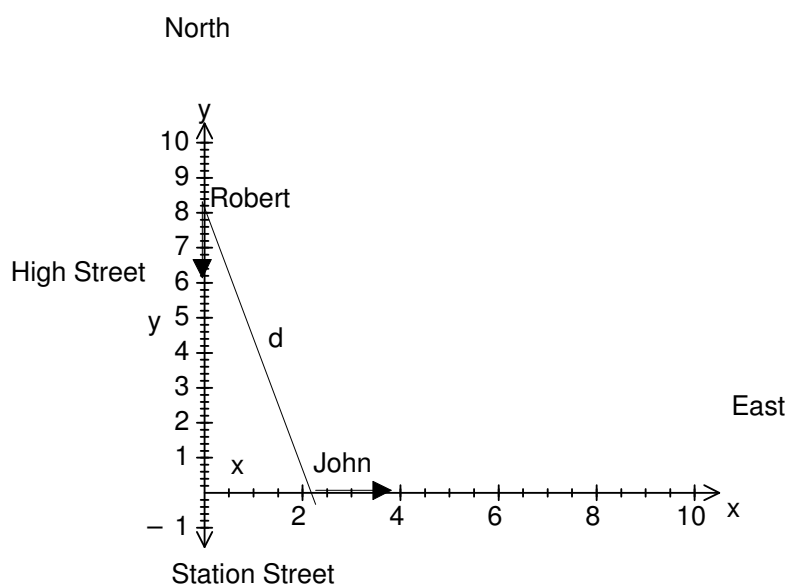


RELATED RATES AND IMPLICIT DIFFERENTIATION EXPLORATION

Objective: Given the rates of change for two variable quantities, find the rate of change for another related quantity using implicit differentiation.

John is walking east on Station Street at 4 km/h. Meanwhile, Robert is walking south on High Street at 3 km/h. Robert wishes to determine whether the straight-line distance between them is increasing or decreasing.



1. Let x be John's distance from the intersection and let y be Robert's distance from the intersection of the two streets. Write the rates including positive or negative signs:
 $\frac{dx}{dt} =$ $\frac{dy}{dt} =$
2. Let d be the straight line distance between Robert and John. Write the symbol for the rate you want:
3. Write the equation relating x , y and d .
4. Differentiate both sides of the equation in Question 3 implicitly with respect to t .
Write the rate $\frac{dd}{dt}$ in terms of x and y .
5. When John is 2 km from the intersection, Robert is 6 km from the intersection. At this time, is the straight-line distance between them increasing or decreasing? At what rate?

6. Since John is going faster away from the intersection than Robert is going toward the intersection, it may lead you to conclude that the distance between them is increasing. Do the calculations confirm or refute this conclusion?

7. Will the distance between them be always decreasing? Discuss. Check when $x = 10$ km and $y = 6$ km.

8. Write a list of the steps you did in solving this **related rates** problem.

9. Assume that you have not learnt implicit differentiation yet; how would you proceed to solve the problem and arrive at the same equation as in Question 4.

Which method is simpler?

10. What did you learn as a result of doing this Exploration that you did not know before?