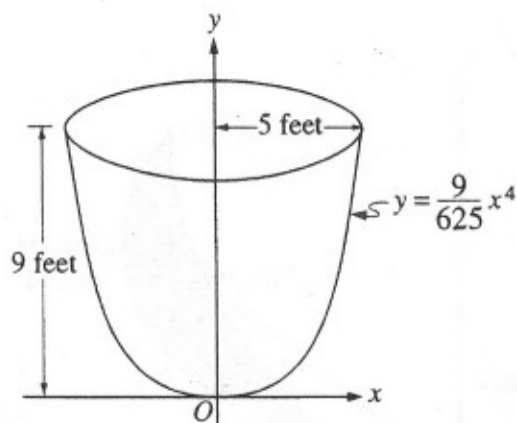5. An oil storage tank has the shape shown above, obtained by revolving the curve $y = \dfrac{9}{625}x^4$ from $x = 0$ to $x = 5$ about the y-axis, where x and y are measured in feet. Oil weighing 50 pounds per cubic foot flowed into an initially empty tank at a constant rate of 8 cubic feet per minute. When the depth of the oil reached 6 feet, the flow stopped.

(a) Let h be the depth, in feet, of oil in the tank. How fast was the depth of the oil in the tank increasing when $h = 4$? Indicate units of measure.

(b) Find, to the nearest foot-pound, the amount of work required to empty the tank by pumping all of the oil back to the top of the tank.
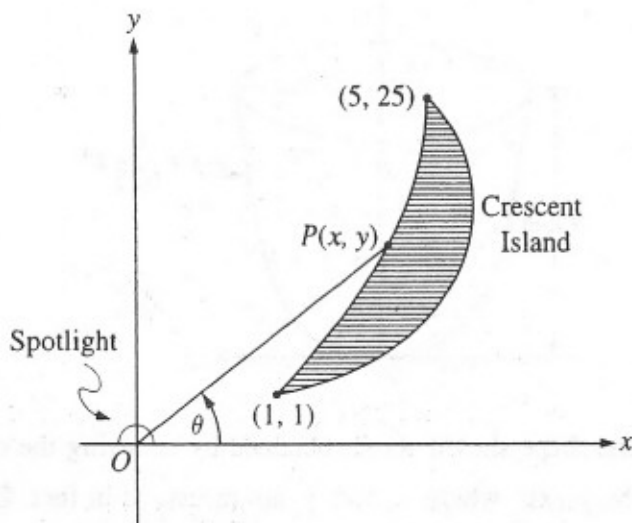
Note: Figure not drawn to scale.

6. The figure above shows a spotlight shining on point $P(x, y)$ on the shoreline of Crescent Island. The spotlight is located at the origin and is rotating. The portion of the shoreline on which the spotlight shines is in the shape of the parabola $y = x^2$ from the point $(1, 1)$ to the point $(5, 25)$. Let θ be the angle between the beam of light and the positive x-axis.

(a) For what values of θ between 0 and 2π does the spotlight shine on the shoreline?

(b) Find the x- and y-coordinates of point P in terms of $\tan \theta$.

(c) If the spotlight is rotating at the rate of one revolution per minute, how fast is the point P traveling along the shoreline at the instant it is at the point $(3, 9)$?

END OF EXAMINATION