

Calculus Quiz  
Sec. 4.1 Related Rates

Name Key

Directions: Show all work. Draw a diagram and show all steps (all 5 of them!) along the way. Circle your final answer and LABEL your answers (proper units). Do each problem from 1 – 5.

15 ft/s

1. A balloon rises vertically at a rate of 25 feet per second. Joe is on the ground 100 feet away from the spot below the rising balloon and watches the balloon go up. At what rate is the balloon moving away from Joe when the balloon is 75 feet above the ground?

550.6 mph

2. At 1:00 p.m. a plane travels over CB East traveling south at a constant velocity of 300 mph. At 2:30 p.m. another plane passes over CB East traveling east at 500 mph. At 4:00 p.m. how rapidly will the distance between the planes be increasing?

.02 cm/min

3. Air is being pumped into a spherical balloon so that the volume is increasing at a rate of 7 cubic cm/min. At what rate is the radius of the balloon increasing when the radius of the balloon is 6 cm?

-10.3 ft/s

4. A ladder 25 ft. long is leaning against the side of a house but is not secured properly. When Sam walks up the ladder, the base of the ladder pulls away from the house wall at a rate of 3 ft/sec. How fast is the top of the ladder moving down the wall when the base of the ladder is 24 ft from the wall?

.3 ft/min

5. Water runs into a conical tank at the rate of  $9 \text{ ft}^3/\text{min}$ . The tank stands point down and has a height of 10 ft and a base radius of 5 ft. How fast is the water level rising when the water is 6 ft. deep?

You may pick any three (3) from problems 6 – 10.

60 cm<sup>3</sup>/s

6. All edges of a cube are expanding at the rate of 5 cm/sec. How fast is the volume changing when the edge is 2 cm?

-.0014 cm/s

7. A spherical snowball is MELTING in such a way that its volume is decreasing at a rate of  $4 \text{ cm}^3/\text{min}$ . At what rate is the radius decreasing when the radius is 15 centimeters?

-150.8 cm<sup>2</sup>/s

8. The radius of a circle is *decreasing* at a rate of 3 cm/s. Find the rate at which the area is changing when the diameter of the circle is 16 cm.

.006 ft/min

9. Sand is falling off a conveyer onto a conical pile at the rate of  $10 \text{ ft}^3/\text{min}$ . The diameter of the base of the cone is three times the altitude. At what rate is the height of the pile changing when it is 15 ft. high?

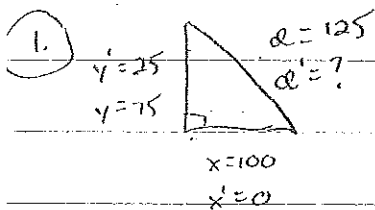
2010.6 ft<sup>2</sup>/s

10. Oil spilled from a tanker spreads in a circle whose circumference increases at a rate of 40 ft/sec. How fast is the area of the spill increasing when the circumference of the circle is  $100\pi$  ft?

$$V_{\text{sphere}} = \frac{4}{3} \pi r^3$$

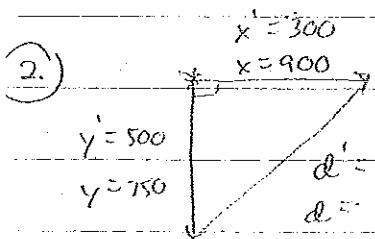
$$V_{\text{cone}} = \frac{1}{3} \pi r^2 h$$

$$A_{\text{circle}} = \pi r^2$$



$$0 + 75(25) = 125 d'$$

$$15 \text{ ft/s} = d'$$



$$900(300) + 750(500) = 1171.5 d'$$

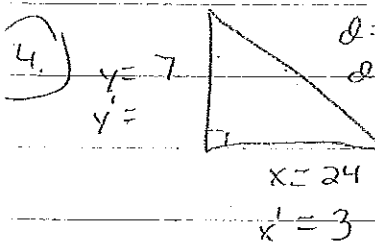
$$550.6 \text{ mph} = d'$$

3.

$$\frac{dV}{dt} = 4\pi r^2 \frac{dr}{dt}$$

$$7 = 4\pi (6)^2 \frac{dr}{dt}$$

$$.02 \text{ cm/min} = \frac{dr}{dt}$$



$$24(3) + 7y' = 0$$

$$y' = -10.3 \text{ ft/s}$$

5.

$$\frac{h}{r} = \frac{10}{5}$$

$$10r = 5h$$

$$r = \frac{h}{2}$$

$$V = \frac{1}{3}\pi r^2 h$$

$$V = \frac{1}{3}\pi \left(\frac{h}{2}\right)^2 h$$

$$V = \frac{1}{3}\pi \frac{h^3}{4}$$

$$\frac{dV}{dt} = \frac{\pi h^2}{4} \frac{dh}{dt}$$

$$9 = \frac{\pi (6)^2}{4} \frac{dh}{dt}$$

$$\frac{dh}{dt} = .3 \text{ ft/min}$$

6.  $V = x^3$

$$\frac{dV}{dt} = 3x^2 \frac{dx}{dt}$$

$$\frac{dV}{dt} = 3(2)^2 \cdot 5$$

$$\frac{dV}{dt} = 60 \text{ cm}^3/\text{s}$$

7.  $\frac{dV}{dt} = 4\pi r^2 \frac{dr}{dt}$

$$-4 = 4\pi (15)^2 \frac{dr}{dt}$$

$$\frac{dr}{dt} = -0.0014 \text{ cm/s}$$

$$\frac{dA}{dt} = 2\pi r \frac{dr}{dt}$$

$$= 2\pi (50)(6.4)$$

$$\frac{dA}{dt} = 2010.6 \text{ ft}^2/\text{sec}$$

8.  $\frac{dA}{dt} = 2\pi r \frac{dr}{dt}$

$$= 2\pi (8)(3)$$

$$\frac{dA}{dt} = 150.8 \text{ cm}^2/\text{s}$$

$$100\pi = 2\pi r$$

$$r = 50$$

$$C = 2\pi r$$

$$\frac{dC}{dt} = 2\pi \frac{dr}{dt}$$

$$40 = 2\pi \frac{dr}{dt}$$

$$\frac{dr}{dt} = 6.4$$

9.  $d = 3h$   
 $2r = 3h$   
 $r = \frac{3h}{2}$

$$V = \frac{1}{3}\pi \left(\frac{3h}{2}\right)^2 h$$

$$V = \frac{1}{3}\pi \frac{9h^3}{4}$$

$$\frac{dV}{dt} = \frac{\pi 9h^2}{4} \frac{dh}{dt}$$

$$10 = \frac{\pi 9(15)^2}{4} \frac{dh}{dt}$$

$$\frac{dh}{dt} = 0.06 \text{ ft/s}$$

10.