1. A 2—Region is bounded by the parabola & the 2 lines $y=\pm\frac{3}{2}x$. Area = $2\int_0^2\left(\frac{3}{8}x^2+\frac{3}{2}x-\frac{3}{2}x\right)dx$

   B $\frac{1}{2}$ --The graphs intersect at x = 0, 1 and -1. Area = $\int_{-1}^0(x^3-x)dx+\int_0^1(x-x^3)dx=\frac{1}{2}$.

   C 3—The x-intercepts of the parabola are x = 0 and x = 2k. Since the area is in the 4th quadrant, it is found by $\int_0^{2k}(-x^2+2kx)dx=36$ and solving gives k = 3.

   D 8—The area = $\int_2^k\frac{dx}{x}=\ln 4$ and solving gives k = 8.

2. A $\frac{2\pi}{3}$ --Area = $\frac{1}{2}\pi\left(\frac{1}{2}y\right)^2=\frac{\pi}{8}y^2\Rightarrow$ Volume $=\int_0^4\frac{\pi}{8}\left(\frac{4-x}{2}\right)^2dx=\frac{2\pi}{3}$.

   B $36\sqrt{3}$ --Area = $\sqrt{3}y^2=\sqrt{3}(9-x^2)\Rightarrow$ Volume $=\sqrt{3}\int_{-3}^3(9-x^2)dx=36\sqrt{3}$.

   C $\frac{\pi}{3}$ --Volume = $2\int_0^{\frac{1}{2}}\frac{1}{2}\pi y^2dx=\int_0^{\frac{1}{2}}\pi(1-4x^2)dx=\frac{\pi}{3}$.

   D $\frac{283}{5}$ --Volume = $\int_0^2(3(x-2)^2)^2dx=\frac{283}{5}$.

3. A 4-- $f'(x)=6x^2-18x+12=0 @ x=1,2$. $f(-1)=-24,\ f(1)=4\ \&\ f(2)=3\Rightarrow y=4$ is the maximum.

   B 2 & -2-- $f'(x)=4x^3-16x=0 @ x=0,2,-2$. Testing these values on a sign chart shows the answer.

   C 1-- $f'(x)=24x^5-24x^2=0 @ x=0\ \&1$. Testing these values on a sign chart shows the answer.

   D 2 – ln4-- $f'(x)=e^x-2=0 @ x=\ln 2$(which is a min). So, $f(\ln 2)$ gives the answer.

4. A 2ln105—The areas of the rectangles are 2ln3 + 2 ln5 + 2ln7 = 2ln105.

   B 5—Only 2 rectangles on [0, 4] can be inscribed under $f(x)=(x-3)^2$. Each rectangle has w =1 and the ht. of the 1st one is 4 and the height of the 2nd one is 1. So, 1(4 + 1) = 5 is the answer.

   C $\frac{89}{20}$ -- $T=\frac{1}{2}\cdot 1[0+2(1.1)+2(1.4)+2(1.2)+1.5]=\frac{8.9}{2}=\frac{89}{20}$.

   D 26—The areas of the rectangles are $2\cdot 1+2\cdot 2+2\cdot 10=2+4+20=26$.

5. A $\frac{-10,000\pi}{30}$ --Use the info to find k = $10,000\cdot 40^2$. $L=\frac{10,000\cdot 40^2}{\left(\frac{40}{\cos\theta}\right)^2}=10,000\cos^2\theta$. Differentiating and using $\theta=\frac{\pi}{4}$ and $\frac{d\theta}{dt}=\frac{\pi}{30}$ gives $\frac{dL}{dt}=2\cdot 10,000\cos\frac{\pi}{4}\left(-\sin\frac{\pi}{4}\right)\left(\frac{\pi}{30}\right)=\frac{-1,000\pi}{3}$.

   B 800 π -- $\frac{dV}{dt}=4\pi r^2\frac{dr}{dt}=4\pi(10)^2\cdot 2=800\pi$.

   C 0.6—Area = $A(w)=\int_0^w(24x^2-12x^3)dx\Rightarrow\frac{dA}{dt}=(24w^2-12w^3)\frac{dw}{dt}=(24\cdot 1-12\cdot 1)(0.05)=0.6$

   D 8-- $\frac{dV}{dt}=4\pi r^2\frac{dr}{dt}\Rightarrow 12=4\pi r^2\frac{dr}{dt}\Rightarrow\frac{dr}{dt}=\frac{3}{\pi r^2}$.

   And $\frac{dS}{dt}=8\pi r\frac{dr}{dt}$. At $V=36\pi, r=3$, so $\frac{dS}{dt}=8\pi(3)\left(\frac{3}{\pi\cdot 9}\right)=8$.

6. A $t<1$ or $t>3$ -- $v(t)=4t(t-3)^2 \Rightarrow v'(t)=4(t-3)(3t-3)$ and $v'(t)>0$ when $t<1$ or $t>3$.

   B t = 0, 2, & 4—The avg. veloc. is change in position ÷ by change in time. For avg. veloc. to = 0, then the change in distance must = 0. Set the position function = 0 and solve to get the answer.

   C $\dfrac{1}{e-1}$ --Avg. Veloc. = change in position ÷ by change in time = $\dfrac{\ln e-\ln 1}{e-1}=\dfrac{1}{e-1}$.

   D $\dfrac{7}{2}$ -- $v(t)=\dfrac{1}{2}\cos t-2\sin(2t) \Rightarrow a(t)=\dfrac{-1}{2}\sin t-4\cos(2t) \Rightarrow a\left(\dfrac{\pi}{2}\right)=\dfrac{7}{2}$.

7. A 0-- $y=(\sin x)^x \Rightarrow \ln y = x\ln(\sin x) \Rightarrow \dfrac{1}{y}y' = \dfrac{x\cos x}{\sin x}+\ln(\sin x) \Rightarrow y'\left(\dfrac{\pi}{2}\right)=0$.

   B $\dfrac{-1}{y^3}$ -- $y' = \dfrac{-x}{y} \Rightarrow y'' = \dfrac{y(-1)-(-x)(y')}{y^2} = \dfrac{-y+x\left(\dfrac{-x}{y}\right)}{y^2} = \dfrac{-x^2-y^2}{y^3} = \dfrac{-1}{y^3}$.

   C 20-- $w=u\circ v \Rightarrow w' = u'(v)\cdot v' \Rightarrow w'(0)=u'(v(0))\cdot v'(0)=u'(2)\cdot 5=20$.

   D 6-- $y=x^4+x^2+1 \Rightarrow dy=(4x^3+2x)dx=(4+2)\cdot 1=6$.

8. A $-1\le x<5$ -- $R=\lim\limits_{n\to\infty}\left|\dfrac{(x-2)^{n+1}}{3^{n+1}(n+1)}\cdot\dfrac{3^n\cdot n}{(x-2)^n}\right| = \lim\limits_{n\to\infty}\left|\dfrac{n(x-2)}{3(n+1)}\right| = \left|\dfrac{x-2}{3}\right| \Rightarrow -1<x<5$. Check endpts (-1 works)

   B 5-- $R=\lim\limits_{n\to\infty}\left|\dfrac{(n+2)x^{n+1}}{5^{n+1}(n^2)}\cdot\dfrac{5^n\cdot(n-1)^2}{(n+1)x^n}\right| = \left|\dfrac{x}{5}\right|<1 \Rightarrow |x|<5$.

   C $\dfrac{-5^{22}\sqrt{2}}{2(22!)}$ -- $f(0)=\dfrac{\sqrt{2}}{2} \Rightarrow f'(0)=\dfrac{5\sqrt{2}}{2} \Rightarrow f''(0)=\dfrac{-25\sqrt{2}}{2} \Rightarrow f'''(0)=\dfrac{-5^3\sqrt{2}}{2}$. Following the pattern yields the answer.

   D $\dfrac{2}{9}$ -- $\lim\limits_{x\to 0}\dfrac{f(x)-\dfrac{1}{3}}{x} = \lim\limits_{x\to 0}\left(\dfrac{2}{3^2}+\dfrac{3x}{3^3}+\dfrac{4x^2}{3^4}+\ldots\right)=\dfrac{2}{9}$.

9. A $\dfrac{3}{2}$ -- $\int_0^1 x^{-1/3}dx = \lim\limits_{a\to 0^-}\int_a^1 x^{-1/3}dx = \lim\limits_{a\to 0^-}\dfrac{3}{2}x^{2/3}\Big|_a^1 = \dfrac{3}{2}$.

   B π -- $\int_0^\infty \dfrac{dx}{\sqrt{x}(x+1)} = \lim\limits_{a\to 0^+}\int_a^1 \dfrac{dx}{\sqrt{x}(x+1)} + \lim\limits_{b\to\infty}\int_1^b \dfrac{dx}{\sqrt{x}(x+1)} = \lim\limits_{a\to 0^+} 2\tan^{-1}\sqrt{x}\Big|_a^1 + \lim\limits_{b\to\infty} 2\tan^{-1}\sqrt{x}\Big|_1^b = \pi$.

   C ln2-- $\int_{-\infty}^0 \dfrac{e^x}{e^x+1}dx = \lim\limits_{a\to -\infty}\int_a^0 \dfrac{e^x}{e^x+1}dx = \lim\limits_{a\to -\infty}\ln(e^x+1)\Big|_a^0 = \ln 2$.

   D div.—Integral= $\lim\limits_{a\to -\infty}\int_a^0 \dfrac{e^x}{e^x+1}dx + \lim\limits_{b\to\infty}\int_0^b \dfrac{e^x}{e^x+1}dx = \lim\limits_{a\to -\infty}\ln(e^x+1)\Big|_a^0 + \lim\limits_{b\to\infty}\ln(e^x+1)\Big|_0^b = \ln(e^\infty-1) \Rightarrow$ div.

10. A $\sqrt{5}$ --Separating variables gives $\int y\,dy = \int \dfrac{\ln x}{x}dx \Rightarrow \dfrac{1}{2}y^2 = \dfrac{1}{2}\ln^2 x + c \Rightarrow c=2 \Rightarrow y(e)=\sqrt{5}$.

    B e^e -- Separating variables gives $\int \dfrac{dy}{y} = dx \Rightarrow \ln|y| = x+c \Rightarrow c=0 \Rightarrow y(e)=e^e$.

    C $\dfrac{10}{3}$ -- Separating variables gives $\int dy = \int x^2dx \Rightarrow y=\dfrac{x^3}{3}+c \Rightarrow c=3 \Rightarrow y(1)=\dfrac{10}{3}$.

    D e^3 -- Separating variables gives $\int \dfrac{\ln y}{y}dy = \int \dfrac{dx}{x} \Rightarrow \dfrac{1}{2}\ln^2 y = \ln|x|+c \Rightarrow c=\dfrac{1}{2} \Rightarrow y(e^4)=e^3$.