

How moving and lifted objects store energy

Grade 7 science (Year 8 · Class 7) · Worksheet

Name: _____ Date: _____ Class: _____

These problems train you to tell kinetic energy from gravitational potential energy, to use $KE = \frac{1}{2} \times m \times v^2$ and $GPE = m \times g \times h$, and to follow energy as an object falls, rolls or swings. They start with recall and finish with multi-step reasoning.

They suit Grade 7 and Year 8 students, and also Class 7 learners. They support NGSS middle school and the early stages of GCSE and IGCSE physics courses.

Level: Grade 7 science (Year 8 · Class 7) · **Curriculum:** MS-PS3-1, MS-PS3-2

Problem 1 Which store of energy? (easy)

Four objects are described. For each one, state whether it mainly has kinetic energy or gravitational potential energy.

1. A football rolling across a pitch.
2. A book on a high shelf.
3. A diver standing still on a high board.
4. A dog running along a beach.

Problem 2 Formulas and units (easy)

Lina is writing a summary card.

1. Write the formula for kinetic energy.
2. Write the formula for gravitational potential energy.
3. State the unit of energy and the unit of mass used in both formulas.

Problem 3 Heavy or fast? (easy)

Kofi in Accra pushes two trolleys along a corridor.

1. Trolley X has a mass of 1 kg and trolley Y has a mass of 3 kg. Both move at 2 m/s. Which has more kinetic energy?
2. Trolley X now moves at 4 m/s instead of 2 m/s. Does its kinetic energy double, triple or quadruple?

Problem 4 A kicked football (easy)

Mei in Singapore kicks a football of mass 0.43 kg. It leaves her boot at 10 m/s.

1. Write the formula you will use.

- Calculate the kinetic energy of the ball.

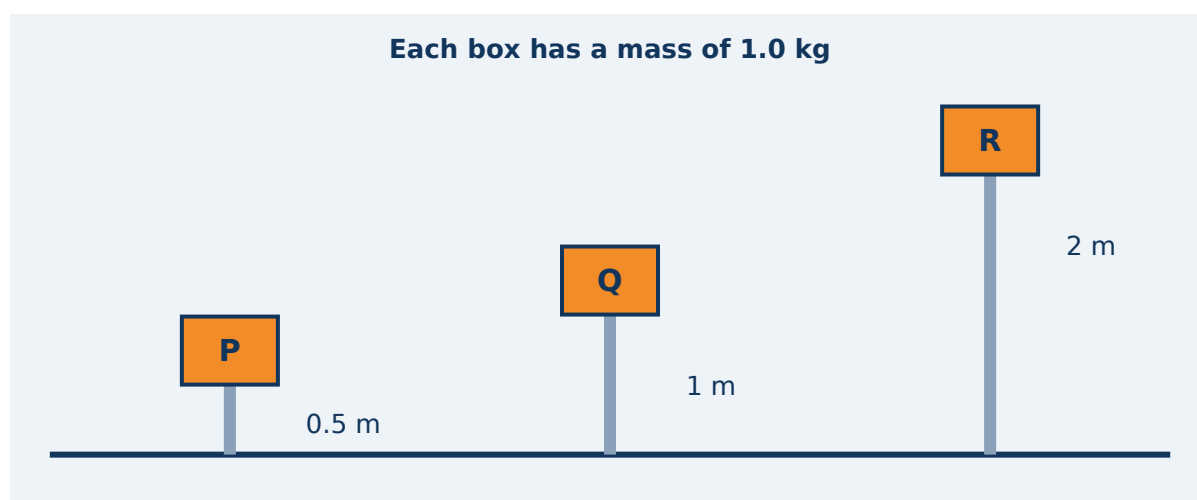
Problem 5 Bag on a shelf (easy)

A backpack of mass 2.0 kg is placed on a shelf 1.5 m above the floor. Use $g = 9.8 \text{ N/kg}$.

- Calculate its gravitational potential energy.
- State what its gravitational potential energy would be on the floor.

Problem 6 Boxes on supports (easy)

Three 1.0 kg boxes stand on supports as shown.



Boxes P, Q and R at different heights.

- Calculate the gravitational potential energy of each box ($g = 9.8 \text{ N/kg}$).
- Which box has the most energy and how many times more than box P?

Problem 7 Mass in grams (easy)

Bilal in Lahore holds a 250 g mango 4.0 m above the ground on a roof terrace.

- Convert the mass to kilograms.
- Calculate the gravitational potential energy of the mango ($g = 9.8 \text{ N/kg}$).

Problem 8 Cyclist in km/h (medium)

Wanjiru in Nairobi cycles at 18 km/h. Her mass together with the bicycle is 70 kg.

- Convert 18 km/h to m/s.
- Calculate her kinetic energy.

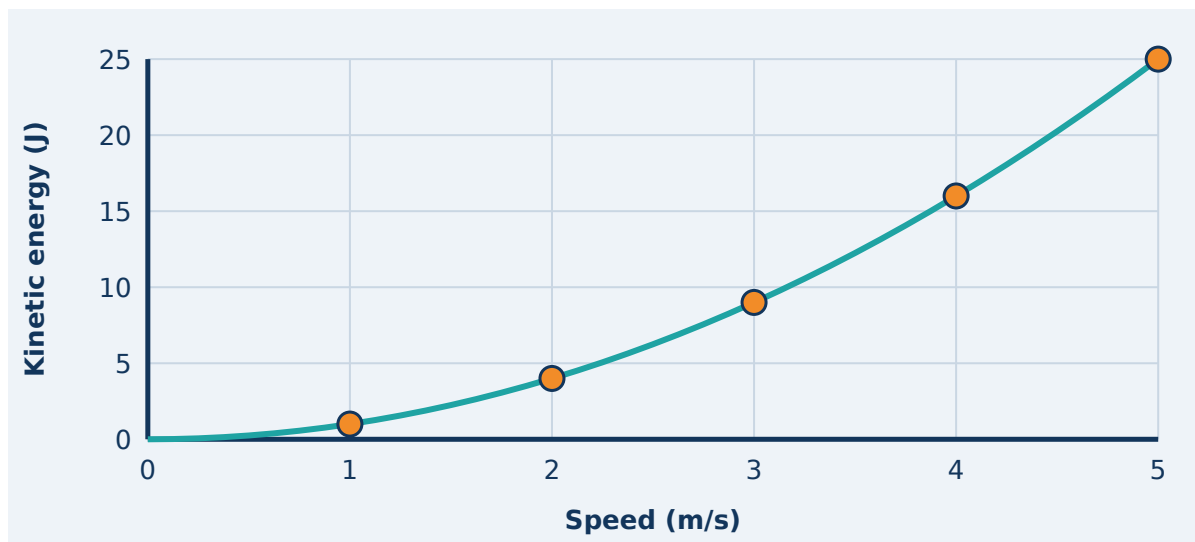
Problem 9 Twice as fast (medium)

A ball of mass 0.50 kg moves at 6 m/s.

- Calculate its kinetic energy.
- Calculate its kinetic energy when it moves at 12 m/s.
- State how many times larger the second answer is and explain why.

Problem 10 Reading an energy graph (medium)

The graph shows the kinetic energy of a 2 kg trolley at different speeds.



Kinetic energy against speed for a 2 kg trolley.

1. Read the kinetic energy at 3 m/s.
2. Read the speed at which the energy is 16 J.
3. Explain why the graph is a curve and not a straight line.

Problem 11 Height of a crate (medium)

A crane lifts a 5.0 kg crate and gives it 147 J of gravitational potential energy.

1. Rearrange $GPE = m \times g \times h$ to make h the subject.
2. Calculate the height of the crate ($g = 9.8 \text{ N/kg}$).

Problem 12 Falling apple (medium)

An apple of mass 0.50 kg falls from a branch 2.0 m above the ground. Ignore air resistance.

1. Calculate the gravitational potential energy it loses.
2. State its kinetic energy just before it lands.

Problem 13 On a playground swing (medium)

Diego in Texas sits on a swing and is pulled back to the highest point, then released.

1. Describe the energy of the swing at the highest point.
2. Describe the energy at the lowest point.
3. Explain why the swing slowly stops if nobody pushes.

Problem 14 Scooter or car? (medium)

A scooter and rider of total mass 150 kg move at 10 m/s. A car of mass 1200 kg moves at 5 m/s.

1. Calculate the kinetic energy of each.

- Decide which has more and state how many times more.

Problem 15 Find the error (medium)

Emma in Leeds writes: "A 4 kg trolley moves at 3 m/s, so its kinetic energy is $4 \times 3^2 = 36$ J. If it speeds up to 6 m/s, the energy doubles to 72 J."

- Spot the two mistakes.
- Give the correct values.

Problem 16 Mass from energy (hard)

A loaded sled has 360 J of kinetic energy when it slides at 6.0 m/s.

- Rearrange $KE = \frac{1}{2} \times m \times v^2$ to make m the subject.
- Calculate the mass of the sled.

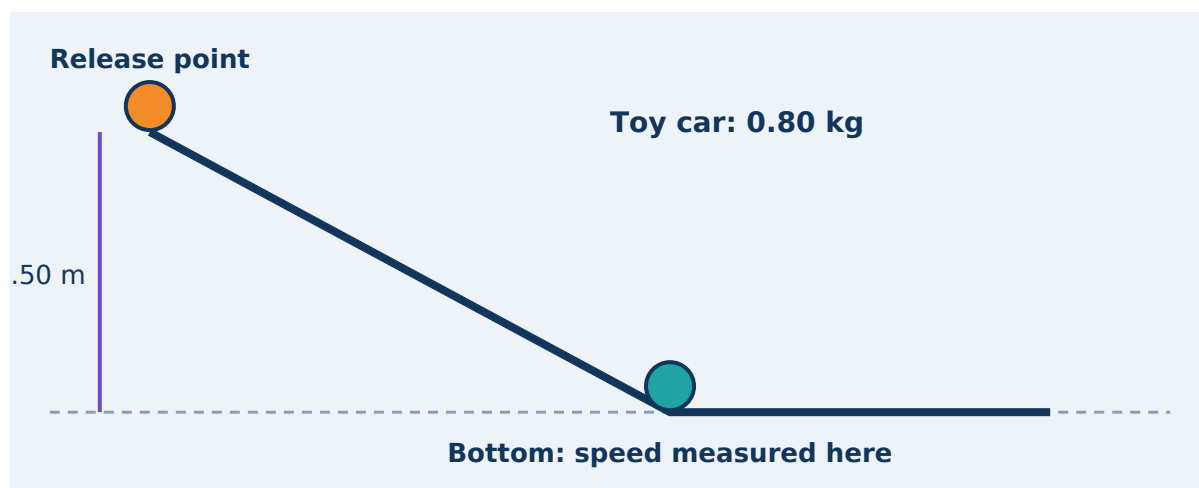
Problem 17 Speed of a cricket ball (hard)

A cricket ball of mass 0.15 kg has 30 J of kinetic energy.

- Write v^2 in terms of KE and m .
- Calculate the speed of the ball in m/s.

Problem 18 Smooth track (hard)

A toy car of mass 0.80 kg is released from rest at the top of a smooth track 0.50 m high.



Toy car on a smooth track.

- Calculate its gravitational potential energy at the top ($g = 9.8$ N/kg).
- State its kinetic energy at the bottom.
- Calculate its speed at the bottom.

Problem 19 Stopping a car (hard)

A car of mass 1000 kg travels at 20 m/s on a village road and later at 30 m/s on a main road.

- Calculate the kinetic energy at each speed.

2. Calculate how many times larger the second energy is.
3. Use your answers to explain why a small increase in speed makes braking much harder.

Problem 20 High jump (hard)

A high jumper of mass 60 kg runs up at 7.0 m/s. Imagine that all her kinetic energy is converted into gravitational potential energy ($g = 9.8 \text{ N/kg}$).

1. Calculate her kinetic energy.
2. Calculate the height she could rise.
3. State why real jumpers reach a lower height for their centre of mass than this.