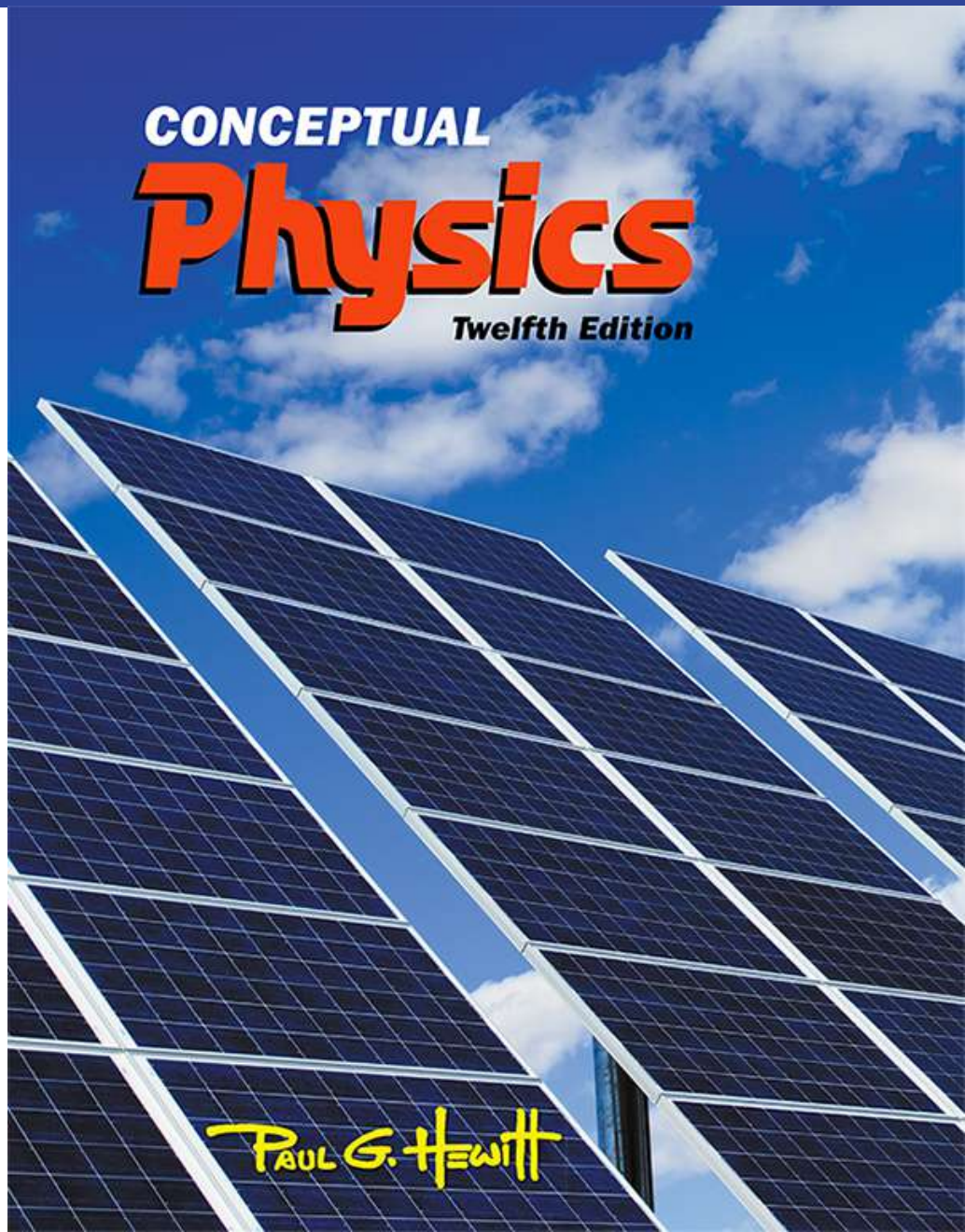
Lecture Outline

Chapter 7: Energy



More about energy:

1. Energy is the ability to do work.

2. Energy and work have the same units: Joules, J

3. Mechanical Energy:

Energy due to the position or movement of something.

4. Two types of mechanical energy:

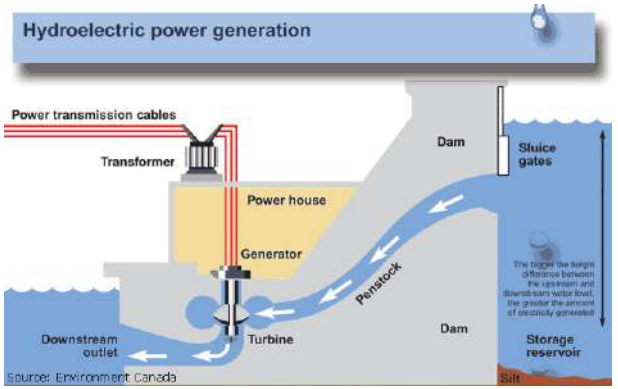
- Potential – due to position or condition of an object
- Kinetic – due to its motion or movement

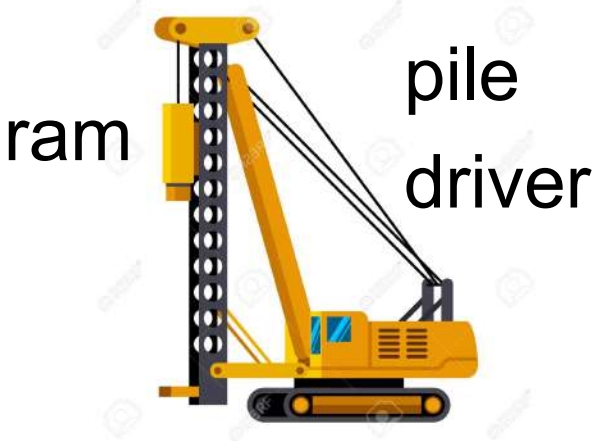
Potential Energy

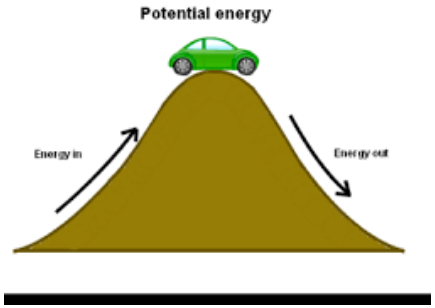
- **Stored** energy held in readiness with a potential for doing work
- Examples:
  - A stretched bow has stored energy that can do work on an arrow.
  - A lifted book has stored energy that can hurt you if it falls on your head
  - A battery has stored energy that can be used to power a cell phone.
  - An atom has nuclear energy that can be used to heat water to steam and run turbines

Potential Energy—Gravitational

- Potential energy due to elevated position
- Examples:
  - water in an elevated reservoir
  - raised ram of a pile driver
  - car at the top of a hill







Potential Energy PE —Gravitational,

- Gravitational PE is equal to the work done (force required to move it upward x the vertical distance moved against gravity) in lifting it

PE = work done
= force x distance
= weight x height
= w·h

Since weight w = mg,
you can also write:
PE = mg·h
where:
g = 9.8 m/s^2
≈ 10 m/s^2

Ex. Calculate PE if given w in newtons:

- What is the increase in PE of a 30-N book that is raised to a height of 2.0 m?

PE = weight x height

= w·h

= (30 N)(2.0 m)

= 60 Nm

= 60 J

How much work was done to lift the book?

W = change in PE = 60 J

Ex. Calculate PE if given m in kilograms:

- What is the increase in PE of a 3.0-kg book that is raised to a height of 2.0 m?

PE = weight x height

$= mg \cdot h$

$= (3.0\ kg)(10\ m/s^2)(2.0\ m)$

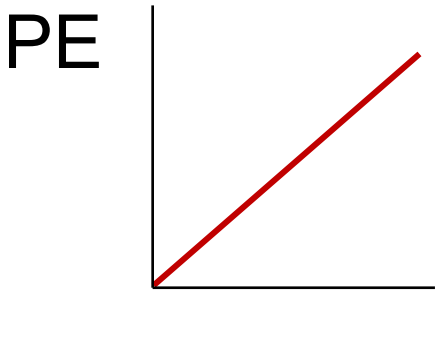
$= 60\ kgm^2/s^2$

$= 60\ J$

How much work was done to lift the book?

W = change in PE = 60 J

PE is proportional to height h:



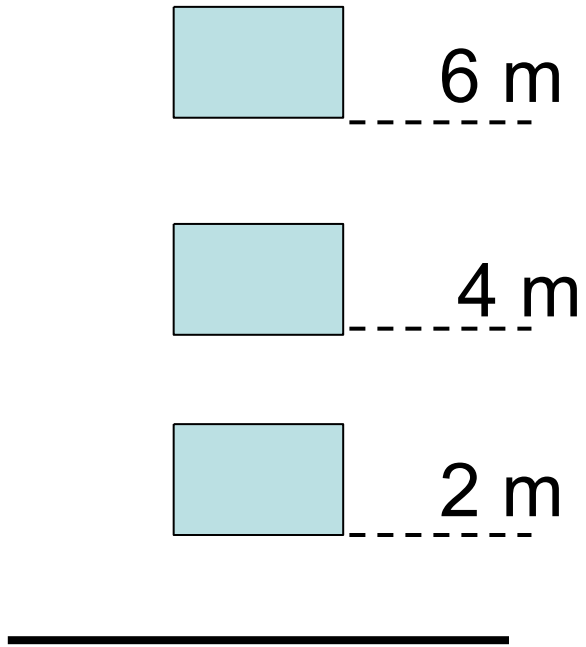
Ex. A block has 5000 J of PE when it is at a height of 2 m.

A) How much PE will it have if moved to a height of 4 m?

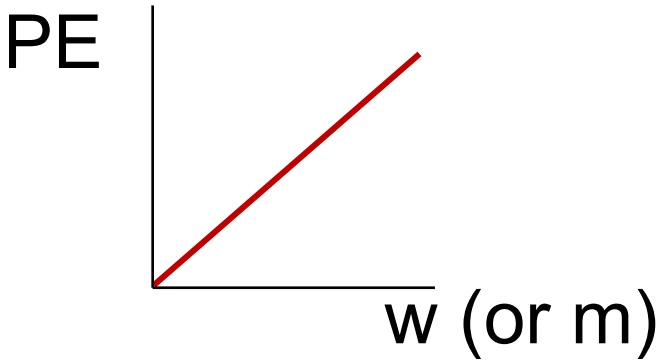
2 x 5000 J= 10000 J

B) At a height of 6 m?

3 x 5000 J= 15000 J



PE is proportional to weight or mass:

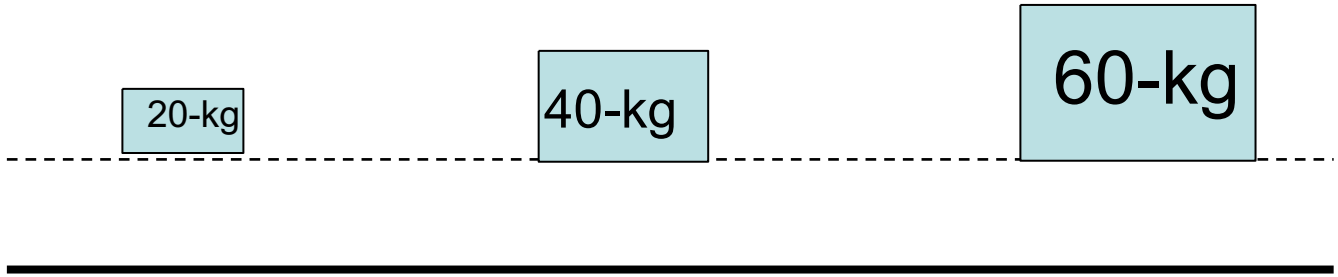


Ex. A 20-kg bag of cement has 600 J of PE when it is at a certain height above the floor.

A) How much PE will a 40-kg block have at the same height?

2 x 600 J= 1200 J

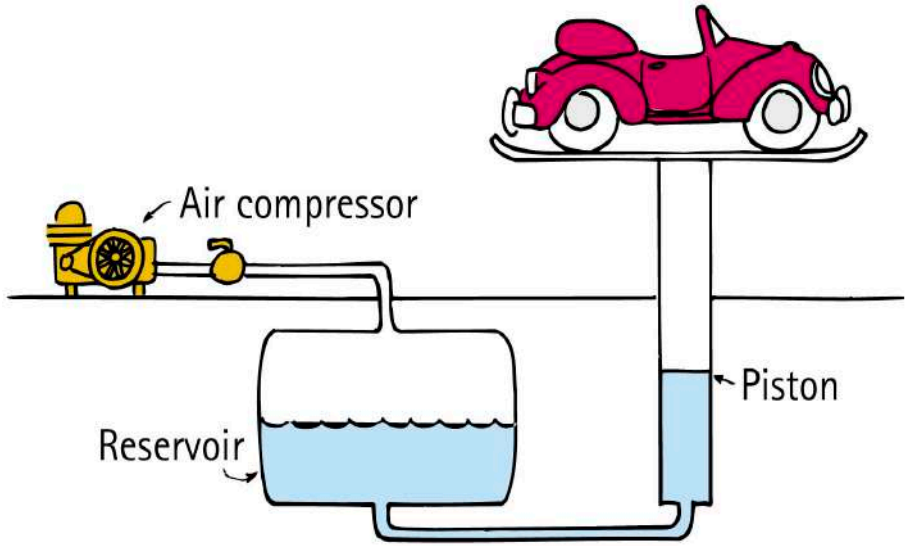
B) A 60-kg block? 3 x 600 J= 1800 J



Potential Energy
CHECK YOUR NEIGHBOR

Does a car hoisted for repairs in a service station have increased potential energy relative to the floor?

A. Yes
B. No
C. Sometimes
D. Not enough information



Potential Energy
CHECK YOUR ANSWER

Does a car hoisted for repairs in a service station have increased potential energy relative to the floor?

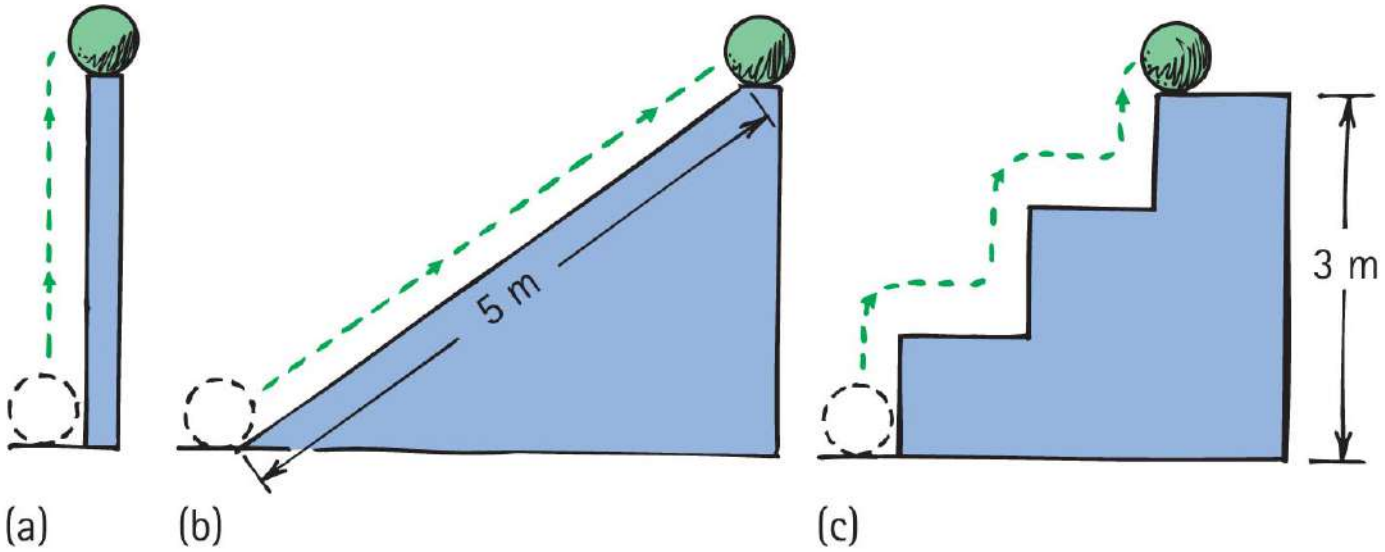
A. Yes

Comment:

If the car were twice as heavy, its increase in potential energy would be twice as great.

PE does not depend on "how you got there."

- Example: Rank the PE of 10-N ball in all 3 cases from smallest to greatest.



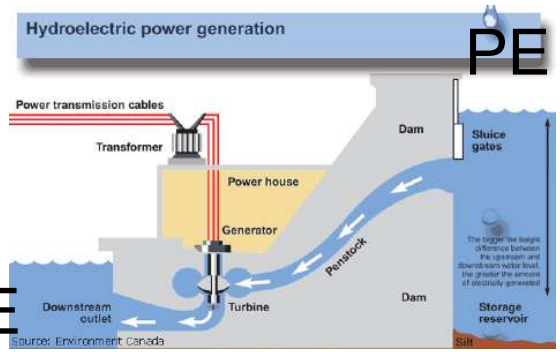
- Potential energy of 10-N ball is the **same** in all 3 cases because work done in elevating it is the same: PE = mgh—*h* is the height, not the path.

When is PE important?

- PE has significance only when it *changes*—when it does work or transforms into energy of some other form.

1. When water falls through a dam, its PE is converted to motion energy:

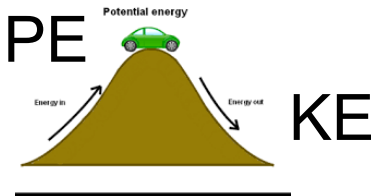
   kinetic energy KE



2. What kind of energy is PE converted to when the ram of a pile drive falls?

KE

3. When a car rolls down a hill?



Homework: due Friday @ 7pm

- On page 126-7:

- do #7-9
- #34-35: “Show that” means show the equation that you used, and how you substitute values into it to get the answer that is given.