[2][a] $\boxed{\dfrac{\text{THOUSANDS OF DOLLARS}}{\text{MILLIONS OF TICKETS}}}$ 2

[b] IF 8 MILLION TICKETS ARE SOLD, (2)
FOR EACH ADDITIONAL MILLION TICKETS SOLD, (3)
ON AVERAGE, EACH WINNING TICKET WILL WIN
(3) AN ADDITIONAL $900,000 BY OUR BEST APPROXIMATION

[3]

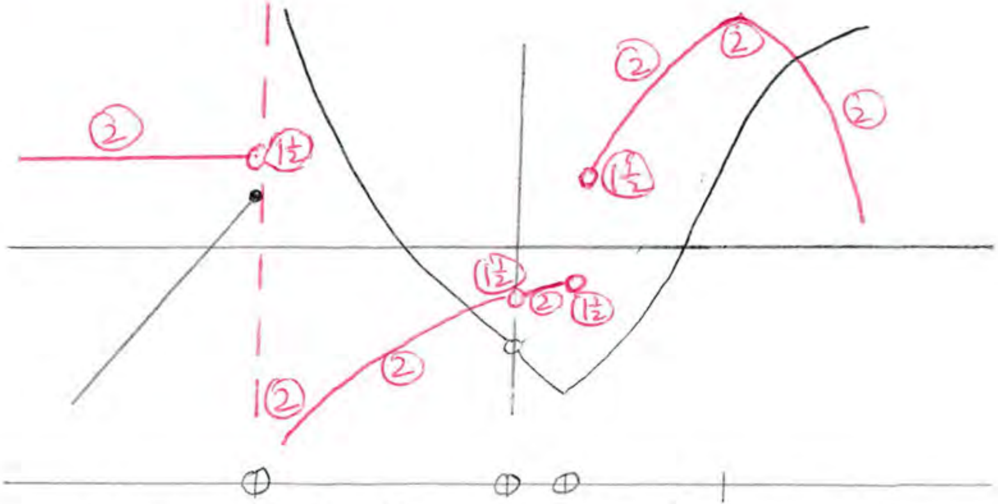
$$(3)\ \boxed{\lim_{x\to\infty} \frac{4-e^{3x}}{\sqrt{5e^{9x}+7}}} \cdot \boxed{\frac{\sqrt{e^{-9x}}}{\sqrt{e^{-9x}}}}\ (3) = \boxed{\lim_{x\to\infty} \frac{4e^{-\frac{9}{2}x}-e^{-\frac{3}{2}x}}{\sqrt{5+7e^{-9x}}}}\ (4) = \boxed{\frac{4(0)-0}{\sqrt{5+7(0)}}}\ (2\tfrac{1}{2}) = \underline{0}\ (1)$$

$$\frac{4-\infty}{\sqrt{\infty+7}} \rightarrow \frac{-\infty}{\infty}$$

$$(3)\ \boxed{\lim_{x\to-\infty} \frac{4-e^{3x}}{\sqrt{5e^{9x}+7}}} = \boxed{\frac{4-0}{\sqrt{5(0)+7}}}\ (2\tfrac{1}{2}) = \boxed{\frac{4}{\sqrt{7}}}\ (1)$$

H.A. $\underline{y=0}$ $(2\tfrac{1}{2})$, $\underline{y=\frac{4}{\sqrt{7}}}$ $(2\tfrac{1}{2})$

[4]



f	INCR	DECR	DECR	INCR	INCR
	—	FLATTER	FLATTER	STEEPER	FLATTER
f'	>0	<0	<0	>0	>0
	—	SMALLER IN SIZE	SMALLER	LARGER	SMALLER

[5][b] $\boxed{\lim_{h \to 0} \dfrac{\dfrac{x+h}{2(x+h)+1} - \dfrac{x}{2x+1}}{h}}$ 6

$$= \boxed{\lim_{h \to 0} \frac{(x+h)(2x+1) - x(2x+2h+1)}{h(2x+2h+1)(2x+1)}} \; 5$$

$$= \boxed{\lim_{h \to 0} \frac{\cancel{2x^2} + \cancel{x} + \cancel{2xh} + \cancel{h}^{1} - \cancel{2x^2} - \cancel{2xh} - \cancel{x}}{\cancel{h}(2x+2h+1)(2x+1)}} \; 5$$

$$= \boxed{\lim_{h \to 0} \frac{1}{(2x+2h+1)(2x+1)}} \; 5 = \boxed{\frac{1}{(2x+1)^2}} \; 2$$

[c] $$\frac{s\left(\frac{3}{2}\right)-s\left(\frac{1}{2}\right)}{\frac{3}{2}-\frac{1}{2}} = 6\ \boxed{\dfrac{\dfrac{\frac{3}{2}}{4} - \dfrac{\frac{1}{2}}{2}}{1}}\ \frac{\text{MILES}}{\text{DAY}} = \left(\frac{3}{8}-\frac{1}{4}\right)\frac{\text{MILES}}{\text{DAY}}$$

$$2 = \boxed{\frac{1}{8}}\ \boxed{\frac{\text{MILES}}{\text{DAY}}}\ 2$$

[d] $f''(1) = \lim_{b \to 1} \frac{f'(b) - f'(1)}{b - 1} = \boxed{\lim_{b \to 1} \frac{\frac{1}{(2b+1)^2} - \frac{1}{9}}{b-1}}$ 6

$4\frac{1}{2}$ $= \boxed{\lim_{b \to 1} \frac{9 - (2b+1)^2}{9(2b+1)^2(b-1)}} = \boxed{\lim_{b \to 1} \frac{(3 + 2b+1)(3-(2b+1))}{9(2b+1)^2(b-1)}}$ $4\frac{1}{2}$

$4\frac{1}{2}$ $= \boxed{\lim_{b \to 1} \frac{(2b+4)(\cancel{-2b+2})^{-2}}{9(2b+1)^2\cancel{(b-1)}}} = \boxed{\lim_{b \to 1} \frac{-2(2b+4)}{9(2b+1)^2}}$ 2

SEE ALTERNATE SOLUTION BELOW

$= \frac{-2(6)^2}{9(3)^2} = \boxed{\frac{-4}{27}}$ 2 $= \left.\frac{d^2y}{dx^2}\right|_{x=1}$

[d] $f''(1) = \lim_{h \to 0} \frac{f'(1+h) - f'(1)}{h} = \boxed{\lim_{h \to 0} \frac{\frac{1}{(2(1+h)+1)^2} - \frac{1}{9}}{h}}$ 6

ALTERNATE SOLUTION

$= \boxed{\lim_{h \to 0} \frac{9 - (3+2h)^2}{9h(3+2h)^2}} = \boxed{\lim_{h \to 0} \frac{(3+3+2h)(3-(3+2h))}{9h(3+2h)^2}}$ 4½ 4½

$= \boxed{\lim_{h \to 0} \frac{-2\cancel{h}(6+2h)}{9\cancel{h}(3+2h)^2}} = \boxed{\lim_{h \to 0} -\frac{2(6+2h)}{9(3+2h)^2}} = -\frac{2(\cancel{6})^{2}}{9(3)^{\cancel{2}}}$ 4½ 2

SEE <u>NOT</u> RECOMMENDED ALTERNATE SOLUTION BELOW

$\frac{d^2y}{dx^2}\Big|_{x=1} = \boxed{-\frac{4}{27}}$ 2

[d] $f''(x) = \lim_{h \to 0} \frac{f'(x+h) - f'(x)}{h} = \boxed{\lim_{h \to 0} \frac{\frac{1}{(2(x+h)+1)^2} - \frac{1}{(2x+1)^2}}{h}}$ 6

NOT

RECOMMENDED

ALTERNATE

SOLUTION

$= \boxed{\lim_{h \to 0} \frac{(2x+1)^2 - (2x+2h+1)^2}{h(2x+1)^2(2x+2h+1)^2}}$ 3

$= \boxed{\lim_{h \to 0} \frac{(2x+1+2x+2h+1)(2x+1-(2x+2h+1))}{h(2x+1)^2(2x+2h+1)^2}}$ 3

$= \boxed{\lim_{h \to 0} \frac{-2\cancel{h}(4x+2h+2)}{\cancel{h}(2x+1)^2(2x+2h+1)^2}}$ 3

$1\frac{1}{2}$ $= \boxed{\lim_{h \to 0} \frac{-2(4x+2h+2)}{(2x+1)^2(2x+2h+1)^2}} = \boxed{\frac{-2(\cancel{4x+2})^{2}}{(2x+1)^{\cancel{4}\,3}}}$ $1\frac{1}{2}$ $= \boxed{-\frac{4}{(2x+1)^3}}$ $1\frac{1}{2}$

$\left.\frac{d^2y}{dx^2}\right|_{x=1} = f''(1) = -\frac{4}{3^3} = \boxed{-\frac{4}{27}}$ 2

[e] SLOPE $= f'(-2) = \frac{1}{(-3)^2} = \boxed{\frac{1}{9}}$ $1\frac{1}{2}$ $f(-2) = \frac{-2}{-3} = \frac{2}{3}$

2 $\boxed{y - \frac{2}{3}} = \boxed{\frac{1}{9}(x+2)}$ 2

[6] $\left(\lim_{x\to 3^+} x\right)\left(\lim_{x\to 3^+} f(x)\right)^2 + 2\lim_{x\to 3^+} g(x) = 3(1)^2 + 2(2) = 7$ ①

④ ②½

$\left(\lim_{x\to 3^-} x\right)\left(\lim_{x\to 3^-} f(x)\right)^2 + 2\lim_{x\to 3^-} g(x) = 3(-2)^2 + 2(-3) = 6$ ①

④ ②½

$\lim_{x\to 3} \left(x[f(x)]^2 + 2g(x)\right)$ DNE ②½ SINCE ONE-SIDED LIMITS NOT EQUAL ②½

[7] $f(x) = \frac{-x^2(x^2+x-2)}{x^2(x^2+4x+4)} = \boxed{-\frac{x^2(x+2)(x-1)}{x^2(x+2)^2}}$ 2

[a] 1 f IS RATIONAL, SO IT IS CONTINUOUS ON ITS DOMAIN 1

1 $x^2(x+2)^2 \neq 0 \longrightarrow x \neq 0, -2$ 1

f IS CONTINUOUS ON $(-\infty,-2), (-2,0), (0,\infty)$ 3

[b] f IS NOT CONTINUOUS AT $x=0,-2$ SINCE $f(0), f(-2)$ DNE

1 $\lim\limits_{x\to 0} f(x) = \lim\limits_{x\to 0} -\frac{x-1}{x+2}$ 1 $= -\frac{-1}{2} = \frac{1}{2}$ 1

2 REMOVABLE DISCONTINUITY AT $x=0$ SINCE $\lim\limits_{x\to 0} f(x)$ EXISTS 2

BUT $f(0)$ DNE 1

$-\frac{-3}{0^+} \to \infty$ 3

1 $\lim\limits_{x\to -2^+} f(x) = \lim\limits_{x\to -2^+} -\frac{x-1}{x+2} = \infty$ 2

2 INFINITE DISCONTINUITY AT $x=-2$