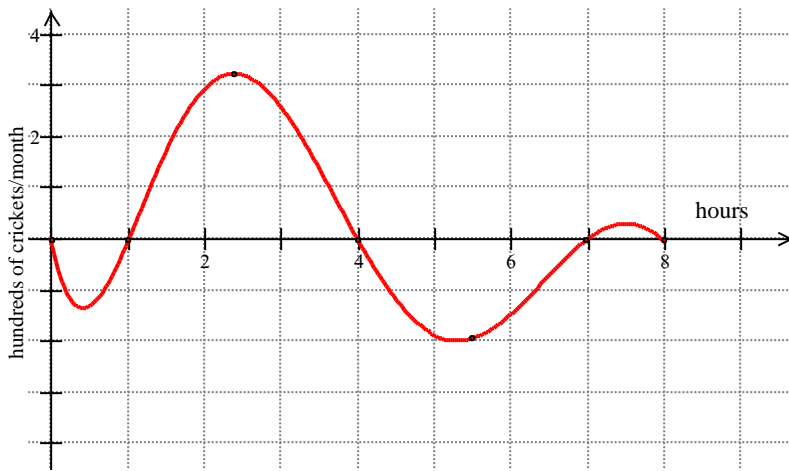Related Rates 3

The rate that the cricket population in a field is changing is graphed below.



1. When is the cricket population the highest?

2. When is the cricket population the lowest?

3. When is the cricket population changing the fastest?

4. Draw a graph of the number of crickets during the 6 hour period, if at t=0 there are 2000 crickets in the field.

Related Rates

5. A spherical balloon is inflated with gas at the rate of $800 \ cm^3/\min$.
    a. How fast is the radius of the balloon changing at the instant that the radius is 30cm?
    b. How fast is the surface area of the sphere changing at the same instant?

6. The radius of a circle is increasing at a rate of $3 \ cm/\min$.
    a. Find the rate of change of the area when the radius is 6 cm
    b. Find the rate of change of the circumference when the radius is 6 cm.

7. All of the edges of a cube are expanding at a rate of 3 cm/s.
    a. How fast is the volume changing, when the edge is 1 cm?
    b. How fast is the surface area changing, when the edge is 1 cm?

8. Water is flowing into a cone (ht = 12cm, r = 4cm) at $5 \ cm^3/\min$.
    a. How fast is the water level rising when it is 8 cm deep?
    b. How fast is the area of the water's surface changing at the same time?

9. At a sand and gravel plant, sand is falling off a conveyor and onto a conical pile at the rate of 10 cubic ft per minute. The diameter of the base of the cone is 3 times the height of the pile. At what rate is the height of the pile changing when the pile is 15 ft high?

10. Water is leaking out of an inverted conical tank a rate of 10,000 $cm^3/\min$ at the same time that water is being pumped into the tank at a constant rate. The cone has a height of 6m and the diameter at the top is 4m. If the water level is rising at a rate of 20 $cm/\min$ when the height of the water is 2m, find the rate which water is being pumped into the tank. (hint: Look out for the *mixed units!*)

11. At noon, ship A is 160 km west of ship B. Ship A is sailing east at 35 km/h and ship B is sailing north at 25 km/h. How fast is the distance between the ships changing a 3 PM?

12. A hot air balloon rises at a constant rate of 20 ft/s. A spectator stands 100 ft from the launch site. How fast is the angle that the spectator tracks the balloon changing when the balloon is 40 ft in the air?

13. A particle passes through along the curve $y = \sqrt{x}$ . As the particle passes through the point (9,3) its x-coordinate increases at a rate of 3 $cm/s$ .
    a. How fast is the y-coordinate increasing at (9,3)?
    b. How fast is the distance from the particle to the origin changing at that instant?

## Answers

1. 4 months
2. 1 months
3. approx 2.5 months
4. –
5. a. 0.71 cm/min      b. 53.33 cm2/min
6. a. 113.01 cm2/min   b. 18.84 cm/min
7. 9 cm3/s             b. 36 cm2/min
8. .224 cm/min         b. 1.25 cm3/min
9. .0063 ft/min
10. 289252 cm3/min
11. -.54 kph
12. 0.172 rads/s
13. a. 0.5 cm/s         b. 3.004 cm/s