

4-20). HINT: Let the point of tangency be  $(A, B)$ . Then  $B = A^2$ .  
 (Why?) Also, the slope of the tangent line is  $\frac{B+4}{A-0} = 2A$ .  
 (Why?)

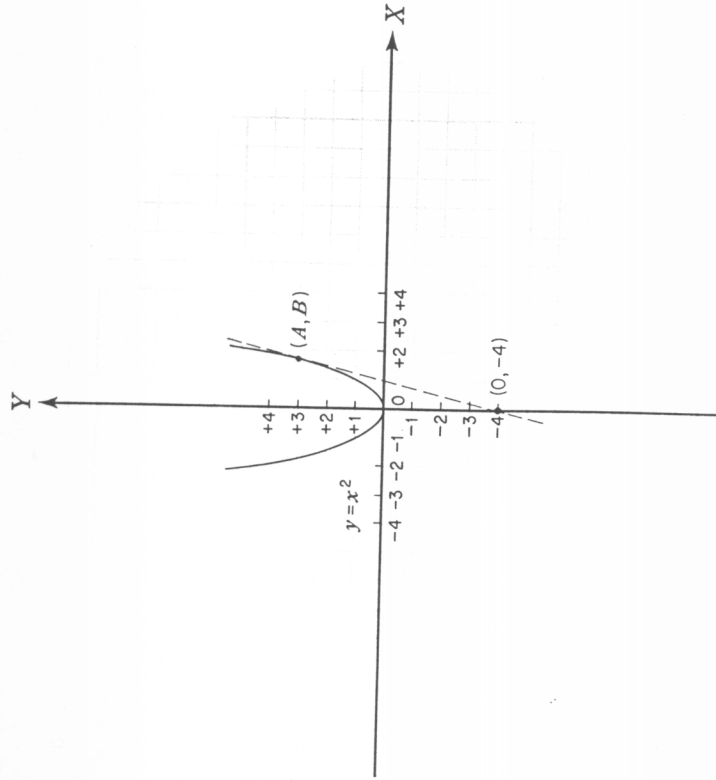


Figure 4-20

- 16) The height of a projectile shot vertically is given as  $h$  where  $h = -16t^2 + v_0t + s_0$  where  $v_0$  is the initial velocity and  $s_0$  is the initial height. If a projectile is shot from ground level and reaches a height of 144 ft in 1 sec, how high will the projectile rise?
17. The cost of fuel for running a steamer, per hour, is proportional to the cube of the speed of the steamer. The fuel costs \$20 per hour when the speed is 10 mph. Other expenses for the steamer are \$135 per hour.
- (a) Find the most economical rate to run the steamer for 27 miles.  
 (b) For 500 miles.

Sec. 4-11. Some Additional Applications

18. The owner of a large apartment project feels that he can keep all 200 of his apartments filled at a rental of \$40 per month per apartment. His experience suggests that if he raises the monthly rental \$5 per apartment one apartment will remain vacant; \$15 a month and there will be nine empty apartments, and so forth; that is, if he raises the rent  $5x$  dollars, then  $x^2$  apartments will remain empty.
- (a) What monthly rental will bring in the greatest income?  
 (b) What percentage of the apartments will be rented at this maximum income?  
 (c) Over what range of values of  $x$  does the function have meaning?  
 (d) Make graphs and explain your conclusions to a nonmathematical friend.
19. Rework Prob. 18, changing the original assumption of a 200-apartment unit to a 500-apartment unit.
20. Solve Prob. 18, assuming that each empty apartment saves the owner \$2 a month on janitorial expenses.
21. A piece of wire 12 ft long is cut into two pieces. One piece is bent into the form of a circle. The other piece is bent into a square.
- (a) Where should the cut be made if the sum of the areas of the circle and square is to be as small as possible?  
 (b) Where should the cut be made if the sum of the two areas is to be as large as possible? Justify your answer.
22. A sluice is to be made from a long strip of metal 12 in. wide by folding up 4 in. on each side to form an isosceles trapezoid. Find the width across the top such that the sluice will have a maximum carrying capacity.
23. The stiffness of a beam of rectangular cross section is proportional to the breadth times the cube of the depth of the beam. What is the shape of the stiffest beam which can be cut from a circular log 1 ft in diameter? Use the delta process if necessary.
24. Find the dimensions of the rectangle of maximum area which may be inscribed in a right triangle having legs 4 ft and 6 ft if one corner of the rectangle is to be at the right angle of the triangle.
25. In what  $x$  intervals does  $y = (x - 2)^2(4x - 5)^3$  increase as  $x$  increases?
26. A square sheet of metal, 30 in. on a side, has square pieces cut out of the corners and the edges turned up to form a box with open