

Problem 1. If the position of an object is given by

$$s(t) = \frac{1}{3}t^3 - t^2 - 10t,$$

find the acceleration when the velocity is 5.

Solution: The velocity is the first derivative of $s(t)$:

$$v(t) = t^2 - 2t - 10.$$

The velocity is 5 when

$$t^2 - 2t - 10 = 5$$

$$t^2 - 2t - 15 = 0$$

$$(t - 5)(t + 3) = 0.$$

Since t refers to time, we choose the positive t value. Thus, the velocity is 5 when $t = 5$. The acceleration is the second derivative of $s(t)$, or the derivative of $v(t)$:

$$a(t) = 2t - 2.$$

Thus when $t = 5$, $a(5) = 8$.

Problem 2. Use implicit differentiation to find an explicit expression for dy/dx , given that

$$e^y + y^2 = xy.$$

Solution: Applying $\frac{d}{dx}$ to both sides yields

$$e^y y' + 2yy' = y + xy'.$$

Solving for y' gives

$$y' = \frac{y}{e^y + 2y - x}.$$