AQA A-Level Further Mathematics Warmup - Paper 2 2022

Let $z = 3 + 4\mathrm{i}$ and $w = 2 + 5\mathrm{i}$. Find zw.	Use the Maclaurin series of $\cos(x)$ to find a series expansion for $\cos(x^2 + 3x)$ up to the term in x^3.	Sketch $\frac{x^2}{49} - \frac{y^2}{25} = 1$	Find the mean value of $f(x) = \cosh(x)$ over the interval $[\ln(2), \ln(4)]$.	Find the eigenvalues and eigenvectors of the matrix $\begin{pmatrix} 1 & 3 \\ 3 & 1 \end{pmatrix}$
The quadratic equation $3x^2 + 10x + 5 = 0$ has roots α, β find the quadratic equation with roots $\frac{\alpha + 1}{2}, \frac{\beta + 1}{2}$.	What is the integrating factor when solving $\frac{\mathrm{d}y}{\mathrm{d}x} + y = \mathrm{e}^{2x}$?	How do you find the volume generated when the function $f(x)$, between $x = a$ and $x = b$ is rotated 2π radians around the $x-$axis?	Find the equations of the asymptotes and vertices of the hyperbola $\frac{(x-3)^2}{25} - \frac{(y+1)^2}{16} = 1$	Give a suitable concluding statement for a proof by induction.
Sketch $y = \frac{3x - 2}{x + 4}$	Use the Mid-ordinate rule to approximate $\int_2^4 \ln(x)\ \mathrm{d}x$ with 4 strips.	Prove by induction that $11^n - 6$ is divisible by 5 for all positive integer n.	Let $z = 3 + 4\mathrm{i}$ and $w = 2 + 5\mathrm{i}$. Find $\frac{z}{w^*}$.	Solve $x\frac{\mathrm{d}y}{\mathrm{d}x} + 2y = 10x^2$
Find the characteristic polynomial of the matrix $A = \begin{pmatrix} 1 & 3 \\ 4 & 1 \end{pmatrix}$	Sketch $y = \sinh(x)$	State Viète's formulae for the cubic equation $ax^3 + bx^2 + cx + d = 0$ with roots α, β and γ.	What is the matrix representing a rotation by 60° anticlockwise followed by a reflection in the line $y = -x$?	Find the volume of revolution when $y = x^3 - 2x^2$ is rotated about the $x-$axis between $x = 1$ and $x = 3$.

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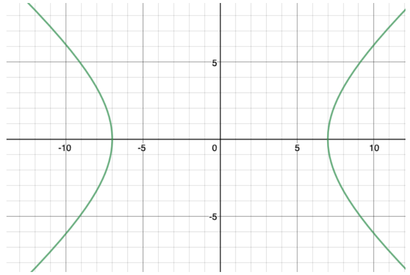
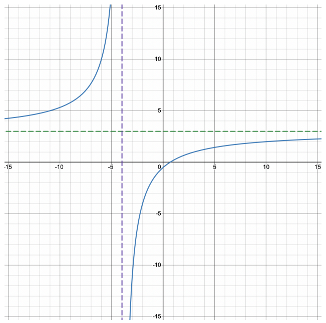
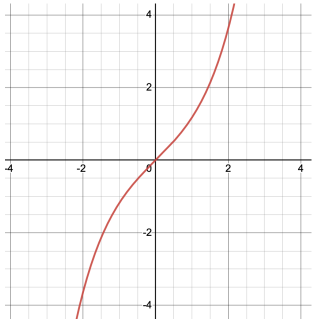
$-14+23\mathrm{i}$	$\cos\left(x^2+3x\right)=1-\frac{9}{2}x^2-3x^3+O(x^4)$		$\frac{9}{8\left(\ln(4)-\ln(2)\right)}$	$\lambda_1=4$ with $\mathbf{v}_1=\begin{pmatrix}1\\1\end{pmatrix}$ $\lambda_2=-2$ with $\mathbf{v}_2=\begin{pmatrix}-1\\1\end{pmatrix}$
Use the substitution $x=2w-1$ to obtain $12w^2+8w-2$.	IF $=\mathrm{e}^{\int 1\,\mathrm{d}x}=\mathrm{e}^x$	$V=\pi\int_a^b y^2\,\mathrm{d}x$	Asymptotes are $y=\frac{4}{5}x-\frac{17}{5}$ and $y=-\frac{4}{5}x+\frac{7}{5}$. Vertices have coordinates $(-2,-1)$ and $(8,-1)$	As the statement is true for $n=1$ and we have shown that if it holds for $n=k$ then it also holds for $n=k+1$ we conclude that the statement must be true for all $n\geq 1$ by the principle of mathematical induction.
	≈ 2.1548	Proof	$\frac{1}{29}\left(-14+23\mathrm{i}\right)$	$IF=x^2$ General solution is $y=\frac{5}{2}x^2+\frac{C}{x^2}$
$p(A)=\lambda^2-2\lambda-11$		$\alpha+\beta+\gamma=\frac{-b}{a}$ $\alpha\beta+\alpha\gamma+\beta\gamma=\frac{c}{a}$ $\alpha\beta\gamma=-\frac{d}{a}$	$\begin{pmatrix}0&-1\\-1&0\end{pmatrix}\begin{pmatrix}\frac{1}{2}&-\frac{\sqrt{3}}{2}\\\frac{\sqrt{3}}{2}&\frac{1}{2}\end{pmatrix}=\begin{pmatrix}-\frac{\sqrt{3}}{2}&-\frac{1}{2}\\-\frac{1}{2}&\frac{\sqrt{3}}{2}\end{pmatrix}$	$\frac{2158\pi}{105}$