Gravitational Potential Energy

- **The energy an object has because of height above the earth.**

$$U_g = mgh$$

- **m = mass**
- **g = 9.8 m/s²**
- **h = height**

- **A scalar quantity**

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Potential Energy - Example

- **You lift a 2.00 kg textbook from the floor to a 2.10 m high shelf.**
  - **What is the book's gravitational potential energy at that height?**

$$\boldsymbol{U_g = mgh}$$
$$\boldsymbol{U_g = (2.00)(9.8)(2.10)}$$
$$\boldsymbol{U_g = 41.2\,J}$$

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Kinetic Energy – Variable Relationships

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

$K = (1)(1)(1)^2 = 1$

- **Determine the effect of the changing variables on variable that remains constant**
  - **What happens to the kinetic energy, if the velocity remains constant while you triple the mass?**

    $K = (1)(3)(1)^2 = 3\times$ GREATER
  - **What happens to the kinetic energy, if the mass remains constant while you double the velocity?**

    $K = (1)(1)(2)^2 = 4\times$ GREATER
  - **The kinetic energy is 5 J. What would be the new kinetic energy if the mass remains the same, while you quadruple the velocity?** $K = (1)(1)(4)^2 = 16\times$ GREATER

$5(16) = 80\,J$

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Potential Energy – Variable Relationships

$U_g = mgh$

$U_g = (1)(1)(1) = 1$

- **Determine the effect of the changing variables on variable that remains constant**
  - **What happens to the potential energy, if the mass remains constant while you triple the height?**

    $U_g = (1)(1)(3) \Rightarrow 3\times$ GREATER
  - **What happens to the potential energy, if the height remains constant while you double the mass?**

    $U_g = (2)(1)(1) = 2\times$ GREATER
  - **The potential energy is 7 J. What would be the new potential energy if the mass is doubled, while you quadruple the height?** $U_g = (2)(1)(4) = 8\times$ GREATER

$7(8) = 56\,J$

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