a place of mind

FACULTY OF EDUCATION

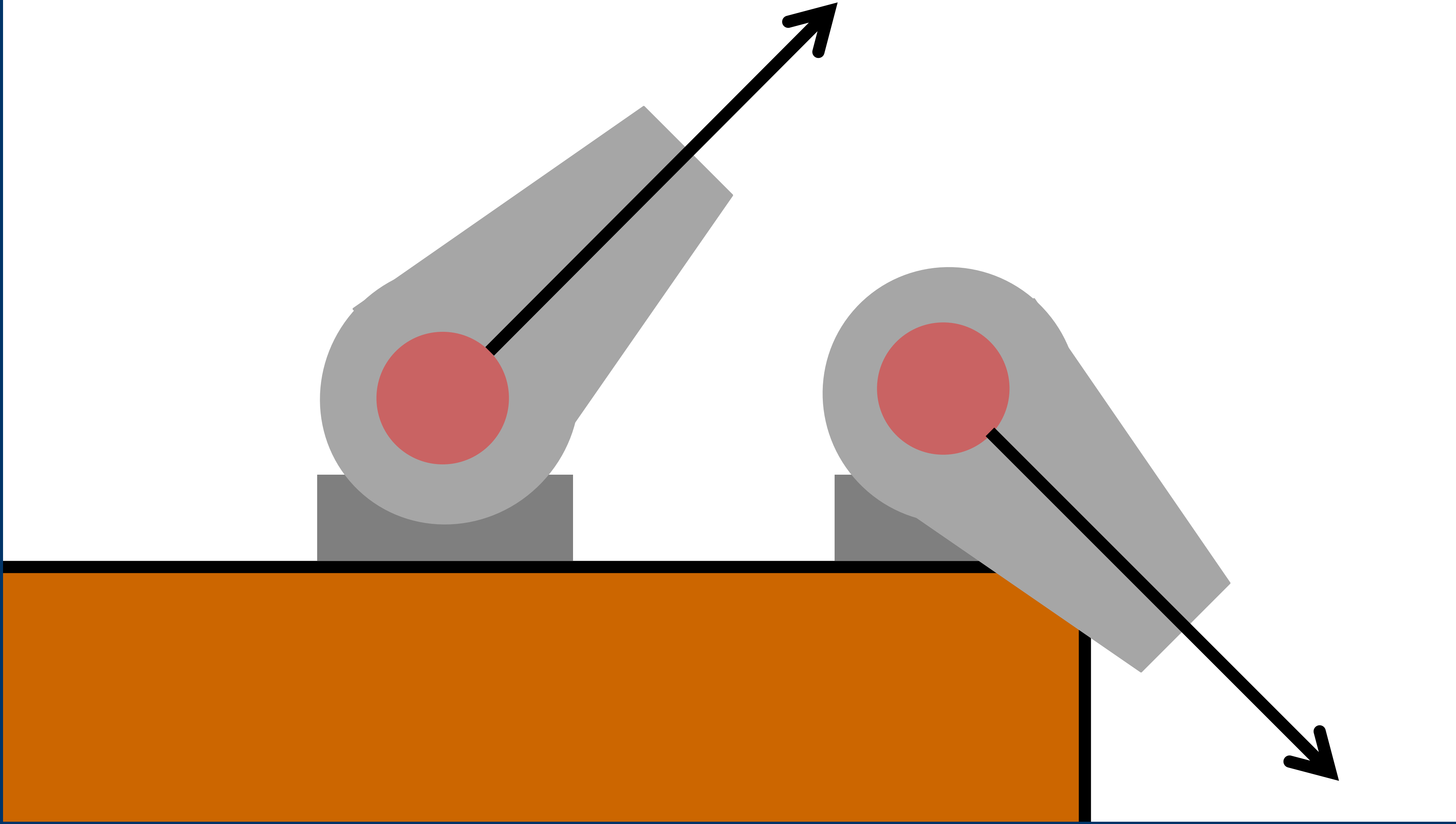
Department of
Curriculum and Pedagogy

Physics
Conservation of Energy

Science and Mathematics
Education Research Group

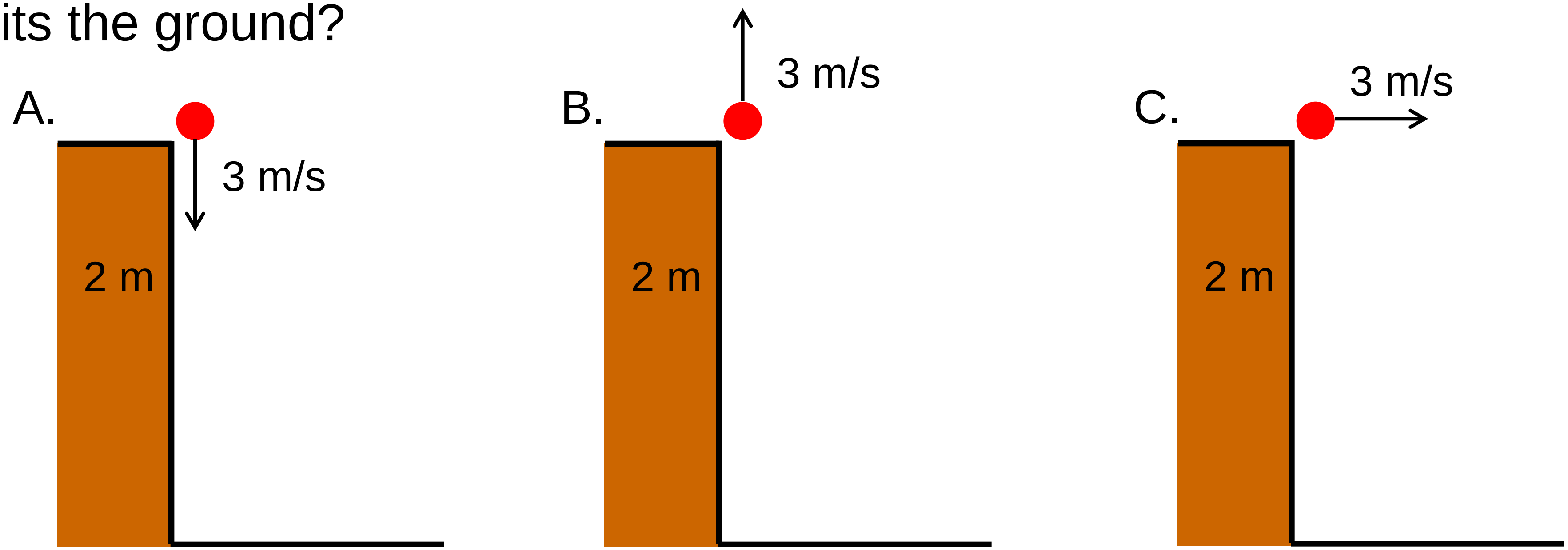
Supported by UBC Teaching and Learning Enhancement Fund 2012-2013

Final Speeds



Final Speed I

A ball is launched off a platform with an initial velocity of 3 m/s in the direction shown. Which ball will have the greatest speed when it hits the ground?



D. Speed of A = B > C

E. All three balls will have the same final speed

Solution

Answer: E

Justification: All three balls start at the same height and initial speed, therefore they all have the same initial kinetic and potential energy.

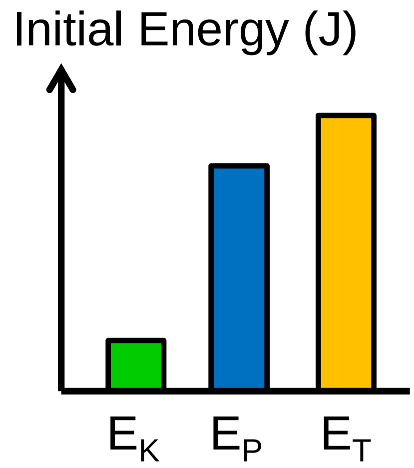
$$E_{k,i} + E_{p,i} = E_{k,f}$$

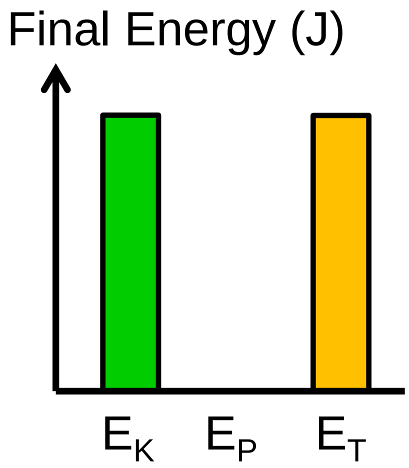
$$\frac{1}{2}mv_0^2 + mgh = \frac{1}{2}mv^2$$

$$v^2 = v_0^2 + 2gh$$

$$v^2 = (3)^2 + 2(10)(2)$$

$$v = 7\,m/s$$

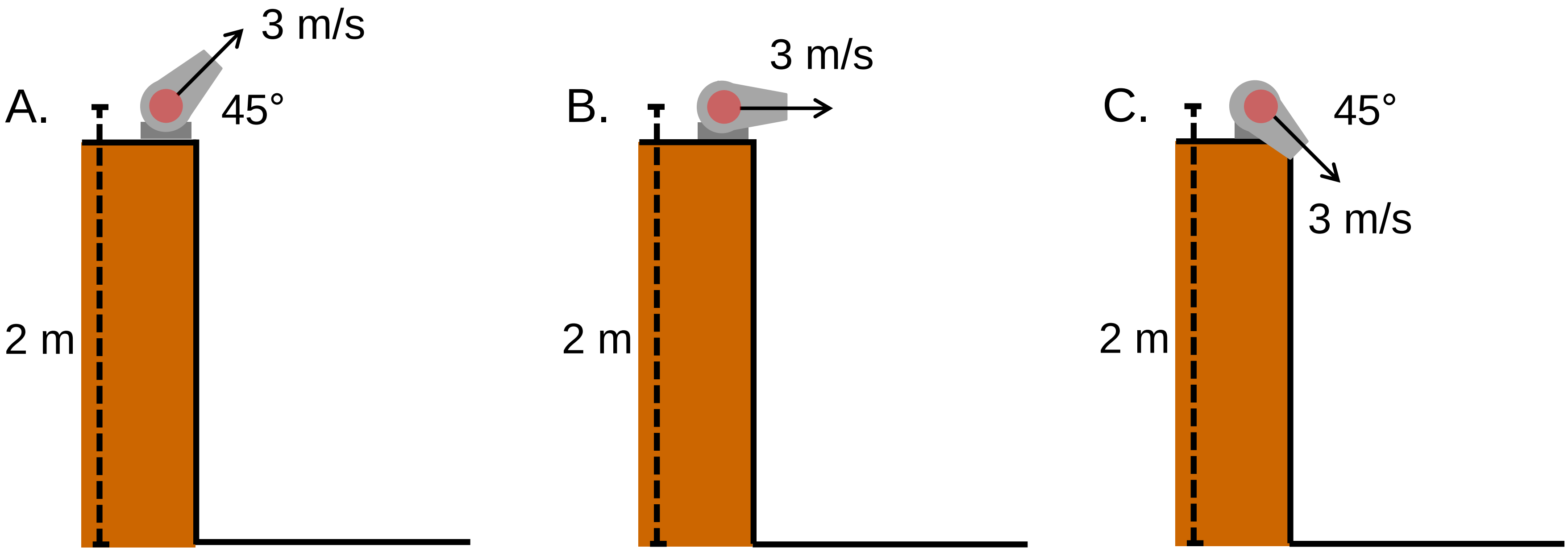




Ball B will take longer to hit the ground than ball A. Ball C hits the ground at an angle: its velocity has horizontal and vertical components. However, all the balls have the same final speed.

Final Speed II

A ball is launched from a cannon with an initial velocity of 3 m/s in the direction shown. Which ball will have the greatest speed when it hits the ground?



D. Speed of A = C > B

E. All three balls will have the same final speed

Solution

Answer: E

Justification: All three balls start at the same height and initial speed, therefore they all have the same initial kinetic and potential energy.

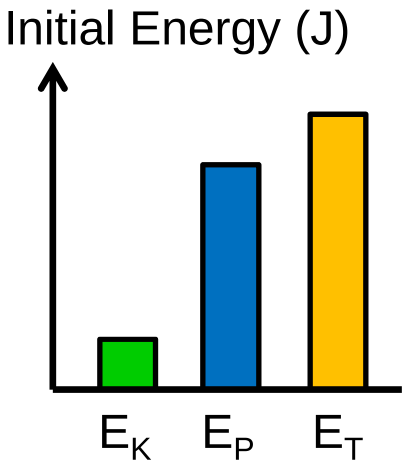
$$E_{k,i} + E_{p,i} = E_{k,f}$$

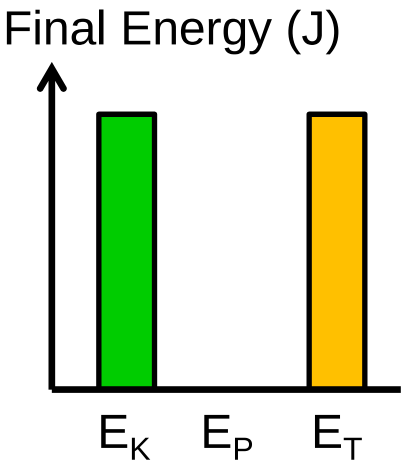
$$\frac{1}{2}mv_0^2 + mgh = \frac{1}{2}mv^2$$

$$v^2 = v_0^2 + 2gh$$

$$v^2 = (3)^2 + 2(10)(2)$$

$$v = 7\, m/s$$



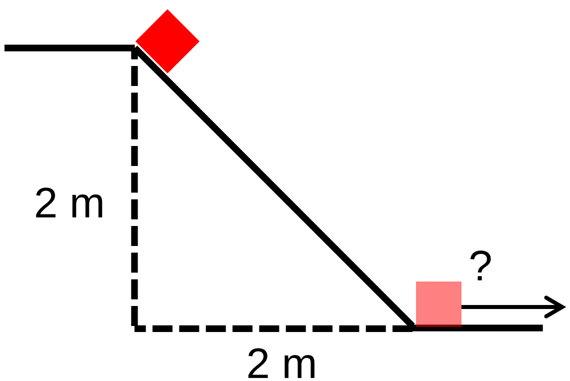


All three balls will hit the ground at different times and distances from the base, but they will have the same final speed.

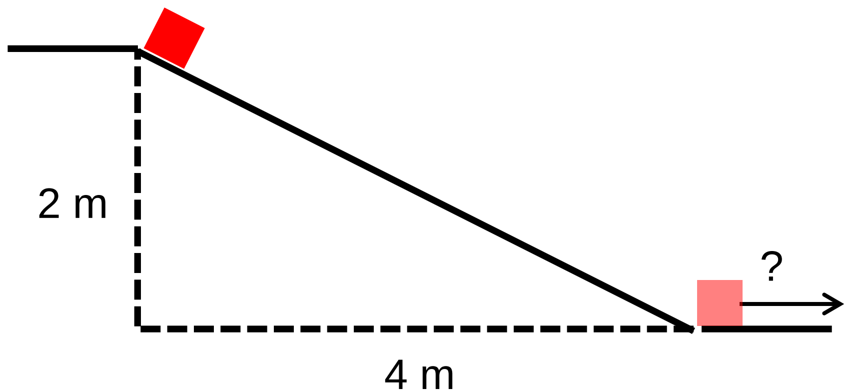
Final Speed III

Three identical blocks slide off a **frictionless** ramp from **rest**. On which ramp will the block have the greatest final speed?

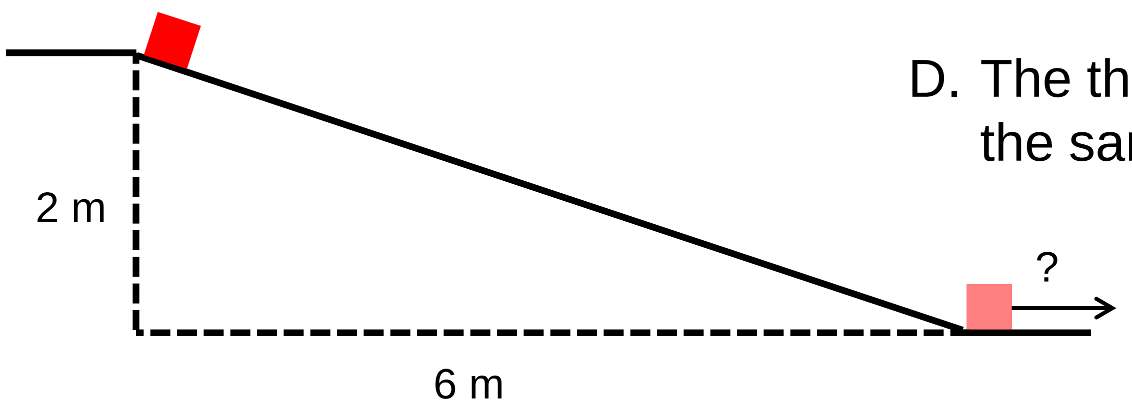
A.



B.



C.



D. The three blocks will have the same final speed

Solution

Answer: D

Justification: All three blocks start at the same height with no initial speed, therefore they all have the same potential energy and no kinetic energy.

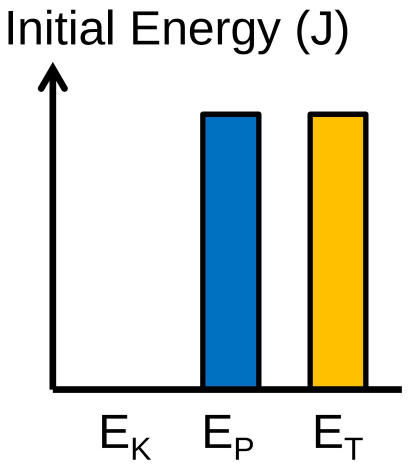
$$E_{p,i} = E_{k,f}$$

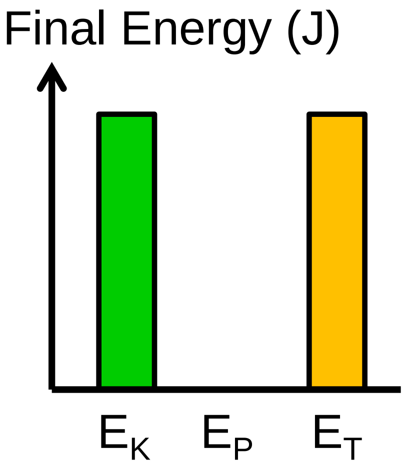
$$mgh = \frac{1}{2}mv^2$$

$$v^2 = 2gh$$

$$v = \sqrt{2(10)(2)}$$

$$v \approx 6.3 m/s$$



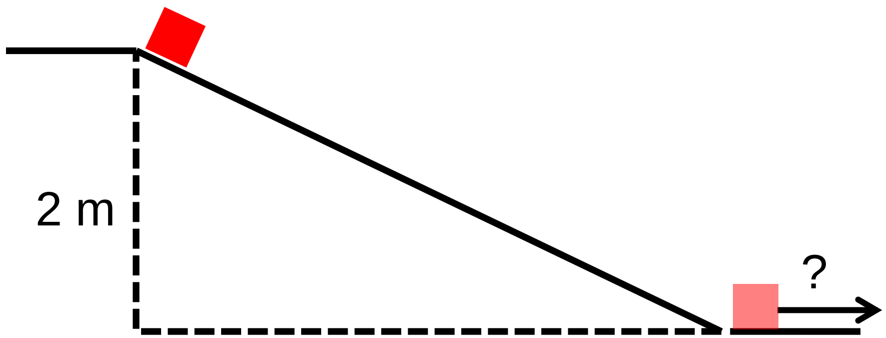


Block A will reach the bottom in the fastest time while block C will be the slowest to reach the bottom, but they will have the same final speed.

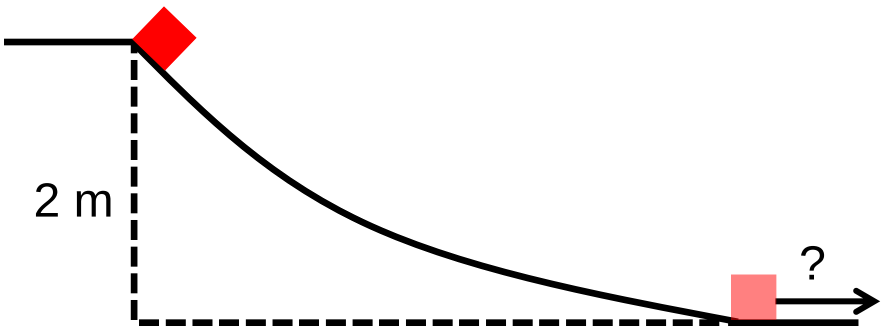
Final Speed IV

Three identical blocks slide off a frictionless ramp from rest. On which ramp will the ball have the greatest final speed?

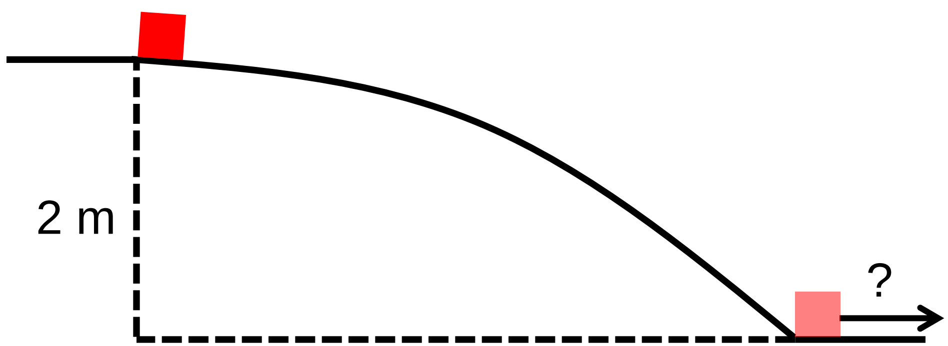
A.



B.



C.



D. The three blocks will have the same final speed

Solution

Answer: D

Justification: All three blocks start at the same height with no initial speed, therefore they all have the same potential energy and no kinetic energy.

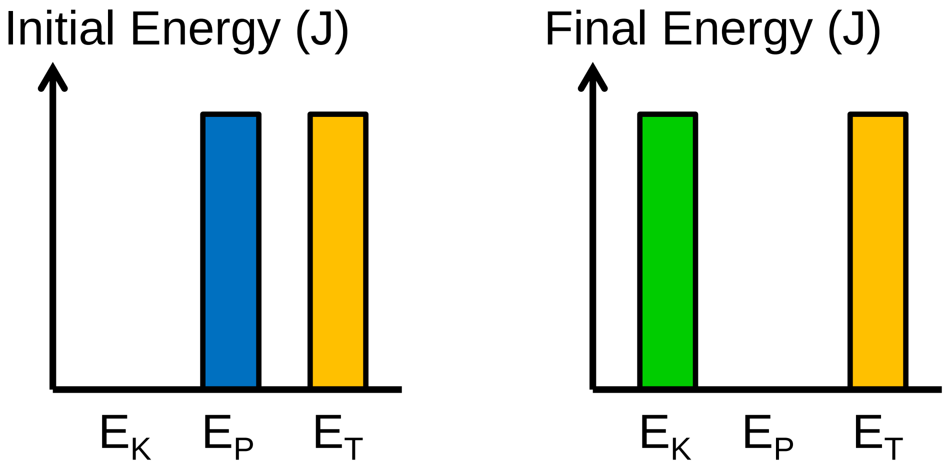
$$E_{p,i} = E_{k,f}$$

$$mgh = \frac{1}{2}mv^2$$

$$v^2 = 2gh$$

$$v = \sqrt{2(10)(2)}$$

$$v \approx 6.3 m/s$$

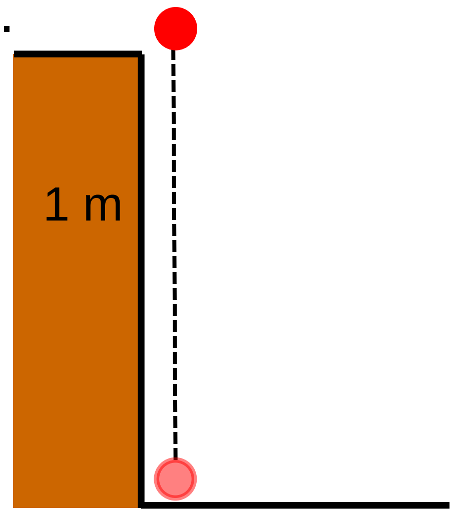


Block B will reach the bottom in the fastest time while block C will be the slowest to reach the bottom, but they will have the same final speed.

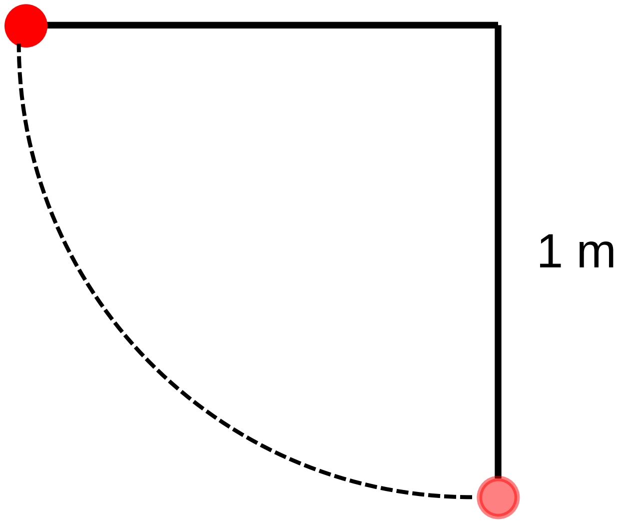
Final Speed V

One ball rolls off a table at a height of 1 m. Another ball is attached to a 1 m string with negligible mass. It is then released from a point where the string is horizontal. Which ball will have the greatest speed at its lowest point?

A.



B.



C. Both balls will have the same final speed

Solution

Answer: C

Justification: Both balls start at the same height above the ground and with no kinetic energy. Thus, when both balls reach the ground, the gravitational potential energy will turn into kinetic energy.

$$E_{p,i} = E_{k,f}$$

$$mgh = \frac{1}{2}mv^2$$

$$v^2 = 2gh$$

$$v = \sqrt{2gh}$$