Dear all,

I am very sorry for my mistake. I should have posted these solutions with those have been posted.

Hope your homework is going well.

Thanks,

Zengming

2.5.IDENTIFY: Given two displacements, we want the average velocity and the average speed.

SET UP: The average velocity is $v_{\text{av-}x} = \dfrac{\Delta x}{\Delta t}$ and the average speed is just the total distance walked divided by the total time to walk this distance.

EXECUTE: **(a)** Let $+x$ be east. $\Delta x = 60.0\text{ m} - 40.0\text{ m} = 20.0\text{ m}$ and

$\Delta t = 28.0\text{ s} + 36.0\text{ s} = 64.0\text{ s}$. So $v_{\text{av-}x} = \dfrac{\Delta x}{\Delta t} = \dfrac{20.0\text{ m}}{64.0\text{ s}} = 0.312\text{ m/s}$.

(b) average speed $= \dfrac{60.0\text{ m} + 40.0\text{ m}}{64.0\text{ s}} = 1.56\text{ m/s}$

EVALUATE: The average speed is much greater than the average velocity because the total distance walked is much greater than the magnitude of the displacement vector.

2.9.IDENTIFY: The average velocity is given by $v_{\text{av-}x} = \dfrac{\Delta x}{\Delta t}$. We can find the displacement Δt for each constant velocity time interval. The average speed is the distance traveled divided by the time.

SET UP: For $t = 0$ to $t = 2.0\text{ s}$, $v_x = 2.0\text{ m/s}$. For $t = 2.0\text{ s}$ to $t = 3.0\text{ s}$, $v_x = 3.0\text{ m/s}$. In part (b), $v_x = 2\ 3.0\text{ m/s}$ for $t = 2.0\text{ s}$ to $t = 3.0\text{ s}$. When the velocity is constant, $\Delta x = v_x \Delta t$.

EXECUTE: **(a)** For $t = 0$ to $t = 2.0\text{ s}$, $\Delta x = (2.0\text{ m/s})(2.0\text{ s}) = 4.0\text{ m}$. For $t = 2.0\text{ s}$ to $t = 3.0\text{ s}$, $\Delta x = (3.0\text{ m/s})(1.0\text{ s}) = 3.0\text{ m}$. For the first 3.0 s, $\Delta x = 4.0\text{ m} + 3.0\text{ m} = 7.0\text{ m}$. The distance traveled is also 7.0 m. The average velocity is $v_{\text{av-}x} = \dfrac{\Delta x}{\Delta t} = \dfrac{7.0\text{ m}}{3.0\text{ s}} = 2.33\text{ m/s}$. The average speed is also 2.33 m/s.

(b) For $t = 2.0$ s to 3.0 s, $\Delta x = (-3.0\text{ m/s})(1.0\text{ s}) = -3.0\text{ m}$. For the first 3.0 s, $\Delta x = 4.0\text{ m} + (-3.0\text{ m}) = +1.0\text{ m}$. The dog runs 4.0 m in the $+x$-direction and then 3.0 m in the $-x$-direction, so the distance traveled is still 7.0 m. $v_{\text{av-}x} = \dfrac{\Delta x}{\Delta t} = \dfrac{1.0\text{ m}}{3.0\text{ s}} = 0.33\text{ m/s}$. The average speed is $\dfrac{7.00\text{ m}}{3.00\text{ s}} = 2.33\text{ m/s}$.

EVALUATE: When the motion is always in the same direction, the displacement and the distance traveled are equal and the average velocity has the same magnitude as the average speed. When the motion changes direction during the time interval, those quantities are different.

2.13. **IDENTIFY:** The average acceleration for a time interval Δt is given by $a_{\text{av-}x} = \dfrac{\Delta v_x}{\Delta t}$.

SET UP: Assume the car is moving in the $+x$ direction. $1\text{ mi/h} = 0.447\text{ m/s}$, so $60\text{ mi/h} = 26.82\text{ m/s}$, $200\text{ mi/h} = 89.40\text{ m/s}$ and $253\text{ mi/h} = 113.1\text{ m/s}$.

EXECUTE: **(a)** The graph of v_x versus t is sketched in Figure 2.13. The graph is not a straight line, so the acceleration is not constant.

(b) (i) $a_{\text{av-}x} = \dfrac{26.82 \text{ m/s} - 0}{2.1 \text{ s}} = 12.8 \text{ m/s}^2$ (ii) $a_{\text{av-}x} = \dfrac{89.40 \text{ m/s} - 26.82 \text{ m/s}}{20.0 \text{ s} - 2.1 \text{ s}} = 3.50 \text{ m/s}^2$

(iii) $a_{\text{av-}x} = \dfrac{113.1 \text{ m/s} - 89.40 \text{ m/s}}{53 \text{ s} - 20.0 \text{ s}} = 0.718 \text{ m/s}^2$. The slope of the graph of v_x versus t decreases as t increases. This is consistent with an average acceleration that decreases in magnitude during each successive time interval.

EVALUATE: The average acceleration depends on the chosen time interval. For the interval between 0 and 53 s, $a_{\text{av-}x} = \dfrac{113.1 \text{ m/s} - 0}{53 \text{ s}} = 2.13 \text{ m/s}^2$.

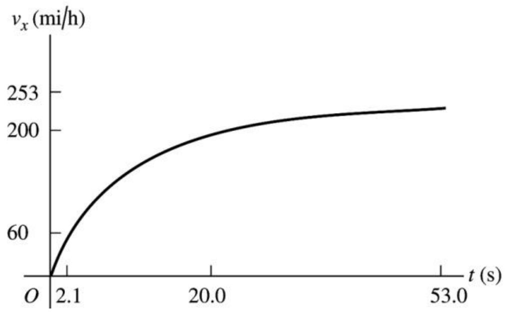

Figure 2.13

2.29. IDENTIFY: The average acceleration is $a_{\text{av-}x} = \dfrac{\Delta v_x}{\Delta t}$. For constant acceleration, Eqs. (2.8), (2.12), (2.13) and (2.14) apply.

SET UP: Assume the shuttle travels in the $+x$ direction. $161 \text{ km/h} = 44.72 \text{ m/s}$ and $1610 \text{ km/h} = 447.2 \text{ m/s}$. $1.00 \text{ min} = 60.0 \text{ s}$

EXECUTE: **(a)** (i) $a_{\text{av-}x} = \dfrac{\Delta v_x}{\Delta t} = \dfrac{44.72\text{ m/s} - 0}{8.00\text{ s}} = 5.59\text{ m/s}^2$

(ii) $a_{\text{av-}x} = \dfrac{447.2\text{ m/s} - 44.72\text{ m/s}}{60.0\text{ s} - 8.00\text{ s}} = 7.74\text{ m/s}^2$

(b) (i) $t = 8.00\text{ s},\ v_{0x} = 0,$ and $v_x = 44.72\text{ m/s}.$

$x - x_0 = \left(\dfrac{v_{0x} + v_x}{2}\right)t = \left(\dfrac{0 + 44.72\text{ m/s}}{2}\right)(8.00\text{ s}) = 179\text{ m}.$ (ii) $\Delta t = 60.0\text{ s} - 8.00\text{ s} = 52.0\text{ s},$

$v_{0x} = 44.72\text{ m/s},$ and $v_x = 447.2\text{ m/s}.$

$x - x_0 = \left(\dfrac{v_{0x} + v_x}{2}\right)t = \left(\dfrac{44.72\text{ m/s} + 447.2\text{ m/s}}{2}\right)(52.0\text{ s}) = 1.28 \times 10^4\text{ m}.$

EVALUATE: When the acceleration is constant the instantaneous acceleration throughout the time interval equals the average acceleration for that time interval. We could have calculated the distance in part (a) as $x - x_0 = v_{0x}t + \tfrac{1}{2}a_x t^2 = \tfrac{1}{2}(5.59\text{ m/s}^2)(8.00\text{ s})^2 = 179\text{ m},$ which agrees with our previous calculation.

2.38. **IDENTIFY:** The putty has a constant downward acceleration of 9.80 m/s^2. We know the initial velocity of the putty and the distance it travels.

SET UP: We can use the kinematics formulas for constant acceleration.

EXECUTE: **(a)** v_{0y} = 9.50 m/s and $y - y_0$ = 3.60 m, which gives

$v_y = \sqrt{v_{0y}^2 + 2a_y(y - y_0)} = -\sqrt{(9.50\text{ m/s})^2 + 2(-9.80\text{ m/s}^2)(3.60\text{ m})} = 4.44\text{ m/s}$

(b) $t = \dfrac{v_y - v_{0y}}{a_y} = \dfrac{4.44\text{ m/s} - 9.50\text{ m/s}}{-9.8\text{ m/s}^2} = 0.517\text{ s}$

EVALUATE: The putty is stopped by the ceiling, not by gravity.

2.97. **IDENTIFY:** Apply constant acceleration equations to the motion of the two objects, the student and the bus.

SET UP: For convenience, let the student's (constant) speed be v_0 and the bus's initial position be x_0. Note that these quantities are for separate objects, the student and the bus. The initial position of the student is taken to be zero, and the initial velocity of the bus is taken to be zero. The positions of the student x_1 and the bus x_2 as functions of time are then $x_1 = v_0 t$ and

$x_2 = x_0 + (1/2)at^2.$

EXECUTE: **(a)** Setting $x_1 = x_2$ and solving for the times t gives $t = \dfrac{1}{a}\left(v_0 \pm \sqrt{v_0^2 - 2ax_0}\right).$

$t = \dfrac{1}{(0.170\text{ m/s}^2)}\left((5.0\text{ m/s}) \pm \sqrt{(5.0\text{ m/s})^2 - 2(0.170\text{ m/s}^2)(40.0\text{ m})}\right) = 9.55\text{ s and } 49.3\text{ s}.$

The student will be likely to hop on the bus the first time she passes it (see part (d) for a discussion of the later time). During this time, the student has run a distance $v_0 t = (5\text{ m/s})(9.55\text{ s}) = 47.8\text{ m}.$

(b) The speed of the bus is $(0.170\text{ m/s}^2)(9.55\text{ s}) = 1.62\text{ m/s}.$

(c) The results can be verified by noting that the *x* lines for the student and the bus intersect at two points, as shown in Figure 2.97a.

(d) At the later time, the student has passed the bus, maintaining her constant speed, but the accelerating bus then catches up to her. At this later time the bus's velocity is

$(0.170\ \text{m/s}^2)(49.3\ \text{s}) = 8.38\ \text{m/s}.$

(e) No; $v_0^2 < 2ax_0,$ and the roots of the quadratic are imaginary. When the student runs at

$3.5\ \text{m/s},$

Figure 2.97b shows that the two lines do *not* intersect:

(f) For the student to catch the bus, $v_0^2 > 2ax_0.$ And so the minimum speed is

$\sqrt{2(0.170\ \text{m/s}^2)(40\ \text{m/s})} = 3.688\ \text{m/s}.$ She would be running for a time $\dfrac{3.69\ \text{m/s}}{0.170\ \text{m/s}^2} = 21.7\ \text{s},$

and covers a distance $(3.688\ \text{m/s})(21.7\ \text{s}) = 80.0\ \text{m}.$

However, when the student runs at $3.688\ \text{m/s},$ the lines intersect at *one* point, at $x = 80\ \text{m},$ as shown in Figure 2.97c.

EVALUATE: The graph in part (c) shows that the student is traveling faster than the bus the first time they meet but at the second time they meet the bus is traveling faster.

$t_2 = t_{\text{tot}} - t_1$

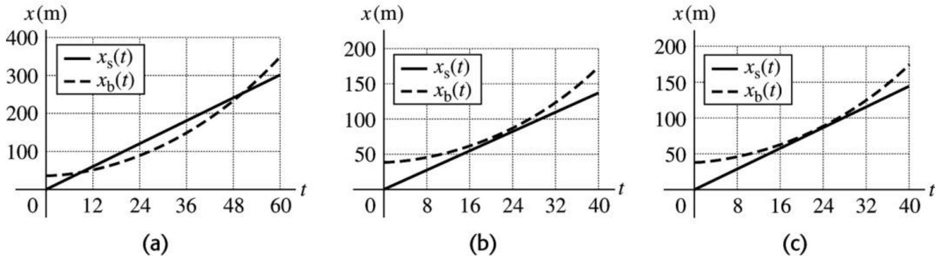

Figure 2.97