Part A: Calculator NOT Allowed

1. $\lim\limits_{x\to\infty}\dfrac{-2x^2+7x-3}{1x^2+2x-3}=\lim\limits_{x\to\infty}\dfrac{\frac{-2x^2}{x^2}+\frac{7x}{x^2}-\frac{3}{x^2}}{\frac{1x^2}{x^2}+\frac{2x}{x^2}-\frac{3}{x^2}}=\lim\limits_{x\to\infty}\dfrac{-2+\frac{7}{x}-\frac{3}{x^2}}{1+\frac{2}{x}-\frac{3}{x^2}}=-2$ $\boxed{B}$

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2. $\int x^{-2}dx=\dfrac{x^{-1}}{-1}+C=-x^{-1}+C$ $\boxed{D}$

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3. Product Rule → $f'(x)=(x-1)\,[3(x^2+2)^2(2x)]+(x^2+2)^3(1)$
$=(x^2+2)^2\ \{6x(x-1)+(x^2+2)\}=(x^2+2)^2\ (7x^2-6x+2)$ $\boxed{D}$

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4. $\int\sin 2x\,dx+\int\cos 2x\,dx\ =\ -\dfrac{1}{2}\cos 2x+\dfrac{1}{2}\sin 2x+C$ $\boxed{B}$

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5. $\lim\limits_{x\to 0}\dfrac{\cancel{x^2}(5x^2+8)}{\cancel{x^2}(3x^2-16)}=-\dfrac{1}{2}$ Therefore, $\boxed{A}$ Or use L'Hopital's Rule Twice

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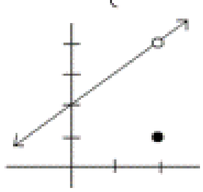
6. $f(x)=\begin{cases}\dfrac{x^2-4}{x-2}, & x\neq 2\\ 1 & x=2\end{cases}$

I) f has a limit at $x=2\Rightarrow\lim\limits_{x\to 2^-}f(x)=\lim\limits_{x\to 2^+}f(x)=\lim\limits_{x\to 2}f(x)=4$

II) Continuous at 2? NO b/c $f(2)=1\neq 4$

III) Differentiable at 2? Since not continuous at 2, NO.



So, only I is true $\boxed{A}$

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7. $\int_0^1 v(t)dt=s(1)-s(0)$ (FTC) $s(1)=s(0)+\int_0^1 v(t)dt=2+(t^3+3t^2)\Big|_0^1=2+4=6$ $\boxed{B}$

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8. f(x)= cos(3x) → $f'(x)=-3\sin(3x)$ Therefore, $f'\left(\dfrac{\pi}{9}\right)=-3\sin\left(\dfrac{\pi}{3}\right)=-3\left(\dfrac{\sqrt{3}}{2}\right)=\dfrac{-3\sqrt{3}}{2}$ $\boxed{E}$

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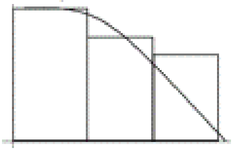
9. $g'(x)=f(x)$ So g has a relative maximum when $g'(x)$ or $f(x)$ changes from + to – .
This happens at $x=1$. $\boxed{D}$

10. Because *f(x)* is decreasing, Right Riemann Sum $< \int_1^3 f(x)dx <$ Left Riemann Sum

Since decreasing and concave down, Right Riemann Sum < both Midpoint Riemann Sum and Trapezoidal Sum, therefore answer is $\boxed{\text{C}}$.



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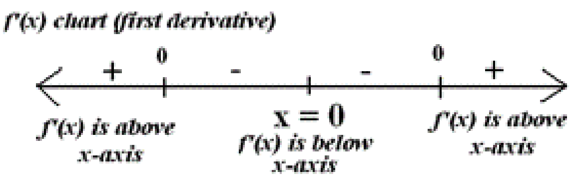
11. 

Therefore, Choice $\boxed{\text{B}}$.

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12. $f'(x) = e^{2/x}(-2x^{-2}) = \dfrac{-2e^{2/x}}{x^2}$ $\boxed{\text{D}}$

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13. Since $f(x) = x^2 + 2x \rightarrow f(\ln x) = (\ln x)^2 + 2\ln x \Rightarrow \dfrac{d}{dx}(f(\ln x)) = 2(\ln x)\left(\dfrac{1}{x}\right) + 2\left(\dfrac{1}{x}\right) = \dfrac{2\ln x + 2}{x}$ $\boxed{\text{A}}$

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14. Nothing about $f'(x)$ is given, eliminating A,B and C. $\boxed{\text{E}}$
Only 29% of the students answered this question correctly; common wrong answer is D.
D is not the correct answer because we do not know the sign of $f''(x)$ to the immediate left & right of x = 1.
Just because $f''(x) = 0$ doesn't mean there is an inflection point – the sign of $f''(x)$ must change to be an inflection point.

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15. $\int \dfrac{x}{x^2-4}dx \rightarrow$ Let $u = x^2 - 4$, $\dfrac{du}{dx} = 2x \rightarrow \dfrac{du}{2} = xdx \Rightarrow \int \dfrac{x}{x^2-4}dx \rightarrow \dfrac{1}{2}\int \dfrac{du}{u} = \dfrac{1}{2}\ln|u| + C = \boxed{\dfrac{1}{2}\ln|x^2-4|+C}$

OR

$\int \dfrac{x}{x^2-4}dx = \square \ln|x^2-4| + C \Rightarrow$ take deriv and compare: $\dfrac{\square 2x}{x^2-4} \Rightarrow 2\square = 1$ so $\square = \dfrac{1}{2} \Rightarrow$

$\int \dfrac{x}{x^2-4}dx = \dfrac{1}{2}\ln|x^2-4| + C$ Answer: $\boxed{\text{C}}$

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16. Chain Rule and Implicit Differentiation: $\cos(xy)\left[xy' + y(1)\right] = 1 \Rightarrow (xy')\cos(xy) + y\cos(xy) = 1$

$\dfrac{dy}{dx} = \boxed{y' = \dfrac{1 - y\cos(xy)}{x\cos(xy)}}$ Answer: $\boxed{\text{D}}$ *Only 37% of students answered it correctly!

17. By the Second Fundamental Theorem of Calculus, $g'(x)=f(x)$ and so $g''(x)=f'(x)$

g has a point of inflection where $g''=f'$ changes sign. This happens when $x=2$ and $x=5$ $\boxed{\text{C}}$

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18. slope of the tangent line is $y'=2x+3=m$

$x+y=k \rightarrow y=-x+k \Rightarrow m=-1$

Solve $2x+3=-1 \rightarrow 2x=-4 \rightarrow x=-2$, $\rightarrow f(-2)=(-2)^2+3(-2)+1=-1=y$

$\Rightarrow x+y=k \Rightarrow -2+(-1)=\boxed{-3}$ $\boxed{\text{A}}$

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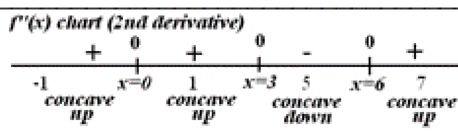
19. For horizontal asymptotes, both $\lim\limits_{x\to\pm\infty} f(x)$ must be considered.

$$y=\frac{5+2^x}{1-2^x}=\frac{\frac{5+2^x}{2^x}}{\frac{1-2^x}{2^x}}=\frac{\frac{5}{2^x}+1}{\frac{1}{2^x}-1}\Rightarrow \lim_{x\to+\infty}\left(\frac{\frac{5}{2^x}+1}{\frac{1}{2^x}-1}\right)=\frac{1}{-1}=-1 \text{ and } \lim_{x\to-\infty}\left(\frac{5+2^x}{1-2^x}\right)=\lim_{x\to+\infty}\frac{5+\frac{1}{2^x}}{1-\frac{1}{2^x}}=\frac{5+0}{1-0}=5=5$$

OR L'Hopital: $\lim\limits_{x\to+\infty}\dfrac{2^x\ln 2}{-2^x\ln 2}=-1$ and $\lim\limits_{x\to-\infty}\left(\dfrac{5+2^x}{1-2^x}\right)=5$ as shown above. So answer: $\boxed{\text{E}}$



20. Points of inflection at x = 3 and x = 6, so Answer: $\boxed{\text{D}}$

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21. Velocity increasing $\leftrightarrow v'=x''>0$ when $x(t)$ is concave up on $0<t<2 \rightarrow$ Answer: $\boxed{\text{A}}$

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22. p changes in direct proportion to the product of p and the difference of N and p where P is the number of people who have heard the rumor and $N-P$ is the number of people who have not heard the rumor.

So: $\dfrac{dp}{dt}=k\left[p(N-p)\right]$ Answer: $\boxed{\text{B}}$

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23. Separation of variables, $\int y\,dy=\int x^2\,dx \Rightarrow \dfrac{y^2}{2}=\dfrac{x^3}{3}+C$ $y(3)=-2 \rightarrow \dfrac{(-2)^2}{2}=\dfrac{3^3}{3}+C, C=-7$

$\Rightarrow \dfrac{y^2}{2}=\dfrac{x^3}{3}-7 \rightarrow y^2=\dfrac{2x^3}{3}-14 \Rightarrow \boxed{y=-\sqrt{\left(\dfrac{2x^3}{3}-14\right)}}$ *Square root is negative because *y(3)* <0 $\boxed{\text{E}}$

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24. $f(2)=1 \leftrightarrow (2,1)$ and $m=f'(2)=4$

$y-y_1=m(x-x_1) \Rightarrow y-1=4(x-2) \rightarrow y=4x-7 \Rightarrow y(1.9)=4(1.9)-7=7.6-7=.6$ $\boxed{\text{B}}$

OR $f(1.9)\approx f(2)+f'(2)(-.1)=1+(4)(-.1)=1-.4=.6$

25. f is differentiable at $x=2$ → $f'(x)=\begin{cases} c & ,x<2 \\ 2x-c & ,x>2 \end{cases}$ So, $c=2x-c$ so $f'(2)\Rightarrow 2c=2(2) \Rightarrow c=2$

f is continuous at $x=2$ (Diff→Cont)

$\therefore \lim\limits_{x\to 2^-}(cx+d)=\lim\limits_{x\to 2^+}(x^2-cx)\Rightarrow 2c+d=4-2c\Rightarrow d=4-4c=4-4(2)=-4$

$\Rightarrow c+d=2+(-4)=-2$ $\boxed{\text{B}}$

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26. $y=\tan^{-1}(4x)\to \dfrac{dy}{dx}=\dfrac{1}{1+(4x)^2}\bullet(4)=\dfrac{4}{1+16x^2}$ $\left.\dfrac{dy}{dx}\right|_{x=\frac{1}{4}}=\dfrac{4}{1+16\left(\frac{1}{4}\right)^2}=\dfrac{4}{2}=2$ $\boxed{\text{A}}$

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27. Slope field:

Consider the point $(-1,1)$. $\Rightarrow$ The slope field indicates $\left.\dfrac{dy}{dx}\right|_{(-1,1)}=0\Rightarrow$ NOT A,B, or D

Consider $(0,0)\Rightarrow \left.\dfrac{dy}{dx}\right|_{(0,0)}=0 \Rightarrow$ NOT E $\therefore$ choice $\boxed{\text{C}}$

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28. Since $f(6)=3, f^{-1}(3)=g(3)=6 \Rightarrow g'(x)=\dfrac{1}{f'(g(x))}\Rightarrow g'(3)=\dfrac{1}{f'(g(3))}=\dfrac{1}{f'(6)}=\dfrac{1}{-2}$ $\boxed{\text{A}}$

ONLY 14% of students answered this correctly.

Part B: Calculator Allowed

76. f increasing $\Rightarrow f' \geq 0$ One could interpret the answer to be $(-2,1)\cup(1,3)$ instead, but it is NOT listed as a choice. $\therefore$ $\boxed{\text{B}}$ [-2,3]

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77. $\lim\limits_{x\to 2^-} f(x) \neq \lim\limits_{x\to 2^+} f(x)$, but each do exist. $\therefore \lim\limits_{x\to 2} f(x)$ DNE $\therefore$ $\boxed{\text{C}}$

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78. f increasing $\rightarrow f'(x)\geq 0$ Graph: $f'(x)=\sin(x^3-x)\geq 0$ when curve is above the x-axis on [-1,1.691] $\boxed{\text{B}}$

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79. $\int\limits_{-5}^{5} f(x)dx = \int\limits_{-5}^{2} f(x)dx + \int\limits_{2}^{5} f(x)dx = \int\limits_{-5}^{2} f(x)\,dx - \int\limits_{5}^{2} f(x)\,dx = -17-(-4) = -13$ $\boxed{\text{B}}$

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80. Points of inflection of f occur when f'' changes signs. This can happen when f' changes from increasing to decreasing or decreasing to increasing at relative max/min of the graph of f' or when the graph of f'' passes through the x-axis. When you graph f', there are 5 relative max/min on $(-2,2)$. The graph of f'' passes through the x-axis 5 times on $(-2,2)$. $\boxed{\text{E}}$

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81. Since G(x) is antiderivative for $f(x)$, $\int\limits_{2}^{4} f(x)\,dx \underset{f.t.c.}{=} G(4) - \underbrace{G(2)}_{-7} = G(4)-(-7) \Rightarrow G(4) = -7 + \int\limits_{2}^{4} f(x)\,dx$ $\boxed{\text{E}}$

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82. $a(3)=v'(3)=0.055$ $\boxed{\text{B}}$ using $\boxed{\text{nDeriv}}$ on your calculator

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83. Graph $f(x)=x^3-8x^2+18x-5$ and $g(x)=x+5$ They intersect at x=1,2,5

$$\text{Area} = \int\limits_{1}^{2}(f-g)\,dx + \int\limits_{2}^{5}(g-f)\,dx = 11.833 \; \boxed{\text{B}} \; \text{Or } Area = \int\limits_{1}^{5}|f-g|\,dx = 11.833$$

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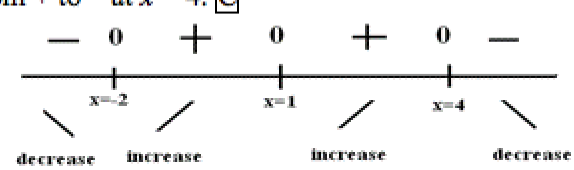
84. f has a rel max when f' changes from + to –. The graph of $f'(x)$ and it's chart show that f' changes from + to – at $x=4$. $\boxed{\text{C}}$



85. $\int_{-4}^{-1} f'(x)dx \underset{FTC}{=} f(-1) - f(-4) = (-1.5) - (.75) = -2.25$ $\boxed{B}$

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86. $v(3) = x'(3) = 0 \leftrightarrow x(t)$ has a horizontal tangent at $t = 3$ $\therefore$ either C or E.

from the table, $v(1) = x'(1) = 2 \rightarrow x(t)$ is inc. at $t = 1$ $\therefore$ not E $\boxed{C}$

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87. $x(3) = x(0) + \int_0^3 v(t)\,dt = 2 + 4.5115 \approx 6.512$ $\boxed{D}$

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88. $S = 4\pi r^2 \rightarrow \frac{dS}{dt} = 8\pi r \frac{dr}{dt} = 8\pi(3)(-2) = -48\pi$ $\boxed{C}$

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89. Think of Rolle's Theorem $\rightarrow$ since $f\,'(c) \neq 0\ for -2 < c < 2$, then either f is not continuous [-2,2] or f is not differentiable on (-2,2). Answer can't be D because if $f\,'(k)$ exists, then it is differentiable meeting the conditions of Rolle's Theorem. Hence, the answer is $\boxed{E}$.

90.

$f'(3) = 2.\ f''(x) < 0$ on (2,4) $\rightarrow f'$ must be decreasing on (2,4)

The answer is NOT tables B,D,or E since $f'(c) = \dfrac{f(4) - f(3)}{4 - 3}$ for $3 \le c \le 4$ are not < 2

($i.e.\ f'$ is not decreasing from 3 to 4) ↑

It is NOT table C because $f'(c) = \dfrac{f(3) - f(2)}{3 - 2} = 2$ for $2 \le c \le 3$, but $f'(3) = 2$ and f' needs to be dec on $2 < x < 3$ So, answer is $\boxed{A}$

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91. $f_{avg} = \frac{1}{b-a}\int_a^b f(x)\,dx = \frac{1}{3-(-1)}\int_{-1}^{3} \frac{\cos x}{x^2 + x + 2}dx = 0.183$ $\boxed{C}$

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92. The population is given as the sum (accumulation) of the population times the population density on the interval from 0 miles to 4 miles:

$Population = \int \frac{Pop}{mi^2} \cdot mi^2 = \int_{x=0}^{4} \frac{Pop}{mi^2} \cdot mi \cdot dx = \int_0^4 7 \cdot f(x)\,dx$ $\boxed{B}$