Projectiles 1

① a) $v_i = 0$
$a = -9.8\ m/s^2$
$t = 2.5\ s$
$v_f = ?$

$v_f = v_i + at$

$= 0 - 9.8(2.5)$

$v_f = \boxed{-24.5\ m/s}$

b) $d = ?$

$d = \left(\frac{v_f + v_i}{2}\right) t$

$= \left(\frac{-24.5 + 0}{2}\right) 2.5$

$d = -30.625\ m$

The bridge is $\boxed{30.6\ m}$ high.

② a) $v_i = -20\ m/s$
$a = -9.8\ m/s^2$
$t = 2s$
$v_f = ?$

$v_f = v_i + at$

$= -20 - 9.8(2)$

$v_f = \boxed{-39.6\ m/s}$

b) $d = ?$

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

$= (-20)(5) + \frac{1}{2}(-9.8)(5)^2$

$d = -100 - 122.5$

$d = -222.5\ m$

The ball has fallen $\boxed{222.5\ m}$.

(3) a) $v_i = +20$ m/s
$a = -9.8$ m/s^2
$t = 0.5$ s
$v_f = ?$

$v_f = v_i + at$

$= 20 - 9.8(0.5)$

$v_f = \boxed{15.1 \text{ m/s}}$

b) $d = ?$

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

$= (20)(3) + \frac{1}{2}(-9.8)(3)^2$

$d = 60 - 44.1$

$d = 15.9$ m

The ball is $\boxed{15.9 \text{ m}}$ above its starting point.

(4) a) $v_i = 0$
$a = -9.8$ m/s^2
$t = 2$ s
$v_f = ?$

$v_f = v_i + at$

$= 0 - 9.8(2)$

$v_f = \boxed{-19.6 \text{ m/s}}$

b) $d = ?$

$d = \left(\frac{v_f + v_i}{2}\right) t$

$= \left(\frac{-19.6 + 0}{2}\right) 2$

$d = -19.6$ m

The bag has fallen $\boxed{19.6 \text{ m}}$.

⑤ a) $v_i = 5$ m/s
$a = -9.8$ m/s^2
$t = 2$ s
$v_f = ?$

$v_f = v_i + at$

$= 5 - 9.8(2)$

$v_f = \boxed{-14.6 \text{ m/s}}$

b) $d = ?$

$d = \left(\frac{v_f + v_i}{2}\right) t$

$= \left(\frac{-14.6 + 5}{2}\right) 2$

$d = -9.6$ m

The bag has fallen $\boxed{9.6 \text{ m}}$.

c) The helicopter continues upward @ 5 m/s for 2s.
∴ the helicopter is 10 m above its starting point.

$d = vt$
$= (5)(2)$

$d = 10$ m

The bag is 9.6 m below its starting point.

∴ The distance between them is $\boxed{19.6 \text{ m}}$.

⑥ a) $v_i = -5$ m/s
$a = -9.8$ m/s^2
$t = 2$ s
$v_f = ?$

$v_f = v_i + at$

$= -5 - 9.8(2)$

$v_f = -24.6$ m/s

b) $d = ?$

$d = \left(\frac{v_f + v_i}{2}\right) t$

$= \left(\frac{-24.6 - 5}{2}\right) 2$

$d = -29.6$ m

The bag has fallen 29.6 m.

c) Helicopter is 10 m below its starting point.

Bag is 29.6 m below its starting point.

∴ They are 19.6 m apart.

⑦ a) $v_i = 0$
$a = -9.8\ m/s^2$
$d = -122.5\ m$
$t = ?$

$d = v_i t + \frac{1}{2}at^2$

$-122.5 = (0)t + \frac{1}{2}(-9.8)t^2$

$-122.5 = -4.9t^2$

$t = \boxed{5\ s}$

b) $v_f = ?$

$v_f = v_i + at$

$= 0 - 9.8(5)$

$v_f = \boxed{-49\ m/s}$

c) $d = ?$

$d = v_i t + \frac{1}{2}at^2$

$= (0)(3) + \frac{1}{2}(-9.8)(3)^2$

$d = 0 - 44.1$

$d = -44.1\ m$

The ball is 44.1 m below its starting position, or $\boxed{78.4\ m}$ above the ground.

d) $v_f = ?$

$v_f = v_i + at$

$= 0 - 9.8(3)$

$v_f = \boxed{-29.4\ m/s}$

(8) a) $v_i = -10$ m/s
$a = -9.8$ m/s^2
$d = -122.5$ m
$t = ?$

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

$-122.5 = -10t + \frac{1}{2}(-9.8)t^2$

$4.9t^2 + 10t - 122.5 = 0$

$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$= \frac{-10 \pm \sqrt{10^2 - 4(4.9)(-122.5)}}{2(4.9)}$

$t = \frac{-10 \pm 50.01}{9.8}$

$t = \boxed{4.083 \text{ s}}$ or ~~-6.123 s~~

b) $v_f = v_i + at$

$= -10 + (-9.8)(4.083)$

$v_f = \boxed{-50.013 \text{ m/s}}$

c) $d = v_i t + \frac{1}{2} a t^2$

$= (-10)(2) + \frac{1}{2}(-9.8)(2)^2$

$d = -20 - 19.6$

$d = -39.6$ m

The ball is 39.6 m below its starting position or $\boxed{82.9 \text{ m}}$ above the ground.

d) $v_f = v_i + at = -10 - 9.8(2) = \boxed{-29.6 \text{ m/s}}$

⑨ a) $v_i = 10$ m/s
$a = -9.8$ m/s^2
$d = -122.5$ m
$t = ?$

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

$-122.5 = 10t + \frac{1}{2}(-9.8)t^2$

$-122.5 = 10t - 4.9t^2$

$4.9t^2 - 10t - 122.5 = 0$

$t = \frac{10 \pm \sqrt{(-10)^2 - 4(4.9)(-122.5)}}{2(4.9)}$

$t = \frac{10 \pm 50.01}{9.8}$

$t = \boxed{6.123 \text{ s}}$ or -4.083 s

b) $v_f = v_i + at$

$= 10 - 9.8(6.123)$

$v_f = \boxed{-50.005 \text{ m/s}}$

c) Trial Up

$v_i = 10$ m/s
$v_f = 0$
$a = -9.8$ m/s^2
$d = ?$

$v_f^2 = v_i^2 + 2ad$

$0^2 = 10^2 + 2(-9.8)d$

$0 = 100 - 19.6d$

$d = \boxed{5.102 \text{ m}}$

d) $a = \boxed{-9.8 \text{ m/s}^2}$

⑨ e) $d = v_i t + \frac{1}{2} a t^2$

$= (10)(0.5) + \frac{1}{2}(-9.8)(0.5)^2$

$d = 5 - 1.225$

$d = \boxed{3.775 \text{ m}}$

f) $v_f = v_i + at$

$= 10 - 9.8(0.5)$

$v_f = \boxed{5.1 \text{ m/s}}$

g) $d = v_i t + \frac{1}{2} a t^2$

$= (10)(3) + \frac{1}{2}(-9.8)(3)^2$

$= 30 - 44.1$

$d = \boxed{-14.1 \text{ m}}$

h) $v_f = v_i + at$

$= 10 - 9.8(3)$

$v_f = \boxed{-19.4 \text{ m/s}}$