Name: ____________________ Date: ______________________

Related Rates Practice 2

1. Suppose the radius of a spherical balloon is shrinking at $\frac{1}{2}\frac{\text{cm}}{\text{min}}$. How fast is the volume decreasing when the radius is 4 cm? $\left(V = \frac{4}{3}\pi r^3\right)$ $-32\pi \ \frac{cm^3}{min}$ (-100.53)

2. Water leaking onto a floor creates a circular pool with an area that increases at the rate of 3 cm^2 per minute. How fast is the radius of the pool increasing when the radius is 10 cm? $\frac{3}{20\pi} \ \frac{cm}{min}$ $(.048)$

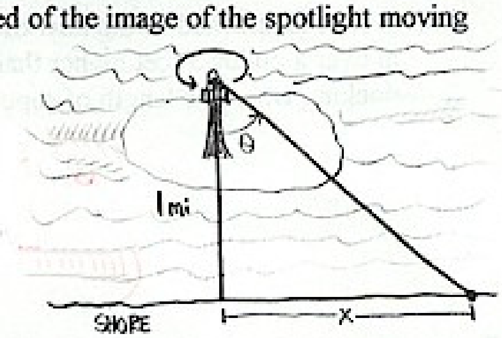
3. A point moves around the circle $x^2 + y^2 = 9$. When the point is at $\left(-\sqrt{3}, \sqrt{6}\right)$, its x-coordinate is increasing at the rate of 20 units per second. How fast is its y-coordinate changing at that instant? $10\sqrt{2}$ units/sec (14.14)

4. A ladder 15 ft long leans against a vertical wall. Suppose that when the bottom of the ladder is x feet from the wall, the bottom is being pushed toward the wall at the rate of $\frac{1}{2}x$ feet per second. How fast is the top of the ladder rising at the moment the bottom is 5 feet from the wall? $\frac{5\sqrt{2}}{8} \ \frac{ft}{sec.}$ $(.884)$

5. A water trough is 12 feet long, and its cross section is an equilateral triangle with sides 2 feet long. Water is pumped into the trough at a rate of 3 cubic feet per minute. How fast is the water level rising when the depth of the water is .5 ft? $\frac{\sqrt{3}}{4} \ \frac{ft}{min}$ $(.433)$

6. A beacon on a lighthouse 1 mile from shore revolves at the rate of 10π radians per minute. Assuming that the shoreline is straight, calculate the speed at which the spotlight is sweeping across the shoreline as it lights up the sand 2 miles from the lighthouse. (Hint: In the figure below, x is the coordinate of the point on the shore at which the light shines. Thus $\frac{d}{dt}x$ is the speed of the image of the spotlight moving across the shoreline, and $\frac{d}{dt}\theta = 10\pi$.) $40\pi \ \frac{mi.}{min}$

(125.66)



7. The tortoise and the hare are having their fabled footrace, each moving along a straight line. The tortoise, moving at a constant rate of 10 feet per minute, is 4 feet from the finish line when the hare wakes up 5001 feet from the finish line and darts off after the tortoise. Let x be the distance from the tortoise to the finish line, and suppose the distance y from the hare to the finish line is given by $y = 5001 - 2500\sqrt{4-x}$,
   a) How fast is the hare moving when the tortoise is 3 feet from the finish line? $12{,}500 \ \frac{ft}{min}$
   b) Who wins? By how many feet? Tortoise wins by 1 foot.

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8. Maple and Main Streets are straight and perpendicular to each other. A stationary police car is located on Main Street $\frac{1}{4}$ mile from the intersection of the two streets. A sports car on Maple Street approaches the intersection at the rate of 40 mph. How fast is the distance between the two cars decreasing when the sports car is $\frac{1}{8}$ mile from the intersection? $-8\sqrt{5}$ mph (−17.89)

9. Suppose in the problem above that the sports car approaches the intersection is such a way that the distance between the sports car and the police car decreases at 30 mph. How far from the intersection would the sports car be at the moment when it is traveling 50 mph? $\frac{3}{16}$ mi (.1875)

10. A kite 100 feet above the ground is being blown away from the person holding its string. It moves in a direction parallel to the ground and at a rate of 10 feet per second. At what rate must the string be let out when the length of string already let out is 200feet? $5\sqrt{3}\ \frac{ft}{sec.}$ (8.66)

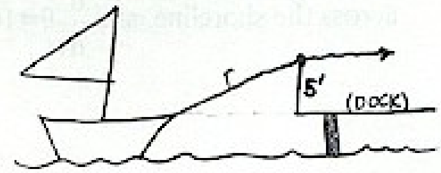
11. When a rocket is 2 km high, it is moving vertically upward at a speed of 300 km per hour. At that instant, how fast is the angle of elevation of the rocket increasing, as seen by an observer on the ground 5 km from the launching pad? $\frac{1500}{29}\ \frac{rad}{hr}$ (51.72)

12. The largest of all ferris wheels was built by the engineer G.W. Gale Ferris for the World's Columbian Exposition in Chicago in 1893. It was 125 feet in radius and could hold 2160 people at one time. Suppose it revolved at 2 radians per minute. How fast would a passenger rise when the passenger was 75 feet higher than the center of the ferris wheel and was rising? 200 ft/min

13. A rope is attached to the bow of a sailboat coming in for the evening. Assume that the rope is drawn in over a pulley 5 feet higher than the bow at the rate of 2 feet per second. How fast is the boat docking when the length of rope from bow to pulley is 13 feet?

$\frac{13}{6}$ ft/sec.

(2.17)



* 14. The escape velocity of a star with a radius of r kilometers and mass of M kilograms is given by $v_{esc} = \sqrt{\frac{2\,GM}{r}}$ where $G = 6.67 \times 10^{-11}$. Suppose that an old star with mass 4×10^{30} Kg is in the process of collapsing and becoming an exceedingly dense neutron star. Assume that at the instant the star has radius 45,000 Km, its radius is decreasing at the rate of 3×10^{-6} Km per second. How fast is its escape velocity increasing at that instant?

.00363 $\frac{km}{sec^2}$