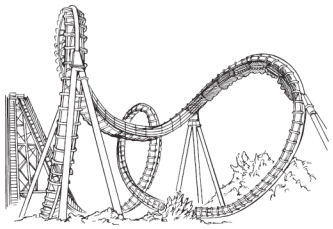

roller coaster

Name _____
Partners in this Project: _____

_____/175 pts Science Number: _____Group #_____

3 pts ec printing Due In Physics Lab Notebook__ Period _____

Energy and Roller Coasters

Video Notes: http://science.howstuffworks.com/roller-coaster-videos-playlist.htm (6pts)

Build it Bigger: Coasters 2pts	Roller Coaster Seats 2pts	How Roller Coasters Work 2pts

After watching the videos, what would your dream rollercoaster look like?? 4pts

Physics Fundamentals & The Future's Channel Roller Coaster Video Notes : 3 bullet points 2pts

_____

_____

_____

_____

_____12 pts/1

Part 1: Physics Research:

Step A: **Terms to Know** *Define the following terms (2 points each)*

Acceleration	***Centripetal Force***	***G Force***
Newton's 2nd Law	***Kinetic Energy (KE)***	***Potential Energy (PE)***

Step B: What is Energy? ***Video Notes*** *(2 points each)*

Eureka: Potential Energy	**Eureka: Kinetic Energy**
What is Potential energy	**What is Kinetic energy**

1. **Energy & Work – Working Together** (page 214) (5 pts)
   - Energy is the ability to do _____.
   - Work occurs when a _____ causes an object to move in the _____ of the force.
   - The unit used to measure work & energy is the _____

2. **Kinetic Energy is Energy of Motion** (p 215)

   Do all moving objects have kinetic energy?_____

   Kinetic Energy Depends on _____ & _____

   Order the vehicles from **figure 3** with the most KE to the least KE: _____ _____ _____

   The equation for Kinetic energy [KE] is:

   KE =

3. **Potential Energy is Energy of Position** (p 216) (3pts)
   - Potential energy [PE] is the energy an object has because of its _____ or _____
   - One example of an object with potential energy is _____
   - **Gravitational Potential Energy Depends on _____ & _____**
   - The equation for gravitational PE is:

PE =

4. **Mechanical Energy Sums It All Up** (p 217)
   - What is the equation for mechanical energy?

Mechanical Energy =

5. **Forms of Energy** (p 218-221) (3pts)

   Label each type of energy:

   - _____ **Energy**: the total KE of the particles that make up an object
   - _____ **Energy**: the energy of a compound that changes as its atoms are rearranged to form new compounds, a form of PE
   - _____ **Energy**: the energy of moving electrons, a form of KE
   - _____ **Energy**: caused by an object's vibrations, a form of PE & KE
   - _____ **Energy**: produced by the vibrations of electrically charged particles
   - _____ **Energy**: associated with changes in the nucleus of an atom

Energy Conversion (5pts)

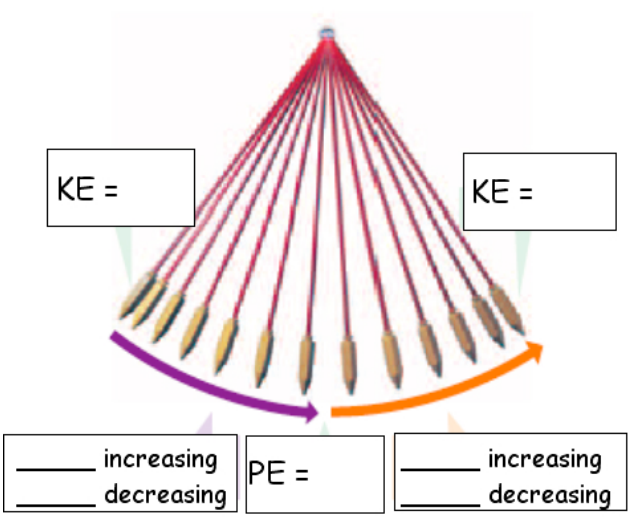
6. An energy conversion is a _____

   _____

   _____

7. **From Kinetic to Potential & Back** (page 222)
   - Complete **Figure 15** to the right:

8. **Conversions Involving Chemical Energy** (p 223-224)
   What are 2 examples of converting energy?
   - _____
   - _____



Conservation of Energy (10pts)

9. **Where does the energy go?** (page 229)
   - On a roller coaster, where is PE the greatest? _____ Least? _____
   - What force prevents an object's PE from converting into KE? _____
   - When energy is used to overcome friction, some of the energy is converted into _____ energy

10. **Energy Is Conserved Within a _____ System** (page 230)

a) A closed system is a well-defined group of objects that _____ energy between one another

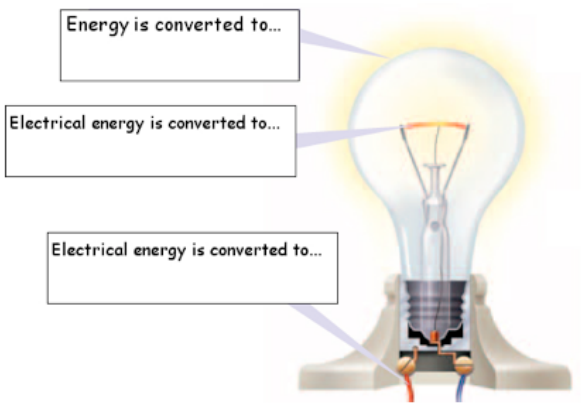
b) An example that involves a roller coaster consists of the track, the _____, & the surrounding _____.

c) On a roller coaster, some mechanical energy (KE + PE) is transferred into _____ energy (because of friction) & _____ energy (because of the noise). Overall, you end up with the _____ total amount of energy as the original amount of _____ energy.

d) The **law of conservation of energy** says that energy can neither be _____ nor _____.

e) One example of conservation in a closed system is a light bulb. While not all of the original _____ is converted into light energy, no energy is _____.

Figure 24 Energy Conservation in a Light Bulb



Step C: Energy Math *(2 pts each)* **SHOW WORK!**

1. A 5000 kg truck is moving at a velocity of 30 m/s. How much **kinetic energy** does it have?

2. A 12 kg dog is running at a velocity of 5 m/s. How much **kinetic energy** does it have?

3. A 5000 kg truck is moving at a velocity of 30 m/s. How much **kinetic energy** does it have?

4. If you lift a 50 N watermelon to the top of a 2 m fridge, how much **potential energy** does it have?

5. Your angry teacher is holding a 1 N book over your head at a height of 0.5 m. How much **potential energy** does the book have?

6. Two divers are standing at the end of a 10 m diving platform. The first diver, Andy, weighs 20 N. The 2nd diver, Jim, weighs 30 N. Which one has more **PE**

Step D: BrainPOP- Potential Energy (PE) & Kinetic Energy (KE) ***(1/2 point each)***

1. KE & PE are the 2 types of energy that relate to:
   a. Change b. Friction c. Density d. Motion

2. Which object has the most PE? A ball:
   a. resting on the ground b. thrown at 100 mph
   c. on top of a refrigerator d. resting on a cliff

3. When does a yo-yo have the most PE? When it's:
a)at its highest point b)at its lowest point c)moving at top speed

4. When is PE transformed into KE? When an object
a. at rest is lifted to a higher elevation b. at rest remains at rest
c. at rest is put into motion d. in motion is stopped and put at rest

5. Which is the best synonym for PE?
   a. Stored energy b. Energy of motion
   c. Energy due to gravity d. Mechanical energy

6. The amount of KE an object has depends on its
   a. Mass & volume b. Volume & friction
   c. Mass & speed d.Speed & density

7. Why do object at high elevations have more PE than objects at low elevations?
   a. Because the thinner air at higher elevations means objects have a greater potential to move fast
   b. Because gravity gives objects at high elevations the potential to fall much further

8. Which of the following has the most KE?
a. A car traveling at 80 kph b.A tractor-trailer traveling at 80 kph
c. A cheetah running at 80 kph dA motorcycle traveling at 80 kph

9. When is KE transferred from object to object? When:
a. Those objects pass one another b. Those objects collide
c. the first object outweighs the second object
d. the 1st object has more PE than the 2nd object

10. There is a finite amount of energy in the universe, which means:
   a. Energy is destroyed & created all the time.
   b. There is a limited amount of energy in the universe.
   c. Stars generate most of the energy in the universe **38pts/pg3-4**

Step E: Describe two roller coaster animations *(2 points each)*

Animation _____:_____

_____

Animation _____:_____

_____

Part 2: Roller Coaster Research

Step F: History of Roller Coasters *(1 point each) Use the links on the web page to help you!*

1. When & where did the first roller coasters appear? _____
2. What was the first coaster made of? _____
3. The coasters were eventually brought to Paris in _____ in the form of *Les Montagnes Russes*. Small wheels were added to the sleds, but little attention was given to _____. Oddly enough, the injuries that passengers suffered from runaway cars _____ attendance.
4. At the turn of the century, trolley companies built amusement parks at the end of their lines to attract riders. The best-known trolley terminus was _____ in New York City
5. Approximately how many coasters are in the world? _____
6. What & where is the largest steel coaster? _____
   - How big is it? _____
7. How fast is the fastest steel coaster? _____

Step G: Roller Coaster Elements *(3 point each)* ***Choose 8 of the elements /explain what they do & draw them***

_____	_____	_____
_____	_____	_____
_____	_____	Video Notes: How Rollercoasters work

38 pts/pg5

Step H: Roller Coaster Motion *(2 points)*

How does a roller coaster continue to move through the twists and turns of its track if it only uses power at the beginning?

_____

_____

_____

Step I: Successful Designs *Pick your favorite 3! (6 points)*

Name of Coaster	Notable Features	Height	Length	Top Speed

Part 3: Design & Planning

Step J: The Design Questions (2 points each)

Build your roller coaster on line! Draw what it looks like here: 5 pts

1. Draw a picture of a clothoid loop & a circular loop. Why is a clothoid loop preferential to a circular loop?

2. Describe two major differences between wooden and steel coasters.

3. What features do most roller coasters have?

4. How do most roller coasters start?

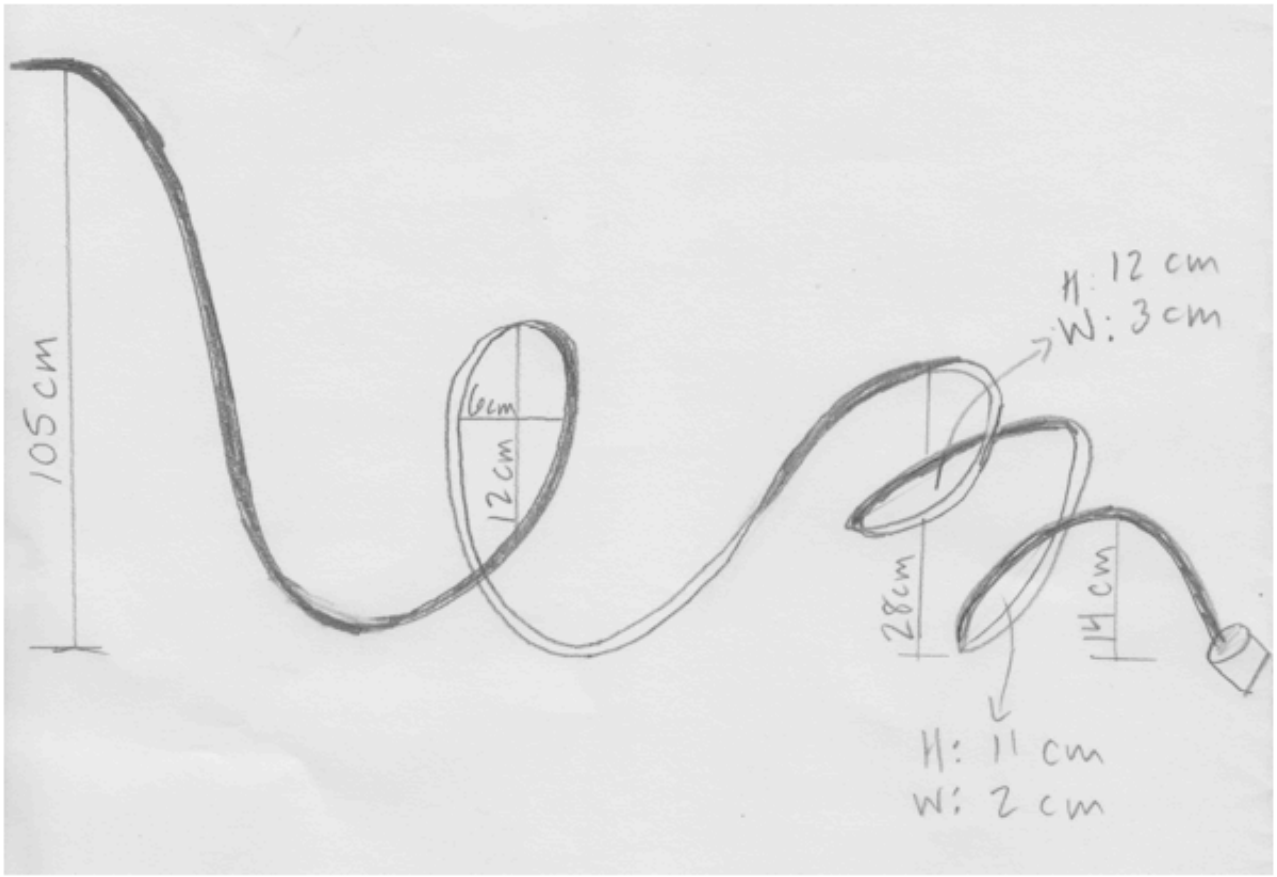
5. How do most roller coasters exit?

Part 4:Testing: Build a coaster with 2 loops/2 hills and NO TUNNELS

Goal: To build a complex marble roller coaster & calculate the marble's average speed.

Final Product: A poster of your group's final coaster, including all of its important measurements.

1. Get 4 foam tubes & a bag of supplies (marble, plastic cup, measuring tape, stopwatch, masking tape). Careful, your group is responsible for returning everything just as you received it.
2. How long is the track? Measure the length in METERS (hint: each one is 6 feet).
    - **Total Track Length:** _____meters
3. Find an empty section of the room. Use masking tape to connect the 4 pieces together to make a track. BE CAREFUL ABOUT THE TAPE: please don't put it on anything that will rip like paper or non-laminated posters. The end of the coaster must empty into the cup.
4. Release the marble down the track. Play around with the coaster to get the biggest, fastest, best one you can.
5. Draw your coaster in the box on the following page.
6. Measure each part of the coaster. Record the measurements on your drawing & be sure to measure in centimeters or meters!! Use the example below. Include the following:
    - Starting & ending height
    - Height & width of each loop and/or hill



7. Release the marble down the track & time how long it takes to complete the track.
    - **Time:** _____
8. Determine the average speed of your marble (average speed = total distance / total time).
    - **Average Speed of Marble:** _____ **3pts pg 7**

MY GROUP'S ROLLER COASTER & MEASUREMENTS-
You may also attach photo and put the measurements on it.

/10

Coaster Conclusion (2 points each)

1. What happened to the PE & KE of the marble as it traveled through the track? Explain.

2. Which force opposed the motion of the marble as it moved? Explain.

3. Does your roller coaster obey the law of conservation of energy? Explain why or why not.

4. What happened to the velocity of the marble as it accelerated down its first hill?

5. List 3 important rules about building a successful coaster.

6. What was your favorite part of this project? Least favorite?

/12

- **Part 6: Group Evaluation**

Everybody in the group is responsible for participating, helping, cleaning, and working. Also, everyone is responsible for contributing their opinion and evidence to support their opinion. Below, **list each group member,** including yourself, and **grade their participation & cooperation** throughout this project. PROVIDE EVIDENCE.

1. _____ deserves _____ out of 5 points because _____
   _____
   _____
2. _____ deserves _____ out of 5 points because _____
   _____
   _____
3. _____ deserves _____ out of 5 points because _____
   _____
   _____
4. _____ deserves _____ out of 5 points because _____
   _____
   _____
5. _____ deserves _____ out of 5 points because _____
   _____
   _____

/4

Conclusion: 5 sentences: (10 pts)
What did you like about this project? What did you find frustrating? What helped you MOST understand the physics of roller coasters? What would you want to do again? What do you now understand well, about the physics?

_____
_____
_____
_____
_____
_____
_____
_____

14pts