Halliday ♦ Resnick ♦Walker

FUNDAMENTALS OF PHYSICS
SIXTH EDITION

Selected Solutions

Chapter 2

7. Using $x = 3t - 4t^2 + t^3$ with SI units understood is efficient (and is the approach we will use), but if we wished to make the units explicit we would write $x = (3\,\text{m/s})t - (4\,\text{m/s}^2)t^2 + (1\,\text{m/s}^3)t^3$. We will quote our answers to one or two significant figures, and not try to follow the significant figure rules rigorously.

(a) Plugging in $t = 1$ s yields $x = 0$. With $t = 2$ s we get $x = -2$ m. Similarly, $t = 3$ s yields $x = 0$ and $t = 4$ s yields $x = 12$ m. For later reference, we also note that the position at $t = 0$ is $x = 0$.

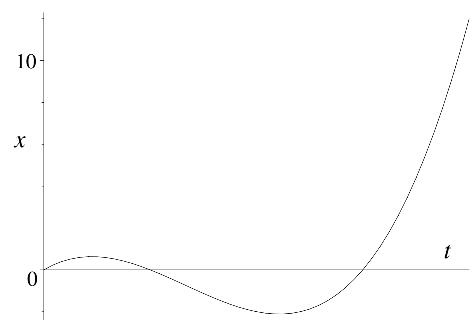
(b) The position at $t = 0$ is subtracted from the position at $t = 4$ s to find the displacement $\Delta x = 12$ m.

(c) The position at $t = 2$ s is subtracted from the position at $t = 4$ s to give the displacement $\Delta x = 14$ m. Eq. 2-2, then, leads to

$$v_{\text{avg}} = \frac{\Delta x}{\Delta t} = \frac{14}{2} = 7 \text{ m/s} .$$

(d) The horizontal axis is $0 \le t \le 4$ with SI units understood.

Not shown is a straight line drawn from the point at $(t, x) = (2, -2)$ to the highest point shown (at $t = 4$ s) which would represent the answer for part (c).



35. The acceleration is constant and we may use the equations in Table 2-1.

(a) Taking the first point as coordinate origin and time to be zero when the car is there, we apply Eq. 2-17 (with SI units understood):

$$x = \frac{1}{2}(v + v_0)\,t = \frac{1}{2}(15 + v_0)(6) \ .$$

With $x = 60.0$ m (which takes the direction of motion as the $+x$ direction) we solve for the initial velocity: $v_0 = 5.00$ m/s.

(b) Substituting $v = 15$ m/s, $v_0 = 5$ m/s and $t = 6$ s into $a = (v - v_0)/t$ (Eq. 2-11), we find $a = 1.67$ m/s^2.

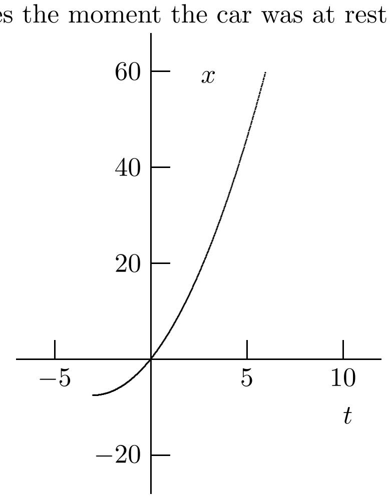
(c) Substituting $v = 0$ in $v^2 = v_0^2 + 2ax$ and solving for x, we obtain

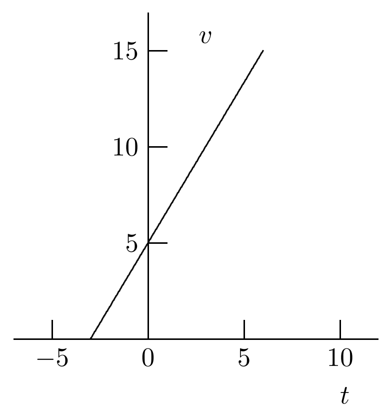
$$x = -\frac{v_0^2}{2a} = -\frac{5^2}{2(1.67)} = -7.50 \text{ m} \ .$$

(d) The graphs require computing the time when $v = 0$, in which case, we use $v = v_0 + at' = 0$. Thus,

$$t' = \frac{-v_0}{a} = \frac{-5}{1.67} = -3.0 \text{ s}$$

indicates the moment the car was at rest. SI units are assumed.





47. We neglect air resistance, which justifies setting $a = -g = -9.8$ m/s^2 (taking *down* as the $-y$ direction) for the duration of the motion. We are allowed to use Table 2-1 (with Δy replacing Δx) because this is constant acceleration motion. The ground level is taken to correspond to the origin of the y axis.

(a) Using $y = v_0 t - \frac{1}{2}gt^2$, with $y = 0.544$ m and $t = 0.200$ s, we find

$$v_0 = \frac{y + \frac{1}{2}gt^2}{t} = \frac{0.544 + \frac{1}{2}(9.8)(0.200)^2}{0.200} = 3.70 \text{ m/s} .$$

(b) The velocity at $y = 0.544$ m is

$$v = v_0 - gt = 3.70 - (9.8)(0.200) = 1.74 \text{ m/s} .$$

(c) Using $v^2 = v_0^2 - 2gy$ (with different values for y and v than before), we solve for the value of y corresponding to maximum height (where $v = 0$).

$$y = \frac{v_0^2}{2g} = \frac{3.7^2}{2(9.8)} = 0.698 \text{ m} .$$

Thus, the armadillo goes $0.698 - 0.544 = 0.154$ m higher.