Review: Kinematics, Free-fall, Going Up

1) Without air resistance: same time
with air resistance: the heavier will land first, assuming they are the same size and shape

2) As it falls the downward velocity increases and acceleration remains at the constant rate of $-9.8\ m/s^2$.

3) $g = -9.8\ m/s^2$

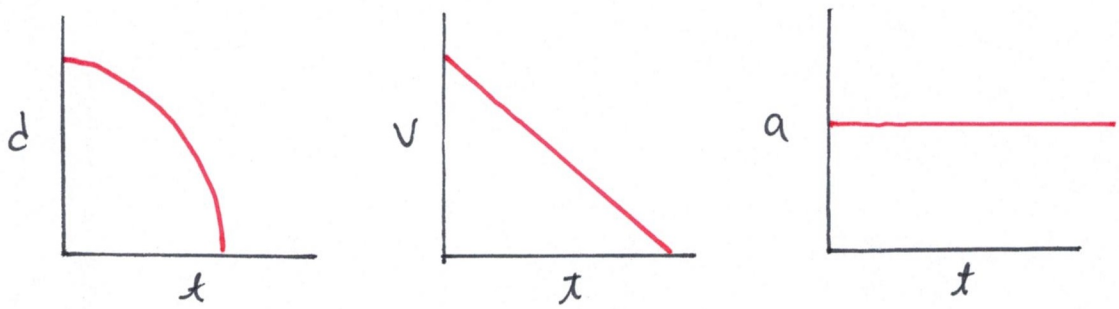
4) The speedometer would increase at a constant rate.
The odometer would increase at an increasing rate

t	V (m/s)	d (m)
1	-9.8	-4.9
2	-19.6	-19.6
3	-29.4	-44.1
4	-39.2	-78.4
5	-49	-122.5
6	-58.8	-176.4

Why are all the values negative?
Because things fall down!

5) It would change by $5\ m/s$ each second.

6)



7) $t = 3.7\ s$
$g = -9.8\ m/s^2$
$V_0 = 0\ m/s$
$\Delta h = ?$
$V_f = ?$

height: $\Delta h = V_0 t + \frac{1}{2} g t^2$

$\Delta h = 0(3.7) + \frac{1}{2}(-9.8)(3.7^2)$

$\Delta h = -67.1\ m$

final vel.: $V_f = V_0 + gt$

$V_f = 0 + (-9.8)(3.7)$

$V_f = -36.3\ m/s$

8) $t = ?$
$V_f = -20\ m/s$
$V_0 = 0\ m/s$
$g = -9.8\ m/s^2$

$V_f = V_0 + gt$

$-20 = 0 + (-9.8)t$

$\frac{-20}{-9.8} = t$

$2.04s = t$

9) $g = ?$
$\Delta h = -.72m$
$t = .63s$
$V_0 = 0\ m/s$

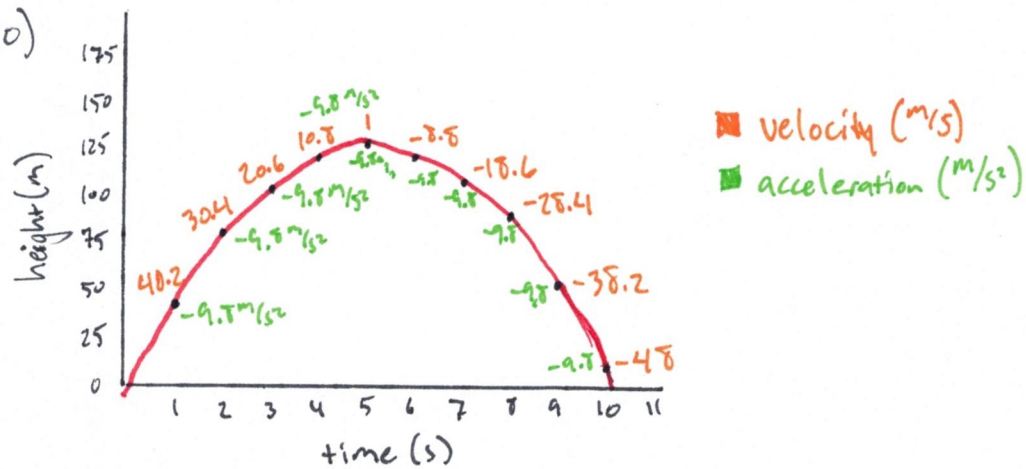
$\Delta h = V_0 t + \frac{1}{2} g t^2$

$-.72 = 0(.63) + \frac{1}{2} g (.63^2)$

$-.72 = .19845\, g$

$-3.63\ m/s^2 = g$

10)



11) $V_{avg} = \frac{\text{total distance}}{\text{total time}} = \frac{(100 + 0 + 30)\,m}{(90 + 15 + 45)\,s} = .87\ m/s$

12) $V_0 = ?$
$g = -9.8\ m/s^2$
$t_{total} = 8s$
$t_{up} = 8s/2 = 4s$
$V_f = 0\ m/s$

$V_f = V_0 + gt$

$0 = V_0 + (-9.8)(4)$

$0 = V_0 - 39.2$

$39.2\ m/s = V_0$

13) $s = 500\ km/h$ $\quad d = 100\ km$ $\quad t = ?$

$s = d/t$

$500 = 100/t$

$500t = 100$

$t = .2$ hours

14) It is moving with a constant velocity of $4\ m/s$ and no acceleration ($0\ m/s^2$).

15) $\Delta d = ?$ $\quad a = 6\ m/s^2$ $\quad v_0 = 5\ m/s$ $\quad t = 12s$

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

$\Delta d = 5(12) + \frac{1}{2}(6)(12^2)$

$\Delta d = 492\ m$

16) $v_0 = 60\ m/s$ $\quad g = -9.8\ m/s^2$

a) time to max height

$v_f = 0\ m/s$ $\quad t = ?$

$v_f = v_0 + gt$

$0 = 60 + (-9.8)t$

$-60 = -9.8t$

$6.12s = t_{up}$

b) max height

$v_f = 0\ m/s$ $\quad \Delta h = ?$

$v_f^2 = v_0^2 + 2g\Delta h$

$0^2 = 60^2 + 2(-9.8)\Delta h$

$0 = 3600 - 19.6\Delta h$

$-3600 = -19.6\Delta h$

$183.7\ m = \Delta h$

c) total time

$t_{total} = 2(t_{up})$

$t_{total} = 2(6.12)$

$t_{total} = 12.24s$

d) total displacement is 0m since it launches from the ground and lands back on the ground... no net change in height.