LESSON MAKER PRO

Energy in Motion

Track energy as objects move, fall, and rise.

HIGH SCHOOL · PHY.3.1

PHY.3.1 "Use mathematical and computational analysis to qualitatively and quantitatively analyze the concept of work, energy, and power to explain and apply the conservation of energy."

NAME _____ **DATE** _____

TRACK THE ENERGY

Gravitational potential energy is PE = mgh, and kinetic energy is KE = (1/2)mv^2. Without friction, a loss of PE equals a gain in KE, so total mechanical energy stays the same. Work transfers energy, and average power is energy transferred divided by time.

WORKED EXAMPLE

On a planet where g = 3 m/s^2, an 11 kg rock drops 9 m from rest. Ignore air resistance. What is its kinetic energy just before it lands?

1. Find the potential energy lost: PE = mgh.
2. Substitute: PE = (11 kg)(3 m/s^2)(9 m) = 297 J.
3. The rock starts from rest, so its initial KE is 0 J.
4. The lost PE becomes KE: KE = 297 J.

Answer: 297 J

PRACTICE 6 problems

1 A 4 kg object is 5 m above the ground. Find its gravitational potential energy relative to the ground. Use g = 10 m/s^2.

ANSWER _____

2 A 6 kg object moves at 8 m/s. Find its kinetic energy.

ANSWER _____

3 A 5 kg object falls from rest through 6 m. Ignore air resistance. Find its kinetic energy after the fall. Use g = 10 m/s^2.

ANSWER _____

4 An 8 kg object rises with an initial kinetic energy of 320 J. Ignore air resistance. How high does it rise before stopping? Use g = 10 m/s^2.

ANSWER _____

5 At one point in its motion, an object has 500 J of mechanical energy and 180 J of gravitational potential energy. Find its kinetic energy.

ANSWER _____

6 A motor transfers 360 J of energy in 12 s. Find its average power.

ANSWER _____

APPLY IT Show your work

1 At a skate park, a 40 kg rider and board start from rest at the top of a ramp. The top is 5 m above the bottom. Ignore friction. What is their speed at the bottom? Use g = 10 m/s^2.

WORK SPACE

ANSWER _____

2 A 60 kg zipline rider drops 4 m in 8 s. Ignore friction. How much gravitational potential energy becomes kinetic energy, and what is the average power of gravity during the drop? Use g = 10 m/s^2.

WORK SPACE

ANSWER _____

CHALLENGE One step up

A 50 kg cyclist and bike start from rest and descend 8 m. At the bottom, their kinetic energy is 3000 J. Assume friction is the only force that transfers mechanical energy to thermal energy. How much work does friction do, and what percent of the starting gravitational potential energy becomes thermal energy? Use g = 10 m/s^2.

WORK SPACE AND ANSWER

ANSWER KEY

Energy in Motion

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A 4 kg object is 5 m above the ground. Find its gravitational potential energy relative to the ground. Use g = 10 m/s^2.	**200 J**
2	A 6 kg object moves at 8 m/s. Find its kinetic energy.	**192 J**
3	A 5 kg object falls from rest through 6 m. Ignore air resistance. Find its kinetic energy after the fall. Use g = 10 m/s^2.	**300 J**
4	An 8 kg object rises with an initial kinetic energy of 320 J. Ignore air resistance. How high does it rise before stopping? Use g = 10 m/s^2.	**4 m**
5	At one point in its motion, an object has 500 J of mechanical energy and 180 J of gravitational potential energy. Find its kinetic energy.	**320 J**
6	A motor transfers 360 J of energy in 12 s. Find its average power.	**30 W**

PART 2 · APPLY IT

1. **10 m/s** The initial PE is (40)(10)(5) = 2000 J, which becomes KE at the bottom. Solve (1/2)(40)v^2 = 2000 to get v = 10 m/s.
2. **2400 J becomes kinetic energy; average power is 300 W.** The lost PE is (60)(10)(4) = 2400 J. Divide the energy transferred by 8 s to get an average power of 300 W.

CHALLENGE

Friction does -1000 J of work; 25% of the starting gravitational potential energy becomes thermal energy.

Accept equivalent energy equations with correct units. In the challenge, friction removes 1000 J from mechanical energy, so its work is -1000 J.