Free Fall II

(6) 

$v_i = 6.0\ m/s$
$\Delta d = 2.0\ m$
$a = -9.8\ m/s^2$
$\Delta t = ?$

(1st) $v_F^2 = v_i^2 + 2a\Delta d$

$v_F = \sqrt{(6.0\ m/s)^2 + 2(-9.8\ m/s^2)(-2.0\ m)}$

$v_F = \sqrt{36\ m^2/s^2 + 39.2\ m^2/s^2} = \sqrt{75.2\ m^2/s^2}$

$v_F = \pm 8.67\ m/s = \boxed{-8.67\ m/s}$

(2nd) $\Delta d = \frac{v_i + v_F}{2}\Delta t$

$\Rightarrow \Delta t = \frac{2\Delta d}{v_i + v_F} = \frac{2(-2m)}{(6.0\ m/s + -8.67\ m/s)} = \frac{-4\ m}{-2.67\ m/s} = \boxed{1.5\ s}$

(7) 

$v_i = 0$
$\Delta d = -24{,}000\ m$
$a = -3.7\ m/s^2$
$\Delta t = ?$
$v_F = ?$

For Δt: $\Delta d = \cancel{v_i \Delta t}^{0} + \frac{1}{2}a\Delta t^2$

$\Delta t = \sqrt{\frac{2\Delta d}{a}} = \sqrt{\frac{-48{,}000\ m}{-3.7\ m/s^2}} = \sqrt{12{,}973\ s^2}$

$\Delta t = 114\ s$
$= \boxed{1\ min\ 54\ s}$

For v_F: $v_F^2 = \cancel{v_i^2}^{0} + 2a\Delta d$

$v_F = \sqrt{2(-3.7\ m/s^2)(-24000\ m)} = \sqrt{1.7\times10^5\ m^2/s^2}$

$v_F = \pm 421\ m/s = \boxed{-421\ m/s}$

(8) 

$v_i = 2.4\ m/s$
$d_i = 1.3\ m$
$a = -9.8\ m/s^2$

@ $d_F \geq 5.3\ m$?

$\Delta d = d_F - d_i \Rightarrow d_F = \Delta d + d_i$

@ peak $v_F = 0$, so

$v_F = v_i + a\Delta d \Rightarrow \Delta d = -\frac{v_i}{2a} = \frac{-(2.4\ m/s)}{2(-9.8\ m/s^2)}$

$\Delta d = 0.12\ m$ so $d_F = 2.5 \neq 5.3$ **No**

(b) $\Delta t = ?$
$\Delta d = -1.3\ m$

(1st) $v_F^2 = v_i^2 + 2a\Delta d$

$v_F = \sqrt{(2.4\ m/s)^2 + 2(-9.8\ m/s^2)(-1.3\ m)}$

$v_F = \sqrt{11.64\ m^2/s^2} = (-3.4\ m/s)$

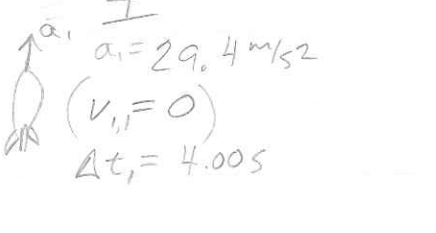
(2nd) $\Delta d = \frac{v_i + v_F}{2}\Delta t \Rightarrow \Delta t = \frac{2\Delta d}{v_i + v_F} = \frac{2(-1.3\ m)}{2.4\ m/s + -3.4\ m/s} = \frac{-2.6\ m}{-1\ m/s}$

$\boxed{\Delta t = 2.6\ s}$

Free Fall II

(9) The accelerations are the same

(10)



① $\Delta d = \Delta d_1 + \Delta d_2$

$\Delta d_1 = \cancel{v_{1,1}\Delta t_1^{\,0}} + \frac{1}{2} a_1 \Delta t_1^2$

$\Delta d_1 = \frac{1}{2}(29.4\ m/s^2)(4.00\ s)^2$

$(\Delta d_1 = 235.2\ m)$

② $v_{F,1} = \cancel{v_{1,1}^{\,0}} + a\Delta t$

$= (29.4\ m/s)(4\ s)$

$(= 117.6\ m/s)$

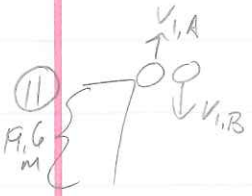
③ $\cancel{v_F^{2\,0}} = v_{1,2}^2 + 2a_2 \Delta d_2$

$\Rightarrow \Delta d_2 = \frac{-v_1^2}{2a} = \frac{-(117.6\ m/s)^2}{2(-9.8\ m/s^2)} = \frac{-13830\ m^2/s^2}{-19.6\ m/s^2}$

$(\Delta d_2 = 705\ m)$

$\Delta d = 235.\ m + 705\ m = \boxed{940\ m}$

(11)



$v_{1,A} = 14.7\ m/s$

$v_{1,B} = -14.7\ m/s$

$a = -9.8\ m/s^2$

$\Delta d = -19.6\ m$

$v_{F,A}^2 = v_{1,A}^2 + 2a\Delta d$

$v_{F,A} = \sqrt{(14.7\ m/s)^2 + 2(-9.8\ m/s^2)(-19.6\ m)}$

$v_{F,A} = \sqrt{216.1\ m^2/s^2 + 384.2\ m^2/s^2}$

$v_{F,A} = \pm 24.5\ m/s = (-24.5\ m/s)$

$(v_{F,B}$ also $= -24.5\ m/s)$ To Find time: $\Delta d = \frac{v_F + v_i}{2}\Delta t = \Delta t = \frac{2\Delta d}{v_i + v_F}$

$\Delta t_A = \frac{2(-19.6\ m)}{-14.7\ m/s + -24.5\ m/s} = \frac{-39.2\ m}{-39.2\ m/s} = 1\ s$

$\Delta t_B = \frac{2(-19.6\ m)}{14.7\ m/s + -24.5\ m/s} = \frac{-39.2\ m}{-9.8\ m/s} = 4\ s$

(A) Difference in time is 3 s

(B) velocity of each ball is $-24.5\ m/s$

(C) $\Delta d_A = v_{1,A}\Delta t_1 + \frac{1}{2} a \Delta t^2 = (-14.7\ m/s)(.8\ s) + \frac{1}{2}(-9.8\ m/s^2)(.8\ s)^2 = -11.76\ m + -3.92\ m = -15.68\ m$

$\Delta d_2 = v_{1,A}\Delta t + \frac{1}{2} a \Delta t = (14.7\ m/s)(.8\ s) + \frac{1}{2}(-9.8\ m/s^2)(.8\ s)^2 = 11.76\ m + -3.92\ m = 7.86\ m$

235 m apart