In class activity: write your name on the back of the sheet in large letters.

Compute the impulse of the car stopping

Write the impulse equation. $Ft = \Delta mv$ or $Ft = m\Delta v$

Below it, identify the units of each variable. $N \cdot s = (kg) \cdot \left(\frac{m}{s}\right)$

Mass of 1000 kg

Initial velocity is 50 $\frac{m}{s}$

Stops in 0.1 second

What is the stopping force? $\frac{(1000\ kg) \cdot \left(50\ \frac{m}{s}\right)}{0.1\ s} = 500{,}000\ N$

Same car, same speed, stops in 10 seconds

What is the stopping force? $\frac{(1000\ kg) \cdot \left(50\ \frac{m}{s}\right)}{10\ s} = 5{,}000\ N$

That's impulse!!

Conservation of momentum

Write the equation for momentum momentum $= m \cdot v$

Below it, identify the units of each variable. $(kg) \cdot \left(\frac{m}{s}\right)$

Initial velocity of each is zero.
Mass of cannon = 1000 kg. Mass of cannonball is 10 kg.

Velocity of cannonball = 150 $\frac{m}{s}$ to the right

What is velocity of cannon? $\frac{(10\ kg) \cdot \left(150\ \frac{m}{s}\right)}{1000\ kg} = 1.5\ \frac{m}{s}$

Work

Write equation for work: Work = Force x distance = F·d

Below it, identify the units of each variable. $\mathrm{N\ m}$, or

$$(\mathrm{kg})\cdot\left(\frac{\mathrm{m}}{\mathrm{s}^2}\right)\cdot \mathrm{m} = \frac{\mathrm{kg}\cdot\mathrm{m}^2}{\mathrm{s}^2} = \mathrm{Joules}$$

What are the base units of JOULE see above

How much work is done when woman lifts 2 kg barbell 2 m? (remember: 2 kg is mass, not the force of weight)—so you need the acceleration of gravity in the calculation!! $\left(10\ \frac{\mathrm{m}}{\mathrm{s}^2}\right)$

$$(2\ \mathrm{kg})\cdot\left(10\ \frac{\mathrm{m}}{\mathrm{s}^2}\right)\cdot 2\ \mathrm{m} = 40\ \mathrm{Joules}$$

Gravitational potential energy

Write the equation for gravitational potential energy: $E_P = m\cdot g\cdot h$

Below it, identify the units of each variable . $(\mathrm{kg})\cdot\left(\frac{\mathrm{m}}{\mathrm{s}^2}\right)\cdot \mathrm{m}$

Write an equation for the gravitational potential energy for a pile driver ram. Calculate its potential energy

The ram has a mass of 10000 kg. It is raised 10 m.

$$(10000\ \mathrm{kg})\cdot\left(10\ \frac{\mathrm{m}}{\mathrm{s}^2}\right)\cdot 10\ \mathrm{m} = 1{,}000{,}000\ \ \mathrm{J}$$

Kinetic energy of motion

Write the equation for kinetic energy $E_K = \frac{1}{2}\,\mathrm{m}\cdot\mathrm{v}^2$

Below it, identify the units of each variable. $(\mathrm{kg})\cdot\left(\frac{\mathrm{m}}{\mathrm{s}}\right)^2 = \frac{\mathrm{kg}\cdot\mathrm{m}^2}{\mathrm{s}^2}$

Using the pile driver ram from the previous calculation, could the velocity be found if it expended all the potential energy gained upon working against gravity?

YES, rewrite E_K equation solved for velocity, substitute in the values

$$\mathrm{v} = \sqrt{\frac{2\cdot E_K}{\mathrm{m}}} = \sqrt{\frac{2\cdot 1{,}000{,}000\ \frac{\mathrm{kg}\cdot\mathrm{m}^2}{\mathrm{s}^2}}{10\ \mathrm{kg}}} = \sqrt{200{,}000\ \frac{\mathrm{m}^2}{\mathrm{s}^2}} = 447\ \frac{\mathrm{m}}{\mathrm{s}}$$

Remember:

$$1{,}000{,}000\ \mathrm{J} = 1{,}000{,}000\ \frac{\mathrm{kg}\cdot\mathrm{m}^2}{\mathrm{s}^2}$$