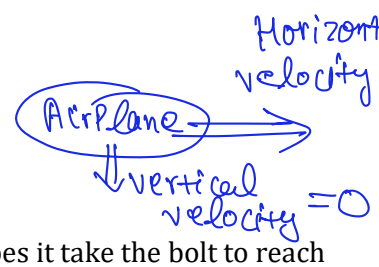
Math 110 – 8.4 Notes with Falling Distance Problems

Falling Distance Problems

1. Use the formula: $s = v_0t + 4.9t^2$ → vertical velocity in downward direction.



a) A bolt falls off an airplane at an altitude of 500 m. Approximately how long does it take the bolt to reach the ground? (speed of airplane) $s = 500$

$500 = \overset{0}{v}t + 4.9t^2 \Rightarrow 500 = 4.9t^2 \Rightarrow t^2 = \frac{500}{4.9}$

$\Rightarrow t = \sqrt{\frac{500}{4.9}} = 102.04$ sec.

(v = vertical velocity.)

b) A ball is thrown downward at a speed of 30 m/s from an altitude of 500 m. Approximately how long does it take the ball to reach the ground? $v_0 = 30$, $s = 500$

$4.9t^2 + 30t = 500 \Rightarrow 4.9t^2 + 30t - 500 = 0 \Rightarrow a = 4.9,\ b = 30,\ c = -500$

$\Rightarrow t = \frac{-30 \pm \sqrt{30^2 - 4(4.9)(-500)}}{2(4.9)} \Rightarrow t = \frac{-30 \pm \sqrt{10700}}{9.8} = \frac{-30 + \sqrt{10700}}{9.8}$

reject $= 7.49$

c) Approximately how far will an object fall in 5 seconds when thrown downward at an initial velocity of 30 m/s from a plane.

$t = 5$, $v_0 = 30$, $s = ?$

$s = 30(5) + 4.9(5)^2$

$= 150 + 122.5 = 272.5$

2. Use the formula: $s = v_0t + 4.9t^2$

a) A life preserver is dropped from a helicopter at an altitude of 75 m. Approximately how long does it take the life preserver to reach the water? $s = 75$

$4.9t^2 + 0(t) = 75 \Rightarrow 4.9t^2 = 75 \rightarrow t = \sqrt{\frac{75}{4.9}} = \ldots$

b) A coin is tossed downward with an initial velocity of 30 m/s from an altitude of 75 m. Approximately how long does it take the coin to reach the ground? $v_0 = 30$, $s = 75$

$4.9t^2 + 30t = 75 \Rightarrow 4.9t^2 + 30t - 75 = 0$

$\Rightarrow a = 4.9,\ b = 30,\ c = -75$ → use quad. formula

c) Approximately how far will an object fall in 2 seconds if thrown downward at an initial velocity of 20 m/s from a helicopter. $t = 2$, $v_0 = 20$

$s = 20(2) + 4.9(2)^2 = \ldots$ HW.

8.4 Notes – Applications involving linear equations

Review – Solving Linear Literal Equations

Ex: $\frac{c}{d} = c + d$ for c

d here is constant

$\Rightarrow \frac{c}{d} - c = d \Rightarrow c\left(\frac{1}{d} - 1\right) = d \Rightarrow c\,\frac{(1-d)}{d} \cdot \frac{d}{(1-d)} = d \cdot \frac{d}{1-d}$

$\frac{1}{d} - \frac{d}{d}$

$\Rightarrow \boxed{c = \frac{d^2}{1-d}}$

Ex: $x = \frac{3}{1-y}$ for y

$(1-y)\,x = \frac{3}{1-y} \cdot (1-y) \Rightarrow (1-y)x = 3 \Rightarrow x - yx = 3$

$\frac{-yx}{-x} = \frac{3-x}{-x} \Rightarrow \boxed{y = \frac{x-3}{x}}$

$\frac{3-x}{-x} \cdot \frac{-1}{-1} = \frac{-3+x}{x}$

Quadratic Type : Solve the following equations for the specified letter

$(ab)^2 = a^2 b^2$

Ex 1: $T = 2\pi\sqrt{\frac{l}{g}}$ for l

Square both sides :-

$T^2 = (2\pi)^2\left(\sqrt{\frac{l}{g}}\right)^2 = 4\pi^2\,\frac{l}{g}$

$\Rightarrow \frac{4\pi^2}{g} l \cdot \frac{g}{4\pi^2} = T^2 \cdot \frac{g}{4\pi^2}$

$\Rightarrow \boxed{l = \frac{T^2 g}{4\pi^2}}$

Ex 2: $48T^2 = V$ for T

$\Rightarrow T^2 = \frac{V}{48}$

$\Rightarrow T = \pm\sqrt{\frac{V}{48}}$

$\Rightarrow T = \sqrt{\frac{V}{48}}$ or $T = -\sqrt{\frac{V}{48}}$

$T^2 = 4 \Rightarrow T = \pm\sqrt{4}$

Ex 3: $A = 4\pi r^2$

Solve for r. (A is surface area of a sphere of radius r)

$\Rightarrow \frac{4\pi r^2}{4\pi} = \frac{A}{4\pi} \Rightarrow r^2 = \frac{A}{4\pi} \Rightarrow r = \pm\sqrt{\frac{A}{4\pi}}$

↳ length cannot be -ve

$\Rightarrow \boxed{r = \sqrt{\frac{A}{4\pi}}}$