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1. $f'(x)=(x^3-2)(3x^2+4)+(x^3-2)(x-7)(6x)+(3x^2+4)(x-7)(3x^2)$
   $f'(2)=(6)(16)+(6)(12)(-5)+(-5)(16)(12)=96-360-960=-1224 \quad \Rightarrow \mathbf{A}$
2. $g'(x)=3x^2-2x-1;\ g''(x)=6x-2=0$ at $x=\frac{1}{3}$. $g''(x)>0$ for values of x greater than $\frac{1}{3}$. $\Rightarrow \mathbf{A}$
3. $A=2xy=2x(\frac{1}{2}-x^2)=x-2x^3$. $A'(x)=1-6x^2=0$ at $x=\frac{\sqrt{6}}{6}$; $y=\frac{1}{2}-\frac{1}{6}=\frac{1}{3}$.
   $P=4\left(\frac{\sqrt{6}}{6}\right)+2\left(\frac{1}{3}\right)=\frac{2+2\sqrt{6}}{3}. \quad \Rightarrow \mathbf{C}$
4. As x approaches C from the left, the expression goes to $-\infty$. As x approaches C from the right, the expression goes to $+\infty$. Therefore, the two-sided limit does not exist. $\Rightarrow \mathbf{D}$
5. $A=\int_{-2}^{0}(y^3-4y)dy+\int_{0}^{2}(4y-y^3)dy=2\int_{0}^{2}(4y-y^3)dy=2(2y^2-\frac{1}{4}y^4)\Big]_0^2=2(8-4)=8 \quad \Rightarrow \mathbf{D}$
6. $\frac{dy}{dx}=0-(-2\sin 2x)+2(2\cos x(-\sin x))=2\sin 2x-2\sin 2x=0 \quad \Rightarrow \mathbf{A}$
7. $h(-4)=-93; h(2)=-3.\ \frac{h(2)-h(-4)}{2-(-4)}=\frac{-3-(-93)}{6}=15.\ h'(x)=6x^2-9=15$ at $x=\pm 2$. Choose $C=-2$ only due to given interval. $\Rightarrow \mathbf{E}$
8. $T(6)=\frac{3-0}{2(6)}\left[1+2\left(\frac{5}{4}\right)+2(2)+2\left(\frac{13}{4}\right)+2(5)+2\left(\frac{29}{4}\right)+10\right]=\frac{1}{4}\left(\frac{97}{2}\right)=\frac{97}{8}=12.125 \quad \Rightarrow \mathbf{A}$
9. $f'(x)=\frac{1}{4}x^4-\frac{2}{3}x^3+5;\ f''(x)=x^3-2x^2=x^2(x-2)=0$ at $x=0$ or $x=2$. The concavity changes sign only at $x=2$, therefore there is exactly one point of inflection. $\Rightarrow \mathbf{B}$
10. $\lim_{x\to-\infty}\left(\sqrt{x^2-\frac{4}{3}x}+2+x\right)=\lim_{x\to-\infty}\left(\sqrt{x^2-\frac{4}{3}x+C}+2+x\right)$ (for any constant C)
    $=\lim_{x\to-\infty}\left(\sqrt{x^2-\frac{4}{3}x+\frac{4}{9}}+2+x\right)=\lim_{x\to-\infty}\left(\sqrt{(x-\frac{2}{3})^2}+2+x\right)=\lim_{x\to-\infty}\left(-(x-\frac{2}{3})+2+x\right)$
    $=\lim_{x\to-\infty}\left(-x+\frac{2}{3}+2+x\right)=\lim_{x\to-\infty}\left(\frac{8}{3}\right)=\left(\frac{8}{3}\right) \quad \Rightarrow \mathbf{C}$
11. $f'(x)=2(x-1);\ f'(-8)=-18,\ f'(-5)=-12,\ f'(-2)=-6,\ f'(1)=0,\ f'(4)=6,\ f'(7)=12,$
    $f'(10)=18$ The sum equals zero. $\Rightarrow \mathbf{A}$
12. $\int_0^1 e^5 dx = e^5x\Big]_0^1 = e^5(1) = e^5. \quad \Rightarrow \mathbf{C}$
13. $\frac{dy}{dx}=-\left(\frac{e^y+4xy-\frac{y}{x}}{xe^y+2x^2-\ln x+4}\right)$. At $(1,0)$, $\frac{dy}{dx}=-\left(\frac{e^0+4(0)(1)-\frac{0}{1}}{1e^0+2(1)-\ln 1+4}\right)=-\left(\frac{1}{1+2+4}\right)=-\frac{1}{7}. \quad \Rightarrow \mathbf{B}$
14. $f'(x)=3-3x^2=0$ at $x=-1$ only. $f'(-1)=-2$ so the maximum area is $A=\frac{1}{2}(5)(|-2|)=5. \quad \Rightarrow \mathbf{D}$
15. $\int_2^5 \ln\left(\frac{1}{e^{1/x}}\right)dx = \int_2^5 \ln\left(e^{-1/x}\right)dx = \int_2^5\left(\frac{-1}{x}\right)dx = -\ln|x|\Big]_2^5 = -\ln\frac{5}{2} = \ln\frac{2}{5} = \ln 0.4. \quad \Rightarrow \mathbf{B}$
16. The left side of the equation is the derivative of $y\ln x$ (by use of the product rule).
    Antidifferentiating both side yields $y\ln x=y+C \Rightarrow y(\ln x-1)=C \Rightarrow y=\frac{C}{\ln x-1}$. At the point $(e^2,3)$; $3=\frac{C}{\ln e^2-1}=\frac{C}{2-1}=C$, so $y=\frac{3}{\ln x-1} \quad \Rightarrow \mathbf{C}$

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17. The graph of $y=\sqrt{-x^2+4x+5}-4 \Rightarrow (x-2)^2+(y+4)^2=9$ is a semicircle (top half of circle) of radius 3 centered at $(2,-4)$. Rotating about the line $x=2$ yields a hemisphere of radius 3. Therefore, $V=\frac{1}{2}\cdot\frac{4}{3}\pi(3)^3=18\pi$. $\Rightarrow$**B**

18. $f'(x)=2e^{2x}-6x$. $x_1=x_0-\frac{f(x_0)}{f'(x_0)}=0-\frac{1}{2}=-\frac{1}{2}$. $x_2=x_1-\frac{f(x_1)}{f'(x_1)}=-\frac{1}{2}-\frac{e^{-1}-3(\frac{1}{4})}{2e^{-1}-6\left(-\frac{1}{2}\right)}=$ $-\frac{1}{2}-\frac{4-3e}{8+12e}=\frac{-8-3e}{8+12e}$; $A=8, B=3, C=12 \Rightarrow A+B-C=8+3-12=-1$. $\Rightarrow$**B**

19. $64x^2-384x+9y^2+36y+36=0 \Rightarrow \frac{(x-3)^2}{9}+\frac{(y+2)^2}{64}=576$. Originally, the major axis has length $16cm$ while the minor axis has length $6cm$. Let Q be the length of the major axis and R be the length of the minor axis. $A=\pi\left(\frac{Q}{2}\right)\left(\frac{R}{2}\right)=\frac{\pi}{4}QR$. $\frac{dA}{dt}=\frac{\pi}{4}\left(Q\frac{dR}{dt}+R\frac{dQ}{dt}\right)$. At $t=2,\ Q=28, R=4, \frac{dQ}{dt}=6, \frac{dR}{dt}=-1$. Therefore, $\frac{dA}{dt}=\frac{\pi}{4}\left(28(-1)+4(6)\right)=-\pi$. $\Rightarrow$**C**

20. Rolle's Theorem applies to I. because $f(0)=f(2010\pi)$ and $f(x)$ is both continuous and differentiable on $(0,2010\pi)$. Rolle's Theorem does not apply to II. because $f(-1)\neq f(1)$ and $f(x)$ is not differentiable on $(-1,1)$. Rolle's Theorem applies to III. because $f(-2010)=f(2010)$ and $f(x)$ is both continuous and differentiable on $(-2010,2010)$. Rolle's Theorem does not apply to IV. because $f(\frac{1}{2010})\neq f(2010)$. Thus, Rolle's Theorem applies to 2 of the functions, I and III. $\Rightarrow$**B**

21. Volume of solid rotated about x-axis: $V=\pi\int_0^1\left(x^2-x^8\right)dx=\pi\left(\frac{1}{3}-\frac{1}{9}\right)=\frac{2\pi}{9}$.

Volume of solid rotated about y-axis: $V=2\pi\int_0^1 x\left(x-x^4\right)dx=2\pi\int_0^1\left(x^2-x^5\right)dx=2\pi\left(\frac{1}{3}-\frac{1}{6}\right)=\frac{\pi}{3}$.

$\frac{\pi}{3}-\frac{2\pi}{9}=\frac{\pi}{9}$. $\Rightarrow$**A**

22. $\frac{1}{6-0}\int_0^6\left(x^2+1\right)dx=\frac{1}{6}\left(\frac{1}{3}x^3+x\right)\Big]_0^6=\frac{1}{6}\left[(72+6)-(0+0)\right]=13$. $f(C)=13; C^2+1=13 \Rightarrow C=\pm 2\sqrt{3}$. Choose $C=+2\sqrt{3}$ only. $\Rightarrow$**E**

23. $x\frac{dy}{dx}+y+2y\frac{dy}{dx}=0 \Rightarrow \frac{dy}{dx}=\frac{-y}{x+2y}$. $\frac{d^2y}{dx^2}=\frac{(x+2y)\left(-\frac{dy}{dx}\right)+y\left(1+2\frac{dy}{dx}\right)}{(x+2y)^2}=\frac{2xy+2y^2}{(x+2y)^3}=\frac{2(xy+y^2)}{(x+2y)^3}$ $=\frac{2(1)}{(x+2y)^3}=\frac{2}{(x+2y)^3}$. $\Rightarrow$**C**

24. $\int_{\frac{\sqrt{3}}{3}}^{1}\frac{\arctan x\,dx}{x\left(x+\frac{1}{x}\right)}=\int_{\frac{\sqrt{3}}{3}}^{1}\frac{\arctan x\,dx}{\left(x^2+1\right)}=\left(\frac{1}{2}\arctan^2 x\right)\Big]_{\frac{\sqrt{3}}{3}}^{1}=\frac{1}{2}\left[\left(\frac{\pi}{4}\right)^2-\left(\frac{\pi}{6}\right)^2\right]=\frac{5\pi^2}{288}$. $\Rightarrow$**A**

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25. $\log_{2010}\cos^2 2010x + \log_{2010}\sec^2 2010x = 0$ since $\cos^2 2010x \cdot \sec^2 2010x = 1$. Therefore $f(x) = e^{2010x} + \pi^{e^\pi}$. $f'(x) = 2010e^{2010x}$ and so $f'\left(\frac{1}{2010}\right) = 2010e$. $\Rightarrow$ **D**

26. When $t = 0, V = 800\pi$. $\frac{dV}{dt} = k\sqrt{V} \Rightarrow \int V^{-1/2}dV = k\int dt \Rightarrow 2\sqrt{V} = kt + C$ and so $C = 40\sqrt{2\pi}$. Also, since $\frac{dV}{dt} = k\sqrt{V}$, then $-20\pi = k\sqrt{800\pi} \Rightarrow k = \frac{-\sqrt{\pi}}{\sqrt{2}}$. So now $2\sqrt{V} = \frac{-\sqrt{\pi}}{\sqrt{2}}t + 40\sqrt{2\pi}$ and let $V = 0$ and solve for t. $\frac{\sqrt{\pi}}{\sqrt{2}}t = 40\sqrt{2\pi} \Rightarrow t = 40\sqrt{2\pi}\cdot\frac{\sqrt{\pi}}{\sqrt{2}} = 80$. $\Rightarrow$ **C**

27. $A(x) = \frac{\pi}{2}(x^2)^2 = \frac{\pi}{2}x^4$. $V = \int_0^4 \frac{\pi}{2}x^4 dx = \frac{\pi}{2}\left(\frac{1}{5}x^5\right)\Big]_0^4 = \frac{\pi}{10}(1024) = \frac{512\pi}{5}$. $\Rightarrow$ **B**

28. The average value is $\frac{1}{6}\int_3^9 \frac{x^2+3x-4}{x^3-4x^2+4x}dx = \frac{1}{6}\int_3^9 \frac{x^2+3x-4}{x(x-2)^2}dx$. Now, resolve into partial fractions: $\frac{1}{6}\int_3^9 \frac{-1}{x}dx + \frac{1}{6}\int_3^9 \frac{2}{x-2}dx + \frac{1}{6}\int_3^9 \frac{3}{(x-2)^2}dx = \frac{1}{6}\left(-\ln|x| + 2\ln|x-2| - \frac{3}{x-2}\right)\Big]_3^9 =$ $\frac{1}{6}\left[\left(-\ln 9 + 2\ln 7 - \frac{3}{7}\right) - \left(-\ln 3 + 2\ln 1 - \frac{3}{1}\right)\right] = \frac{1}{6}\left(-\ln 3 + 2\ln 7 + \frac{18}{7}\right) = \frac{1}{6}\ln\left(\frac{49}{3}e^{18/7}\right) = \ln\sqrt[6]{\frac{49}{3}e^{18/7}} =$ $\ln\left(e^{\frac{3}{7}}\sqrt[6]{\frac{49}{3}}\right)$. $\Rightarrow$ **D**

29. $f(x) = -\int_{x^2}^4 (3t+2)dt = \int_4^{x^2}(3t+2)dt$. $f'(x) = (3x^2+2)(2x) = 6x^3 + 4x$. $f''(x) = 18x^2 + 4$. $f''(2) = 18(4) + 4 = 76$. $\Rightarrow$ **D**

30. Using u-substitution, let $u = \sqrt{2+\sqrt{x}}$; $u^2 = 2 + \sqrt{x}$; $\sqrt{x} = u^2 - 2$; $x = (u^2-2)^2$ and $dx = (4u^3 - 8u)du$. $\int\sqrt{2+\sqrt{x}}\ dx = \int u(4u^3-8u)du = \int(4u^4 - 8u^2)du = \frac{4}{5}u^5 - \frac{8}{3}u^3 + C =$ $\frac{4}{15}u^3(3u^2-10) + C = \frac{4}{15}(2+\sqrt{x})^{3/2}(6 + 3\sqrt{x} - 10) + C = \frac{4}{15}(2+\sqrt{x})^{3/2}(3\sqrt{x} - 4) + C$. $\Rightarrow$ **D**