Kinetic, potential and mechanical energy worksheet

1. A car travels at a speed of 60.0 km/h and has a mass of 1 005 kg. What is its kinetic energy?

$K = .5mv^2$ $.5 \times 1005 \times 16.7^2 =$ $\left(\frac{60.0 \times 1000}{3600}\right) = 16.7 m/s$

140 000 J or 1.40×10^5 J

2. A quarterback throws a football weighing 205 g at a speed of 2.78 m/s at a height of 20.0 m. What is the football's mechanical energy?

$K = .5mv^2$ $P = mgh$

$.5 \times .205 \times 2.78^2$ $.205 \times 9.8 \times 20.0$

$= .792$ J + 40.2 J

$=$ 41.0 J

3. A truck weighing 12 000 kg has 91 000 J of kinetic energy. What speed it is travelling at?

$v^2 = \frac{K}{.5m}$ $\sqrt{\frac{91000}{(.5 \times 12000)}} =$ 3.9 m/s

4. A van travels at a speed of 40.0 km/h with a kinetic energy of 7 600 J. What is the van's mass?

$m = \frac{K}{.5v^2}$ $\frac{7600}{(.5 \times 11.1^2)} =$ 120 kg $\frac{40.0 \times 1000}{3600} =$ 11.1 m/s

5. A hammer weighing 200.0 g is raised 3.0 m above the ground. What is its potential energy?

$P = mgh$ $.2000 \times 9.8 \times 3.0 =$ 5.9 J

$K = .5mv^2$

$\frac{180 \times 1000}{3600} = 50$ m/s

6. A four cylinder Toyota can reach a maximum of 150.0 km/h while a six cylinder Toyota can reach a maximum of 180 km/h. If they both weigh 1 500 kg, what is the maximum kinetic energy each car can have?

$\frac{150 \times 1000}{3600} = 41.67$ m/s

① $.5 \times 1500 \times 41.67^2 =$

1.3×10^6 J

② $.5 \times 1500 \times 50^2 =$

1.9×10^6 J

7. You will attempt to ski for the first time. On a good day you weigh 50.0 kg. You are now at the top of a 15 m hill trying to get courage to go down. How fast will you be travelling when you reach the bottom of the hill?

$V^2 = \frac{K}{.5m}$ $V^2 = \frac{mgh}{.5m}$ $K = P$

$\sqrt{\frac{50.0 \times 9.8 \times 15}{(.5 \times 50.0)}} = 17$ m/s

8. Tiger Woods is very upset about all his personal problems and he decides to go golfing to release his pent up anger. He hits a golf ball weighing 400.0 g at a speed of 4.0 km/h and reaches a height of 30.0 m. What is the ball's mechanical energy?

$\frac{4.0 \times 1000}{3600} = 1.1$ m/s

$K = .5mv^2$ $P = mgh$

$.5 \times .4000 \times 1.1^2 = .4000 \times 9.8 \times 30.0 =$

$= .24$ J $+$ 118 J $=$ 118 J

9. A group of students are attempting to throw a 55 g ball as high as they can, vertically upwards. The record height that they have achieved so far is 6 meters. Jeremy wishes to break the record of 6 meters. He throws the 55 g ball vertically upwards with a speed of 11.2 m/s.

$h = \frac{P}{mg}$ $h = \frac{.5mv^2}{mg} = \frac{.5 \times .055 \times 11.2^2}{(.055 \times 9.8)}$

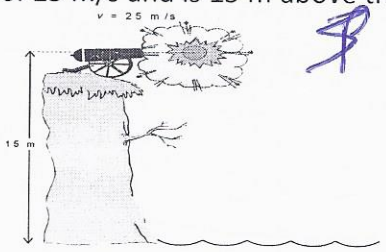
$P = K$

$= 6.4$ m

Will Jeremy exceed the record height of 6 meters? Explain your answer. ~~Neglect air resistance~~

yes he broke the record.

10. The special effects department of a Hollywood film company is working on a movie about pirates. They are testing the performance of their cannons. They fire a cannonball, with a mass of 2.5 kg, from the top of a cliff. The cannonball has a velocity of 25 m/s and is 15 m above the water when it leaves the cannon.



a) What is the total energy of the cannonball the moment it is fired?

$P = mgh$

$2.5 \times 9.8 \times 15 =$

$= 370\text{J} +$

$K = .5mv^2$

$.5 \times 2.5 \times 25^2 =$

$780\text{J} = 1150\text{J}$

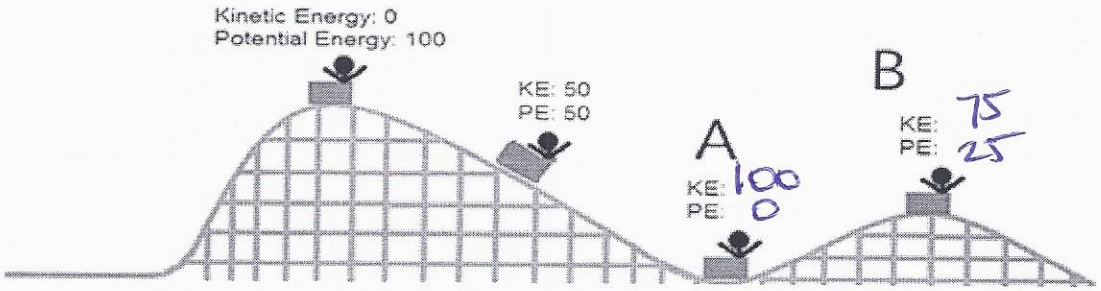
b) Assuming complete transfer of energy, what is the speed of the cannonball right before entering the water? *Neglect resistance forces.*

$V^2 = \frac{K}{.5m}$

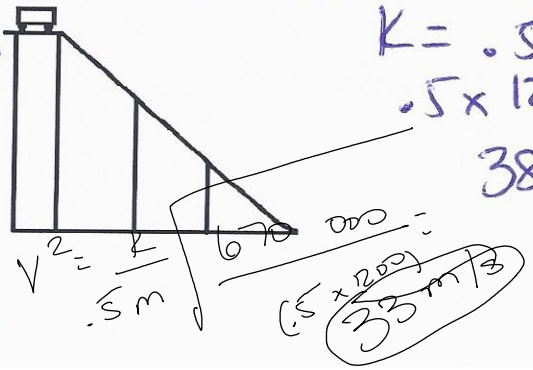
$K = m$

$\sqrt{\frac{1150}{(.5 \times 2.5)}} = 30\text{ m/s}$

11. In the picture below fill out the KE and PE for sections A and B. Section B is 25% of the height.



12. What is the final speed of the roller coaster shown below if it is travelling at 90.0 km/h at the top of a 25 m hill and it has a mass of 1 200 kg?



$\frac{90.0 \times 1000}{3600}$

25.0 m/s

$K = .5mv^2$

$.5 \times 1200 \times 25.0^2$

380000J

$P = mgh$

$1200 \times 9.8 \times 25$

$+ 290000\text{J}$

670000J

$m = \text{full k}$

$V^2 = \frac{K}{.5m}$

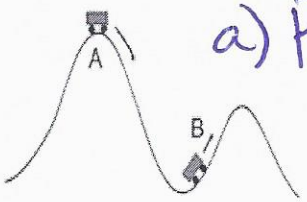
$\frac{670000}{(.5 \times 1200)} = 33\text{ m/s}$

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

13. A roller coaster with a mass of 550 kg was travelling at its fastest with a speed of 65km/h at point B.

a- What was the potential energy of the rollercoaster at point A when it had not moved yet?

b- What is it's mechanical energy? How do you know?



a) $P = K$ $.5mv^2$

$.5 \times 550 \times 18^2$

89000J

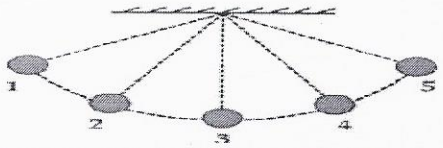
b) 89000J because full $K = M$

14. What was the mass of a ball if its potential energy was 205 J at a height of 22 000 cm?

A) 0.930 kg B) 9.00 kg C) 1.300 kg (D) 0.095 kg

$m = \frac{P}{gh}$ $\frac{205}{(9.8 \times 220)} =$

15. Below is a picture of a marble at 5 different positions attached to a plank. Position 1 is the starting point of the marble before it is released. Position 5 represents the final point before the marble would descend back down again. Which answer correctly matches the type of energy with the position of the marble?



	Position 1	Position 2	Position 3	Position 4	Position 5
A)	Ep = Ek	Max Ep and 0 Ek	Max Ek and 0 Ep	Max Ep and 0 Ek	Ep = Ek
B)	Max Ek and 0 Ep	Ep = Ek	Max Ep and 0 Ek	Ep = Ek	Max Ek and 0 Ep
(C)	Max Ep and 0 Ek	Ep = Ek	Max Ek and 0 Ep	Ep = Ek	Max Ep and 0 Ek
D)	Max Ep and 0 Ek	Ep = Ek	Max Ek and 0 Ep	Ep = Ek	Max Ek and 0 Ep

16. Professional hockey players can reach a velocity of up to 30 km/h on the ice. If the velocity of a hockey player doubles, what will be the effect on the player's kinetic energy?

A) The kinetic energy will be two times smaller.
B) The kinetic energy will be two times greater.
C) The kinetic energy will be four times smaller.
(D) The kinetic energy will be four times greater.

30^2

60^2