Math 161: Groupwork 13

1. A spherical snowball of radius r cm has surface area S cm^2. As the snowball gathers snow, its radius increases as in Figure 4.12. Approximately how fast, in cm^2/min, is S increasing when the radius is 20 cm?

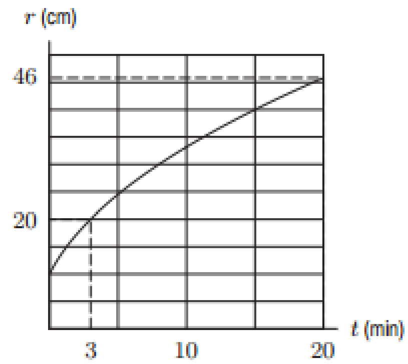


Figure 4.12

(a) $4\pi \cdot 3^2$	(b) $4\pi \cdot 20^2$	(c) $4\pi \cdot 46^2$
(d) $8\pi \cdot 3 \cdot 2.5$	(e) $8\pi \cdot 20 \cdot 2.5$	(f) $8\pi \cdot 46 \cdot 1$

2. A car is driving along a straight flat road when a plane flies overhead. Let x miles be the distance traveled by the car and y miles be the distance traveled by the plane at time t in hours since the plane was directly over the car. At time t, the distance D miles between the car and the plane is given by

$$D^2 = x^2 + y^2 + 2^2.$$

At one moment, the car has gone 3 miles and is moving at 60 mph, and the plane has gone 30 miles and is moving at 500 mph. To find the rate at which D is increasing at that time, you should:

(a) Substitute $x = 3$, $y = 30$ into $D^2 = x^2 + y^2 + 2^2$.
(b) Differentiate $D^2 = x^2 + y^2 + 2^2$ after substituting $x = 3$, $y = 30$. Then substitute $dx/dt = 60$, $dy/dt = 500$.
(c) Differentiate $D^2 = x^2 + y^2 + 2^2$. Then substitute $x = 3$, $y = 30$, $dx/dt = 60$, $dy/dt = 500$.
(d) None of the above.

The foot of the ladder in Figure 4.13 moves away from the wall at a speed of 2 ft/min, causing the top of the ladder to slide down the wall without leaving it. Label each of the following statements as True or False and give a reason.

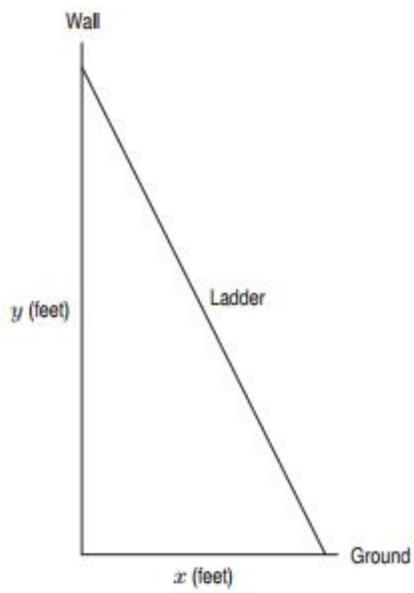


Figure 4.13

(a) dx/dt and dy/dt have the same sign.
(b) The top of the ladder is moving faster and faster.
(c) Keeping dx/dt constant, doubling x, y, and the length of the ladder, doubles dy/dt.

A student is drinking a milkshake with a straw from a cylindrical cup with a radius of 5.5 cm. If the student is drinking at a rate of 4.5 cm^3 per second, then the level of the milkshake dropping at a rate of _____ cm per second. Round to 2 decimal places.

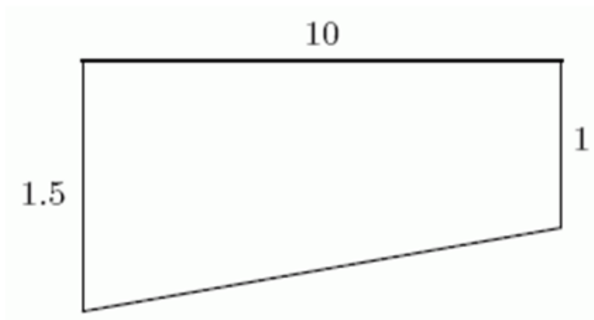
A fan is watching a 100-meter footrace from a seat in the bleachers 15 meters back from the midway point. The winning runner is moving approximately 8 meters per second. How fast is the distance from the fan to the winning runner changing when he is x meters into the race?

A Brian's candy sugar wand is made from flavored sugar inside a straw. The straw is 210 mm long and 5 mm in diameter. The child accidentally poked a hole in the bottom, making the height of the sugar fall at a rate of 1 mm per second. The child realizes that there is a hole after 1 seconds. What was the rate of change of the volume of the sugar at this time?

$[V = \pi r^2 h]$

Frank decided to ride in a hot air balloon. His brother Damien was going to videotape the lift off from a distance of 30 feet away. The hot air balloon rises to a height of 2000 feet in 19 minutes. What is the rate at which the camera's angle should be raised in order to follow the balloon? (specify units)

A rectangular swimming pool is 10 meters long and 6 meters wide. It has a depth of 1 meter at the shallow end, then slopes to a depth of 1.5 meters at the deep end, as shown in the following cross section (not to scale). It is being filled with a hose at a rate of 50,000 cubic centimeters per minute. 225 minutes after the hose is turned on, the water is rising at a rate of _____ cm per second. Round to 3 decimal places.



A cupful of olive oil falls on the floor forming a circular puddle. Its radius is increasing at a constant rate of 0.2 cm/sec. What is the rate of increase in the area of the olive oil when its circumference measures 20π cm?

A spherical lollipop has a circumference of 7.9 centimeters. A student decides to measure the rate of change of the volume of the lollipop, in cm^3 per minute. The student licks the lollipop and measures the circumference every minute. The radius is decreasing at a rate of 0.18 cm/min. Determine the rate at which the volume is changing when the circumference is half of it's original size. [$V = \frac{4}{3}\pi r^3$]