

## Kinetic Movement Worksheet

*example answers*

In your group, choose one person to be the test subject, another to watch the scale, and another to record measurements and values.

### Walking

1. Measure the mass of the test subject (in kg).

$$m = 60 \text{ kg}$$

2. Have the test subject walk across the scale.
  - a. What is the maximum weight recorded?

$$W = 120 \text{ N}$$

- b. Calculate the maximum force exerted on the scale, using Newton's second law.

$$\begin{aligned} F &= m * a = m * g \\ F &= 120 \text{ kg} * 9.8 \text{ m/s} \\ F &= 1176 \text{ N} \end{aligned}$$

3. Assuming that the impact of the foot with the ground takes 0.02 seconds, calculate the impulse of the step.

$$\begin{aligned} I &= F * t \\ I &= 1176 \text{ N} * 0.02 \text{ s} \\ I &= 24 \text{ N} * \text{s} \end{aligned}$$

4. Calculate the impact velocity of the shoe with the ground.

$$\begin{aligned} I &= m * \Delta v \\ \Delta v &= I / m \\ \Delta v &= 24 \text{ N} * \text{s} / 60 \text{ kg} \\ \Delta v &= 0.4 \text{ m/s} \end{aligned}$$

## Running

1. Have the test subject jog across the scale. What is the maximum massweight recorded (in kg)?

$$W = 240 \text{ kg}$$

2. Calculate the maximum force using Newton's second law. How does this force compare to that of walking?

$$\begin{aligned} F &= m * a = m * g \\ F &= 240 \text{ kg} * 9.8 \text{ m/s} \\ F &= 2,352 \text{ N} \end{aligned}$$

3. Assuming that the impact takes 0.02 seconds, calculate the impulse of the step.

$$\begin{aligned} I &= F * t \\ I &= 2,352 \text{ N} * 0.02 \text{ s} \\ I &= 47 \text{ N} * \text{s} \end{aligned}$$

4. Calculate the impact velocity of the shoe with the ground. How does the impact velocity compare to that of walking?

$$\begin{aligned} \Delta v &= I / m \\ \Delta v &= 47 \text{ N} * \text{s} / 60 \text{ kg} \\ \Delta v &= 0.78 \text{ m/s} \end{aligned}$$