1.	C	I. False II. True III. True
2.	A	$f_{avg} = \frac{1}{4-1}\int_1^4 (xln(x))dx$ Using integration by parts: $u = \ln(x)$, $du = \frac{dx}{x}$, $dv = xdx$, $v = \frac{1}{2}x^2$ $\int (xln(x))dx = \frac{1}{2}x^2\ln(x) - \int \frac{1}{2}x^2\left(\frac{dx}{x}\right)$ $\int (xln(x))dx = \frac{1}{2}x^2\ln(x) - \frac{1}{4}x^2 + C$ $\int_1^4 (xln(x))dx = \left[\frac{1}{2}(4^2)\ln(4) - \frac{1}{4}(4^2)\right] - \left[\frac{1}{2}\ln(1) - \frac{1}{4}\right]$ $\int_1^4 (xln(x))dx = 8\ln(4) - 4 + \frac{1}{4} = 8\ln(4) - \frac{15}{4}$ $f_{avg} = \frac{1}{4-1}\int_1^4 (xln(x))dx = \frac{8}{3}\ln(4) - \frac{5}{4}$
3.	B	$\lim_{x\to 0}\left(\frac{4\sin^2(x)}{3\sin(x)\cos^2(x) - 2\sin^2(x)}\right) = \lim_{x\to 0}\left(\frac{4\sin(x)}{3\cos^2(x) - 2\sin(x)}\right)$ $\lim_{x\to 0}\left(\frac{4\sin^2(x)}{3\sin(x)\cos^2(x) - 2\sin^2(x)}\right) = \frac{4\sin(0)}{3\cos^2(0) - 2\sin(0)}$ $\lim_{x\to 0}\left(\frac{4\sin^2(x)}{3\sin(x)\cos^2(x) - 2\sin^2(x)}\right) = \frac{0}{3-0} = 0$
4.	A	$V = \pi\int_{-1}^{1}\left[(3-(-2))^2 - (x^2 - 1 - (-2))^2\right]dx$ $V = \pi\int_{-1}^{1}[25 - (x^2+1)^2]dx$ $V = \pi\int_{-1}^{1}[25 - x^4 - 2x^2 - 1]dx$ $V = \pi\left[25x - \frac{1}{5}x^5 - \frac{2}{3}x^3 - x\Big\|_{-1}^{1}\right]$ $V = \pi\left[\left(25 - \frac{1}{5} - \frac{2}{3} - 1\right) - \left(-25 + \frac{1}{5} + \frac{2}{3} + 1\right)\right] = \pi\left(50 - \frac{2}{5} - \frac{4}{3} - 2\right)$ $V = \frac{694}{15}\pi$
5.	D	$\int_2^3\left(\frac{6x}{x^2+1}\right)dx = 3\ln\|x^2+1\|\Big\|_2^3$ $\int_2^3\left(\frac{6x}{x^2+1}\right)dx = 3\ln(9+1) - 3\ln(4+1)$ $\int_2^3\left(\frac{6x}{x^2+1}\right)dx = 3[\ln 10 - \ln 5] = \ln 8$
6.	A	$s = \langle\csc^2(t), \tan^2(t)\rangle$ $\frac{ds}{dt} = \langle 2\csc(t)(-\csc(t)\cot(t)), 2\tan(t)(\sec^2(t))\rangle$ $\frac{ds}{dt}\Big\|_{\frac{3\pi}{4}} = \left\langle 2\csc\left(\frac{3\pi}{4}\right)\left(-\csc\left(\frac{3\pi}{4}\right)\cot\left(\frac{3\pi}{4}\right)\right), 2\tan\left(\frac{3\pi}{4}\right)\left(\sec^2\left(\frac{3\pi}{4}\right)\right)\right\rangle$ $\frac{ds}{dt}\Big\|_{\frac{3\pi}{4}} = \langle 2(\sqrt{2})(-\sqrt{2})(-1), 2(-1)(2)\rangle$ $\frac{ds}{dt}\Big\|_{\frac{3\pi}{4}} = \langle 4, -4\rangle$ $speed = \left\|\frac{ds}{dt}\Big\|_{\frac{3\pi}{4}}\right\| = 4\sqrt{2}$

7.	B	I. Divergent by comparison test with $\sum_{n=1}^{\infty}\left(\frac{1}{\sqrt{n}}\right)$ II. Converges by the ratio test III. Divergent by comparison test with $\sum_{n=2}^{\infty}\left(\frac{n}{\ln(n)}\right)$
8.	C	$\frac{1}{1-x}=\sum_{n=0}^{\infty}x^n$ $M(x)=2+4\left(x-\frac{1}{2}\right)+8\left(x-\frac{1}{2}\right)^2$ $M\left(\frac{3}{4}\right)=2+4\left(\frac{1}{4}\right)+8\left(\frac{1}{4}\right)^2=\frac{7}{2}$ $\varepsilon\left(\frac{3}{4}\right)=\frac{1}{1-(3/4)}-\frac{7}{2}=\frac{1}{2}$
9.	A	$r=-4\sin(\theta)$ $\quad x=r\cos(\theta)$ $\quad y=r\sin(\theta)$ $r'=-4\cos(\theta)$ $\quad x'=r'\cos(\theta)-r\sin(\theta)$ $\quad y'=r'\sin(\theta)+r\cos(\theta)$ $r\left(\frac{5\pi}{3}\right)=-4\sin\left(\frac{5\pi}{3}\right)=2\sqrt{3}$ $r'\left(\frac{5\pi}{3}\right)=-4\cos\left(\frac{5\pi}{3}\right)=-2$ $x'\left(\frac{5\pi}{3}\right)=(-2)\cos\left(\frac{5\pi}{3}\right)-\left(2\sqrt{3}\right)\sin\left(\frac{5\pi}{3}\right)=2$ $y'\left(\frac{5\pi}{3}\right)=(-2)\sin\left(\frac{5\pi}{3}\right)+\left(2\sqrt{3}\right)\cos\left(\frac{5\pi}{3}\right)=2\sqrt{3}$ $\frac{dy}{dx}=\sqrt{3}$ $slope\ of\ normal\ line=-\left(\frac{1}{\sqrt{3}}\right)=-\frac{\sqrt{3}}{3}$
10.	B	$y=y_0+f(t_0,y_0)(t-t_0)$ $y(3.2)=0+(3-0+1)(0.2)=0.8$ $y(3.4)=0.8+(3.2-0.8+1)(0.2)=1.48$
11.	D	$\int_0^{\frac{\pi}{4}}\sin(4x)\sin(x)\,dx=\int_0^{\frac{\pi}{4}}2\sin(2x)\cos(2x)\sin(x)\,dx$ $\int_0^{\frac{\pi}{4}}\sin(4x)\sin(x)\,dx=\int_0^{\frac{\pi}{4}}4\sin(x)\cos(x)\cos(2x)\sin(x)\,dx$ $\int_0^{\frac{\pi}{4}}\sin(4x)\sin(x)\,dx=\int_0^{\frac{\pi}{4}}4\sin^2(x)\cos(x)\cos(2x)\,dx$ $\int_0^{\frac{\pi}{4}}\sin(4x)\sin(x)\,dx=\int_0^{\frac{\pi}{4}}4\sin^2(x)\cos(x)\left[1-2\sin^2(x)\right]dx$ $\int_0^{\frac{\pi}{4}}\sin(4x)\sin(x)\,dx=\int_0^{\frac{\pi}{4}}4\sin^2(x)\cos(x)\,dx-\int_0^{\frac{\pi}{4}}8\sin^4(x)\cos(x)\,dx$ $\int_0^{\frac{\pi}{4}}\sin(4x)\sin(x)\,dx=\frac{4}{3}\sin^3(x)\Big\vert_0^{\frac{\pi}{4}}-\frac{8}{5}\sin^5(x)\Big\vert_0^{\frac{\pi}{4}}$ $\int_0^{\frac{\pi}{4}}\sin(4x)\sin(x)\,dx=\frac{4}{3}\left(\frac{\sqrt{2}}{2}\right)^3-\frac{8}{5}\left(\frac{\sqrt{2}}{2}\right)^5$ $\int_0^{\frac{\pi}{4}}\sin(4x)\sin(x)\,dx=\frac{4}{3}\left(\frac{2\sqrt{2}}{8}\right)-\frac{8}{5}\left(\frac{4\sqrt{2}}{32}\right)$ $\int_0^{\frac{\pi}{4}}\sin(4x)\sin(x)\,dx=\frac{\sqrt{2}}{3}-\frac{\sqrt{2}}{5}=\frac{2\sqrt{2}}{15}$

12.	A	$\frac{1}{(x-2)(x+3)}=\frac{2}{x-2}-\frac{2}{x+3}$ $\int_3^7 \frac{10dx}{(x-2)(x+3)}=\int_3^{10}\left(\frac{2}{x-2}-\frac{2}{x+3}\right)dx$ $\int \frac{10dx}{(x-2)(x+3)}=2\ln\|x-2\|-2\ln\|x+3\|+c$ $\int \frac{10dx}{(x-2)(x+3)}=2\ln\left\|\frac{x-2}{x+3}\right\|+c$ $\int_3^7 \frac{10dx}{(x-2)(x+3)}=2\ln\left(\frac{7-2}{7+3}\right)-2\ln\left(\frac{3-2}{3+3}\right)$ $\int_3^7 \frac{10dx}{(x-2)(x+3)}=2\ln\left(\frac{1}{2}\right)-2\ln\left(\frac{1}{6}\right)=\ln 9$
13.	E	$\int_{\frac{\pi}{6}}^{\frac{\pi}{3}}(\tan(2x))dx=\int_{\frac{\pi}{6}}^{\frac{\pi}{3}}\left(\frac{\sin(2x)}{\cos(2x)}\right)dx$ $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}}(\tan(2x))dx=-\frac{1}{2}\ln\|\cos(2x)\|\Big\|_{\frac{\pi}{6}}^{\frac{\pi}{3}}$ $\ln\|\cos(2x)\|$ is not continuous on the interval $\left[\frac{\pi}{6},\frac{\pi}{3}\right]$ because $\ln\left\|\cos\left(2\left(\frac{\pi}{4}\right)\right)\right\|$ does not exist
14.	B	$\lim_{x\to 0}\left[\frac{(1-e^0)\cos(0)}{e^1(\sin(0))}\right]$ $\lim_{x\to 0}\left[\frac{0}{0}\right]$ is undefined, use L'Hopital's rule $\lim_{x\to 0}\left[\frac{(1-e^x)\cos(x)}{e^x(\sin(x))}\right]=\lim_{x\to 0}\left[\frac{\frac{d}{dx}[(1-e^x)\cos(x)]}{\frac{d}{dx}[e^x(\sin(x))]}\right]$ $\lim_{x\to 0}\left[\frac{(1-e^x)\cos(x)}{e^x(\sin(x))}\right]=\lim_{x\to 0}\left[\frac{-\sin(x)-e^x\cos(x)+e^x\sin(x)}{e^x\sin(x)+e^x\cos(x)}\right]$ $\lim_{x\to 0}\left[\frac{(1-e^x)\cos(x)}{e^x(\sin(x))}\right]=\lim_{x\to 0}\left[\frac{-\sin(0)-e^0\cos(0)+e^0\sin(0)}{e^0\sin(0)+e^0\cos(0)}\right]$ $\lim_{x\to 0}\left[\frac{(1-e^x)\cos(x)}{e^x(\sin(x))}\right]=\lim_{x\to 0}\left[\frac{0-(1)(1)+0}{0+(1)(1)}\right]=-1$
15.	A	$\ln(1+x)=\sum_{n=1}^{\infty}\frac{(-1)^{n+1}(x)^n}{n}$ $\ln(x)=\ln(1+(x-1)=\sum_{n=1}^{\infty}\frac{(-1)^{n+1}(x-1)^n}{n}$
16.	B	The shape of the graph is a conical Frustum $SA=2\pi\int y\sqrt{1+\left(\frac{dy}{dx}\right)^2}\,dx$ $SA=2\pi\int_2^{14}\left(\frac{1}{2}x\right)\sqrt{1+\frac{1}{4}}dx=\frac{\pi\sqrt{5}}{2}\int_2^{14}xdx$ $SA=\frac{\pi\sqrt{5}}{2}\left(\frac{1}{2}x^2\right)\Big\|_2^{14}$ $SA=\frac{\pi\sqrt{5}}{2}(98)-\frac{\pi\sqrt{5}}{2}(2)=48\sqrt{5}\pi$

17.	A	$\lim_{x\to 4}\left(\frac{x^3-2x^2-2x-24}{x^2-16}\right)=\frac{0}{0}$ is undefined, use L'Hopital's rule $\lim_{x\to 4}\left(\frac{x^3-2x^2-2x-24}{x^2-16}\right)=\lim_{x\to 4}\left(\frac{\frac{d}{dx}(x^3-2x^2-2x-24)}{\frac{d}{dx}(x^2-16)}\right)$ $\lim_{x\to 4}\left(\frac{x^3-2x^2-2x-24}{x^2-16}\right)=\lim_{x\to 4}\left(\frac{3x^2-4x-2}{2x}\right)$ $\lim_{x\to 4}\left(\frac{x^3-2x^2-2x-24}{x^2-16}\right)=\frac{3(4)^2-4(4)-2}{2(4)}$ $\lim_{x\to 4}\left(\frac{x^3-2x^2-2x-24}{x^2-16}\right)=\frac{48-16-2}{8}=\frac{15}{4}$
18.	C	$L=\int_a^b\left(\sqrt{1+\left(\frac{dy}{dx}\right)^2}\right)dx$ $\frac{dy}{dx}=3\sqrt{x}$ $L=\int_7^{11}(\sqrt{1+9x})dx$ $L=\frac{2(1+9x)^{\frac{3}{2}}}{27}\Big\|_7^{11}=\frac{2(1+9(11))^{\frac{3}{2}}}{27}-\frac{2(1+9(7))^{\frac{3}{2}}}{27}$ $L=\frac{2(1+9x)^{\frac{3}{2}}}{27}\Big\|_7^{11}=\frac{2(100)^{\frac{3}{2}}}{27}-\frac{2(64)^{\frac{3}{2}}}{27}$ $L=\frac{2(1+9x)^{\frac{3}{2}}}{27}\Big\|_7^{11}=\frac{2(1000)-2(512)}{27}=\frac{976}{27}$
19.	D	$\sin(8\theta)$ has a period of $\frac{2\pi}{8}$ or $\frac{\pi}{4}$ $A=\frac{1}{2}\int_a^b r^2 d\theta$ $A=\frac{1}{2}\int_0^{\frac{\pi}{8}}(\sin(8\theta))^2 d\theta$ $Recall\ \cos(2n\theta)=1-2\sin^2(n\theta)$ $A=\frac{1}{2}\int_0^{\frac{\pi}{8}}-\frac{1}{2}[\cos(16\theta)-1]d\theta$ $A=-\frac{1}{4}\int_0^{\frac{\pi}{8}}[\cos(16\theta)-1]d\theta$ $A=-\frac{1}{4}\times\left(\frac{1}{16}\sin(16\theta)-\theta\Big\|_0^{\frac{\pi}{8}}\right)$ $A=-\frac{1}{4}\times\left[\frac{1}{16}(0-0)-\left(\frac{\pi}{8}-(0)\right)\right]=\frac{\pi}{32}$

20.	C	$A=\int_a^b\big(f(x)-g(x)\big)dx$ where $f(x)=8-4x$ and $g(x)=x^2-3x+2$ From Algebra: $f(x)$ and $g(x)$ intersect at $x=-3$ and $x=2$ $A=\int_a^b\big(f(x)-g(x)\big)dx$ $A=\int_{-3}^{2}(6-x-x^2)dx=\left(6x-\frac{1}{2}x^2-\frac{1}{3}x^3\right)\Big\|_{-3}^{2}$ $A=\left(12-2-\frac{8}{3}\right)-\left(-18-\frac{9}{2}+9\right)=\frac{125}{6}$ $\bar{y}=\frac{1}{A}\int_a^b\frac{1}{2}\big(f^2(x)-g^2(x)\big)dx$ $\bar{y}=\frac{1}{2A}\int_{-3}^{2}[(64-64x+16x^2)-(x^4-6x^3+13x^2-12x+4)]dx$ $\bar{y}=\frac{1}{2A}\int_{-3}^{2}(60-52x+3x^2+6x^3-x^4)dx$ $\bar{y}=\frac{1}{2A}\left[\left(60x-26x^2+x^3+\frac{3}{2}x^4-\frac{1}{5}x^5\right)\Big\|_{-3}^{2}\right]$ $\bar{y}=\frac{1}{2A}\left[\left(120-104+8+24-\frac{32}{5}\right)-\left(-180-234-27+\frac{243}{2}+\frac{243}{5}\right)\right]$ $\bar{y}=\frac{1}{2A}\left[\left(48-\frac{32}{5}\right)-\left(-441+\frac{243}{2}+\frac{243}{5}\right)\right]$ $\bar{y}=\frac{1}{2A}\left(489-\frac{32-243}{5}-\frac{243}{2}\right)=\frac{1}{2A}\left(489-55-\frac{243}{2}\right)$ $\bar{y}=\frac{1}{2A}\left(434-\frac{243}{2}\right)=\frac{1}{2A}\left(\frac{625}{2}\right)$ $\bar{y}=\frac{6}{2\times125}\left(\frac{625}{2}\right)=\frac{15}{2}$
21.	B	$\frac{dy_h}{dt}+[\sin(t)]y_h=0$ $\int\frac{dy_h}{dt}\left(\frac{1}{y_h}\right)=\int-\sin(t)$ $\ln\|y_h\|=\cos(t)+C_1$ $y_h=C_2e^{\cos(t)}$ $4=C_2e^{\cos\left(\frac{\pi}{3}\right)}$ → $C_2=4e^{-\frac{1}{2}}$ $y_h=\left(4e^{-\frac{1}{2}}\right)e^{\cos(t)}$ $y(\pi)=\left(4e^{-\frac{1}{2}}\right)e^{\cos(\pi)}=4e^{-\frac{3}{2}}$
22.	D	$\frac{d}{dx}\left(\int_a^u[f(t)]dt\right)=\frac{d}{du}\left(\int_a^u[f(t)]dt\right)\times\frac{du}{dx}$ where *a* is a constant $\frac{d}{dx}\left(\int_a^u[f(t)]dt\right)=\frac{d}{du}\big(F(u)-F(a)\big)\times\frac{du}{dx}$ $\frac{d}{dx}\left(\int_a^u[f(t)]dt\right)=f(u)\times\frac{du}{dx}$ $h(x)=\frac{d}{dx}\left(\int_1^{x^2}[e^{4t}]dt\right)=2xe^{4x^2}$ $h(2)=2(2)e^{4(2)^2}=4e^{16}$

23.	B	$x = t^3 \qquad y = 3t^5 - t^7$ $t = \sqrt[3]{x} \rightarrow \quad y = 3x^{\frac{5}{3}} - x^{\frac{7}{3}}$ $\frac{dy}{dx} = 5x^{\frac{2}{3}} - \frac{7}{3}x^{\frac{4}{3}}$ $\frac{d^2y}{dx^2} = \frac{10}{3}x^{-\frac{1}{3}} - \frac{28}{9}x^{\frac{1}{3}}$ $\left.\frac{d^2y}{dx^2}\right\vert_{x=9} = \frac{10}{3}(8)^{-\frac{1}{3}} - \frac{28}{9}(8)^{\frac{1}{3}}$ $\left.\frac{d^2y}{dx^2}\right\vert_{x=9} = \frac{10}{6} - \frac{56}{9} = -\frac{41}{9}$
24.	C	Conditionally convergent if $\sum(a_n)$ converges but $\sum\lvert a_n\rvert$ diverges I. Converges Absolutely (comparison test $e^x = \sum_{n=1}^{\infty}\left(\frac{x^n}{n!}\right)$) II. Converges Absolutely (geometric series with $\lvert r\rvert < 1$) III. Conditionally convergent (comparison test $\sum_{n=1}^{\infty}\left(\frac{1}{\sqrt{n^2}}\right)$ diverges)
25.	A	Let $u = \ln(\sqrt{x})$ and $dv = dx$ $du = \frac{1}{\sqrt{x}}\left(\frac{1}{2}x^{-\frac{1}{2}}\right)dx \qquad v = x$ $du = \frac{1}{2x}dx$ $\int \ln(\sqrt{x})\,dx = xln(\sqrt{x}) - \int x\left(\frac{1}{2x}\right)dx$ $\int \ln(\sqrt{x})\,dx = xln(\sqrt{x}) - \int \frac{1}{2}dx$ $\int \ln(\sqrt{x})\,dx = xln(\sqrt{x}) - \frac{1}{2}x + C$ $\int_4^{16} \ln(\sqrt{x})\,dx = \left[16ln(\sqrt{16}) - \frac{1}{2}(16)\right] - \left[4ln(\sqrt{4}) - \frac{1}{2}(4)\right]$ $\int_4^{16} \ln(\sqrt{x})\,dx = [16ln(4) - 8] - [4ln(2) - 2]$ $\int_4^{16} \ln(\sqrt{x})\,dx = [32ln(2) - 8] - [4ln(2) - 2] = 28\ln(2) - 6$ $A + B + C = 28 + 2 + 6 = 36$
26.	A	$L = \int \sqrt{r^2 + \left(\frac{dr}{d\theta}\right)^2}\,d\theta$ $L = \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \sqrt{(\csc(\theta))^2 + (-\csc(\theta)\cot(\theta))^2}\,d\theta$ $L = \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \sqrt{\csc^2(\theta) + \csc^2(\theta)\cot^2(\theta)}\,d\theta$ $L = \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} [\csc(\theta)]\sqrt{1 + \cot^2(\theta)}\,d\theta$ $L = \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} [\csc^2(\theta)]\,d\theta$ $L = -\cot(\theta)\Big\vert_{\frac{\pi}{6}}^{\frac{\pi}{3}}$ $L = \left(-\frac{\sqrt{3}}{3}\right) - \left(-\sqrt{3}\right) = \frac{2\sqrt{3}}{3}$

27.	C	$xy\frac{dy}{dx} + 4x^2 + y^2 = 0$ $\left(\frac{y}{x}\right)\frac{dy}{dx} = -4 - \left(\frac{y}{x}\right)^2$ Let $u = \frac{y}{x}$. Then $\frac{dy}{dx} = u + x\frac{du}{dx}$. $u\left(u + x\frac{du}{dx}\right) = -4 - u^2$ $\frac{u}{4+2u^2}du = -\frac{1}{x}dx$ $\frac{1}{4}\ln(4 + 2u^2) = -\ln x + C$ $\sqrt[4]{4 + 2u^2} = \frac{C}{x}$ $u^2 = \frac{1}{2}\left(\frac{K}{x^4} - 4\right)$ $y^2 = \frac{K-4x^4}{2x^2}$ With the initial condition, $K = 576$ and $y = \sqrt{\frac{288-2x^4}{x^2}}$. The largest value of x in the domain of this solution is the one that causes the numerator to equal 0. Solving $288 - 2x^4 = 0$ gives $x = \sqrt{12}$.
28.	D	First, simplify using long division $$\int_{-1}^{1}\left(\frac{1-2x^2+x^4}{x^2+1}\right)dx = \int_{-1}^{1}\left(x^2 - 3 + \frac{4}{x^2+1}\right)dx$$ $$\int_{-1}^{1}\left(\frac{1-2x^2+x^4}{x^2+1}\right)dx = \left[\frac{1}{3}x^3 - 3x\Big\|_{-1}^{1}\right] + 4\int_{-1}^{1}\left(\frac{1}{x^2+1}\right)dx$$ $$\int_{-1}^{1}\left(\frac{1-2x^2+x^4}{x^2+1}\right)dx = \left[\left(\frac{1}{3} - 3\right) - \left(-\frac{1}{3} + 3\right)\right] + 4[\arctan(x)\|_{-1}^{1}]$$ $$\int_{-1}^{1}\left(\frac{1-2x^2+x^4}{x^2+1}\right)dx = \left[-\frac{16}{3}\right] + 4[\arctan(1) - \arctan(-1)]$$ $$\int_{-1}^{1}\left(\frac{1-2x^2+x^4}{x^2+1}\right)dx = \left[-\frac{16}{3}\right] + 4\left[\frac{\pi}{4} - \left(-\frac{\pi}{4}\right)\right]$$ $$\int_{-1}^{1}\left(\frac{1-2x^2+x^4}{x^2+1}\right)dx = 2\pi - \frac{16}{3} = \frac{6\pi - 16}{3}$$

29.	D	Consider $\int_0^{2\pi} \frac{dx}{a+b\cos x+c\sin x}$ for $a^2 > b^2+c^2$. $b\cos x + c\sin x = \sqrt{b^2+c^2}\sin(x+\theta)$ for some θ. Periodicity can eliminate the $+\theta$ with a substitution. Let $k = \sqrt{b^2+c^2}$. $\int_0^{2\pi} \frac{dx}{a+\sqrt{b^2+c^2}\sin x} = \int_0^{2\pi} \frac{dx}{a+k\sin x} = \int_0^{\pi} \frac{dx}{a+k\sin x} + \int_0^{\pi} \frac{dx}{a-k\sin x} = \int_0^{\pi} \frac{2a}{a^2-k^2\sin^2 x}\, dx = \int_0^{\pi/2} \frac{4a}{a^2(\sin^2 x+\cos^2 x)-k^2\sin^2 x}\, dx = \int_0^{\pi/2} \frac{4a\sec^2 x}{a^2+(a^2-k^2)\tan^2 x}\, dx$. Let $u = \tan x$. Then $\frac{du}{dx} = \sec^2 x$. $\int_0^{\pi/2} \frac{4a\sec^2 x}{a^2+(a^2-k^2)\tan^2 x}\, dx = \int_0^{\infty} \frac{4a}{a^2+(a^2-k^2)u^2}\, du = \frac{1}{a^2-k^2}\int_0^{\infty} \frac{4a}{u^2+\left(\frac{a}{\sqrt{a^2-k^2}}\right)^2}\, du.$ Evaluating, this equals $\left.\frac{4a\arctan\frac{x}{\frac{a}{\sqrt{a^2-k^2}}}}{(a^2-k^2)\cdot\frac{a}{\sqrt{a^2-k^2}}}\right]_0^{\infty} = \frac{2\pi}{\sqrt{a^2-k^2}}$. With $a=7$ and $k^2 = 6^2+3^2 = 45$, this evaluates to π.
30.	B	$\frac{d}{dx}f(x) = \int f(x)\, dx$. $f(x) = e^x$ and $f(x) = e^{-x}$ are well-known solution to this equation. Differentiating gives $\frac{d^2}{dx^2}f(x) = f(x)$, which also provides the solutions $f(x) = \sinh x = \frac{e^x - e^{-x}}{2}$ and $f(x) = \cosh x = \frac{e^x+e^{-x}}{2}$ for a total of 4.