

AP Calculus BC

Unit 4 Review

1) $f(x) = 2x^2 - x$; $a = 3$

$f(3) = 15$

$f'(x) = 4x - 1$ $f'(3) = 11$

$L(x) = 15 + 11(x - 3)$

$f(3.1) \approx L(3.1) = 16.1$

2) $Q'(4) = -0.171$

At $t = 4$, the electric charge is decreasing at a rate of -0.171 coulombs/sec.

3) $t = f(A) \rightarrow \text{time}$

$f'(A) \rightarrow \text{min/mL}$

$f''(A) \rightarrow \text{m/(mL)}^2$

4) a) The particle is moving to the right on $(0, 2)$, $(2, 3)$, $(4, 4.5]$ b/c $v(t) > 0$

b) The particle changes direction at $t = 3$ & $t = 4$ b/c $v(t)$ changes signs.

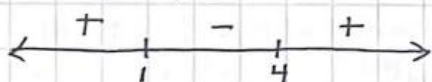
5) $y(t) = \frac{2}{3}t^3 - 5t^2 + 8t$

$v(t) = 2t^2 - 10t + 8 = 0$

$t^2 - 5t + 4 = 0$

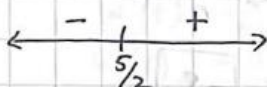
$(t - 4)(t - 1) = 0$

$t = 4$ $t = 1$



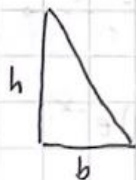
$a(t) = 4t - 10 = 0$

$t = 5/2$



The speed of the particle is increasing on $(1, 5/2)$ & $(4, \infty)$ b/c $a(t)$ & $v(t)$ have the same sign.

6)



$h = 3b$

$A = \frac{1}{2}bh \rightarrow A = \frac{3}{2}b^2$

$\frac{dA}{dt} = 3b \frac{db}{dt}$

7) $x^2 + y^2 = 100$

$\frac{dx}{dt} = 5 \text{ units/sec}$

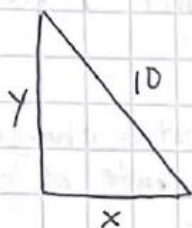
$2x \frac{dx}{dt} + 2y \frac{dy}{dt} = 0$

$8(5) + 6 \frac{dy}{dt} = 0$

$\frac{dy}{dt} = -\frac{40}{6} = -\frac{20}{3}$

The y -coordinate is changing at a rate of $-\frac{20}{3}$ units/sec.

8)



MOMENT

$$x = 9$$

$$y = \sqrt{19}$$

Rate

$$\frac{dx}{dt} = 1$$

$$\frac{dy}{dt} = ?$$

$$x^2 + y^2 = 100$$

$$2x \frac{dx}{dt} + 2y \frac{dy}{dt} = 0$$

$$9(1) + \sqrt{19} \frac{dy}{dt} = 0$$

$$\frac{dy}{dt} = -\frac{9}{\sqrt{19}} \text{ ft/sec}$$

9) In order for $L(3.25) < f(3.25)$, $f''(3.25) > 0 \rightarrow f$ is concave up

10)

$$a) \lim_{x \rightarrow 0} \frac{4x^2}{\cos(x)-1} \rightarrow \frac{0}{0}$$

$$\frac{L'H}{\lim_{x \rightarrow 0} \frac{8x}{-\sin x}} \rightarrow \frac{0}{0}$$

$$\lim_{x \rightarrow 0} \frac{8}{-\cos x} = \boxed{-8}$$

$$b) \lim_{x \rightarrow 3} \frac{\ln\left(\frac{x}{3}\right)}{x^2 - 7x + 12} \rightarrow \frac{0}{0}$$

$$\frac{L'H}{\lim_{x \rightarrow 3} \frac{1}{x(2x-7)}} = \boxed{-\frac{1}{3}}$$

$$c) \lim_{x \rightarrow \pi} \frac{\pi - x}{\sin(2x) - 1} = \boxed{0}$$

$$d) \lim_{x \rightarrow \infty} \frac{x^{10}}{e^{2x+x}} = \boxed{0}$$

$$11) \lim_{x \rightarrow 2} \frac{x^2 f(x) - 16}{g(x) - 2} \rightarrow \frac{0}{0}$$

$$\frac{L'H}{\lim_{x \rightarrow 2} \frac{x^2 f'(x) + 2x f(x)}{g'(x)}}$$

$$= \frac{4(3) + 4(4)}{1}$$

$$= \boxed{28}$$

$$12) \lim_{x \rightarrow 0} \frac{f(x)e^{-x} - 2}{x^2 - 2x} \rightarrow \frac{2-2}{0} \rightarrow \frac{0}{0}$$

$$\frac{L'H}{\lim_{x \rightarrow 0} \frac{-f(x)e^{-x} + f'(x)e^{-x}}{2x - 2}}$$

$$= \frac{-f(0) + f'(0)}{-2}$$

$$= \frac{-2 + (-2)}{-2}$$

$$= \boxed{2}$$

Too many 2s!

