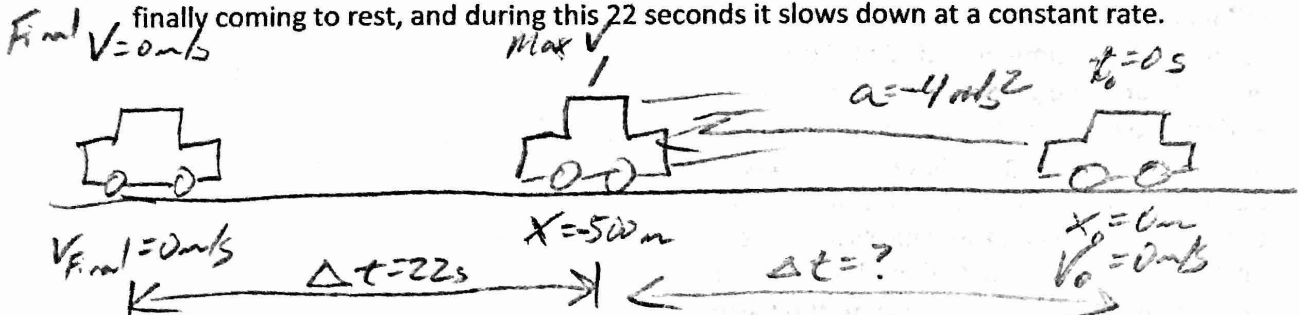


1. A car accelerates from rest at a constant rate of -4m/s^2 . After accelerating at this rate for a distance of 500m , the car turns off its engine and begins to coast. The car coasts for 22seconds before finally coming to rest, and during this 22seconds it slows down at a constant rate.



- a. What was the car's maximum speed during this event?

$$v^2 = v_0^2 + 2a\Delta x$$

$$v^2 = 0 + 2(-4\text{m/s}^2)(-500\text{m}) \Rightarrow v^2 = 4,000 \frac{\text{m}^2}{\text{s}^2}$$

$$v = 63.2 \text{ m/s} \Rightarrow \text{speed} = 63.2 \text{ m/s}$$

- b. What was the car's velocity when it reached its maximum speed?

-63.2 m/s

- c. At what time did the car reach that velocity?

$$v = v_0 + at$$

$$-63.2 \text{ m/s} = 0 + -4 \text{ m/s}^2 (t)$$

$$t = 15.8 \text{ s}$$

- d. What was the car's acceleration during its coasting period?

$$v = v_0 + at$$

$$0 \text{ m/s} = -63.2 \text{ m/s} + a(22\text{s}) \Rightarrow 63.2 \text{ m/s} = a(22\text{s})$$

$$a = 2.87 \text{ m/s}^2$$

- e. How far did the car travel after its motor turned off?

$$\Delta x = v_0 t + \frac{1}{2} a t^2 = -63.2 \text{ m/s}(22\text{s}) + \frac{1}{2}(2.87 \text{ m/s}^2)(22\text{s})^2$$

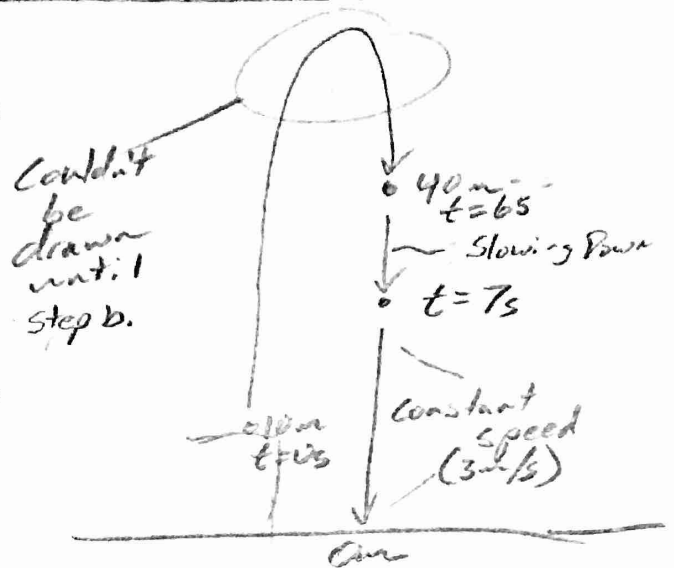
$$\Delta x = -1390 \text{ m} + 695 \text{ m} = -695 \text{ m}$$

- f. What was the car's total displacement?

$$-500 \text{ m} + -695 \text{ m} = -1195 \text{ m}$$

✓ accel. period
✓ deaccel. period

2. A plastic action figure is launched vertically upward from a point 10m above the ground [At $t = 0s$, the height of the action figure is 10m above the ground]. From $t=0s$ to $t=6s$, the action figure travels solely under the influence of gravity. Air resistance can be ignored for this time period. At $t=6s$, the action figure's height is 40m. Between $t=6s$ and $t=7s$, a parachute pops out of the figure and deploys, causing the figure's speed to decrease at a constant rate for that 6s to 7s time period. At $t=7s$, the figure's speed is 3m/s. From $t=7s$ onward, the action figure floats the rest of the way to the Earth (height = 0m) at a constant speed of 3m/s.



a. What was the action figure's initial velocity?

$$\Delta x = v_0 t + \frac{1}{2} a t^2$$

$$30m = v_0 (6s) + \frac{1}{2} (-9.8m/s^2) (6s)^2$$

$$30m = v_0 (6s) - 176.4m$$

$$206m = v_0 (6)$$

$$v_0 = 34.3m/s$$

b. What was the action figure's velocity at $t=6s$?

$$v = v_0 + at = 34.3m/s + (-9.8m/s^2)(6s)$$

$$v = 34.3m/s - 58.8m/s = -24.5m/s$$

c. What was the action figure's average acceleration between $t=6s$ and $t=7s$?

$$v = v_0 + at$$

$$-3m/s = -24.5m/s + a(1s)$$

$$21.5 = a(1s)$$

$$a = 21.5m/s^2$$

d. What was the action figure's displacement between $t=6s$ and $t=7s$?

One way $\rightarrow \Delta x = v_0 t + \frac{1}{2} a t^2$

$$\Delta x = -24.5m/s(1s) + \frac{1}{2} (21.5m/s^2)(1s)^2$$

$$\Delta x = -24.5m + 10.75m = -13.75m$$

Another way $\rightarrow \bar{v} = \frac{v_i + v_f}{2} = \frac{-3m/s + (-24.5m/s)}{2}$

$$\bar{v} = -13.75m/s$$

$$\bar{v} = \frac{\Delta x}{\Delta t} \Rightarrow -13.75m/s = \frac{\Delta x}{1s} \Rightarrow \Delta x = -13.75m$$

e. What was the action figure's elevation at $t=7s$?

$$40m - 13.75m = 26.25m$$

f. How long did the entire trip last?

Final 26.25m traveled @ 3m/s

$$\bar{v} = \frac{\Delta x}{\Delta t} \quad -3m/s = \frac{-26.25m}{\Delta t} \Rightarrow \Delta t = 8.75s$$

$$\text{total } t = 7s + 8.75s = 15.75s$$

**What was the action figure's average speed?

Ave speed = $\frac{\text{total Dist.}}{\text{total time}}$

Need to know max height.

$$v^2 = v_0^2 + 2a\Delta x \Rightarrow (0m/s)^2 = (34.3m/s)^2 + 2(-9.8m/s^2)(\Delta x)$$

$\Delta x = 60.0m = \text{max height}$

Total distance = 50m up, 60m down $\Rightarrow 110m$ total

$$\text{Ave speed} = \frac{110m}{15.75s} = 6.98m/s$$