

Exercise walk-through

3.4

Conservation of Energy

AP Physics 1

Conservation of energy

Total energy is conserved

– it only changes form.

- conservative forces keep **mechanical energy** $KE + U$ constant
- friction turns it into **thermal energy** (still conserved overall)

Drop 1 kg from 5 m: 49 J of $U_g \rightarrow KE$, so
 $v \approx 9.9 \text{ m/s}$.



Mechanical energy trades kinetic and potential

Exercises 2.1·2.3

2.1 A 2.0 kg cart starts from rest at the top of a 3.0 m high frictionless ramp (take $g = 10 \text{ m s}^{-2}$). Find its speed at the bottom. [2]

2.2 State the main energy change when friction acts on a moving block. [1]

2.3 A pendulum bob swings down through a height of 0.20 m. Find its speed at the lowest point (take $g = 10 \text{ m s}^{-2}$). [2]

Exercises 2.1-2.3

2.1 A 2.0 kg cart starts from rest at the top of a 3.0 m high frictionless ramp (take $g = 10 \text{ m s}^{-2}$). Find its speed at the bottom. [2]

2.1

- $\frac{1}{2}mv^2 = mgh \Rightarrow v = \sqrt{2gh} = \sqrt{2(10)(3.0)} = 7.7 \text{ m s}^{-1}$

2.2 State the main energy change when friction acts on a moving block. [1]

2.2

- mechanical energy is converted to thermal energy (heat)

2.3 A pendulum bob swings down through a height of 0.20 m. Find its speed at the lowest point (take $g = 10 \text{ m s}^{-2}$). [2]

2.3

- $v = \sqrt{2gh} = \sqrt{2(10)(0.20)} = 2.0 \text{ m s}^{-1}$

Exercises 3.1-3.2

3.1 As a skier descends a frictionless slope, her gravitational potential energy is [1]

☐

A increased

B converted to kinetic energy

C unchanged

D converted to thermal energy

3.2 When friction acts on a moving object, its mechanical energy is [1]

☐

A created

B exactly conserved

C partly converted to thermal energy

D destroyed

Exercises 3.1-3.2

3.1 As a skier descends a frictionless slope, her gravitational potential energy is [1]

☐

- A increased
- B converted to kinetic energy
- C unchanged
- D converted to thermal energy

3.1 B

- converted to kinetic energy.

3.2 When friction acts on a moving object, its mechanical energy is [1]

☐

- A created
- B exactly conserved
- C partly converted to thermal energy
- D destroyed

3.2 C

- partly converted to thermal energy.

Exercise 3.3 (a)

3.3 A 0.50 kg ball is dropped from 8.0 m and hits the ground at 10 m s^{-1} (take $g = 10 \text{ m s}^{-2}$).

(a) Find the initial gravitational potential energy.

[1]

Exercise 3.3 (a)

3.3 A 0.50 kg ball is dropped from 8.0 m and hits the ground at 10 m s^{-1} (take $g = 10 \text{ m s}^{-2}$).

(a) Find the initial gravitational potential energy. [1]

(a)

- $U_g = mgh = 0.50 \times 10 \times 8.0 = 40 \text{ J}$

Exercise 3.3 (b)

3.3 A 0.50 kg ball is dropped from 8.0 m and hits the ground at 10 m s^{-1} (take $g = 10 \text{ m s}^{-2}$).

(b) Find the kinetic energy on landing.

[1]

Exercise 3.3 (b)

3.3 A 0.50 kg ball is dropped from 8.0 m and hits the ground at 10 m s^{-1} (take $g = 10 \text{ m s}^{-2}$).

(b) Find the kinetic energy on landing. [1]

(b)

- $KE = \frac{1}{2}(0.50)(10)^2 = 25 \text{ J}$

Exercise 3.3 (c)

3.3 A 0.50 kg ball is dropped from 8.0 m and hits the ground at 10 m s^{-1} (take $g = 10 \text{ m s}^{-2}$).

(c) Find the energy converted to thermal and other forms.

[1]

Exercise 3.3 (c)

3.3 A 0.50 kg ball is dropped from 8.0 m and hits the ground at 10 m s^{-1} (take $g = 10 \text{ m s}^{-2}$).

(c) Find the energy converted to thermal and other forms. [1]

(c)

- $40 - 25 = 15 \text{ J}$ lost to thermal/other forms