \frac{134}{33}\right)$

$\left(\frac{48}{11}, \frac{125}{33}\right)$

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for P(A), P(B)

(13) (a)

P(A) = 2/5				P(B) = 1/5				P(C) = 2/5			
P(G) = 4/11		P(R) = 7/11		P(G) = 7/12		P(R) = 5/12		P(G) = 3/14		P(R) = 11/14	
P(G) = 3/10	P(R) = 7/10	P(G) = 4/10	P(R) = 6/10	P(G) = 6/11	P(R) = 5/11	P(G) = 7/11	P(R) = 4/11	P(G) = 2/13	P(R) = 11/13	P(G) = 3/13	P(R) = 10/13

(a)(i) $P(S) = \frac{2}{5}\times\frac{4}{11}\times\frac{3}{10} + \frac{2}{5}\times\frac{7}{11}\times\frac{6}{10} + \frac{1}{5}\times\frac{7}{12}\times\frac{6}{11} + \frac{1}{5}\times\frac{5}{12}\times\frac{4}{11} + \frac{2}{5}\times\frac{3}{14}\times\frac{2}{13}$

$+ \frac{2}{5}\times\frac{11}{14}\times\frac{10}{13} = \frac{108}{550} + \frac{62}{660} + \frac{232}{910} = 0.5452$ (A1) – correct input

(ii) $P(B|S) = P(B \cap S) = \frac{\frac{62}{660}}{0.5452} = 0.1723$ (M1) (A1) → correct

(b)

x	0	1	2
P(X=x)	$\frac{2}{5}\times\frac{7}{11}\times\frac{6}{10} + \frac{1}{5}\times\frac{5}{12}\times\frac{4}{11} + \frac{3}{5}\times\frac{11}{14}\times\frac{10}{13}$ = 0.4248	$\frac{2}{5}\times\frac{4}{11}\times\frac{7}{10} + \frac{2}{5}\times\frac{7}{11}\times\frac{4}{10} + \frac{1}{5}\times\frac{7}{12}\times\frac{5}{11} + \frac{1}{5}\times\frac{5}{12}\times\frac{7}{11} + \frac{2}{5}\times\frac{3}{14}\times\frac{11}{13} + \frac{2}{5}\times\frac{11}{14}\times\frac{3}{13}$ = 0.4548	$\frac{2}{5}\times\frac{4}{11}\times\frac{3}{10} + \frac{1}{5}\times\frac{7}{12}\times\frac{6}{11} + \frac{2}{5}\times\frac{3}{14}\times\frac{2}{13}$ = 0.1204
xP(X=x)	0	0.4548	0.2408 (M1)
$x^2P(X=x)$	0	0.4548	0.4816

E(X) = 0.6956 (B1) (B1) E(X) = 0.6956

E(X) = 0.6956 (A1) → correct output (2 s.f.)

E(X²) = 0.9364

$S.d(S) = \sqrt{E(X^2) - (E(X))^2} = \sqrt{0.9364 - (0.6956)^2}$ (M1) For S.D

= 0.6727 (A1) → correct output (2 s.f.)

(14)(a) $h = \frac{\frac{3}{4} - 0}{5} = 0.15 = \frac{3}{20}$ (B1) → Attempt to find h

x	f(x) = √(1 − x²)	
0	1.0000	
0.15		0.9887
0.3		0.9539
0.45		0.8930
0.6		0.8000
0.75 = 3/4	0.6614	
Sum (B1)	1.6614 (B1)	3.6356 (B1)

Sum(F(x)) + ...

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$$\int_0^{0.15}\sqrt{(1-x^2)}\,dx \approx \frac{0.15}{2}\left(1.6614 + 2\times 3.6356\right) \quad (M1)$$

$$\approx 0.669945 \approx 0.670 \text{ (3 d.p.s)} \quad (A1)$$

(b) $E.Y = \int_0^{0.75=3/4}\sqrt{(1-x^2)}\,dx$, let $x = \sin\theta$, $\theta = \sin^{-1}(x)$

$dx = \cos\theta\, d\theta$

$$E.Y = \int_0^{\cdots}\sqrt{(1-\sin^2\theta)}\cos\theta\,d\theta = \int\cos^2\theta\,d\theta = \frac{1}{2}\int(1+\cos 2\theta)\,d\theta$$

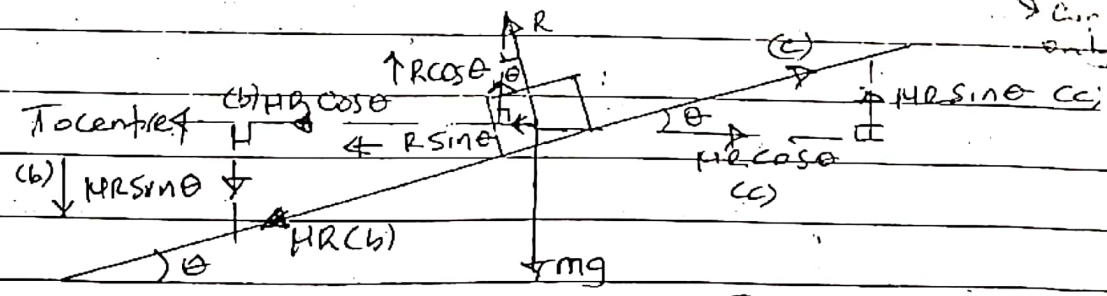
$$E.Y = \frac{1}{2}\left(\theta + \frac{1}{2}\sin 2\theta\right) \quad (M1) \quad \frac{1}{2}\left(\sin^{-1}(x) + \frac{1}{2}\sin(2\sin^{-1}(x))\right)$$

$$E.Y = \frac{1}{2}\left(\sin^{-1}(0.75) + \frac{1}{2}\sin(2\sin^{-1}(0.75))\right) \quad (M1) = 0.6721 \approx 0.672 \quad (A1)$$

$A.E = |E.Y - A.Y| = |0.672 - 0.670| = 0.002$ (M1) (A1)

by Increasing number of Sub-intervals or Strips or ordinates. (B1)

(15) (a)



↑ $R\cos\theta = mg$ (↓) (M1) → Resolving vertically

→ $R\sin\theta = \frac{mv^2}{r}$ (→), (←) (M1) → Resolving horizontally

$$\frac{mv^2}{mgr} = \frac{R\sin\theta}{R\cos\theta} = \tan\theta$$

(M1) → Expression for $\tan\theta$ (Attempt to find θ)

$$\tan\theta = \frac{v^2}{gr} = \frac{(30)^2}{9.8\times 25}$$

$\theta = \tan^{-1}\left(\frac{900}{2450}\right) = 20.17°$ (A1) → correct angle (2 d.p.)

(b) ↑: $R\cos\theta = mg + H R\sin\theta$, $R\cos\theta - HR\sin\theta = mg$ (1) (M1)

→: $R\sin\theta + HR\cos\theta = \frac{mv^2}{r}$, (2), (2) ÷ (1) (M1) → Horizontal equation

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$m \times (40)^2 = R(\sin 20.17^\circ + \mu \cos 20.17^\circ)$ (M1) → Attempt to find μ
$m \times 98 \times 250 = R(\cos 20.17^\circ - \mu \sin 20.17^\circ)$

$(0.9387 + 0.6531 \times 0.3448)\mu = 0.6531 \times 0.9387 - 0.3448$

$\mu = 0.2305$ (A1) → correct output (→ 2 d.p.)

(c) $\uparrow \; R\cos 20.17^\circ + 0.2305 R \sin 20.17^\circ = mg$ (B1) → vertical

$\rightarrow \; R\sin 20.17^\circ - 0.2305 R \cos 20.17^\circ = \frac{mv^2}{r}$, $r = 250$ (M1) → Horizontal

$v_{min} = \sqrt{\frac{9.8 \times 250 R(\sin 20.17^\circ - 0.2305 \cos 20.17^\circ)}{R(\cos 20.17^\circ + 0.2305 \sin 20.17^\circ)}}$ (M1) → Attempt to find v

$v_{min} = 17.6131 \text{ ms}^{-1}$ (A1) → Correct output of v_{min}

(16) (a)

x	2	3	5	6
$f(x) = \frac{x}{3} - \frac{2}{3}$	0	$\frac{1}{3}$		
$f(x) = a$		a	a	
$f(x) = 2 - bx$			$2-5b$	$2-6b$

$a = \frac{1}{3}$ or 0.3333 (B1) → For correct value of a

$a = 2 - 5b$

$\frac{1}{3} = 2 - 5b$, $5b = 2 - \frac{1}{3} = \frac{5}{3}$, $\therefore b = \frac{1}{3}$ (M1) (A1) → Attempt to find b; correct value of b or 0.3333

$$f(x) = \begin{cases} \frac{x}{3} - \frac{2}{3} & ; \; 2 < x < 3 \\ \frac{1}{3} & ; \; 3 < x < 5 \\ 2 - \frac{x}{3} = \frac{6-x}{3} & ; \; 5 < x < 6 \\ 0 & ; \; \text{otherwise} \end{cases}$$

(B1) → correct $f(x)$ with b substituted

(b) $F(x) = 0 \quad ; \quad x < 2$

$F(x) = \int_2^x \left(\frac{x}{3} - \frac{2}{3}\right) dx = \left| \frac{x^2}{6} - \frac{2}{3}x \right|_2^x = \frac{x^2}{6} - \frac{2x}{3} + \frac{2}{3}$

$F(x) = \frac{1}{6}(x^2 - 4x + 4) \; ; \; 2 < x < 3$ (B1) → $F(x)$ for $2 < x < 3$

$x = 3$, $F(3) = \frac{1}{6}$

$F(x) = \frac{1}{6} + \int_3^x \frac{1}{3} dx = \frac{1}{6} + \left| \frac{x}{3} \right|_3^x = \frac{1}{6} + \frac{x}{3} - 1 = \frac{x}{3} - \frac{5}{6}$

$F(x) = \frac{1}{6}(2x - 5) \; ; \; 3 < x < 5$ (B1) → $F(x)$ for $3 < x < 5$

$x = 5$, $F(5) = \frac{5}{6}$

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$F(x) = \frac{5}{6} + \int_5^x \left(2 - \frac{x}{3}\right)dx = \frac{5}{6} + \left(2x - \frac{x^2}{6}\right)\Big|_5^x = \frac{5}{6} + \left(2x - \frac{x^2}{6}\right) - \frac{35}{6}$

$F(x) = 2x - \frac{x^2}{6} - 5 = \frac{1}{6}(12x - x^2 - 30) \; ; \; 5 < x < 6$ (B1) – F(x) for $5 < x < 6$

$x = 6 \quad F(6) = \frac{1}{6}(72 - 36 - 30) = \frac{6}{6} = 1$ (B1) → upper limit of F(x) i.e. F(x) = 1

$$F(x) = \begin{cases} 1 & ; x > 6 \\ 0 & ; x < 2 \\ \frac{1}{6}(x^2 - 4x + 4) & ; 2 < x < 3 \\ \frac{1}{6}(2x - 5) & ; 3 < x < 5 \\ \frac{1}{6}(12x - x^2 - 30) & ; 5 < x < 6 \\ 1 & ; x > 5 \end{cases}$$

(B1) – correct expression for F(x)

(c) $P(1.5 < x < 3.5) = F(3.5) - F(1.5)$

$= \frac{1}{6}(2(3.5) - 5) - \frac{1}{6}((2.5)^2 - 4(2.5) + 4)$ (M1) correct substitution (B1) correct expression

$= \frac{2}{6} - \frac{1}{24} = \frac{7}{24}$ OR 0.2917 (A1) – correct output