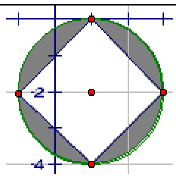
		Solutions
1	A	$\theta = \frac{\text{arclength}}{\text{radius}} = \frac{30}{50} = \frac{3}{5}$
2	B	$\begin{vmatrix} 2 & 1 & -1 \\ 5 & 0 & -3 \\ 1 & -2 & 1 \end{vmatrix} = \lvert -10 \rvert = 10$
3	D	There are 12 minutes between the 43 minute mark and the 11 hour mark. This 12/60 of the circle. There is an additional angle caused by the movement of the hour hand. This is 43/60 or the 5 minutes between 12 and 12. So total fraction of the circle moved is the sum of these two fractions. Multiply by 2π to convert to radians. $\left(\frac{12}{60} + \frac{43}{60} \cdot \frac{5}{60}\right) \cdot 2\pi = 1.631882$
4	B	$49 \cdot 4 + 2 = 198$
5	B	$e^{-d} = \tan\left(\frac{\frac{\pi}{4}}{2}\right) = \tan\left(\frac{\pi}{8}\right) = \sqrt{2} - 1$ $-d = \ln\left(\sqrt{2} - 1\right)$ $d = \ln\left(\sqrt{2} + 1\right)$
6	C	2^{1001}
7	E	None are always true
8	C	$z = re^{i\theta} \quad z = i$ $i = 1 \cdot e^{i\frac{\pi}{2}}$ so $\ln i = \ln\left(e^{i\frac{\pi}{2}}\right) = i\frac{\pi}{2}$ $i^i = e^{i(\ln i)} = e^{i\left(0 + \frac{i\pi}{2}\right)}$ $= e^{-\frac{\pi}{2}} = \frac{1}{\sqrt{e^{\pi}}}$ $= \frac{\sqrt{e^{\pi}}}{e^{\pi}}$
9	A	For all values of n, the answer is 0
10	D	p(x)=5 is equivalent to p(x)-5=0. The constant 5 doesn't change the degree so p(x)-5 is of the same degree as p(x) (which is <=4) If p(x) is not equal to the constant function y=0, it can have at most 4 roots, and the problem says that we must be able to find 5 distinct. If the function is the constant function y=0, then every number is a root, so we can find the five that we need (there are more!) Since p(x) is y=0, then the p(x)=5 is the constant function y=5, so p(5)=5
11	C	Earth rotates $\frac{2\pi}{24}$ radians/hr Arclength = $\left(\frac{2\pi}{24}\right) \cdot 4000$ ≈ 1047 mph
12	C	${}_{12}C_6 \cdot {}_7C_6 \cdot 6! = 4656960$
13	A	A=4, B=$\frac{2\pi}{3}$, C=$\frac{16}{3}$, D=2, E=6 $\frac{A+B+C+D-E}{E^2} = .20632 \approx .21$
14	E	Volume of tetrahedron $\frac{1}{2} \cdot \begin{vmatrix} 2 & 3 & -1 & 1 \\ 1 & 2 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & -4 & -2 & 1 \end{vmatrix} = \frac{1}{2}$ perimeters $\sqrt{(1-2)^2 + (2-3)^2 + (1+1)^2} = \sqrt{6}$ similarly the other perimeters are $1, 3\sqrt{5}, 3, \sqrt{51}, \sqrt{34}$ perimeter is 26.130073 $AB \approx 13$
15	B	Todd: $Todd = 1000\left(1 + \frac{.15}{4}\right)^{40} \approx 4360.38$ $Jen = 1000e^{.15(10)} \approx 4481.69$ $Jen - Todd = 121.31$

		Solutions
16	C	$100 = 200e^{30k} \Rightarrow$ $.5 = e^{30k} \Rightarrow k = \frac{\ln .5}{30}$ So $P(75) = 300e^{\frac{\ln .5}{30} \cdot 75} = 35.3553$
17	D	1,1,2,3,4,8,13,21,34,55,89, take sum 232
18	C	$70° = \frac{70 \cdot \pi}{180} = \theta$ $\theta \cdot \text{radius} = \text{arclength}$ $\Rightarrow \frac{70\pi}{180} \cdot 5 \approx 6.1$
19	D	Minor of 2 $\begin{bmatrix} 1 & 4 & 7 \\ 2 & 3 & 6 \\ 4 & 0 & 7 \end{bmatrix} = \begin{bmatrix} 4 & 7 \\ 0 & 7 \end{bmatrix} = 28$ (the Cofactor matrix would be the 3x3 matrix made up of the minors times $(-1)^n$ $\begin{bmatrix} -21 & 10 & 12 \\ -28 & -21 & 16 \\ 45 & 8 & -11 \end{bmatrix}$ note that the sign of 28 has been changed due to its location. The adjoint matrix is the TRANSPOSE of this matrix $\begin{bmatrix} -21 & -28 & 45 \\ 10 & -21 & 8 \\ 12 & 16 & -11 \end{bmatrix}$ The product is $\begin{bmatrix} 19180 & 15960 & -27916 \\ 15960 & 41468 & \underline{-44912} \\ -27916 & -44912 & 61880 \end{bmatrix}$ answer is -44912
20	B	If points are on circle they satisfy the circle equation. $(x+1)^2 + (y-5)^2 = r^2$ $(x-5)^2 + (y-5)^2 = r^2$ $(x-7)^2 + (y-1)^2 = r^2$ subtracting equation 1 and 2 $(x+1)^2 - (x-5)^2 = 0$ and implies x=2 subtracting equation 2 and 3 and subbing x=2 $9 + (y-5)^2 - \left(25 - (y-1)^2\right) = 0$ which implies y=1 thus equation is subbing x=2 andy=1 into equation 1, $3^2 + (-4)^2 = 25$ implies the radius is 5 equation $(x-2)^2 + (y-1) = 25$
21	B	$V = \pi (1.2r)^2 \cdot (.9h) = 1.296\pi r^2 h$ $\Rightarrow$ 29.6% increase
22	D	$\cos a + \cos b = 2\cos\left(\frac{a+b}{2}\right)\cos\left(\frac{a-}{2}\right.$ $\Rightarrow a + b = 7, \quad a - b = 3$ $\Rightarrow a = 5, b = 2$
23	D	$y - 500 = \frac{1}{4c}(x-500)^2$ (1000,0) is on the parabola so $0 - 500 = \frac{1}{4c}(1000-500)^2$ so 4c = -500 $y - 500 = -\frac{1}{500}(x-500)^2$ $150 - 500 = -\frac{1}{500}(x-500)^2$ so $x = 500 \pm 50\sqrt{70}$ use the larger to indicate falling

		Solutions
24	A	$x^2+2x-4y^2=3$ $\Rightarrow x^2+2x+1-4y^2=4$ $\Rightarrow (x+1)^2-4y^2=4$ $\Rightarrow \frac{(x+1)^2}{2^2}-\frac{y^2}{1^2}=1$ asymptotes $y=\pm\frac{1}{2}(x+1)$ $\theta=\tan^{-1}\left(\frac{m_1-m_2}{1+m_1m_2}\right)$ $=\tan^{-1}\left(\frac{4}{3}\right)$ so $\cos\theta=\frac{3}{5}$
25	A	P(-x) has 1 sign change → maximum of 1 negative root
26	E	 Area of a circle-area of square $\pi 2^2-\left(2\sqrt{2}\right)^2=4\pi-8$
27	C	*ok* *no* – 5 0 25 6 4 20 7 8 15 8 12 10 total of 6 9 16 5 10 20 0
28	A	$A=\sqrt{5+\sqrt{5+\sqrt{5...}}}=\frac{1+\sqrt{21}}{2}$ $B=\sqrt{5-\sqrt{5-\sqrt{5...}}}=\frac{-1+\sqrt{21}}{2}$ A-B = 1
29	D	$\frac{_{20}C_6}{_{45}C_6}+\frac{_{15}C_6}{_{45}C_6}+\frac{_{10}C_6}{_{45}C_6}=\frac{43975}{8145060}$

		Solutions
30	A	Has formula $r=\frac{ed}{1+e\cos\theta}$ Substitute $1=\frac{ed}{1+e\cos 0}=\frac{ed}{1+e}$ $\Rightarrow 1+e=ed$ $3=\frac{ed}{1+e\cos\pi}=\frac{ed}{1-e}$ $\Rightarrow 3-3e=ed$ so 1 + e = 3 - 3e so e = 1/2 and 1/2 d = 1 + 1/2 so d = 3 $r=\frac{3}{2+\cos\theta}$