Teacher: Stork **Class:** Physics **Google Classroom Code:** apyvrve	Name: Section:

How can roller coasters include such huge drops, high speeds, terrifying upside down loops, and sharp turns without malfunctioning or injuring riders? Is your Mom actually right when she yells at you for wasting a ton of money by leaving one light on over night? Why can your little brother shock you after he shuffles his feet along a carpet? Why do car manufacturers purposely design the front of cars to crumple in an accident? If you are being chased across a river by vicious alligators, will you reach the bank faster if you swim straight across or at an angle? Answers to these and other vital questions await you in your upcoming physics class!

This summer homework assignment is designed to help us jump into a great year of physics. There are three parts to the assignment:

1. **Classroom vision statement**- Reflect on the kind of classroom culture you would like to create. You will think and write about the kinds of actions and discussions you hope to see in physics class this year.
2. **Rube Goldberg machine analysis**- Jump into our study of energy by analyzing crazy machines!
3. **Challenge problems**- Brush up your algebra and trigonometry skills while solving problems that will get you thinking about the physics concepts you will see this throughout the upcoming year.

This assignment should take about 2-5 hours to complete

Why should you do this?

The first few weeks of physics class will be based on this assignment. You will be expected to participate in discussions about each part of the summer homework. Additionally, the skills you will practice in parts 2 and 3 will set you up to better understand the material in our first unit of study.

Resources Available:

1. Example Classroom Vision Statement, attached
2. Background Information on Energy, attached
3. Calendar to assist in your planning.
4. Email me with questions at mstork@goldercollegeprep.org
5. Explore The Physics Classroom website for more information on the topics in parts 2 and 3: www.physicsclassroom.com
6. Assignments are posted on my google classroom. The code is apyvrve

SUMMER CALENDAR The space below is a calendar of your summer. Insert all vacations/work commitments you may have. Then, within the remaining time, write when you plan to have each section of the summer homework completed. Include any available dates your teachers are in the school to help you.

S	M	T	W	TH	F	S
14-	15	16- JUNE Q4RCPU	17	18	19	20
S	**M**	**T**	**W**	**TH**	**F**	**S**
21	22	23	24	25	26	27
S	**M**	**T**	**W**	**TH**	**F**	**S**
28	29	30	1 – JULY	2	3	4
S	**M**	**T**	**W**	**TH**	**F**	**S**
5	6	7	8	9	10	11
S	**M**	**T**	**W**	**TH**	**F**	**S**
12	13	14	15	16	17	18
S	**M**	**T**	**W**	**TH**	**F**	**S**
19	20	21	22	23	24	25
S	**M**	**T**	**W**	**TH**	**F**	**S**
26	27	28	29	30	31	1 – AUG
S	**M**	**T**	**W**	**TH**	**F**	**S**
2	**3**	**4**	**5**	**6**	**7**	**8**
S	**M**	**T**	**W**	**TH**	**F**	**S**
9	**10**	**11**	**12**	**13**	**14**	**15**
S	**M**	**T**	**W**	**TH**	**F**	**S**
16	**17**	**18**	**19**	**20**	**21**	**22**
S	**M**	**T**	**W**	**TH**	**F**	**S**
23	**24**	**25**	**26**	**27**	**28**	**29**

Part 1- Classroom Vision Statement

Physics can be a very challenging subject for many people. It will take great teamwork and support to make sure everyone gets the opportunity to succeed in physics this year. My hope is that our classroom is a place where you feel safe to take risks, empowered to tackle difficult problems, and appreciated for your efforts. At the beginning of the year, we will discuss the expectations for how students should speak and act in our class. I want to hear your input during that discussion! To get some ideas started, you will write below a "Classroom Vision Statement." The statement will be a description of how people would act and speak in an ideal physics class. Here are a few questions to think about before you write your statement:

- How should students approach difficult questions requiring rigorous conceptual knowledge and mathematical skills?
- How should the teacher and students react when someone makes a mistake or gets a question wrong?
- What are the characteristics of excellent group work?
- What are the expectations for behavior when performing lab experiments?

Your statement should be ***typed***. It should be written in paragraph format with complete sentences, and proper spelling and grammar. Write a ***minimum of 8 sentences***.

Example

Ms. Stork's physics class is a team working together to overcome challenges. When I start working on a difficult problem, I read the directions and then give it my best attempt. If I cannot solve it right away, I reread the directions, use my notes, and write down everything I know about the problem, like formulas or any variables that are defined. I ask questions of my group members, and we talk it through until all of us understand every step of the solution. If my group cannot figure it out together, we ask someone from another group. If the other group cannot figure it out either, then I raise my hand to ask Ms. Stork. While I am waiting for Ms. Stork to come over and answer my question, my group and I move on to the next problem. I am never afraid to try to answer a question, even if I am not sure that I am right. Some of my most important learning moments happen through the great discussions we had when someone made a mistake. During experiments I am always looking out for my group mates. If someone is confused I explain what we are doing before moving on, and if someone is shy I ask questions or offer to work together on part of the experiment to get that person involved. Physics class is tough, but my classmates and I are able to achieve success by working as a team.

Part 2- Rube Goldberg Machinces

Background Information

The first physics concept we study this year will be *energy*. You can think of energy kind of like money. Suppose you have a necklace worth $200. Then, you sell the necklace and have $200 cash. Then, you deposit $50 into a checking account so you have $50 in the bank and $150 cash, for a total of $200. Then you buy a $100 gift card, so you have $50 in the bank, $50 cash, and $100 in a gift card for a total of $200. During each of these transactions, you changed how the money was stored, but the total amount of money never changed. Energy works in much the same way. You can store energy a variety of different ways, and you can move energy into different storage mechanisms, but the total amount of energy stays the same. A few of the ways to store energy are listed below:

- **Kinetic energy**- energy stored in motion of a massive object. Objects have more kinetic energy if they are moving (or spinning) faster or if they have more mass (example: a bowling ball moving fast toward the pins has more energy than a golf ball rolling slowly down a bowling alley).
- **Gravitational potential energy**- energy stored in a massive object's height above a reference point. The higher up an object is located, and the more massive it is, the more gravitational potential energy it has (example: a thick textbook held 2 meters above your head has much more gravitational potential energy than a piece of paper held 2 centimeters above your head).
- **Elastic energy**- energy stored in a stretched or compressed object. This usually includes springs, rubber bands, or other stretchy objects. The further you stretch or compress it the more energy it holds.
- **Thermal energy**- energy stored in an object's temperature. Thermal energy is created when 2 objects rub together, and it can never be moved back into any other storage mechanism.
- **Chemical energy**- energy stored in molecular bonds. Includes energy stored in gasoline, rocket fuel, batteries, the food you eat, and even in your muscles!
- **Electrical energy**- energy stored in the location of charged objects. When you bring two objects with the same charge close to each other, they store energy. Electricity is based off of electrical energy.

Your task:

You will analyze the transfer of energy in a Rube Goldberg machine. A Rube Goldberg machine is a very complicated machine that has a very simple purpose, like turning the channel on the TV or pouring a cup of coffee. Watch the OK Go music video for "This Too Shall Pass" for an example of a Rube Goldberg machine: https://www.youtube.com/watch?v=qybUFnY7Y8w

You must identify at least 8 energy transfers in a Rube Goldberg machine. The transfers you identify must include a total of at least 4 energy storage mechanisms (HINT: almost every system will include kinetic energy moving to dissipated energy as 2 components of the machine rub together!). You may choose to analyze the OK Go machine, draw a picture or comic of your own machine, or actually build a machine and send a video of it to mstork@goldercollegeprep.org.

Rube Goldberg Machine Used (check one):

_____ OK Go video

_____ My own drawing (attached)

_____ My own video (sent to mstork@goldercollegeprep.org)

Energy transfers:

Example from OK Go video: A tire rolls down a ramp. As the tire rolls, its kinetic energy increases because it speeds up, and its gravitational potential energy decreases because it is moving downward and losing height.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____
_____
_____

Part 3- Challenge Problems

DIRECTIONS: The following questions are designed to be challenging. You will have to think critically in order to answer them accurately. When grading this assignment, I will be looking for evidence of effort. You must attempt all problems. If you are unable to solve a problem, write at least 3 complete sentences stating: (1) what you have already tried, (2) why that did not work, and (3) what information you would need in order to finish answering the question.

1. A golf ball and a bowling ball are both dropped from rest at a height of 20 meters above the ground. The golf ball has a mass of 25 grams, and the bowling ball has a mass of 6 kilograms.
   a. Which do you think will hit the ground first, the golf ball or the bowling ball? Why?

   b. Draw and label a diagram of the force(s) acting on each object in the space below. Ignore air resistance. Be sure to indicate the size and direction of the force(s) in your diagram.

   c. The formula for the force of gravity is $F_g = mg$, or the force of gravity (F_g) equals mass (m) times gravitational field strength (g). Earth's gravitational field strength is 9.8 N/kg. Calculate the force of gravity acting on each object. Be sure to convert all masses to kg first. (1 g = 1000 kg)

   d. Using your answer to part c, calculate the acceleration of each object. Use the formula F=ma, or force equals mass times acceleration.

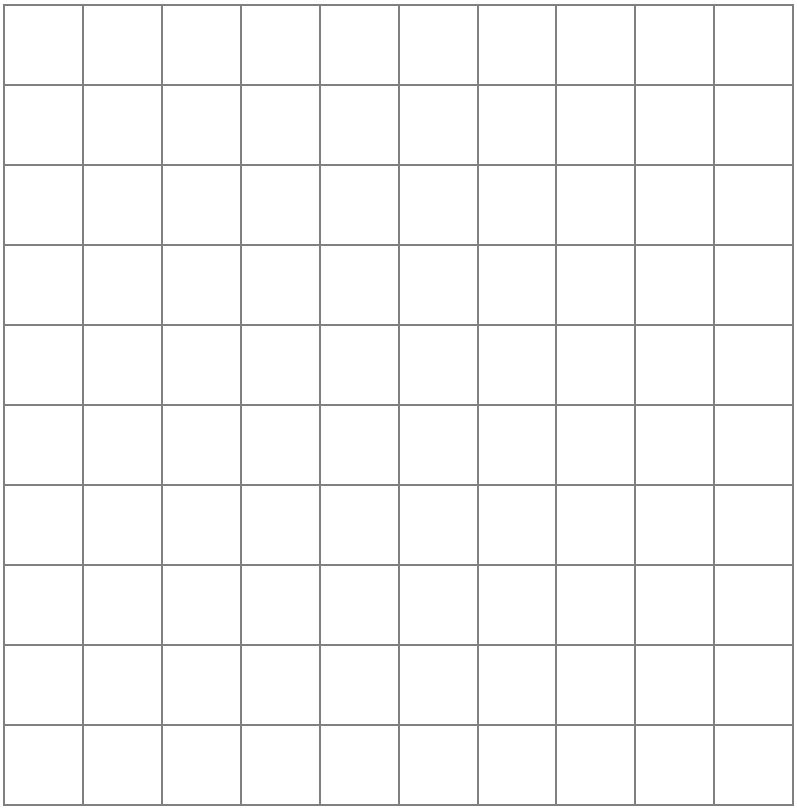
   e. Calculate the time it takes each object to hit the ground using the formula:
   $x = x_0 + v_0 t + \frac{1}{2} a t^2$: x = final position, x_0 = initial position, t = time
   v_0 = initial velocity, and a = acceleration.

   f. Was your prediction in part a correct? _____

2. Alexis applies a constant force of 8 Newtons to a box for 5 seconds and measures the change in the momentum of the box. He repeats the same procedure with the same force for 7 seconds, 10 seconds, and 15 seconds. His results are given in the table below.

Time (s)	Change in Momentum (kg*m/s)
5	40
7	56
10	80
15	120

Create a line graph of the data. Do not forget to include a title, trend line, axis labels, units, and appropriate scales.



a. What is the slope of your graph? Show your work:

b. What do you think is the significance of the slope?

c. Write an equation in slope intercept form (y=mx+b) for your graph.

d. Rewrite your equation from part 'c' so that it only includes the variables Δp (change in momentum), F (force), and t (time).

3. Three girls are standing on the South sideline of a soccer field when they all begin running toward the ball on the North sideline of the field. Maya runs 1 m/s due North. Lyra runs 200 cm/s 45^{o} East of North. Vanessa runs 10,800 m/hr 60^{o} East of North. Who gets to the soccer ball first? (Hints: Convert all velocities into m/s. 1 m = 100 cm, 1 hr = 60 min, 1 min = 60 sec. Then use trigonometry. Who has the greatest Northward component of velocity?)