

Pulleys and Gears Science Review

Use your science notebook to help you answer the following questions.

1. Define the following:

- a. Force
- b. Motor
- c. Torque
- d. Load
- e. Effort
- f. Work
- g. Axis
- h. Gear Train
- i. Revolution
- j. Advantage

Force - a natural power or effect that is able to change the speed or direction of something

Motor - a machine that produces motion or power for doing work

Torque - a force that causes something to rotate

Load - the amount of work done or expected to be done

Effort - amount of energy used to do something or complete work

Work - to move something into or out of a particular position

Axis - the imaginary line around which an object rotates

Gear Train - a group of gears working together to accomplish work

Revolution - a complete turn that is made by something around its centre point

Advantage - something, such as a good position or condition, that helps to make someone or something better or more likely to succeed than others

2. What are the 3 types of pulleys? Explain each one.

The 3 types of pulleys are the following:

- Fixed Pulley – most basic pulley. It consists of one attached pulley to a permanent location. It helps to lift a load by changing the direction that you have applied the force – i.e. flag pole, water well, clothesline, window blinds
- Moveable Pulley – part of the load is supported by a fixed object and the other part is supported by a person, make it easier to lift a load by making it lighter – i.e. construction cranes, modern elevators, weight lifting machines, garage doors
- Compound Pulley – combination of a fixed and moveable pulley. They can change the direction of a force as well as reduce the effort needed to lift it. For example, on sailboats,

3. What is a mechanical advantage and how do you calculate it?

- Mechanical advantage allows you to use less effort/force to do work than you would have to if you did not use the simple machine (i.e. pulley system or gear train)

$$\text{Mechanical Advantage} / \text{Load} = \text{effort}$$

4. What are the different types of gears and what do they do?

Spur Gears - Most typical type of gear, two round gears that could be the same or different sizes. They have straight teeth and they are mounted on parallel axis'. Usually used in household appliances, windup clocks, or small power tools.

Rack and Pinion - Consists of a wheel gear and a straight bar gear.

They are used to convert rotary motion into linear motion. Their most common usage is in cars as steering devices.

Worm Gear - A worm gear is a combination of a circular gear and a cylinder shaped gear that looks like a screw. These types of gears are great for generating a lot of torque (force) at slow speeds. They can be used to run conveyor belts in factories to act as a break in the

line. They are also found on the end of guitars to tighten strings and keep them from slipping out of tune.

5. What is the difference between a driven gear and a human force gear?

In human driven gear trains, the driving gear will usually have a crank attached to it so that a person can begin to generate rotary motion.

In a machine driven gear train the driving gear is attached to an axle that is attached to an engine or a motor that generates rotary motion. The gears transfer that motion through other idle gears to the output device such as a wheel on a car.

6. Explain how a gear train works.

A gear train that is designed to increase speed needs to have a large gear driving a smaller gear.

A gear train that is designed to increase force needs to have a small gear driving a larger gear. If a gear system increases force then it cannot also increase speed. Therefore, if force is increased then speed is decreased and if speed is increased then force is decreased.

7. Explain how gears work on a bicycle and how we can use them to our advantage.

8. A bicycle is a great example of a crank powered gear train. With bicycles, the gear teeth are meshed together using a chain rather than directly touching one another. In a way, they are like a pulley system and gear train combined into one! The person's legs supply the force which drives the input gear and the effort is transmitted to the output gears which are attached to the back wheel and make it spin. The driver has two options: they can choose a gear that requires very little force and makes it easier to pedal, but will only move the tire a very small amount, or they can choose a gear that requires a lot of force and makes it harder to pedal but will allow the tire to move a large amount.

9. Provide examples of both pulleys and gears in the real world and how they help us in our daily life.

Pulleys and gears can help us to do work. For example, a crane can help to lift heavy items on a construction site. They do the heavy lifting that humans cannot do. Pulleys can also make things a little more convenient for us by changing the direction of a force. We pull down a window blind string to get the windows to open up. The system allows us to stand still while creating movement somewhere else. Gears can do the same things for us. For example, the gears in a car can be used to spin the wheels at very high speeds which allow us to travel from one place to another much faster than if we had to walk. The gears in a blender allow the cutting mechanism to spin at really high speeds which can mulch up food much more efficiently and effectively than doing it by hand.

10. How do gears and pulleys affect the environment?

When we use pulley and gear systems that are driven by motors or engines we are usually harming the environment. Most motors and engines are driven using either electricity or fuels such as gasoline. By using electric motors we are affecting the environment by adding to the amount of energy consumption in our society. This means that the more we use the more that will have to be provided. Since our power plants are heavily reliant on burning fossil fuels to generate electricity, we are harming the environment by polluting the air. Gasoline driven motors also pollute the environment by releasing harmful gases into the air. The only way to lessen our impact on the environment is to reduce the amount we are relying on mechanisms that are driven by electricity or gasoline. For example, instead of driving a car to work or school, we could walk.