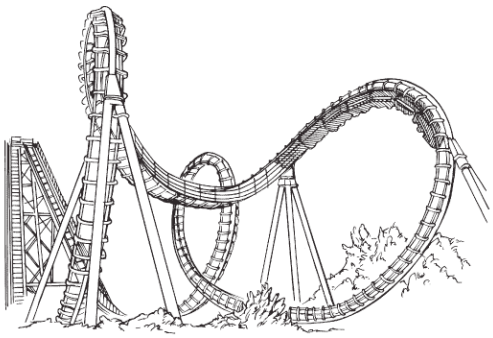
3 pts ec printing

Name: _____Period: _____ Science Number: _____

Roller Coaster Partners/ Science Numbers: _____

Total pts _____ / 125 pts _____/ec photo pts

Energy and Roller Coasters



roller coaster

Introduction: My dream rollercoaster drawing:

Watch "Build It Bigger: Kinetic Madness" and then draw your Dream Roller Coaster below 4pts

Physics Fundamentals & The Future's Channel Video: Roller Coasters Notes: (3 bullet points) 3 pts

_____

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_____

/7

Part 1: Physics Research

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

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

Step B: BrainPOP- Potential Energy (PE) & Kinetic Energy (KE) *(1/2 point ea) Log in: mms308/marshall*

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. A ball resting on the ground
    b. A ball thrown at 100 mph
    c. A ball on top of a refrigerator
    d. A ball resting on a cliff
3. When does a yo-yo have the most PE?
    a. When it's at its highest point
    b. When it's at its lowest point
    c. When it's moving between it's highest & lowest point
    d. When it's moving at top speed
4. When is PE transformed into KE?
    a. When an object at rest is lifted to a higher elevation
    b. When an object at rest remains at rest
    c. When an object at rest is put into motion
    d. When an object 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. 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
7. The amount of KE an object has depends on its
    a. Mass & volume
    b. Volume & friction
    c. Mass & speed
    d. Speed & density
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
    d. A motorcycle traveling at 80 kph
9. When is KE transferred from object to object?
    a. When those objects pass one another
    b. When the first object outweighs the second object
    c. When the first object has more PE than the second object
    d. When those objects collide
10. There is a finite amount of energy in the universe. What does this mean?
    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

Step C: Describe two animations *(2 points each)*

Animation _____:_____

_____

Animation _____:_____

_____ **_/21**

Step D: What is Energy?

1. **Energy & Work – Working Together** (page 214)
   - 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 _____ & _____**
   - The equation for Kinetic energy [KE] is:

     KE =

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

     _____ _____ _____

3. **Potential Energy is Energy of Position** (p 216)
   - 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)

   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

/10

Energy Conversion

6. An energy conversion is a _____ _____ _____

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

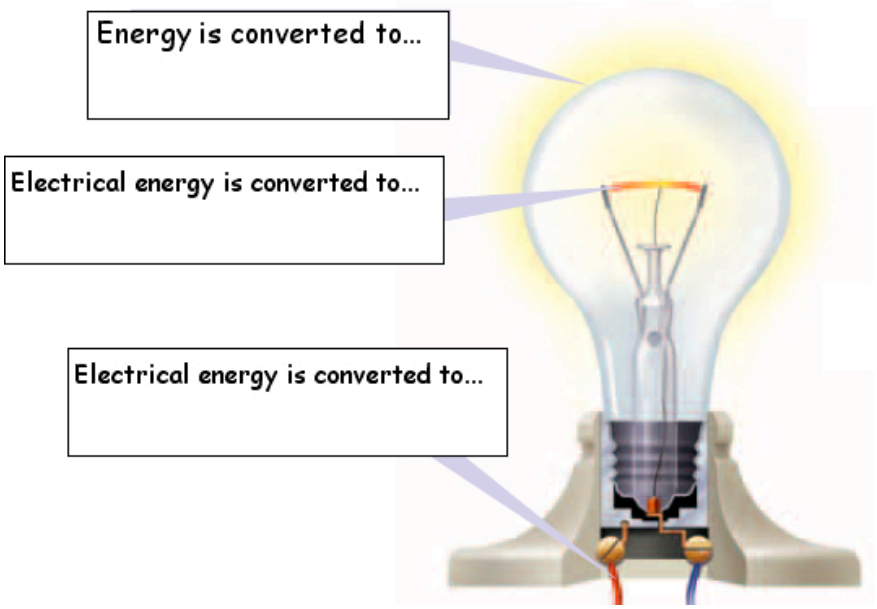
8. **Conversions Involving Chemical Energy** (p 223-224)
   What are 2 examples of converting energy?
   - _____
   - _____

Conservation of Energy

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 closed system is a well-defined group of objects that _____ energy between one another
    - An example that involves a roller coaster consists of the track, the _____, & the surrounding _____.
    - 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.
    - The **law of conservation of energy** says that energy can neither be _____ nor _____.
    - 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



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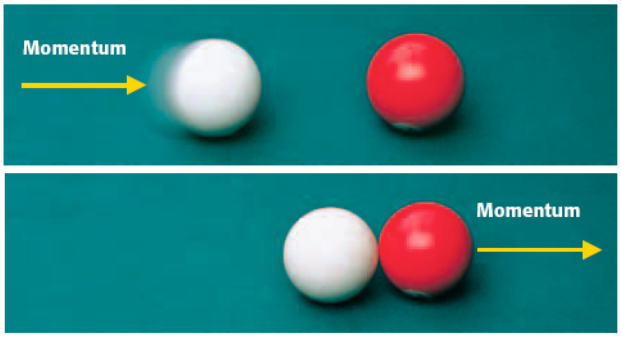
Step E: Momentum (page 152)

1. Momentum is a Property of _____ Objects

- If a compact car & a large truck are traveling with the same velocity, it takes longer for the _____ to stop than it does for the _____ if the same braking force is applied.
- Likewise, it takes longer for a _____ moving car to stop than it does for a _____ moving car with the same mass.
- **Momentum** is a property of a moving object that depends on the object's _____ & _____
- The more momentum an object has, the harder it is to _____ the object or change its _____.

2. Momentum is Conserved



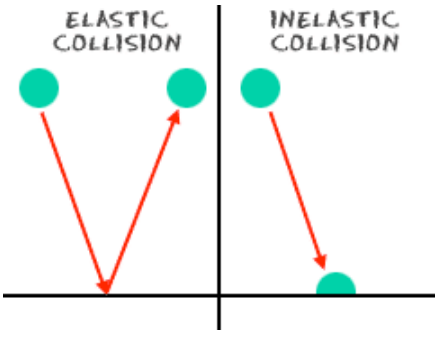
- When a moving object hits another object, some or all of the momentum of the first object is _____ to the other object.
- **Figure 19** The momentum _____ a collision is _____ to the momentum _____ the collision.
- This example illustrates the law of _____ of _____

Go To: Momentum Website (Physics4Kids)to answer these questions

3. Momentum Basics

- Momentum = _____
- Example: if you were running at a velocity of 10 m/s W & your mass is 50 kg, your momentum is _____.
- Think about it. If you throw a small ball & a large ball at the same speeds, the _____ ball will hit a person with a greater momentum, be harder to stop, & hurt more. When the _____ is greater (at the same speeds), the momentum is greater.
- What is an example of an object with a small mass, but a lot of momentum? _____

4. Conserving Momentum



- In an **elastic collision**, _____ kinetic energy is lost.
- All of that energy is still in the object, so we say that energy was _____.
- An example of an elastic collision is _____ _____
- In an **inelastic collision**, some of the energy will be lost to _____ or _____ or _____ or some other energy.
- The _____ energy didn't change, but some of it escaped into the air, ground, etc. The object would then have less energy when it rebounded, so the KE & momentum would be less. The energy of the object was not conserved, but the total energy was.
- An example of an inelastic collision is _____

/10

Part 2: Roller Coaster Research

Step F: History of Roller Coasters *(1 point each)*

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: Successful Designs *(5 points)*

Name of Coaster	Notable Features	Height	Length	Top Speed

Step H: Roller Coaster Motion *(4 points)*

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

Step I: Roller Coaster Elements *(1 point each)*

_____	_____	_____

/20

Part 3: Design & Planning

Step J: The Design (2 points each)

1. Draw a picture of a clothoid loop and a circular loop.

2. Why is a clothoid loop is preferential to a circular loop?

3. What is the difference between wooden and steel coasters?

4. What features do most roller coasters have?

5. How do most roller coasters start?

6. How do most roller coasters end (exit)?

Step K: Planning Your Coaster

Think about what part of the room you want to build your marble roller coaster in. What kind of special features do you want? Hills? Loops? Corkscrews? Your group will be provided with 6 foam insulation pipes and a roll of masking tape. Jot down at least 5 of your ideas below. (5 points)

1._____
2._____
3._____
4._____
5._____

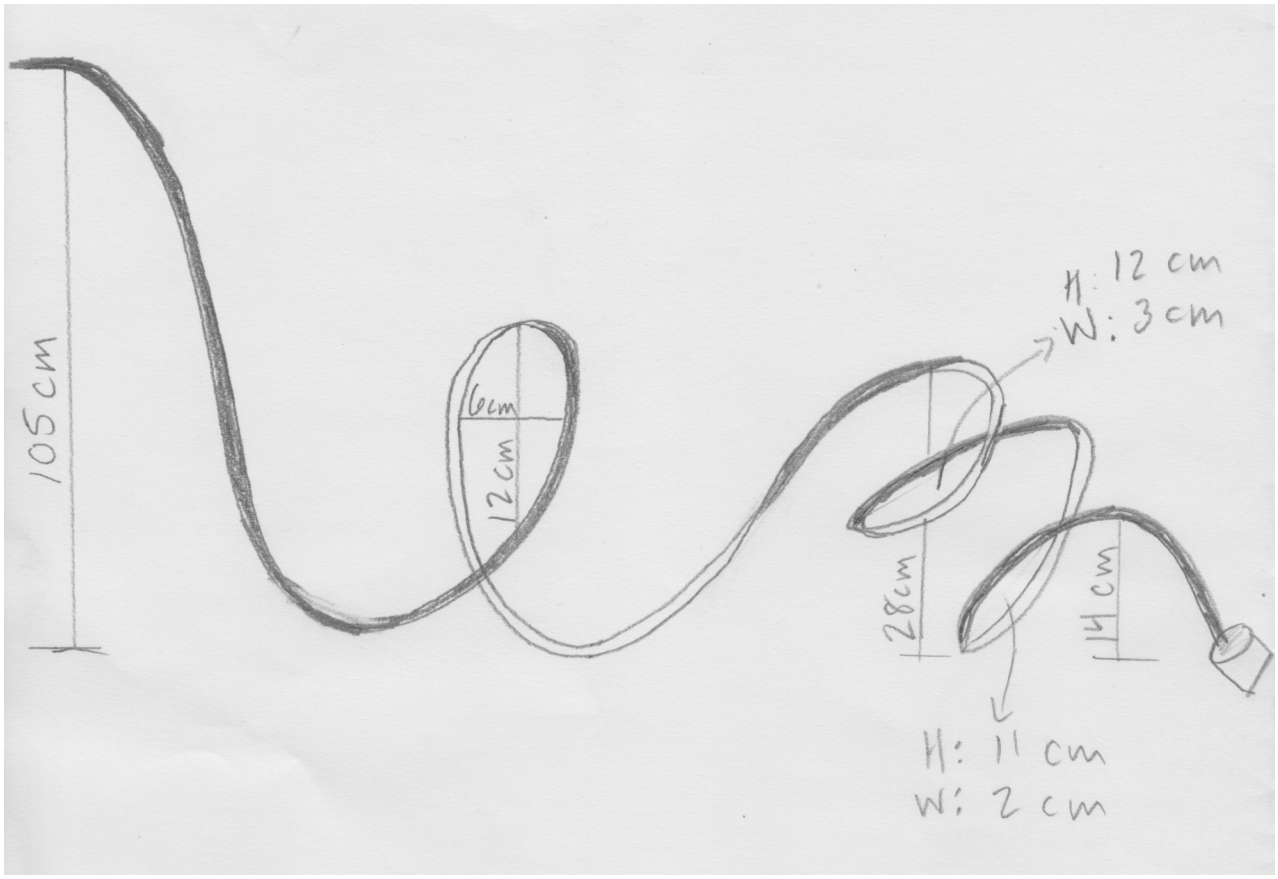
/17

Part 4: Testing

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 6 foam tubes & 1 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 of the 6 tubes in METERS (hint: each one is 6 feet).
    - **Track Length:** _____meters_
3. Find an empty section of the room. Use masking tape to connect the 6 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. Once finished, draw the coaster on **page 8** of your handout. (Or you may take a photo and attach it ☺
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. Run at least 5 trials
    - **Time: 1._____2._____3. _____4. _____5. _____**
8. Determine the average speed of your marble (average speed = total distance / total time).
    - **Average Speed of Marble: _____**

/10

MY GROUP'S ROLLER COASTER & MEASUREMENTS **(you may turn the paper landscape too)**

/10

You may attach your photo here: (4 ec pts)

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.

_____

_____

_____

_____

_____**/10 pts**