March 18, Week 9

Today: Finish Chapter 6 and begin Chapter 7, 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.

If interested in Physics 110, you can still start attending tomorrow

Help sessions with Jonathan:

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

Work Review

Work - How much effort goes into causing motion.

Unit: $N \cdot m = kg \cdot m^2/s^2 = J$.

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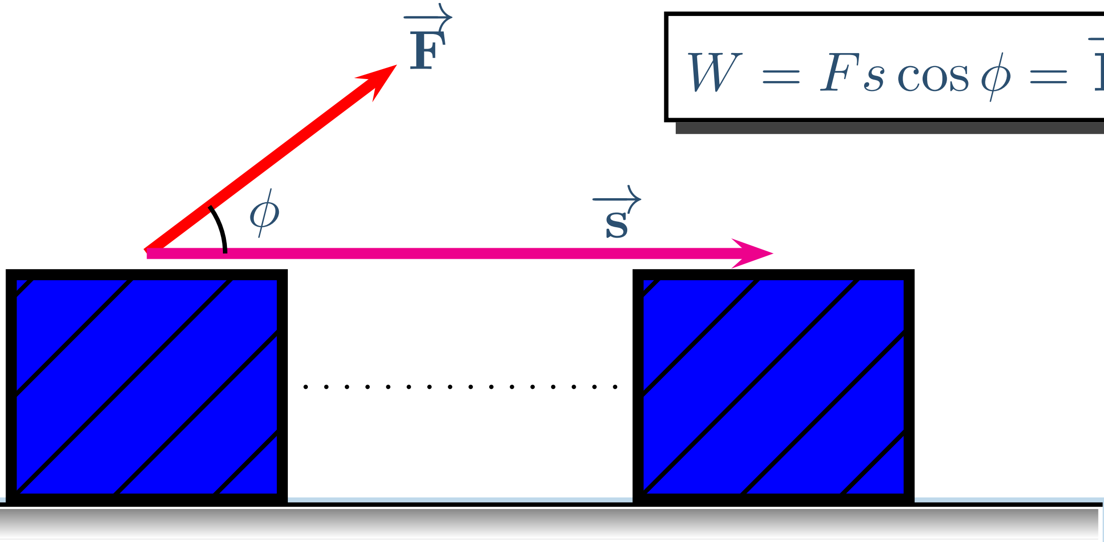
For Constant Force and Straight-line Motion:

$\overrightarrow{\mathbf{s}}$ = displacement
= distance and direction

$\phi =$ angle between $\overrightarrow{\mathbf{F}}$ and $\overrightarrow{\mathbf{s}}$

$$W = Fs\cos\phi = \overrightarrow{\mathbf{F}} \cdot \overrightarrow{\mathbf{s}}$$



Variable Forces

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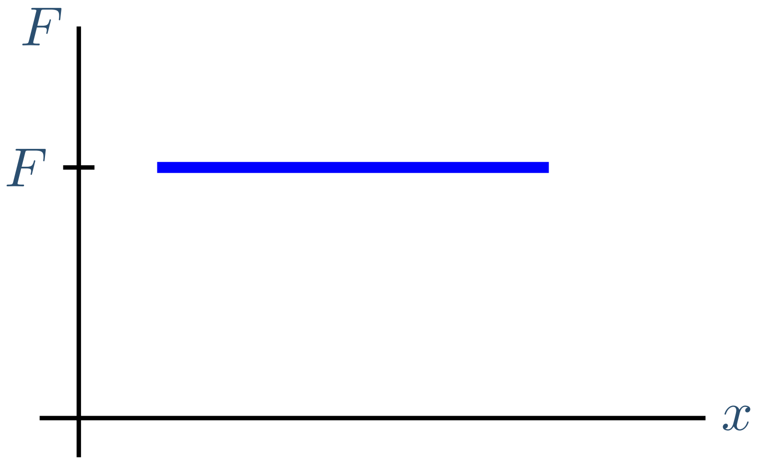

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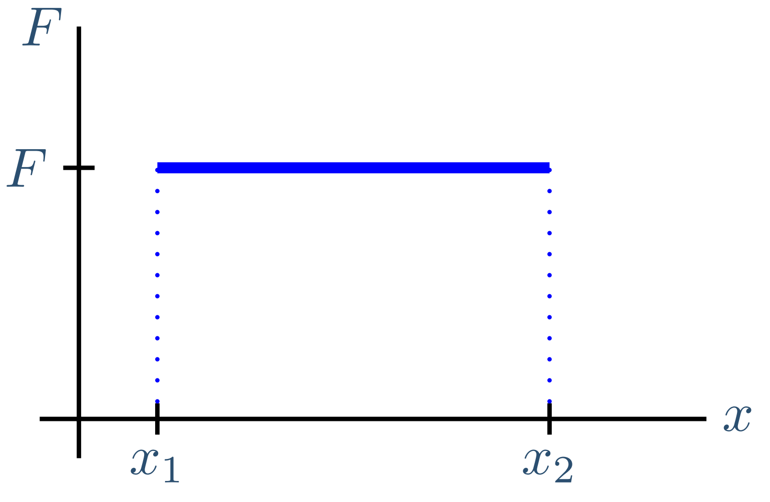

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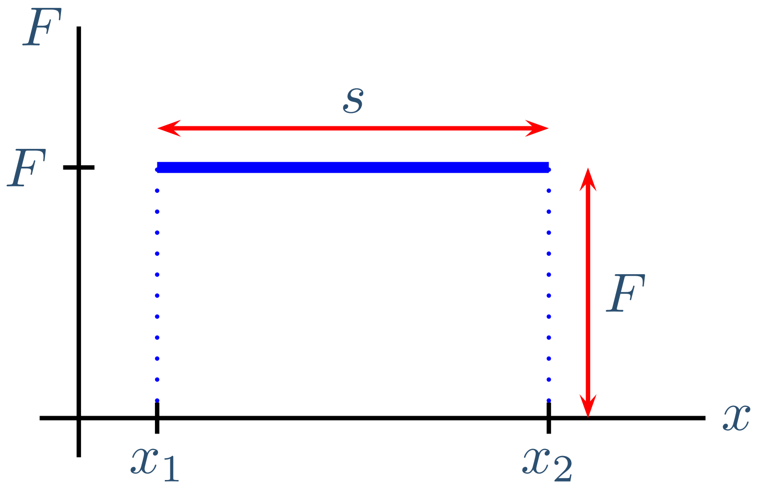

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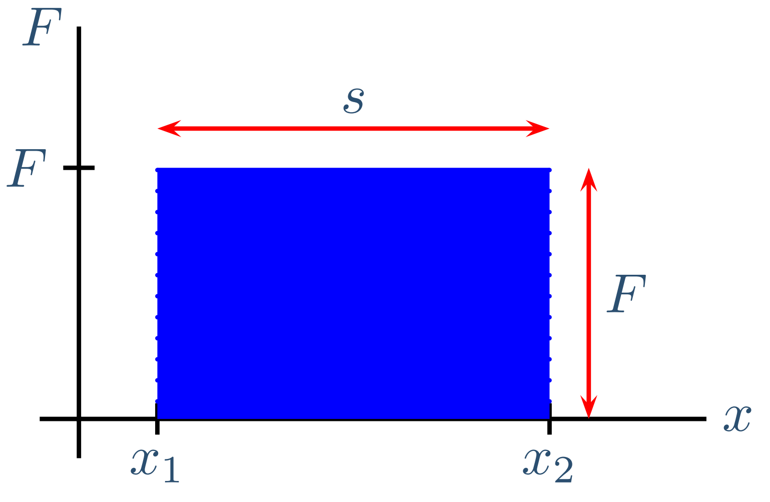

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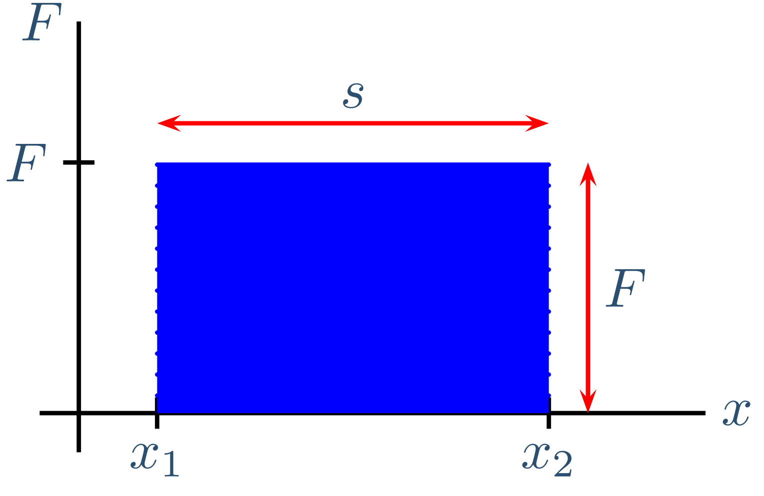

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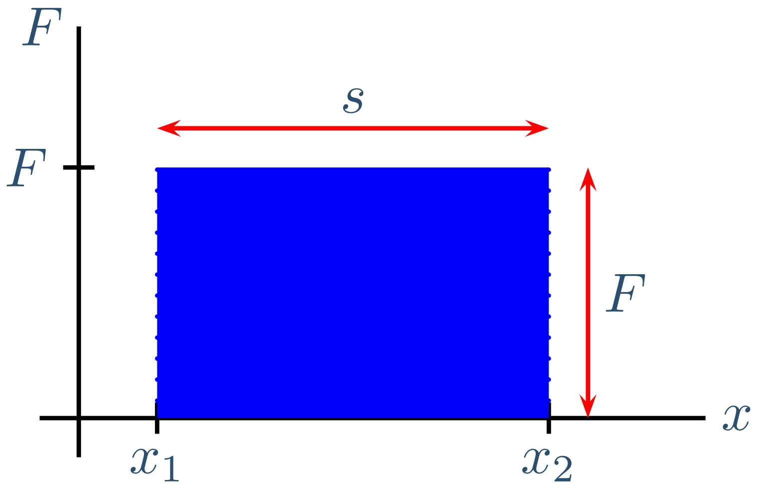

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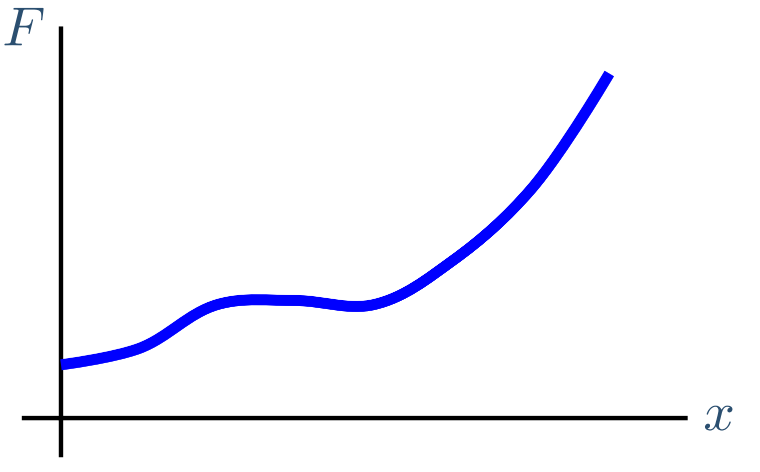

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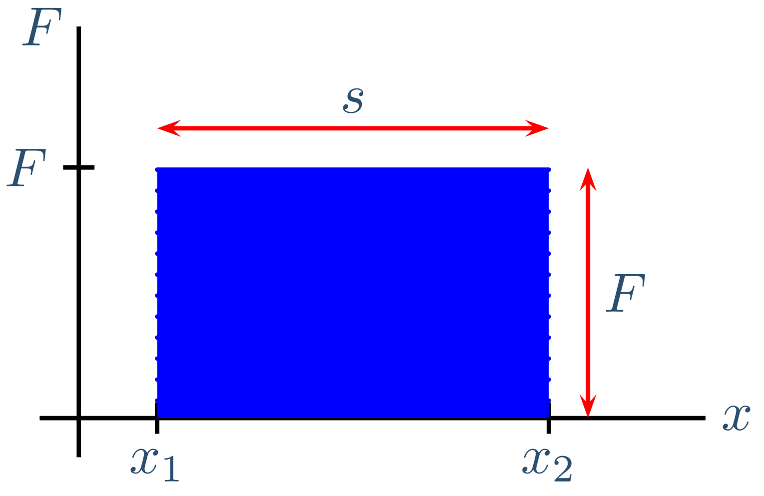

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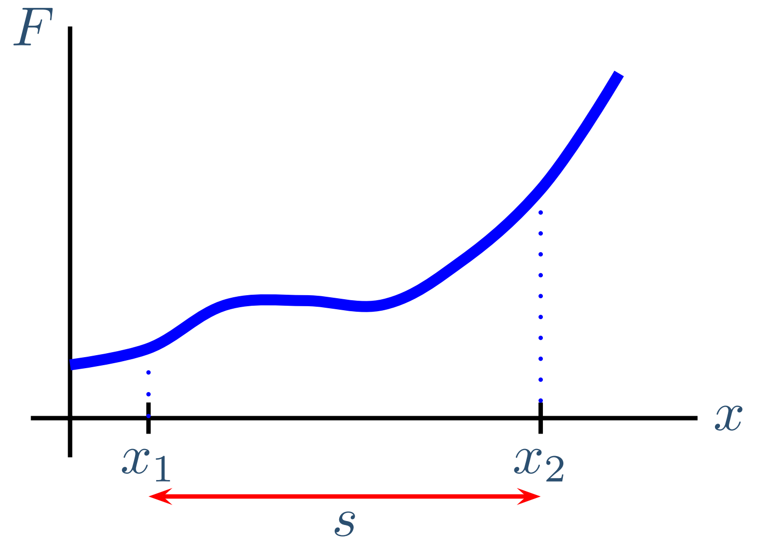

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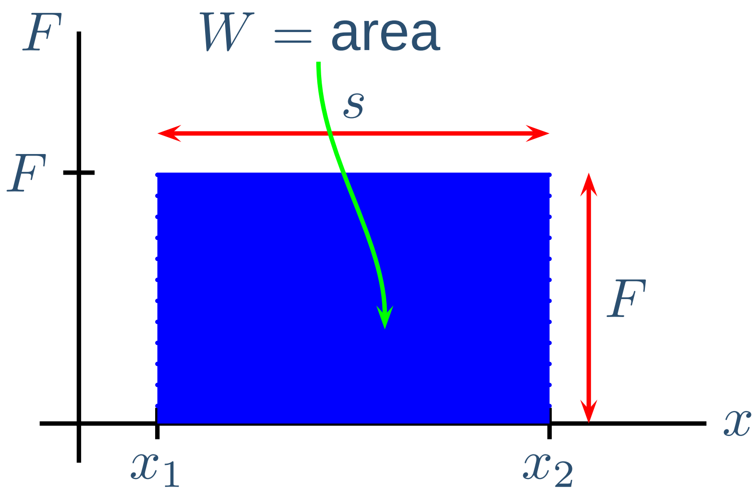

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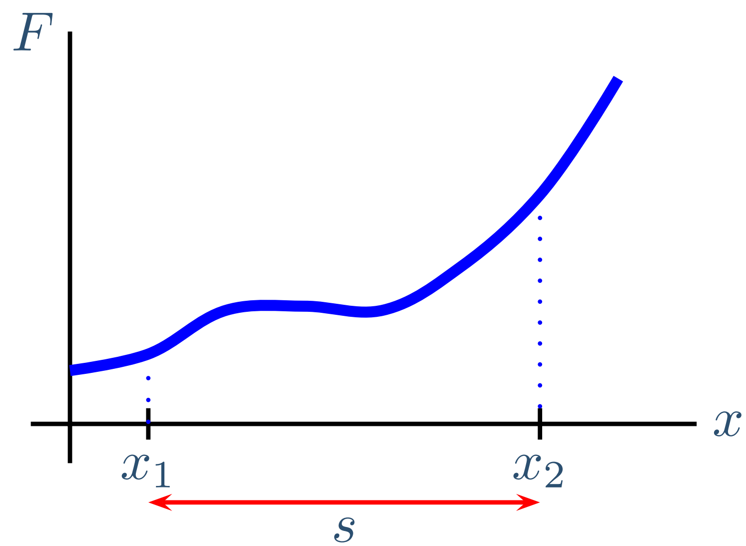

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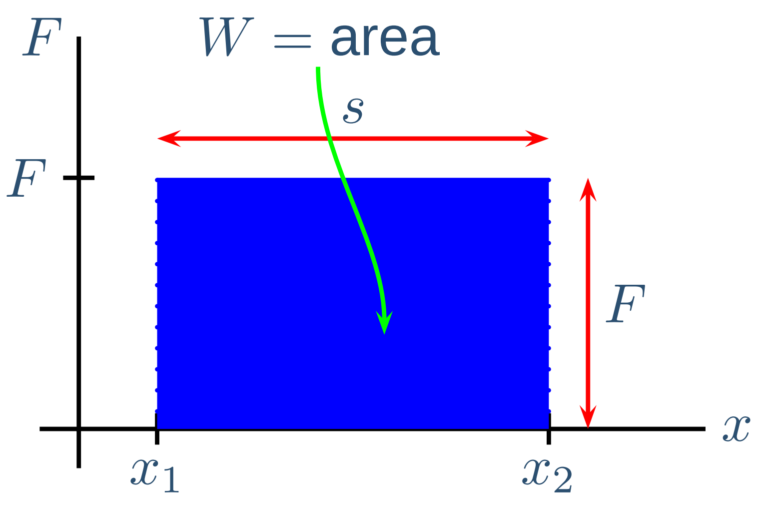

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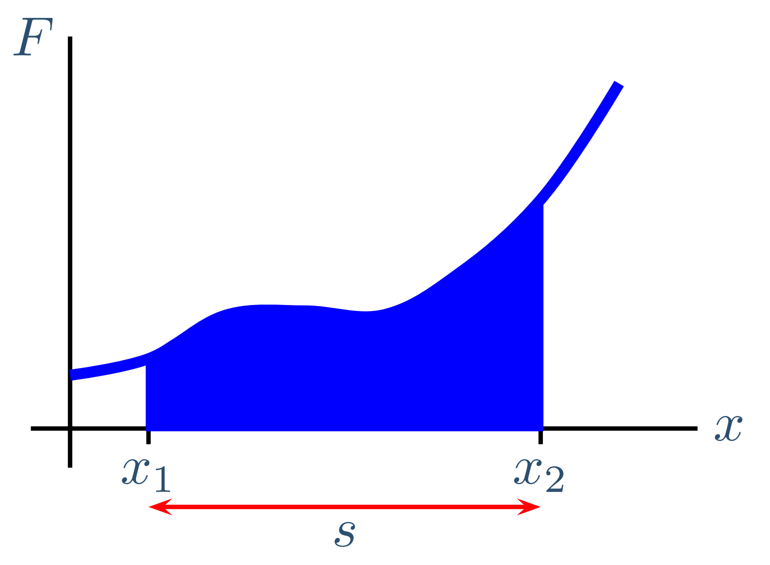

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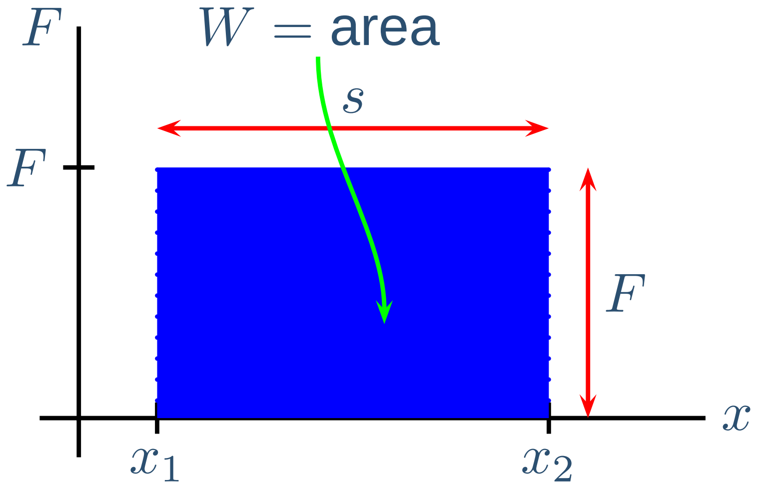

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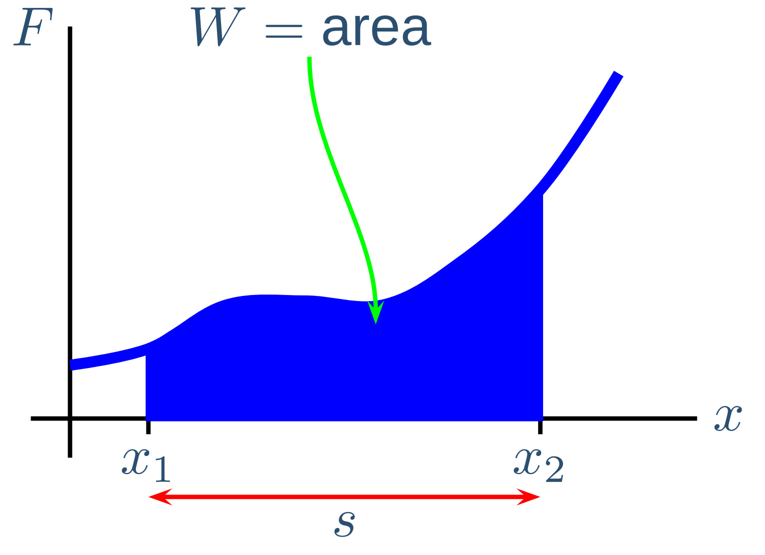

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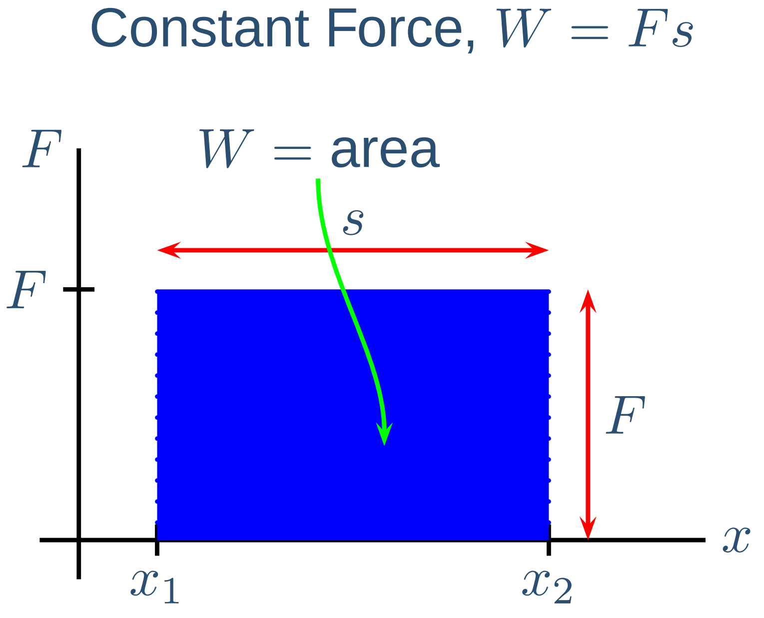

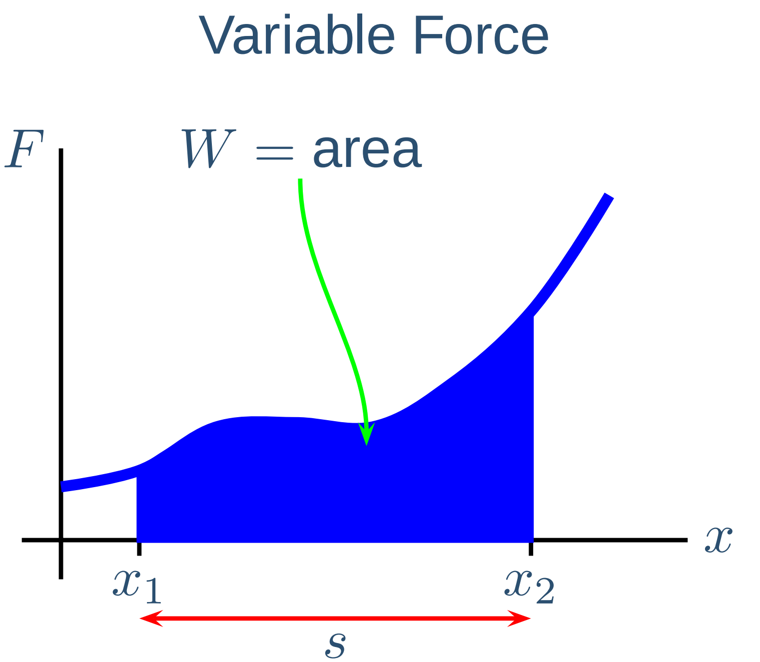

For any type of force, it can be shown that the work-energy theorem holds! $W_{total} = \Delta K = \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2$

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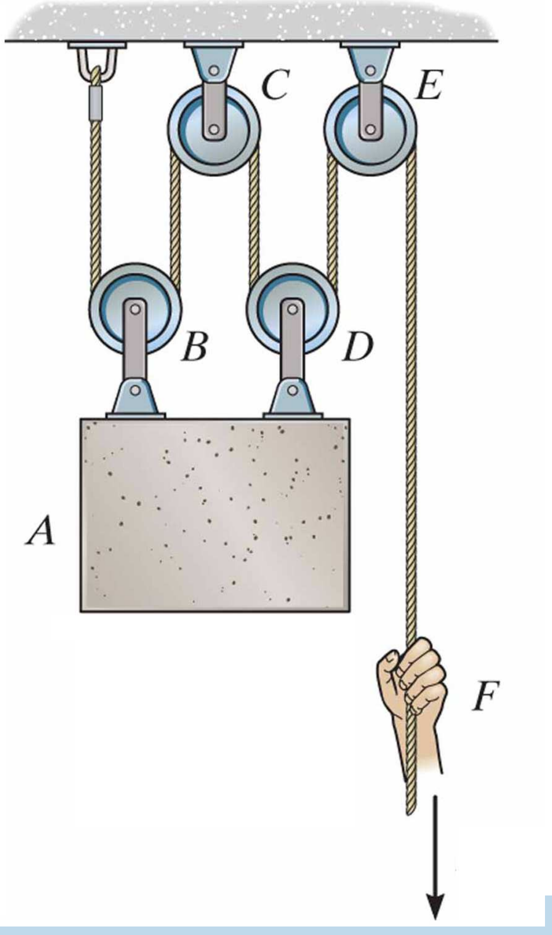
$$\boxed{1\, hp = 550\, lb \cdot ft/s = 746\, Watt}$$

Power Exercise

The power supplied by the person pulling the rope can't exceed the power of the rising block! If the person is pulling the rope down at $4\,m/s$, with what speed is the block rising?



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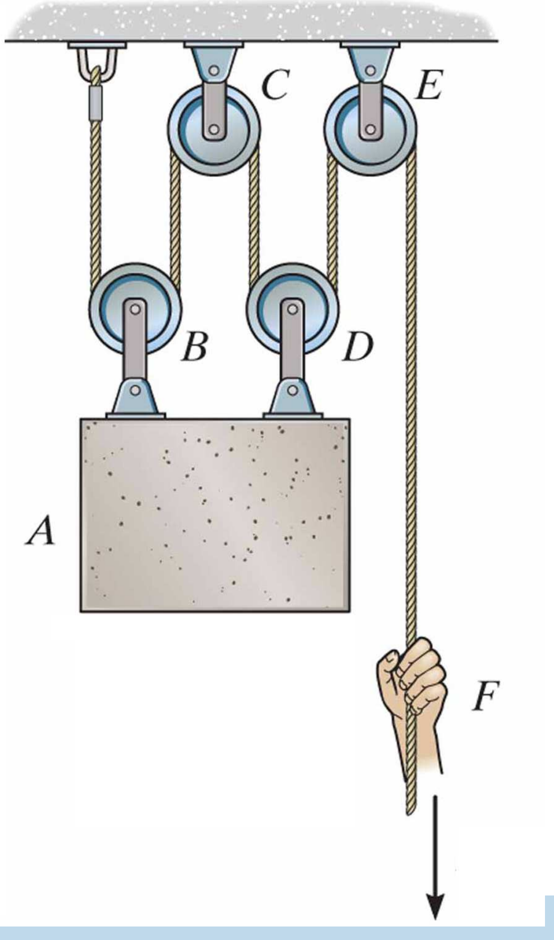

(a) $0\,m/s$

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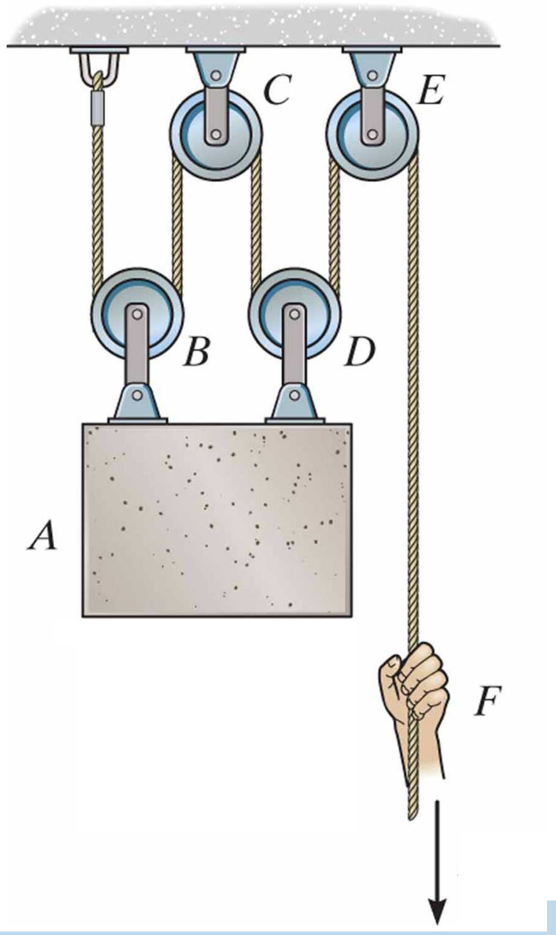

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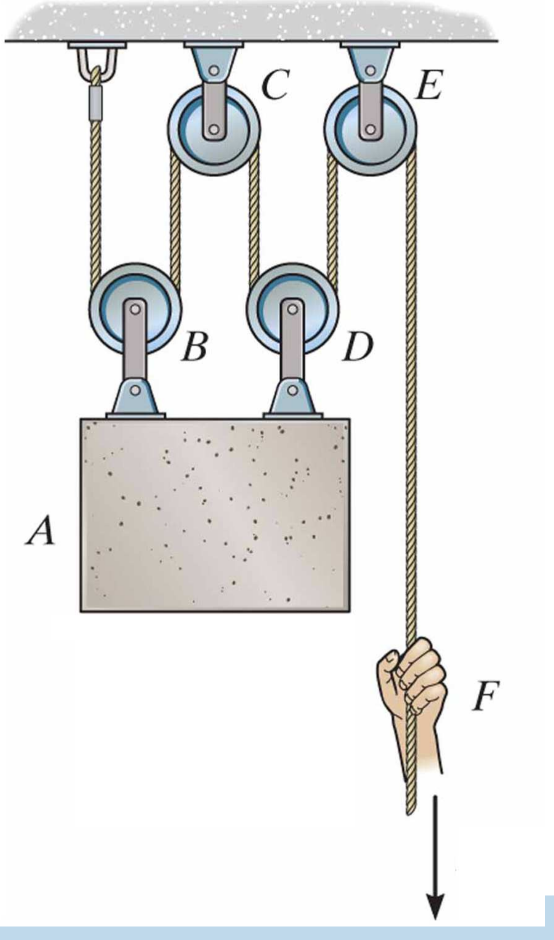

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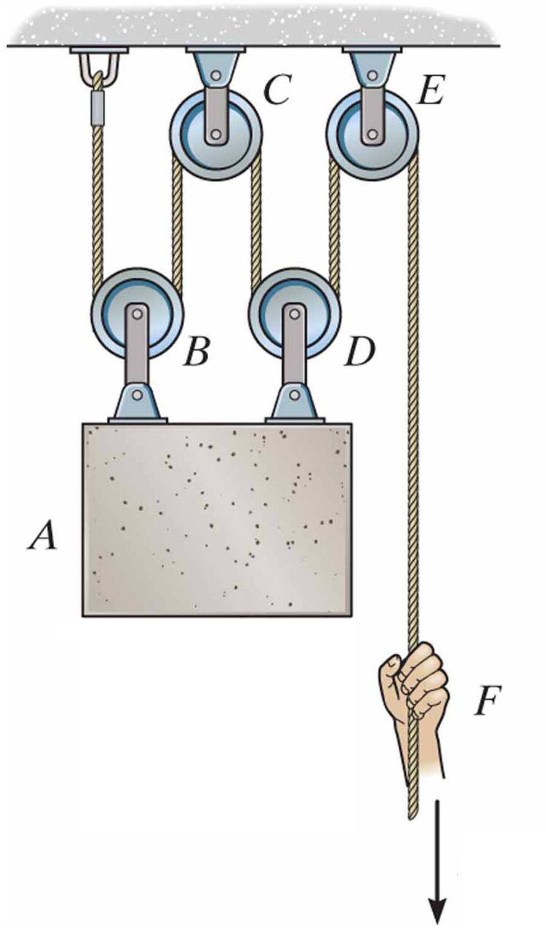

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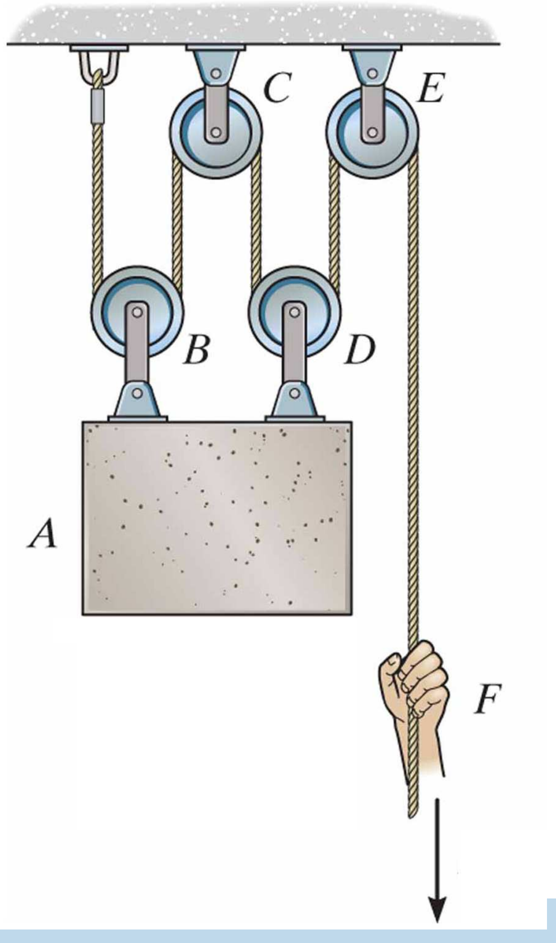

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(e) $4\,m/s$

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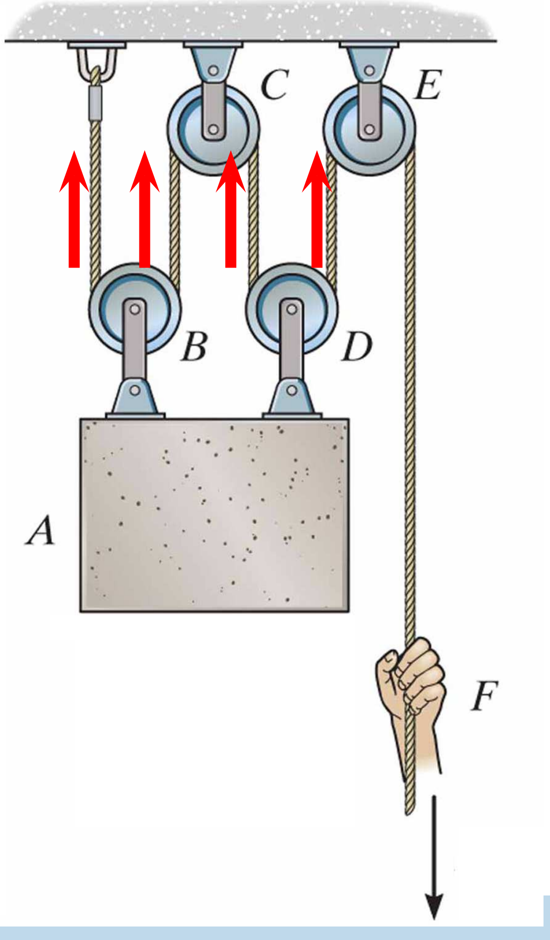

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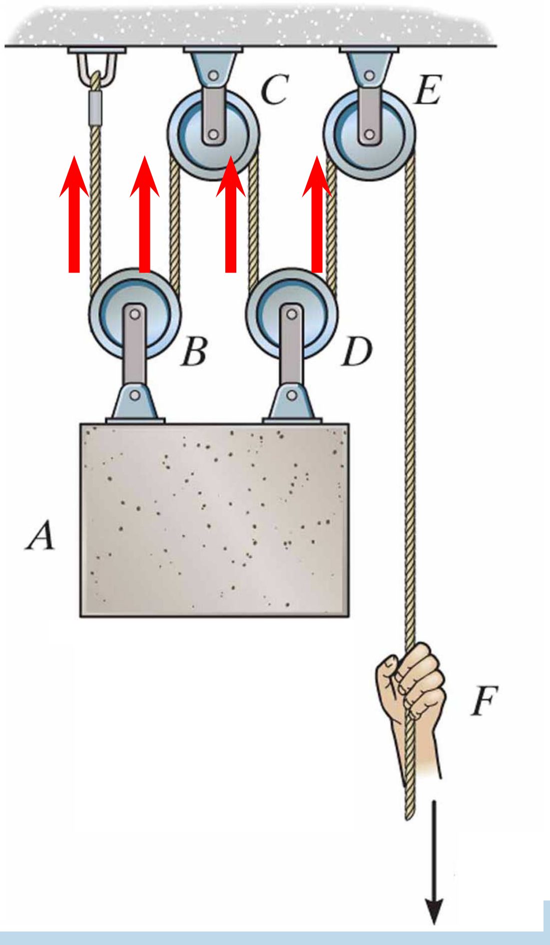

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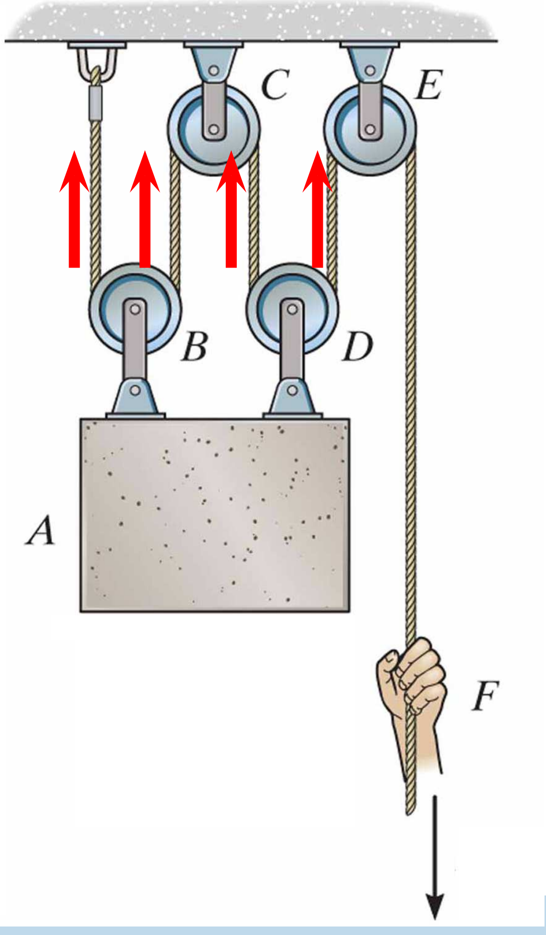

$P_{Hand} = T(4\,m/s)$ (Downwards pull and velocity $\Rightarrow \phi = 0^\circ$)

$P_{Block} = (4T)v_{block}$ (Upwards force and velocity on block $\Rightarrow \phi = 0^\circ$ here too)

$P_{Hand} = P_{Block} \Rightarrow T(4\,m/s) = (4T)v_{block}$

(b) $1\,m/s$

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Conservative Forces - Forces that create potential energy.

Conservative forces are rare. Only gravity and the spring force are conservative. (You'll learn two more next term - the electric and magnetic force.) For a force to be conservative, the work it does must be independent of path.

Conservation of Energy

For a conservative force,

$$W = -\Delta U$$

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Conservation of Energy - If only conservative forces do work on an object, its total energy cannot change.

Total Energy, E = the sum of kinetic and potential energy.

$$\boxed{E = K + U}$$

Conservation of Energy II

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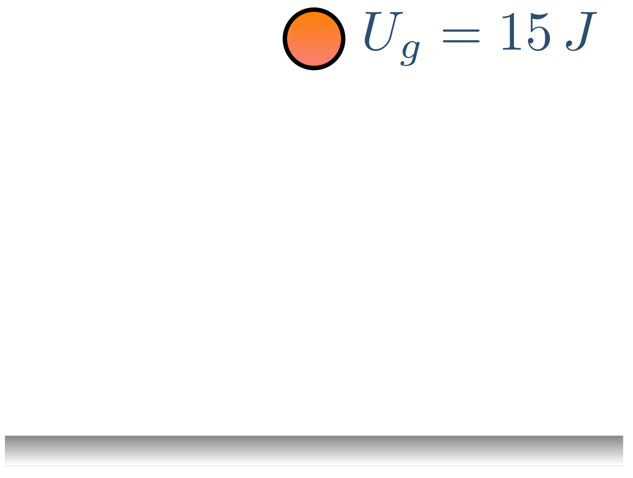
$$\Rightarrow E_1 = E_2$$

Energy Conservation Exercise

A block having $15\,J$ of gravitational potential energy is dropped from rest. When the block hits the ground, it has $15\,J$ of kinetic energy. If gravity is the only force acting on the block, how much potential energy does the block have when it hits the ground?



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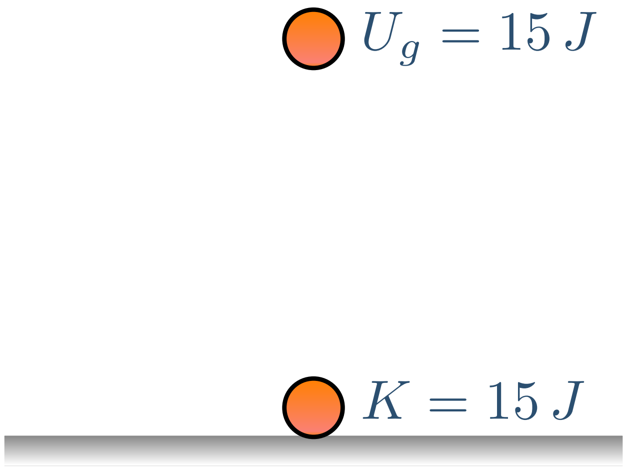

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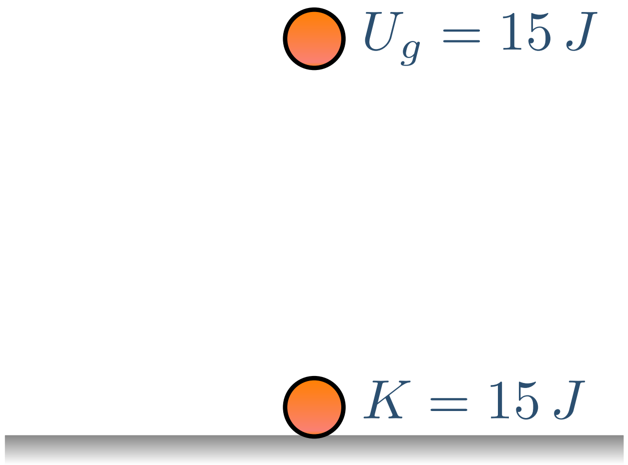

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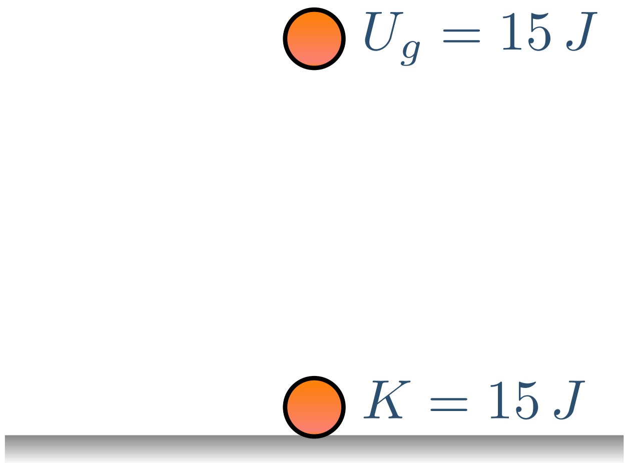

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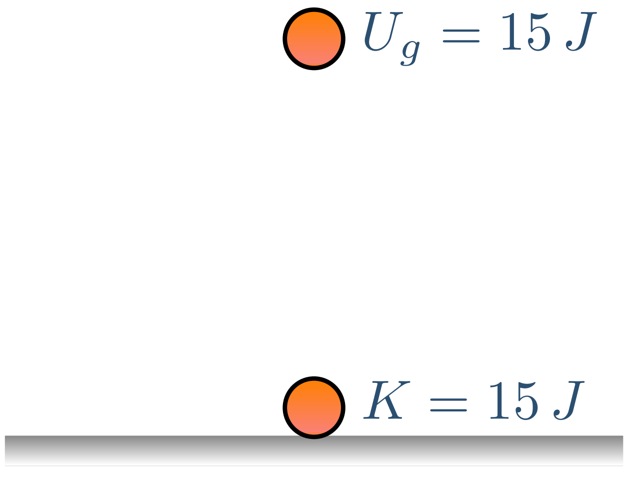

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(c) $15\,J$

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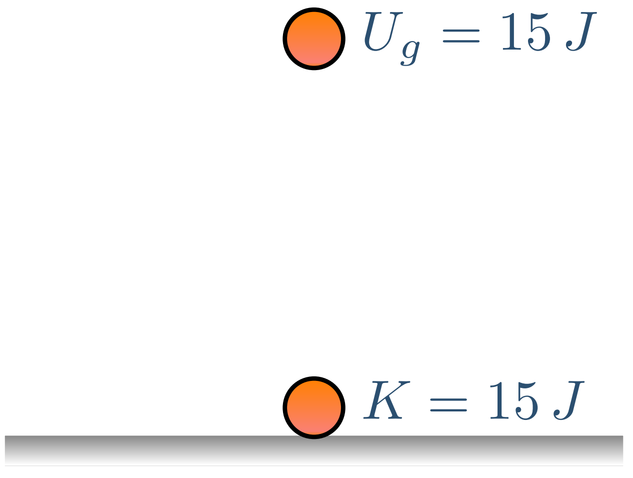

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(d) $30\,J$

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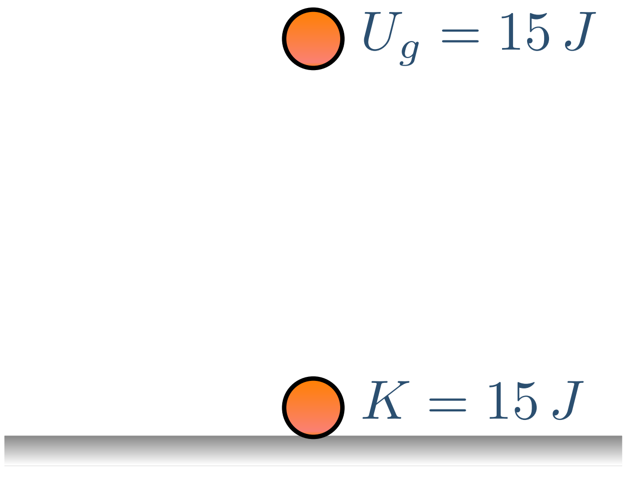

(a) $0\,J$

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(d) $30\,J$

(e) Cannot be determined

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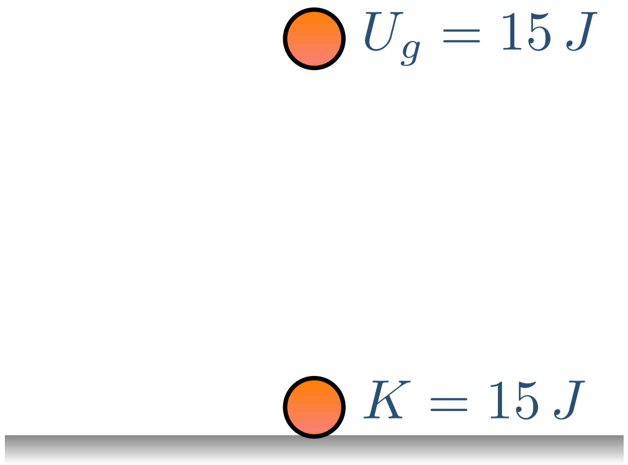

(a) $0\,J$

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(d) $30\,J$

(e) Cannot be determined

$$K_1 + U_1 = K_2 + U_2 \Rightarrow$$

$$0 + 15\,J = 15\,J + U_2$$