PHYSICS IN MOTION
gpb.org/physics-motion

Unit 4E
Kinetic Energy and Gravitational Potential Energy
Practice Problems TEACHER

Work each of the following problems. SHOW ALL WORK.

1. **What is the kinetic energy of a 3 kg object moving at 4 m/s?**

$$KE = \frac{1}{2}mv^2$$
$$KE = \frac{1}{2}(3\,kg)(4\,^{m}/_{s})^2$$
$$KE = 24\,J$$

2. **A 4 kg object possesses 18 J of kinetic energy. What is its velocity?**

$$KE = \frac{1}{2}mv^2$$
$$18\,J = \frac{1}{2}(4\,kg)v^2$$
$$\sqrt{9\,^{m^2}/_{s^2}} = \sqrt{v^2}$$
$$v = 3\,^{m^2}/_{s^2}$$

3. **An object has 90,000 J of kinetic energy and is moving at 12 m/s. What is the object's mass?**

$$KE = \frac{1}{2}mv^2$$
$$90000\,J = \frac{1}{2}m(12\,^{m}/_{s})^2$$
$$90000\,J = \frac{1}{2}m(144\,^{m^2}/_{s^2})$$
$$m = 1250\,kg$$

4. **A 40 kg box is placed on a 2 m tall shelf.**

   a. What is the gravitational potential energy of the box?

$$PE_G = mgh$$
$$PE_G = (40\,kg)(9.8\,^{m}/_{s^2})(2\,m)$$
$$PE_G = 784\,J$$

questions continued on next page

Work each of the following problems. SHOW ALL WORK.

b. If the box falls off the shelf, what is its kinetic energy as it strikes the ground?

As the box falls, its gravitational potential energy is converted to kinetic energy, so it has 784 J of kinetic energy as it strikes the ground.

c. What is the velocity of the box immediately before it strikes the ground?

$$KE = \frac{1}{2}mv^2$$
$$784\ J = \frac{1}{2}(40\ kg)v^2$$
$$\sqrt{39.2\ m^2/s^2} = \sqrt{v^2}$$
$$v = 6.26\ m/s$$

5. A 1.5 kg ball is thrown upward with a velocity of 6 m/s.

a. What is the kinetic energy of the ball as it is thrown upward?

$$KE = \frac{1}{2}mv^2$$
$$KE = \frac{1}{2}(1.5\ kg)(6\ m/s)^2$$
$$KE = 27\ J$$

b. What is the gravitational potential energy of the ball when it reaches its highest point?

As the ball rises, its kinetic energy is converted to gravitational potential energy, so it has 27 J of gravitational potential energy at its peak.

c. To what height above the thrower's hand will the ball rise?

$$PE_G = mgh$$
$$27\ J = (1.5\ kg)(9.8\ m/s^2)h$$
$$27\ J = (14.7\ kg\ m/s^2)h$$
$$h = 1.84\ m$$

questions continued on next page

PHYSICS INMOTION
gpb.org/physics-motion

Unit 4E
Kinetic Energy and Gravitational Potential Energy
Practice Problems TEACHER

Work each of the following problems. SHOW ALL WORK.

6. A 2 kg watermelon is dropped from a 4 m tall roof. How fast will the watermelon be moving as it strikes the ground below?

First Step: Determine the initial gravitational potential energy of the watermelon.

$$PE_G = mgh$$
$$PE_G = (2\ kg)(9.8\ {}^{m}/_{s^2})(4\ m)$$
$$PE_G = 78.4\ J$$

As the watermelon falls, its gravitational potential energy is converted to kinetic energy, so it has 78.4 J of kinetic energy as it strikes the ground.

$$KE = \frac{1}{2}mv^2$$
$$78.4\ J = \frac{1}{2}(2\ kg)v^2$$
$$\sqrt{78.4\ {}^{m^2}/_{s^2}} = \sqrt{v^2}$$
$$v = 8.85\ {}^{m}/_{s}$$

7. To what height will a 250 g soccer ball rise if it is kicked directly upward at 8 m/s?

First Step: Determine the initial kinetic energy of the soccer ball.

$$KE = \frac{1}{2}mv^2$$
$$KE = \frac{1}{2}(0.25\ kg)(8\ {}^{m}/_{s})^2$$
$$KE = 8\ J$$

As the ball rises, its kinetic energy is converted to gravitational potential energy, so it has 8 J of gravitational potential energy at its peak.

$$PE_G = mgh$$
$$8\ J = (0.25\ kg)(9.8\ {}^{m}/_{s^2})h$$
$$8\ J = (2.45\ kg\ {}^{m}/_{s^2})h$$
$$h = 3.27\ m$$