



$$S_x = U_x t + \frac{1}{2} a_x t^2$$

$a_x = 0$

$$S_x = U_x t$$

$$S_x = 2.0 \text{ m/s} (0.45 \text{ s})$$

$$S_x = 0.90 \text{ m}$$

$$U_x = 2.0 \frac{\text{m}}{\text{s}} \quad U_y = 0 \text{ m/s}$$

$$a_x = 0 \text{ m/s}^2 \quad a_y = -9.81 \text{ m/s}^2$$

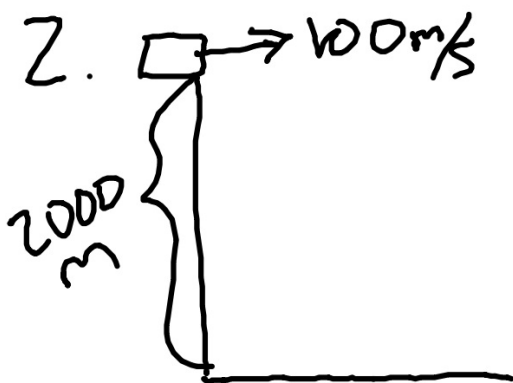
$$S_x = ? \quad S_y = -1 \text{ m}$$

$$S_y = \cancel{U_y t} + \frac{1}{2} a_y t^2$$

$U_y = 0$

$$\sqrt{\frac{2 S_y}{a_y}} = t$$

$$\sqrt{\frac{2(-1)}{-9.81 \text{ m/s}^2}} = t = 0.45 \text{ s}$$



$$S_y = -2000.0 \text{ m} \quad S_x = ?$$

$$U_y = 0 \text{ m/s} \quad U_x = 100.0 \text{ m/s}$$

$$a_y = -9.81 \text{ m/s}^2 \quad a_x = 0 \text{ m/s}^2$$

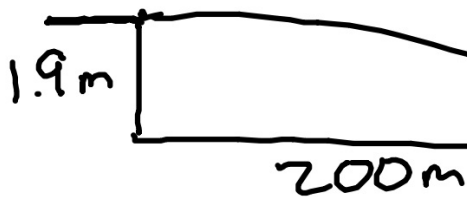
$$S_y = U_y t + \frac{1}{2} a_y t^2 \quad S_x = U_x t + \frac{1}{2} a_x t^2$$

$$S_x = U_x t$$

$$S_x = (100) (20.19)$$

$$\sqrt{\frac{2 \cdot -2000 \text{ m}}{-9.81 \text{ m/s}^2}} = t = 20.19 \text{ s} \quad S_x = 2019 \text{ m}$$

3.



$$S_x = 200.0 \text{ m} \quad S_y = -1.90 \text{ m}$$

$$a_x = 0 \text{ m/s}^2 \quad a_y = -9.81 \frac{\text{m}}{\text{s}^2}$$

$$U_x = ? \quad U_y = 0 \text{ m/s}$$

$$S_y = U_y t + \frac{1}{2} a_y t^2$$

$$S_y = \frac{1}{2} a_y t^2$$

$$t = \sqrt{\frac{2 S_y}{a_y}}$$

$$t = \sqrt{\frac{2 \times 1.9 \text{ m}}{-9.81 \text{ m/s}^2}}$$

$$t = 0.6224$$

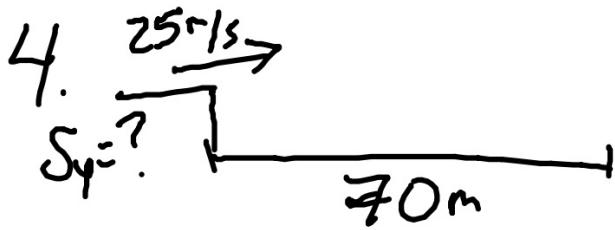
$$S_x = U_x t + \frac{1}{2} a_x t^2$$

$$S_x = U_x t$$

$$U_x = \frac{S_x}{t}$$

$$U_x = \frac{200 \text{ m}}{0.6224 \text{ s}}$$

$$U_x = 321 \text{ m/s}$$



$$S_x = U_x t + \frac{1}{2} a_x t^2$$

$$S_x = U_x t$$

$$\frac{S_x}{U_x} = t$$

$$t = \frac{70.0 \text{ m}}{25.0 \text{ m/s}}$$

$$t = 2.8 \text{ s}$$

$$S_x = 70.0 \text{ m} \quad S_y = ?$$

$$U_x = 25.0 \frac{\text{m}}{\text{s}} \quad U_y = 0 \frac{\text{m}}{\text{s}}$$

$$a_x = 0 \frac{\text{m}}{\text{s}^2} \quad a_y = -9.81 \frac{\text{m}}{\text{s}^2}$$

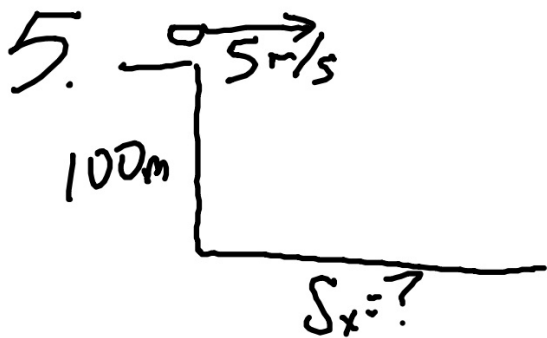
$$S_y = U_y t + \frac{1}{2} a_y t^2$$

$$S_y = \frac{1}{2} a_y t^2$$

$$S_y = \frac{1}{2} (-9.81 \frac{\text{m}}{\text{s}^2}) (2.8 \text{ s})^2$$

$$S_y = 38.4552 \text{ m}$$

$$S_y = 38.5 \text{ m}$$



$$U_x = 5.00 \text{ m/s} \quad U_y = 0 \text{ m/s}$$

$$a_x = 0 \frac{\text{m}}{\text{s}^2} \quad a_y = -\frac{9.81 \text{ m}}{6 \text{ s}^2}$$

$$S_x = ? \quad S_y = -100.0 \text{ m}$$

$$S_x = U_x t + \frac{1}{2} a_x t^2$$

$$S_x = U_x t$$

$$S_x = (5.00 \text{ m/s})(11.06 \text{ s})$$

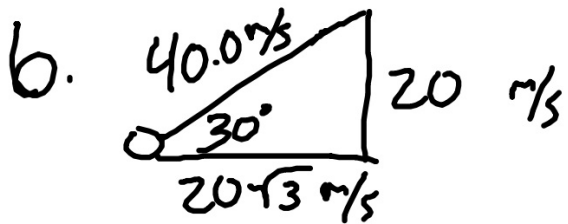
$$S_x = 55.3 \text{ m}$$

$$S_y = U_y t + \frac{1}{2} a_y t^2$$

$$S_y = \frac{1}{2} a_y t^2$$

$$\sqrt{\frac{2 S_y}{a_y}} = t$$

$$\sqrt{\frac{2(100 \text{ m})}{\frac{9.81 \text{ m}}{6 \text{ s}^2}}} = t = 11.06 \text{ s}$$



$$S_x = ? \quad S_y = 0 \text{ m}$$

$$a_x = 0 \text{ m/s}^2 \quad a_y = -9.81 \text{ m/s}^2$$

$$U_x = 20\sqrt{3} \frac{\text{m}}{\text{s}} \quad U_y = 20 \frac{\text{m}}{\text{s}}$$

$$S_x = U_x t + \frac{1}{2} a_x t^2$$

$$S_x = U_x t$$

$$S_x = \left(20\sqrt{3} \frac{\text{m}}{\text{s}}\right) (4.077 \text{ s})$$

$$S_x = 141.24 \text{ m}$$

$$S_x = 141 \text{ m}$$

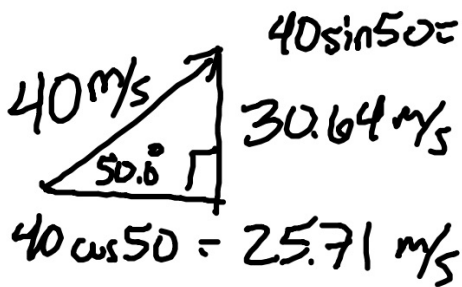
$$V_y = -20 \frac{\text{m}}{\text{s}}$$

$$V_y = U_y + a_y t$$

$$\frac{V_y - U_y}{a_y} = t$$

$$\frac{-20 \frac{\text{m}}{\text{s}} - 20 \frac{\text{m}}{\text{s}}}{-9.81 \text{ m/s}^2} = t = 4.077 \text{ s}$$

7.



$$X = U_x t + \frac{1}{2} a t^2$$

$$X = U_x t$$

$$X = (25.71 \frac{m}{s})(6.247 s)$$

$$X = 160.62 m$$

$$S_x = 170.0 m - X$$

$$S_x = 9.38 m$$

$$S_x = 170 m - X \quad S_y = 0$$

$$U_x = 25.71 \frac{m}{s} \quad U_y = 30.64 \frac{m}{s}$$

$$a_x = 0 \frac{m}{s^2}$$

$$a_y = -9.81 \frac{m}{s^2}$$

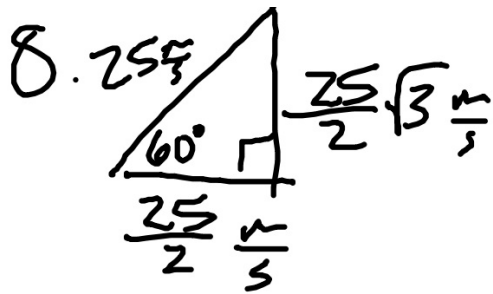
$$V_y = -30.64 \frac{m}{s}$$

$$V_y = U_y + a t$$

$$\frac{V_y - U_y}{a} = t$$

$$\frac{-61.28 \frac{m}{s}}{-9.81 \frac{m}{s^2}} = t$$

$$t = 6.247 s$$



$$\Delta x = U_x t + \frac{1}{2} a_x t^2$$

$$\Delta x = U_x t$$

$$\Delta x = \left(\frac{25 \text{ m}}{2}\right) (4.414 \text{ s})$$

$$b) \Delta x = 55.2 \text{ m}$$

$$\Delta x = ?$$

$$U_x = \frac{25}{2} \frac{m}{s}$$

$$a_x = 0 \frac{m}{s^2}$$

$$\Delta y = 0 \text{ m}$$

$$U_y = \frac{25\sqrt{3}}{2} \frac{m}{s}$$

$$a_y = -9.81 \frac{m}{s^2}$$

$$V_y = -\frac{25\sqrt{3}}{2} \frac{m}{s}$$

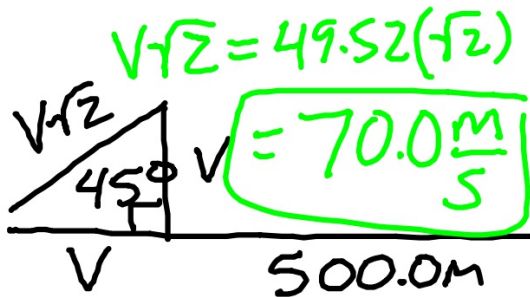
$$V_y = U_y + a t$$

$$\frac{V_y - U_y}{a_y} = t$$

$$\frac{-25\sqrt{3} \frac{m}{s}}{-9.81 \frac{m}{s^2}} = t$$

$$a) t = 4.414 \text{ s}$$

9.



$$S_x = 500.0 \text{ m} \quad S_y = 0 \text{ m}$$

$$a_x = 0 \frac{\text{m}}{\text{s}^2} \quad a_y = -9.81 \frac{\text{m}}{\text{s}^2}$$

$$U_x = V \quad U_y = V$$

$$V_y = -V$$

$$S_x = U_x t + \frac{1}{2} a_x t^2$$

$$S_x = U_x t$$

$$S_x = V \left(\frac{-2V}{a} \right)$$

$$\frac{S_x(a)}{-2} = V^2$$

$$V = \sqrt{\frac{500(-9.81)}{-2} - \frac{2V}{a}} = t$$

$$V = 49.52 \frac{\text{m}}{\text{s}}$$

$$V_y = U_y + a_y t$$

$$\frac{V_y - U_y}{a} = t$$

10.



$$S_x = ?$$

$$V_y = U_y + a_y t$$

$$t = \frac{V - U}{a_y}$$

$$t = \frac{-10}{-9.81}$$

$$t = 1.019 \text{ s}$$

$$S_x = U_x t$$

$$S_x = (8.08) (1.019 \text{ s})$$

$$S_x = 8.24 \text{ m}$$



$$\sin 60 = \frac{14.0 \text{ m/s}}{V}$$

$$V = \frac{14}{\sin 60}$$

$$V = 16.2 \frac{\text{m}}{\text{s}}$$

a.

$$U_x = \frac{14.0 \text{ m}}{\tan 60}$$

$$U_x = 8.08 \frac{\text{m}}{\text{s}}$$

$$S_y = 10 \text{ m}$$

$$V_y = 0 \frac{\text{m}}{\text{s}}$$

$$U_y = ?$$

$$a_y = -9.81 \frac{\text{m}}{\text{s}^2}$$

$$V_y^2 = U_y^2 + 2a_y S_y$$

$$-2a_y S_y = U_y^2$$

$$\sqrt{-2(-9.81 \frac{\text{m}}{\text{s}^2})(10 \text{ m})} = U_y$$

$$U_y = 14.0 \frac{\text{m}}{\text{s}}$$

11. a.

$$S_x = ? \quad S_y = -196.00 \text{ m}$$

$$U_x = 8.50 \frac{\text{m}}{\text{s}} \quad U_{y1} = 14.70 \frac{\text{m}}{\text{s}} \quad V_{y1} = -14.70 \frac{\text{m}}{\text{s}}$$

$$a_x = 0 \frac{\text{m}}{\text{s}^2} \quad a_y = -9.81 \frac{\text{m}}{\text{s}^2} \quad V_{y1} = U_{y2}$$

$$t_1 + t_2 = 2.997 \text{ s} + 5.00 \text{ s} = 8.00 \text{ s}$$

$$t_T = t_1 + t_2 \quad V_{y1} = U_{y1} + a_y t_1$$

$$S_y = U_{y1} t_1 + \frac{1}{2} a_y t_1^2 \quad t_1 = \frac{V_{y1} - U_{y1}}{a_y}$$

$$-196 \text{ m} = -14.7 \frac{\text{m}}{\text{s}} t_1 + \frac{-9.81 \frac{\text{m}}{\text{s}^2}}{2} t_1^2 \quad t_1 = \frac{-29.4 \frac{\text{m}}{\text{s}}}{-9.81 \frac{\text{m}}{\text{s}^2}}$$

$$0 = -4.905 t_1^2 - 14.7 t_1 + 196$$

$$t_1 = \frac{14.7 \pm \sqrt{14.7^2 - 4(-4.905)(196)}}{2(-4.905)} \quad t_1 = 2.997 \text{ s}$$

$$t_2 = 5.00 \text{ s} - 2.997 \text{ s} = 2.003 \text{ s}$$

11.
b.

$$S_x = ?$$

$$U_x = 8.50 \frac{\text{m}}{\text{s}}$$

$$t = 8.00 \text{ s}$$

$$a_x = 0 \frac{\text{m}}{\text{s}^2}$$

$$S_x = U_x t + \frac{1}{2} a_x t^2$$

$$S_x = U_x t$$

$$S_x = (8.5 \frac{\text{m}}{\text{s}})(8 \text{ s})$$

$$S_x = 68.0 \text{ m}$$

11.
C.

$$V_y = ?$$

$$U_y = 14.7 \frac{\text{m}}{\text{s}}$$

$$a_y = -9.81 \frac{\text{m}}{\text{s}^2}$$

$$S_y = -196 \text{ m}$$

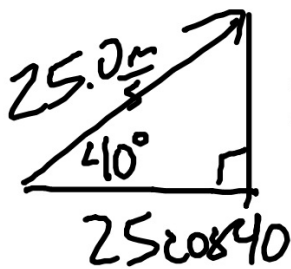
$$V^2 = U^2 + 2as$$

$$V^2 = 14.7^2 + 2(-9.81)(-196)$$

$$V^2 = 4061.61$$

$$V = -63.7 \frac{\text{m}}{\text{s}}$$

12.



$$25 \sin 40$$

$$U_x = 25 \cos 40 \frac{m}{s}$$

$$a_x = 0 \frac{m}{s^2}$$

$$S_x = ?$$

$$V = U + a t$$

$$\frac{V - U}{a} = t$$

$$\frac{-50 \sin 40 \frac{m}{s}}{-18 \frac{m}{s^2}} = t$$

$$t = 1.7855 \text{ s}$$

$$S_x = 34.2 \text{ m}$$

$$U_y = 25 \sin 40 \frac{m}{s}$$

$$a_y = -18.0 \frac{m}{s^2}$$

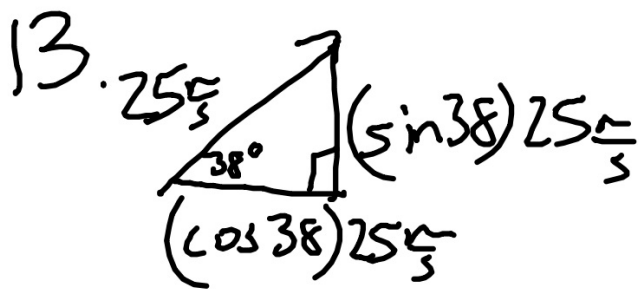
$$S_y = 0 \text{ m}$$

$$V_y = -25 \sin 40 \frac{m}{s}$$

$$S_x = U_x t + \frac{1}{2} a t^2$$

$$S_x = U_x t$$

$$S_x = \left(25 \cos 40 \frac{m}{s} \right) (1.7855 \text{ s})$$



$$U_x = (\cos 38) 25 \frac{m}{s} \quad U_y = (\sin 38) 25 \frac{m}{s}$$

$$S_x = ?$$

$$V_y = -U_y$$

$$a_x = 0 \frac{m}{s^2}$$

$$a_y = -9.81 \frac{m}{s^2}$$

$$S_x = U_x t + \frac{1}{2} a_x t^2$$

$$S_y = 0$$

$$S_x = U_x t$$

$$S_x = (25 \cos 38) \left(3.1379 \right)$$

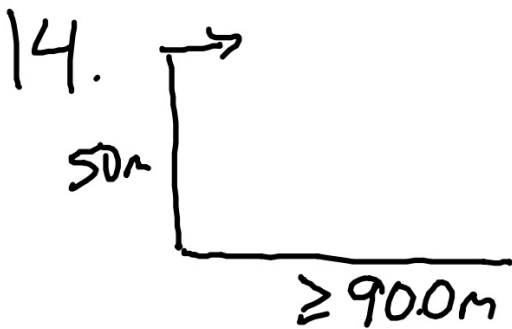
$$V_y = U_y + a_y t$$

$$\frac{V_y - U_y}{a_y} = t = \frac{-2U_y}{a_y}$$

$$t = \frac{-50 \sin 38}{-9.81}$$

$$t = 3.1379 s$$

$$S_x = 61.8 m$$



$$S_x \geq 90.0 \text{ m}$$

$$S_y = -50 \text{ m}$$

$$U_x = ?$$

$$a_y = -9.81 \frac{\text{m}}{\text{s}^2}$$

$$a_x = 0 \frac{\text{m}}{\text{s}^2}$$

$$U_y = 0 \frac{\text{m}}{\text{s}}$$

if $a_x = 0 \frac{\text{m}}{\text{s}^2}$

$$V = \frac{\Delta S}{t}$$

$$V = \frac{90.0 \text{ m}}{3.1928 \text{ s}}$$

$$S_y = U_y t + \frac{1}{2} a_y t^2$$

$$\sqrt{\frac{2 S_y}{a_y}} = t$$

$$3.1928 \text{ s} = t$$

$$V = \frac{28.19 \text{ m}}{\text{s}} \quad \left| \quad \frac{1 \text{ km}}{1000 \text{ m}} \quad \right| \quad \frac{3600 \text{ s}}{1 \text{ h}} = 101.47 \frac{\text{km}}{\text{h}}$$

$$\boxed{102 \frac{\text{km}}{\text{h}}}$$

15. $S_x = U_x t_T = \boxed{40.5 \text{ m}}$ $U_y = 20 \sin 37^\circ$ $U_x = 20 \cos 37^\circ$
 $20 \frac{\text{m}}{\text{s}}$
 $(\sin 37^\circ) 20$
 37°
 $(\cos 37^\circ) 20$
 $a_y = -9.81 \frac{\text{m}}{\text{s}^2}$ $a_x = 0 \frac{\text{m}}{\text{s}^2}$
 $S_y = -1.00 \text{ m}$ $S_x = ?$

$t_T = t_L + t_D$ $U_{yL} = -V_{yL}$ $S_y = U_{y0} t_D + \frac{1}{2} a t_D^2$

$V_{yL} = U_{yL} + a_y t_L$ $U_{yD} = -U_{yL}$ $0 = \frac{a}{2} t_D^2 + U_{y0} t_D - S_y$

$t_L = \frac{-2 U_{yL}}{a_y}$

$0 = -4.905 t_D^2 - 12.04 t_D + 1$

$t_L = \frac{-2 (20 \sin 37^\circ)}{-9.81 \frac{\text{m}}{\text{s}^2}}$

$t_D = \frac{12.04 \pm \sqrt{12.04^2 + 4(4.905)(1)}}{-9.81}$

$t_L = 2.454 \text{ s}$

$t_D = 0.08 \text{ s}$

$t_T = 2.534 \text{ s}$

16.a.

$$S_y = ?$$

$$U_y = 20 \sin 37 \frac{m}{s}$$

$$V_y = 0 \frac{m}{s}$$

$$a_y = -9.81 \frac{m}{s^2}$$

$$V_y^2 = U_y^2 + 2a_y S_y$$

$$\frac{V_y^2 - U_y^2}{2a_y} = S_y$$

$$S_y = \frac{-(20 \sin 37 \frac{m}{s})^2}{2(-9.81 \frac{m}{s^2})}$$

$$S_y = 7.38 m$$

16 b. $U_y = 20 \sin 37 \frac{m}{s}$

$$V_y = -20 \sin 37 \frac{m}{s}$$

$$a_y = -9.81 \frac{m}{s^2}$$

$$t = ?$$

$$V_y = U_y + a_y t$$

$$\frac{V_y - U_y}{a_y} = t$$

$$\frac{-40 \sin 37 \frac{m}{s}}{-9.81 \frac{m}{s^2}} = t$$

$$t = 2.45 s$$

16c. $t = 2.45 \text{ s}$

$$U_x = 20 \cos 37 \frac{\text{m}}{\text{s}}$$

$$a_x = 0 \frac{\text{m}}{\text{s}^2}$$

$$S_x = ?$$

$$S_x = U_x t + \frac{1}{2} a_x t^2$$

$$S_x = U_x t$$

$$S_x = \left(20 \cos 37 \frac{\text{m}}{\text{s}} \right) (2.45 \text{ s})$$

$$S_x = 39.2 \text{ m}$$

16d.

Velocity vector at max height

at max height $V_y = 0 \frac{m}{s}$

$$V_x = 20 \cos 37$$

$$V_x = 15.97 \frac{m}{s}$$

$$V = 16.0 \frac{m}{s} \text{ in the x-direction}$$

16.e.

acceleration at max height

$$a_x = 0 \frac{m}{s^2}$$

$$a_y = -9.81 \frac{m}{s^2}$$

$$a = -9.81 \frac{m}{s^2}$$