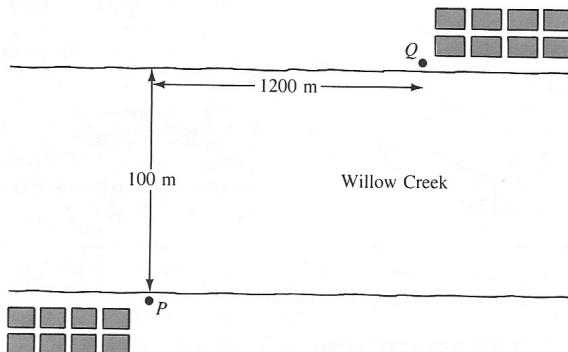


UNIT 3 – DERIVATIVES AND THEIR APPLICATIONS

SUPPLEMENTARY REVIEW PROBLEMS

- 1) The position of a particle is given by $s(t) = t^2 - 8t + 4$, $t \geq 0$, where s is measured in metres and t in seconds. Find all values of t for which the particle moves in the negative direction.
- 2) A water balloon is thrown straight upward. Its height as a function of time can be modeled by $h(t) = 13t - 4.9t^2$, where the height is measured in metres and the time is in measures in seconds.
 - a) What is the maximum height of the water balloon?
 - b) How long does the thrower have to get out of the way before the water balloon hits the ground and pops?
- 3) The position, in kilometers, of a particle at t hours is given by $d(t) = t^3 - 15t^2 + 44t + 60$, where $t \geq 0$.
 - a) What is the initial position of the particle?
 - b) What is the particle's velocity at 4 hours?
 - c) What is the total distance that the particle travels in the first 10 hours?
- 4) A health club has 1500 members who are charged \$60 each per year. The club proposes to increase the annual charges. For every increase of \$10, the club will lose 125 members. What increase will bring the maximum revenue to the club?
- 5) Determine the maximum slope of a tangent to the curve $y = -x^3 + 3x^2 + 9x - 27$.
- 6) A closed rectangular box with a square base is to be made such that its volume is 1000 m^3 . The cost of material per square metre for the bottom is \$15, for the top is \$25, and for the sides is \$20. Find the dimensions of the box such that the cost is minimized.
- 7) A cylinder is inscribed in a sphere that has a diameter of 20 cm. What are the dimensions of the cylinder if its volume is maximized?
- 8) A cable television company is laying cable in an area with underground utilities. Two subdivisions are located on opposite sides of Willow Creek, which is 100 m wide. The company must connect points P and Q with cable, where Q is on the north bank 1200 m east of P , as shown below. It costs \$40/m to lay cable underground and \$80/m to lay cable underwater. What is the least expensive way to lay the cable?



- 9) Find the points on the parabola $y = 6 - x^2$ that are closest to the point $(0, 3)$. Express your answer in **exact form**.