

MAT1575 Module 2 – Motion.

Objectives: Learn to compute the change in position/velocity of an object given its velocity/acceleration function.

In Calculus I, you learned that if $s(t)$ is the position of an object at time t , then its velocity at any time is given by $v(t) = s'(t)$ and its acceleration at any time is given by $a(t) = v'(t) = s''(t)$. We will now use integration to “go backwards” from acceleration to velocity and from velocity to position.

1. Since $a(t) = v'(t)$, by the FTC (part 2), we have that

$$\int_0^t a(y) dy = \text{_____}.$$

(Hint: Your solution should be in terms of the velocity function.)

2. Similarly, since $v(t) = s'(t)$, by the FTC (part 2), we have that

$$\int_0^t v(y) dy = \text{_____}.$$

(Hint: Your solution should be in terms of the position function.)

Note: The integrals in parts 1 and 2 give the **change** in velocity and position from time 0 to time t . They **do not** give the velocity and position at time t .

3. Suppose that the velocity of a particle (over time) is given by $v(t) = t - t^2$. By how much has the particle’s position changed from $t = 0$ to $t = 1$?

Note: When an object is thrown upwards it experiences a downward acceleration due to gravity of 9.8 m/s^2 .

4. Compute the formula for the velocity at time t of a ball thrown upwards with an initial velocity of 3 m/s .
5. Compute the formula for the position at time t of the ball in part 4 if it was thrown upwards at an initial height of 1 m .
6. How long does it take the ball in part 5 to hit the ground?