Roller Coaster Project ***Names***_____

Purpose: In this project, you and a partner will design a roller coaster using kinetic and potential energy, as well as the law of conservation of energy. Your roller coasters may only use a total of 10,000,000 J of energy. This seems like a lot (and it is) but you will have to be careful not to go over this limit. All work/calculations need to be done neatly on a separate sheet of paper and attached to your work. Record each step on the attached data sheet.

Step 1: Name your roller coaster.

Step 2: Design the train. Make it unique to your coaster.

- Research a real roller coaster train and find its mass. Convert it to kg if it is given in lbs.
- What is the train's empty mass? You will use this in all of your energy calculations. Consider about how many people it needs to hold. Also consider how mass affects energy.
- How many people can ride it at once? (Keep in mind, each person will add on average 75 kg of mass.)

Step 3: Make a 2 dimensional scale drawing of your roller coaster on graph paper.

- Yes, it has to be to scale. Draw the height on the y-axis so you can accurately see how the heights compare.
- It needs to have at least 3 hills of different heights
- Make sure to label the height of each hill.

Step 4: For the first hill:

- Let the KE at the top of the first hill be zero.
- Calculate Potential Energy at the top
- Calculate Total Mechanical Energy at the top
- At the bottom of the first hill, calculate the KE, PE, and ME.
- Label these on your scale model

Step 5: For the second hill:

- Calculate Potential Energy at the top
- Calculate Kinetic Energy at the top
- Calculate Total Mechanical Energy at the top
- At the bottom of the second hill, calculate the KE, PE, and ME.
- Label these on your scale model

Step 6: For the third hill:

- Calculate Kinetic Energy at the top
- Calculate Potential Energy at the top
- Calculate Total Mechanical Energy at the top
- At the bottom of the third hill, calculate the KE, PE and ME.
- Label these on your scale model

Step 7: Calculate the maximum speed of your roller coaster. (This will be in m/s. For advertising purposes, convert to miles per hour.)

Step 8: Create a poster that will make someone want to ride your roller coaster. Include things like top speed, height, and any other cool features. Your classmates will be scoring these, so make sure they are appealing.

Roller Coaster Follow up questions ***Name***_____

1. In what two ways does the height affect your roller coaster? How would it change things if your ride was taller or shorter?

2. In what ways does the mass affect the roller coaster? How would it change things if your train with passengers was more or less massive?

3. In this project, we assumed mechanical energy was conserved. Why would it not be conserved, and where would all of that extra energy go? Explain.

4. From a manufacturing/engineering standpoint, discuss 3 factors that would make your ride easy or difficult to actually build.

5. If you doubled the height of your roller coaster, how much would your speed change? Prove this by using your formulas for KE and PE and do some math. Show your work below.

Data Sheet

Roller coaster name:_____

Mass of real roller coaster: _____

Mass of your roller coaster train: _____

Number of riders: _____ Mass of riders:_____

Total mass: _____

Hill 1:

Top Height: Bottom Height:

KE: 0 J KE:

PE: PE:

ME: ME:

Hill 2:

Top Height: Bottom Height:

KE: KE:

PE: PE:

ME: ME:

Hill 3:

Top Height: Bottom Height:

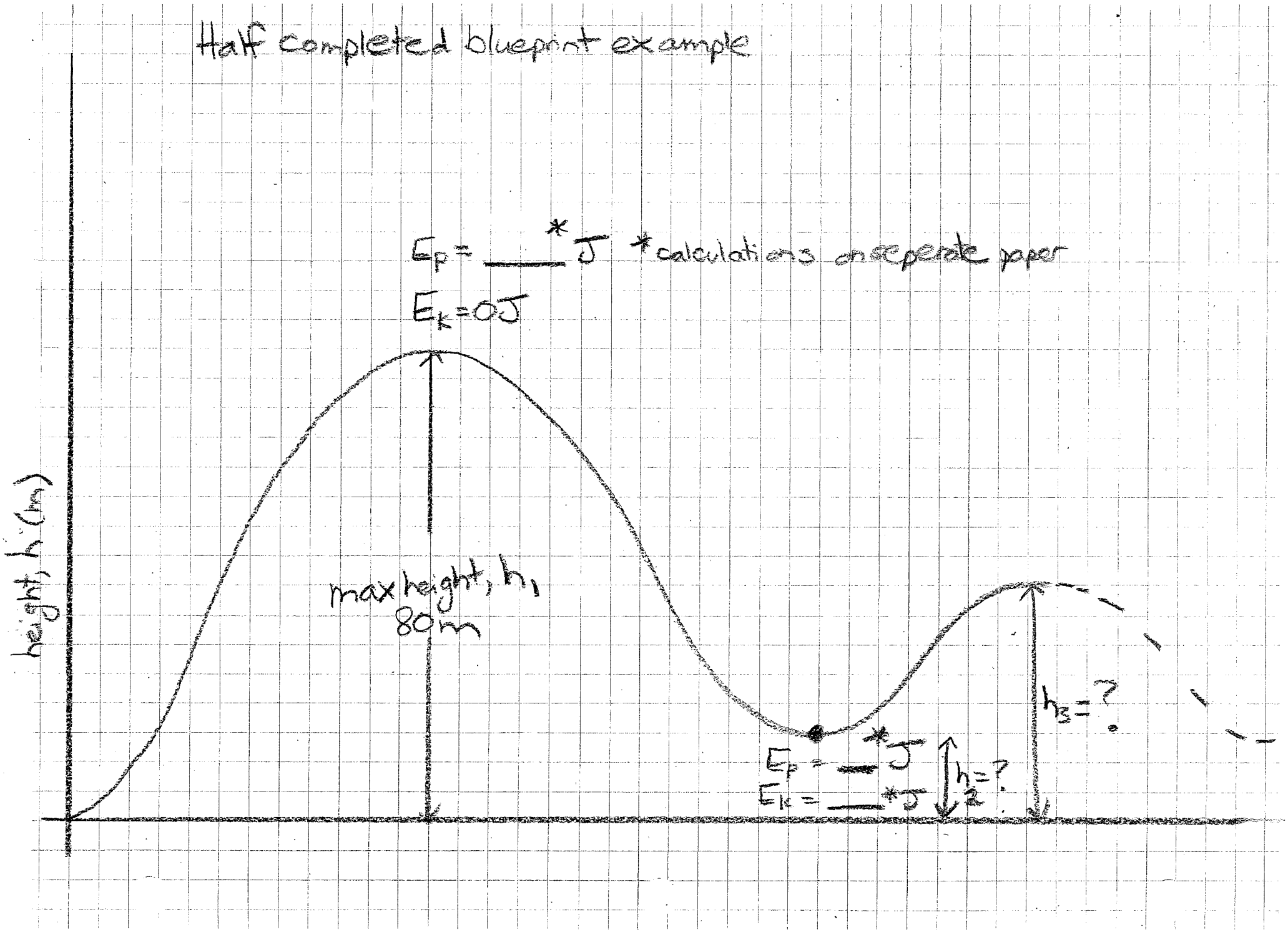
KE: KE:

PE: PE:

ME: ME:

Top speed:

Half completed blueprint example



Names: _____ Block: _____

Amusement Park End of Energy Unit Project

RUBRIC /70

Setup (10 pts)

Good Use of Class Time	/10 (*Personal Responsibility*)
Rollercoaster mass research and decisions clearly identified	□yes □no

Scale "Model" (Blueprint on grid paper) (10 pts)

Critical Thinking: I can construct and analyze models.

Appropriate label of y-axis	/2
Appropriate scale	/3
Heights labeled	/3
Effort and clarity of model	/2

Poster/Model/PowerPoint (10 pts)

Communication: I can communicate my ideas using scientific language and present my ideas to others.

Organized	/3
Colorful/Effort Demonstrated	/3
Displays necessary information	/4

Physics calculations and concepts (20 pts)

Critical Thinking: I can describe variables and analyze models.

Calculation for E_K at top and bottom of each hill	/5
Calculation for E_P at top and bottom of each hill	/5
Calculation for mechanical energy at top and bottom of each hill	/5
Problem Solving Steps are shown and clear	/5

Presentation (20 pts)

Communication: I can communicate my ideas using scientific language and present my ideas to others.

Teacher follow up questions	/10 pts
Peer Scoring	/10 pts

Roller coaster peer scoring ***Name***_____

Instructions: Pick one roller coaster to "ride." Verify the work below for each step.

Name of roller coaster:

Is mechanical energy conserved? How do you know?

Are there calculations for the following: (yes or no)

- ***Kinetic Energy:***
- ***Potential Energy:***
- ***Mechanical Energy***
- ***Velocity:***

Do all kinetic and potential energy add up to total mechanical energy?

Are KE, PE, and ME labeled on the scale model?

Verify the calculation for velocity of the roller coaster.

Does the poster make you want to ride their roller coaster?

Roller coaster peer scoring ***Name***_____

Instructions: Pick one roller coaster to "ride." Verify the work below for each step.

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- ***Kinetic Energy:***
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- ***Mechanical Energy***
- ***Velocity:***

Do all kinetic and potential energy add up to total mechanical energy?

Are KE, PE, and ME labeled on the scale model?

Verify the calculation for velocity of the roller coaster.

Does the poster make you want to ride their roller coaster?