March 20, Week 9

Today: Chapter 7, Gravitational Potential Energy

Homework Assignment #6 - Due Friday, March 22

Mastering Physics: 9 problems from chapters 5 and 6

Written Questions: 6.73

Exams and Midterm grades are in your mailbox. Exam #2 grade is on white sheet.

Help sessions with Jonathan:

M: 1000-1100, RH 111 T: 1000-1100, RH 114
Th: 0900-1000, RH 114

Gravitational Potential Energy

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

Gravitational Potential Energy

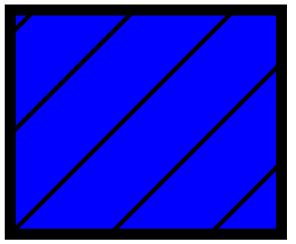
Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

We need to find the work done by gravity.

Gravitational Potential Energy

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

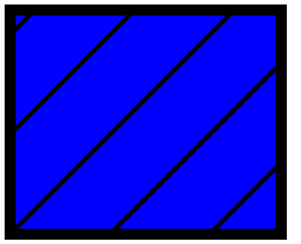
We need to find the work done by gravity.

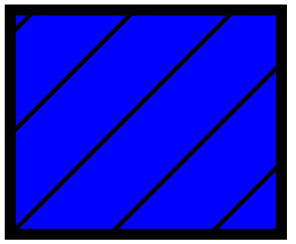


Gravitational Potential Energy

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

We need to find the work done by gravity.

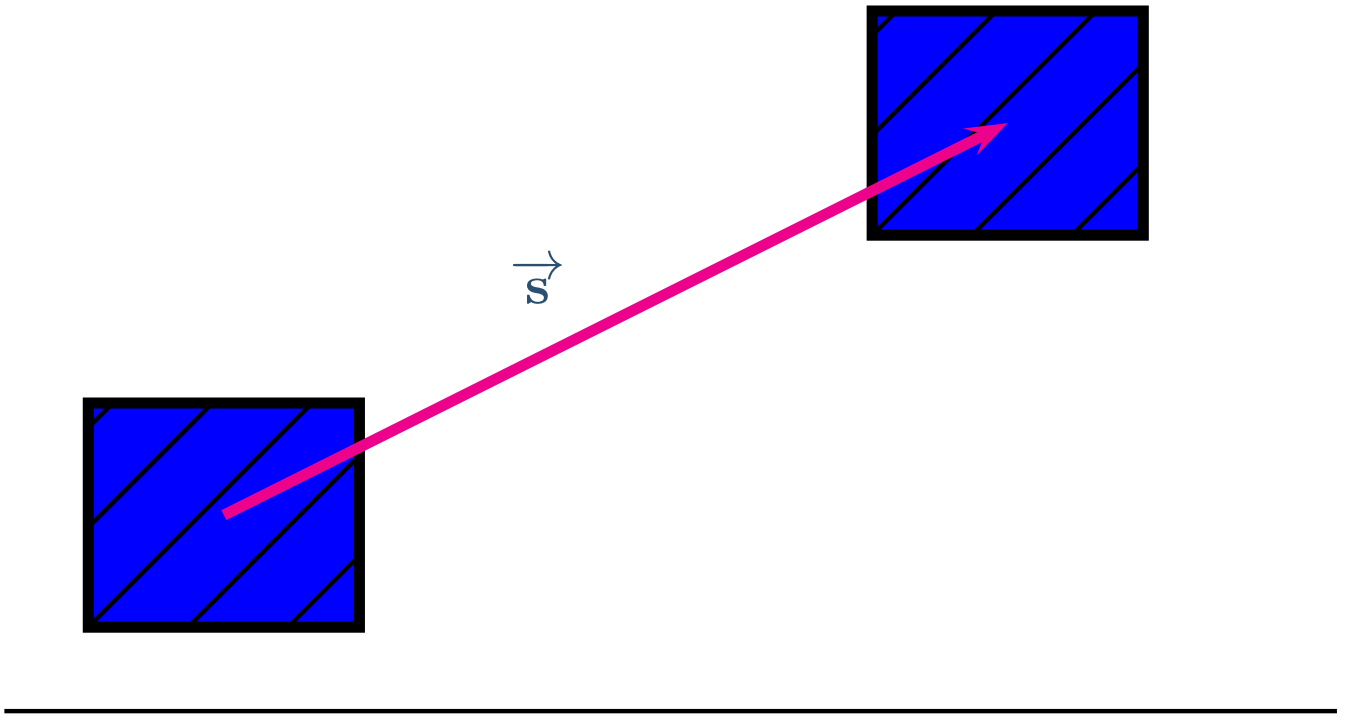




Gravitational Potential Energy

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

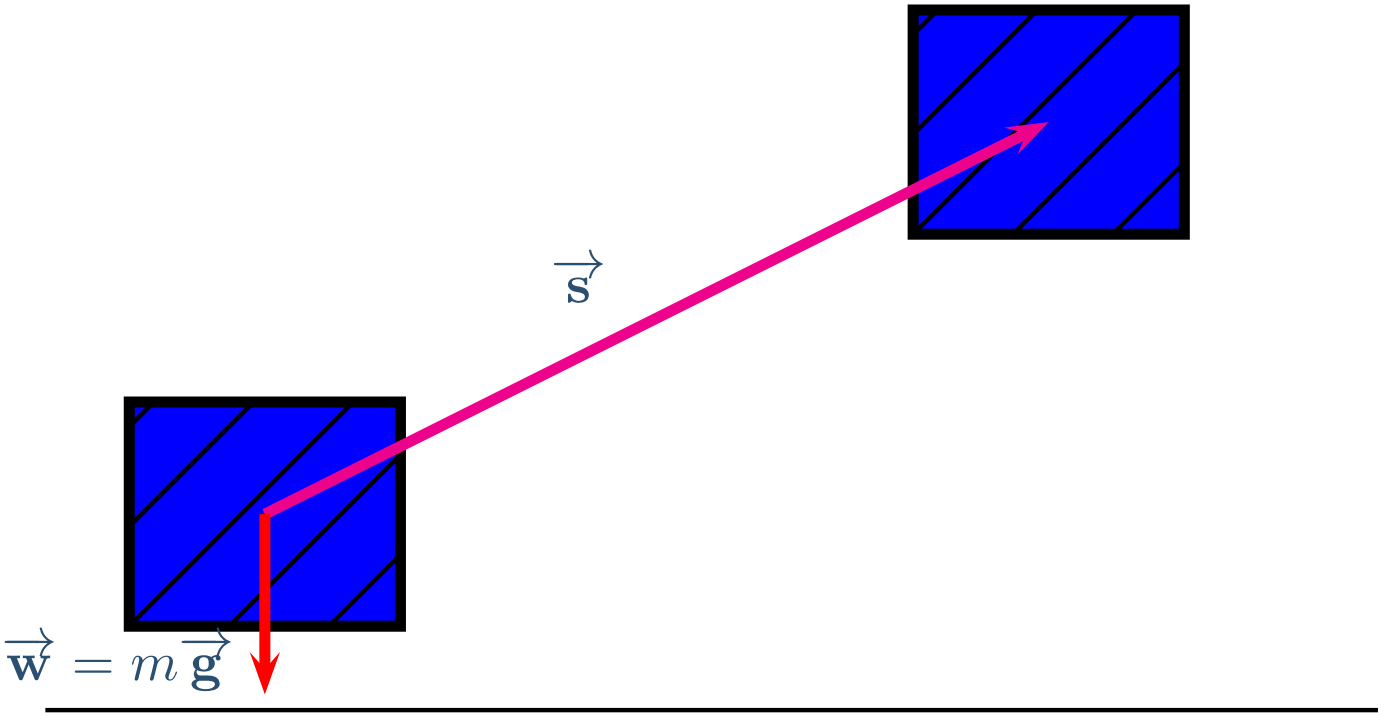
We need to find the work done by gravity.



Gravitational Potential Energy

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

We need to find the work done by gravity.

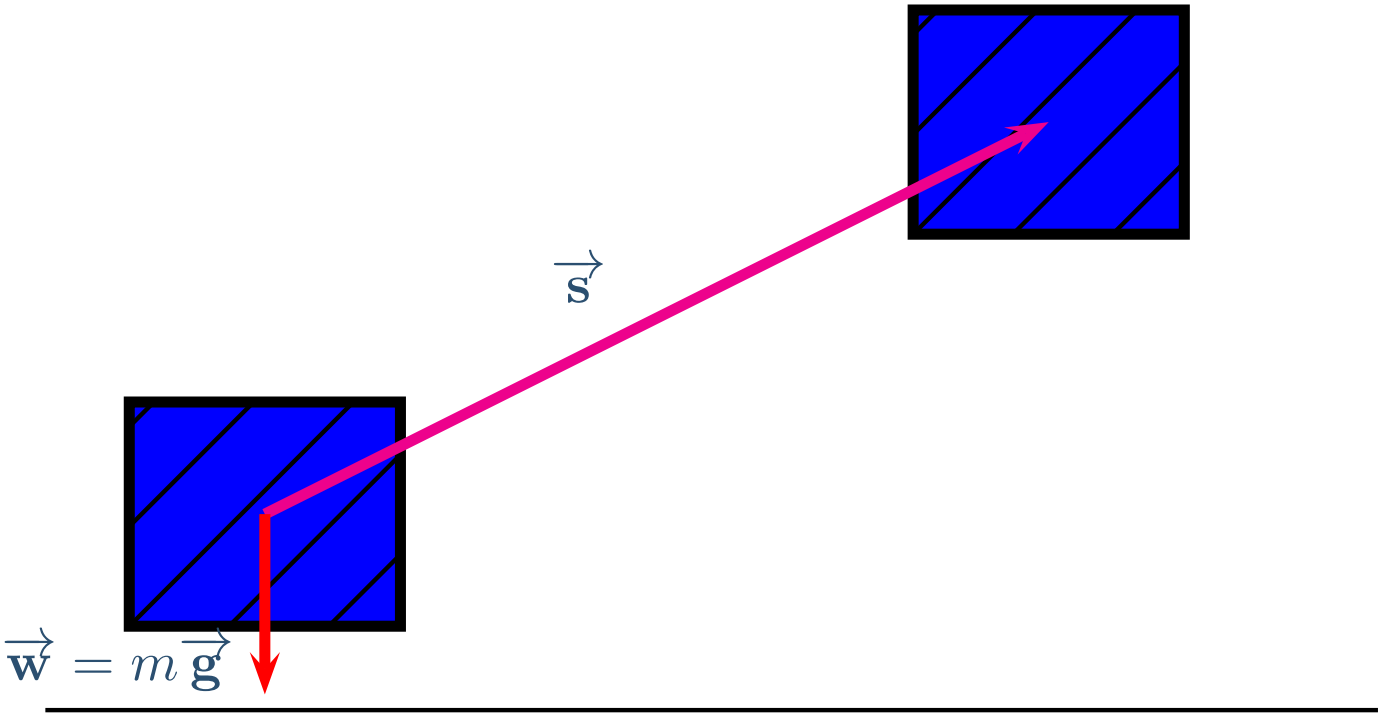


Gravitational Potential Energy

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

We need to find the work done by gravity.

$$W_g = \vec{\mathbf{w}} \cdot \vec{\mathbf{s}}$$



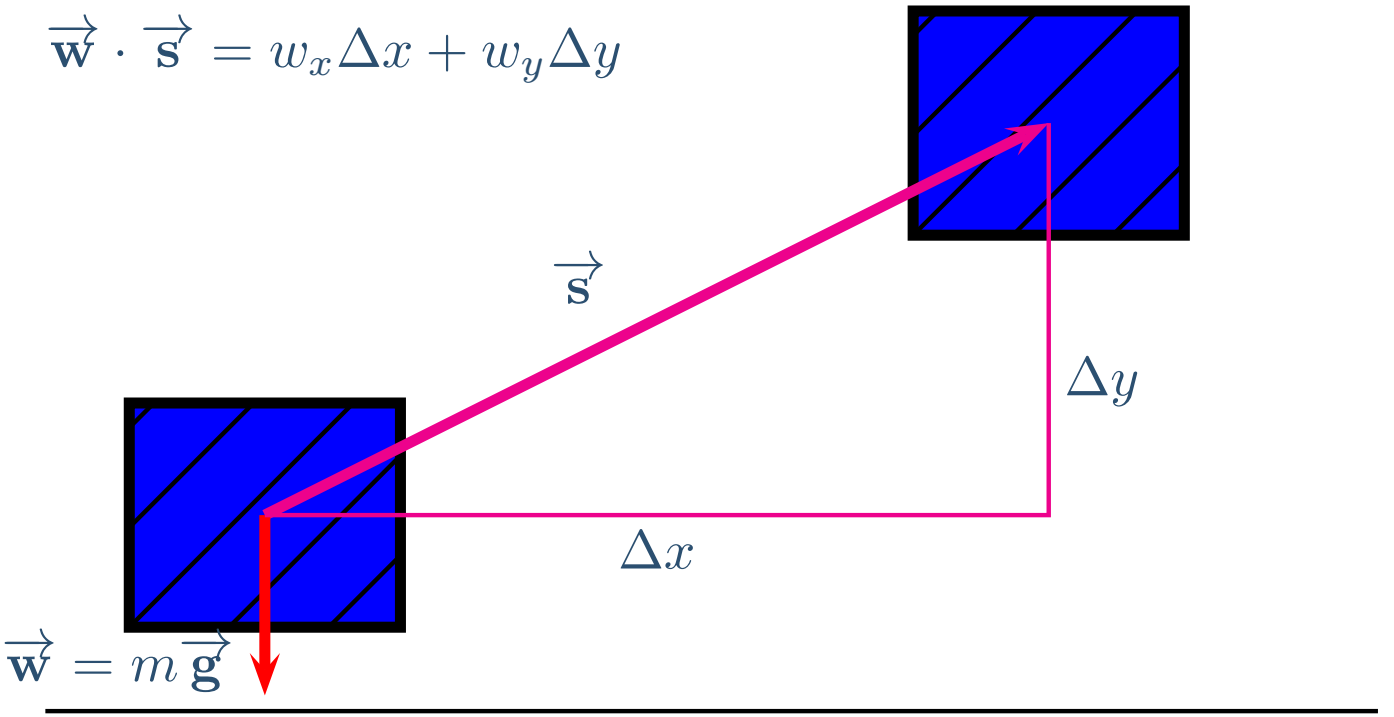
Gravitational Potential Energy

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

We need to find the work done by gravity.

$$W_g = \vec{\mathbf{w}} \cdot \vec{\mathbf{s}}$$

$$\vec{\mathbf{w}} \cdot \vec{\mathbf{s}} = w_x \Delta x + w_y \Delta y$$



Gravitational Potential Energy

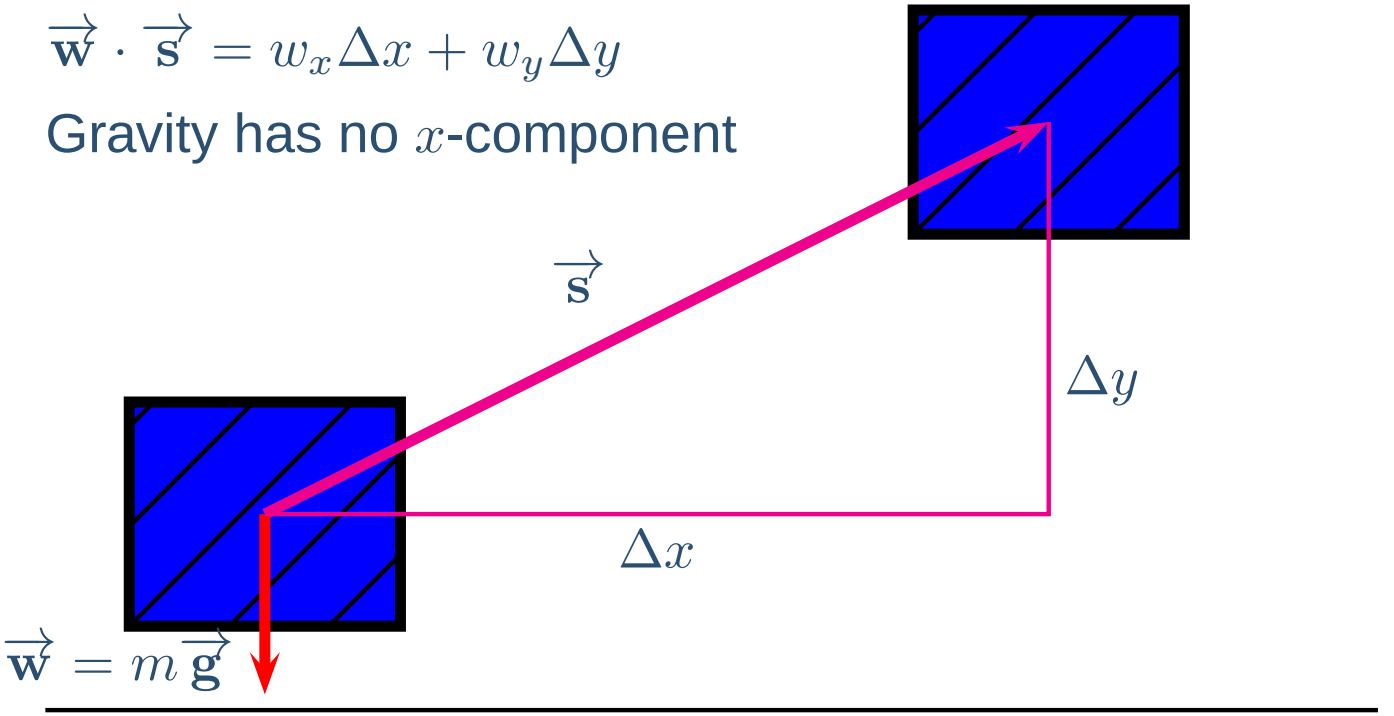
Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

We need to find the work done by gravity.

$$W_g = \vec{\mathbf{w}} \cdot \vec{\mathbf{s}}$$

$$\vec{\mathbf{w}} \cdot \vec{\mathbf{s}} = w_x \Delta x + w_y \Delta y$$

Gravity has no x-component



Gravitational Potential Energy

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

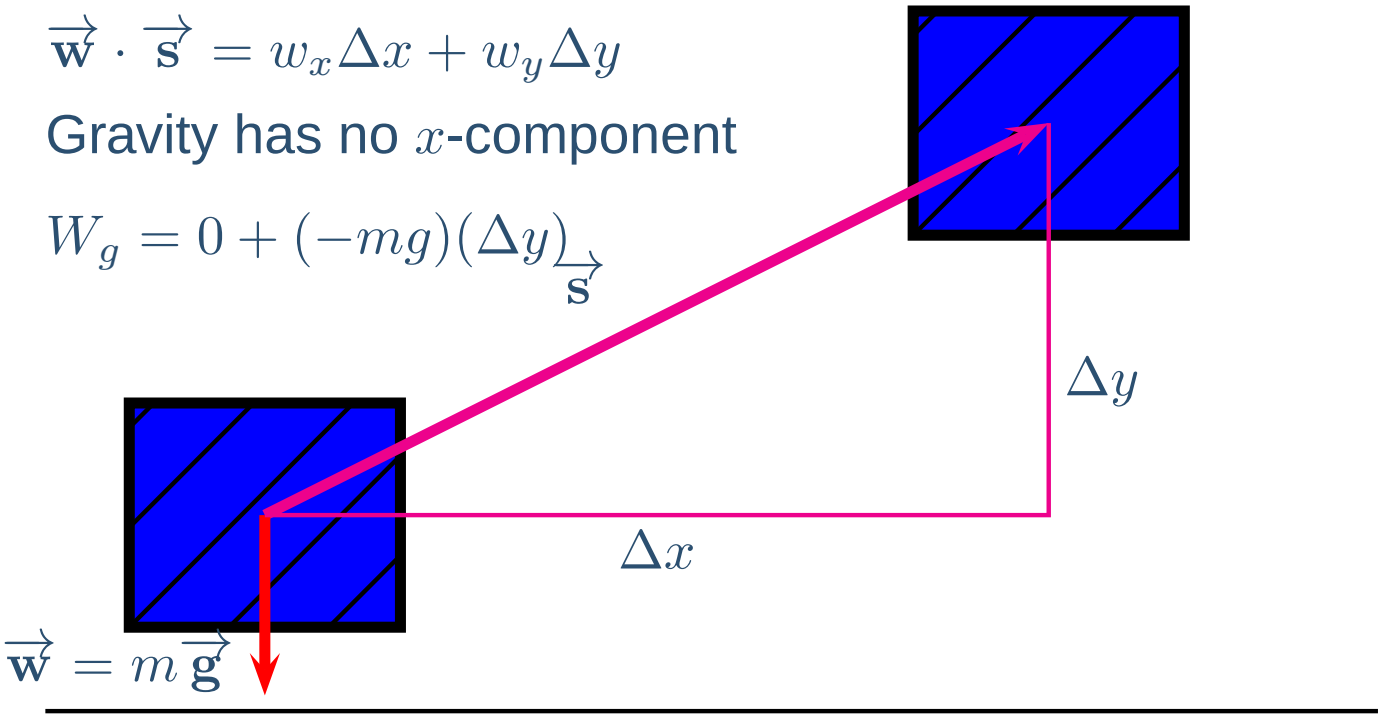
We need to find the work done by gravity.

$$W_g = \vec{\mathbf{w}} \cdot \vec{\mathbf{s}}$$

$$\vec{\mathbf{w}} \cdot \vec{\mathbf{s}} = w_x \Delta x + w_y \Delta y$$

Gravity has no x-component

$$W_g = 0 + (-mg)(\Delta y)$$



Gravitational Potential Energy

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

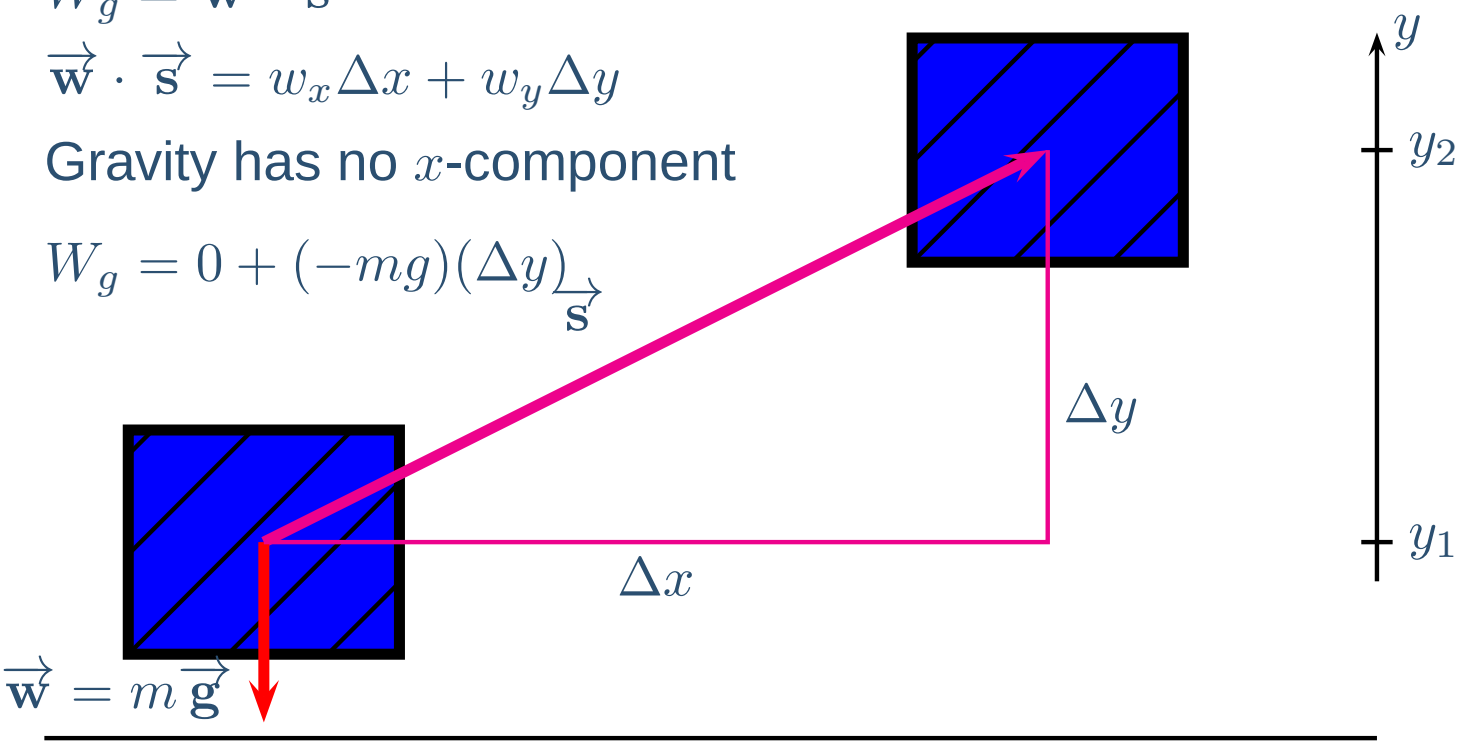
We need to find the work done by gravity.

$$W_g = \vec{\mathbf{w}} \cdot \vec{\mathbf{s}}$$

$$\vec{\mathbf{w}} \cdot \vec{\mathbf{s}} = w_x \Delta x + w_y \Delta y$$

Gravity has no x-component

$$W_g = 0 + (-mg)(\Delta y)$$



Gravitational Potential Energy

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

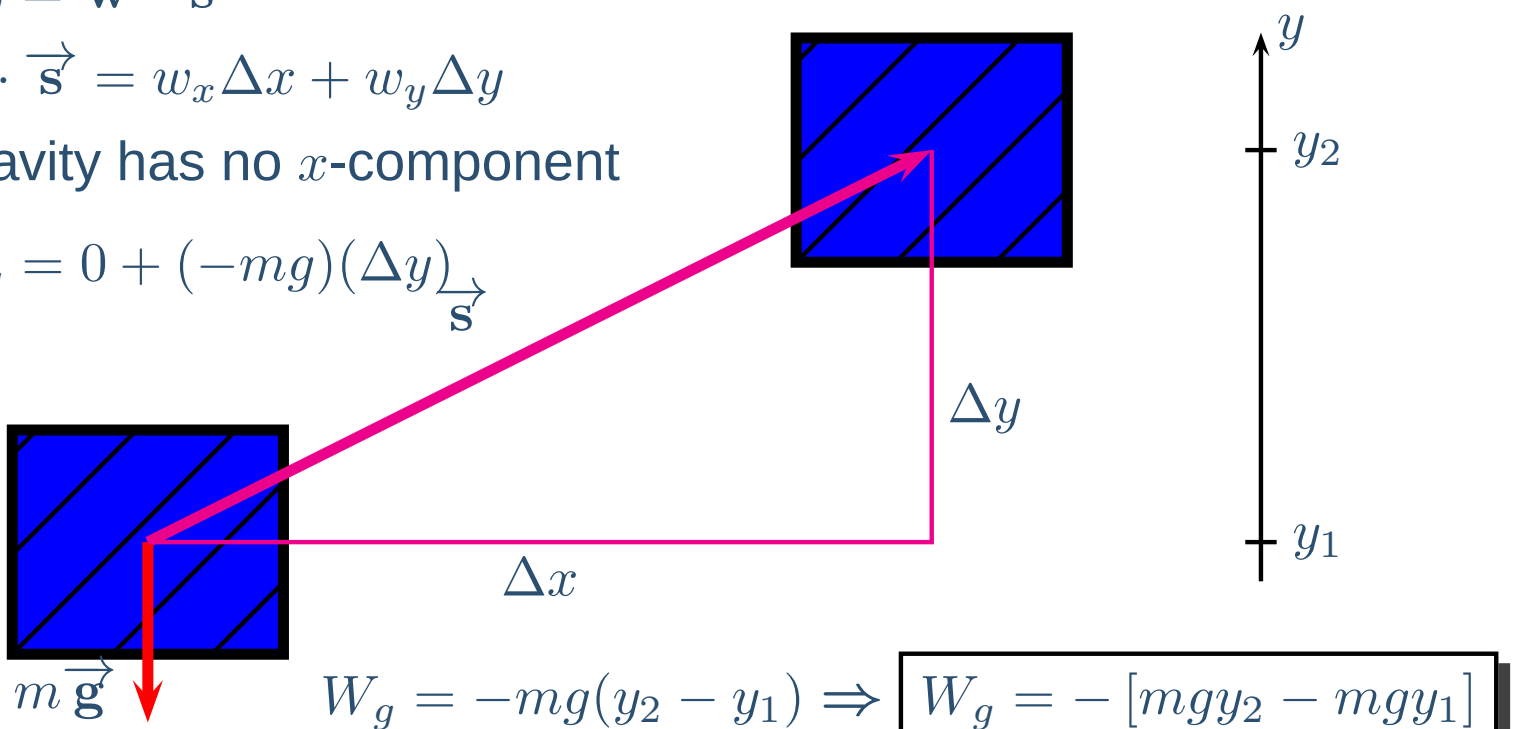
We need to find the work done by gravity.

$$W_g = \vec{\mathbf{w}} \cdot \vec{\mathbf{s}}$$

$$\vec{\mathbf{w}} \cdot \vec{\mathbf{s}} = w_x \Delta x + w_y \Delta y$$

Gravity has no x-component

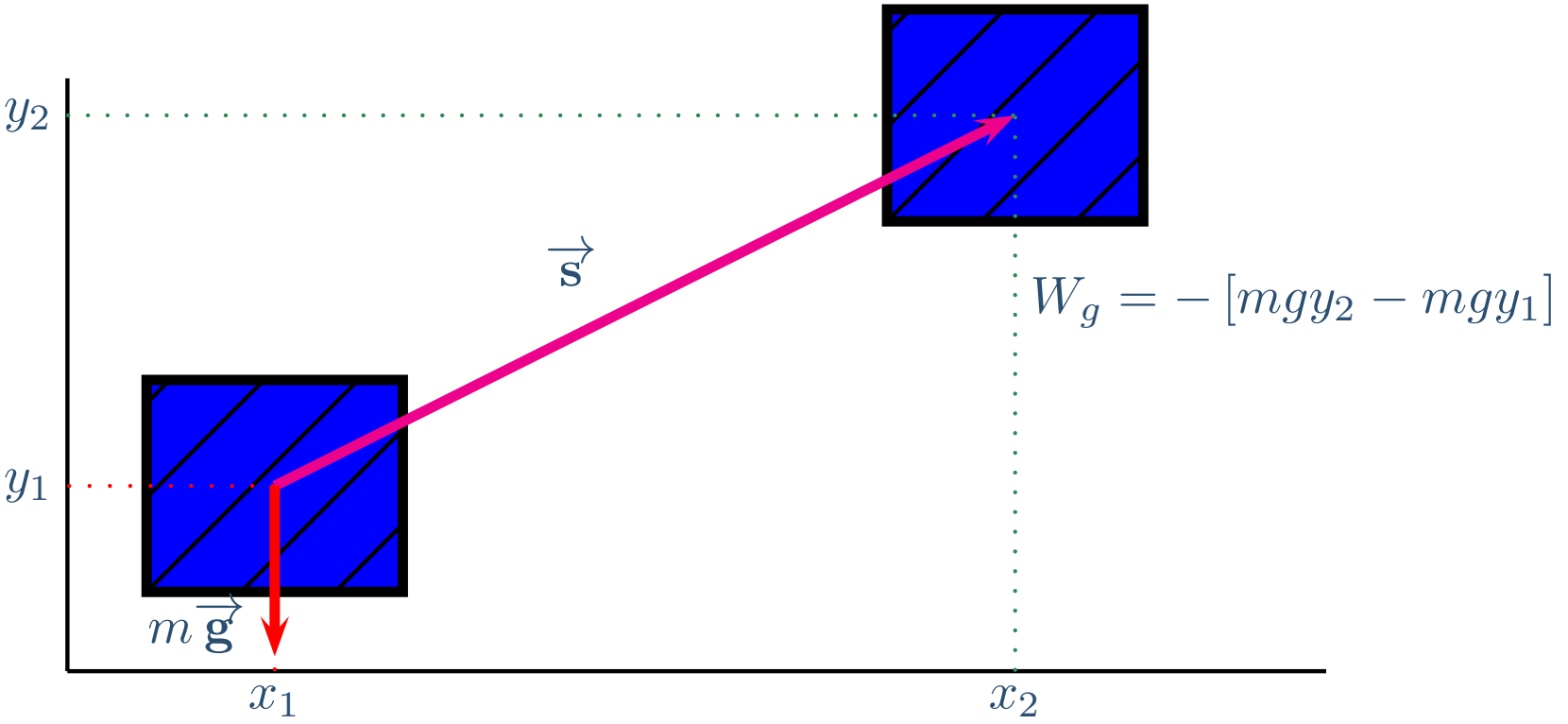
$$W_g = 0 + (-mg)(\Delta y)$$



Gravitational Potential Energy II

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

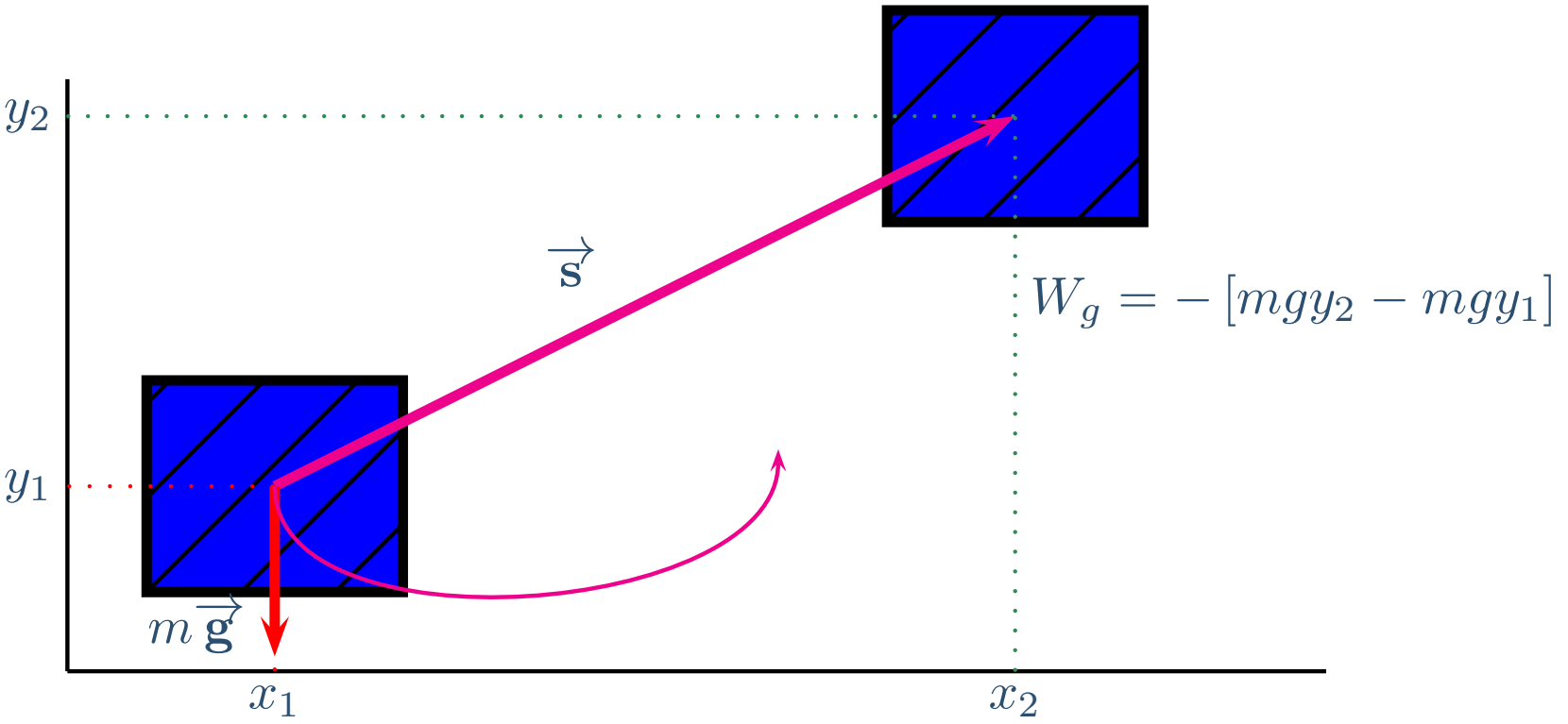
We need to find the work done by gravity.



Gravitational Potential Energy II

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

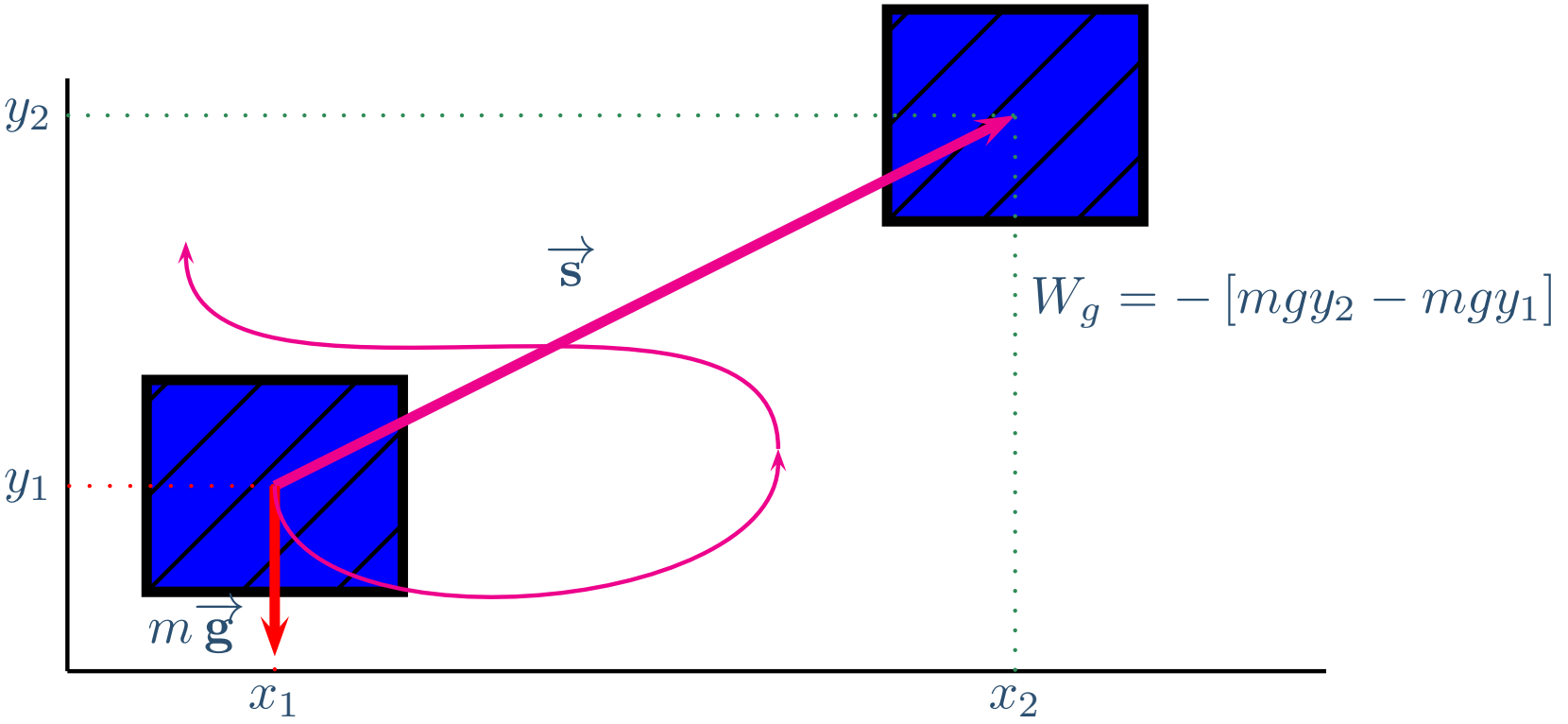
We need to find the work done by gravity.



Gravitational Potential Energy II

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

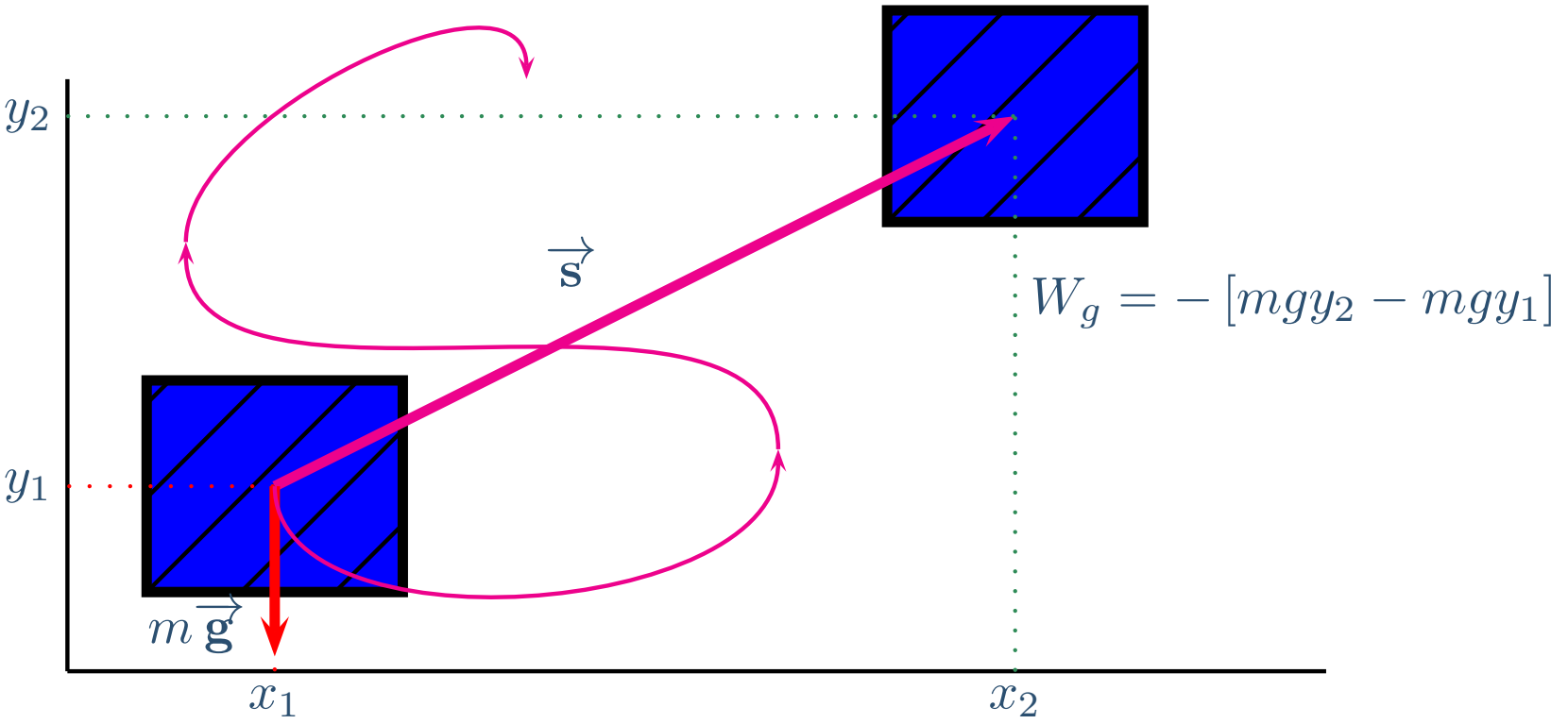
We need to find the work done by gravity.



Gravitational Potential Energy II

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

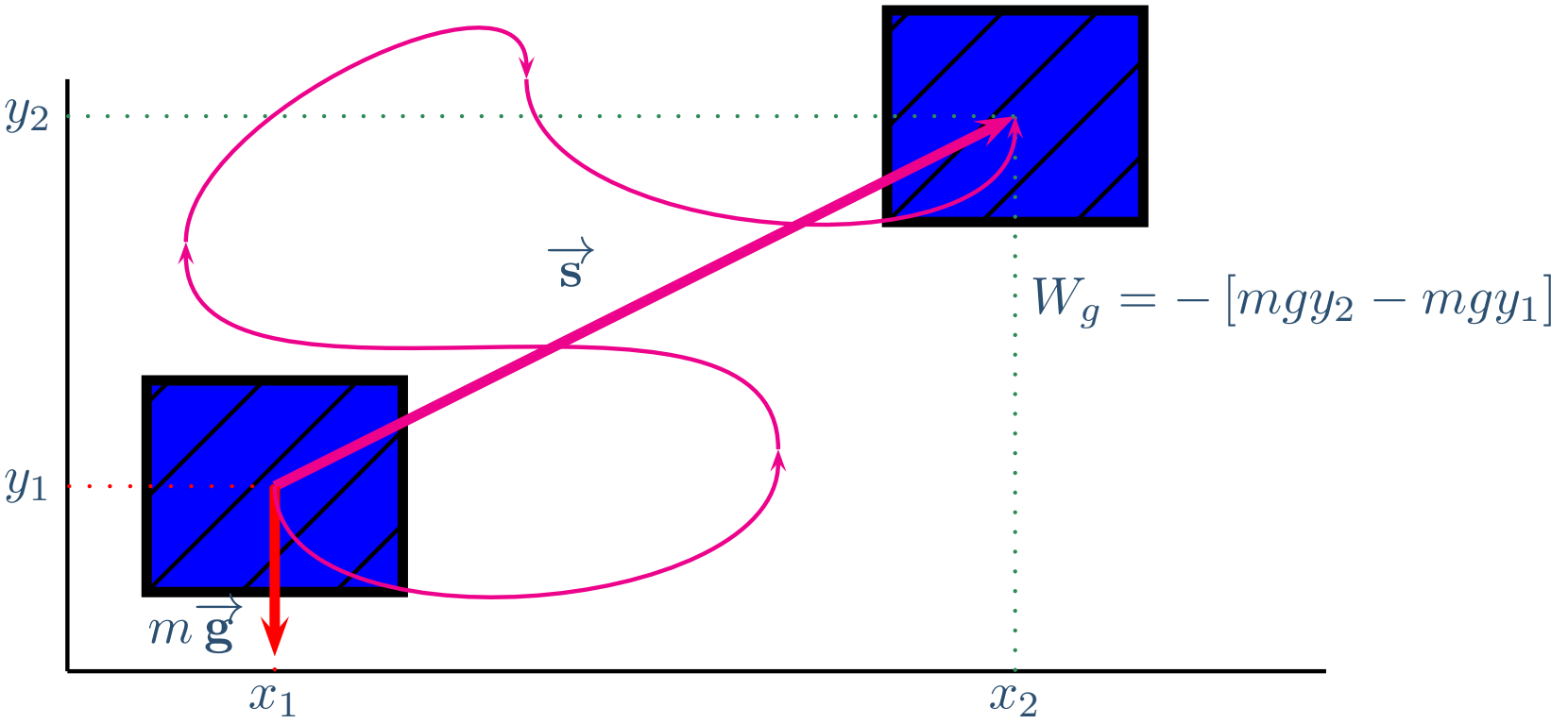
We need to find the work done by gravity.



Gravitational Potential Energy II

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

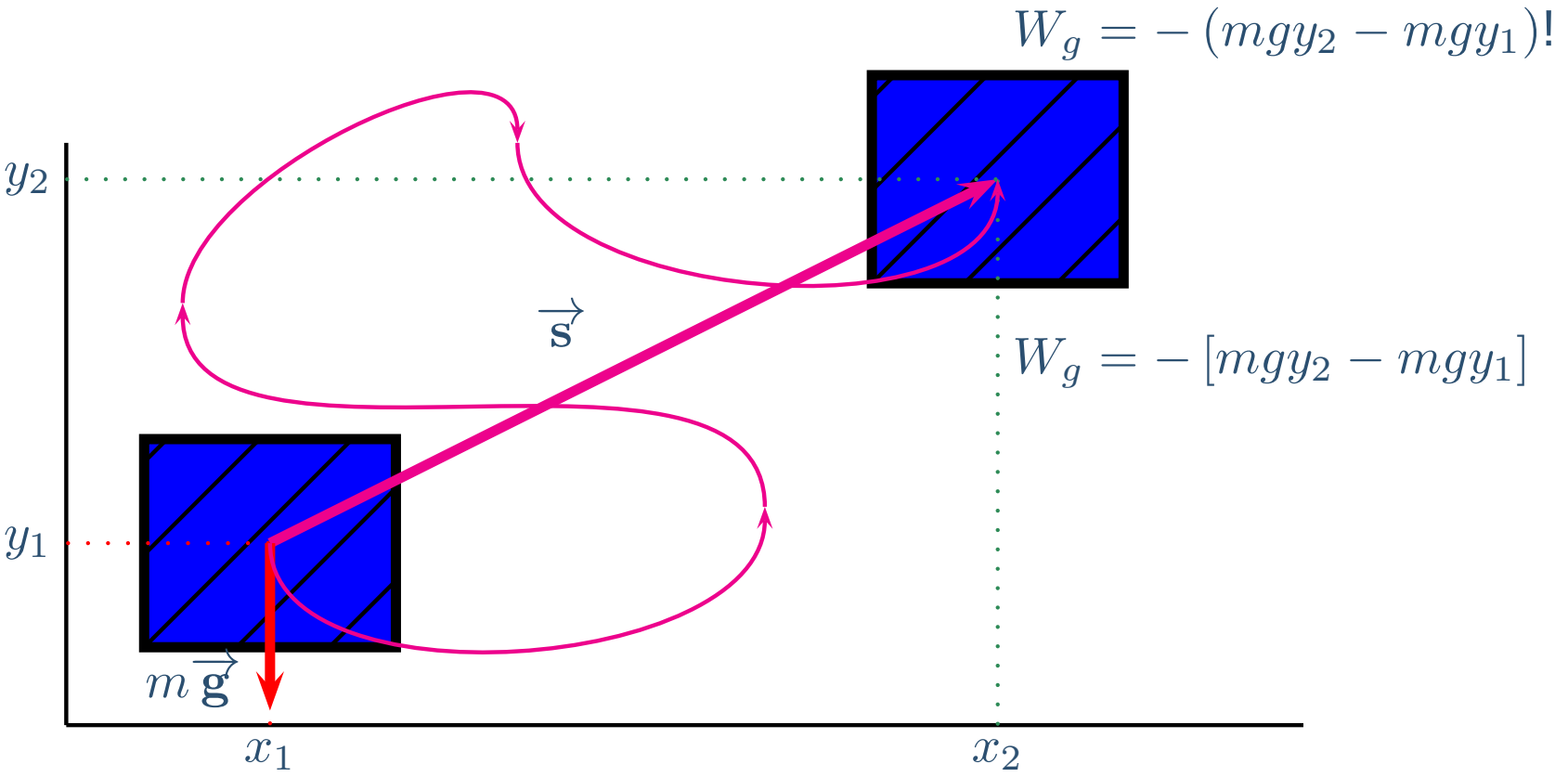
We need to find the work done by gravity.



Gravitational Potential Energy II

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

We need to find the work done by gravity.

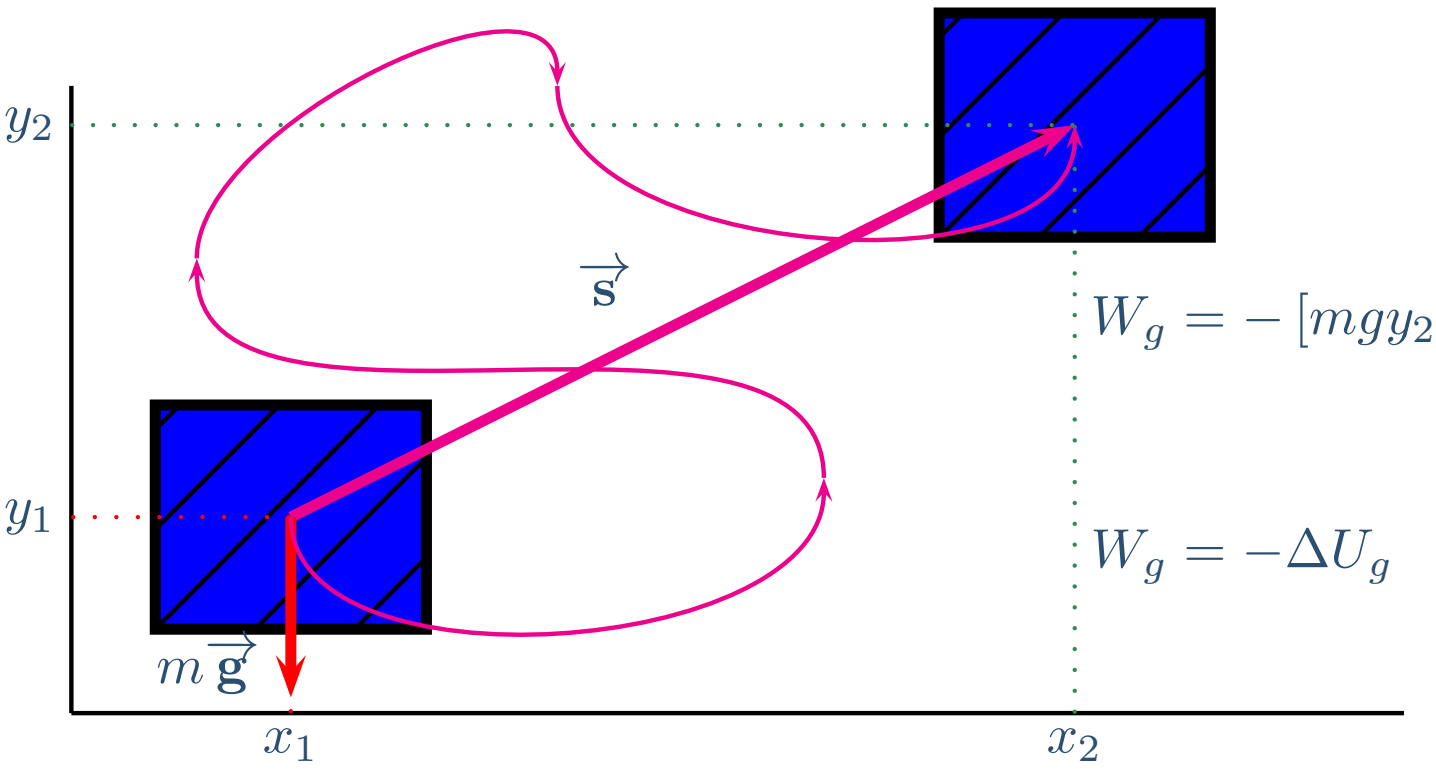


Gravitational Potential Energy II

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

We need to find the work done by gravity.

$$W_g = -\left(mgy_2 - mgy_1\right)!$$



$$W_g = -\left[mgy_2 - mgy_1\right]$$

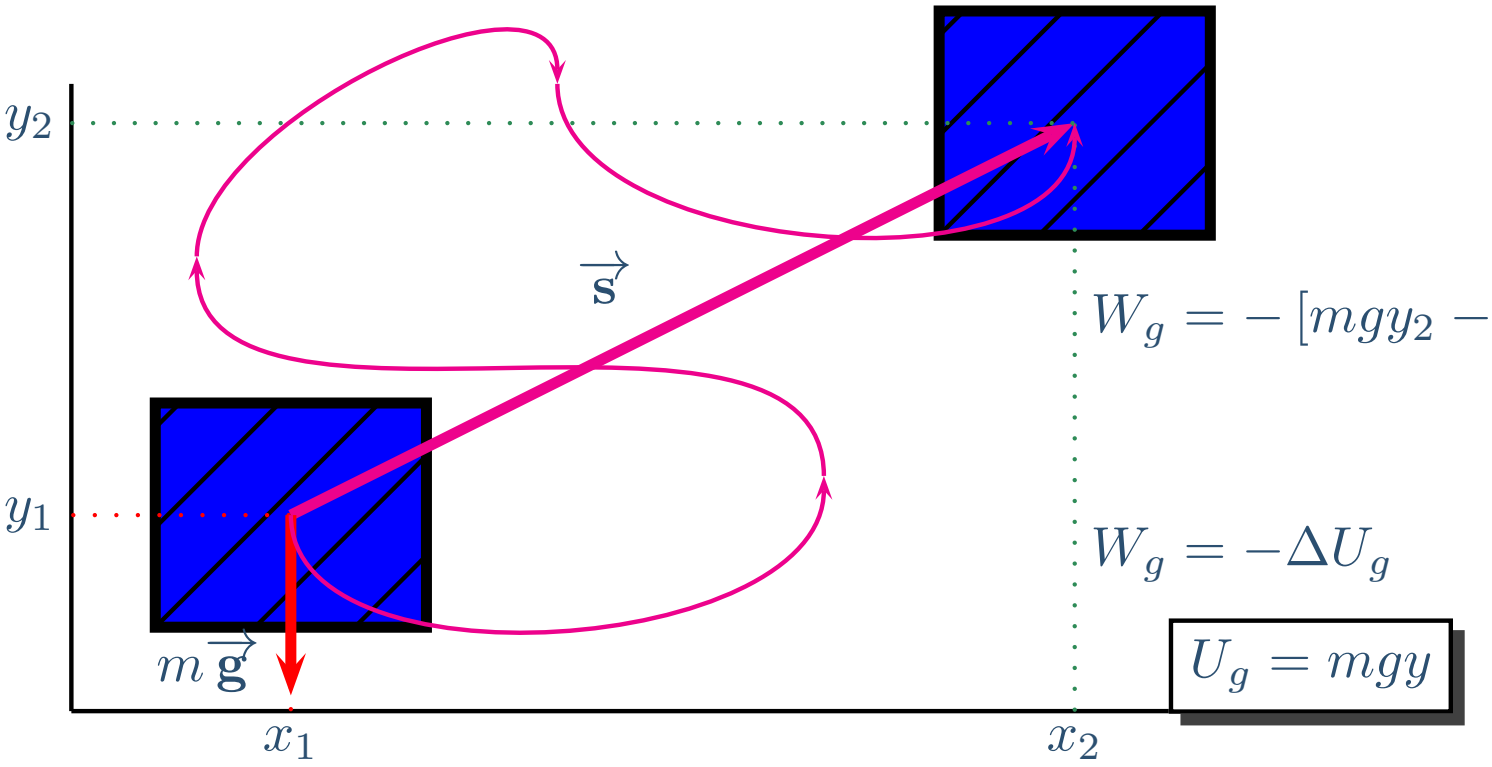
$$W_g = -\Delta U_g$$

Gravitational Potential Energy II

Gravitational Potential Energy - Stored energy due to gravity.
Depends only on an object's height above the ground.

We need to find the work done by gravity.

$$W_g = -\left(mgy_2 - mgy_1\right)!$$



$$W_g = -\left[mgy_2 - mgy_1\right]$$

$$W_g = -\Delta U_g$$

$$U_g = mgy$$

Conservation of Mechanical Energy

If gravity is the only force doing work on an object, $E_1 = E_2$.

Conservation of Mechanical Energy

If gravity is the only force doing work on an object, $E_1 = E_2$.

Mechanical Energy,

$$E = K + U_g = \frac{1}{2}mv^2 + mgy$$

Conservation of Mechanical Energy

If gravity is the only force doing work on an object, $E_1 = E_2$.

Mechanical Energy,

$$E = K + U_g = \frac{1}{2}mv^2 + mgy$$

$$\boxed{\frac{1}{2}mv_1^2 + mgy_1 = \frac{1}{2}mv_2^2 + mgy_2}$$

Conservation of Mechanical Energy

If gravity is the only force doing work on an object, $E_1 = E_2$.

Mechanical Energy,

$$E = K + U_g = \frac{1}{2}mv^2 + mgy$$

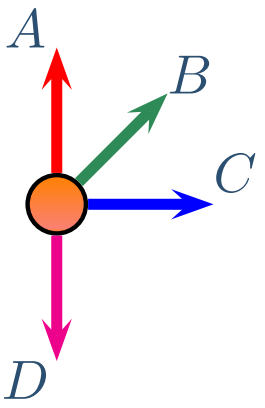
$$\boxed{\frac{1}{2}mv_1^2 + mgy_1 = \frac{1}{2}mv_2^2 + mgy_2}$$

Example: A mass is started from rest at the top of a frictionless slide of height h, how fast is it going at the bottom?

Mechanical Energy Exercise

$$\frac{1}{2}mv_1^2 + mgy_1 = \frac{1}{2}mv_2^2 + mgy_2$$

Four Balls, A, B, C, and D, are launched from the same height and with the same speed but at the different angles shown. Ignoring air resistance, which of the balls is going fastest when it hits the ground?

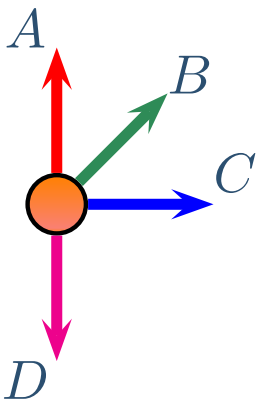


Mechanical Energy Exercise

$$\frac{1}{2}mv_1^2 + mgy_1 = \frac{1}{2}mv_2^2 + mgy_2$$

Four Balls, A, B, C, and D, are launched from the same height and with the same speed but at the different angles shown. Ignoring air resistance, which of the balls is going fastest when it hits the ground?

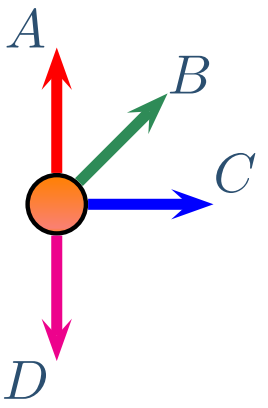
(a) A



Mechanical Energy Exercise

$$\frac{1}{2}mv_1^2 + mgy_1 = \frac{1}{2}mv_2^2 + mgy_2$$

Four Balls, A, B, C, and D, are launched from the same height and with the same speed but at the different angles shown. Ignoring air resistance, which of the balls is going fastest when it hits the ground?



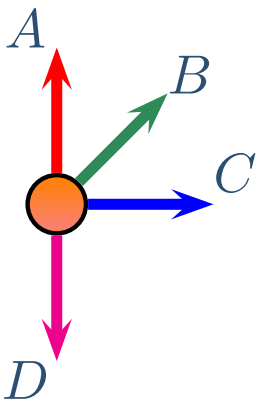
(a) A

(b) B

Mechanical Energy Exercise

$$\frac{1}{2}mv_1^2 + mgy_1 = \frac{1}{2}mv_2^2 + mgy_2$$

Four Balls, A, B, C, and D, are launched from the same height and with the same speed but at the different angles shown. Ignoring air resistance, which of the balls is going fastest when it hits the ground?



(a) A

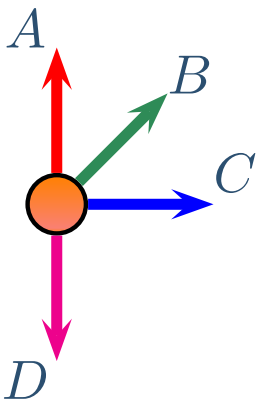
(b) B

(c) C

Mechanical Energy Exercise

$$\frac{1}{2}mv_1^2 + mgy_1 = \frac{1}{2}mv_2^2 + mgy_2$$

Four Balls, A, B, C, and D, are launched from the same height and with the same speed but at the different angles shown. Ignoring air resistance, which of the balls is going fastest when it hits the ground?



(a) A

(b) B

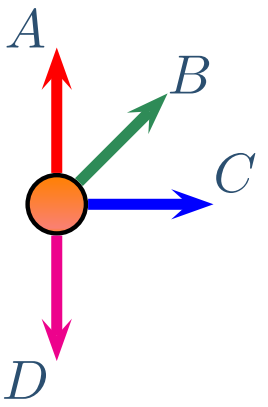
(c) C

(d) D

Mechanical Energy Exercise

$$\frac{1}{2}mv_1^2 + mgy_1 = \frac{1}{2}mv_2^2 + mgy_2$$

Four Balls, A, B, C, and D, are launched from the same height and with the same speed but at the different angles shown. Ignoring air resistance, which of the balls is going fastest when it hits the ground?



(a) A

(b) B

(c) C

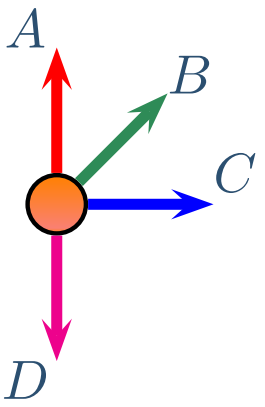
(d) D

(e) They all have the same speed

Mechanical Energy Exercise

$$\frac{1}{2}mv_1^2 + mgy_1 = \frac{1}{2}mv_2^2 + mgy_2$$

Four Balls, A, B, C, and D, are launched from the same height and with the same speed but at the different angles shown. Ignoring air resistance, which of the balls is going fastest when it hits the ground?



(a) A

(b) B

(c) C

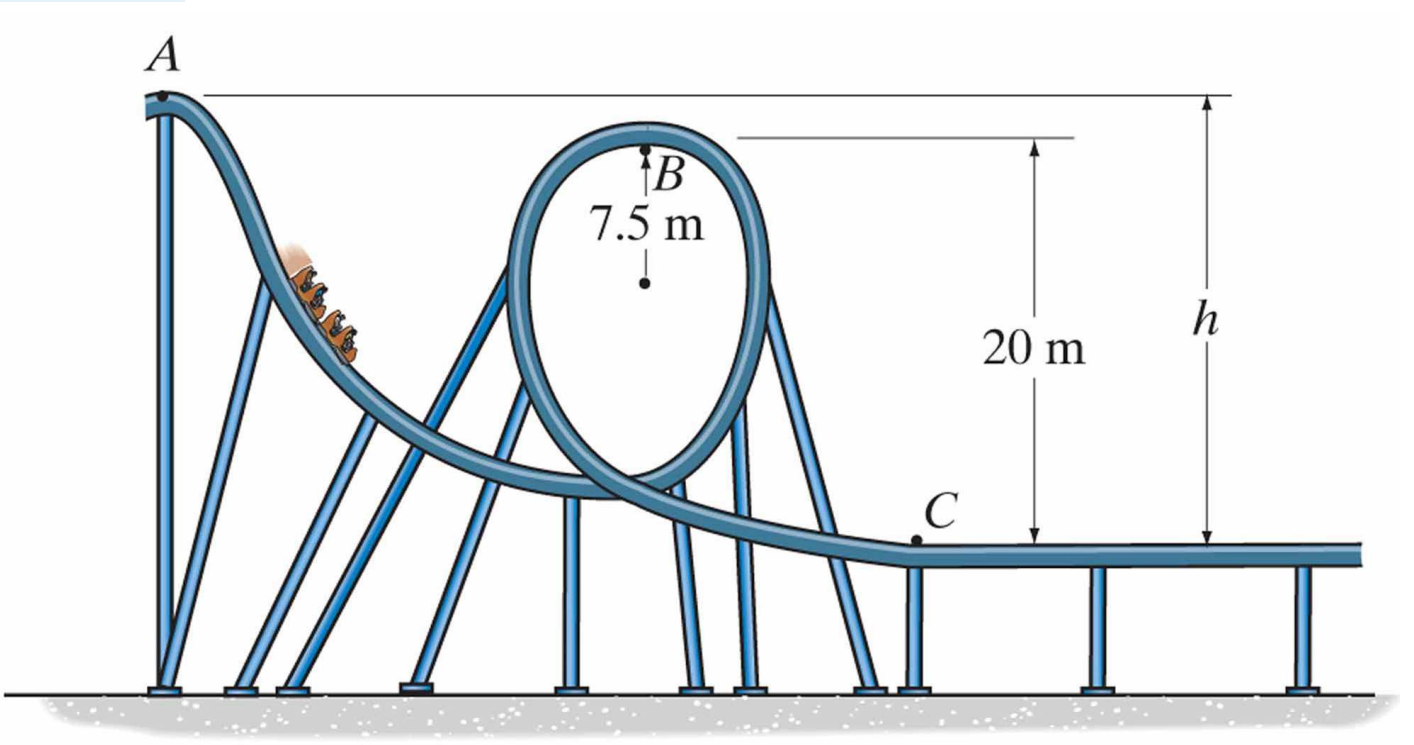
(d) D

Each of them have the same v_1, y_1, and $y_2 \Rightarrow$ same v_2

(e) They all have the same speed

Mechanical Energy Exercise II

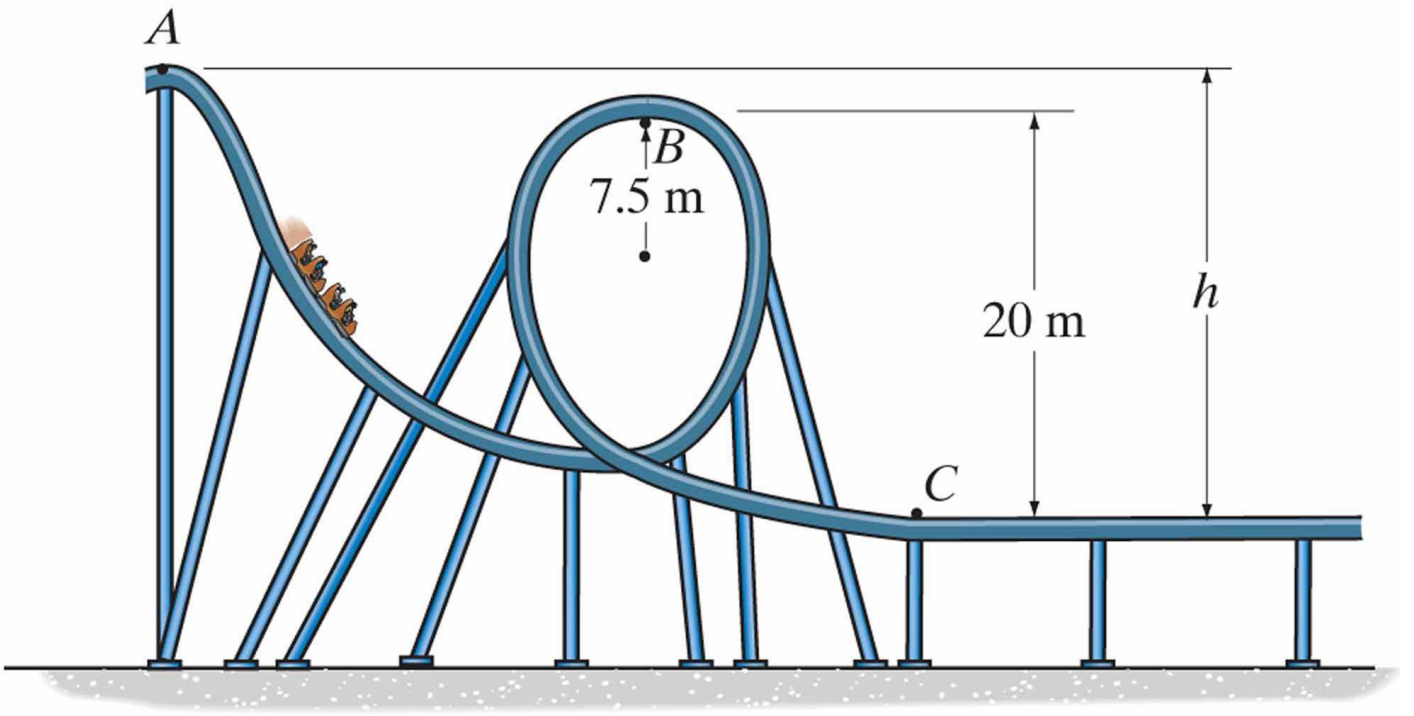
A roller coaster starts from rest at point A, goes through the loop-to-loop, and arrives at point C. If friction can be ignored, the roller coaster simply slides along its track, and $h = 25\,m$, how fast will the roller coaster be going at C?



Mechanical Energy Exercise II

A roller coaster starts from rest at point A, goes through the loop-to-loop, and arrives at point C. If friction can be ignored, the roller coaster simply slides along its track, and $h = 25\,m$, how fast will the roller coaster be going at C?

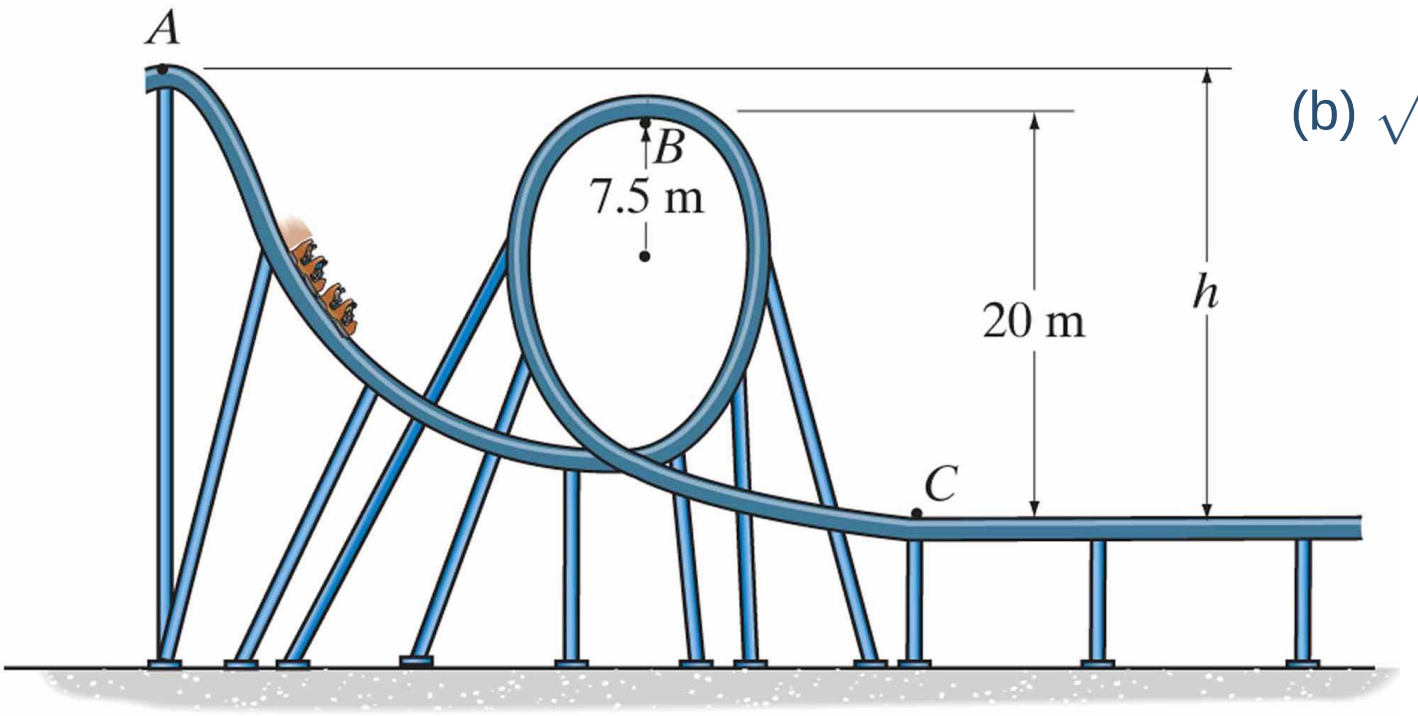
(a) $\sqrt{2gh} = 22\,m/s$



Mechanical Energy Exercise II

A roller coaster starts from rest at point A, goes through the loop-to-loop, and arrives at point C. If friction can be ignored, the roller coaster simply slides along its track, and $h = 25\,m$, how fast will the roller coaster be going at C?

(a) $\sqrt{2gh} = 22\,m/s$

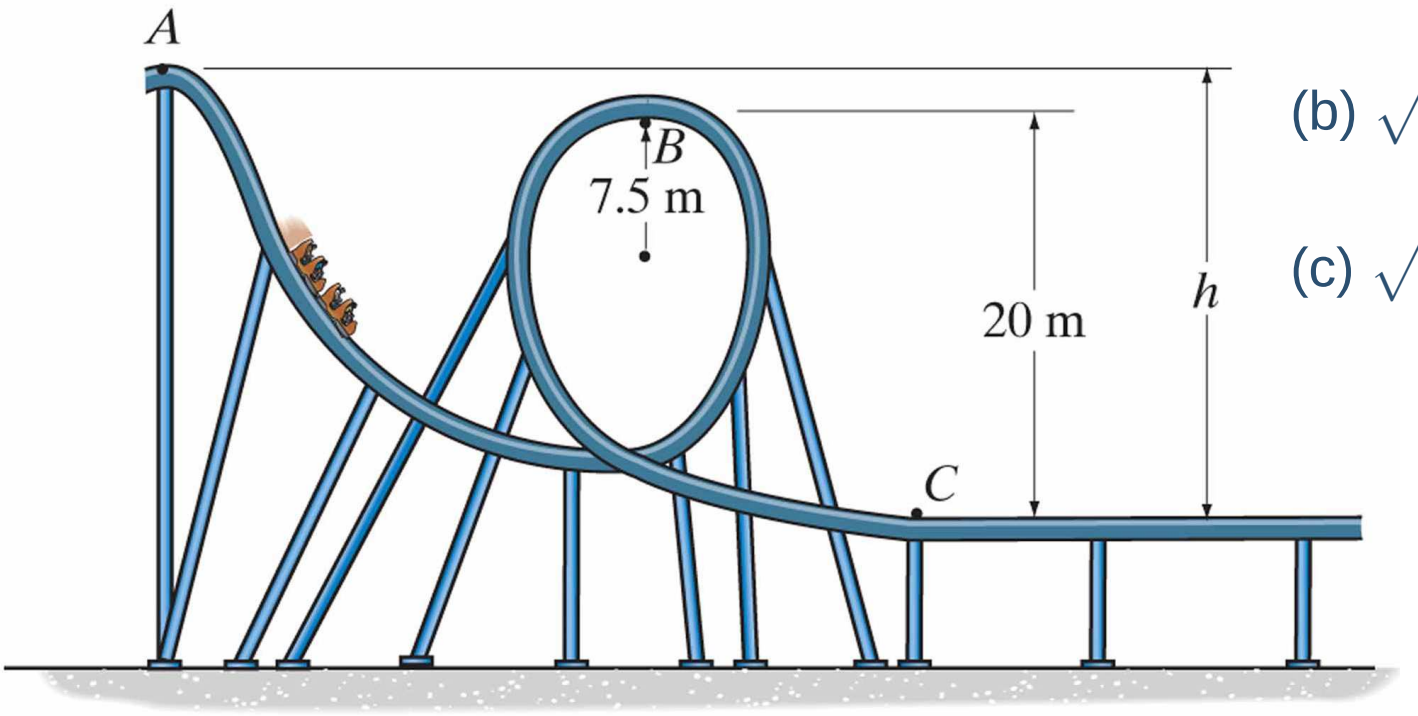


(b) $\sqrt{2g(h - 20\,m)} = 10\,m/s$

Mechanical Energy Exercise II

A roller coaster starts from rest at point A, goes through the loop-to-loop, and arrives at point C. If friction can be ignored, the roller coaster simply slides along its track, and $h = 25\,m$, how fast will the roller coaster be going at C?

(a) $\sqrt{2gh} = 22\,m/s$

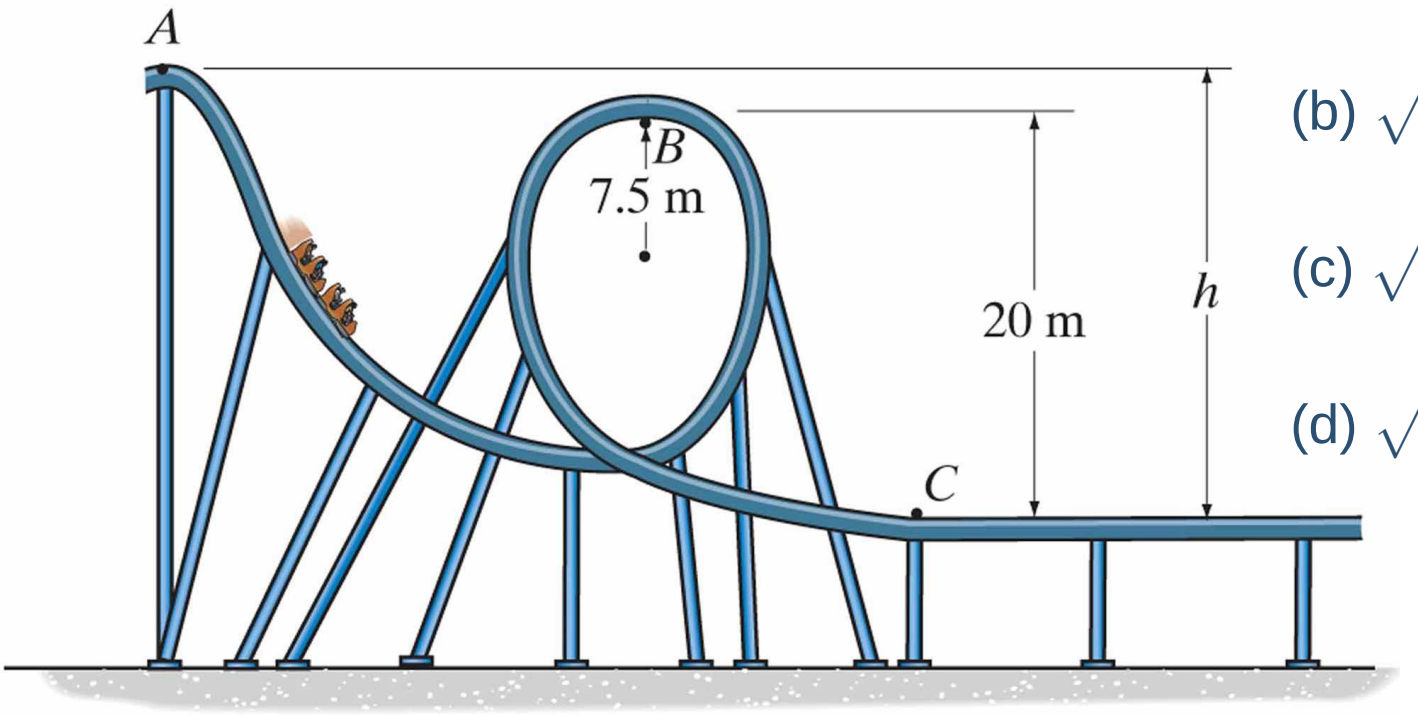


(b) $\sqrt{2g(h - 20\,m)} = 10\,m/s$

(c) $\sqrt{2g(h - 7.5m)} = 19\,m/s$

Mechanical Energy Exercise II

A roller coaster starts from rest at point A, goes through the loop-to-loop, and arrives at point C. If friction can be ignored, the roller coaster simply slides along its track, and $h = 25\,m$, how fast will the roller coaster be going at C?



(a) $\sqrt{2gh} = 22\,m/s$

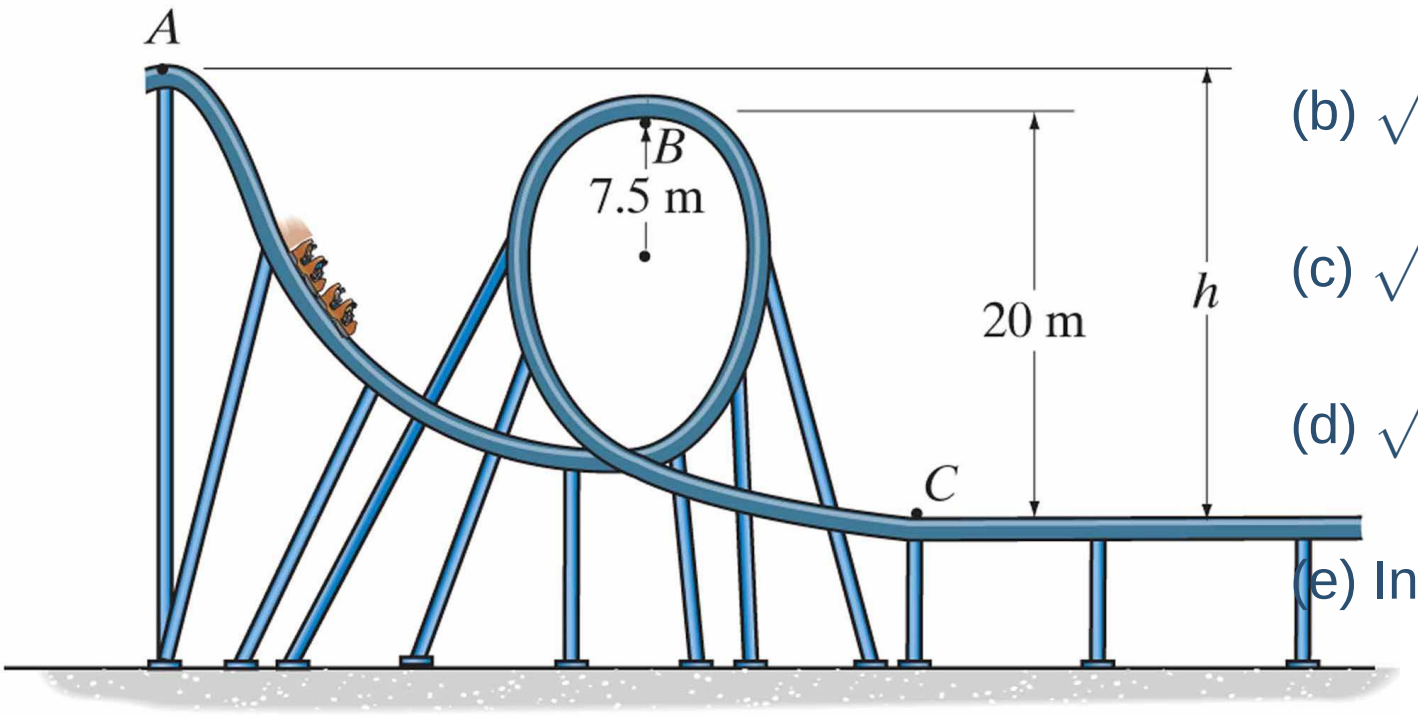
(b) $\sqrt{2g(h - 20\,m)} = 10\,m/s$

(c) $\sqrt{2g(h - 7.5m)} = 19\,m/s$

(d) $\sqrt{2g(h - 15\,m)} = 14\,m/s$

Mechanical Energy Exercise II

A roller coaster starts from rest at point A, goes through the loop-to-loop, and arrives at point C. If friction can be ignored, the roller coaster simply slides along its track, and $h = 25\,m$, how fast will the roller coaster be going at C?



(a) $\sqrt{2gh} = 22\,m/s$

(b) $\sqrt{2g(h - 20\,m)} = 10\,m/s$

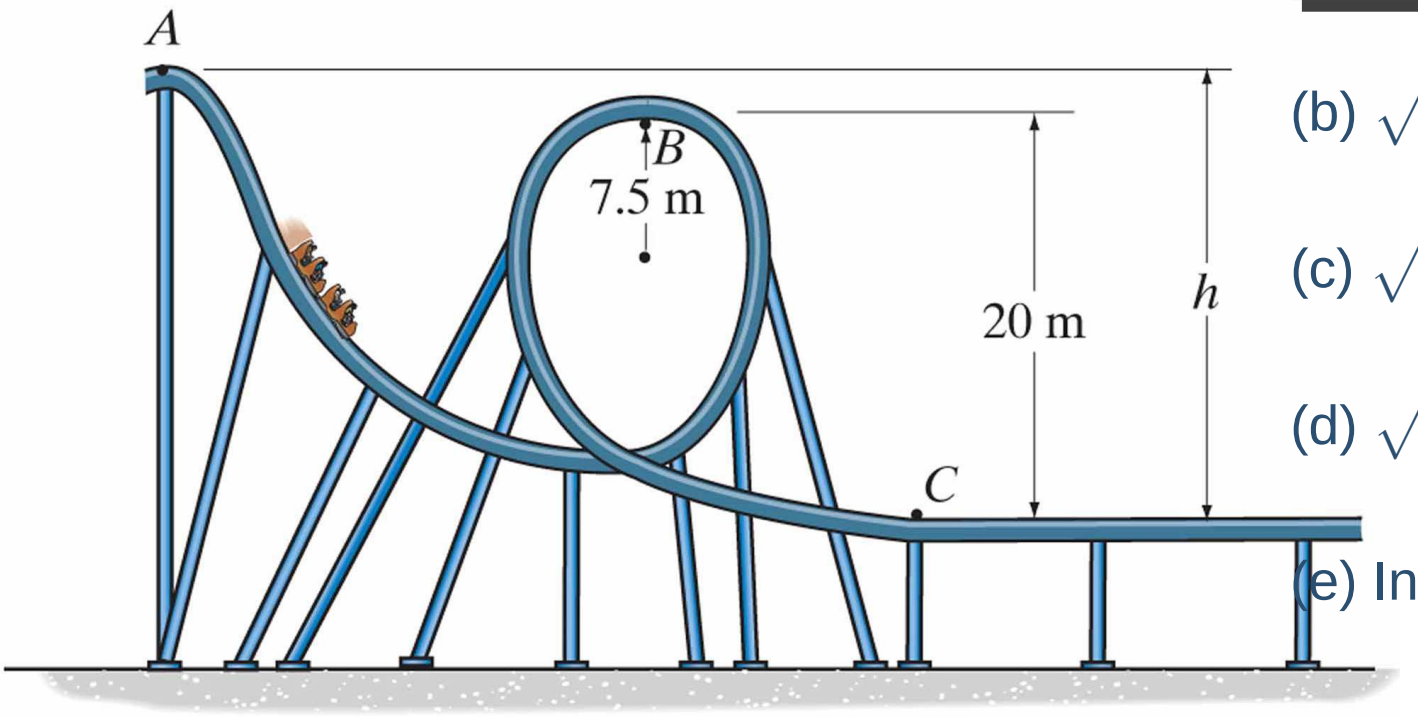
(c) $\sqrt{2g(h - 7.5m)} = 19\,m/s$

(d) $\sqrt{2g(h - 15\,m)} = 14\,m/s$

(e) Intentionally left blank

Mechanical Energy Exercise II

A roller coaster starts from rest at point A, goes through the loop-to-loop, and arrives at point C. If friction can be ignored, the roller coaster simply slides along its track, and $h = 25\,m$, how fast will the roller coaster be going at C?



(a) $\sqrt{2gh} = 22\,m/s$

(b) $\sqrt{2g(h - 20\,m)} = 10\,m/s$

(c) $\sqrt{2g(h - 7.5m)} = 19\,m/s$

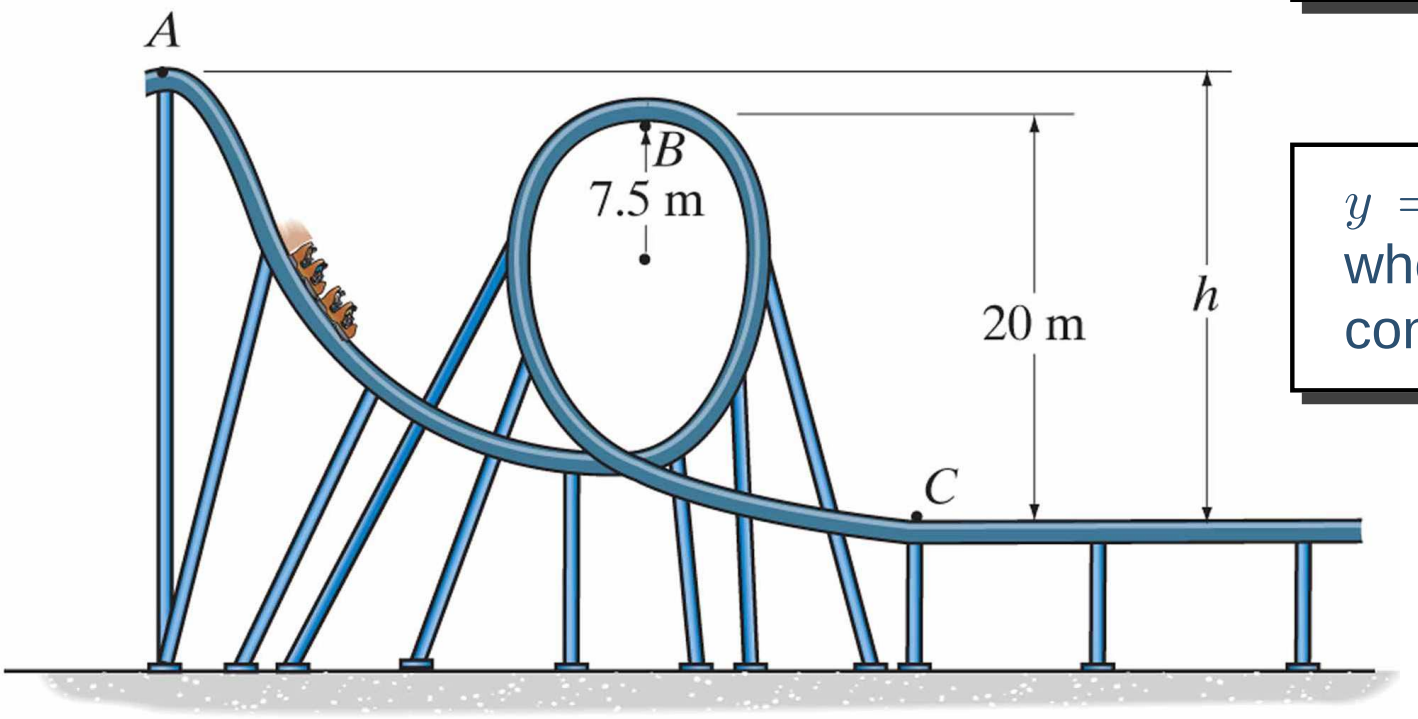
(d) $\sqrt{2g(h - 15\,m)} = 14\,m/s$

(e) Intentionally left blank

Mechanical Energy Exercise II

A roller coaster starts from rest at point A, goes through the loop-to-loop, and arrives at point C. If friction can be ignored, the roller coaster simply slides along its track, and $h = 25\,m$, how fast will the roller coaster be going at C?

(a) $\sqrt{2gh} = 22\,m/s$



$y = 0$ can be set wherever is most convenient