AQA A-Level Further Mathematics Warmup - Paper 2 2019

Find a vector perpendicular to both $\begin{pmatrix}3\\4\\1\end{pmatrix}$ and $\begin{pmatrix}2\\1\\-5\end{pmatrix}$	Use the exponential definitions to find $\int e^{2x}\cosh(x)\ dx$	Find the characteristic polynomial of the matrix $A = \begin{pmatrix}1 & 3\\4 & 1\end{pmatrix}$	Solve $(x+1)(x+4)(x-3) > 0$	Sketch the curve $r = 2\sqrt{\theta}$ for $0 \le \theta \le 2\pi$.
For $I_n = \int x^n e^{-x}\ dx$ the reduction formula $I_n = nI_{n-1} - x^n e^{x}$. Use this to find $I_3 = \int x^3 e^{-x} dx$	Find $\int_2^4 \frac{1}{\sqrt{x-2}}\ dx$	Prove by induction that $\begin{pmatrix}1 & 0\\1 & a\end{pmatrix}^n = \begin{pmatrix}1 & 0\\ \frac{a^n-1}{a-1} & a^n\end{pmatrix}$	Prove that $\int \frac{1}{\sqrt{a^2+x^2}}\ dx = \text{arsinh}\left(\frac{x}{a}\right) + C$	Find the area enclosed by the polar curve $r = 5 - 4\sin(\theta)$
Use Simpson's rule to approximate $\int_2^4 \ln(x)\ dx$ with 4 strips.	Prove that $\text{arcosh}(x) = \ln\left(x + \sqrt{x^2-1}\right)$	Show that $(b-a)$ is a factor of $\begin{vmatrix}bc & 1 & a\\1 & a & b\\ac & 1 & b\end{vmatrix}$	Find the volume of revolution when $y = x^3 - 2x^2$ is rotated about the $x-$axis between $x = 1$ and $x = 3$.	Show that $\sin^5(\theta) = \frac{1}{16}\sin(5\theta) - \frac{5}{16}\sin(3\theta) + \frac{5}{8}\sin(\theta)$
Find the acute angle between the lines $\mathbf{r}_1 = \begin{pmatrix}2\\1\\2\end{pmatrix} + \lambda\begin{pmatrix}4\\1\\3\end{pmatrix}$ and $\mathbf{r}_2 = \begin{pmatrix}1\\1\\2\end{pmatrix} + \lambda\begin{pmatrix}2\\3\\1\end{pmatrix}$	Find a line of invariant points for the transformation $T = \begin{pmatrix}3 & 2\\4 & 5\end{pmatrix}$	Find the eigenvalues and eigenvectors of the matrix $\begin{pmatrix}1 & 3\\3 & 1\end{pmatrix}$	Sketch $\frac{x^2}{49} - \frac{y^2}{25} = 1$	Using the identity $r(r+1) - r(r-1) = 2r$ and the method of differences find $\sum_{r=1}^{n} r$.

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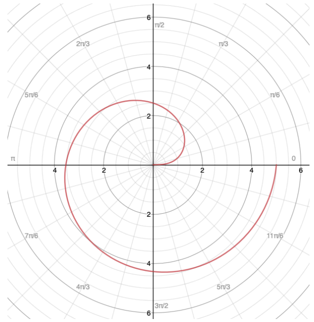
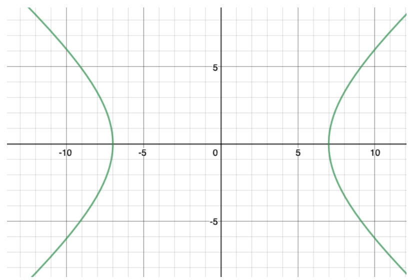
$\begin{pmatrix}-21\\17\\-5\end{pmatrix}$	$\frac{1}{4}(2x+e^{2x})$	$p(A)=\lambda^2-2\lambda-11$	$\{-4<x<-2\}\cup\{x>4\}$	
$-e^{-x}(^3+3x^2+6x+6)+C$	Consider $\lim_{t\to 2}\int_t^4 \frac{1}{\sqrt{x-2}}\,dx$. Solution = -2.3811	Proof.	Let $x=a\sinh(u)$ and integrate by substitution. $dx=a\cosh(u)du$ and $\frac{1}{\sqrt{a^2+x^2}}=\frac{1}{a\cosh(u)}$	$A=\frac{1}{2}\int_a^b r^2 d\theta$ $A=33\pi$
2.158813487	Proof. Ley $y=\text{arcosh}(x)$ and then apply cosh to both sides. Use exponential definitions to form a quadratic and solve resulting quadratic.	$\begin{vmatrix}bc&1&a\\1&a&b\\ac&1&b\end{vmatrix}=\begin{vmatrix}c(b-a)&0&a-b\\1&a&b\\ac&1&b\end{vmatrix}$ $=(b-a)\begin{vmatrix}c&0&-1\\1&a&b\\ac&1&b\end{vmatrix}$	$\frac{2158\pi}{105}$	Let $z=\cos(\theta)+i\sin(\theta)$ and then expand $\left(z-\frac{1}{z}\right)^n$ using the binomial expansion. Recall that $z^n-\frac{1}{z^n}=2i\sin(n\theta)$
$42.794°$	$y=-x$	$\lambda_1=4$ with $\mathbf{v}_1=\begin{pmatrix}1\\1\end{pmatrix}$ $\lambda_2=-2$ with $\mathbf{v}_2=\begin{pmatrix}-1\\1\end{pmatrix}$		$\sum_{r=1}^{n} r=\frac{1}{2}n(n+1)$