Calculus 4.1 - Related Rates [97 pts]

Review Problems [5pts]

1. Implicit differentiation. \( \frac{dy}{dx} = -\frac{y^2}{2xy + e^y} \)
   [5pts: 3pts for differentiation, 2pts for solving for \( \frac{dy}{dx} \)]

Basic Knowledge [54pts]

[6pts each problem: 2pts for setting up equation, 2pts for differentiating, 2pts for plugging values in and solving for the unknown (12pts for problem 7)]

2. \( \frac{3}{49\pi} \) ft/min
3. \( \pi \) cm²/min
4. \( \frac{3}{50\pi} \) km/s
5. \( \frac{15}{2} \) ft/sec
6. \(-12\) ft/sec
7. (a) \( 1200\pi \) mm³/hr (b) \( 240\pi \) mm²/hr
8. \(-4\) in/min
9. \(-120\) cm²/min

Intermediate Knowledge [18pts]

[6pts each problem: 2pts for setting up equation, 2pts for differentiating, 2pts for plugging values in and solving for the unknown]

10. \(-16\) units/sec
11. \(360\) mi/hr
12. \(4\sqrt{34}\) mi/hr

Advanced Knowledge [20pts]

13. the water level \(-\frac{1}{100\pi}\) m/hr;  
   [8pts for answering first question: 2pts for setting up equation, 2pts for eliminating the radius from the volume equation, 2pts for differentiating, 2pts for plugging values in and solving for the unknown]
   the radius \(-\frac{1}{25\pi}\) m/hr
   [4pts for answering the second question 2pts for differentiating equation with radius and depth, 2pts for plugging values in and solving for the unknown ]

14. \( \frac{7\sqrt{25\pi^2}}{45\pi} \) ft/min
   [8pts: 2pts for setting up equation, 2pts for eliminating the radius from the volume equation, 2pts for differentiating, 2pts for plugging values in and solving for the unknown]