

kinematics

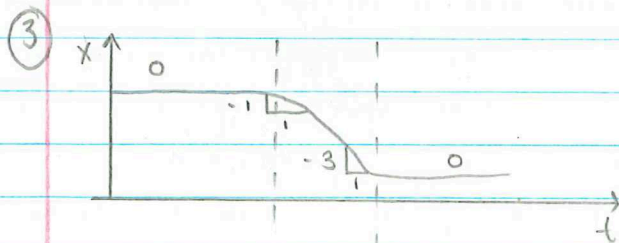
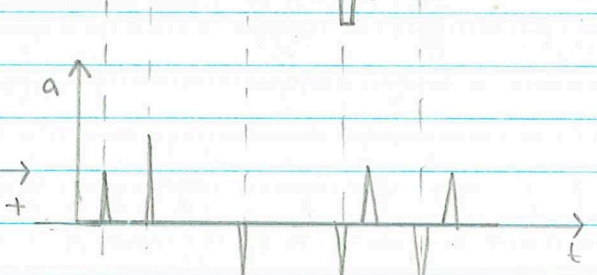
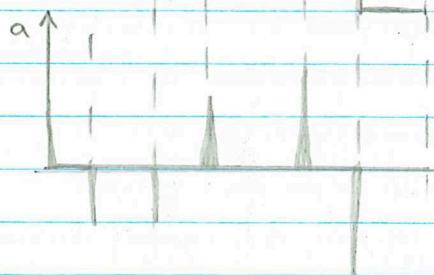
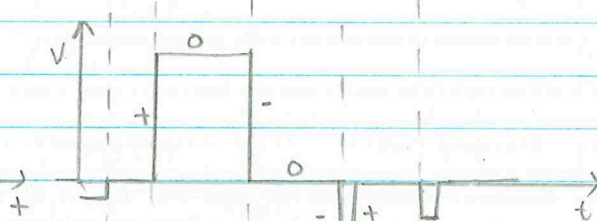
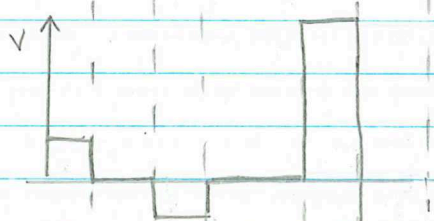
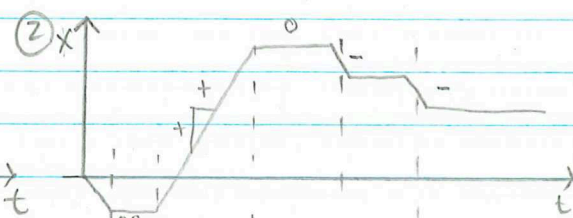
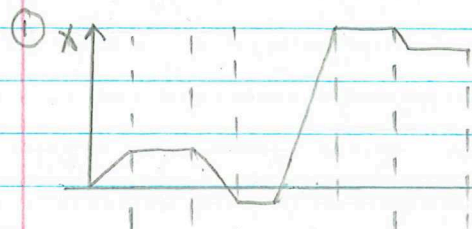
$\Delta = \text{change}$

Jan 10.23 ①

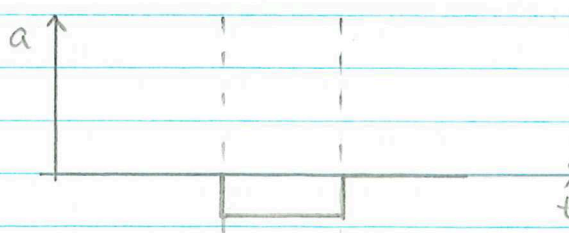
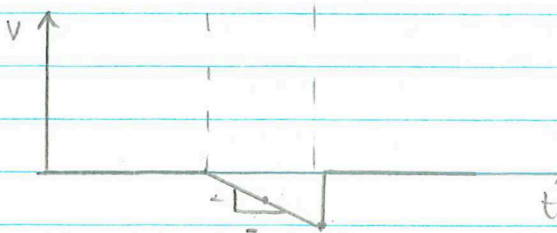
$$\vec{v} = \frac{\Delta \vec{x}}{\Delta t} = \frac{d\vec{x}}{dt} \quad \begin{matrix} \text{infinitesimal} \\ \text{change} \end{matrix}$$

derivative: the rate of change of a function

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{d\vec{v}}{dt}$$



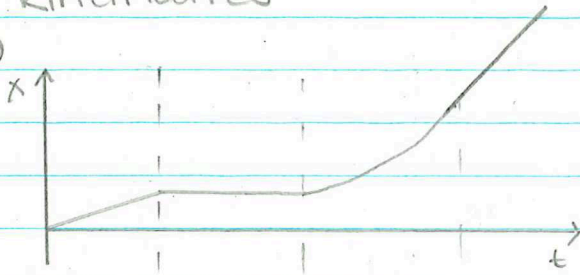
Straight line $\rightarrow$ constant
Curved line $\rightarrow$ straight line



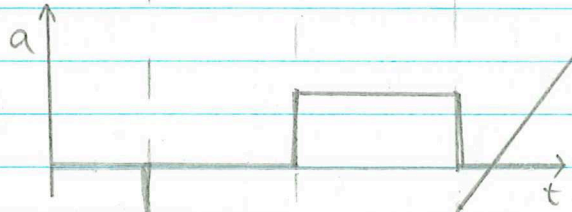
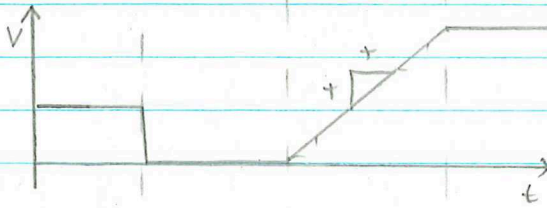
Kinematics

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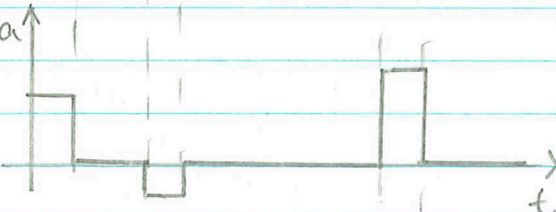
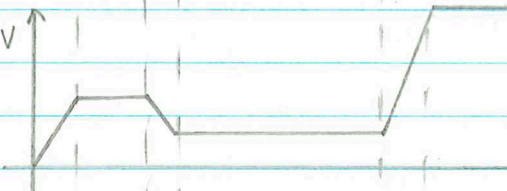
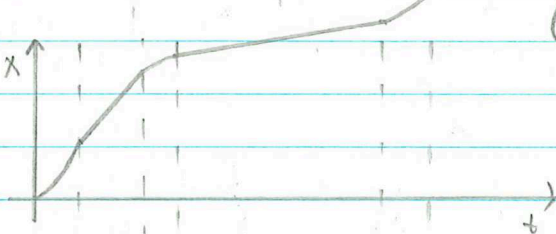
④



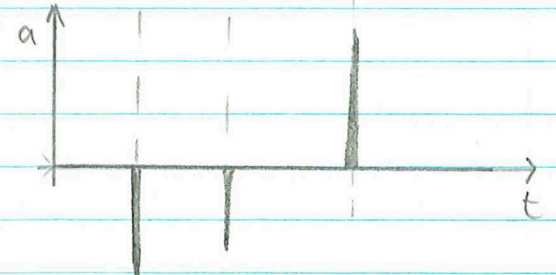
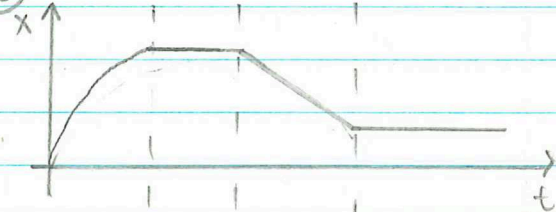
$$\frac{d(t^2)}{dt} \rightarrow t, \quad \frac{d(t)}{dt} \rightarrow 1$$



⑤



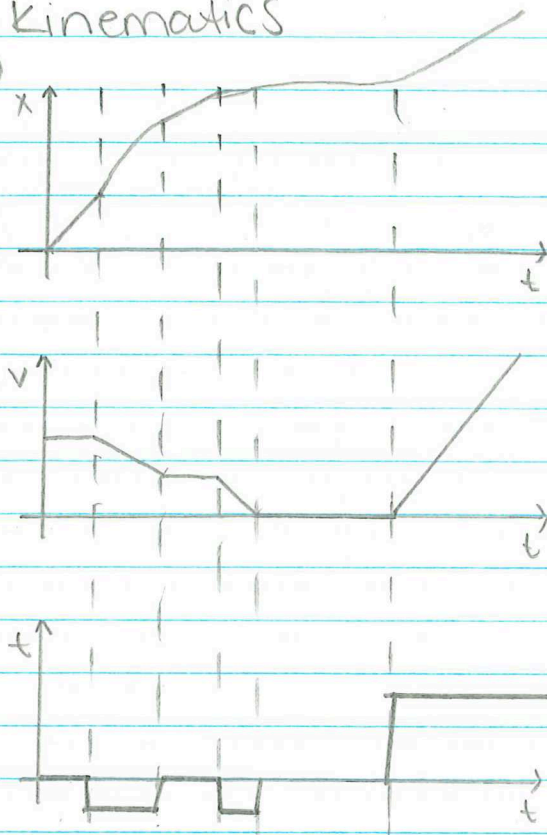
⑥



Kinematics

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Kinematics

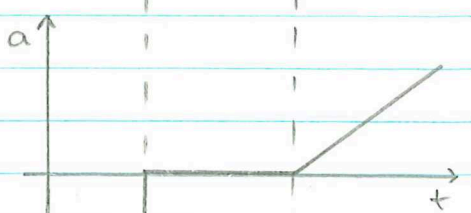
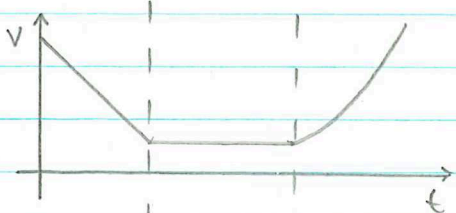
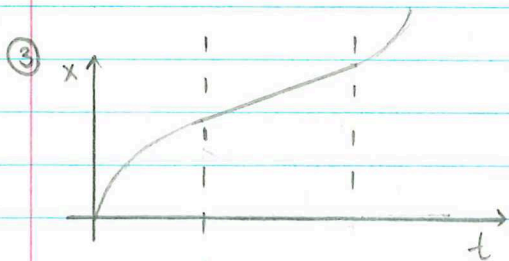
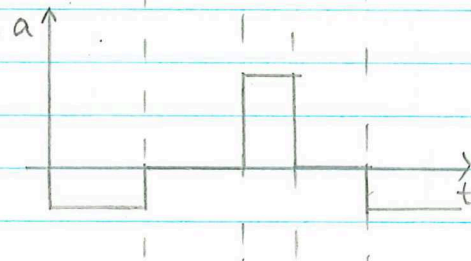
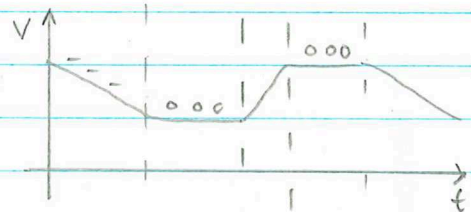
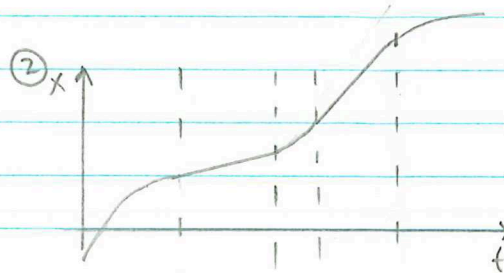
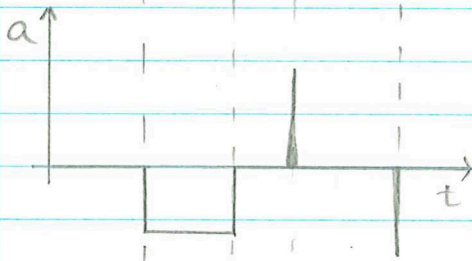
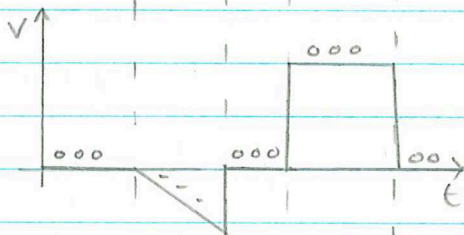
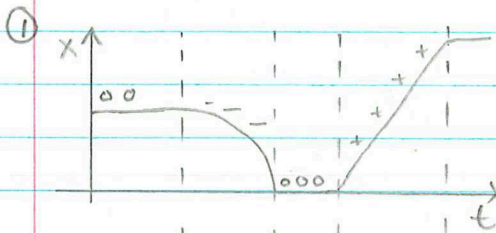
Jan 11.23①

$\vec{x}$ = position

$$\vec{v} = \frac{d\vec{x}}{dt} \text{ (slope of } \vec{x})$$

$$\vec{a} = \frac{d\vec{v}}{dt} \text{ (slope of } \vec{v})$$

x		
v		
a		



$\rightarrow$ = vector

Definitions

$\vec{x}$ = position

$$\vec{v} = \frac{d\vec{x}}{dt}$$

$$\vec{a} = \frac{d\vec{v}}{dt} = \text{constant}$$

Intro to Calculus

$$\int_0^t \vec{a} dt = \int_0^t d\vec{v}$$

$$\vec{a} [+]_0^t = [\vec{v}]_0^t$$

$$\vec{a} [+, - +] = [\vec{v}_1 - \vec{v}_0]$$

$$\vec{a} t = \vec{v}_1 - \vec{v}_0$$

$$\boxed{\vec{v} = \vec{v}_0 + \vec{a}t}$$

Jan 11. 23 (2)

$$\vec{v} = \vec{v}_0 + \vec{a}t$$

$$\vec{x} = \vec{x}_0 + \vec{v}_0 t + \frac{1}{2} \vec{a} t^2$$

$$\vec{v}^2 = \vec{v}_0^2 + 2\vec{a}(\vec{x} - \vec{x}_0)$$

$$\vec{a} = \text{constant}$$

$$\int_0^t \vec{v} dt = \int_0^t d\vec{x}$$

$$\int (\vec{v}_0 + \vec{a}t) dt = [\vec{x}]_0^t$$

$$\left[\vec{v}_0 t + \frac{1}{2} \vec{a} t^2 \right]_0^t = [\vec{x}]_0^t$$

$$\vec{v}_0 t + \frac{1}{2} \vec{a} t^2 = \vec{x}_1 - \vec{x}_0$$

$$\boxed{\vec{x} = \vec{x}_0 + \vec{v}_0 t + \frac{1}{2} \vec{a} t^2}$$

$$\vec{v} = \vec{v}_0 + \vec{a}t$$

↓

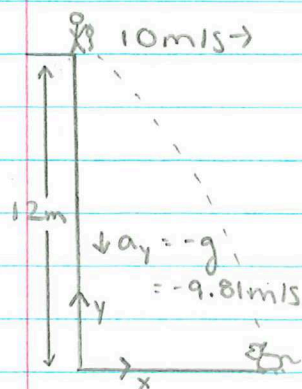
$$\vec{v} = (v_{0x} + a_x t) \hat{x} + (v_{0y} + a_y t) \hat{y}$$

$$v_x = v_{0x} + a_x t$$

$$\vec{O}_{\text{freefall}} = 0\hat{x} - 9.81\hat{y} + 0\hat{z}$$

(horizontal plane always 0)

Jan 11, 23 ③



x direction	y direction	time
$x_0 = 0$	$y_0 = 12$	$t = ?$
$x_1 = ?$	$y_1 = 0$	
$v_{0x} = 10$	$v_{0y} = 0$	
$v_{1x} = 10$	$v_{1y} = ?$	
$a_x = 0$ (always 0 when freeball)	$a_y = -9.81 \text{ m/s}^2$	

OR

$$① v_{y1}^2 = v_{0y}^2 + 2a_y(y_1 - y_0)$$

$$v_y = \pm \sqrt{2a_y(y_1 - y_0)}$$

$$v_y = \pm \sqrt{(2)(-9.81)(0 - 12)}$$

$$v_y = \pm 15.34$$

$$\boxed{v_y = -15.34 \text{ m/s}}$$

↓

$$② v_y = v_{0y} + a_y t \Rightarrow t = \frac{v_y - v_{0y}}{a_y}$$

$$t = \frac{-15.34 - 0}{-9.81}$$

$$\boxed{t = 1.56 \text{ s}}$$



$$③ x = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$$

$$x_1 = v_{0x}t$$

$$x_1 = (10)(1.56)$$

$$\boxed{x_1 = 15.6 \text{ m}}$$

$$① y_1 = y_0 + v_{0y}t + \frac{1}{2}a_y t^2$$

$$\frac{1}{2}a_y t^2 = y_1 - y_0$$

$$t = \pm \sqrt{\frac{2(y_1 - y_0)}{a_y}}$$

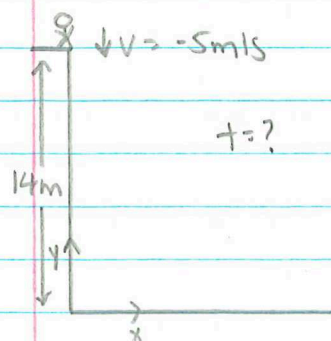
$$t = \pm \sqrt{\frac{2(0 - 12)}{-9.81}}$$

$$t = \pm 1.56$$

$$\boxed{t = 1.56 \text{ s}}$$



Jan. 11.23 (4)



y direction
 $y_0 = 14\text{m}$
 $y_1 = 0$
 $v_{0y} = -5\text{m/s}$
 $v_{1y} = ?$
 $a_y = -9.81\text{m/s}^2$

$$\textcircled{1} v_{y1}^2 = v_{y0}^2 + 2a_y(y - y_0) \quad \text{OR} \quad \textcircled{1} y_1 = y_0 + v_{0y}t + \frac{1}{2}a_y t^2$$

$$v_{y1}^2 = (-5)^2 + 2(-9.81)(0 - 14)$$

$$0 = (y_0 - y_1) + (v_{0y})t + \left(\frac{1}{2}a_y\right)t^2$$

$$v_{y1} = \pm \sqrt{25 + 274.68}$$

$$0 = (14 - 0) + (-5)t + \frac{1}{2}(-9.81)t^2$$

$$v_{y1} = \pm 17.31$$

$$0 = -4.905t^2 - 5t + 14$$

$$v_{y1} = -17.31\text{m/s}$$

$$0 = 4.905t^2 + 5t - 14$$

$$\textcircled{2} v_{y1} = v_{y0} + a_y t$$

$$\textcircled{2} t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad \text{quadratic formula}$$

$$t = \frac{v_{y1} - v_{y0}}{a_y}$$

$$t = \frac{-5 \pm \sqrt{(-5)^2 - 4(4.905)(-14)}}{2(4.905)}$$

$$t = \frac{-17.31 - (-5)}{-9.81}$$

$$t = -0.50968 \pm 1.7646$$

$$t = 1.25\text{s}$$

$$t = 1.25, -2.274$$

$$t = 1.25\text{s}$$

• (1)

Kinematics

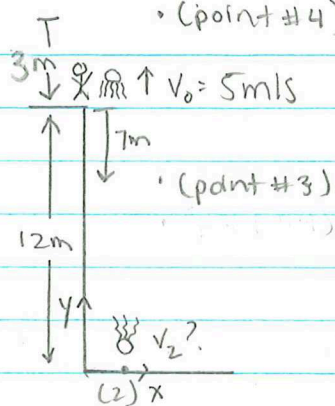
• (point #4)

Jan 13, 23 ①

$$\vec{v} = \vec{v}_0 + \vec{a}t$$

$$\vec{x} = \vec{x}_0 + \vec{v}_0t + \frac{1}{2}\vec{a}t^2$$

$$\vec{v}^2 = \vec{v}_0^2 + 2\vec{a}(\vec{x} - \vec{x}_0)$$



y-direction	time
$y_0 = 12$	$t_1 = ?$
$y_1 = ? 13.3$	$t_2 = 2.15s$
$y_2 = 0$	$t_3 = 1.8s$
$y_3 = 5$	$t_4 = ?$
$y_4 = 15$	
$v_{0y} = 5$	
$v_{1y} = 0$	
$v_{2y} = -16.14$	
$v_{3y} = ? -12.7$	
$v_{4y} = ?$	
$a_y = -9.81$	

① $v_{zy}^2 = v_0^2 + 2a(y - y_0)$

$$v_{zy}^2 = (5)^2 + 2(-9.81)(0 - 12)$$

$$v_{zy} = \pm \sqrt{260.44}$$

$$v_{zy} = \pm 16.138$$

$$v_{zy} = -16.14 \text{ m/s}$$

② $v_y = v_{0y} + a_y t$

$$t = \frac{v_y - v_{0y}}{a_y}$$

$$t = \frac{-16.14 - (5)}{-9.81}$$

$$t = 2.15s$$

Solve point 1

$$v_y^2 = v_{0y}^2 + 2a_y(y_1 - y_0)$$

$$(y_1 - y_0) = \frac{v_{1y}^2 - v_{0y}^2}{2a_y}$$

$$y_1 = \frac{v_{1y}^2 - v_{0y}^2}{2a_y} + y_0$$

$$y_1 = \frac{(0)^2 - (15)^2}{2(-9.81)} + 12$$

$$y_1 = 13.3 \text{ m}$$

Jan 13.23 ②

Solve V point 3

$$V_{y3}^2 = V_{0y}^2 + 2a_y(y_3 - y_0)$$

$$V_{y3} = \pm \sqrt{V_{0y}^2 + 2a_y(y_3 - y_0)}$$

$$V_{y3} = \pm \sqrt{(5)^2 + 2(-9.81)(5 - 12)}$$

$$V_{y3} = \pm 12.7$$

$$V_{y3} = -12.7 \text{ m/s}$$

Solve time point 3

$$V_y = V_{0y} + a_y t_3$$

$$t_3 = \frac{V_y - V_{0y}}{a_y}$$

$$t_3 = \frac{-12.7 - (5)}{-9.81}$$

$$t_3 = 1.8 \text{ s}$$

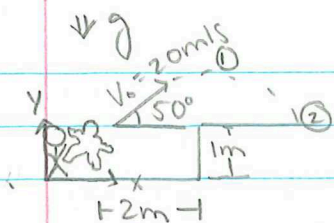
Solve V at point 4

$$V_{4y}^2 = V_{0y}^2 + 2a_y(y_4 - y_0)$$

$$V_{4y} = \pm \sqrt{V_{0y}^2 + 2a_y(y_4 - y_0)}$$

Error.

③



How high and far does the rock go? Jan. 13.23

x direction

$x_0 = 0$

$x_1 =$

$x_2 =$

$v_{0x} = 12.86$

$v_{1x} = 12.86$

$v_{2x} = 12.86$

$a_x = 0$ (no gravity)

y direction

$y_0 = 0$

$y_1 = 11.9m$

$y_2 = 1$

$v_{0y} = 15.32$

$v_{1y} = 0$

$v_{2y} = -14.67m/s$

$a_y = -9.81$

time

$t_1 =$

$t_2 = 0.067$

SOH CAH TOA

$\sin 50 = \frac{y}{20}$

$y = 15.32$ STOA

$\cos 50 = \frac{x}{20}$

$x = 12.86$ STOB

Solve point 2 V_y

$V_{2y}^2 = V_{0y}^2 + 2a_y(y_2 - y_0)$

$V_{2y} = \pm \sqrt{(15.32)^2 + 2(-9.81)(1-0)}$

$V_{2y} = \pm 14.67$

$V_{2y} = 14.67m/s$

Solve t_2

$V_{2y} = V_{0y} + a t_2$

$\frac{V_{2y} - V_{0y}}{a} = t_2$

$t_2 = \frac{-14.67 - 15.32}{-9.81}$

$t_2 = 3.05$

Solve point 1 y_1

$V_{1y}^2 = V_{0y}^2 + 2a_y(y_1 - y_0)$

$(y_1 - y_0) = \frac{V_{1y}^2 - V_{0y}^2}{2a_y}$

$y_1 = \frac{V_{1y}^2 - V_{0y}^2}{2a_y} + y_0$

$y_1 = \frac{0^2 - (15.3)^2}{2(-9.81)} + 0$

$y_1 = 11.9m$

Solve

$x_2 = x_0 + V_{0x}t + \frac{1}{2}a_x t^2$

$x_2 = x_0 + V_{0x}t$

$x_2 = 0 + (12.8)(3.05)$

$x_2 = 39.04m$

Kinematics

x-direction

Jan. 13, 23

$$\vec{v} = \vec{v}_0 + \vec{a}t$$

$$v_x = v_{0x} + a_x t$$

$$\vec{x} = \vec{x}_0 + \vec{v}_0 t + \frac{1}{2} \vec{a} t^2 \Rightarrow x = x_0 + v_{0x} t + \frac{1}{2} a_x t^2$$

$$v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$$

$$\vec{v}^2 = \vec{v}_0^2 + 2\vec{a}(\vec{x} - \vec{x}_0)$$

↓

y-direction

Recipe

$$v_y = v_{0y} + a_y t$$

establish 

$$x = x_0 + v_{0x} t + \frac{1}{2} a_x t^2$$

• make variable list

$$x_0 =$$

$$x_1 =$$

$$v_{x0} =$$

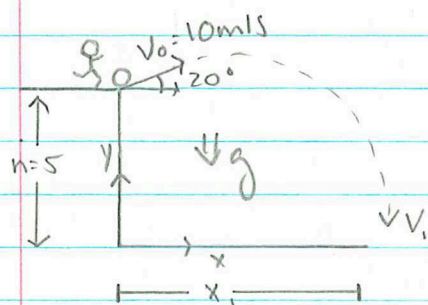
$$v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$$

• find equation to solve unknown

• solve

• update list

Jan 18.23 ①

x direction

$$\begin{aligned} x_0 &= 0 \\ x_1 &= 13.3 \\ v_{0x} &= 9.40 \\ v_{1x} &= 9.40 \\ a_x &= 0 \end{aligned}$$

y direction

$$\begin{aligned} y_0 &= 5 \\ y_1 &= 0 \\ v_{0y} &= 3.42 \\ v_{1y} &= -10.48 \\ a_y &= -9.81 \text{ m/s}^2 \end{aligned}$$

time

$$t_1 = 1.42 \text{ s}$$

$$\sin 20 = \frac{v_{0y}}{10} \quad v_{0y} = 3.42$$

$$\cos 20 = \frac{v_{0x}}{10} \quad v_{0x} = 9.40$$

① Solve v_{1y}

$$v_{1y}^2 = v_{0y}^2 + 2a_y(y_1 - y_0)$$

$$v_{1y}^2 = (3.42)^2 + 2(-9.81)(0 - 5) \quad x_1 = 0 + 9.40(1.42)$$

$$v_{1y} = \pm 10.48$$

③ Solve x_1

$$x_1 = x_0 + v_{0x}t$$

$$x_1 = 13.3$$

$$v_{1y} = -10.48 \text{ m/s}$$

④ final velocity

$$|v_1| = \sqrt{(9.4)^2 + (-10.5)^2}$$

② Solve time

$$v_{1y} = v_{0y} + a_y t$$

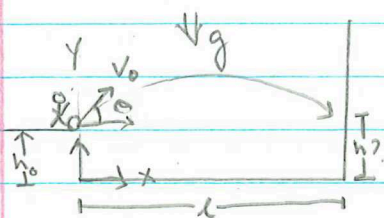
$$|v_1| = 14.1 \text{ m/s}$$

$$-10.48 = 3.42 + (-9.81)(t)$$

$$\frac{-10.48 - 3.42}{-9.81} = t$$

$$t_1 = 1.42 \text{ s}$$

Jan. 17.23 ①



$l = 5\text{m}$ $\theta = 30^\circ$
 $v_0 = 35\text{m/s}$ $h_0 = 1$

x direction

$x_0 = 0\text{m}$
 $x_1 = 5\text{m}$
 $v_{0x} = 30.3$
 $v_{1x} = 30.3$
 $a_x = 0$

y direction

$y_0 = 1\text{m}$
 $y_1 = 3.75\text{m}$
 $v_{0y} = 17.5$
 $v_{1y} = \text{not needed (15.88)}$
 $a_y = -9.81\text{m/s}^2$

time

$t_1 = 0.165\text{s}$

$\sin 30^\circ = \frac{v_{0y}}{35} = 17.5$ ① Solve for time
 $x_1 = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$

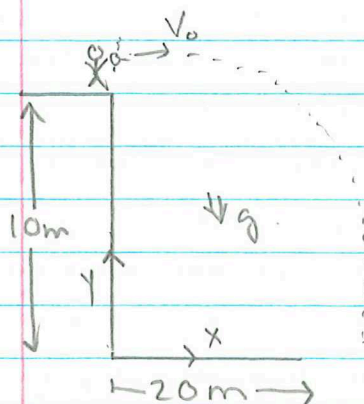
$\cos 30^\circ = \frac{v_{0x}}{35} = 30.3$ $5 = 0 + 30.3(t)$

Solve for y_1 $t = \frac{5}{30.3} = 0.165\text{s}$
 ② $y_1 = y_0 + v_{0y}t + \frac{1}{2}a_y t^2$

$y_1 = 1 + 17.5(0.165) + \frac{1}{2}(-9.81)(0.165)^2$

$y_1 = 3.75\text{m}$

Jan 18.23②

x direction

$x_0 = 0$

$x_1 = 20$

$V_{0x} = 14.0$

$V_{1x} = 14.0$

$a_x = 0$

y direction

$y_0 = 10$

$y_1 = 0$

$V_{0y} = 0$

$V_{1y} = -14.0 \text{ m/s}$

$a_y = -9.81$

time

$t_1 = 1.42$

① Solve V_{1y}

$$V_{1y}^2 = V_{0y}^2 + 2a_y(y_1 - y_0)$$

③ $x_1 = x_0 + V_{0x}t + \frac{1}{2}a_x t^2$

$$V_{1y}^2 = 0^2 + 2(-9.81)(0 - 10)$$

$$20 = 0 + V_{0x}(1.42)$$

$$V_{1y} = \pm 14.0 \text{ m/s}$$

$$V_{0x} = 14.0 \text{ m/s}$$

$$V_{1y} = -14.0 \text{ m/s}$$

② Solve time

$$V_{1y} = V_{0y} + a_y t$$

$$-14.0 = 0 + (-9.81)t$$

$$t = 1.42 \text{ s}$$

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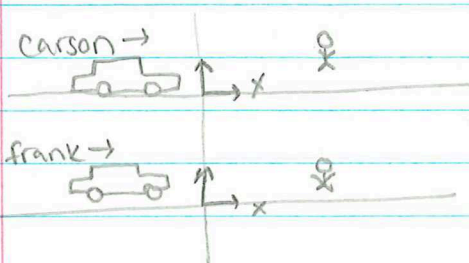
assume

$$a_{\text{brakes}} = 7.0 \text{ m/s}^2$$

difference in stopping distance

$$V_{\text{carson}} = 11 \text{ m/s (40 km/hr)}$$

$$V_{\text{frank}} = 19.4 \text{ m/s (70 km/hr)}$$



carson

$$x_0 = 0$$

$$x_i =$$

$$V_{0x} = 11$$

$$V_{ix} = 0$$

$$a = -7.0$$

frank

$$x_0 = 0$$

$$x_i =$$

$$V_{0x} = 19.4$$

$$V_{ix} = 0$$

$$a = -7.0$$

carson x_i

$$V_i^2 = V_0^2 + 2(a)(x_i - x_0)$$

$$0 = (11)^2 + (2)(-7.0)(x_i - 0)$$

$$\frac{-121}{-14} = x_i$$

$$x_i = 8.64 \text{ m}$$

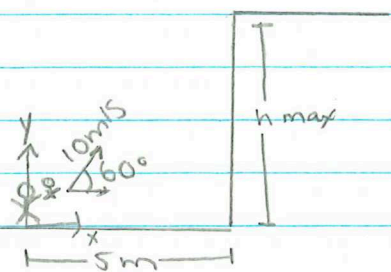
frank x_i

$$V_i^2 = V_0^2 + 2a(x_i - x_0)$$

$$0 = (19.4)^2 + (2)(-7.0)(x_i - 0)$$

$$\frac{-376.36}{-14} = 26.9 \text{ m}$$

Jan 18.23 (4)



x dir	y dir	time
$x_0 = 0$	$y_0 = 0$	$t_1 = 0.5775$
$x_1 = 5$	$y_1 =$	
$v_{0x} = 5.00$	$v_{0y} = 8.66$	
$v_{1x} = 5.00$	$v_{1y} =$	
$a_x = 0$	$a_y = -9.81$	

$$\sin 60 = \frac{v_{0y}}{10} \quad v_{0y} = 8.66$$

$$\cos 60 = \frac{v_{0x}}{10} \quad v_{0x} = 5.00$$

Solve time

$$x_1 = x_0 + v_0 t + \frac{1}{2} a t^2$$

$$5 = 0 + 5.00(t)$$

② Solve y_1

$$t = 1s$$

$$y_1 = y_0 + v_{0y} t + \frac{1}{2} a_y t^2$$

$$y_1 = 0 + 8.66(1) + \frac{1}{2}(-9.81)(1)^2$$

$$y_1 = 3.75$$

Kinematics

Newton's Law

Jan 20.23 ①

$$\vec{v} = \vec{v}_0 + \vec{a}t$$

$$\vec{x} = \vec{x}_0 + \vec{v}_0t + \frac{1}{2}\vec{a}t^2$$

$$\vec{v}^2 = \vec{v}_0^2 + 2\vec{a}(\vec{x} - \vec{x}_0)$$

$$\vec{v} = \frac{d\vec{x}}{dt}$$

$$\vec{a} = \frac{d\vec{v}}{dt} = \text{constant}$$

1. An object will stay in motion unless acted on by a force.

$$2. \sum \vec{F} = m\vec{a}$$

← mass
↑ acceleration

3. Every action will have an equal and opposite reaction (force)

A force will change an object's motion.

Types of forces

• Electromagnetic force $\left\{ \begin{array}{l} \text{Chemistry} \\ \text{magnets} \end{array} \right\}$ $\left\{ \begin{array}{l} \text{covalent} \\ \text{photons} \end{array} \right\}$ } micro-
scopic

• Gravity force = $F_g = \frac{Gm_1m_2}{r^2}$ $\left\{ \begin{array}{l} \text{friction} \\ \text{Air drag} \end{array} \right\}$ } macro-
scopic
tidal forces from the moon

• Strong force $\left\{ \begin{array}{l} \text{Keep atoms together} \end{array} \right\}$

• Weak force $\left\{ \begin{array}{l} \text{nuclear decay} \\ \text{radiation} \end{array} \right\}$ $\left(1\text{Kg} \right) = \# \text{ of atoms in a caesium ball}$

Kinematics

x-direction

Jan. 13. 23

$$\vec{v} = \vec{v}_0 + \vec{a}t$$

$$v_x = v_{0x} + a_x t$$

$$\vec{x} = \vec{x}_0 + \vec{v}_0 t + \frac{1}{2} \vec{a} t^2 \Rightarrow$$

$$x = x_0 + v_{0x} t + \frac{1}{2} a_x t^2$$

$$v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$$

$$\vec{v}^2 = \vec{v}_0^2 + 2\vec{a}(\vec{x} - \vec{x}_0)$$

⇓

y-direction

Recipe

$$v_y = v_{0y} + a_y t$$

• establish $\begin{matrix} y \\ \uparrow \\ \text{ } \\ \downarrow \\ x \end{matrix}$

$$x = x_0 + v_{0x} t + \frac{1}{2} a_x t^2$$

• make variable list

$x_0 =$

$x_i =$

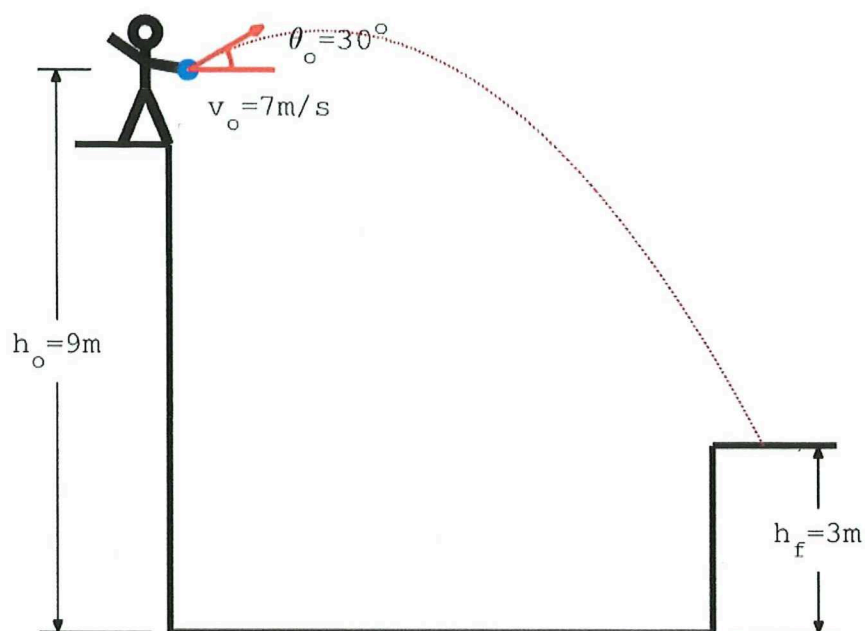
$v_{x0} =$

$$v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$$

• find equation to solve unknown

• solve

• update list



Determine the time it takes for the ball to hit the ground. Answer to 2 decimal places.

Selected Answer: ❌ 1.46

Correct Answer: ✅ 1.52

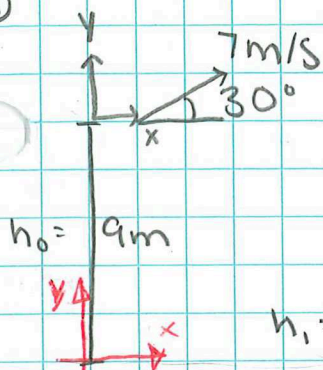
Answer range +/- 0.02 (1.50 - 1.54)

Question 2

0 out of 1 points

Attempt 3.

①



$$\sin 30 = \frac{y}{7}$$

$$V_y = 3.5$$

$$\cos 30 = \frac{x}{7}$$

$$V_x = 6.062177826$$

X

$$x_0 =$$

$$x_1 =$$

$$V_{0x} = 6.06$$

$$V_{1x} = 6.06$$

$$a_x = 0$$

Y

$$y_0 = 9$$

$$y_1 = 3$$

$$V_{0y} = 3.5$$

$$V_{1y} = \checkmark$$

$$a_y = -9.81$$

t

$$t = ?$$

$$V_{1y}^2 = V_{0y}^2 + 2a(y_1 - y_0)$$

$$V_{1y}^2 = (3.5)^2 + 2(-9.81)(3-9)$$

$$V_{1y}^2 = 12.25 + 117.72$$

$$V_{1y} = \pm 10.84988479$$

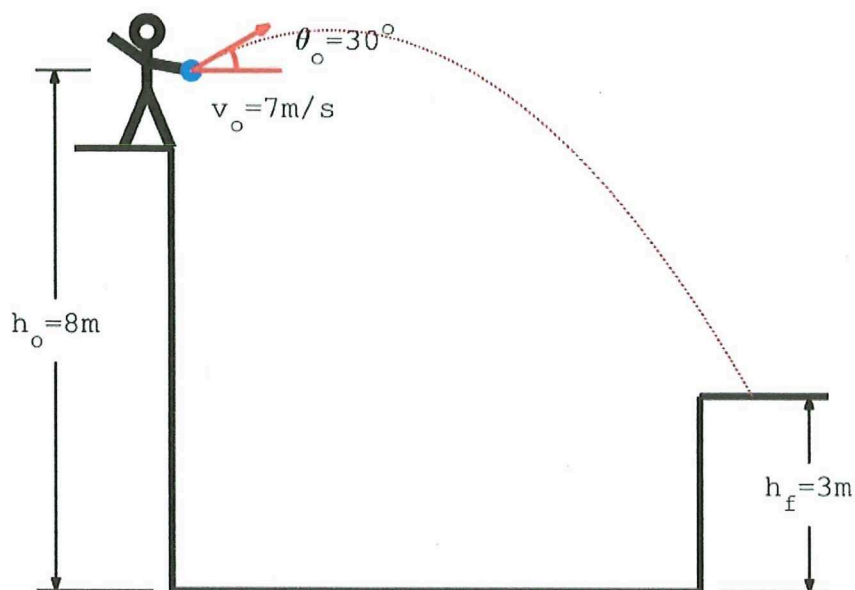
$$V_{1y} = -10.84988479$$

$$= -11.4$$

$$V_{1y} = V_{0y} + a_y t$$

$$\frac{-10.84988479 - 3.5}{-9.81} = t$$

$$t = 1.46 \text{ s} \quad \times \quad A = 1.52 \text{ s}$$



Determine the velocity magnitude of the ball just before it hits the ground. Answer to 2 decimal places.

Selected Answer: 11.61

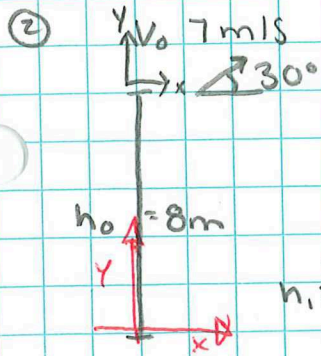
Correct Answer: 12.13

Answer range +/- 0.02 (12.11 - 12.15)

Wednesday, February 1, 2023 8:46:05 AM EST

← OK

Attempt 3.



$$\sin 30 = \frac{y}{7}$$

$$V_{0y} = 3.5$$

$$\cos 30 = \frac{x}{7}$$

$$V_{0x} = 6.062177826$$

$$\begin{matrix} x \\ x_0 = 0 \\ x_1 = \end{matrix}$$

$$V_{0x} = 6.06$$

$$V_{1x} = 6.06$$

$$a_x = 0$$

$$\begin{matrix} y \\ y_0 = 8 \\ y_1 = 3 \end{matrix}$$

$$V_{0y} = 3.5$$

$$V_{1y} =$$

$$a_y = -9.81$$

$$\begin{matrix} t \\ t = \end{matrix}$$

$$V_{1y}^2 = V_{0y}^2 + 2a(y_1 - y_0)$$

$$V_{1y}^2 = (3.5)^2 + 2(-9.81)(3 - 8)$$

$$V_{1y}^2 = 12.25 + 98.1$$

$$V_{1y} = \pm 9.90454412$$

$$V_{1y} = -9.90454412$$

$$V_{1x} = -10.5$$

$$V_{x1} = 6.06$$

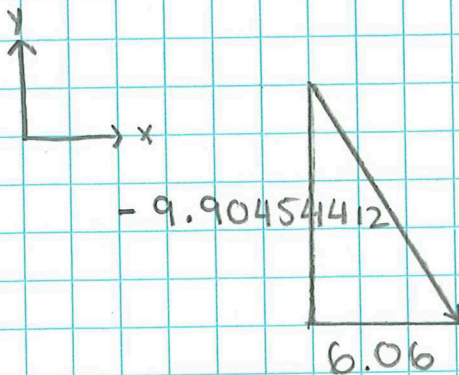
$$V_{1y} = V_{0y} + at$$

$$\frac{-9.90454412 - 3.5}{-9.81} = t$$

$$V_1 = \sqrt{V_{x1}^2 + V_{y1}^2}$$

$$-3.5 - = 12.12$$

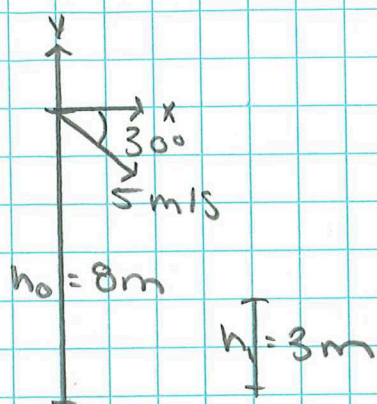
$$t = 1.366416352 \text{ s}$$



$$a^2 + b^2 = c^2$$

$$11.61 = c$$

$$A = 12.13$$



$$\sin 30 = \frac{V_{0y}}{5}$$

$$V_{0y} = -2.5$$

$$\cos 30 = \frac{V_{0x}}{5}$$

$$V_{0x} = 4.330127019$$

$$\underline{x}$$

$$x_0 = 0$$

$$x_1 =$$

$$V_{0x} = 4.33$$

$$V_{1x} = 4.33$$

$$a_x = 0$$

$$\underline{y}$$

$$y_0 = 0$$

$$y_1 = -5$$

$$V_{0y} = -2.5$$

$$V_{1y} =$$

$$a_y = -9.81$$

$$\underline{t}$$

$$t =$$

$$V_{1y}^2 = V_{0y}^2 + 2\vec{a}(y_1 - y_0)$$

$$V_{1y}^2 = (-2.5)^2 + 2(-9.81)(-5 - 0)$$

$$V_{1y}^2 = 6.25 + 98.1$$

$$V_{1y} = \pm 10.21518478$$

$$V_{1y} = -10.21518478$$

$$V_{1y} = V_{0y} + a t$$

$$-10.21518478 = -2.5 + (-9.81)t$$

$$\frac{-10.21518478 + 2.5}{-9.81} = t$$

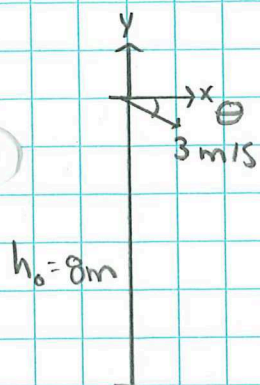
$$t = 0.7864612418$$

$$x_1 = \cancel{x_0}^0 + 4.33(0.786) + \frac{1}{2} a t^2$$

$$x_1 = 3.405$$

$$|a| = \sqrt{V_{1y}^2 + V_{1x}^2}$$

$$= 11.09$$



$$\sin 30 = \frac{V_{0y}}{3}$$

$$V_{0y} = -1.5$$

$$\cos 30 = \frac{V_{0x}}{3}$$

$$V_{0x} = -2.598076211$$

$$\begin{array}{l} \underline{x} \\ x_0 = 0 \\ x_1 = ? \end{array}$$

$$V_{0x} = +2.59$$

$$V_{1x} = +2.59$$

$$a_x = 0$$

$$\begin{array}{l} \underline{y} \\ y_0 = 0 \\ y_1 = -5 \end{array}$$

$$V_{0y} = -1.5$$

$$V_{1y} = -10.0$$

$$a_y = -9.81$$

$$\begin{array}{l} \underline{t} \\ t = ? \end{array}$$

$$V_{1y}^2 = V_{0y}^2 + 2a(y_1 - y_0)$$

$$V_{1y}^2 = (-1.5)^2 + 2(-9.81)(-5 - 0)$$

$$V_{1y}^2 = 2.25 + 98.1$$

$$V_{1y} = \pm 10.01748471$$

$$V_{1y} = -10.01748471$$

$$V_{1y} = V_{0y} + a_y t$$

$$\frac{-10.01748471 + 1.5}{-9.81} = t$$

$$t = 0.868245128$$

$$x_1 = x_0 + V_{0x}t + \frac{1}{2}a_x t^2$$

$$x_1 = 0 + (+2.59)(0.868) + \frac{1}{2}(0)(0.868)^2$$

$$x_1 = 2.248754884$$