1 (a) T (b) F (c) T (d) T (e) F

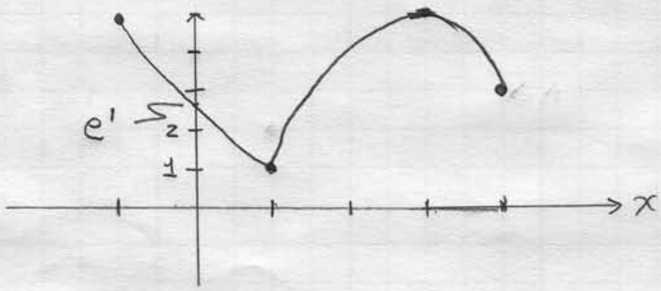
2
$$f(x) = \begin{cases} e^{-(x-1)} & x \le 1 \\ -(x-3)^2 + b & x > 1 \end{cases}$$

NEED $f(1) = \lim_{x \to 1} f(x)$

$$\lim_{x \to 1^-} f(x) = \lim_{x \to 1^-} e^{-(x-1)} = e^0 = 1 = f(1) \text{ OK}$$

$$\lim_{x \to 1^+} f(x) = \lim_{x \to 1^+} -(x-3)^2 + b = -4 + b = f(1) = 1$$

$$\boxed{b = 5}$$



3 (a) $\lim_{x \to 4} \dfrac{\ln[\cos(\pi x/4)]}{x-2}$ IS UNDEFINED BECAUSE $\cos(\pi) = -1$, AND $\ln(x)$ IS ONLY DEFINED FOR $x > 0$

(b) NEED TO LOOK AT ONE-SIDED LIMITS

$$\lim_{x \to 2^+} \sin(x-2) \frac{(x-2)}{x-2} = \lim_{x \to 2^+} \sin(x-2) = 0$$

$$\lim_{x \to 2^-} \sin(x-2) \frac{-(x-2)}{x-2} = \lim_{x \to 2^-} -\sin(x-2) = 0$$

$$\Rightarrow \boxed{\lim_{x \to 2} \sin(x-2) \frac{|x-2|}{x-2} = 0}$$

4 (a) $$g'(x) = \lim_{h \to 0} \frac{\sqrt{x+h+1} - \sqrt{x+1}}{h} = \lim_{h \to 0} \frac{x+h+1-x-1}{h(\sqrt{x+h+1} + \sqrt{x+1})}$$

$$= \lim_{h \to 0} \frac{1}{\sqrt{x+h+1} + \sqrt{x+1}} \Rightarrow \boxed{g'(x) = \frac{1}{2\sqrt{x+1}}}$$

4 (b) $m(x) = \sqrt{x} + 5x^2$ $\quad m'(x) = \frac{1}{2\sqrt{x}} + 10x$

$m'(4) = \frac{1}{4} + 40 = \frac{161}{4} = m'(4)$ $\quad m(4) = 2 + 80 = 82$

TANGENT LINE AT $x=4$: $\boxed{y = \frac{161}{4}(x-4) + 82 = \frac{161}{4}x - 79}$

(c) $K''(\text{area})$ HAS UNITS OF $\boxed{\text{HOURS}/m^4}$

BECAUSE HE IS SLOWING DOWN, HE WILL TAKE LONGER AND LONGER TO PAINT A UNIT AREA; $K(x)$ MUST BE CONCAVE UP $\Rightarrow$ $\boxed{K''(20) > 0}$

5

(a) $f(x)$ INCREASING ON $\underline{0 < x < 1 \text{ SEC}}$

$f(x)$ DECREASING ON $\underline{1 < x < 2 \text{ s}}$

(b) $f(x)$ CONCAVE UP ON $\underline{0 < x < 0.6 \text{ s} \text{ AND } 1.6 < x < 2 \text{ s}}$

$f(x)$ CONCAVE DOWN ON $\underline{0.6 < x < 1.6 \text{ s}}$

(c) BECAUSE $f(x)$ IS INCREASING ON $0 < x < 1$, $\underline{f(1) \text{ MUST BE GREATER THAN } f(0.25)}$

6 (a) AVE. VELOCITY ON $2 \le t \le 5$ s $= \frac{y(5) - y(2)}{5-2} = \frac{85 - 70}{3} \frac{\text{ft}}{\text{s}} = \boxed{5 \frac{\text{ft}}{\text{s}}}$

(b) INSTANTANEOUS VEL. AT $t = 3$ s $\approx \frac{y(4) - y(3)}{4-3} = \frac{90 - 85}{1} \frac{\text{ft}}{\text{s}} = \boxed{5 \frac{\text{ft}}{\text{s}}}$

OR

$\frac{y(3) - y(2)}{3-2} = 15 \frac{\text{ft}}{\text{s}}$

THE BETTER ESTIMATE

$\frac{1}{2}\left(15 \frac{\text{ft}}{\text{s}} + 5 \frac{\text{ft}}{\text{s}}\right) = \boxed{10 \frac{\text{ft}}{\text{s}}}$

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