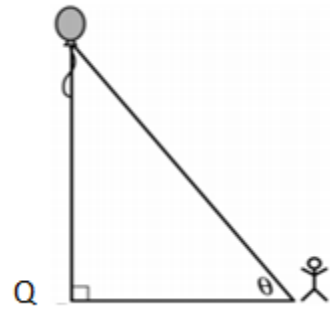


**Calculus AB 2020 Mock AP Exam #3**

**1) Related Rates Assorted Problems 25 minutes 15 points**

- a) A person stands 40 feet from point Q and watches the balloon rise vertically from point Q. The balloon is rising at a constant rate of 3 feet per second. What is the rate of change, in radians per second, of angle  $\theta$  at the instant when the balloon is 30 feet above the point.



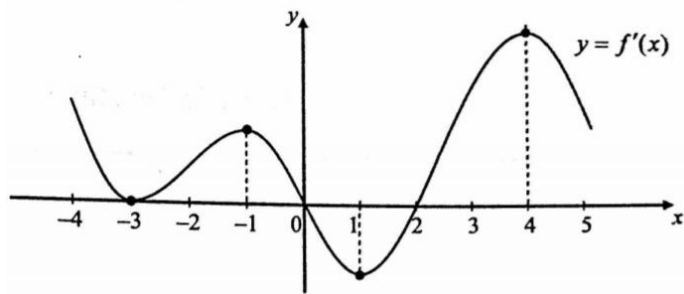
- b) Bikes A and B are traveling on perpendicular roads. At the same time, bike A is leaving the intersection at a rate of 2 feet per second and bike B is leaving the intersection at 3 feet per second. How fast is the distance, in feet per second, between them changing after 5 seconds?

- c) A person 2 meters tall walks directly away from a streetlight that is 8 meters above the ground. If the person is walking at a constant rate and the person's shadow is lengthening at the rate of  $\frac{4}{9}$  meters per second:
- i) at what rate, in meters per second, is the person walking? ii) the rate at which the tip of the shadow is moving?

- d) A beach ball is deflating at a constant rate of 10 cubic centimeters per second. When the volume of the ball is  $\frac{256}{3}\pi$  cubic centimeters, what is the rate of change of the surface area? ( $S = 4\pi r^2$  and  $V = \frac{4}{3}\pi r^3$ )

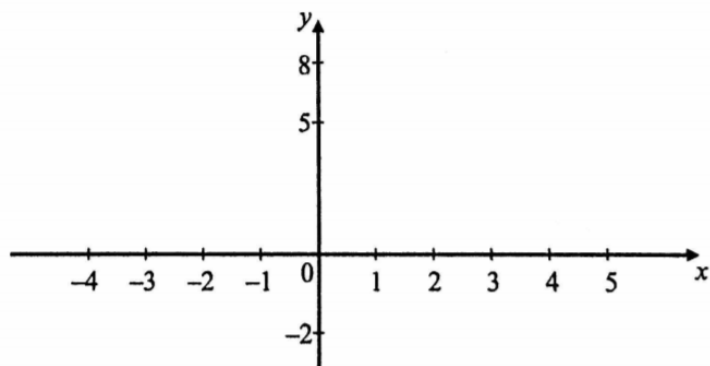
2) 15 minutes 9 points

The figure to the right shows graph of  $f'$ , the derivative of the function  $f$ , for  $-4 \leq x \leq 5$ . The graph of  $f'$  has horizontal tangent lines at  $x = -3, -1, 1,$  and  $4$ .



- Find all the value of  $x$ , for  $-4 \leq x \leq 5$  for which  $f$  is increasing. Justify your answer.
- Find all the value of  $x$ , for  $-4 \leq x \leq 5$  for which  $f$  has a relative maximum. Justify answer.
- Find all the value of  $x$ , for  $-4 \leq x \leq 5$ , for which the graph of  $f$  is concave down.
- Given  $f(-4) = -2$ ,  $f(0) = 5$ , and  $f(5) = 8$ , sketch a possible graph of  $f(x)$  on the axes below.
- Sketch a possible graph of  $f''(x)$  on the axes below.

d)  $f(x)$



e)  $f''(x)$

