Kinetic Potential and Mechanical Energy
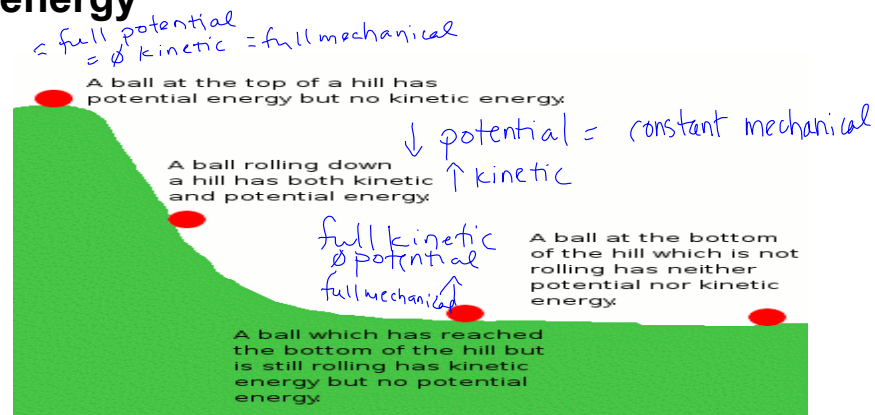
	Kinetic	Potential	Mechanical
Formula	$K = 0.5mv^2$	$P = mg \cdot h$	$K + P$
Units	$K = J$ $m = mass = kg$ $v^2 = velocity = m/s$	$P = J$ $m = mass = kg$ $g = N/kg$ $h = metres$	J

Conversions

Km/h to m/s	g to kg	cm to m
$\dfrac{35 \times 1000}{3600}$	$\div 1000$	$\div 100$

Constant : gravitational pull = $9.8 \, N/kg$

Relationship between kinetic and potential energy

= full potential = Ø kinetic = full mechanical

A ball at the top of a hill has potential energy but no kinetic energy.

↓ potential = constant mechanical
↑ kinetic

A ball rolling down a hill has both kinetic and potential energy.

full kinetic
Ø potential
full mechanical

A ball at the bottom of the hill which is not rolling has neither potential nor kinetic energy.

A ball which has reached the bottom of the hill but is still rolling has kinetic energy but no potential energy.

Mechanical Energy → does not vary in the question. P + K change proportionally keeping mechanical a constant value.

MythBusters- Penny Drop _ MiniMyth.mp4

Sample kinetic energy questions

1. A marble weighing 4.0 kg, travels at a speed of 1.9 m/s. What is its kinetic energy?

$K = 0.5 m v^2$

$$K = (0.5)(4.0 kg)(1.9^2 m/s)$$
$$K = 7.22 \ J = \boxed{7.2 J}$$

2. What is the mass of a truck if its kinetic energy is 5500 J and travels at a speed of 65 km/h.

$$\frac{65 \times 1000}{3600}$$
$$18.05$$
$$18 m/s$$

$$m = \frac{K}{0.5(v^2)} \qquad m = \frac{5500 J}{(0.5)(18^2)}$$
$$M = 33.95 kg$$
$$\boxed{34 kg}$$

3. A car having 75 000 J of kinetic energy and a mass of 330 kg, travels at what speed?

$$v^2 = \frac{K}{(0.5)(m)} \qquad v^2 = \frac{75000 J}{(0.5)(330 kg)} \qquad = \sqrt{454.54}$$
$$= 21.32 m/s$$
$$= 21 m/s$$

Example potential energy questions

1. A bar weighing 550 g is raised 3.0 m off the ground. What is its potential energy?

$$550 \div 1000$$
$$= 0.55 kg$$

$$P = m g h$$
$$P = (55 kg)(9.8 N/kg)(3.0)$$
$$16.17 J = 16 J$$

2. What is the mass of a girl if she was raised 2.00 m off the ground and has a potential energy of 555 J?

$$M = \frac{P}{g \times h} \quad \frac{555 J}{9.8 \times 2.00 m} = 28.316 \ldots$$
$$28.3 kg$$

3. A rock weighs 700 g and has a potential energy of 1 500 J. What height is it found at?

$$700 \div 1000$$
$$= 0.7 kg$$

$$h = \frac{P}{m \times g} \quad \frac{1500}{0.7 \times 9.8} = 218.65$$
$$200 m$$

Example mechanical energy questions

1. A car weighing 5500 kg, travels at a speed of 55 km/h up a 15 m hill. What is its mechanical energy?
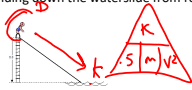
$$K = (0.5)(m)(v^2) \qquad \frac{55 \times 1000}{3600} \qquad P = m g h$$
$$(0.5)(5500)(15^2) \qquad (15.27) \qquad P = (5500)(9.8)(15)$$
$$= 618750 \qquad\qquad P = 808500$$
$$= 620000 J \qquad\qquad \boxed{810 000 J}$$
$$M = P + K \quad 620000 + 810000$$
$$= 1430 000 J$$

Past Exam Questions

1. A camp has a waterslide that is 5.0 meters high. Debra, a 55 kg camper, is sliding down the waterslide from rest. See Figure 5 below.

$$P = (m)(g)(h)$$
$$(55)(9.8)(5)$$

a) How fast will Debra be travelling when she reaches the water? Neglect resistance forces (air and friction).

$$v^2 = \frac{K}{.5 \times m} \quad \frac{2695}{0.5 \times 55 kg} = \sqrt{98} = 9.899 \ldots$$
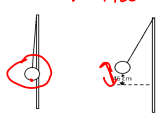$$9.9 m/s$$

b) Explain, using scientific terminology, why doubling the velocity of an object increases the kinetic energy by a factor of four.

Because Velocity is squared.

$$ek: 5^2 = 25 \qquad 10^2 = 100$$
original   4x

2. You are playing tether ball in the playground. When the height of the 5 kg ball rose to 46 cm above the initial position, its velocity was 5.0 m/s.

$$\div 100 \quad .46$$

Free potential = full mechanical

What is the maximum height, above the initial position, that the tether ball will reach?

$$K = 0.5 \times m \times v^2$$
$$0.5 \times 5 kg \times (5.0^2)$$
$$62.5 J \ (K)$$
$$60 J$$

$$② \quad P = m g h$$
$$(5 kg)(9.8)(.46)$$
$$22.54$$
$$20 J$$

$$③ \ m = k + p \qquad\qquad ④ \ h = \frac{P}{m \times g} \quad \frac{80 J}{5 kg \times 9.8}$$
$$60 + 20$$
$$= 80 J \qquad\qquad\qquad\qquad \boxed{2m} \ 1.63$$

Attachments

📎   MythBusters-_Penny_Drop___MiniMyth.mp4

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