

Self-TEST and University Related Rates Problems

1. If a (spherical) snowball melts so that its surface area decreases at a rate of $1 \text{ cm}^2/\text{min}$, find the rate at which the diameter decreases when the diameter is 10 cm . The surface area of the snowball is $A = 4\pi r^2$ (where r is a radius of the snowball). Answer: *decreases at $0.0159 \text{ cm}/\text{min}$.*

Oregon State University

2. In a video game a 3 cm by 2 cm rectangle starts to expand in such a way that the 2 cm side is expanding at the rate of $4 \text{ cm}/\text{sec}$ and the proportions of the rectangle never change. How fast is the area of the rectangle increasing when its dimensions are 12 cm by 8 cm ? answer: $96 \text{ cm}^2/\text{sec}$.

UBC

3. A child attempts to climbing wall in a climbing gym. His father decided to just pull him to the top by hanging on to the end of the rope and walking away with it. If the rope is 32 ft . long, the pulley is 20 ft from the floor and the father holds the end of the rope 4 ft from the floor, while walking away at a speed of $3 \text{ ft}/\text{s}$, at what speed does the boy rise when his father is 12 ft away from the wall? Answer: $9/5 \text{ ft}/\text{s}$

UBC

4. At what rate is soda being sucked out of a *cylindrical* glass that is 6 in tall and has a radius of 2 in ? The depth of the soda decreases at a constant rate of $0.25 \text{ in}/\text{s}$. Answer: $3.1415 \text{ in}^3/\text{s}$

5. UBC

Gravel is being dumped from a conveyor belt at the rate of $30 \text{ ft}^3/\text{min}$ in such a way that gravel forms a conical pile whose base diameter and height are always equal. How fast is the height of the pile increasing when the height is 10 ft ? (Hint: the volume of a cone of radius r and height h is $V = \frac{1}{3}\pi r^2 h$.)

Answer: 0.38 ft/s

University of Berkley California

6. A runner sprints around a circular track of radius 100 m at a constant speed of 7 m/s . The runner's friend is standing at a distance 200 m from the center of the track. How fast is the distance between the friends changing when the distance between them is 200 m ? Draw a good picture. **Use cosine law.** Find rate of change of angle first in rads/s . *Answer: 6.78 m/s*

7. The monthly revenue R (in dollars) of a telephone polling service is related to the number x of completed responses by the function

$$R(x) = -13450 + 60\sqrt{6x^2 + 20x},$$

where $0 \leq x \leq 1500$. If the number of completed responses is increasing at the rate of 10 forms per month, find the rate at which the monthly revenue is changing when $x = 700$.

Answer: $\$1469.70$

8. *Larry and Moe have each bought recently a pickup truck and they meet to show them off to each other. As they leave, Larry heads West with a constant acceleration of 2 m/sec^2 , while Moe looks at him for 3 seconds and then heads North-East also with a constant acceleration of 2 m/sec^2 . After 10 more seconds, how far is Larry from the departure point? And how fast is the distance between the two friends changing?*

Answer: 42.5 m/s