Name: _____ Date: _____

PHYSICS
Energy Calculations

Energy is defined as the capacity to do work. Energy makes forces. The forces made by energy make the work happen. The units for work and for energy is JOULES (J).

Translational Kinetic Energy

Kinetic Energy is energy attributed to matter in motion; energy in moving objects. All objects in motion, whether at the macroscopic (whole object) or microscopic level (atoms and molecules) have at least one form of kinetic energy. Translational kinetic energy is the energy attributed to an object that moves with a velocity from one place to another.

Translational KE	**Calculate velocity**	
$KE = \frac{1}{2} m \cdot v^2$	$v = \sqrt{\frac{2 \cdot KE}{m}}$	KE = kinetic energy (J) m = mass (kg) v = velocity or speed (m/s)

- Show all of your work in the box under the question.
- Time must be in seconds.
- Use the correct equation.
- Solve the problem.

1. Gertrude is riding her bicycle with a velocity of 3.5 m/s. The combined weight of Gertrude and her bicycle is 75 kg. Calculate KE.

Show calculations	

2. Derek is riding is riding his skateboard with a velocity of 4.7 m/s. The combined mass of Derek and his skateboard is 66 kg. Calculate KE.

Show calculations	

3. Derek is riding is riding his skateboard. He has a translational kinetic energy of 1395 J. The combined mass of Derek and his skateboard is 66 kg. Calculate speed.

Show calculations.	

4. Gertrude is riding her bicycle. She has a translational kinetic energy of 2100 J. The combined weight of Gertrude and her bicycle is 75 kg. Calculate speed.

Complete the chart. Solve for the kinetic energy. Mass is constant (10 kg). What happens to the KE as the velocity is increased?

Translational KE $KE = \frac{1}{2} m \cdot v^2$	KE = kinetic energy (J) m = mass (kg) v = velocity or speed (m/s)

Mass (kg)	Velocity (m/s)	KE (J)
10 kg	4 m/s	
10 kg	8 m/s	
10 kg	12 m/s	
10 kg	16 m/s	

Complete the chart. Solve for the kinetic energy. Velocity is constant (10 m/s). What happens to the KE as the mass is increased?

Mass (kg)	Velocity (m/s)	KE (J)
4 kg	10 m/s	
8 kg	10 m/s	
12 kg	10 m/s	
16 kg	10 m/s	

Gravitational Potential Energy

Potential Energy: energy stored in matter to be released at a later time; energy created by work against resistance or against force. All forms of potential energy have the potential to be transformed into other forms of energy in the future. ***Work against resistance will produce at least one form of potential energy.*** **Gravitational potential energy** is stored energy because of an object's **position above a permanent surface**. If the object were to fall from higher to lower position because of the force of gravity, that energy can be released as another form of energy and perform work. GPE is created by **work against gravity,** work by lifting**.**

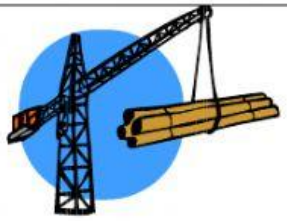
Work against gravity	**Gravitational potential energy**	**Height**
$W = m \cdot g \cdot h$	$GPE = m \cdot g \cdot h$	$h = \frac{GPE}{m \cdot g}$

W = work (J)
m = mass of object
g = acceleration in Earth's gravity field (m/s^2)
h = height (m)
GPE = gravitational potential energy (J)

- Show all of your work in the box under the question.
- Time must be in seconds.
- Use the correct equation.
- Solve the problem.

5. Michael walked up stairs from the 1st floor to the 3rd floor of his office building, a height of 12 m. Michael has a mass 80 kg. Calculate the GPE he gained when he arrived at the 3rd floor.

6. A crane lifted four steel beams from the ground to a height of 120 meters. The mass of the beams is 200 kg. Calculate the GPE gained by the beams as the crane lifted them.



7. The elevator carried four persons. The total mass of the elevator with the persons is 1800 kg. When the elevator reached the 8th floor, it had gained a gravitational potential energy of 529,740 J. How high did the elevator go up?

Calculate height	

8. The 1.8 kg ball bounced. It had a gravitational potential energy of 56.5 J at its maximum bounce height. Calculate the maximum height.

Calculate height	

Total Mechanical Energy (Total energy)

The total mechanical energy is the combined energy attributed to an object because of its motion (kinetic energy) and its position (potential energy), and does not include heat. Total mechanical energy is calculated as the sum of all potential energy and all kinetic energy.

$$TOT\ E = PE + KE$$

- Show your work in the box under the question.
- Time must be in seconds.
- Use the correct equation.
- Solve the problem.

9. A 6 kg lamp sits motionless on a desk 1.33 meters above the floor. Calculate the GPE, KE, and the total mechanical energy of the lamp.

GPE	KE	TOT E

10. A 1.6 kg toy car moves across the floor with a speed of 1.4 m/s. Calculate the GPE, KE, and the total mechanical energy of the toy car.

GPE	KE	TOT E

11. John Deere runs up a very long staircase. He runs at 0.90 m/s up the stairs. John's mass is 85 kg. Calculate the GPE, KE, and the total mechanical energy when he is 16 m above the bottom of the stairs.

GPE	KE	TOT E

12. The elevator is moving upwards with a velocity of 2.5 m/s. The mass of the elevator with passengers is 2400 kg. Calculate the GPE, KE, and TOT E of the moving elevator when it is at 50 m above the ground floor.

GPE	KE	TOT E