Unit 5 Extra Test Practice Name: ____________

Honors ICM Period: ____

1. The position of a particle at time t sec is $s = t^3 - 8t^2 + 7t$ meters.

(a) Find the instantaneous velocity t = 3 seconds.

1st Find velocity function $v = s' = 3t^2 - 16t + 7$

2nd Substitute t = 3 sec into velocity function

$v(3) = 3(3)^2 - 16(3) + 7$

$v(3) = \boxed{-14 \text{ m/sec}}$

(b) Find the acceleration for each time the particle's velocity is zero.

1st Find when v = 0

$0 = 3t^2 - 16t + 7$ Find zeros in Calc → $t = 0.481, 4.852$

2nd find acceleration function

$a = v' = s'' = 6t - 16$

$a = 6(0.481) - 16 \,;\, 6(4.852) - 16$

$\boxed{a = -13.114 \text{ m/sec}^2 \text{ and } 13.112 \text{ m/sec}^2}$

2. A projectile is shot upward from the surface of earth with an initial velocity of 120 meters per second. The position equation is $s(t) = -4.9t^2 + 150t$

a. What is the projectile's velocity after 5 seconds?

$s'(t) = v(t) = -9.8t + 150$

$v(5) = -9.8(5) + 150 = \boxed{101 \text{ m/sec}}$

b. What is the projectile's acceleration after 5 seconds?

$s''(t) = v'(t) = -9.8$ $\boxed{-9.8 \text{ m/sec}^2}$

Note: no variable here, so it's same acceleration at all times :)

Find the derivative. Express answers as positive, whole exponents or radicals.

3. $f(x) = 7x^{-2} + \sqrt{3x^5 - x^2}$

$f(x) = 7x^{-2} + (3x^5 - x^2)^{1/2}$

$f'(x) = -14x^{-3} +$ chain rule needed

$f'(x) = -14x^{-3} + \dfrac{15x^4 - 2x}{2\sqrt{3x^5 - x^2}}$

$\boxed{f'(x) = -\dfrac{14}{x^3} + \dfrac{15x^4 - 2x}{2\sqrt{3x^5 - x^2}}}$

chain rule needed because $g(x) = 3x^5 - x^2$ is inside $f(x) = x^{1/2}$:

$f'(x) = \frac{1}{2}x^{-1/2}$

$g'(x) = 15x^4 - 2x$

$f'(g(x)) \cdot g'(x) = \frac{1}{2}(3x^5 - x^2)^{-1/2} \cdot (15x^4 - 2x)$

$= (15x^4 - 2x)/(2\sqrt{3x^5 - x^2})$

4. $f(x) = (3x^2 - 2x + 1)(5x - 6)$

$f'(x) = (5x - 6)(6x - 2) + (3x^2 - 2x + 1)(5)$

$= 30x^2 - 46x + 12 + 15x^2 - 10x + 5$

$\boxed{f'(x) = 45x^2 - 56x + 17}$

5. $f(x) = x\sqrt{3x - 7}$

$f(x) = x(3x - 7)^{1/2}$

*Remember that you CANNOT distribute powers due to the (binomial)^{power} AND x can't be distributed from the front since (3x-7) has an exponent

$f'(x) = (3x - 7)^{1/2} \cdot 1 + x(\text{chain rule})$

$\frac{d}{dx}(3x - 7)^{1/2} = \frac{1}{2}(3x - 7)^{-1/2} \cdot 3$

$f'(x) = (3x - 7)^{1/2} + x \cdot \frac{3}{2}(3x - 7)^{-1/2}$

$\boxed{f'(x) = \sqrt{3x - 7} + \dfrac{3x}{2\sqrt{3x - 7}}}$

6. $f(x) = \dfrac{3}{x^2} + 5bx^2 - \dfrac{x}{8} - 7c + 4$

*Remember $-\frac{x}{8} = -\frac{1}{8}x$ and only variables in denominator must move :)

$f(x) = 3x^{-2} + 5bx^2 - \frac{1}{8}x - 7c + 4$

Remember, derivatives of constant values are = 0 :)

$f'(x) = -6x^{-3} + 10bx - \frac{1}{8}$

$\boxed{f'(x) = \dfrac{-6}{x^3} + 10bx - \dfrac{1}{8}}$

7. $g(x) = 14x^{\frac{3}{4}} + \sqrt[3]{4x^2 - 7x}$

$g(x) = 14x^{3/4} + (4x^2 - 7x)^{1/3}$

$g'(x) = \frac{21}{2}x^{-1/4} + \dfrac{8x - 7}{3\sqrt[3]{(4x^2 - 7x)^2}}$

$\boxed{g'(x) = \dfrac{21}{2\sqrt[4]{x}} + \dfrac{8x - 7}{3\sqrt[3]{(4x^2 - 7x)^2}}}$

chain Rule needed here because function inside function

$f(x) = x^{1/3}$; $f'(x) = \frac{1}{3}x^{-2/3}$

$g(x) = 4x^2 - 7x$; $g'(x) = 8x - 7$

$f'(g(x)) \cdot g'(x) = \frac{1}{3}(4x^2 - 7x)^{-2/3}(8x - 7)$

$= \dfrac{8x - 7}{3\sqrt[3]{(4x^2 - 7x)^2}}$

8. $h(x) = \dfrac{\sqrt[3]{x^2}}{6x - 3} = \dfrac{x^{2/3}}{6x - 3}$ if $\frac{f}{g} \to h'(x) = \dfrac{gf' - fg'}{g^2}$

$h'(x) = \dfrac{(6x - 3)(\frac{2}{3}x^{-1/3}) - (x^{2/3})(6)}{(6x - 3)^2}$

$h'(x) = \dfrac{4x^{2/3} - 2x^{-1/3} - 6x^{2/3}}{(6x - 3)^2}$

$h'(x) = \dfrac{(-2x^{2/3} - 2x^{-1/3})x^{1/3}}{(6x - 3)^2 x^{1/3}}$

$\boxed{h'(x) = \dfrac{-2x - 2}{\sqrt[3]{x}(6x - 3)^2}}$

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