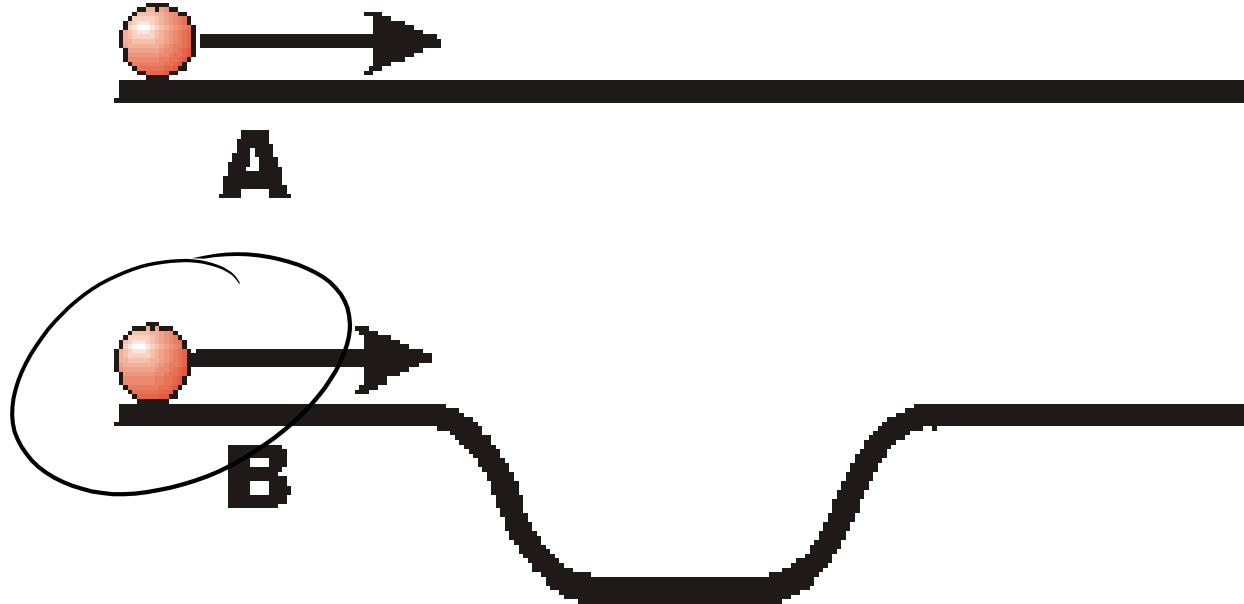


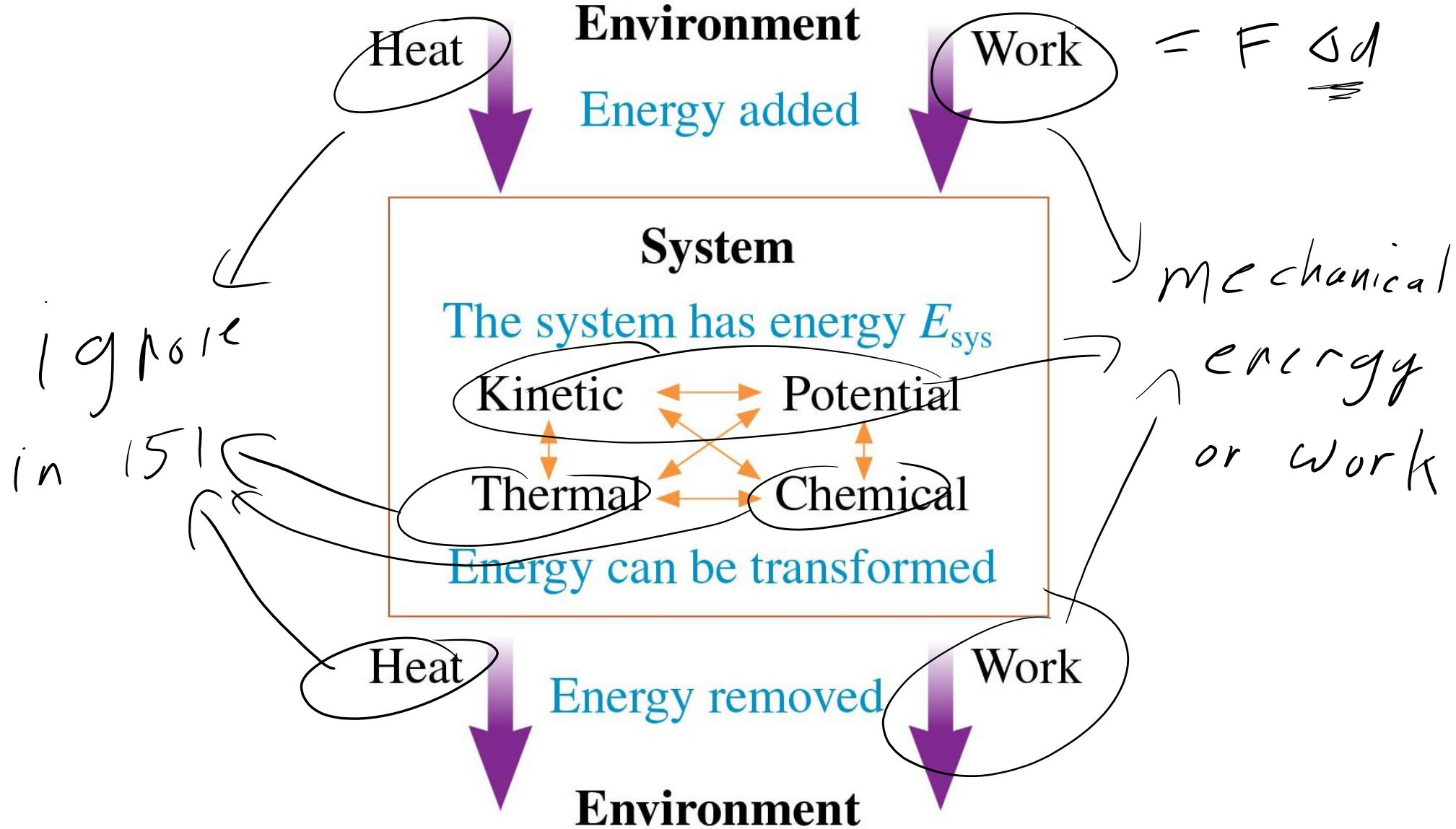
Which ball should win the race? Or will it be a tie?



Chapter 9 – Work and Kinetic Energy

- Energy and systems
- Work
- Thermal energy
- Power





What is power?

P \vec{P}

Power is the rate at which energy is transferred or transformed. For machines, power is the rate at which they do work. For electricity, power is the rate at which electric energy is transformed into heat, sound, or light. Power is measured in **watts**, where 1 watt is a rate of 1 joule per second.

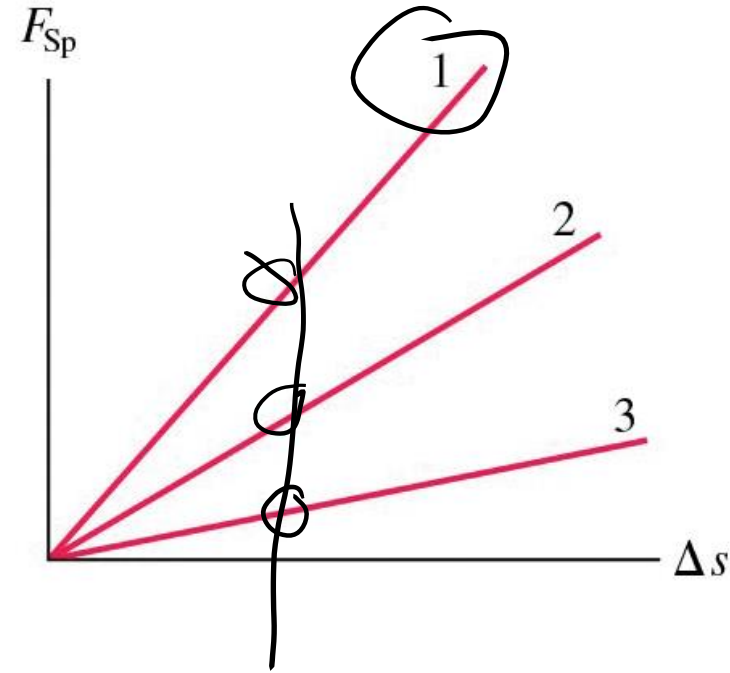


$$P = \frac{dE}{dt} \rightarrow P = \vec{F} \cdot \vec{v}$$

Team Up Questions

STOP TO THINK 9.7 The graph shows the force magnitude versus displacement for three springs. Rank in order, from largest to smallest, the spring constants k_1 , k_2 , and k_3 .

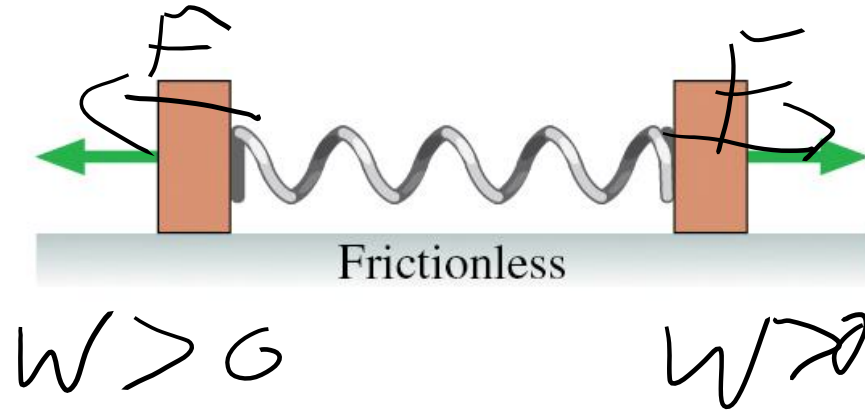
$$|F_{sp}| = |k \Delta s|$$



Team Up Questions

STOP TO THINK 9.8 A compressed spring pushes two equal-mass blocks apart, as shown. Is the work done by the spring positive, negative, or zero?

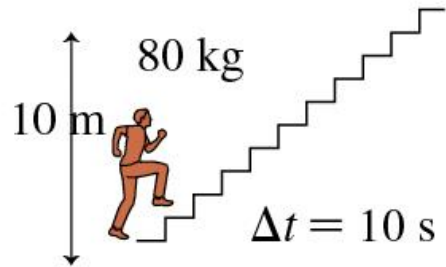
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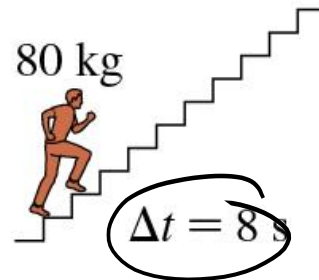
Team Up Questions

STOP TO THINK 9.9 Four students run up the stairs in the time shown. Rank in order, from largest to smallest, their power outputs P_A to P_D .

$$P = \frac{\Delta U}{\Delta t}$$

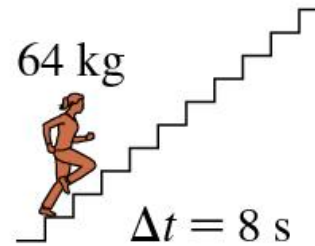


A

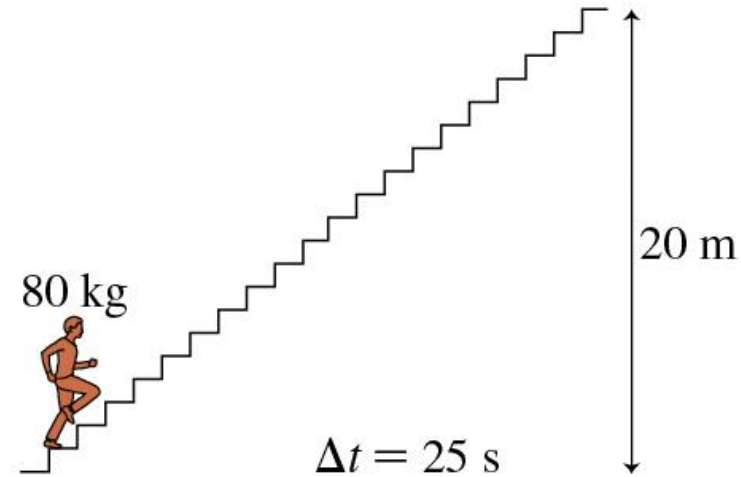


B

Smaller

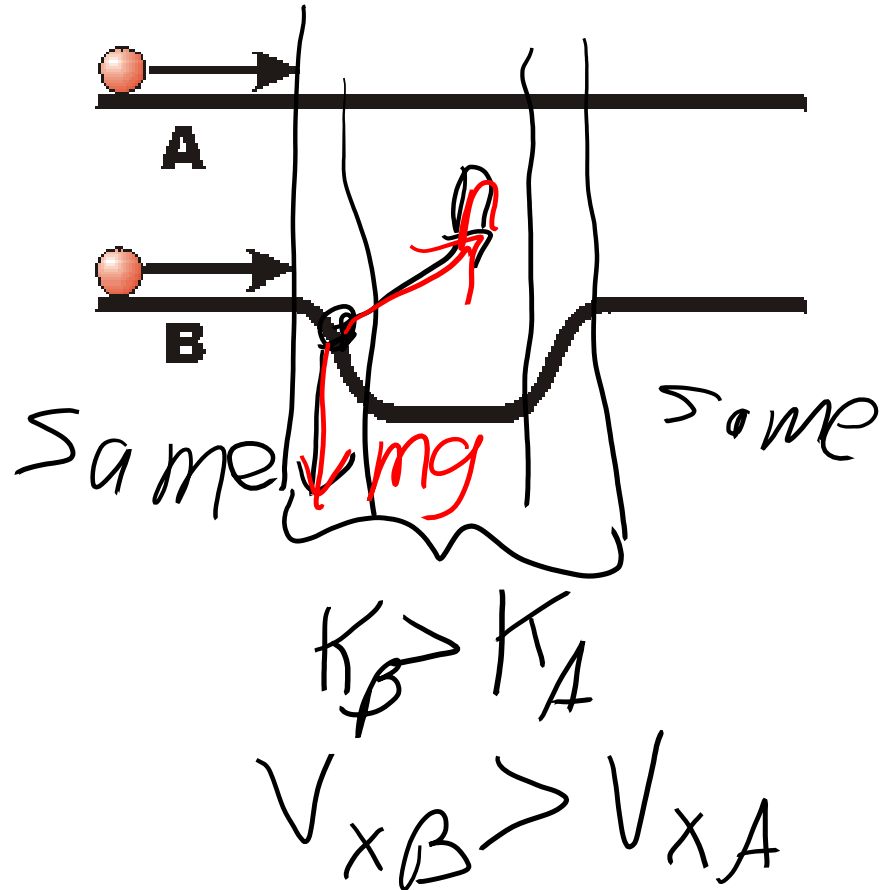


C



D

Which ball should win the race? Or will it be a tie?



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

$$\Delta t = \frac{\Delta x}{V_x} \leftarrow \text{Same}$$

(flat road)
Find $v(t)$ for a car with a constant power output.

$$P = \text{constant} = \frac{dE}{dt} = \frac{d}{dt} \left(\frac{1}{2} m v^2 \right)$$

$$\int P = \int \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) dt \quad v_f = \sqrt{v_i^2 + \frac{2P}{m} t}$$

$$P_0 t = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$

