

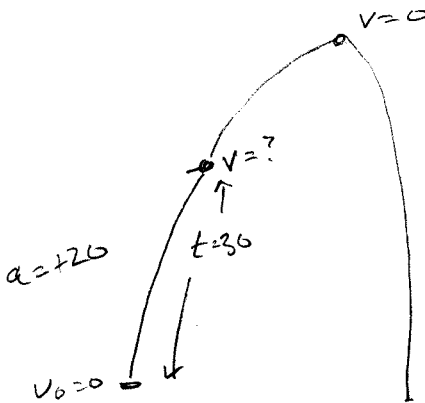
1. A car is driving at a constant speed of 10 m/s for 5 seconds. Then the driver slows to a stop by braking with an acceleration of -2 m/s^2 . How far does the car travel from the beginning of the problem?

$$\begin{aligned} \bar{v} &= 10 \text{ m/s} \\ \Delta t &= 5 \text{ s} \\ \Delta x &=? \\ \bar{v} &= \frac{\Delta x}{\Delta t} \\ 10 &= \frac{\Delta x}{5} \\ \Delta x &= 50 \text{ m} \end{aligned}$$

$$\begin{aligned} a &= -2 \text{ m/s}^2 \\ v_0 &= 10 \text{ m/s} \\ v &= 0 \\ \Delta x &=? \\ v^2 &= v_0^2 + 2a\Delta x \\ 0^2 &= 10^2 + 2(-2)(\Delta x) \\ 0 &= 100 - 4\Delta x \\ \Delta x &= 25 \text{ m} \end{aligned}$$

$$\Delta x_{\text{total}} = 75 \text{ m}$$

2. A rocket is fired upward from rest with an acceleration of 20 m/s^2 . The rocket's engine shuts off after 30 seconds.
- How high in the air will the rocket go?
 - How long is the rocket in the air?



Part 1 - Engine firing

$$\begin{aligned} a &= +20 \text{ m/s}^2 \\ v_0 &= 0 \\ t &= 30 \text{ s} \\ v &=? \\ \Delta x &=? \\ v &= v_0 + at \\ v &= 0 + 20(30) \\ v &= 600 \text{ m/s} \\ \Delta x &= v_0 t + \frac{1}{2} a t^2 \\ &= 0 + \frac{1}{2} (20)(30)^2 \\ \Delta x &= 9000 \text{ m} \end{aligned}$$

Part 2 - engine off to highest point.

$$\begin{aligned} v_0 &= 600 \text{ m/s} \\ a &= -9.8 \\ v &= 0 \text{ (cut top)} \\ v &= v_0 + at \\ 0 &= 600 + (-9.8)t \\ 61.2 \text{ s} &= t \\ \Delta x &= v_0 t + \frac{1}{2} a t^2 \\ \Delta x &= (600)(61.2) + \frac{1}{2} (-9.8)(61.2)^2 \\ &= 36720 - 18353 \\ \Delta x &= 18367 \\ \text{TOTAL HEIGHT} &= 27,367 \end{aligned}$$

Part 3 Falling

$$\begin{aligned} v_0 &= 0 \\ a &= -9.8 \text{ m/s}^2 \\ \Delta x &= -27,367 \\ t &=? \\ \Delta x &= v_0 t + \frac{1}{2} a t^2 \\ -27,367 &= 0t + \frac{1}{2} (-9.8)t^2 \\ -27,367 &= -4.9t^2 \\ 74.7 &= t \\ \text{total time} &= 30 + 61.2 + 74.7 \\ t &= 165.9 \text{ s} \end{aligned}$$

3. A runner runs the 100 meter dash by accelerating at a rate of 2 m/s^2 for the first 20 meters. He travels the rest of the race at a constant speed. How long does it take him to finish the race?

accelerating

$$v_0 = 0$$

$$a = 2$$

$$\Delta x = 20$$

$$v = ?$$

$$t = ?$$

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

$$v^2 = 0^2 + 2(2)(20)$$

$$v^2 = 80$$

$$v = 8.94 \text{ m/s}$$

$$v = v_0 + at$$

$$8.94 = 0 + 2(t)$$

$$4.47 \text{ s} = t$$

const. speed

$$\bar{v} = 8.94 \text{ m/s}$$

$$\Delta x = 80 \text{ m}$$

$$t = ?$$

$$\bar{v} = \frac{\Delta x}{\Delta t}$$

$$8.94 = \frac{80}{\Delta t}$$

$$\Delta t = 8.95 \text{ s}$$

total time

$$4.47 + 8.95 =$$

$$t = 13.4 \text{ s}$$

4. A cheetah can accelerate at 3 m/s^2 for 10 seconds, then run for another 10 seconds at a constant speed. A gazelle is 10 meters from the cheetah traveling at a constant speed of 20 m/s . Will the cheetah catch the gazelle? If so, how far has the cheetah run? If not, what is the closest the cheetah will get to the gazelle?

<i>t</i>	<i>x</i> _{cheetah}	<i>x</i> _{gazelle}
0	0	10
1	1.5	30
2	6	50
3	13.5	70
4	24	90
5	37.5	110
6	54	130
7	73.5	150
8	96	170
9	121.5	190
10	150	210
11	180	230
12	210	250
13	240	270
14	270	290
15	300	310
16	330	330
17		350
18		370
19		390
20		410