## 7.1 Modeling with Differential Equations

Calculus Name: ______________________________ **CA #1**

**Write a differential equation that describes each relationship. If necessary, use $k$ as the constant of proportionality.**

1. The rate of change of $Y$ with respect to $w$ is directly proportional to the square of x.

2. The rate of change of $S$ with respect to $y$ is proportional to the square root of $u$ and inversely proportional to $v$.

3. $L$ is increasing with respect to $x$ at a rate that is proportional to the cube root of $m$. The rate of change of $L$ is 12 when $m = 5$.

4. The rate of change of $U$ with respect to $a$ is inversely proportional to the cube of $v$. The rate of change of $U$ is $-5$ when $v = \frac{1}{2}$.

5. The height of a rocket is given by the function $h(t)$, where $t$ is measured in seconds since the launch and $h$ is measured in meters. The acceleration is proportional to the cube root of the time since the start of the launch. At 12 seconds, the acceleration is 3 meters per second per second.

6. A scientist is studying the relationship of two quantities $A$ and $B$ in an experiment. The scientist finds that the quantity of $A$ decreases and the quantity of $B$ increases. The scientist determines that the rate of change of the quantity of $A$ with respect to the quantity of $B$ is inversely proportional to the square of the quantity of $B$.

7. The number of packets, $p$, Mr. Sullivan completes for Pre-Calculus is increasing as he nears the end of the school year. The rate of change of $p$ with respect to time $t$ is inversely proportional to the natural log of $t$.

8. Mr. Brust is running down his street. His position is given by the function $p(t)$, where $t$ is measured in minutes since the start of his run. His acceleration is inversely proportional to the cube of the time since the start of his run.

Answers to 7.1 CA #1

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| 1. $\frac{dY}{dw} = kx^2$ | 2. $\frac{dS}{dy} = \frac{k\sqrt{u}}{v}$ | 3. $\frac{dL}{dx} = 7.0176\sqrt[3]{m}$ | 4. $\frac{dU}{da} = -\frac{0.625}{v^3}$ |
| 5. $\frac{d^2h}{dt^2} = 1.310\sqrt[3]{t}$ | 6. $\frac{dA}{dB} = \frac{k}{B^2}$ | 7. $\frac{dp}{dt} = \frac{k}{\ln t}$ | 8. $\frac{d^2p}{dt^2} = \frac{k}{t^3}$ |