HW2-4 Soln)

So the idea is that, even though the acceleration is not constant over the entire trip, it is constant for each of two parts. Essentially, this is two problems. The final conditions or the first part become the initial conditions for the second part.

Let up be positive and the ground level be the origin.

Part I

$x_i = 0$ m

$x_f = ?$ ←

$v_i = 0$ m/s (starts from rest)

$v_f = ?$ ←

$a = +40$ m/s^2

$t = 5$ sec

(1):

$$v_f = v_i + at$$

$$v_f = 0 + 40(5) = 200 \text{ m/s}$$

(3)

$$x = x_i + v_i t + \frac{1}{2} a t^2$$

$$x = 0 + 0 + \frac{1}{2}(40)\, 5^2 = 500 \text{ m}$$

Part II

$x_i = 500$m

$x_f = ?$ ←

$v_i = 200$ m/s

$v_f = 0$ (stops at the top)

$a = -10$ m/s^2 (coasting with only gravity acting on it)

$t = ?$ ← (reset the time to zero at the beginning of Part II)

(1):

$$v_f = v_i + at$$

$$t = \frac{v_f - v_i}{a} = \frac{0 - 200}{-10} = 20 \text{ seconds}$$

This makes the total time to maximum altitude to be 5 + 20 = 25 seconds.

(3)

$$x = x_i + v_i t + \frac{1}{2} a t^2$$

$$x = 500 + 200(20) + \frac{1}{2}(-10)\, 20^2 = 2500 \text{ m}$$