CALCULATING GRAVITATIONAL POTENTIAL ENERGY

WRITE THE FORMULA TO WORK OUT GRAVITATIONAL POTENTIAL ENERGY

$E_{GP} = m \times g \times h$

m = mass (kg) g = gravity (9.8 m/s²) h = height (m)

CALCULATE THE GPE OF THE FOLLOWING OBJECTS

1. A rollercoaster is at the top of a 72m hill and has a mass of 966kg.

Mass = 966 Gravity = 9.8 Height = 72

GPE = 966 x 9.8 x 72 = 681,609.6 J

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2. There is a bell at the top of a tower that is 45m high. The bell weighs 190kg. Calculate its GPE.

Mass = 190 Gravity = 9.8 Height = 45

GPE = 190 x 9.8 x 45 = 83,790 J

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3. An apple is hanging on a branch 6m above the ground. It's mass is 0.2kg. Calculate its GPE.

Mass = 0.2 Gravity = 9.8 Height = 6m

GPE = 0.2 x 9.8 x 6 = 11.76 J

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4. A child is sitting on the ground. Do they have any GPE? NO

Give a reason for your answer: Not above the ground.

CALCULATING KINETIC ENERGY

WRITE THE FORMULA TO WORK OUT KINETIC ENERGY

$E_K = 0.5 \times m \times V^2$

m = mass (kg) V = velocity (m/s)

CALCULATE THE KINETIC ENERGY OF THE FOLLOWING OBJECTS

1. A car is travelling with a speed of 40m/s and has a mass of 1120kg. Calculate its kinetic energy.

Mass = 1120 Speed = 40

Kinetic energy = $0.5 \times 1120 \times 40^2$ = 896,000 J

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2. You serve a volleyball with a mass of 2.1kg. The ball leaves your hand with a speed of 30m/s. Calculate its kinetic energy.

Mass = 2.1 Speed = 30

Kinetic energy = $0.5 \times 2.1 \times 30^2$ = 945 J

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3. A dolphin is swimming at a speed of 20m/s and has a mass of 110kg. Calculate its kinetic energy.

Mass = 110 Speed = 20

Kinetic energy = $0.5 \times 110 \times 20^2$

= 22,000 J

KINETIC ENERGY
Calculations Worksheet

✓ The formula for calculating kinetic energy is: $0.5 \times m \times v^2$

✓ The two factors that determine the amount of kinetic energy in an object are mass and velocity

✓ Kinetic energy is measured in units of: Joules

✓ Mass must be measured in units of: kg

✓ Velocity must be measured in units of m/s

1. A shot putter heaves a 7.26kg shot with a final velocity of 7.5m/s. What is the kinetic energy of the shot?

$E_K = 0.5 \times 7.26 \times 7.5^2$
$= 204.19\text{J}$

2. A bike rider approaches a hill with a speed of 8.5m/s. The total mass of the rider and the bike is 85kg. Find the kinetic energy of the bike and rider.

$E_K = 0.5 \times 85 \times 8.5^2$
$= 3070.63\text{J}$

3. What is the kinetic energy of a ball with a mass of 5 kg rolling at 10 m/s?

$E_K = = 0.5 \times 5 \times 10^2$
$= 250\text{J}$

4. What kinetic energy has a 2560kg car travelling at 15 m/s?

$E_K = 0.5 \times 2560 \times 15^2$
$= 288{,}000\text{J}$

5. How much kinetic energy has a 5 gram bullet speeding at 100 m/s?

$E_K = 0.5 \times 0.05 \times 100^2$
$= 25\text{J}$

6. What kinetic energy has a 4 kg shotput thrown with a velocity of 13 m/s?

$E_K = 0.5 \times 4 \times 13^2$
$= 338\text{J}$

7. Calculate the kinetic energy a 12kg rock rolling down a hill with a velocity of 8 m/s.

$E_K = 0.5 \times 12 \times 8^2$
$= 384\text{J}$

8. Calculate the kinetic energy of a truck that has a mass of 2900 kg and is moving at 55 m/s.

$E_K = 0.5 \times 2900 \times 55^2$
$= 4{,}386{,}250\text{J}$

9. Find the mass of a car that is travelling at a velocity of 60 m/s North. The car has 5,040,000 J of kinetic energy.

$E_K = 0.5 \times m \times 60^2$

10. Determine whether work is being done in each of the following examples: (yes/no)

a. a train engine pulling a loaded boxcar initially at rest YES

b. a tug of war that is evenly matched NO

c. a crane lifting a car YES

11. A 1.12kg coconut falls at 3.3m/s from its tree. How much KE does that coconut have while it is falling?

$E_K = 0.5 \times 1.12 \times 3.3^2$
$= 6.1\text{J}$

12. How much kinetic energy does an object have if it 56kg and is travelling at 15m/s?

$E_K = 0.5 \times 56 \times 15^2$
$= 6300\text{J}$

K-K-K-K-K-K-KINETIC ENERGY CALCULATIONS

1. Kinetic energy can be defined as:

Energy of movement

2. The equation to be used to calculate kinetic energy (Ek) is: $0.5 \times m \times v^2$

3. The unit in which Ek is often measured is the :

Joules

4. Rodger swung a bat which had a mass of 2kg at a velocity of 45 m/s.
How many joules of kinetic energy could he give to a ball?

$E_k = 0.5 \times 2 \times 45^2$
$= 2025J$

5. Barry swings a bat which has a mass of 1.5 Kg at a velocity of 55 m/s.
How many joules of kinetic energy could he give to a ball?

$E_k = 0.5 \times 1.5 \times 55^2$
$= 2,268.75\ J$

6. What TWO FACTORS could INCREASE the KE of an object?

4 mass , 4 velocity

7. A golf pro swings his driver which weighs 0.75 kg at a velocity of 60 m/s.
Calculate the kinetic energy of the club.

$E_k = 0.5 \times 0.75 \times 60^2$
$= 1350J$

8. Calculate the Ek of a car which has a mass of 1000 kg and is moving at the rate of 20 m/s.

$E_k = 0.5 \times 1000 \times 20^2$
$= 200,000\ J$

9. What is the Ek of a soccer ball which has a mass of 0.8 kg and is kicked at a velocity of 10m/s?

$E_k = 0.5 \times 0.8 \times 10^2$
$= 40J$

10. Calculate the Ek of a runner that has a mass of 80 kg and is running at a velocity of 8 m/s.

$E_k = 0.5 \times 80 \times 8^2$
$= 2560J$

11. Circle the one with **MORE** Kinetic energy and briefly explain why.

A. A 25 kg mass or a (30 kg mass) going 5 m/s.

greater mass

B. Two 10 kg masses, one going (75 m/s), one going 45 m/s.

greater velocity

C. A car at rest or a (car rolling) down a hill.

Rolling car is moving

12. A 4 kg rock is rolling 10 m/s. Find its kinetic energy.

$E_k = 0.5 \times 4 \times 10^2$
$= 200J$

13. A 8 kg cat is running 4 m/s. How much kinetic energy does it have?

$E_k = 0.5 \times 8 \times 4^2$
$= 64J$

POTENTIAL ENERGY CALCULATIONS
WHOOP WHOOP!!

1. A baby carriage is sitting at the top of a hill that is 21m high. The carriage with the baby has a mass of 12kg. Calculate its GPE.

$Ep = 12 \times 9.8 \times 21 = 2469.6J$

2. A wooden block is sitting on a platform 20m high. Its mass is 79kg. Calculate its GPE.

$Ep = 79 \times 9.8 \times 20$

$= 15,484J$

3. There is a bell at the top of a tower that is 45m high. The bell weighs 190kg. Calculate its GPE.

$Ep = 190 \times 9.8 \times 45$

$= 83,790J$

4. A rollercoaster cart is stationary at the top of a 72m hill and weighs 966kg. Calculate its GPE.

$Ep = 966 \times 9.8 \times 72$

$= 681,609.6J$

5. The potential energy of an apple is 6 joules. The apple is 3m high. What is the mass of the apple?

$Ep = mgh$

$6 = m \times 9.8 \times 3$

$6 = m \times 29.4$

$\frac{6}{29.4} = m$

$m = 0.204kg$

6. Two objects were lifted by a machine. One object had a mass of 2 kg, and was lifted at a speed of 2m/s. the other object had a mass of 4kg and was lifted at rate of 3m/s.

a) Which had more kinetic energy while it was being lifted?

- Object with 4kg mass + lifted 3m/s

b) Which object had more potential energy when it was lifted to a distance of 10 metres? Show your calculation.

$Ep = 2 \times 9.8 \times 10$

$= 196J$

$Ep = 4 \times 9.8 \times 10$

$= 392J$

7. You are on roller blades on top of a small hill. Your potential energy is equal to 1000 joules. The last time you checked your mass was 60kg.

a) What is the height of the hill?

$E_p = mgh$

$1000 = 60 \times 9.8 \times h$

$1000 = 588 \times h$

$\frac{1000}{588} = h$

$h = 1.7m$

b) If you start skating down this hill, your potential energy will be converted to kinetic energy. At the bottom of the hill, your **kinetic energy will be equal to your potential energy at the top**, this is the law of conservation of energy. What will be your speed at the bottom of the hill?

NOTE: **PE = KE** So: $PE = \frac{1}{2}mv^2$

$E_K = 1000\ J$

$1000 = 0.5 \times 60 \times v^2$

$1000 = 30 \times v^2$

$\frac{1000}{30} = v^2$

$33.33 = v^2$

$\sqrt{33.33}$

$v = 5.77\ m/s$

8. i) What was the kinetic energy of a 1kg ball thrown into the air with an initial velocity of 30m/s? Include a diagram!

$E_K = 0.5 \times 1 \times 30^2$

$= 450\ J$

ii) How much potential energy does the ball have when it reaches the top of its ascent? (Think about the law of conservation PE = KE)

450 J

iii) How high into the air did the ball travel? *KE = PE

$450 = 1 \times 9.8 \times h$

$\frac{450}{9.8} = h$

$h = 45.2m$

9. What is the potential energy of a 3kg ball that is on the ground?

0 J