MOCK 2025 - MATHEMATICS MARK GUIDE PMM 0765 P1

1	B	11	A	21	A	31	B	41	B
2	A	12	C	22	C	32	C	42	C
3	C	13	A	23	A	33	A	43	B
4	D	14	D	24	B	34	A	44	A
5	B	15	B	25	D	35	D	45	A
6	A	16	B	26	A	36	A	46	C
7	B	17	A	27	B	37	C	47	B
8	A	18	C	28	D	38	D	48	A
9	D	19	A	29	C	39	A	49	D
10	B	20	C	30	A	40	A	50	C

SOUTH WEST REGIONAL MOCK 2025 MARKING GUIDE – PMM/PMS PAPER 2

Qtn	Solution	Marks
1.	(i) $\alpha^2\beta+\beta^2\alpha=2 \Rightarrow \alpha\beta\left(\alpha+\beta\right)=2$ ……….(1)	M1
	$\left(\alpha^2\beta\right)\left(\beta^2\alpha\right)=27 \Rightarrow \left(\alpha\beta\right)^3=27 \Rightarrow \alpha\beta=3$	
	$\left(1\right) \Rightarrow 3\left(\alpha+\beta\right)=2 \Rightarrow \alpha+\beta=\frac{3}{2}$	M1A1
	$\therefore$ Equation is $x^2-\frac{3}{2}x+3=0 \Rightarrow 2x^2-3x+6=0$	A1
	(ii) $f\left(-1\right)=3f\left(1\right) \Rightarrow 2a+b=-3$ ………(1)	A1 M1
	$f\left(0\right)=1 \Rightarrow b=1$	A1
	$\left(1\right) \Rightarrow 2a+1=-3 \Rightarrow a=2$	M1A1
	(iii) $\log_6 5=y \Rightarrow \frac{\log_3 5}{\log_3 6}=y \Rightarrow \log_3 5=xy$	M1
	$\therefore \log_3 10=\log_3 2+\log_3 5=\log_3 6-\log_3 3+\log_3 5$ $=x-1+xy=x\left(y+1\right)-1$	M1A1
2.	(i) (a) $f\left(a\right)=f\left(b\right) \Rightarrow \frac{2a-2}{a+1}=\frac{2b-2}{b+1} \Rightarrow a=b$	M1A1
	Thus, f is injective.	
	$y=\frac{2\left(x-1\right)}{x+1} \Rightarrow x=\frac{y+2}{2-x},\ x\neq 2$	M1
	$\text{Range}\left(f\right)=\mathbb{R}-\left\{2\right\}=\text{Codom}\left(f\right)$, i.e f is surjective. $\therefore$ f is bijective.	A1
	(b) $fg\left(x\right)=\frac{1}{x} \Rightarrow g\left(x\right)=f^{-1}\left(\frac{1}{x}\right)=\frac{\frac{1}{x}+2}{2-\frac{1}{x}}=\frac{1+2x}{2x-1}$	M1M1 A1

Qtn	Solution	Marks
	(ii) $\left(5x-\frac{1}{2x}\right)^8=\sum_{r=0}^{n}\left[{}^nC_r 5^r\left(\frac{1}{2}\right)^r x^{2r-8}\right]$	M1A1
	Constant tern $\Rightarrow 2r-8=0 \Rightarrow r=4$	M1A1
	$\therefore$ Constant term $={}^8C_4\times 5^4\times\left(-\frac{1}{2}\right)^4$	
3.	(i) (a) $\left(2\mathbf{i}-3\mathbf{j}+5\mathbf{k}\right)\times\left(-\mathbf{i}+2\mathbf{k}\right)=\left(-6\mathbf{i}-9\mathbf{j}-3\mathbf{k}\right)$	M1
	$\mathbf{a}\cdot\left(\mathbf{a}\times\mathbf{b}\right)=\left(2\mathbf{i}-3\mathbf{j}+5\mathbf{k}\right)\cdot\left(-6\mathbf{i}-9\mathbf{j}-3\mathbf{k}\right)=0$	M1A1
	(b) $\mathbf{n}=\mathbf{a}\times\mathbf{b}=\left(-6\mathbf{i}-9\mathbf{j}-3\mathbf{k}\right)$	
	$\mathbf{r}\cdot\mathbf{n}=\mathbf{a}\cdot\mathbf{n} \Rightarrow \mathbf{r}\cdot\left(-6\mathbf{i}-9\mathbf{j}-3\mathbf{k}\right)=0$ $\Rightarrow -6x-9y-3z=0$	M1A1
	(c) $D=\frac{\lvert -6\left(2\right)-9\left(1\right)-3\left(1\right)\rvert}{\sqrt{(-6)^2+(-9)^2+(-3)^2}}=\frac{24}{\sqrt{126}}$	M1A1
	(ii) $P\left(A\right)=\left\{\phi,\left\{1\right\},\left\{5\right\},\left\{7\right\},\left\{1,5\right\},\left\{1,7\right\},\left\{5,7\right\},\left\{1,5,7\right\}\right\}$	M1A1
4.	(i) (a)	
	$\sin 2\theta\cos\frac{\pi}{4}+\sin\frac{\pi}{4}\cos 2\theta=3\cos 2\theta\cos\frac{\pi}{4}-3\sin 2\theta\sin\frac{\pi}{4}$	M1
	$\Rightarrow \sin 2\theta\frac{\sqrt{2}}{2}+\frac{\sqrt{2}}{2}\cos 2\theta=3\cos 2\theta\frac{\sqrt{2}}{2}-3\sin 2\theta\frac{\sqrt{2}}{2}$	
	$\Rightarrow \sin 2\theta+\cos 2\theta=3\cos 2\theta-3\sin 2\theta$	
	$\Rightarrow 4\sin 2\theta=2\cos 2\theta$	M1A1
	$\Rightarrow \tan 2\theta=\frac{1}{2}$	
	(b) $\tan 2\theta=\frac{1}{2} \Rightarrow \frac{2\tan\theta}{1-\tan^2\theta}=\frac{1}{2} \Rightarrow \tan^2\theta+4\tan\theta-1=0$	M1
	$\Rightarrow \tan\theta=-2+\sqrt{5}$ or $\tan\theta=-2-\sqrt{5}$	A1

	But, since θ is obtuse, then $\tan\theta=-2-\sqrt{5}$	
	(ii) $R\cos\alpha=7$, $R\sin\alpha=24$ $\Rightarrow$ $R=25$ and $\alpha=73.74^o$	M1A1
	$\therefore\quad f(x)\equiv 25\cos\left(x+73.74^o\right)$	A1
	$-25\le 25\cos\left(x+73.74^o\right)\le 25$ $\Rightarrow\quad 11\le 12+25\cos\left(x+73.74^o\right)\le 13$ $\Rightarrow\quad -13\le g(x)\le 37$	M1A1
	Hence, the range of $g(x)$ is $[-13,\ 37]$	
5.	(i) (a) $y=\ln\left(\dfrac{(x+1)^3}{x}\right)=3\ln(x+1)-\ln x$	M1
	$\Rightarrow\quad \dfrac{dy}{dx}=\dfrac{3}{x+1}-\dfrac{1}{x}=\dfrac{2x-1}{x(x+1)}$	M1A1
	(b) $x=2t\ \Rightarrow\ \dfrac{dx}{dt}=2$ and $y=\dfrac{2}{t}\ \Rightarrow\ \dfrac{dy}{dt}=-\dfrac{2}{t^2}$	M1
	$\therefore\quad \dfrac{dy}{dx}=\dfrac{dy}{dt}\div\dfrac{dx}{dt}=-\dfrac{1}{t^2}$	M1A1
	(ii) $f(x)=x^3-1\ \Rightarrow\ f'(x)=3x^2$	M1
	From MVT, $f'(x)=\dfrac{f(2)-f(-2)}{2--2}\ \Rightarrow\ 3x^2=\dfrac{7-(-9)}{4}\ \Rightarrow\ 3x^2=4$	M1A1
	$\Rightarrow\quad x=\pm\dfrac{2}{\sqrt{3}},\quad -2<x<2$	M1A1
6.	(i) (a) For any complex number z and $n\in\mathbb{R}$, $z=r(\cos\theta+i\sin\theta)\ \Rightarrow\ z^n=r^n(\cos n\theta+i\sin n\theta)$	B1
	(b) $z=1+i\sqrt{3}\Rightarrow \lvert z\rvert=\sqrt{1+3}=2$ and $\theta=\arg(z)=\dfrac{\pi}{3}$	M1 A1 A1

	Thus, $\left(1+i\sqrt{3}\right)\equiv 2\left(\cos\dfrac{\pi}{3}+i\sin\dfrac{\pi}{3}\right)$	
	$\therefore\quad \left(1+i\sqrt{3}\right)^{10}=\left[2\left(\cos\dfrac{\pi}{3}+i\sin\dfrac{\pi}{3}\right)\right]^{10}$	M1
	$=2^{10}\left(\cos\dfrac{10\pi}{3}+i\sin\dfrac{10\pi}{3}\right)$ $=1024\left(-\dfrac{1}{2}+i\dfrac{\sqrt{3}}{2}\right)=\left(512-512\sqrt{3}i\right)$	M1A1
	(ii) $x=0\ \Rightarrow\ y^2+4y+4=0$	M1A1
	Since $b^2-4ac=4^2-4(1)(4)=16-16=0$, then the line $x=0$ is a tangent to the circle.	M1A1
7.	(i) $u=2\cos\theta\ \Rightarrow\ du=-2\sin\theta d\theta$	M1
	$I=\displaystyle\int_{\frac{\pi}{3}}^{\frac{\pi}{4}}\frac{-2\sin\theta d\theta}{(2\cos\theta)^2\sqrt{4-(2\cos\theta)^2}}=\int_{\frac{\pi}{4}}^{\frac{\pi}{3}}\frac{2\sin\theta}{(4\cos^2\theta)(2\sin\theta)}d\theta$	M1
	$=\displaystyle\int_{\frac{\pi}{4}}^{\frac{\pi}{3}}\frac{1}{4\cos^2\theta}d\theta=\frac{1}{4}\int_{\frac{\pi}{4}}^{\frac{\pi}{3}}\sec^2\theta$	M1A1
	$\therefore\ \displaystyle\int_{1}^{\sqrt{2}}\frac{1}{x^2\sqrt{4-x^2}}dx=\frac{1}{4}\int_{\frac{\pi}{4}}^{\frac{\pi}{3}}\sec^2\theta=\frac{1}{4}\tan\theta\Big\rvert_{\frac{\pi}{4}}^{\frac{\pi}{3}}=\frac{1}{4}\left(\sqrt{3}-1\right)$	M1A1
	(ii) $\dfrac{dy}{dx}=e^{x+2y}\ \Rightarrow\ \dfrac{dy}{dx}=e^xe^{2y}\ \Rightarrow\ \displaystyle\int e^{-2y}dy=\int e^xdx$	M1
	$\Rightarrow\quad -\dfrac{1}{2}e^{-2y}=e^x+k$	M1A1
	$x=0,\ y=-\frac{1}{2}\ln 2\ \Rightarrow\ -\dfrac{1}{2}e^{\ln 2}=1+k\ \Rightarrow\ k=-2$	M1
	$\therefore\quad -\dfrac{1}{2}e^{-2y}=e^x-2\ \Rightarrow\ y=-\dfrac{1}{2}\ln\left(4-2e^x\right)$	A1

8	(i) $\frac{T_2}{T_7}=\frac{1}{4} \Leftrightarrow 4T_2=T_7 \Leftrightarrow 4(a+d)=a+6d$ $\Rightarrow 4(2+d)=2+6d \Rightarrow d=3$	M1 M1A1
	(ii) $\mathbf{AB}=\begin{pmatrix}1&0&0\\0&1&0\\0&0&1\end{pmatrix}$ and $\mathbf{BA}=\begin{pmatrix}1&0&0\\0&1&0\\0&0&1\end{pmatrix}$	A1 M1 A1
	(a) $A^{-1}=\mathbf{B}=\begin{pmatrix}6&-2&7\\-5&2&-6\\3&-1&4\end{pmatrix}$	A1
	(b $\begin{pmatrix}x\\y\\z\end{pmatrix}=\mathbf{A}^{-1}\begin{pmatrix}1\\0\\2\end{pmatrix}\Rightarrow\begin{pmatrix}x\\y\\z\end{pmatrix}=\begin{pmatrix}6&-2&7\\-5&2&-6\\3&-1&4\end{pmatrix}\begin{pmatrix}1\\0\\2\end{pmatrix}=\begin{pmatrix}9\\-17\\11\end{pmatrix}$	M1A1
9.	(a) Vertical asymptote: $x=b \Rightarrow b=1$ $\lim_{x\to\infty}f(x)=\lim_{x\to\infty}\frac{ax+1}{x-b}=a \Rightarrow a=2$	A1 M1 A1

	(b) $f(x)=\frac{2x+1}{x-1} \Rightarrow f'(x)=-\frac{3}{(x-1)^2}$ No value of x for which $f'(x)=0$, hence no turning point.	M1A1
	(c) $f'(x)=-\frac{3}{(x-1)^2}<0 \quad \forall x\in\mathbb{R}$ Hence f is decreasing.	M1A1
	(d) Sketch with intercepts, asymptotes and correct shape.	M1A1
10.	(i) (a) x is a prime number and is greater than or equal to 2. (b) It is not true that if x is less than 2, then it is prime. (c) If x is less than 2, then it is not prime	B1 B1 B1
	(ii) $f(0)=-1$ and $f(2)=19$ $f(0)\times f(2)<0$ hence a root in the interval. $f'(x)=6x^2=2x$ $x_1=x_0-\frac{2x_0^{\ 3}+x_0^{\ 2}-1}{6x_0^{\ 2}+2x_0}=\frac{4x_0^{\ 3}+x_0^{\ 2}+1}{6x_0^{\ 2}+2x_0}$ $x_0=1 \Rightarrow x_1=\frac{4(1)^3+1^2+1}{6(1)^2+2(1)}=0.75$	M1A1 A1 M1A1 A1

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Qtn	Solutions	Marks
1	(a) $\cos 2t = 0 \Rightarrow t = k\pi \pm \frac{\pi}{4}$	M1
	For the first time, $t = \frac{\pi}{4}$	M1A1
	(b) $\mathbf{v} = \frac{d\mathbf{r}}{dt} = \left[(2\cos 2t)\mathbf{i} - (2\sin 2t)\mathbf{j}\right]$ ms^{-1}	M1A1
	$\mathbf{a} = \left[(-4\sin 2t)\mathbf{i} - (4\cos 2t)\mathbf{j}\right]$ ms^{-2}	M1A1
	(c) $v = \lvert\mathbf{v}\rvert = \sqrt{(2\cos 2t)^2 + (-2\sin 2t)^2} = 2$ ms^{-1}	M1M1 A1
	(d) $t = \frac{\pi}{2} \Rightarrow \mathbf{a} = \left[(-4\sin \pi)\mathbf{i} - (4\cos\pi)\mathbf{j}\right] = (-4\mathbf{j})$ ms^{-2}	M1
	$\mathbf{F} = m\mathbf{a} = 3(-4\mathbf{j}) = (-12\mathbf{j})$ N $\Rightarrow \lvert\mathbf{F}\rvert = 12$ N	M1A1
2.	(i) $\sum \mathbf{F} = \mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_3 = \mathbf{0}$	M1A1
	$\sum(\mathbf{r}\times\mathbf{F}) = (\mathbf{r}_1\times\mathbf{F}_1) + (\mathbf{r}_2\times\mathbf{F}_2) + (\mathbf{r}_3\times\mathbf{F}_3) = \mathbf{0}$ Hence, system is in equilibrium.	M1M1 A1
	(ii) $\uparrow): R_g = 4W + 2W + W = 7W$	
	$\rightarrow): R_w = \frac{1}{2}R_g = \frac{1}{2}(7W)$	M1A1
	Let x be the distance climbed by the son. Moments about the point on the ground:	
	$R_w(8a\sin 45^o) = 4W(5a\cos 45^o) + 2W(x\cos 45^o) + W\left(\frac{7a}{2}\cos 4\right.$	M1A1
	$\Rightarrow x = \frac{9a}{4}$	M1A1
	$\therefore$ Separation between man and son $= 5a - \frac{9a}{4} = \frac{11a}{4}$	M1A1
3.	(i) $\mathbf{I} = m(\mathbf{v} - \mathbf{u}) \Rightarrow (4\mathbf{i} + \lambda\mathbf{j}) = 2\left[(\mu\mathbf{i} + 8\mathbf{j}) - (2\mathbf{i} - 3\mathbf{j})\right]$	M1
	$2\mu - 4 = 4 \Rightarrow \mu = 4$ and $\lambda = 22$	M1A1

Qtn	Solutions	Marks
		A1
	(ii) (a) LCM: $m(2u) + 3m(u) = mv_1 + 3m(ku)$	M1
	$\Rightarrow v_1 = u(5 - 3k)$	M1A1
	(b) NLR: $\frac{ku - u(5-3k)}{u - 2u} = -e \Rightarrow e = 4k - 5$	M1M1 A1
	(c) $0 \le e \le 1 \Rightarrow 0 \le 4k - 5 \le 1 \Rightarrow \frac{5}{4} \le k \le \frac{3}{2}$	M1M1 A1
4.	(a) On level road, $\frac{P}{v} - (a + bv) = ma \Rightarrow \frac{54000}{60} - (a + 60b) = 0$	M1
	$\Rightarrow a + 60b = 900$ .... (1)	M1A1
	On inclined plane, $\frac{54000}{50} - 3000\left(\frac{2}{25}\right) - (a + 50b) = 0$	M1
	$\Rightarrow a + 50b = 840$ …………….. (2)	M1A1
	Solving the two equations for a and b, $a = 540$, and $b = 6$	M1A1 A1
	(b) On level road, $\frac{54000}{30} - \left[540 + 6(30)\right] = 300a$	M1M1
	$\Rightarrow a = 3.6$ ms^{-2}	M1A1
5.	(a) First wall: $20 = 40\tan\alpha - \frac{10(40)^2}{2u^2}(1 + \tan^2\alpha)$	
	$\Rightarrow 4u^2 = 8u^2\tan\alpha - 1600(1 + \tan^2\alpha)$ ………. (1)	A1
	Second wall: $20 = 80\tan\alpha - \frac{10(80)^2}{2u^2}(1 + \tan^2\alpha)$	M1
	$\Rightarrow u^2 = 4u^2\tan\alpha - 1600(1 + \tan^2\alpha)$ .... (2)	A1
	$(1) - (2) \Rightarrow 3u^2 = 4u^2\tan\alpha \Rightarrow \tan\alpha = \frac{3}{4} \Rightarrow \alpha = \tan^{-1}\left(\frac{3}{4}\right)$	M1A1

$(1) \quad \Rightarrow \quad 4u^2 = 8u^2\left(\frac{3}{4}\right) - 1600\left[1+\left(\frac{3}{4}\right)^2\right]$ — M1

$\Rightarrow \quad u^2 = 1250 \quad \Rightarrow \quad u = 25\sqrt{2}$ — M1A1

(b) At Max Height, $\mathbf{v} = \left[\left(u\cos\alpha\right)\mathbf{i}\right] \text{ ms}^{-1} = \left[\left(20\sqrt{2}\right)\mathbf{i}\right] \text{ ms}^{-1}$

and $\left|\mathbf{v}\right| = 20\sqrt{2} \text{ ms}^{-1}$ — M1M1 A1

$\therefore \ K.E = \frac{1}{2}m\left|\mathbf{v}\right|^2 = \frac{1}{2}(0.5)\left(20\sqrt{2}\right)^2 = 200 \text{ J}$ — M1A1

6. (i) (a) $T - 2g\sin\theta = 2a$ — M1A1

$\Rightarrow \quad T - 20\sin 30^o = 2\times\frac{5}{2} \quad \Rightarrow \quad T = 15 \text{ N}$ — M1A1

(b) $mg - T = ma \quad \Rightarrow \quad 10m - 15 = \frac{5}{2}m \ \Rightarrow \ m = 2 \text{ kg}$ — M1A1

(c) $R = 2T\cos 30^o = 2\times 15\times\frac{\sqrt{3}}{2} = 15\sqrt{3} \text{ N}$ — M1A1

(ii) Pythagoras' Theorem: $\left(2a\right)^2 = h^2 + a^2 \quad \Rightarrow \quad h = a\sqrt{3}$ — M1

$\rightarrow): \ R\cos\theta = mg \ \Rightarrow \ R\left(\frac{a\sqrt{3}}{2a}\right) = mg \ \Rightarrow \ R = \frac{2mg}{\sqrt{3}}$ — M1A1

$\uparrow): \ R\sin\theta = \frac{mu^2}{a} \ \Rightarrow \frac{2mg}{\sqrt{3}}\left(\frac{a}{2a}\right) = \frac{mu^2}{a} \Rightarrow \ u^2\sqrt{3} = ga$ — M1A1

7. (i) $A = \int_0^2 \left(4 - x^2\right)dx = \frac{16}{3}$ — M1

$\bar{x} = \frac{\int_0^2 x\left(4-x^2\right)dx}{A} = \frac{\int_0^2 \left(4x - x^3\right)dx}{A} = \frac{4}{16/3} = \frac{3}{4}$ — M1A1

$\bar{y} = \frac{\frac{1}{2}\int_0^2 \left(4-x^2\right)^2 dx}{A} = \frac{\frac{1}{2}\int_0^2 \left(16 + x^4 - 8x^2\right)dx}{A} = \frac{\frac{1}{2}\left(\frac{256}{15}\right)}{16/3}$ — M1A1

$= \frac{8}{5}$

(ii) (a) Let λ be the weight per unit area.

Portion	Weight	Distance of centre of gravity	
		From Oy	From Ox
OABC	24λ	3	2
ODC	$\frac{16}{3}\lambda$	$\frac{3}{4}$	$\frac{8}{5}$
Remainder	$\left(24 - \frac{16}{3}\right)\lambda$	$\bar{x}$	$\bar{y}$

M1A1

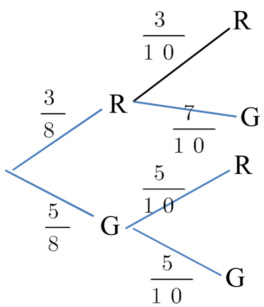
Moments about Oy:

$24\lambda\left(3\right) - \frac{16}{3}\lambda\left(\frac{3}{4}\right) = \left(24 - \frac{16}{3}\right)\lambda\bar{x} \quad \Rightarrow \quad \bar{x} = \frac{51}{14}$ — M1A1

Moments about Ox:

$24\lambda\left(2\right) - \frac{16}{3}\lambda\left(\frac{8}{5}\right) = \left(24 - \frac{16}{3}\right)\lambda\bar{y} \quad \Rightarrow \quad \bar{y} = \frac{74}{35}$ — M1A1

(b) $\tan\theta = \frac{6-\bar{x}}{4-\bar{y}} = \frac{5}{4} \quad \Rightarrow \quad \theta = \tan^{-1}\left(\frac{5}{4}\right)$ — M1A1

8.	(i) (a) $P\left(2 \text{ vowels}\right)=\dfrac{{}^{3}C_{2}\times{}^{4}C_{2}}{{}^{7}C_{4}}=\dfrac{3\times 6}{35}=\dfrac{18}{35}$	M1A1
	(b) $P\left(\text{least } 2 \text{ vowels}\right)=\dfrac{\left({}^{3}C_{2}\times{}^{4}C_{2}\right)+\left({}^{3}C_{3}\times{}^{4}C_{1}\right)}{{}^{7}C_{4}}=\dfrac{22}{35}$	M1M1 A1
	ii) (a) 	M1A1 A1
	(b) $P\left(RG\right)=\dfrac{3}{8}\times\dfrac{7}{10}=\dfrac{21}{80}$	M1A1
	(c) $P\left(RR\right)+P\left(GG\right)=\left(\dfrac{3}{8}\times\dfrac{3}{10}\right)+\left(\dfrac{5}{8}\times\dfrac{5}{10}\right)=\dfrac{17}{40}$	M1M1 A1