Law of Conservation of Energy
Energy Transformations

Pre-Class Assignment #3

Explain why roller coasters are able to continue moving if Potential Energy is 'spent' by the time it reaches the bottom of the first hill.

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1) What is the Law of Conversation of Energy? ________________________

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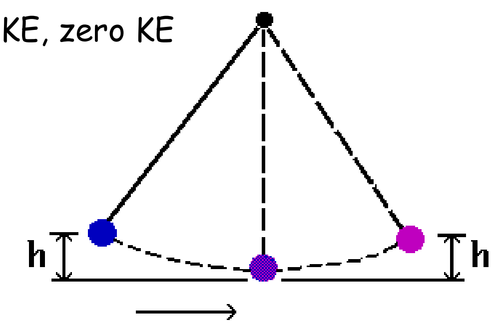
2) Label the diagram for with max PE, zero PE, max KE, zero KE



3) Describe what you see in the image where there is a transfer of potential to kinetic energy: Watch the bar graph for total energy. What do you notice about the total energy?

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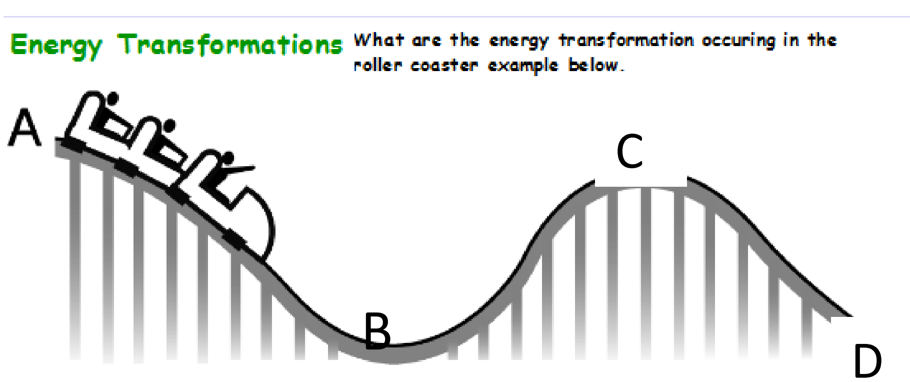
4)



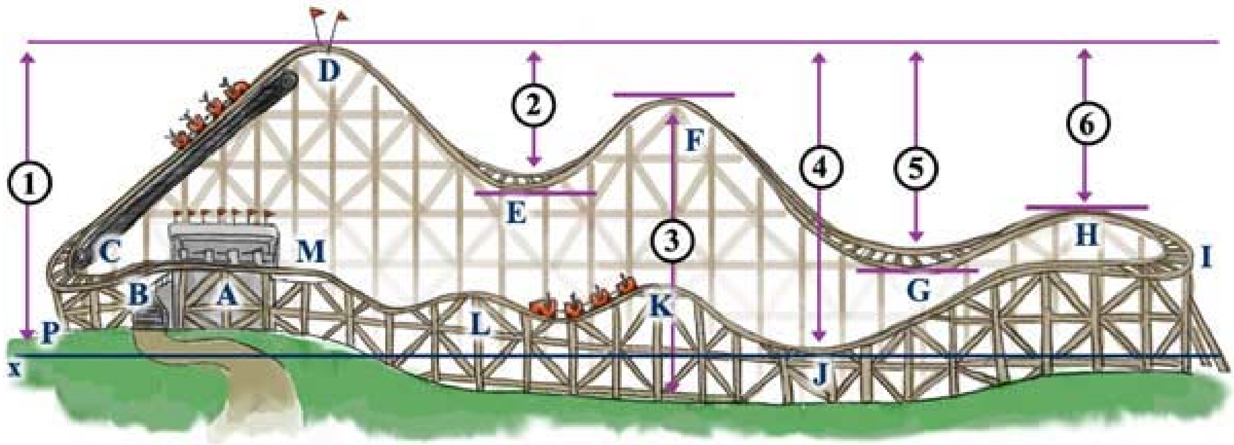
From A → B

From B→C
Why is this hill not as high as the first one?

From C→D

What will eventually happen to the coaster if the track remains flat?

5) Use the image to answer the following questions:



i. Which letter represents the highest point of potential energy? ______

ii. When the coaster falls down the ramp "D-E", the potential energy drop is changed into ________________ energy which accelerates the coaster.

iii. Name 3 points other than D-E that show continuous changes in potential and kinetic energy. ______, ______ & ______

iv. There is a drop in potential energy from A to B which allows the coaster to get enough kinetic energy and ________________ to allow it to reach and lock on the uplift at C.

v. Explain why it is not possible for point G to be above point E. ____________
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6) <u>Law of Conservation of Energy Equation</u>

$$PE_i + KE_i = PE_f + KE_f$$

In a simple example of an object at rest at the top of a hill, and rolling to the bottom of the hill

KE_i = ___ because the object _________________

PE_f = ___ because the object _________________

This equation simplifies to:

7) <u>Solve a Problem:</u>

You are on frictionless, air resistance-free roller coaster paused at the top of the first hill. Your coaster car is 22 m above the ground and weighs approx 535kg with its passengers.

How much PE do you have at the top?

How much KE will you have at the bottom?

How fast will you be going at the bottom?

8) <u>What if $KE_i \neq 0$</u> The object is moving at the start, so it has KE

PE_i = ____ you are at the _________

KE_f= ____ you pause at the _________

This equation simplifies to:

Superman is a high velocity ride at Six Flags Magic Mountain. You are launched at high velocity and continue up the track until you stop… then plummet back down. Superman's linear synchronous motor launches you at 160 km/h. Assuming no friction, how far up do you travel?

<u>To Solve:</u>

a. We need 160 km/h into m/s shortcut is divide by 3.6

b. Find KE at bottom of ride. Oh no! We were not given mass!

   BUT all ____ becomes ____ at top of ride

   $KE_i = PE_f$ substitute in your equations!

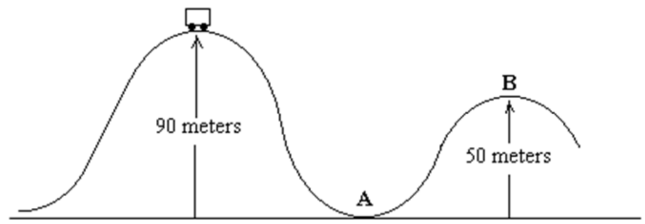
both sides of the equation have an "m"….they cancel, now we can solve without a number for mass!!

c. Use some fancy algebra skills to solve for h….
Fill in all the numbers you know first. Algebra is so cool, when done correctly!

$$\frac{1}{2}\cancel{m}v^2 = \cancel{m}gh$$

9 <u>What if there is not an initial = 0 AND a final = 0?</u>

What is the velocity of the car at point B?

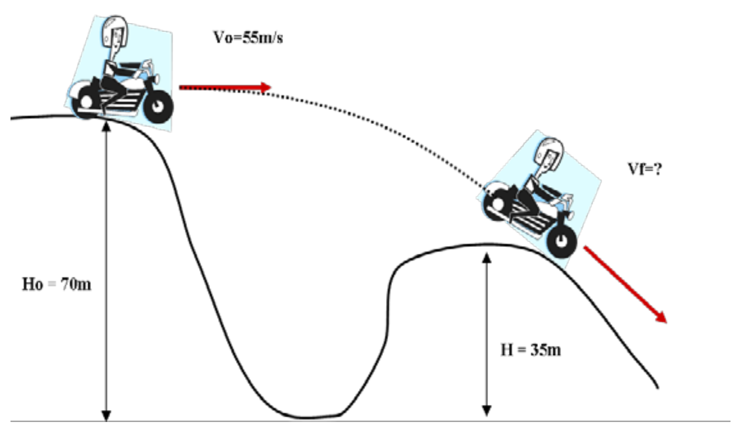


Use Δh Δ = delta = change in… Δh =40m
To find the ΔPE from the top to point B. $\Delta PE = mg\Delta h$

Loss of PE = Gain of KE so we can solve for velocity

$mg\Delta h = \frac{1}{2} mv^2$ Get out your fancy algebra skills, cancel your masses and give it a go!

10. <u>What if initial velocity is not = 0? What if no part of the LoCoE equation =0?</u>



Equation: $PE_i + KE_i = PE_f + KE_f$

Substitute: $mgh_i + \frac{1}{2}mv_i^2 = mgh_f + \frac{1}{2}mv_f^2$

Cancel all masses: $mgh_i + \frac{1}{2}mv_i^2 = mgh_f + \frac{1}{2}mv_f^2$

Fill in numbers:

Calculate each part:

Gather like terms:

Do fancy algebra:

Round Final Answer: