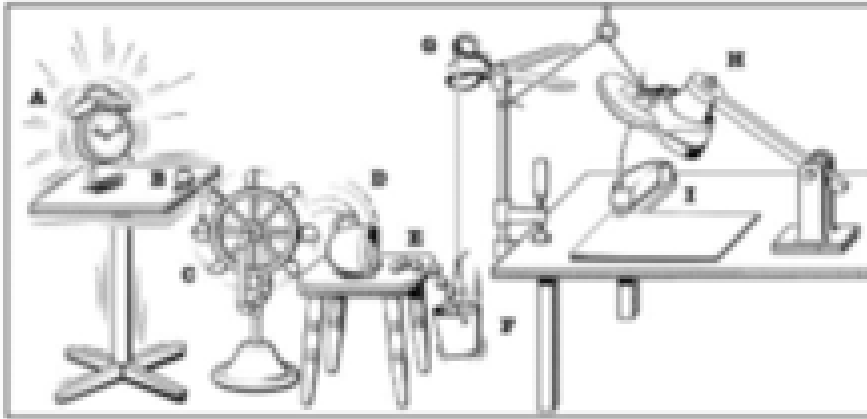


Engineering and Mechanics (Level 3)

Create Your Own Goldberg Machine

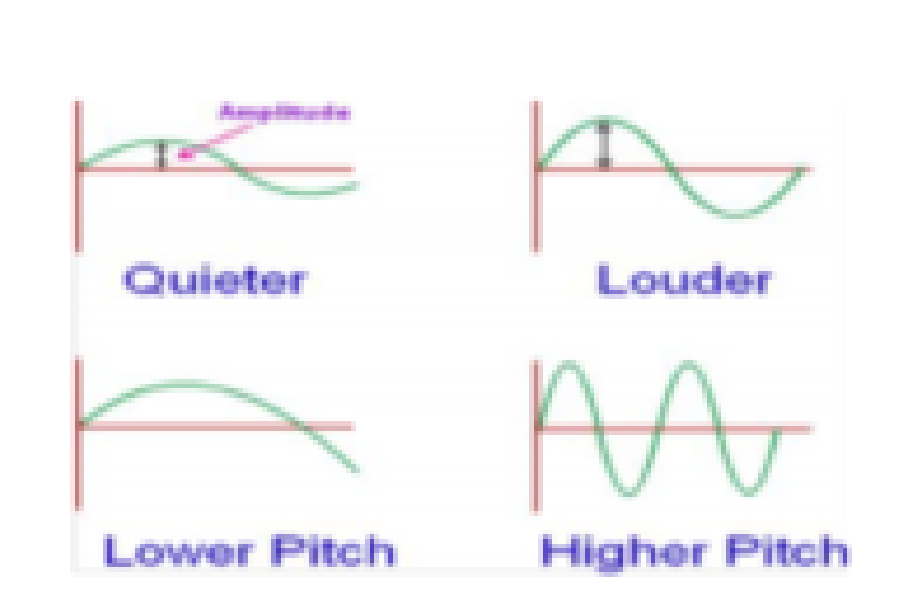
1. What are simple machines? Give 2 examples.
2. What are compound machines? Give 2 examples.
3. Which of Newton's three laws of motion do the following examples show? Write the law for each.
 - i. It is easier to push an empty bag than a full bag because the empty bag has less mass and therefore needs less force.
 - ii. When you kick a football, it does not stop moving until another player or the goal post stops it.
 - iii. When air rushes out of a balloon, the balloon flies in the opposite direction.
4. Design a Goldberg machine of your own that performs any simple task. Draw the design on paper.



5. Observe the picture given above and answer the following questions:
 - i. Is this a Rube Goldberg machine? Why or why not?
 - ii. What does this machine do?
 - iii. Which event triggers the machine?
 - iv. In Event H, the shoe remains in that position until the string is cut. Which law of motion does this show?
 - v. Give an example of kinetic energy transfer in the machine.

Managing Our Need for Speed

1. Define gravity.
2. Define friction.
3. What is density? How is it calculated?
4. What is the difference between an object's mass and volume?



5. What is inertia? Give any example.
6. What is a hypothesis? Give any example.
7. True or false:

A motorcycle going up a rocky road will move fast and smoothly due to increased friction, which propels it forward faster than if it was traveling on a paved road."

8. You want to conduct an experiment to find out what happens to an object that is in a state of inertia when it is hit by a fast-moving object. Write your hypothesis for this experiment.
9. Choose the right option: which traffic signs would you place in the following situations:
 - a. A busy road with cars and trucks passing.
 - b. A road next to a school
 - c. A dangerous road where accidents always happen because of speeding vehicles.
 - d. A busy road in a residential area next to a shopping center to which people often walk.

Options: zebra/pedestrian crossing; speed limit sign; school zone sign; traffic signals

10. Design a banner to be put up on a busy main road to raise awareness about car accidents or the need to drive carefully.
11. Explain the concepts of thrust, drag and lift. How do these affect the movement of a paper plane?
12. How would you design a paper plane so that it defies gravity? (i.e., it flies for a long period of time) Explain using the concepts of thrust, drag, and lift.
13. Why do some objects sink while others float?
14. True or false: the mass of an object alone determines whether it floats or sinks in water.
15. Explain Archimedes principle of displacement with an example (i.e., experiment).
16. What is the relationship between the mass of an object and its gravitational pull? OR Which object will fall faster if thrown from a height - a bowling ball or a can of soda? Why?

The Magic of Magnets

1. What are the main properties of magnets?
2. Identify three materials that are magnetic and three that are non-magnetic.
3. What are the two poles of a magnet called, and how do they interact with each other?
4. Compare the properties of magnetic and non-magnetic materials. Provide examples of each.
5. Explain why a freely suspended magnet always points in the north-south direction. [OBJ]
6. Describe a real-world application of magnetic forces and explain its importance.
7. Propose an innovative use of magnets in a field of your choice.

Fast... Faster... Fastest!

1. What is speed?
2. What is the difference between periodic and non-periodic motion?
3. Differentiate between uniform and non-uniform motion. Provide examples of each.
4. What is rectilinear motion? Give two examples.
5. Describe circular motion and provide two examples. [OBJ] A cyclist covers a distance of 20 kilometers (about 12.43 mi) in 1 hour and 15 minutes. What is the cyclist's speed in kilometers per hour?

6. How can friction affect the speed of an object?
7. How can you identify uniform motion on a distance-time graph?
8. Imagine you are designing a new vehicle. What factors would you consider making it the fastest possible?
9. How would you explain the concept of speed to someone who has never studied it before?

Fun With Machines

1. What is the difference between a simple machine and a compound machine? Give two examples of each.
2. Define contact force and non-contact force. Give an example of each from your daily life.
3. Explain friction and its types. Why is friction considered a necessary evil?
4. How is pressure related to force? Write the formula for calculating pressure and give an example.
5. If a force of 50 Newtons is applied on an area of 2 square meters, what is the pressure exerted? Show your calculation.
6. How do liquids and gases exert pressure? Provide an example for each.
7. Explain how a lever works and provide an example of a lever in everyday life.
8. If you could create a Rube Goldberg machine to solve any real-world problem, what would it be and how would it work?
9. Can you think of an everyday activity that would be impossible without friction? Explain why.