PHY 1120 - Dr. Rowley

Chapter 19 - Electric Potential

Summer 2020

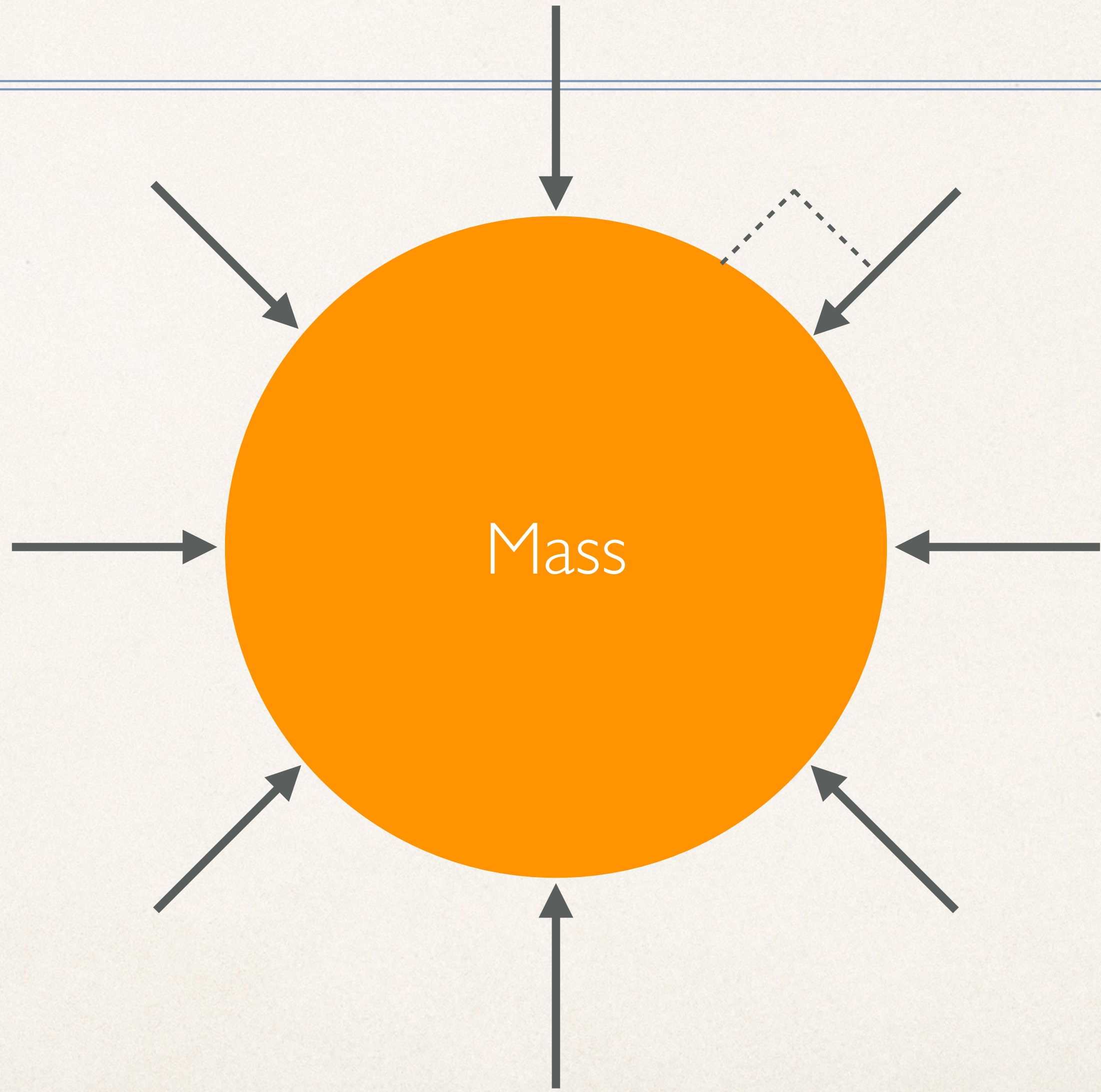
Chapter 19 - Objectives

- Connect the concepts of electric field, electric potential energy, and electric potential
- Determine the electric potential between two parallel plates
- Determine the motion of charged particles within an electric field
- Show understanding of the basics of capacitors.

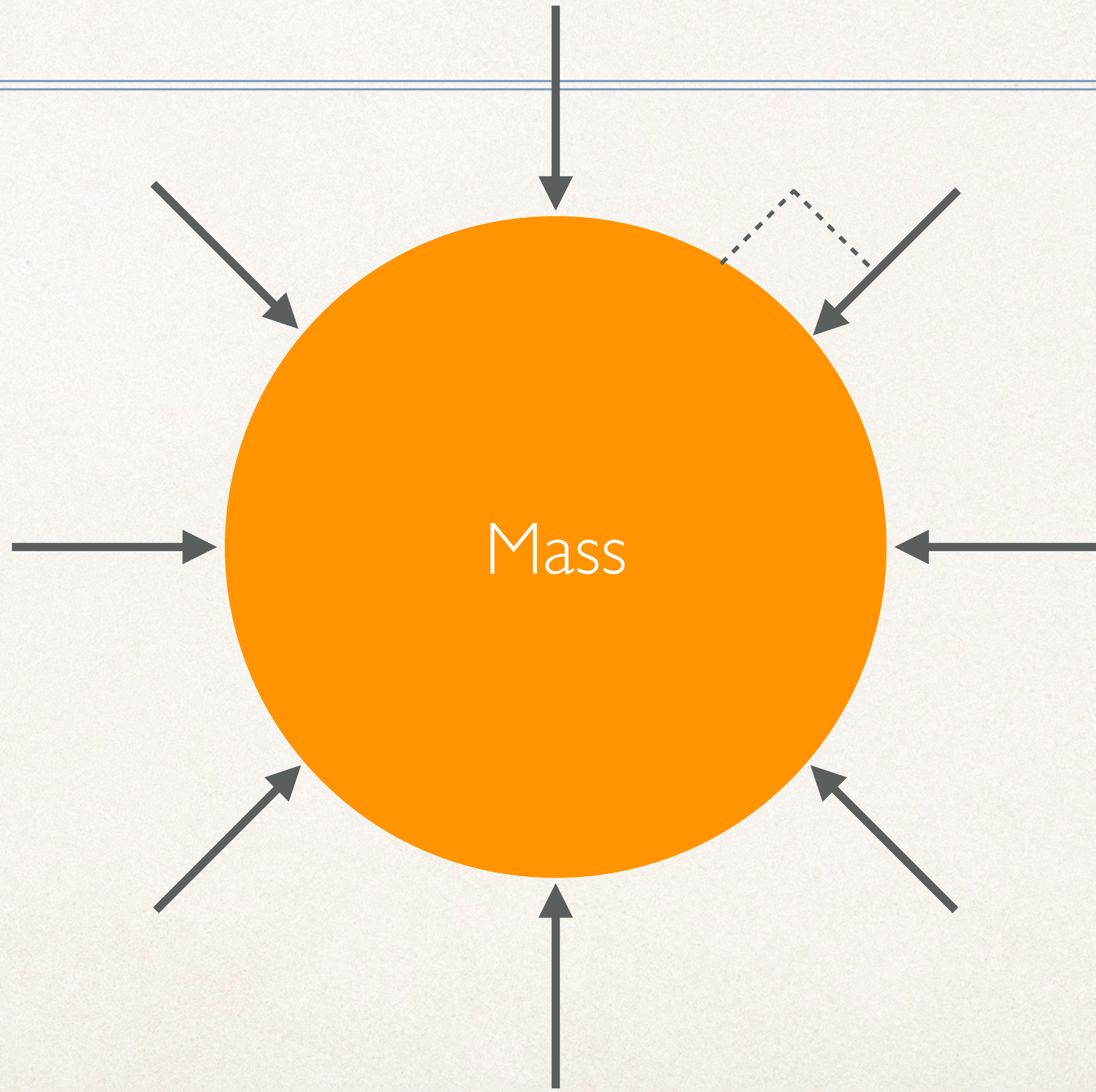
Chapter 19

- In PHY 1110 we used the idea of ENERGY to help solve more complex problems. It allowed us to find answers more easily in some situations.
- Let's revisit a few of those concepts briefly.

Gravitational Fields?



Gravitational Force?

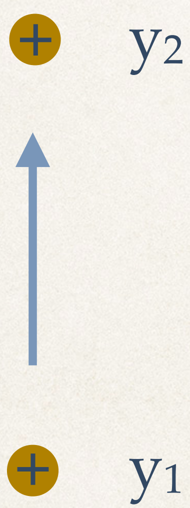


Chapter 19

- Determine the GPE of a 15kg mass on the Earth that is 100 m off the ground. 14,700 J 980 J/kg
- Determine the GPE of a 100 kg mass on the moon that is 300 m off the ground. 50,100 J 501 J/kg
- Determine the GPE per kilogram in each case.
- How does this make a comparison useful?

Chapter 19

- When lifting a block (mass = m) from point y_1 **up** to point y_2…



$$W_{Gravity} = Fd\cos\theta$$

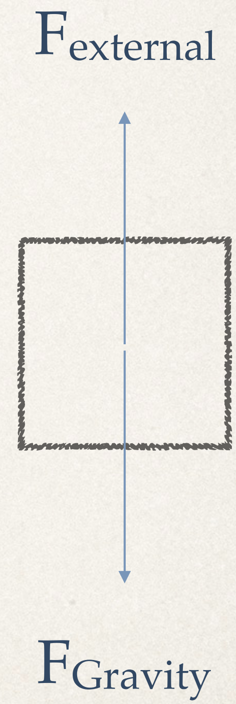
$$W_{Gravity} = Fd\cos(180°)$$

$$W_{Gravity} = -mg\Delta h$$

$$W_{Gravity} = -mg(y_2 - y_1)$$

$$W_{Gravity} = -(mgy_2 - mgy_1)$$

$$\boxed{W_{Gravity} = -\Delta PE}$$



Chapter 19

- What about **positive** electrical charge moved from (a) to (b) by an electrostatic force?

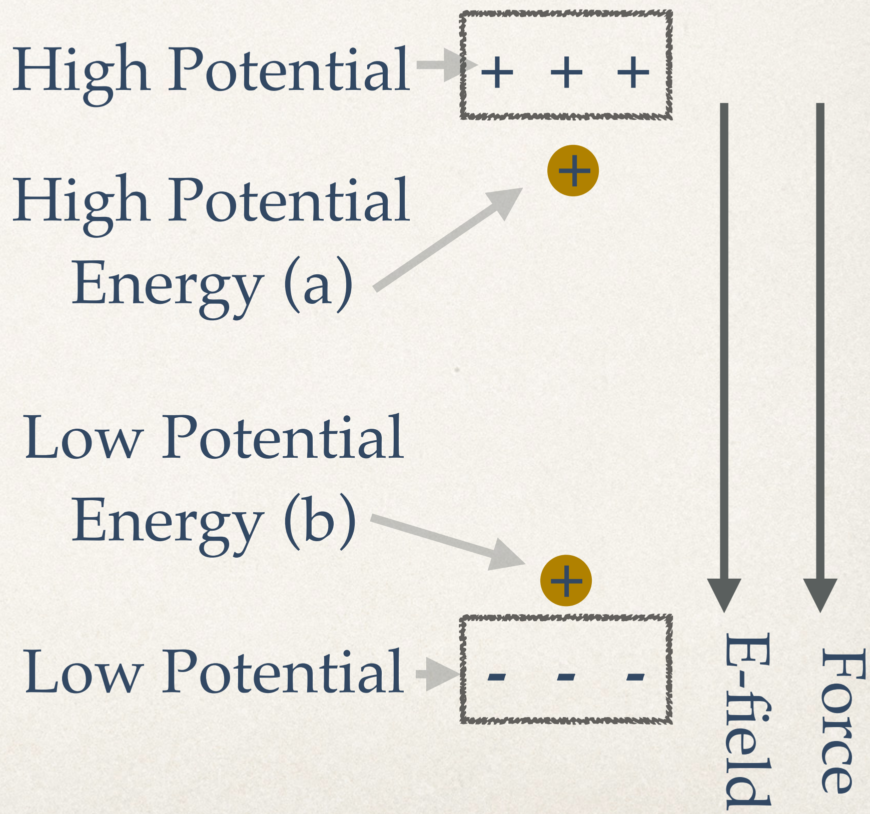
$$W = Fd\cos\theta$$

$$W = (qE)d\cos(0°)$$

$$W = (qE)d$$

$$\Delta PE = -W$$

$$\Delta PE = -qEd$$



Do One

- A +20.0 uC charge is moved 0.30 m parallel (same direction) to a 450 N/C electric field. What is the change in the Electrical Potential Energy?

  A. $+2.7\times10^{-3}$ J

  B. $+2.7\times10^{-4}$ J

  C. 0.0 J

  D. -2.7×10^{-3} J

  E. -2.7×10^{-4} J

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- A +20.0 uC charge is moved 0.30 m parallel (same direction) to a 450 N/C electric field. What is the change in the Electrical Potential Energy?

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C. 0.0 J

D. -2.7×10^{-3} J

E. -2.7×10^{-4} J

Chapter 19

- What about **negative** electrical charge moved from (a) to (b) by an electrostatic force?

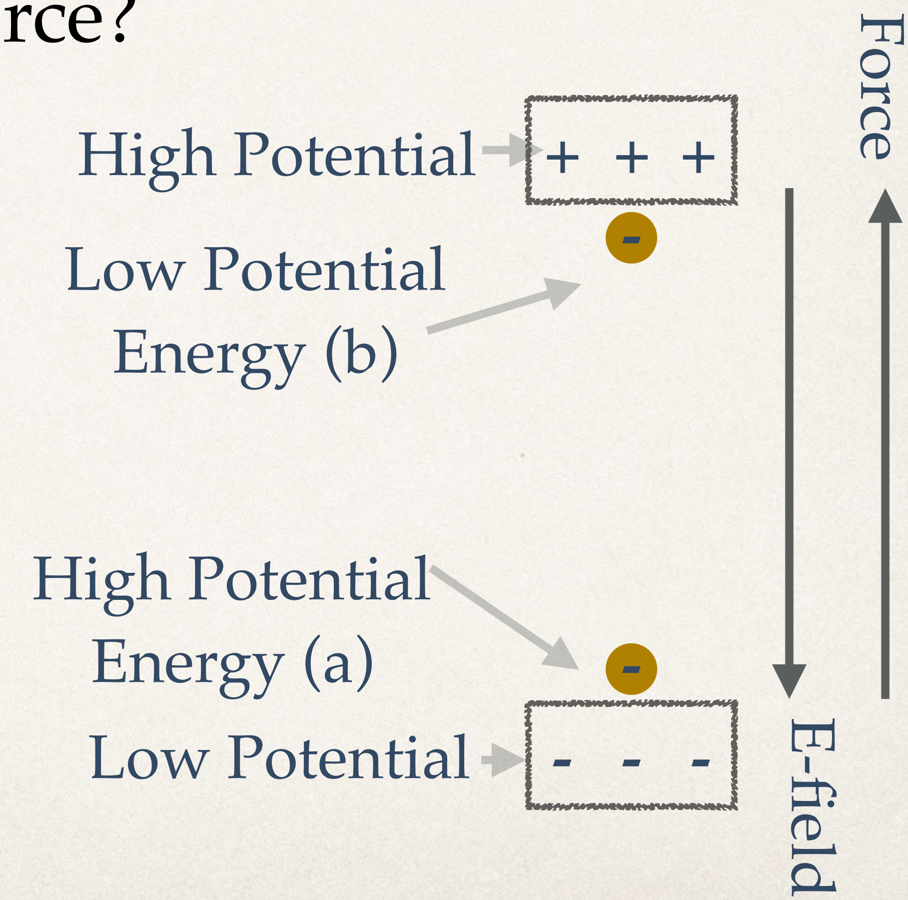
$$W = Fd\cos\theta$$

$$W = (qE)d\cos(0°)$$

$$W = (qE)d$$

$$\Delta PE = -W$$

$$\Delta PE = -qEd$$



Do One

- A +20.0 uC charge is moved 0.30 m perpendicular to a 450 N/C electric field. What is the change in the Electrical Potential Energy?

   A. $+2.7 \times 10^{-3}$ J

   B. $+2.7 \times 10^{-4}$ J

   C. 0.0 J

   D. -2.7×10^{-3} J

   E. -2.7×10^{-4} J

Do One

- A +20.0 uC charge is moved 0.30 m perpendicular to a 450 N/C electric field. What is the change in the Electrical Potential Energy?

A. $+2.7 \times 10^{-3}$ J

B. $+2.7 \times 10^{-4}$ J

C. 0.0 J

D. -2.7×10^{-3} J

E. -2.7×10^{-4} J

Chapter 19

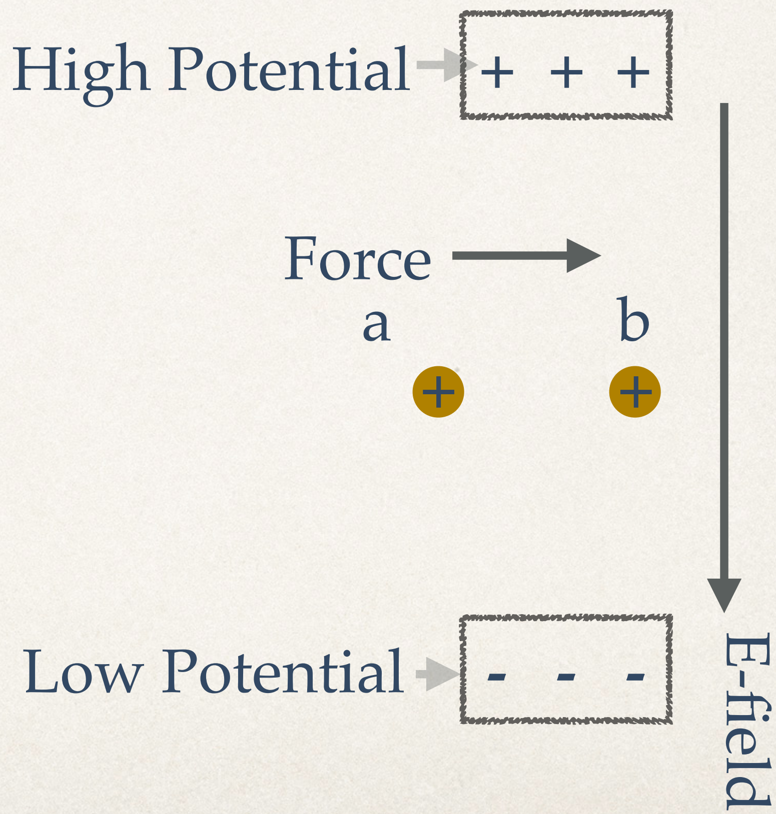
- What about **positive** electrical charge moved from (a) to (b) by an electrostatic force?

$$W = Fd\cos\theta$$

$$W = (qE)d\cos(90°)$$

$$W = 0!$$

$$\Delta PE = 0$$



Equipotential Lines

- Where the potential (V) is the same.
- **Moving a charge along an equipotential line requires no work.**

Group Work

- Predict: What would the equipotential lines look like for …
    - a positive point charge?
    - a negative point charge?
    - an infinite plate?

Equipotential Lines

- What would the equipotential lines look like for a positive point charge?

Equipotential Lines

- What would the equipotential lines look like for a negative point charge?

Equipotential Lines

- Examples: What would the equipotential lines look like for an infinite plate?