MOCK 2026 F. MATHS GUIDE P1 AND P2

PAPER 1 KEYS

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

PAPER 2

1(a) $y=\frac{u}{x} \;\Rightarrow\; \frac{dy}{dx}=\frac{xu'-u}{x^2}, \frac{d^2y}{dx^2}=\frac{x^2u''-2xu'+2u}{x^3}$.

Substituting into $\frac{d^2y}{dx^2}+\frac{2}{x}\frac{dy}{dx}+y=0$, gives $\frac{x^2u''-2xu'+2u}{x^3}+\frac{2}{x}\cdot\frac{xu'-u}{x^2}+\frac{u}{x}=0$. **M1M1M1A1**

Hence, $x^2u''+x^2u=0 \;\Rightarrow\; u''+u=0$.

(b) AE: $m^2+1=0 \Rightarrow m=\pm i$.

Thus $u=A\cos x+B\sin x$.

Since $y=\frac{u}{x}$, $y=\frac{A\cos x+B\sin x}{x}, x>0$. **M1M1M1A1**

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2 (a) $\frac{2x^2+5x+3}{(x-1)^2(x^2+4)}=\frac{A}{x-1}+\frac{B}{(x-1)^2}+\frac{Cx+D}{x^2+4}$.

Solving gives: $A=1, B=2, C=-1, D=-1$. **M1M1M1M1**

$\int_0^2 \frac{2x^2+5x+3}{(x-1)^2(x^2+4)}dx=\left[\ln|x-1|-\frac{2}{x-1}-\frac{1}{2}\ln(x^2+4)-\frac{1}{2}\tan^{-1}\left(\frac{x}{2}\right)\right]_0^2$

$=\left(\ln 1-2-\frac{1}{2}\ln 8-\frac{\pi}{8}\right)-\left(\ln 1+2-\frac{1}{2}\ln 4\right)$ **M1M1M1**

$=-4-\frac{1}{2}\ln 2-\frac{\pi}{8}$ **A1**

(b)Using $\sinh x=\frac{e^x-e^{-x}}{2}, \cosh x=\frac{e^x+e^{-x}}{2}$,

gives $5e^{2x}-10e^x+1=0$. $e^x=1\pm\frac{2\sqrt{5}}{5}$ Hence $x=\ln\left(1\pm\frac{2\sqrt{5}}{5}\right)$. M1M1A1

3(a) For $n=1$, $5^2-1=24$.

i.Assume for some $k\in\mathbb{N}$, $5^{2k}-1=24m$.

Then, for n=k+1, $5^{2(k+1)}-1=25(5^{2k}-1)+24=24(25m+1)$,

which is divisible by 24. Hence $5^{2n}-1$ is divisible by 24 for all $n\in\mathbb{N}$. **M1M1M1A1**

(bi) Let $G=\{1,\omega,\omega^2,\omega^3,\omega^4,\omega^5\}$, $\omega^6=1$.

- Closure and associativity hold for the multiplication of complex numbers
- e =1
- Each element has an inverse in G

element	1	ω	ω^2	ω^3	ω^4	ω^5
inverse	1	ω^5	ω^4	ω^3	ω^2	ω

Thus G is a group under multiplication. **M1M1A1**

ii) Since $G=\langle\omega\rangle$, a generator of G is ω, and its order is 6. **M1A1**

4(a) $\overrightarrow{AB}\times\overrightarrow{AC}=\begin{vmatrix} \mathrm{i} & \mathrm{j} & \mathrm{k} \\ -3 & 3 & 4 \\ 1 & -3 & 8 \end{vmatrix}=36\mathrm{i}+28\mathrm{j}+6\mathrm{k}$

i.Thus the plane is $36x+28y+6z=82$. **M1M1A1** ii.The perpendicular distance from $D(4,1,2)$ is $d = \frac{|184-82|}{\sqrt{36^2+28^2+6^2}} = \frac{51}{23}$. **M1A1**

iii.The volume of tetrahedron $ABCD$ is $V = \frac{1}{6}|(36,28,6)\cdot(2,0,5)| = 17$. **M1A1**

(b) $r = \frac{4}{1+\cos\theta}, \Rightarrow\ r + r\cos\theta = 4$.

i.$\sqrt{x^2+y^2} + x = 4 \Rightarrow y^2 = 16 - 8x$ **M1A1**

(ii) $r = 4(1+\cos\theta)^{-1} \Rightarrow \frac{dr}{d\theta} = \frac{4\sin\theta}{(1+\cos\theta)^2}$.

At $\theta = \frac{\pi}{2}$, $\frac{dr}{d\theta} = 4, r = 4$. The point on the curve is $(x,y) = (0,4)$.

The gradient is $\frac{dy}{dx} = \frac{r'\sin\theta + r\cos\theta}{r'\cos\theta - r\sin\theta} = \frac{4}{-4} = -1$.

Thus, the equation of the tangent is $y = -x + 4$. **M1M1A1**

5(a) $A = \begin{pmatrix} 1 & -2 \\ 2 & 1 \end{pmatrix}$.

The image of the direction vector $(2,1)$ is $A(2,1) = (0,5)$,

and the image of the point $(1,-1)$ is $A(1,-1) = (3,1)$.

Thus, the image line has equations $x = 3, y = 1 + 5t$. **M1M1M1A1**

(bi) $S(x,y) = (2x - y, 4x - 2y)$.

$2x - y = 0 \Rightarrow y = 2x$.

$\ker S = \{(x,2x)\} = x < 1,2 >$ **M1M1A1**

ii) $\dim(\ker S) = 1$ **1**

6(a) $f(1) = -3 < 0$, $f(2) = 1 > 0$. Since f is continuous on $[1,2]$, by the IVT there is at least one real root in $(1,2)$. **M1A1**

(b) f is continuous on $[0,2]$ and differentiable on $(0,2)$. By the MVT, there exists $c \in (0,2)$ such that $f'(c) = \frac{f(2)-f(0)}{2-0}$. **M1A1**

(c) $f'(x) = 3x^2 - 3$ and $\frac{f(2)-f(0)}{2} = 1$. Hence, $3c^2 - 3 = 1 \Rightarrow 3c^2 = 4 \Rightarrow c = \frac{2}{\sqrt{3}}$. **1**

7(a) $\frac{v_{n+1}}{v_n} = 3$. Thus (v_n) is a GP. **M1A1**

(b) $u_{n+1} - u_n = \frac{4v_n}{(3v_n+1)(v_n+1)} > 0$, so (u_n) is strictly increasing. **M1M1A1**

(c) $\lim_{n\to\infty} u_n = \lim_{v\to\infty} \frac{2v}{v+1} = 2$. Hence (u_n) converges to 2. **M1A1**

8(a)(i) $252 = 198 + 54, 198 = 3\cdot 54 + 36, 54 = 36 + 18, 36 = 2\cdot 18$,

so $\gcd(252,198) = 18$. **M1M1A1**

(ii) using back substitution, $18 = 252(4) + 198(-5)$. Hence, p =4, q = −5 **M1A1**

(b)(i) an ellipse. $4x^2 + 9y^2 = 16 \Rightarrow \frac{x^2}{4} + \frac{y^2}{16/9} = 1$, **M1A1**

(ii) $c^2 = 4 - \frac{16}{9} = \frac{20}{9} \Rightarrow c = \frac{2\sqrt{5}}{3}. \Rightarrow e = \frac{c}{a} = \frac{\sqrt{5}}{3}$ **1**

(iii) Foci: $\left(\pm\frac{2\sqrt{5}}{3}, 0\right)$ **M1A1**

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9 (a) (i) Domain of $f = \mathbb{R}$ **1**

(ii) $\lim_{x\to+\infty} f(x) = 0$ and $\lim_{x\to-\infty} f(x) = -2$ **1,1**

(iii)False. A curve may cross a horizontal asymptote provided that it approaches the line as $x \to \pm\infty$. **1**

(iv) C_f lies above the line $y = -1$ for $x \in]-1,+\infty[$ and below the line for $x \in]-\infty,-1[$ **M1A1**

(b)(i) $\lim_{x\to 0} g(x) = 0 + 2 + 1 = 3$ and $\lim_{x\to+\infty}[g(x) - (x+2)] = \lim_{x\to+\infty} e^{-x} = 0$. **M1M1A1**

(ii) The curve has an oblique asymptote $y = x + 2$. There is no vertical asymptote. **M1A1**

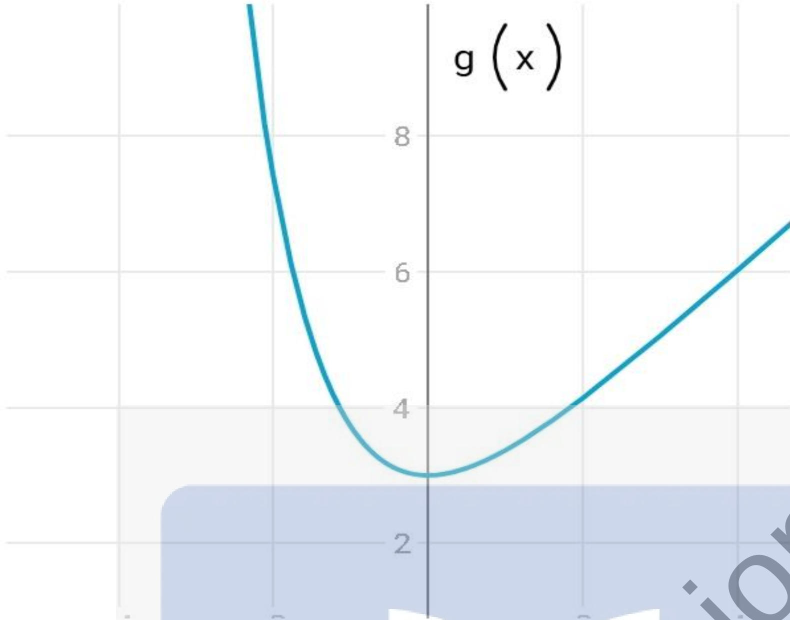
(iii) $g'(x) = 1 - e^{-x}$. Setting $g'(x) = 0 \Rightarrow x = 0$

Thus, the curve has a turning point at (0,3) **M1A1**

(iv) Variation of g

x	$-\infty$	0	$+\infty$
$g'(x)$	$-$	0	$+$
$g(x)$	$+\infty$	$\searrow 3 \nearrow$	$+\infty$

2



(v) **2**

10(a) $r = 2$ and $\theta = \frac{5\pi}{6}$.

Hence, $z = 32\left(\cos\frac{5\pi}{6} + i\sin\frac{5\pi}{6}\right)$. **M1A1**

(ii) $R = 32^{1/4} = 2\sqrt{2}$, and $\alpha_k = \frac{5\pi}{24} + \frac{k\pi}{2}, k = 0,1,2,3.$

$w_0 = 32^{\frac{1}{4}}\left(\cos\frac{5\pi}{24} + i\sin\frac{5\pi}{24}\right)$, $w_1 = 32^{\frac{1}{4}}\left(\cos\frac{17\pi}{24} + i\sin\frac{17\pi}{24}\right)$,

$w_2 = 32^{1/4}\left(\cos\frac{29\pi}{24} + i\sin\frac{29\pi}{24}\right)$, $w_3 = 32^{1/4}\left(\cos\frac{41\pi}{24} + i\sin\frac{41\pi}{24}\right)$ **A1A1A1A1**

(b)(i) $z(z+1) = 2z - i$.

$z^2 + z - 2z + i = 0 \Rightarrow z^2 - z + i = 0$. Thus, $z = \frac{1 \pm \sqrt{1-4i}}{2}$. **M1A1**

(ii) Let $z = x + iy$ $but\ y = 0$ $\Rightarrow z = x$ where $x \in \mathbb{R}$.

$w = \frac{2z-i}{z+1} \Rightarrow w = \frac{2x-i}{x+1}$.

Let $w = u + iv$. Then $u = \frac{2x}{x+1}, v = \frac{-1}{x+1}$.

Eliminating x gives $u = -2v + 2$. **M1M1M1A1**

Hence, the image of the real axis is the straight line $u + 2v - 2 = 0$.

(iii) $|z+1| = 2$

Let $w = \frac{2z-i}{z+1} \Rightarrow z = \frac{-w-i}{w-2}$

$|z+1| = 2 \Rightarrow \left|\frac{-2-i}{w-2}\right| = 2$

Taking moduli, $|w-2| = \frac{|i+2|}{2} = \frac{\sqrt{5}}{2}$.

$|w-2| = \frac{\sqrt{5}}{2}$ Thus, the image is the circle with centre $2 + i0$ and radius $\frac{\sqrt{5}}{2}$: **M1M1A1**

GRADE BOUNDARIES

U: $\leq$ **30**; $\emptyset$: $\leq$ **39.9**; **E**: $\leq$ **44.9** **C**: $\leq$ **59.9**; **B**: $\leq$ **74.9**; **A**: $\geq$ **75**