

Today: Sections 2.5 & 2.6

L6



Today: Sections 2.5 & 2.6

L6


Free
fall



Today: Sections 2.5 & 2.6

L6

Velocity
& position
by integration



Today: Sections 2.5 & 2.6

L6

Friday: Sections 3.1 & 3.2

Today: Sections 2.5 & 2.6

L6

Friday: Sections 3.1 & 3.2

Position
& velocity
vectors

Today: Sections 2.5 & 2.6

L6

Friday: Sections 3.1 & 3.2

Acceleration
vector

Today: Sections 2.5 & 2.6

L6

Friday: Sections 3.1 & 3.2

Monday: Holiday 😊

Today: Sections 2.5 & 2.6

L6

Friday: Sections 3.1 & 3.2

Monday: Holiday 😊

HW #1 Due today

Today: Sections 2.5 & 2.6

L6

Friday: Sections 3.1 & 3.2

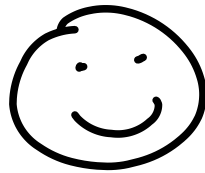
Monday: Holiday 😊

HW #1 Due today

HW #2 Due Friday

Now SI Leader

Marika Cunningham will
talk to us for a few
minutes



Freely falling objects

Freely falling objects

Let $g \equiv$ acceleration due to gravity

Freely falling objects

Let $g \equiv$ acceleration due to gravity

$$g = 32.2 \frac{\text{ft}}{\text{s}^2}$$

Freely falling objects

Let $g \equiv$ acceleration due to gravity

$$g = 32.2 \frac{\text{ft}}{\text{s}^2} \quad \& \quad g = 9.81 \frac{\text{m}}{\text{s}^2}$$

Freely falling objects

Let $g \equiv$ acceleration due to gravity

$$g = 32.2 \frac{\text{ft}}{\text{s}^2} \quad \& \quad g = 9.81 \frac{\text{m}}{\text{s}^2}$$

Near earth's surface

Freely falling objects

Let $g \equiv$ acceleration due to gravity

$$g = 32.2 \frac{\text{ft}}{\text{s}^2} \quad \& \quad g = 9.81 \frac{\text{m}}{\text{s}^2}$$

Near earth's surface

Other examples :

Freely falling objects

Let $g \equiv$ acceleration due to gravity

$$g = 32.2 \frac{\text{ft}}{\text{s}^2} \quad \& \quad g = 9.81 \frac{\text{m}}{\text{s}^2}$$

Near earth's surface

Other examples :

$$g_{\text{moon}} = 1.6 \text{ m/s}^2$$

Freely falling objects

Let $g \equiv$ acceleration due to gravity

$$g = 32.2 \frac{\text{ft}}{\text{s}^2} \quad \& \quad g = 9.81 \frac{\text{m}}{\text{s}^2}$$

Near earth's surface

Other examples :

$$g_{\text{moon}} = 1.6 \frac{\text{m}}{\text{s}^2}$$

$$g_{\text{sun}} = 270 \frac{\text{m}}{\text{s}^2}$$

Freely falling objects

Let $g \equiv$ acceleration due to gravity

$$g = 32.2 \frac{\text{ft}}{\text{s}^2} \quad \& \quad g = 9.81 \frac{\text{m}}{\text{s}^2}$$

Near earth's surface

Other examples :

$$g_{\text{moon}} = 1.6 \frac{\text{m}}{\text{s}^2}$$

$$g_{\text{sun}} = 270 \frac{\text{m}}{\text{s}^2}$$

Near surface

Freely falling objects

Let $g \equiv$ acceleration due to gravity

$$g = 32.2 \frac{\text{ft}}{\text{s}^2} \quad \& \quad g = 9.81 \frac{\text{m}}{\text{s}^2}$$

Near earth's surface

Other examples :

$$g_{\text{moon}} = 1.6 \frac{\text{m}}{\text{s}^2}$$

$$g_{\text{sun}} = 270 \frac{\text{m}}{\text{s}^2}$$

Near surface

Note: g is always positive

Freely falling objects

Let $g \equiv$ acceleration due to gravity

$$g = 32.2 \frac{\text{ft}}{\text{s}^2} \quad \& \quad g = 9.81 \frac{\text{m}}{\text{s}^2}$$

Near earth's surface

Other examples :

$$g_{\text{moon}} = 1.6 \frac{\text{m}}{\text{s}^2}$$

$$g_{\text{sun}} = 270 \frac{\text{m}}{\text{s}^2}$$

Near surface

Note: g is always positive. So
 $-g$ is always negative

Example : Coin dropped from
tower & falls freely

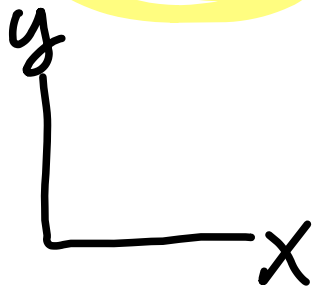
Example : Coin dropped from tower & falls freely {No air resistance}.

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t = 1.0\text{s}, 2.0\text{s}, 3.0\text{s}$

Example: Coin dropped from tower & falls freely {No air resistance}.

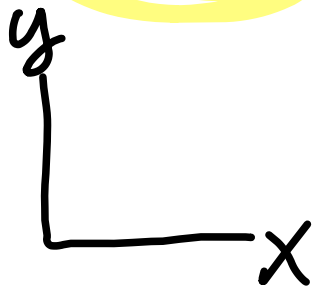
Find position & velocity at $t=1.0s, 2.0s, 3.0s$



In setting coordinate system such that $x_0 = y_0 = 0$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$

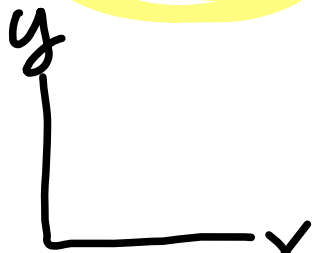


In setting coordinate system such that $x_0 = y_0 = 0$

$$y = -\frac{1}{2}gt^2 - v_{y0}t + y_0$$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$

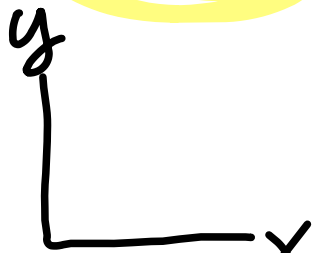


In setting coordinate system such that $x_0 = y_0 = \theta$

$$y = -\frac{1}{2}gt^2 - \cancel{y_0}t + \cancel{y_0}$$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$

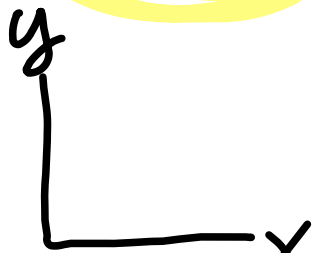


In setting coordinate system such that $x_0 = y_0 = \theta$

$$y = -\frac{1}{2}gt^2 - \cancel{y_0}t + \cancel{y_0} = -\frac{1}{2}gt^2$$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$



In setting coordinate system such that $x_0=y_0=0$

$$y = -\frac{1}{2}gt^2 - \cancel{v_{y0}}t + \cancel{y_0} = -\frac{1}{2}gt^2$$

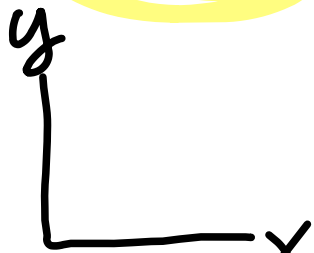
Note: Could

have had orientation of coordinate system like



Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$



In setting coordinate system such that $x_0=y_0=0$

$$y = -\frac{1}{2}gt^2 - \cancel{v_{y0}}t + \cancel{y_0} = -\frac{1}{2}gt^2$$

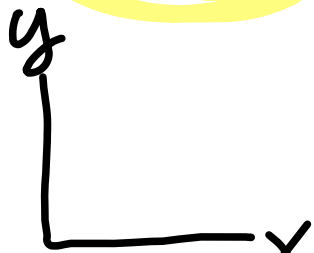
Note: Could

have had orientation of coordinate system like

In such a case
 $y = +\frac{1}{2}gt^2$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$



In setting coordinate system such that $x_0=y_0=0$

$$y = -\frac{1}{2}gt^2 - \cancel{v_{y0}}t + \cancel{y_0} = -\frac{1}{2}gt^2$$

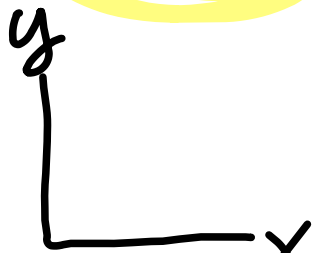
Note: Could

have had orientation of coordinate system like

In such a case
 $y = +\frac{1}{2}gt^2$
Down is positive!

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$



In setting coordinate system such that $x_0 = y_0 = \theta$

$$y = -\frac{1}{2}gt^2 - \cancel{y_0}t + \cancel{y_0} = -\frac{1}{2}gt^2$$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$



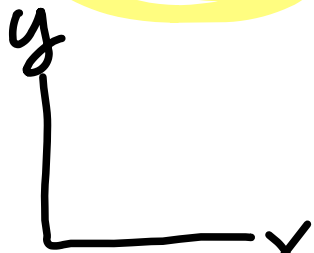
In setting coordinate system such that $x_0 = y_0 = \theta$

$$y = -\frac{1}{2}gt^2 - \cancel{y_0}t + \cancel{y_0} = -\frac{1}{2}gt^2 \quad \text{So}$$

$$y(1s) = -\left(\frac{9.8}{2}\right)\left(\frac{m}{s^2}\right)(1s)^2 = -4.9m$$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$



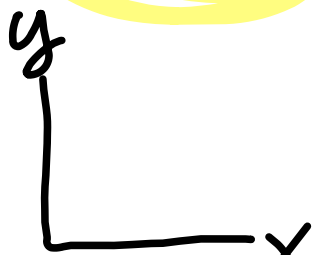
In setting coordinate system such that $x_0 = y_0 = 0$

$$y = -\frac{1}{2}gt^2 - \cancel{y_0}t + \cancel{y_0} = -\frac{1}{2}gt^2 \quad \text{So}$$

$$y(2s) = -\left(\frac{9.8}{2}\right)\left(\frac{m}{s^2}\right)(2s)^2 = -19.6m$$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$



In setting coordinate system such that $x_0 = y_0 = 0$

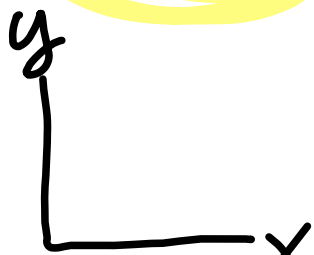
$$y = -\frac{1}{2}gt^2 - \cancel{y_0}t + \cancel{y_0} = -\frac{1}{2}gt^2 \quad \text{So}$$

$$y(2s) = -\left(\frac{9.8}{2}\right)\left(\frac{m}{s^2}\right)(2s)^2 = \underbrace{-19.6m}$$

too many sig figs!

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$



In setting coordinate system such that $x_0 = y_0 = 0$

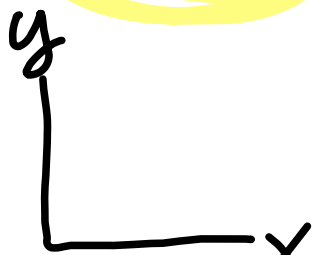
$$y = -\frac{1}{2}gt^2 - \cancel{v_{y0}}t + \cancel{y_0} = -\frac{1}{2}gt^2 \quad \text{So}$$

$$y(2s) = -\left(\frac{9.8}{2}\right)\left(\frac{m}{s^2}\right)(2s)^2 = \underbrace{-19.6m}_{\text{Right sig figs}} = 20m \text{ figs}$$

too many sig figs!

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$



In setting coordinate system such that $x_0 = y_0 = 0$

$$y = -\frac{1}{2}gt^2 - \cancel{y_0}t + \cancel{y_0} = -\frac{1}{2}gt^2 \quad \text{So}$$

$$y(3s) = -\left(\frac{9.8}{2}\right)\left(\frac{m}{s^2}\right)(3s)^2 = 44m$$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t = 1.0\text{s}, 2.0\text{s}, 3.0\text{s}$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t = 1.0\text{s}, 2.0\text{s}, 3.0\text{s}$

$$v = -gt + v_0$$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t = 1.0\text{s}, 2.0\text{s}, 3.0\text{s}$

$$v = -gt + v_0$$

Starts at rest

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t = 1.0s, 2.0s, 3.0s$

$$v = -gt + v_0 \Rightarrow v(1s) = \left(-9.8 \frac{m}{s^2}\right)(1s)$$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t = 1.0\text{s}, 2.0\text{s}, 3.0\text{s}$

$$v = -gt + v_0 \Rightarrow v(1\text{s}) = (-9.8 \frac{\text{m}}{\text{s}^2})(1\text{s})$$
$$= 9.8 \text{ m/s}$$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t = 1.0s, 2.0s, 3.0s$

$$v = -gt + v_0 \Rightarrow v(2s) = (-9.8 \frac{m}{s^2})(2s)$$

$$= 19.6 \frac{m}{s}$$

$$= \boxed{20 \frac{m}{s}}$$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t = 1.0s, 2.0s, 3.0s$

$$v = -gt + v_0 \Rightarrow v(3s) = \left(-9.8 \frac{m}{s^2}\right)(3s)$$
$$= \boxed{29 \frac{m}{s}}$$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$

So

at $t=1s$, $y=4.9m$ & $v=-9.8m/s$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$

So

at $t=1s$, $y = -4.9m$ & $v = -9.8m/s$

at $t=2s$, $y = -20m$ & $v = -20m/s$

Example: Coin dropped from tower & falls freely {No air resistance}.

Find position & velocity at $t=1.0s, 2.0s, 3.0s$

So

at $t=1s$, $y = -4.9m$ & $v = -9.8m/s$

at $t=2s$, $y = -20m$ & $v = -20m/s$

at $t=3s$, $y = -44m$ & $v = -29m/s$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s ; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.



You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s ; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$$v_0 = 15 \text{ m/s}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s ; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$$v_0 = 15 \text{ m/s}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s ; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$
& positive y is up

$$v_0 = 15 \text{ m/s}, \quad a = -g$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$$v_0 = 15 \text{ m/s}, \quad a = -g$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s ; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up
 $v_0 = 15 \text{ m/s}$, $a = -g$, Find y at 1 s & 4 s

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y at 1s & 4s

$$y = -\frac{1}{2}gt^2 + v_0t + y_0$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y at 1s & 4s

$$y = -\frac{1}{2}gt^2 + v_0t + \cancel{y_0}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y at 1s & 4s

$$y = -\frac{1}{2}gt^2 + v_0t + \cancel{y_0} \Rightarrow$$

$$y(1s) = \left[\frac{-9.8 \frac{\text{m}}{\text{s}^2}}{2} \right] (1s)^2 + 15 \frac{\text{m}}{\text{s}} (1s)$$
$$= -4.9\text{m} + 15\text{m} = \boxed{10.1\text{m}}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y at 1s & 4s

$$y = -\frac{1}{2}gt^2 + v_0t + \cancel{y_0} \Rightarrow$$

$$y(4s) = \left[\frac{-9.8 \frac{\text{m}}{\text{s}^2}}{2} \right] (4s)^2 + 15 \frac{\text{m}}{\text{s}} (4s)$$

$$= -78.4 \text{ m} + 60 \text{ m} = \boxed{-18.4 \text{ m}}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up
 $v_0 = 15 \text{ m/s}$, $a = -g$, Find v at 1s & 4s

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v at 1s & 4s

$$v = -gt + v_0$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v at 1s & 4s

$$v = -gt + v_0 = (-9.8 \frac{\text{m}}{\text{s}^2})(1 \text{ s}) + 15 \text{ m/s}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v at 1s & 4s

$$v = -gt + v_0 = (-9.8 \frac{\text{m}}{\text{s}^2})(1 \text{ s}) + 15 \text{ m/s}$$

$$= -9.8 \text{ m/s} + 15 \text{ m/s}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v at 1s & 4s

$$v = -gt + v_0 = (-9.8 \frac{\text{m}}{\text{s}^2})(1 \text{ s}) + 15 \text{ m/s}$$

$$= -9.8 \text{ m/s} + 15 \text{ m/s}$$

$$= \boxed{5.2 \text{ m/s}}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v at 1s & 4s

$$\begin{aligned} v &= -gt + v_0 = (-9.8 \frac{\text{m}}{\text{s}^2})(4 \text{ s}) + 15 \text{ m/s} \\ &= -39.2 \text{ m/s} + 15 \text{ m/s} \end{aligned}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v at 1s & 4s

$$v = -gt + v_0 = (-9.8 \frac{\text{m}}{\text{s}^2})(4 \text{ s}) + 15 \text{ m/s}$$

$$= -39.2 \text{ m/s} + 15 \text{ m/s}$$

$$= \boxed{-24.2 \text{ m/s}}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s ; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v when $y = 5 \text{ m}$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v when $y = 5 \text{ m}$

Here we have NO time information

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v when $y = 5 \text{ m}$

$$v_x = v_{0x} + a_x t \quad (2.8) \quad t \quad v_x \quad a_x$$

$$x = x_0 + v_{0x} t + \frac{1}{2} a_x t^2 \quad (2.12) \quad t \quad x \quad a_x$$

$$v_x^2 = v_{0x}^2 + 2a_x(x - x_0) \quad (2.13) \quad x \quad v_x \quad a_x$$

$$x - x_0 = \frac{1}{2}(v_{0x} + v_x)t \quad (2.14) \quad t \quad x \quad v_x$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v when $y = 5 \text{ m}$

$$v^2 = v_0^2 + 2(-g)(y - y_0)$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v when $y = 5 \text{ m}$

$$v^2 = v_0^2 + 2(-g)(y - y_0)$$

$$= (15 \text{ m/s})^2 - 2 * (9.8 \frac{\text{m}}{\text{s}^2})(5 \text{ m} - 0)$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v when $y = 5 \text{ m}$

$$v^2 = v_0^2 + 2(-g)(y - y_0)$$

$$= (15 \text{ m/s})^2 - 2 * (9.8 \frac{\text{m}}{\text{s}^2})(5 \text{ m} - 0)$$

$$= 225 \text{ m}^2/\text{s}^2 - 98 \text{ m}^2/\text{s}^2$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v when $y = 5 \text{ m}$

$$v^2 = v_0^2 + 2(-g)(y - y_0)$$

$$= (15 \text{ m/s})^2 - 2 * (9.8 \frac{\text{m}}{\text{s}^2}) (5 \text{ m} - 0)$$

$$= 225 \text{ m}^2/\text{s}^2 - 98 \text{ m}^2/\text{s}^2$$

$$= 127 \text{ m}^2/\text{s}^2$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v when $y = 5 \text{ m}$

$$v^2 = v_0^2 + 2(-g)(y - y_0)$$

$$= (15 \text{ m/s})^2 - 2 * (9.8 \frac{\text{m}}{\text{s}^2})(5 \text{ m} - 0)$$

$$= 225 \text{ m}^2/\text{s}^2 - 98 \text{ m}^2/\text{s}^2$$

$$= 127 \text{ m}^2/\text{s}^2 \Rightarrow v = \sqrt{127} \frac{\text{m}}{\text{s}}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find v when $y = 5 \text{ m}$

$$v^2 = v_0^2 + 2(-g)(y - y_0)$$

$$= (15 \text{ m/s})^2 - 2 * (9.8 \frac{\text{m}}{\text{s}^2}) (5 \text{ m} - 0)$$

$$= 225 \text{ m}^2/\text{s}^2 - 98 \text{ m}^2/\text{s}^2$$

$$= 127 \text{ m}^2/\text{s}^2 \Rightarrow v = \sqrt{127} \frac{\text{m}}{\text{s}} = \boxed{11.3 \frac{\text{m}}{\text{s}}}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$$v_0 = 15 \text{ m/s}, \quad a = -g,$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s ; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y_{max} :

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y_{max} :

Note: function $y(t)$ has a local max or min when $\frac{dy}{dt} = 0$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$$v_0 = 15 \text{ m/s}, \quad a = -g, \quad \underline{\text{Find } y_{\text{max}}:}$$

Note: function $y(t)$ has a local max or min when $\frac{dy}{dt} = 0$

$$\text{But } \frac{dy}{dt} = v$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y_{max} :

Note: function $y(t)$ has a local max or min when $\frac{dy}{dt} = 0$

But $\frac{dy}{dt} = v$ so y_{max} when $v = 0$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y_{max} :

$$v = -gt + v_0$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y_{max} :

$$v = -gt + v_0 \quad \text{So } v = 0 \Rightarrow gt_m = v_0$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y_{max} :

$v = -gt + v_0$ so $v = 0 \Rightarrow gt_m = v_0$,
where t_m is time at y_{max}

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y_{max} :

$v = -gt + v_0$ So $v = 0 \Rightarrow gt_m = v_0$,
where t_m is time at y_{max}

$$\Rightarrow t_m = \frac{v_0}{g}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y_{max} :

$v = -gt + v_0$ So $v = 0 \Rightarrow gt_m = v_0$,
where t_m is time at y_{max}

$\Rightarrow t_m = \frac{v_0}{g}$ Now $y_m = -\frac{g}{2} \left(\frac{v_0}{g}\right)^2 + v_0 \left(\frac{v_0}{g}\right)$


You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y_{max} :

$v = -gt + v_0$ So $v = 0 \Rightarrow gt_m = v_0$,
where t_m is time at y_{max}

$$\Rightarrow t_m = \frac{v_0}{g} \quad \text{Now } y_m = -\frac{g}{2} \left(\frac{v_0}{g}\right)^2 + v_0 \left(\frac{v_0}{g}\right)$$



$$y_m = -\frac{v_0^2}{2g} + \frac{v_0^2}{g}$$


You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y_{max} :

$v = -gt + v_0$ So $v = 0 \Rightarrow gt_m = v_0$,
where t_m is time at y_{max}

$$\Rightarrow t_m = \frac{v_0}{g} \quad \text{Now } y_m = -\frac{g}{2} \left(\frac{v_0}{g}\right)^2 + v_0 \left(\frac{v_0}{g}\right)$$



$$y_m = -\frac{v_0^2}{2g} + \frac{v_0^2}{g} = \frac{v_0^2}{2g}$$


You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y_{max} :

$v = -gt + v_0$ So $v = 0 \Rightarrow gt_m = v_0$,
where t_m is time at y_{max}

$$\Rightarrow t_m = \frac{v_0}{g} \quad \text{Now } y_m = -\frac{g}{2} \left(\frac{v_0}{g}\right)^2 + v_0 \left(\frac{v_0}{g}\right)$$



$$y_m = -\frac{v_0^2}{2g} + \frac{v_0^2}{g} = \frac{v_0^2}{2g} = \frac{225 \text{ m}^2/\text{s}^2}{19.6 \text{ m/s}^2}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find y_{max} :

$v = -gt + v_0$ So $v = 0 \Rightarrow gt_m = v_0$,
where t_m is time at y_{max}

$$\Rightarrow t_m = \frac{v_0}{g} \quad \text{Now } y_m = -\frac{g}{2} \left(\frac{v_0}{g}\right)^2 + v_0 \left(\frac{v_0}{g}\right)$$

$$y_m = -\frac{v_0^2}{2g} + \frac{v_0^2}{g} = \frac{v_0^2}{2g} = \frac{225 \frac{\text{m}^2}{\text{s}^2}}{19.6 \frac{\text{m}}{\text{s}^2}} = \boxed{11.5 \text{ m}}$$



You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up
 $v_0 = 15 \text{ m/s}$, $a = -g$, Find a at y_{max} :

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find a at y_{max} :

This one is trivial 😊

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find a at y_{max} :

This one is trivial 😊

$$a = \text{constant} = -g$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Find a at y_{max} :

This one is trivial 😊

$$a = \text{constant} = -g$$

So

$$a = 9.8 \text{ m/s}^2$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s ; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up
Bonus question:
 $v_0 = 15 \text{ m/s}$, $a = -g$,

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s ; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$$v_0 = 15 \text{ m/s}, \quad a = -g,$$

Bonus question:

Find t at $y = -5.00 \text{ m}$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$$v_0 = 15 \text{ m/s}, \quad a = -g,$$

Bonus question:
Find t at $y = -5.00 \text{ m}$

$$y = -\frac{g}{2}t^2 + v_0t$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

$v_0 = 15 \text{ m/s}$, $a = -g$, Bonus question:
Find t at $y = -5.00 \text{ m}$

$$y = -\frac{g}{2}t^2 + v_0t \Rightarrow \frac{g}{2}t^2 - v_0t + y = 0$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

Bonus question:

$v_0 = 15 \text{ m/s}$, $a = -g$, Find t at $y = -5.00 \text{ m}$

$$y = -\frac{g}{2}t^2 + v_0t \Rightarrow \frac{g}{2}t^2 - v_0t + y = 0$$

Remember quadratic formula:

$$Ax^2 + Bx + C = 0 \Rightarrow$$

$$x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

Bonus question:

$v_0 = 15 \text{ m/s}$, $a = -g$, Find t at $y = -5.00 \text{ m}$

$$y = -\frac{g}{2}t^2 + v_0t \Rightarrow \frac{g}{2}t^2 - v_0t + y = 0$$

$$\text{So } t = \frac{v_0 \pm \sqrt{v_0^2 - 4(\frac{g}{2})y}}{2(\frac{g}{2})}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

Bonus question:

$v_0 = 15 \text{ m/s}$, $a = -g$, Find t at $y = -5.00 \text{ m}$

$$y = -\frac{g}{2}t^2 + v_0t \Rightarrow \frac{g}{2}t^2 - v_0t + y = 0$$

$$\text{So } t = \frac{v_0 \pm \sqrt{v_0^2 - 4(\frac{g}{2})y}}{2(\frac{g}{2})} = \frac{v_0 \pm \sqrt{v_0^2 - 2gy}}{g}$$

You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

Bonus question:

$v_0 = 15 \text{ m/s}$, $a = -g$, Find t at $y = -5.00 \text{ m}$

$$y = -\frac{g}{2}t^2 + v_0t \Rightarrow \frac{g}{2}t^2 - v_0t + y = 0$$

$$\text{So } t = \frac{v_0 \pm \sqrt{v_0^2 - 4(\frac{g}{2})y}}{2(\frac{g}{2})} = \frac{v_0 \pm \sqrt{v_0^2 - 2gy}}{g}$$

$$= \left\{ \frac{15 \pm [225 + 2 \times 9.8 \times 5]^{1/2}}{9.8} \right\} \text{ s}$$



You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

Bonus question:

$v_0 = 15 \text{ m/s}$, $a = -g$, Find t at $y = -5.00 \text{ m}$

$$y = -\frac{g}{2}t^2 + v_0t \Rightarrow \frac{g}{2}t^2 - v_0t + y = 0$$

$$\text{So } t = \frac{v_0 \pm \sqrt{v_0^2 - 4(\frac{g}{2})y}}{2(\frac{g}{2})} = \frac{v_0 \pm \sqrt{v_0^2 - 2gy}}{g}$$

$$= \left\{ \frac{15 \pm [225 + 2 \times 9.8 \times 5]^{1/2}}{9.8} \right\} \text{ s} = \left[\frac{15 \pm 18.0}{9.8} \right] \text{ s}$$



You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

Bonus question:

$v_0 = 15 \text{ m/s}$, $a = -g$, Find t at $y = -5.00 \text{ m}$

$$y = -\frac{g}{2}t^2 + v_0t \Rightarrow \frac{g}{2}t^2 - v_0t + y = 0$$

$$\text{So } t = \frac{v_0 \pm \sqrt{v_0^2 - 4(\frac{g}{2})y}}{2(\frac{g}{2})} = \frac{v_0 \pm \sqrt{v_0^2 - 2gy}}{g}$$

$$= \left\{ \frac{15 \pm [225 + 2 \times 9.8 \times 5]^{1/2}}{9.8} \right\} \text{ s} = \left[\frac{15 \pm 18.0}{9.8} \right] \text{ s}$$

sign does not make sense here



You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. (We ignore air resistance.) On its way back down, it just misses the railing. Find (a) the ball's position and velocity 1.00 s and 4.00 s after leaving your hand; (b) the ball's velocity when it is 5.00 m above the railing; (c) the maximum height reached; (d) the ball's acceleration when it is at its maximum height.

I have chosen coordinate system such that $x_0 = y_0 = 0$ & positive y is up

Bonus question:

$v_0 = 15 \text{ m/s}$, $a = -g$, Find t at $y = -5.00 \text{ m}$

$$y = -\frac{g}{2}t^2 + v_0t \Rightarrow \frac{g}{2}t^2 - v_0t + y = 0$$

$$\text{So } t = \frac{v_0 \pm \sqrt{v_0^2 - 4(\frac{g}{2})y}}{2(\frac{g}{2})} = \frac{v_0 \pm \sqrt{v_0^2 - 2gy}}{g}$$

$$= \left\{ \frac{15 \pm [225 + 2 \times 9.8 \times 5]^{1/2}}{9.8} \right\} \text{ s} = \left[\frac{15 \pm 18.0}{9.8} \right] \text{ s} = \boxed{3.37 \text{ s}}$$



Velocity by integration

Velocity by integration

Since $\frac{dv}{dt} = a$

Velocity by integration

Since $\frac{dv}{dt} = a$ then $dv = a dt$

Velocity by integration

Since $\frac{dv}{dt} = a$ then $\int dv = \int a dt$

Velocity by integration

Since $\frac{dv}{dt} = a$ then $\int dv = \int a dt$

$$\Rightarrow v - v_0 = \int a dt$$

Velocity by integration

Since $\frac{dv}{dt} = a$ then $\int dv = \int a dt$

$$\Rightarrow v - v_0 = \int a dt \Rightarrow v = v_0 + \int a dt$$

Velocity by integration

Since $\frac{dv}{dt} = a$ then $\int dv = \int a dt$

$$\Rightarrow v - v_0 = \int a dt \Rightarrow v = v_0 + \int a dt$$

Velocity by integration

Since $\frac{dv}{dt} = a$ then $\int dv = \int a dt$

$$\Rightarrow v - v_0 = \int a dt \Rightarrow v = v_0 + \int a dt$$

Example: $a = \alpha t$, where $\alpha = 3 \frac{m}{s^3}$

Velocity by integration

Since $\frac{dv}{dt} = a$ then $\int dv = \int a dt$

$$\Rightarrow v - v_0 = \int a dt \Rightarrow v = v_0 + \int a dt$$

Example: $a = \alpha t$, where $\alpha = 3 \frac{m}{s^3}$

Find $v(t)$:

Velocity by integration

Since $\frac{dv}{dt} = a$ then $\int dv = \int a dt$

$$\Rightarrow v - v_0 = \int a dt \Rightarrow v = v_0 + \int a dt$$

Example: $a = \alpha t$, where $\alpha = 3 \frac{m}{s^3}$

Find $v(t)$: $v = v_0 + \int \alpha t dt$

Velocity by integration

Since $\frac{dv}{dt} = a$ then $\int dv = \int a dt$

$$\Rightarrow v - v_0 = \int a dt \Rightarrow v = v_0 + \int a dt$$

Example: $a = \alpha t$, where $\alpha = 3 \frac{m}{s^3}$

Find $v(t)$:

$$v = v_0 + \int \alpha t dt$$
$$= v_0 + \alpha \int t dt$$

Velocity by integration

Since $\frac{dv}{dt} = a$ then $\int dv = \int a dt$

$$\Rightarrow v - v_0 = \int a dt \Rightarrow v = v_0 + \int a dt$$

Example: $a = \alpha t$, where $\alpha = 3 \frac{m}{s^3}$

Find $v(t)$:

$$\begin{aligned} v &= v_0 + \int \alpha t dt \\ &= v_0 + \alpha \int t dt \\ &= v_0 + \frac{1}{2} \alpha t^2 \end{aligned}$$

Velocity by integration

Since $\frac{dv}{dt} = a$ then $\int dv = \int a dt$

$$\Rightarrow v - v_0 = \int a dt \Rightarrow v = v_0 + \int a dt$$

Example: $a = \alpha t$, where $\alpha = 3 \frac{m}{s^3}$

Find $v(t)$:

$$v = v_0 + \int \alpha t dt$$
$$= v_0 + \alpha \int t dt$$

$$\text{so } v = v_0 + \frac{1}{2} \alpha t^2$$

Position by integration

Position by integration

Since $\frac{dx}{dt} = v$

Position by integration

Since $\frac{dx}{dt} = v$ then $dx = v dt$

Position by integration

Since $\frac{dx}{dt} = v$ then $\int dx = \int v dt$

Position by integration

Since $\frac{dx}{dt} = v$ then $\int dx = \int v dt$

$$\Rightarrow x - x_0 = \int v dt$$

Position by integration

Since $\frac{dx}{dt} = v$ then $\int dx = \int v dt$

$$\Rightarrow x - x_0 = \int v dt \Rightarrow x = x_0 + \int v dt$$

Position by integration

Since $\frac{dx}{dt} = v$ then $\int dx = \int v dt$

$$\Rightarrow x - x_0 = \int v dt \Rightarrow x = x_0 + \int v dt$$

Example: $v = v_0 + \frac{1}{2} \alpha t^2$

Position by integration

Since $\frac{dx}{dt} = v$ then $\int dx = \int v dt$

$$\Rightarrow x - x_0 = \int v dt \Rightarrow x = x_0 + \int v dt$$

Example: $v = v_0 + \frac{1}{2} a t^2$

← From
previous
example

where
 $a = \alpha t$

Position by integration

Since $\frac{dx}{dt} = v$ then $\int dx = \int v dt$

$$\Rightarrow x - x_0 = \int v dt \Rightarrow x = x_0 + \int v dt$$

Example: $v = v_0 + \frac{1}{2} \alpha t^2 \Rightarrow$

$$x = x_0 + \int (v_0 + \frac{1}{2} \alpha t^2) dt$$

Position by integration

Since $\frac{dx}{dt} = v$ then $\int dx = \int v dt$

$$\Rightarrow x - x_0 = \int v dt \Rightarrow x = x_0 + \int v dt$$

Example: $v = v_0 + \frac{1}{2} \alpha t^2 \Rightarrow$

$$x = x_0 + \int (v_0 + \frac{1}{2} \alpha t^2) dt = x_0 + v_0 \int dt + \frac{1}{2} \alpha \int t^2 dt$$

Position by integration

Since $\frac{dx}{dt} = v$ then $\int dx = \int v dt$

$$\Rightarrow x - x_0 = \int v dt \Rightarrow x = x_0 + \int v dt$$

Example: $v = v_0 + \frac{1}{2} \alpha t^2 \Rightarrow$

$$x = x_0 + \int (v_0 + \frac{1}{2} \alpha t^2) dt = x_0 + v_0 \int dt + \frac{1}{2} \alpha \int t^2 dt$$

Let $t_0 = 0$

Position by integration

Since $\frac{dx}{dt} = v$ then $\int dx = \int v dt$

$$\Rightarrow x - x_0 = \int v dt \Rightarrow x = x_0 + \int v dt$$

Example: $v = v_0 + \frac{1}{2} \alpha t^2 \Rightarrow$

$$x = x_0 + \int (v_0 + \frac{1}{2} \alpha t^2) dt = x_0 + v_0 \int dt + \frac{1}{2} \alpha \int t^2 dt$$

Let $t_0 = 0$, now

Position by integration

$$\text{Since } \frac{dx}{dt} = v \text{ then } \int dx = \int v dt$$

$$\Rightarrow x - x_0 = \int v dt \Rightarrow x = x_0 + \int v dt$$

Example: $v = v_0 + \frac{1}{2} \alpha t^2 \Rightarrow$

$$x = x_0 + \int (v_0 + \frac{1}{2} \alpha t^2) dt = x_0 + v_0 \int dt + \frac{1}{2} \alpha \int t^2 dt$$

Let $t_0 = 0$, now

$$x = x_0 + v_0 \int_0^t dt + \frac{1}{2} \alpha \int_0^t t^2 dt$$

Position by integration

Since $\frac{dx}{dt} = v$ then $\int dx = \int v dt$

$$\Rightarrow x - x_0 = \int v dt \Rightarrow \boxed{x = x_0 + \int v dt}$$

Example: $v = v_0 + \frac{1}{2} \alpha t^2 \Rightarrow$

$$x = x_0 + \int (v_0 + \frac{1}{2} \alpha t^2) dt = x_0 + v_0 \int dt + \frac{1}{2} \alpha \int t^2 dt$$

Let $t_0 = 0$, now

$$x = x_0 + v_0 \int_0^t dt + \frac{1}{2} \alpha \int_0^t t^2 dt = \underline{\underline{x_0 + v_0 t + \frac{1}{6} \alpha t^3}}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50 \text{ m}$. Her x -acceleration as a function of time is

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50 \text{ m}$. Her x -acceleration as a function of time is

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50 \text{ m}$. Her x -acceleration as a function of time is

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

$$\underline{a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t}$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find v :

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find v : $v = v_0 + \int a dt$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find v : $v = v_0 + \int a dt$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find v : $v = v_0 + \int a dt$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find v :
$$v = v_0 + \int_0^t a \, dt = v_0 + \int_0^t [\alpha - \beta t] \, dt$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

- (a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find v :
$$v = v_0 + \int_0^t a \, dt = v_0 + \int_0^t [\alpha - \beta t] \, dt$$
$$= v_0 + \alpha t - \frac{1}{2} \beta t^2$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

- (a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find v : $v = v_0 + \int_0^t a dt = v_0 + \int_0^t [\alpha - \beta t] dt$

$$= v_0 + \alpha t - \frac{1}{2} \beta t^2 = \underline{10 \text{ m/s} + (2 \text{ m/s}^2)t - (0.05 \text{ m/s}^3)t^2}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find v :
$$v = v_0 + \int_0^t a \, dt = v_0 + \int_0^t [\alpha - \beta t] \, dt$$

$$= v_0 + \alpha t - \frac{1}{2} \beta t^2 = \underline{10 \text{ m/s} + (2 \text{ m/s}^2)t - (0.05 \text{ m/s}^3)t^2}$$

Find x :

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find v : $v = v_0 + \int_0^t a \, dt = v_0 + \int_0^t [\alpha - \beta t] \, dt$

$$= v_0 + \alpha t - \frac{1}{2} \beta t^2 = \underline{10 \text{ m/s} + (2 \text{ m/s}^2)t - (0.05 \text{ m/s}^3)t^2}$$

Find x : $x = x_0 + \int_0^t v \, dt$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find v : $v = v_0 + \int_0^t a \, dt = v_0 + \int_0^t [\alpha - \beta t] \, dt$

$$= v_0 + \alpha t - \frac{1}{2} \beta t^2 = 10 \text{ m/s} + (2 \text{ m/s}^2)t - (0.05 \text{ m/s}^3)t^2$$

Find x : $x = x_0 + \int_0^t v \, dt = x_0 + \int_0^t (v_0 + \alpha t - \frac{1}{2} \beta t^2) \, dt$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find v : $v = v_0 + \int_0^t a \, dt = v_0 + \int_0^t [\alpha - \beta t] \, dt$

$$= v_0 + \alpha t - \frac{1}{2} \beta t^2 = \underline{10 \text{ m/s} + (2 \text{ m/s}^2)t - (0.05 \text{ m/s}^3)t^2}$$

Find x : $x = x_0 + \int_0^t v \, dt = x_0 + \int_0^t (v_0 + \alpha t - \frac{1}{2} \beta t^2) \, dt$

$$\Rightarrow x = x_0 + v_0 t + \frac{1}{2} \alpha t^2 - \frac{1}{6} \beta t^3$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find v : $v = v_0 + \int_0^t a \, dt = v_0 + \int_0^t [\alpha - \beta t] \, dt$

$$= v_0 + \alpha t - \frac{1}{2} \beta t^2 = \underline{10 \text{ m/s} + (2 \text{ m/s}^2)t - (0.05 \text{ m/s}^3)t^2}$$

Find x : $x = x_0 + \int_0^t v \, dt = x_0 + \int (v_0 + \alpha t - \frac{1}{2} \beta t^2) \, dt$

$$\Rightarrow x = x_0 + v_0 t + \frac{1}{2} \alpha t^2 - \frac{1}{6} \beta t^3$$

$$= 50 \frac{\text{m}}{\text{s}} + (10 \frac{\text{m}}{\text{s}})t + (1 \frac{\text{m}}{\text{s}^2})t^2 - \left(\frac{0.1 \text{ m/s}^3}{6}\right)t^3$$



Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$
$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$
$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find t at v_{MAX} :

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$
$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find t at v_{MAX} : Note local max or min when $\frac{dv}{dt} = 0$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find t at v_{MAX} : Note local max or min when $\frac{dv}{dt} = 0$ & since $\frac{dv}{dt} = a$ then local max or min at $a = 0$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$
$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find t at v_{MAX} : setting $a_x = 0$

$$\Rightarrow \quad 0 = \alpha - \beta t$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$
$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find t at v_{MAX} : setting $a_x = 0$

$$\Rightarrow \quad 0 = \alpha - \beta t \quad \Rightarrow \quad \alpha = \beta t$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$\underline{a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}} \\ \alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find t at v_{MAX} : setting $a_x = 0$

$$\Rightarrow \quad 0 = \alpha - \beta t \quad \Rightarrow \quad \alpha = \beta t \quad \Rightarrow$$

$$t = \frac{\alpha}{\beta}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$
$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find t at v_{MAX} : setting $a_x = 0$

$$\Rightarrow \quad 0 = \alpha - \beta t \quad \Rightarrow \quad \alpha = \beta t \quad \Rightarrow$$

$$t = \frac{\alpha}{\beta} = \frac{(2 \text{ m/s}^2)}{(0.1 \text{ m/s}^3)}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$
$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find t at v_{MAX} : setting $a_x = 0$

$$\Rightarrow 0 = \alpha - \beta t \Rightarrow \alpha = \beta t \Rightarrow$$

$$t = \frac{\alpha}{\beta} = \frac{(2 \text{ m/s}^2)}{(0.1 \text{ m/s}^3)} = \boxed{20 \text{ s}}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$\underline{a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}}$$
$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find $v(t=20\text{s})$:

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find $v(t=20\text{s})$: $v = 10 \text{ m/s} + (2 \text{ m/s}^2)t - (0.05 \text{ m/s}^3)t^2$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find $v(t=20\text{s})$: $v = 10 \text{ m/s} + (2 \text{ m/s}^2)t - (0.05 \text{ m/s}^3)t^2 \Rightarrow$

$$v(20\text{s}) = 10 \text{ m/s} + 40 \text{ m/s} - (0.05 \text{ m/s}^3) 400 \text{ s}^2$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find $v(t=20\text{s})$: $v = 10 \text{ m/s} + (2 \text{ m/s}^2)t - (0.05 \text{ m/s}^3)t^2 \Rightarrow$

$$v(20\text{s}) = 10 \text{ m/s} + 40 \text{ m/s} - (0.05 \text{ m/s}^3) 400 \text{ s}^2$$

$$= 50 \text{ m/s} - 20 \text{ m/s}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find $v(t=20\text{s})$: $v = 10 \text{ m/s} + (2 \text{ m/s}^2)t - (0.05 \text{ m/s}^3)t^2 \Rightarrow$

$$v(20\text{s}) = 10 \text{ m/s} + 40 \text{ m/s} - (0.05 \text{ m/s}^3) 400 \text{ s}^2$$

$$= 50 \text{ m/s} - 20 \text{ m/s} = 30 \text{ m/s}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$\underline{a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}} \\ \alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find $v(t=20\text{s})$: $v = 10 \text{ m/s} + (2 \text{ m/s}^2)t - (0.05 \text{ m/s}^3)t^2 \Rightarrow$

$$v(20\text{s}) = 10 \text{ m/s} + 40 \text{ m/s} - (0.05 \text{ m/s}^3) 400 \text{ s}^2 \\ = 50 \text{ m/s} - 20 \text{ m/s} = \boxed{30 \text{ m/s}}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$\underline{a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}}$$
$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$
$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find $x(20\text{s})$:

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find $x(20\text{s})$: $x = 50 \text{ m} + (10 \frac{\text{m}}{\text{s}})t + (1 \frac{\text{m}}{\text{s}^2})t^2 -$
 $(\frac{0.1 \text{ m/s}^3}{6})t^3$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find $x(20\text{s})$: $x = 50 \text{ m} + (10 \frac{\text{m}}{\text{s}})t + (1 \frac{\text{m}}{\text{s}^2})t^2 -$
 $(\frac{0.1 \text{ m/s}^3}{6})t^3 \Rightarrow$

$$x(20\text{s}) = 50 \text{ m} + 200 \text{ m} + 400 \text{ m} - (\frac{0.1}{6}) * 8000 \text{ m}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}$$

$$\alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

Find $x(20\text{s})$: $x = 50 \text{ m} + (10 \frac{\text{m}}{\text{s}})t + (1 \frac{\text{m}}{\text{s}^2})t^2 -$
 $(\frac{0.1 \text{ m/s}^3}{6})t^3 \Rightarrow$

$$x(20\text{s}) = 50 \text{ m} + 200 \text{ m} + 400 \text{ m} - (\frac{0.1}{6}) * 8000 \text{ m}$$

$$= 650 \text{ m} - 133 \text{ m} = \boxed{517 \text{ m}}$$

Sally is driving along a straight highway. At $t = 0$, when she is moving at 10 m/s in the positive x -direction, she passes a signpost at $x = 50$ m. Her x -acceleration as a function of time is

Let

$$\underline{a_x = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t = \alpha - \beta t, \text{ where}} \\ \alpha \equiv 2 \text{ m/s}^2 \quad \& \quad \beta = 0.1 \text{ m/s}^3$$

(a) Find her x -velocity v_x and position x as functions of time. (b) When is her x -velocity greatest? (c) What is that maximum x -velocity? (d) Where is the car when it reaches that maximum x -velocity?

$$v_0 = 10 \text{ m/s}, \quad x_0 = 50 \text{ m}$$

$$\underline{\text{Find } x(20\text{s}):} \quad x = 50 \text{ m} + (10 \frac{\text{m}}{\text{s}})t + (1 \frac{\text{m}}{\text{s}^2})t^2 - \left(\frac{0.1 \text{ m/s}^3}{6}\right)t^3 \Rightarrow$$

$$x(20\text{s}) = 50 \text{ m} + 200 \text{ m} + 400 \text{ m} - \left(\frac{0.1}{6}\right) * 8000 \text{ m} \\ = 650 \text{ m} - 133 \text{ m} =$$

