Machines with Gears and Levers Lab

Name_____**Date**_____**Group**_____**Period**___

In our previous lever lab we learned that for it to balance,the torque on both sides had to be the same. The recent labs with gears, have taught you that whenever two gears intermesh, they form a gear ratio. In this lab investigation, you will work with two different size gears at a time with levers attached to each, and weights hanging from the levers in various positions. Your task is to derive a simple mathematical rule that describes a balanced gear and lever machine.
Problem: How does the gear ratio in your machine, relate mathematically to the torque of the top lever and the bottom lever?
Hypothesis :_____

_____

Variables: By the time you finish this experiment , you will need to identify the different types of variables present in this investigation. Consult your notes for definitions of the types of variables.

Independent Variables:_____

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Dependent Variables: Getting the top lever and gear to balance with the bottom lever and gear

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Controlled Variables: Same size gears and weights,weights only on one side of lever

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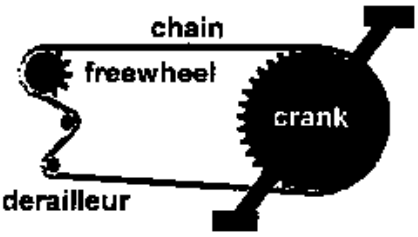
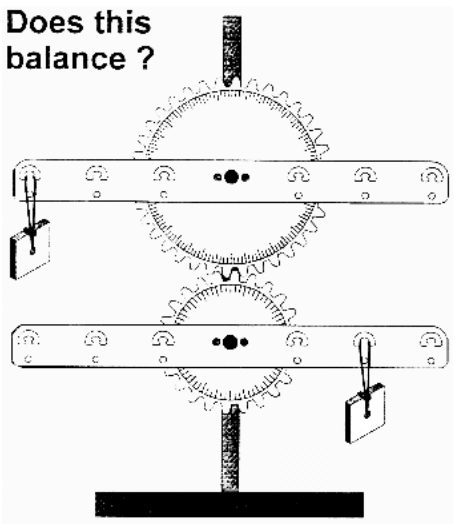
Machines use gears to change forces. The bicycle is the most efficient machine ever invented for converting human muscle power into motion. Bicycles use gears and levers to connect the muscle power from your legs to turning the rear wheel. Very little effort is needed to turn a gear that has a lever attached to it (as in the crank on a bicycle) compared to an identical gear with no lever attached. The connection is made with a chain so that the gear ratio between the crank and the freewheel can be changed while the bicycle is moving. Modern bicycles have between one and 28 different speeds. Each speed corresponds to a different gear ratio.



Some gear ratios are easier to pedal than others, while other gear ratios allow you to go faster than others.
In this experiment you will investigate what happens to forces that are applied through levers to a gear machines.

To Do the Experiment

1. Use the long thumbscrews to attach a gear and lever to the stand on the same axle. The Lever must be in the **outside** position.
2. Create machines with gears and levers similar to the one shown below at left.
3. Add weights to the levers. Move the weights around and try to find the rule which will make the machine balance. Use a different number of weights on each lever.
4. Keep the weights on just one side of the levers, and use just one of the positions for the weights on the top lever and just one of the positions for the weights on the bottom lever. Just make sure you use a different position on each lever. This will make it easier for you to come up with the rule.

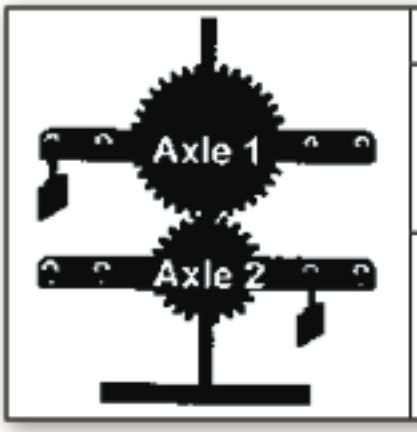


The rule must include the following things:

1. The number of weights.
2. The distance that the weight is hung from the center of the lever,
3. The number of teeth in the gear.

Does the setup at the left balance? _____

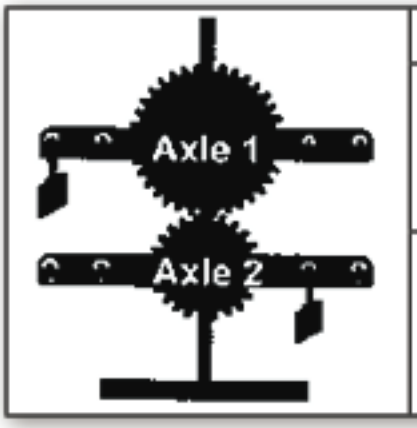
As long as it does not rotate either clockwise or counterclockwise, it's considered balanced. It does not have to be level with the table or floor.
Use the table on the back to write down your setups that you find which balance the levers. Use the combinations of two gears shown with different arrangements of weights provided they are not simply mirror images of previous setups. Place weights on just the right or left sides of the levers.



		Setups Which Balance the Lever					
Axle 1	Teeth	36	36	24	24	12	12
	Weights						
	Distance						
Axle 2	Teeth	12	24	12	36	24	36
	Weights						
	Distance						

Question 1. Determine the gear ratio formed for the top gear compared to the bottom gear. Now look at the number of weights and their position on the top lever compared to the bottom lever. The rule must include the number of teeth, weights, and distance for **axle 1** and the number of teeth, weights, and distance for **axle 2**. Write your rule in the form of an equation with an equal sign, just like the gear rule.

Use your rule to fill in the missing blanks in the table below. (hint: you may need gears with numbers of teeth other than 12,24, or 36)



		Setups Which Balance the Lever					
Axle 1	Teeth	24	24		12	96	12
	Weights	4	1	1	4		3
	Distance	3	2	1	3	1	1
Axle 2	Teeth	12		36	36	12	
	Weights		2	4		1	9
	Distance	1	1	1	3	1	1

Overall Conclusion: State if your original hypothesis was correct or incorrect using specific references from the lab to support your answer.

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Sources of Error : Identify ***two*** things that people may have done incorrectly that would have caused them to get totally different answers from the rest of the class. These errors must be unique, in other words they have not been applicable in previous labs. They must be ***new*** sources of error. Be ***specific*** about what might have been done.

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