## 7.1 Modeling with Differential Equations

Calculus Name: ______________________________ **CA #2**

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

1. The rate of change of $A$ with respect to $s$ is inversely proportional to the cube of $x$.

2. The rate of change of $T$ with respect to $y$ is proportional to the square root of $y$.

3. $L$ is increasing with respect to $x$ at a rate that is proportional to the square of $m$. The rate of change of $L$ is 10 when $m = -3$.

4. The rate of change of $S$ with respect to $t$ is proportional to the natural log of $u$ and inversely proportional to $v$.

5. Mr. Bean is slow-walking down his street. His position is given by the function $p(t)$, where $t$ is measured in seconds since the start of his run. His acceleration is inversely proportional to the square root of the time since the start of his run.

6. The rate of water, $w$ with respect to time, $t$, leaking out of a large tank is proportional to the natural log of $t$ and inversely proportional to the square of $t$.

7. 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 10 seconds, the acceleration is 7 meters per second per second. What is a differential equation that models this situation?

8. The number of sandwiches, $s$, is increasing with respect to workers, $w$, at a rate proportional to the number of workers in the kitchen. Assuming there are 9 workers, and the rate of change of the number of sandwiches is 9.5 sandwiches per worker, what is a differential equation to model this situation?

| | | | |
|---|---|---|---|
| 1. $\frac{dA}{ds} = \frac{k}{x^3}$ | 2. $\frac{dT}{dy} = k\sqrt{y}$ | 3. $\frac{dL}{dx} = \frac{10}{9}m^2$ | 4. $\frac{dS}{dt} = k\frac{\ln u}{v}$ |
| 5. $\frac{d^2p}{dt^2} = \frac{k}{\sqrt{t}}$ | 6. $\frac{dw}{dt} = k\frac{\ln t}{\sqrt{t}}$ | 7. $\frac{d^2h}{dt^2} = 3.249\sqrt[3]{t}$ | 8. $\frac{ds}{dw} = 1.0555w$ |

Answers to 7.1 CA #2