HW2-4 Soln)

This is really two problems, but with some parameters in common. For example, it requires the same amount of time for the speeder to go from where he passes the cop to where the cop passes him, and of course, these two displacements are equal as well.

Let the origin be where the speeder passes the resting cop.

Then,

Speeder (S)	Cop (C)
$x_{iS} = 0$	$x_{iC} = 0$
$x_{fS} = ?$ ←	$x_{fC} = x_{fS} = x$
$v_{iS} = +40$ m/s	$v_{iC} = 0$
$v_{fS} = +40$ m/s	$v_{fC} = ?$
$a_S = 0$ m/s^2	$a_C = +5$ m/s^2
$t_S = ?$ ←	$t_C = t_S = t$

(3) Speeder

$$x_S = x_{iS} + v_{iS}t + \frac{1}{2}a_S t^2$$

$$x_S = 0 + v_{iS}t + 0$$

$$x_S = v_{iS}t$$

(3) Cop

$$x_C = x_{iC} + v_{iC}t + \frac{1}{2}a_C t^2$$

$$x_C = 0 + 0 + \frac{1}{2}a_C t^2$$

$$x_C = \frac{1}{2}a_C t^2$$

Set these final positions equal and solve for the time:

$$v_{iS}t = \frac{1}{2}a_C t^2 \qquad t = 0$$

$$v_{iS} = \frac{1}{2}a_C t \qquad t = \frac{2v_{iS}}{a_C} = \frac{2(40)}{5} = 16 \text{ seconds}$$

Then, the displacement of each is found by going back to either eq (3):

$$x = v_{iS}t = 40(16) = 640 \text{ m}$$

or

$$x_C = \frac{1}{2}a_C t^2 = \frac{1}{2}5(16)^2 = 640 \text{ m}$$

Then the final velocity of the cop is given by (1):

$$v_{fC} = v_{iC} + a_C t = 0 + 5(16) = 80 \text{ m/s}.$$