f(3)

1) $\int_2^x (3t^2-1)\,dt = t^3 - t\Big|_2^x =$
$(x^3-x)-(8-2) = \boxed{x^3-x-6}$ A

2) $y=\ln(2x)$ $x=4$
$y' = \frac{2}{2x} = \frac{1}{x} \rightarrow \boxed{\frac{1}{4}}$ B

3) $f(x) = 4x^{-2} + \frac{1}{4}x^2 + 4$
$f'(x) = -8x^{-3} + \frac{1}{2}x$
$f'(2) = -1 + 1 = \boxed{0}$ D

4) $\int_1^2 \frac{dx}{2x+1}$ $u=2x+1$ $du = 2\,dx$
$\frac{1}{2}\int \frac{1}{u}\,du = \frac{1}{2}\ln|2x+1|\Big|_1^2 =$
$\boxed{\frac{1}{2}(\ln 5 - \ln 3)}$ E

5) I true $-1=-1$ II true $-1=-1$ III false $-1 \neq -3$
$\boxed{\text{I and II}}$ C

6) $\frac{d}{dx}(\sin^3(x^2))^3 = 3(\sin(x^2))^2\cos(x^2)(2x)$
$\boxed{6x(\sin(x^2))^2\cos(x^2)}$ E

7) $\lim_{x\to\infty} \frac{x^3}{e^{3x}}$ bottom larger $\lim = \boxed{0}$ A

8) $\int_{\pi/6}^{\pi/2} \sin^5(2x)\cos(2x)\,dx$ $u=\sin(2x)$ $du = \cos(2x)\cdot 2$
$u = \sin\frac{\pi}{3}$ $u = \frac{\sqrt{3}}{2}$ $u=\sin\pi$ $u=0$
$\boxed{\frac{1}{2}\int_{\sqrt{3}/2}^{0} u^5\,du}$ D

9) $f'(x) = x(x-3)^2(x+1)$
$+\ \ -1\ \ -\ \ 0\ \ +\ \ 3\ \ +$ $\boxed{\max x=-1}$ A

10) $f(x) = \begin{cases} \frac{(x-2)(x-5)}{b(x-2)} = \frac{x-5}{b} & \frac{-3}{b} = b \\ b & b^2=-3 \end{cases}$
$\boxed{\text{no value}}$ E $b = \sqrt{-3}$

11) max where $f'(x)$ changes from pos. to neg. $x=3$
max value $f(3) = 1 + \int_0^3 f(x) = E$
D

12) $f(x) = 9^x$ $\frac{2-0}{4} = \frac{1}{2}$ $\frac{b-a}{n}$
$0, \frac{1}{2}, 1, \frac{3}{2}, 2$
$\frac{1}{2}(\cancel{9^0} + 9^{1/2} + 9^1 + 9^{3/2} + 9^2)$
$= \frac{1}{2}(3+9+27+81) = \frac{1}{2}(120)$
$= \boxed{60}$ C

13) $\frac{d}{dx}\left(\frac{x+1}{x^2+1}\right) = \frac{(x^2+1)-(x+1)(2x)}{(x^2+1)^2}$
$= x^2+1-2x^2-2x / (x^2+1)^2$
$= \boxed{\frac{-x^2-2x+1}{(x^2+1)^2}}$ C

14) $v(t) = \sin(2t)$ $t=0$ $x=4$
$x(t) = \int \sin(2t)$ $u=2t$ $du=2$
$= -\frac{1}{2}\cos(2t) + C = 4$
$-\frac{1}{2} + C = 4$ $C = 4.5$
$-\frac{1}{2}\cos(2\cdot\frac{\pi}{2}) + 4.5 = \boxed{5}$ D

15) $y = g(x^3-6x^2)$
$3x^2-12x=0$
$3x(x-4)=0$ $x=0,4$
$+\ \ 0\ \ -\ \ 4\ \ +$ A
$\boxed{(-\infty,0]\ (4,\infty)}$

16) $\lim_{x\to 3^-} \frac{|x-3|}{x-3} = \frac{x-3}{x-3}$ $\frac{-(x-3)}{x-3}$
$\boxed{\lim_{x\to 3^-} = -1}$ 1 -1
B

17) $f(x) = ae^{-ax}$ $a>0$
$f'(x) = ae^{-ax}(-a)$
$= \boxed{-a^2e^{-ax}}$ E

✓ 18) $\frac{dy}{dx} = xy$ $\quad y=2 \quad x=0$

$\boxed{\text{Step } 3}$ B $\quad |y| = e^{x^2/2 + c}$

✓ 19) $y = 3x^5 + 10x^4$

$y' = 15x^4 + 40x^3$

$y'' = 60x^3 + 120x^2 = 0$

$60x^2(x+2) = 0$

$x = 0, -2$ $\quad \overset{-}{\longleftarrow}\!\!\underset{-2}{|}\!\overset{+}{\;}\underset{0}{|}\!\overset{+}{\longrightarrow}$

$\boxed{x=-2}$ B

✓ 21) $\frac{dx}{dt} = -1 \quad \frac{dy}{dt} = 4 \quad x=6 \quad y=20 \quad \frac{dw}{dt} = ?$

$w = x^2 y$

$\rightarrow w' = x^2 \frac{dy}{dt} + y\,2x\frac{dx}{dt}$

$w' = 36(4) + 20(2)(6)(-1)$

$w' = 144 - 240 = \boxed{-96}$ C

* ✓20) $\lim\limits_{x \to 2} \frac{\ln(x+3) - \ln(5)}{x-2}$ $\quad$ B

$f(x) = \ln x$ $\quad$ alt def of der

$f'(x) = \frac{1}{x}$

$\boxed{f'(5) = 1/5}$ B

✓ 22) $f(x) = 2x^3 - 3x^2 - 12x + 18$

$f'(x) = 6x^2 - 6x - 12 = 0$

$6(x^2 - x - 2) = 0 \quad (x-2)(x+1)$

$\overset{+}{\longleftarrow}\!\!\underset{-1}{|}\!\overset{-}{\;}\underset{2}{|}\!\overset{+}{\longrightarrow}$ $\quad$ dec $(-1, 2)$

$\underset{-1}{\;}\;\underset{1/2}{\;}\;\underset{2}{\;}$

$f''(x) = 12x - 6 = 0$

$6(2x-1) \quad x = 1/2$

$\overset{-}{\longleftarrow}\!\!\underset{1/2}{|}\!\overset{+}{\longrightarrow}$ $\quad$ ccu $(1/2, \infty)$

dec and ccu $\boxed{(1/2, 2)}$ D

✓ 23) $f'(x) = \begin{cases} 3 & x < -1 \\ -2x & x \geq -1 \end{cases}$

$f'(-1) =$ $\boxed{\text{nonexistent}}$ E

✓24) $f(x) = \frac{(3x+8)(5-4x)}{(2x+1)^2}$

horiz asy $- \lim\limits_{x\to\infty} = \frac{-12x^2 \ldots}{4x^2 \ldots}$

$\boxed{y = -3}$ B

✓25) $y = x^2 - 2x \quad u = 2x+1$

$y = \left(\frac{u-1}{2}\right)^2 - 2\left(\frac{u-1}{2}\right) \quad \frac{u-1}{2} = x \qquad \frac{dy}{du}$

$y = \frac{u^2 - 2u + 1}{4} - u + 1$

$y = \frac{u^2 - 2u + 1 - 4u + 4}{4}$

$y = \frac{1}{4}(u^2 - 6u + 5)$

$y' = \frac{1}{4}(2u - 6) = \frac{1}{2}u - \frac{3}{2}$

$= \frac{1}{2}(2x+1) - \frac{3}{2}$

$= x + \frac{1}{2} - \frac{3}{2} = \boxed{x - 1}$ D

✓ 26) $\frac{d}{dx}\int_1^{\sqrt{x}} \frac{1}{1+t^2}\,dt$

$= \frac{1}{1+\sqrt{x}^2}\left(\frac{1}{2}x^{-1/2}\right)$

$= \boxed{\frac{1}{1+x}\left(\frac{1}{2\sqrt{x}}\right)}$ A

✓ 27) $x(t) = \sin(2\pi t) + 2\pi t$

$v(t) = \cos(2\pi t)(2\pi) + 2\pi = 0$

$2\pi(\cos(2\pi t) + 1) = 0$

$\cos(2\pi t) = -1$

$2\pi t = \pi$

$t = \pi/2\pi = \boxed{1/2}$ D

✓ 28) check $(1,1)$ $(-1,1)$ $(1,-1)$,

zero slope at $y = 1$, $x = 0$ A

76) average $v(t) = \frac{S(8)-S(2)}{6}$ C

77) $\sin\left(\frac{1}{x^2+1}\right) = \int_1^2 f(x)\,dx$ $\Big|_1^2$

$\sin\left(\frac{1}{5}\right) - \sin\left(\frac{1}{2}\right) = -.281$ A

78) $f(x)$ inc $\rightarrow$ $f'(x)$ positive

1 POI $\rightarrow_{f''(x)\,+\,-}$ $f'(x)$ changes from inc $\leftrightarrow$ dec 1 time A

79) $y = 2+\sin x$ $\pi\int_0^5 (2+\sin x)^2\,dx = 80.115$ E

80) $f''(x) > 0$ $f'(x)$ inc (slopes) $f(x)$ CCU

$\frac{3.6-2.4}{3-1} = \frac{1.2}{2} = .6$ pos $\frac{5.4-3.6}{5-3} = \frac{1.8}{2} = .9$

between .6 and .9 B

81) $t=0$ $y=1500$ $(0,1500)$

$1500 + \int_0^3 R(t)\,dt = 1041$ D

82) A

max $f'(x)$ changes $+ \rightarrow -$ min $f'(x)$ changes $-$ to $+$

POI $f'(x)$ changes inc/dec $\rightarrow$ dec/inc

83) $\int_0^3 \frac{1}{2} f(x) - 3(g(x))\,dx$

$\frac{1}{2}\int_0^3 f(x)\,dx - 3\int_0^3 g(x)\,dx$

$\frac{1}{2}(4) \qquad - 3(7)$

$2 - 21 = -19$ B

$\int_3^0 g(x) = -7 \rightarrow \int_0^3 g(x) = 7$

$\int_0^6 - \int_3^6 = \int_0^3 f(t) = 4$

$9 - 5 = 4$

84) $\frac{14+(-16)+52}{8} = 48/8 = 6$ A

85 $\int_0^2 |v(t)|\,dt = .927$ D

92) $x = f(y)$

$f(x) = y$

$\boxed{g'(x) = \frac{1}{f'(g(x))}}$

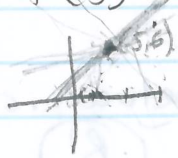
$g'(4) = \frac{1}{f'(g(4))} = \frac{1}{f'(-2)} = \boxed{\frac{1}{4}}$ D

91) $F'(x) > 0$ $F(x)$ inc // slopes inc
$F''(x) > 0$ $F(x)$ ccu f' inc
(B) compute slopes

$y' = e^x$ $y'(k) = e^k$

86) line → $y - e^k = e^k(x-k)$ y int → $x=0$
$\frac{1}{2} - e^k = e^k(0-k)$
$\frac{1}{2} - e^k = -ke^k$
$\frac{1}{2} = -ke^k + e^k$
$\frac{1}{2} = e^k(-k+1)$
$k = .768$ (B)

87) $f(5) = 6$ $f'(x) \le 3$ $1 \le x \le 8$



$\frac{6}{3} = 2$

I could be true (C)
II could be true
III $f(7) = 13$ $f(5) = 6$ $\frac{13-6}{7-5} = \frac{7}{2} = 3.5 > 3$
cannot be true

88) graph is $f = h'$
$h'(2) = 0$
$h(2) = \int_0^2 f(t)\,dt = +$ area

$h''(2)$ = slope of $h'(2) = -$

$h''(2) < h'(2) < h(2)$ (E)

89) $\int_0^{1.054} (\sin x - (e^x - 2))\,dx = .745$ (C)

90) speed inc when vel and accel have same sign
$v(t) = -t^3 + 2t^2 + 2^{-t}$
$a(t) = -3t^2 + 4t + 2^{-t}(-1)\ln 2$
$(.177, 1.256)$ $(2.057, \infty)$ (E)