

Science Eight

Unit Four:

Mechanical Systems

Name:

Date Received:

Date In:

Unit D: Mechanical Systems

Outcome #1- Illustrate the development of science and technology by describing, comparing and interpreting mechanical devices that have been improved over time

| Essential Outcomes (Ideas I must understand) | My Understanding | | | |
|---|------------------|---|---|---|
| <ul style="list-style-type: none"> investigate and provide examples of mechanical devices used in the past to meet particular needs (<i>e.g., describe and interpret devices developed to move water or be moved by water, such as the Persian wheel, Archimedes' screw, mill wheel</i>) | 1 | 2 | 3 | 4 |
| <ul style="list-style-type: none"> illustrate how a common need has been met in different ways over time (<i>e.g., development of different kinds of lifting devices</i>) | 1 | 2 | 3 | 4 |
| <ul style="list-style-type: none"> illustrate how trial and error and scientific knowledge both play a role in technological development (<i>e.g., development of aircraft</i>) | 1 | 2 | 3 | 4 |

Outcome #2- Analyze machines by describing the structures and functions of the overall system, the subsystems and the component parts

| Essential Outcomes (Ideas I must understand) | My Understanding | | | |
|---|------------------|---|---|---|
| <ul style="list-style-type: none"> analyze a mechanical device, by: <ul style="list-style-type: none"> describing the overall function of the device describing the contribution of individual components or subsystems to the overall function of the device | 1 | 2 | 3 | 4 |
| <ul style="list-style-type: none"> identify the source of energy for some familiar mechanical devices | 1 | 2 | 3 | 4 |
| <ul style="list-style-type: none"> identify linkages and power transmissions in a mechanical device, and describe their general function (<i>e.g., identify the purpose and general function of belt drives and gear systems within a mechanical device</i>) | 1 | 2 | 3 | 4 |

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the success of any business and for the protection of the interests of all parties involved.

2. The second part of the document outlines the various methods and techniques used to collect and analyze data. It describes the different types of data that can be collected and the various ways in which this data can be analyzed to identify trends and patterns. It also discusses the importance of ensuring that the data is accurate and reliable.

3. The third part of the document discusses the various factors that can affect the accuracy and reliability of the data. It identifies the different sources of error and the various ways in which these errors can be minimized. It also discusses the importance of ensuring that the data is kept up-to-date and that it is regularly reviewed and updated.

4. The fourth part of the document discusses the various ways in which the data can be used to make decisions and to plan for the future. It describes the different types of decisions that can be made and the various ways in which the data can be used to inform these decisions. It also discusses the importance of ensuring that the data is used in a responsible and ethical manner.

5. The fifth part of the document discusses the various ways in which the data can be used to improve the performance of the business. It describes the different types of performance metrics that can be used and the various ways in which the data can be used to identify areas for improvement. It also discusses the importance of ensuring that the data is used in a way that is consistent with the overall goals and objectives of the business.

6. The sixth part of the document discusses the various ways in which the data can be used to improve the customer experience. It describes the different types of customer feedback that can be collected and the various ways in which this feedback can be used to improve the customer experience. It also discusses the importance of ensuring that the data is used in a way that is consistent with the overall goals and objectives of the business.

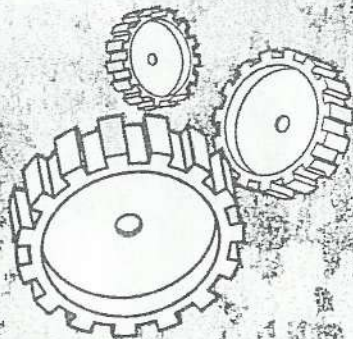
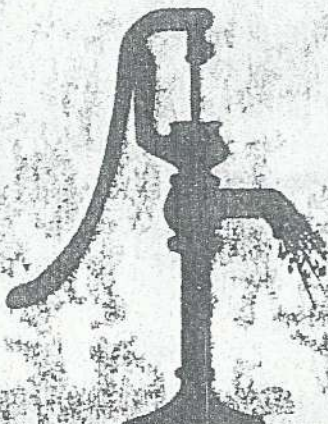
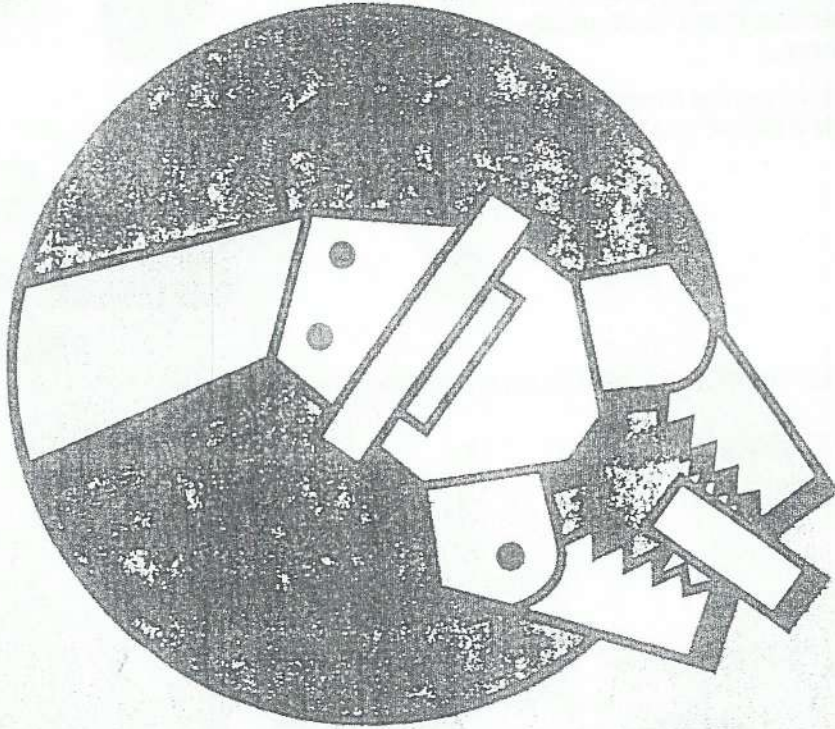
7. The seventh part of the document discusses the various ways in which the data can be used to improve the financial performance of the business. It describes the different types of financial metrics that can be used and the various ways in which the data can be used to identify areas for improvement. It also discusses the importance of ensuring that the data is used in a way that is consistent with the overall goals and objectives of the business.

8. The eighth part of the document discusses the various ways in which the data can be used to improve the overall performance of the business. It describes the different types of performance metrics that can be used and the various ways in which the data can be used to identify areas for improvement. It also discusses the importance of ensuring that the data is used in a way that is consistent with the overall goals and objectives of the business.

9. The ninth part of the document discusses the various ways in which the data can be used to improve the overall performance of the business. It describes the different types of performance metrics that can be used and the various ways in which the data can be used to identify areas for improvement. It also discusses the importance of ensuring that the data is used in a way that is consistent with the overall goals and objectives of the business.

10. The tenth part of the document discusses the various ways in which the data can be used to improve the overall performance of the business. It describes the different types of performance metrics that can be used and the various ways in which the data can be used to identify areas for improvement. It also discusses the importance of ensuring that the data is used in a way that is consistent with the overall goals and objectives of the business.

MECHANICAL SYSTEMS



GRADE
TOPIC FOUR

8

NAME

Part A: What is a mechanical device?

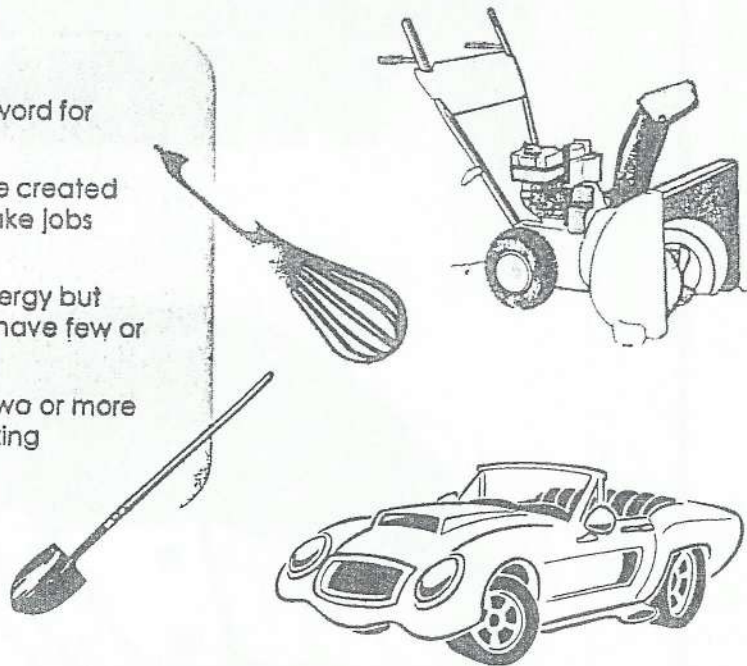
Mechanical Device

"Mechanical device" is the scientific word for "machine."

Machines are things that humans have created or built to help them do work and make jobs easier.

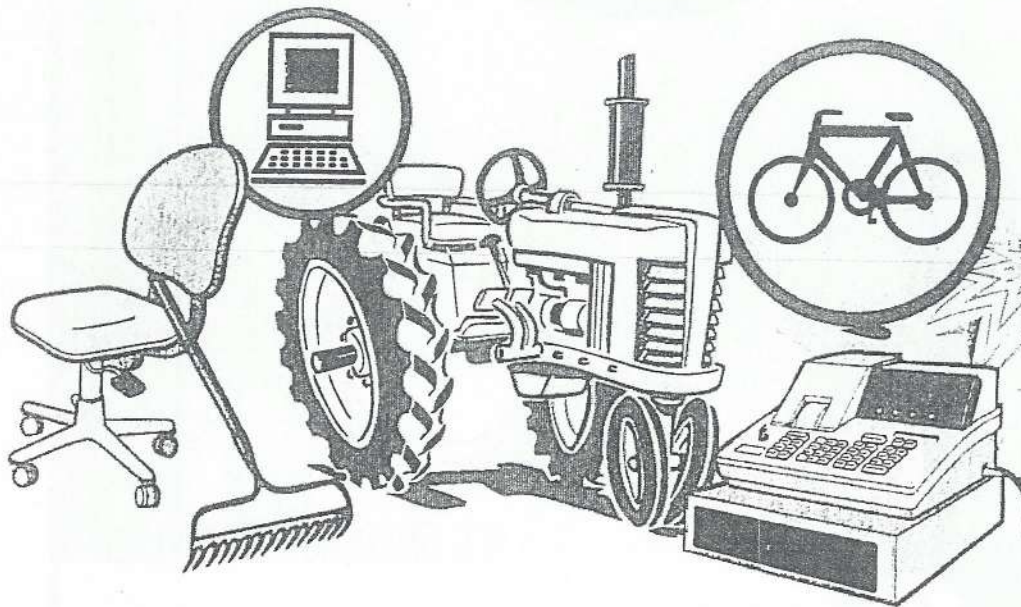
Simple machines are tools that use energy but make work easier. These tools usually have few or no moving parts.

Complex machines are made up of two or more interconnected simple machines working together.



1. Put a check mark beside the six machines below.

- | | | | |
|-----------------------------|---------------|-----------------------------|------------|
| a. <input type="checkbox"/> | Rake | b. <input type="checkbox"/> | Tractor |
| c. <input type="checkbox"/> | Blanket | d. <input type="checkbox"/> | Computer |
| e. <input type="checkbox"/> | Chair | f. <input type="checkbox"/> | Can opener |
| g. <input type="checkbox"/> | Book | h. <input type="checkbox"/> | House |
| i. <input type="checkbox"/> | Cash register | j. <input type="checkbox"/> | Bike |



The Language of Machines

| | |
|----------------------------|---|
| Interconnected: | Parts joined together to make a machine or part of a machine. |
| Components: | The parts of a machine. |
| Force: | The power or strength of the energy that a machine uses or produces. |
| Magnitude of Force: | The amount of force used or produced by a machine. |
| Direction of Force: | The way in which energy goes or moves into or out of a machine. |
| Transmit Energy: | When a machine sends, passes on, or spreads energy from one place to another. |
| Modify Energy: | When a machine changes the amount or type of energy. |

Explain which definition(s) best matches each of the examples below.

Hint: For some examples, there may be more than one correct answer.

1. An egg beater has two sets of blades, a turning wheel and a handle.

2. A pair of scissors has two blades that are held together by a fulcrum in the middle.

3. An electric can opener changes the energy of electricity into mechanical energy (the energy of movement) as it turns a can around against a sharp edge.

4. A hammer drives a nail into a piece of wood.

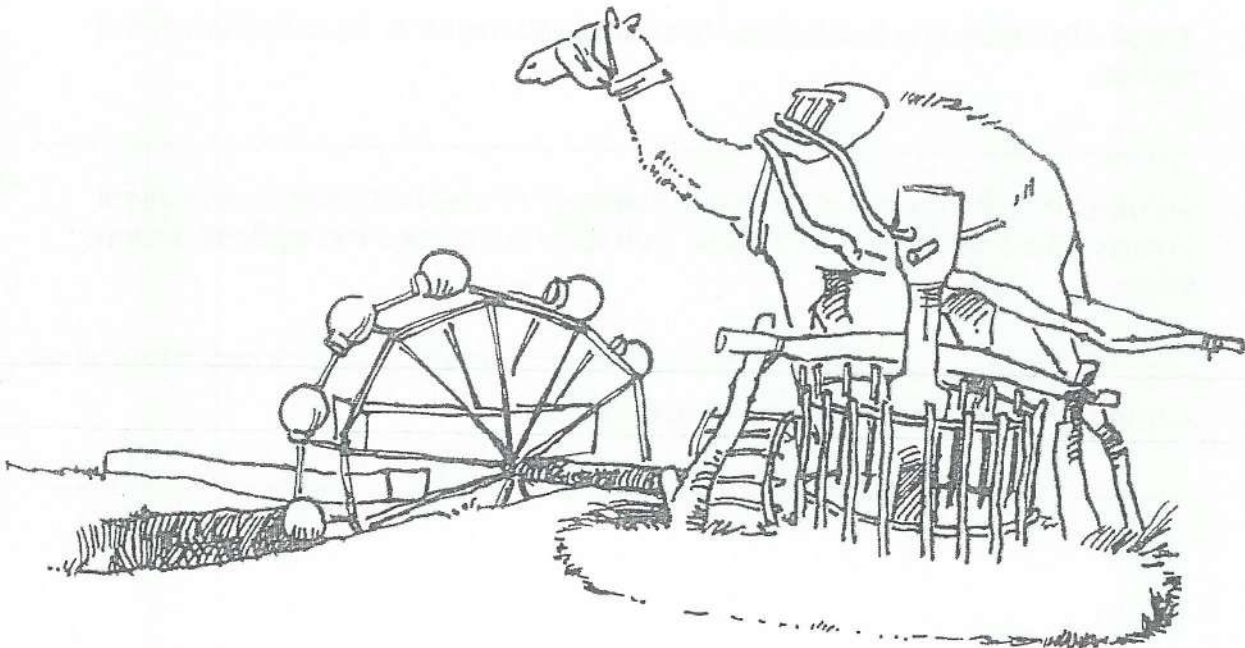
Part B: How have mechanical devices been used to supply people's water?

As you know, water is one of our most basic needs. It is necessary for our survival. The following devices were used in the past to help communities get the water they needed.

Persian Wheel

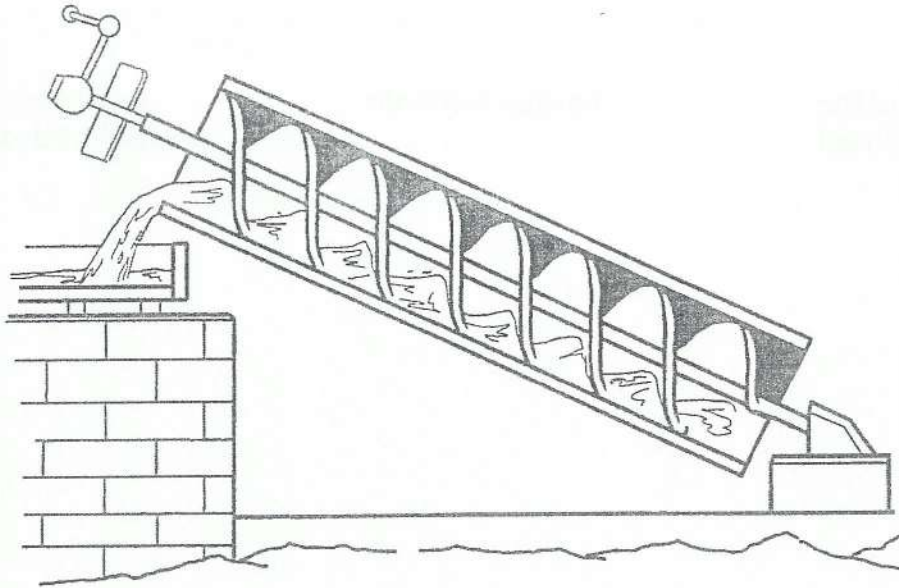
Before pumps were invented, gravity (the Earth's force that pulls everything downwards) was used to make water travel to where it was needed. The only problem was, the water had to be up high before it could flow down with the force of gravity. People created large tanks (containers) that were kept high above the community and then water would be let out of the tanks to flow down through pipes to where it was needed.

To fill the tanks, people used a mechanical device called the **Persian Wheel** (also called a *sakia*). The Persian Wheel had a long rope with buckets tied around it that would collect water from the source (well, river, etc.) and lift it up. Animals such as cows or camels were harnessed to the wheel and used to move it around and around. In this way, the large tanks were filled with the buckets of water collected by the Persian Wheel.



Archimedes Screw

In later times, Archimedes (a Greek scientist and mathematician) invented a faster, easier and more reliable way to move water. The mechanical device he invented was made of a long tube with a large screw inside. One end of the tube would be put under the water and the other end would be placed in a container to collect the water. Since water will always flow from an area where there is a lot to where there is less, the end of the tube in the water would automatically begin to fill with water. The grooves (lines cut into the sides) of the screw would fill with water and, as the screw was turned, the water would be pushed around and around up the grooves to the top of the screw. In this way, water would be pushed through the tube and out into the storage container.



Sort and recopy the following information into the chart below to show how the Persian Wheel and the Archimedes Screw had similarities and differences.

- parts move in a circular motion
- uses buckets
- mechanical device
- is the step before gravity is used as a tool

- works against gravity to lift water up
- uses a piece of metal with grooves
- transports water for storage
- supplied people with a necessity

- moves water most efficiently
- uses a long rope
- powered by animals
- used long ago

Features of the Persian Wheel

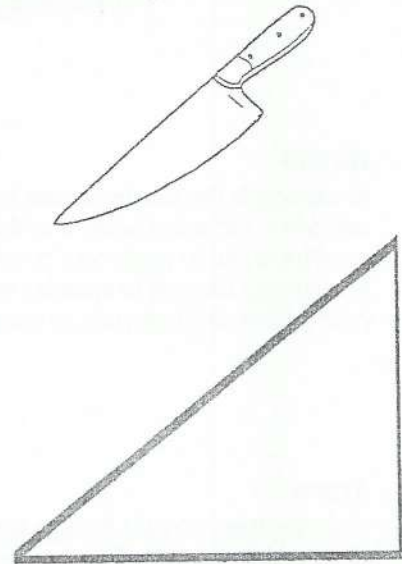
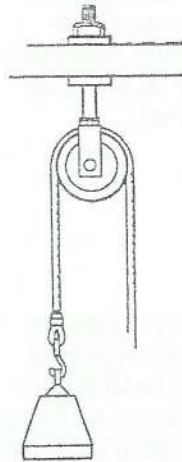
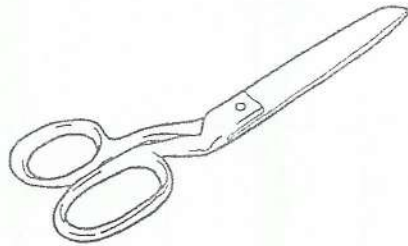
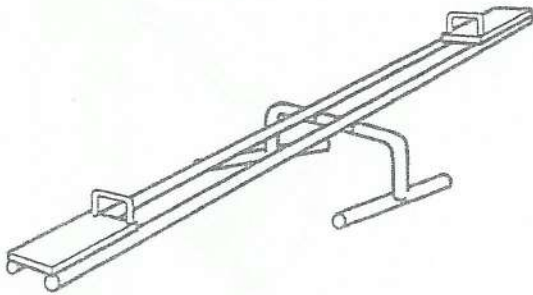
Features of both

Features of the Archimedes Screw

Part C: What are simple machines?

Simple Machine

A simple machine is any tool or device that is made up of only one basic machine.



Lever

Levers have been used since early times. A lever is a flat bar or plank that can move over a fixed point. Levers are used to magnify (make bigger) the amount of effort a person needs to use to do things like pulling out nails, opening bottles and cutting paper.

Effort force is how hard the person is pushing down on the end of the lever.

Load force is how heavy the large boulder is that the lever is trying to move (how much it is pushing down on the lever).

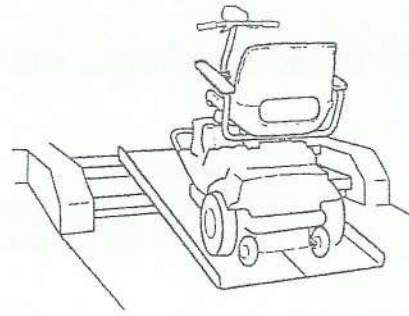


Lever is the flat bar or plank.

Fulcrum (or pivot) is the small boulder the lever is resting on or pushing against.

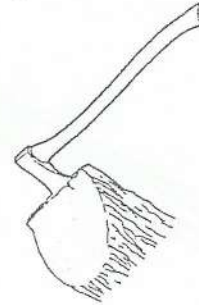
Inclined Plane

An inclined plane is also called a "ramp." A ramp makes it easier to move objects by sliding or rolling them slowly up or down instead of lifting them straight up or down.



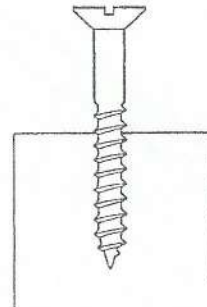
Wedge

A wedge is the same shape as a ramp but it is used in a different way. The thin edge of the wedge is put in position on an object and then the object begins to spread apart as the wider part of the wedge gets pushed into it.



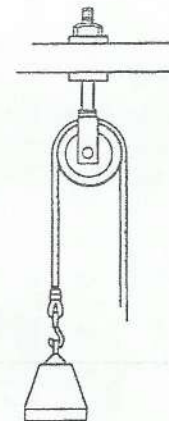
Screw

A screw is a cylinder (long tube-shaped piece) that has a long groove cut in a spiral running around and around it. You learned earlier that screws can be used to transport water, but they can also be used to push into wood more easily and the grooves "grab on" to hold it in place.



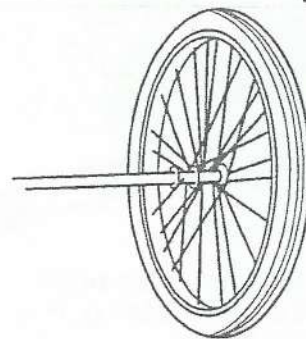
Pulley

A pulley is made of a wire, rope or cable that moves along a groove in a wheel. Pulleys are used to lift things. The heavier the load, the more pulleys are put together to do the job.



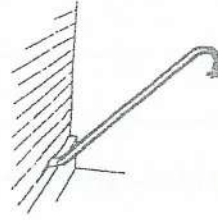
Wheel and Axle

A wheel and axle is made up of two different-sized wheels (round objects) that turn together. The bigger wheel takes a longer time to turn, but it pushes the smaller wheel around much faster. In this way, less force needs to be used to turn whatever is attached to the smaller wheel.



Decide which kind of simple machine is used to do work in each of the following mechanical devices.

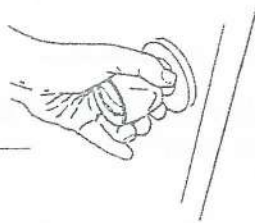
1. Crowbar _____



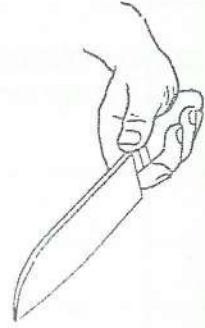
2. Flag Pole _____



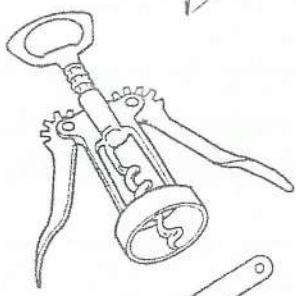
3. Doorknob _____



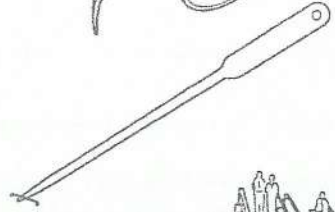
4. Knife _____



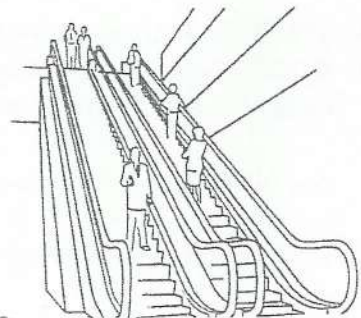
5. Corkscrew _____



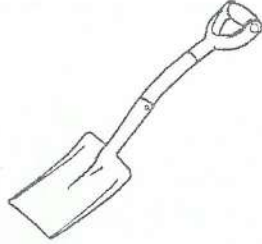
6. Staple Remover _____



7. Escalator _____



8. Spade _____



9. Which of the simple machines can be used to help people to lift heavy objects?

10. How do machines help people do work?

11. If a machine already exists that can be used to do a job, why would people bother to invent another one?

12. Describe a simple machine that you use (or see used) on a daily basis. Explain how it works and how it makes it easier to do a task.

13. Imagine you are trying to get a couch from a moving van up to a fifth-floor apartment. How many different ways (using simple machines) can you think of to get the couch to where it needs to be?

Part D: How does trial and error learning play a role in the invention of mechanical devices?

Trial and Error

Trial and error is a term used to describe a way of finding out the best way to do something. It's trying one or more ways and learning not to repeat the same mistakes but build on the things that worked well. In other words, keep trying different things until one works!

The Aircraft—A Product of Trial and Error Design

Some of the earliest plans for making machines of flight were created by Leonardo Da Vinci. Many people used his ideas as a springboard to create plans and models of their own. Time after time, crafts were built and tested; some bounced along the ground, others rose into the air for a short time before crashing. Most models of flight were based on the study of birds. It was just a matter of creating something that worked like a bird, which was difficult because you can't see what is happening inside a bird as it flies. It was also difficult to understand the challenges of moving through the air (wind currents) because up until then, man lived firmly on the ground. Eventually, after many changes to plans based on mistakes made along the way, the Wright brothers were finally able to build a craft that would fly.

Considering how the airplane was created through trial and error, it would be easy to imagine that a submarine was the product of similar trial and error work. Explain why this is likely true, using evidence similar to that described for the airplane.

Optional: Research the invention of the submarine and see if your predictions were close!

Part E: How do complex machines work?

Complex Machine

A complex machine is a mechanical device that is made up of a number of different simple machines working together.

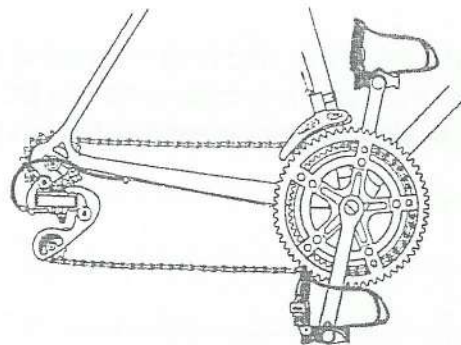
System

The whole complex machine—all the parts working together.



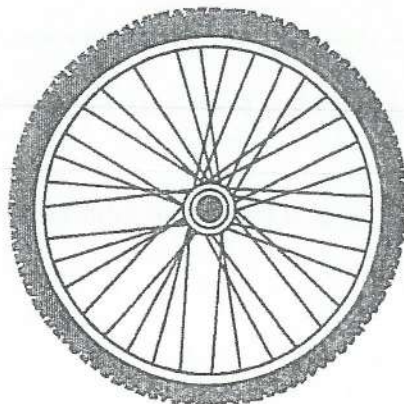
Subsystem

A part of the whole machine that includes certain parts working together to do a certain job. Subsystems working together make up the whole system.



Components

The individual parts (usually simple machines) that make up subsystems.



Gears are circles of different sizes that have teeth all around the outside edge. When gears are linked together by a chain, they are called **sprockets**.

As the bigger **sprocket** turns, the teeth stick into the holes in the chain and pull the chain around in a circle. The smaller wheel attached at the back turns around much faster because there are fewer teeth. In this way, less force needs to be used to turn bike wheels.

Brake handles act as levers so you only have to push a little to get them to react a lot.

The brake handle is attached to the **brake** that pushes against the wheel causing **friction** (rubbing) that slows the bike down.

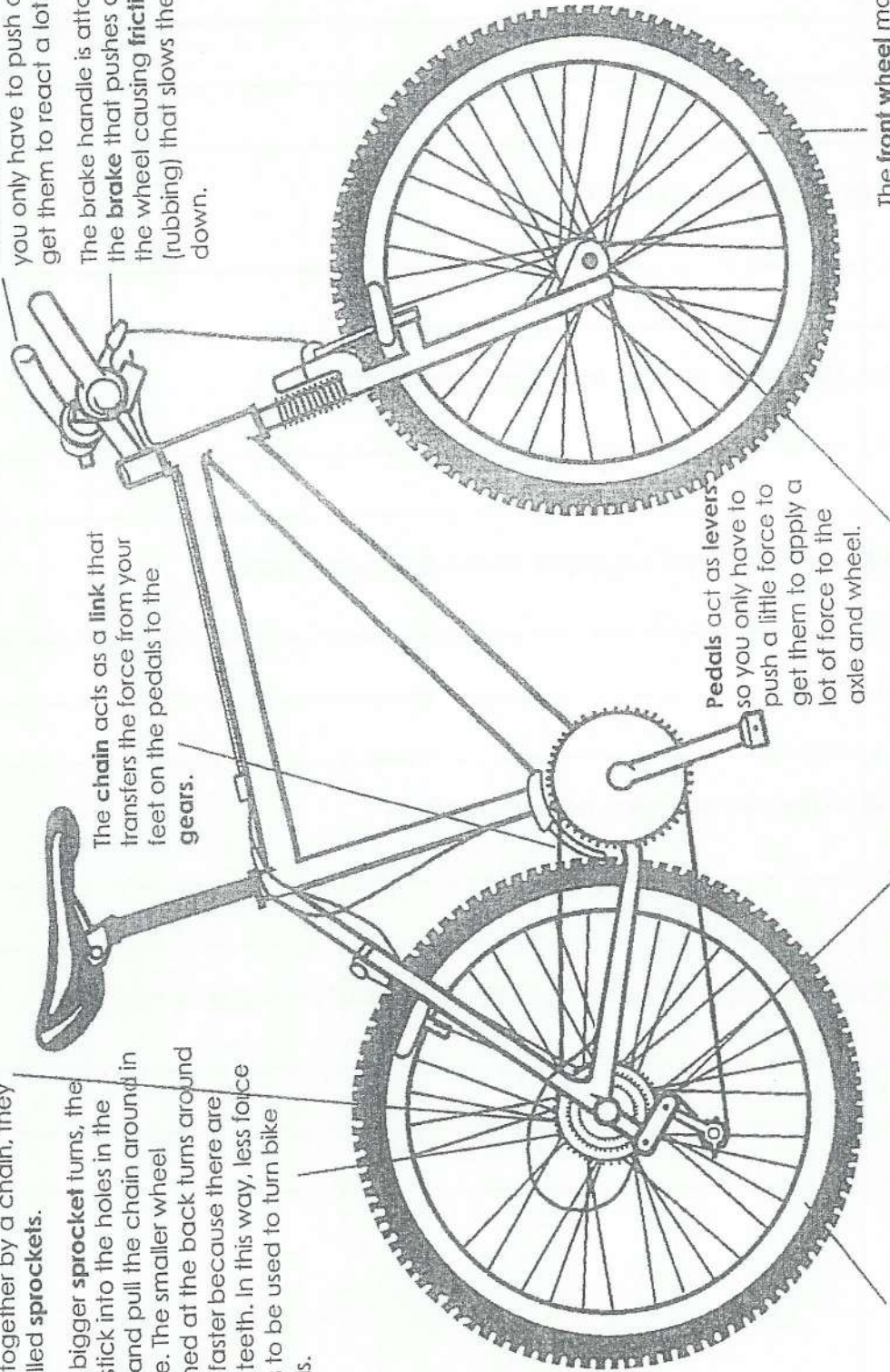
The **chain** acts as a **link** that transfers the force from your feet on the pedals to the **gears**.

Pedals act as levers so you only have to push a little force to get them to apply a lot of force to the axle and wheel.

Wheels have **axles** (cylinders) running through them so the **force** from the pedal makes the axle move quickly and the wheel it is attached to rolls in its large circle.

The **back wheel** powers the bike because the small, fast-moving **sprocket** is attached to the axle that is attached to the wheel.

The **front wheel** moves because it is being pushed from behind, and wheels are always ready to roll.



1. What makes a bike move?

2. What makes a bike slow down?

3. What is the source of energy that starts a bike moving?

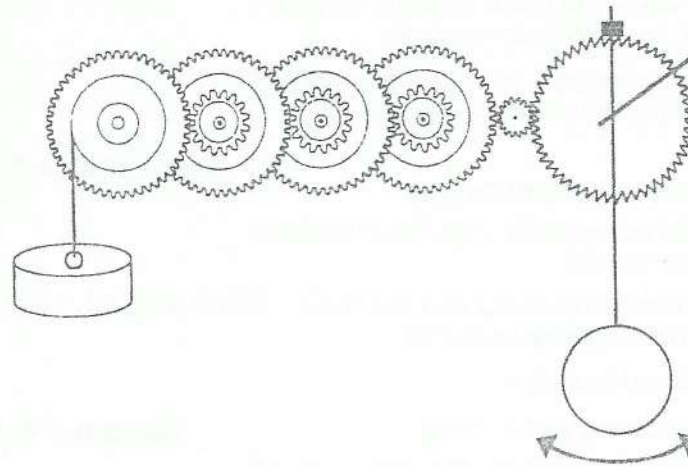
4. Which parts of a bike work together as a subsystem? How?

5. What is one of the component parts of a bike?

6. What is the most surprising thing you learned about how a bike works?

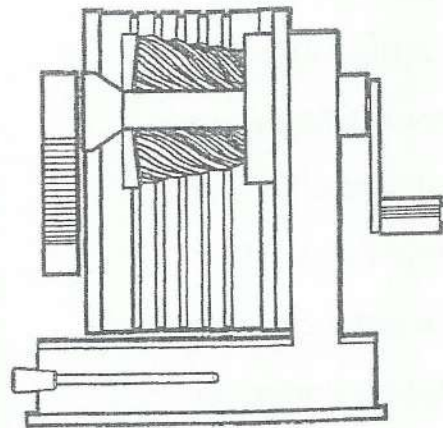
Analyze each of the diagrams below and label parts that you recognize as gears, gear trains, sprockets, wheel and pinion systems, driver gears, follower gears, and simple machines.

Inside of a Grandfather Clock



Bicycle

Inside of a Pencil Sharpener



Part G: What are mechanical advantage, speed ratio and efficiency?

Work and Force

The scientific meaning of work is that work happens when a force acts on an object to make it move. Without movement, it is not considered to be work.

$$\text{Work} = \text{Force} \times \text{Distance}$$

Work input is how much work is put into the machine and **work output** is how much work is done by the machine.

$$\text{Work input} = F_{\text{input}} \times d_{\text{input}}$$

How to calculate Work Input and Output

Work input is calculated by multiplying the input force used by the distance moved.

Work output is calculated by multiplying the force output (created) and the distance output.

$$\text{Work output} = F_{\text{output}} \times d_{\text{output}}$$

Note: Work is measured in Joules.

How to calculate Efficiency (Total Work)

Total work is calculated by dividing the work output by the work input (how much energy was used compared to the distance moved).

$$\text{Efficiency} = \frac{\text{Work output}}{\text{Work input}} \times 100$$

Calculate **work input**, **work output**, and **efficiency**:

- | | | |
|---------------------|--------------|-------|
| 1. Input Force: 3N | Work Input: | _____ |
| Output Force: 6N | Work Output: | _____ |
| Input Distance: 12m | Efficiency: | _____ |
| Output Distance: 4m | | |
| 2. Input Force: 8N | Work Input: | _____ |
| Output Force: 16N | Work Output: | _____ |
| Input Distance: 18m | Efficiency: | _____ |
| Output Distance: 3m | | |
| 3. Input Force: 1N | Work Input: | _____ |
| Output Force: 1N | Work Output: | _____ |
| Input Distance: 10m | Efficiency: | _____ |
| Output Distance: 5m | | |

Part F: What are gears and how do they work?

Gear

A gear is an object that looks like a wheel with teeth around the rim (outside edge).

Gear Train

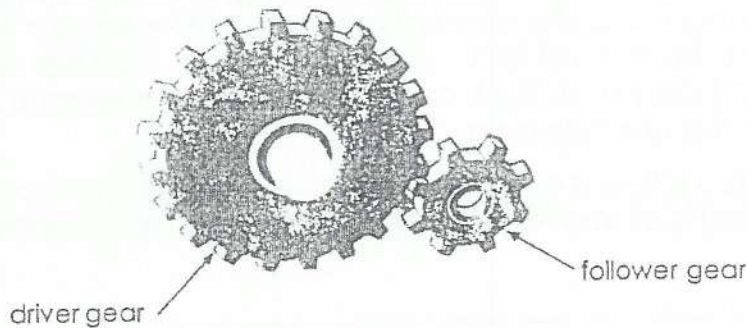
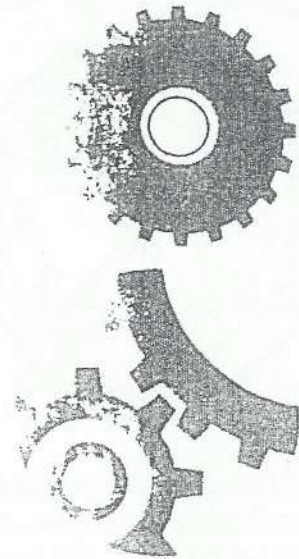
A gear train is when two or more gears are used together. When gears work together, the teeth of the first gear fit in between the teeth of the other gear, so when one turns, both turn.

Driver Gear

The driver gear is the gear that is in front of a gear train. The driver gear turns because it is attached to a handle or a motor.

Follower Gear

The follower gear comes after the driver gear. The follower gear moves because the driver gear is moving and the teeth of the two gears "mesh" together.



Use the information above to help you fill in the blanks in the passage below.

A gear is shaped like a 1 and has 2 around the 3.

When two or more 4 work together in a 5, the

6 of the different gears 7 together. The front gear in a

8 is called the 9 gear and the next

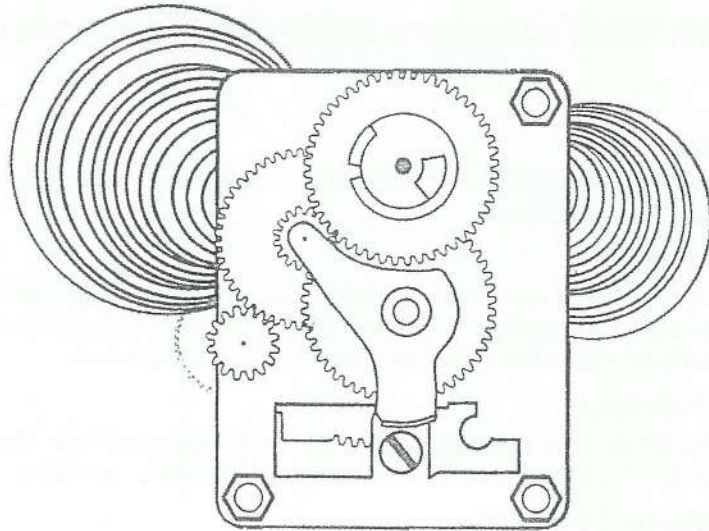
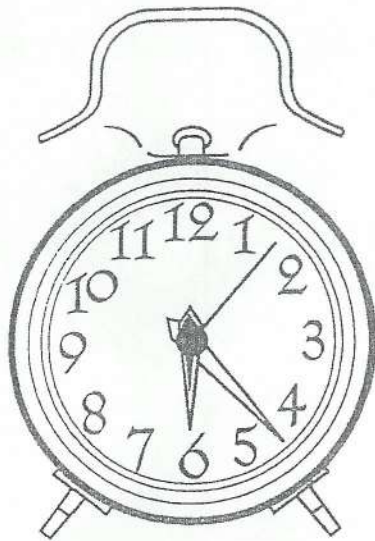
gears are called 10 gears. The 11 gear usually

moves because it is attached to a 12 or a 13. The

14 gears move because the 15 of the gears

16 together and when the 17 gear moves the other gears

do too.



The inside of a clock has a number of different-sized gears. There is usually one driver gear connected to the power source (wind-up or battery) and then a follower gear for the hour hand, a follower gear for the minute hand and a follower gear for the second hand. As you know, the second hand moves the fastest, then the minute hand and the slowest is the hour hand. Think back to what you first learned about gears on bikes and answer the question below.

The inside of a clock has three follower gears: one large, one medium and one small. Which gear do you think likely runs (moves) each of the different clock hands? Explain how you know.

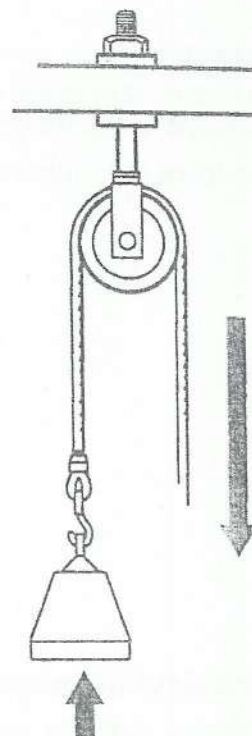
Gears often work together inside machines to connect different parts to the source of energy that starts the movement (e.g., a turning handle or a motor). As you learned about bikes, when gears are linked together by a chain, they are called sprockets. When gears are directly linked together, they are often called a wheel and pinion system (the wheel being the driver and the pinion being the follower).

Mechanical Advantage

Mechanical advantage is how much more power or force you get by using a machine. Machines "multiply" force.

E.g., You can lift more weight using a pulley system.

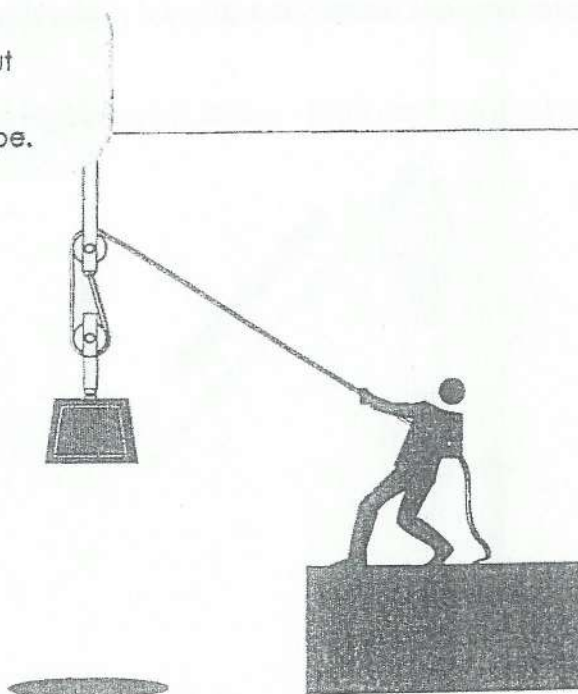
Note: How a machine is made and how many gears and pulleys there are, determines how much mechanical advantage it gives you.



Input Force

Input force is how much force (or power) you put into a machine.

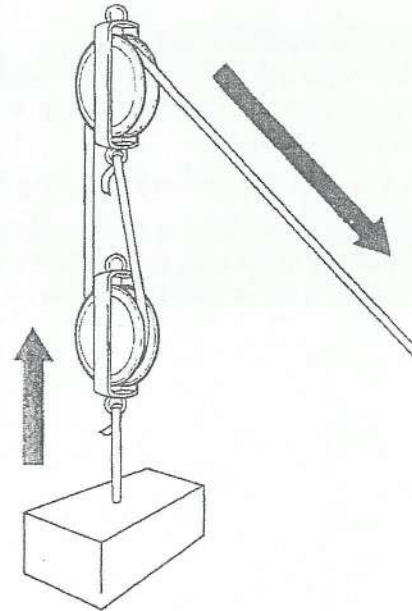
E.g., The power or force of you pulling on the rope.



Output Force

Output force is how much force (or power) the machine puts out in the end.

E.g., The force with which the weight is lifted.



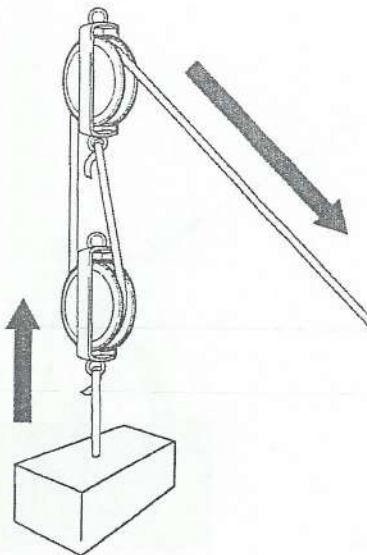
How to calculate Mechanical Advantage

Mechanical advantage can be calculated by **dividing** the total **output force** by the total **input force**. Remember, both force amounts must be in the **same units**.

Note: Force is usually measured in Newtons (N).

$$MA = \frac{F_{\text{output}}}{F_{\text{input}}}$$

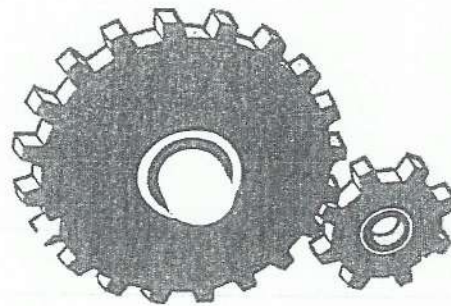
1. Calculate the mechanical advantage of the following mechanical devices:



Output Force = 8N

Input Force = 4N

Mechanical Advantage =



Output Force = 24N

Input Force = 8N

Mechanical Advantage =

Speed Ratio

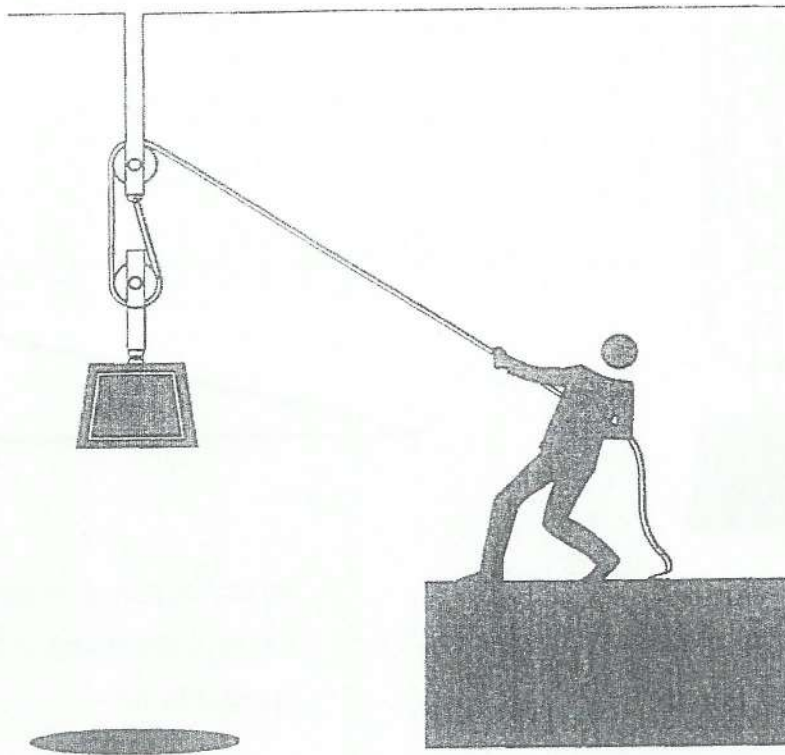
The speed ratio is how much faster you can do a task (job) by using a machine. Machines reduce the amount of time it takes to do the same amount of work and move the same distance.

E.g., How much faster you can lift a weight using a pulley.

Input Distance

Input distance is the length along which force is put in (for how long).

E.g., How far you pull the rope down.



Output Distance

Output distance is how far the device moves in total.

E.g., How far the weight moves upward.

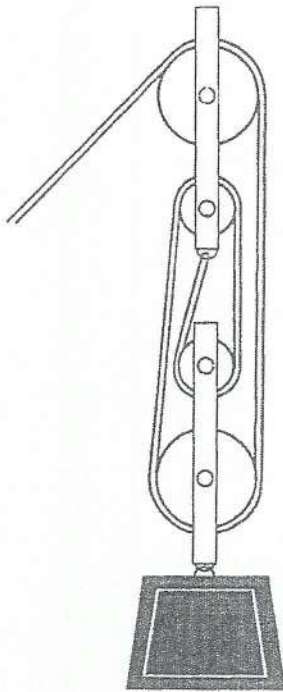
How to calculate Speed Ratio

Speed ratio calculations work opposite to mechanical advantage. It is calculated by **dividing** the total **input distance** by the total **output distance**. Remember, both distance amounts must be in the **same units**.

Note: Distance is usually measured in meters (m).

$$SR = \frac{D_{\text{input}}}{D_{\text{output}}}$$

1. Calculate the speed ratio of the following mechanical devices.



Input Distance = 4m
Output Distance = 2m
Speed Ratio =



Input Distance = 6m
Output Distance = 2m
Speed Ratio =

2. Did you notice that more work was needed to move less distance in each case? That's because the mechanical devices makes the work easier, you just have to do it for longer! Can you think of a time when this wouldn't be an advantage?

Mechanical Efficiency

Mechanical efficiency is a measure of how well a machine uses energy. It is important to know because it helps you decide whether the amount of energy you have to put into it is worth what you get out.

How does friction affect efficiency?

Friction (the amount of force working against the machine) has the biggest effect on efficiency. Friction includes things like wind blowing against a machine, parts rubbing against the ground, and inner parts "sticking" from lack of lubrication.

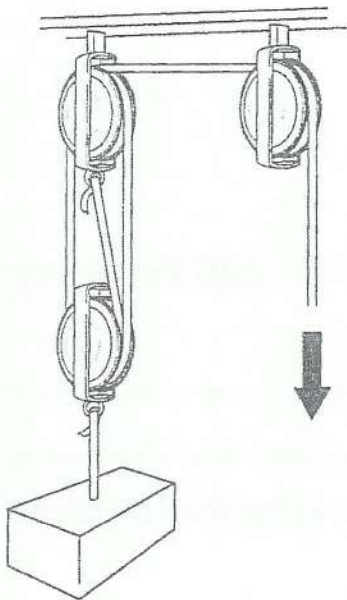
Another way to calculate efficiency

Efficiency is also calculated by dividing the mechanical advantage (the added force of using the machine) by the speed ratio (how far you get compared to how hard you work) and then multiplying by 100 to get a percent.

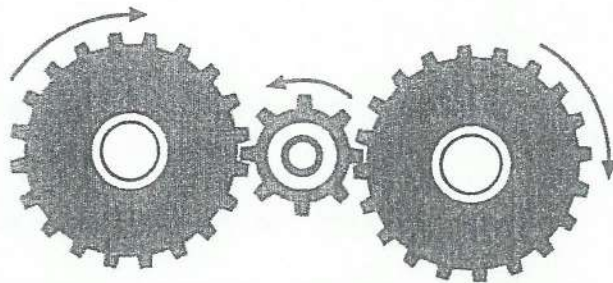
$$\text{Efficiency} = \frac{\text{MA}}{\text{SR}} \times 100$$

Note: Efficiency is described in percent (%) because it is being compared to a situation where no energy was wasted (that would be 100% efficient).

1. Calculate the efficiency of the following mechanical devices:



Mechanical Advantage = 6N
Speed Ratio = 2m
Efficiency =



Mechanical Advantage = 1N
Speed Ratio = 2m
Efficiency =

Calculate the mechanical advantage, speed ratio and efficiency of mechanical devices with the following recorded forces and distances. Show your work!

1. Input Force: 3N Mechanical Advantage: _____ N
Output Force: 6N Speed Ratio: _____ m
Input Distance: 12m Efficiency: _____ %
Output Distance: 4m

2. Input Force: 8N Mechanical Advantage: _____ N
Output Force: 16N Speed Ratio: _____ m
Input Distance: 18m Efficiency: _____ %
Output Distance: 3m

3. Input Force: 1N Mechanical Advantage: _____ N
Output Force: 1N Speed Ratio: _____ m
Input Distance: 10m Efficiency: _____ %
Output Distance: 5m

4. Are any of the mechanical devices above not worth using? Explain your answer.

5. Which mechanical device was likely working against the most friction? How do you know?

Part H: What does Pascal's Law have to do with it?

Pascal's Law

Pascal was a scientist who discovered that when fluids are put under pressure, it is spread out equally through the whole fluid.

Pressure

Pressure is a measure of the amount of force applied to a given area (how hard one thing pushes against another thing).

Fluid

Fluids are liquids and gases that flow (can be poured) and have no definite shape.

Hydraulic (hy-draw-lic) Equipment

Hydraulic equipment is a category of devices that use **liquids under pressure** to make it easier to do work.

Pneumatic (new-mat-ick) Equipment

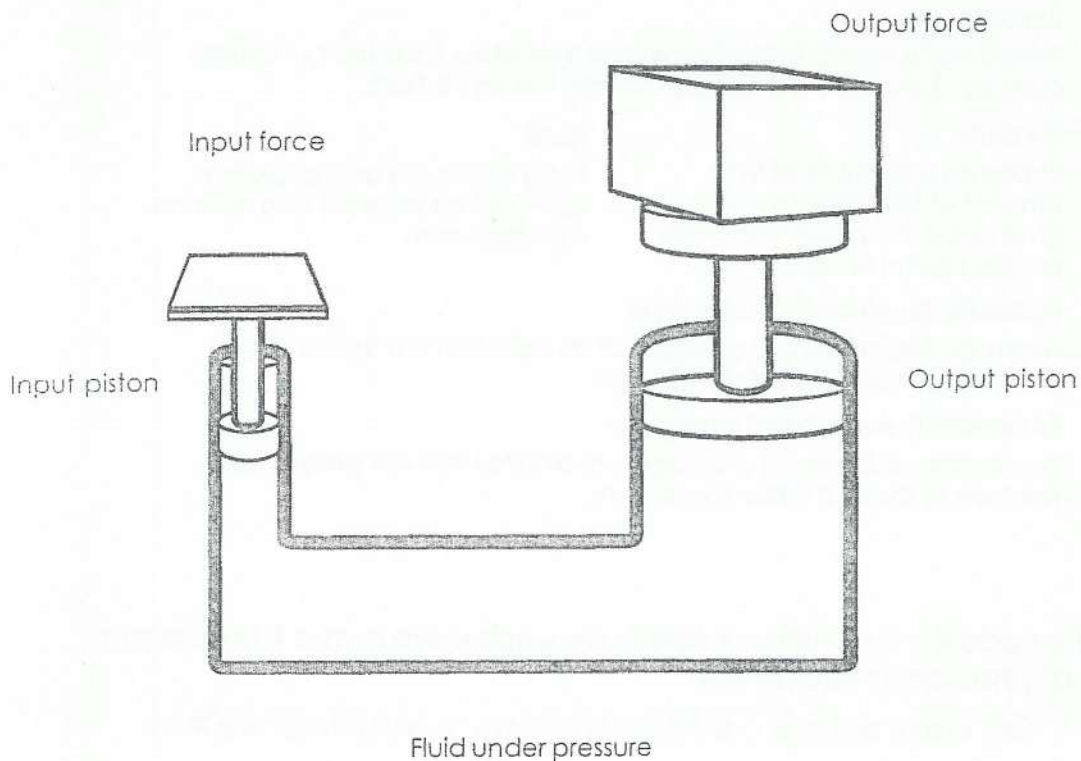
Pneumatic equipment is a category of devices that use **gases under pressure** to make it easier to do work.

Write an **H** beside the examples of **hydraulic equipment** and a **P** beside the examples of **pneumatic equipment**.

1. ___ Car brake systems are filled with pressurized liquid brake fluid.
2. ___ A jack hammer uses compressed air.
3. ___ A dump truck uses liquid under pressure to lift the back bed.
4. ___ Many power tools are hooked to air compressors.
5. ___ A hair stylist's chair is raised and lowered using the power of compressed air.



How Hydraulic Systems Work



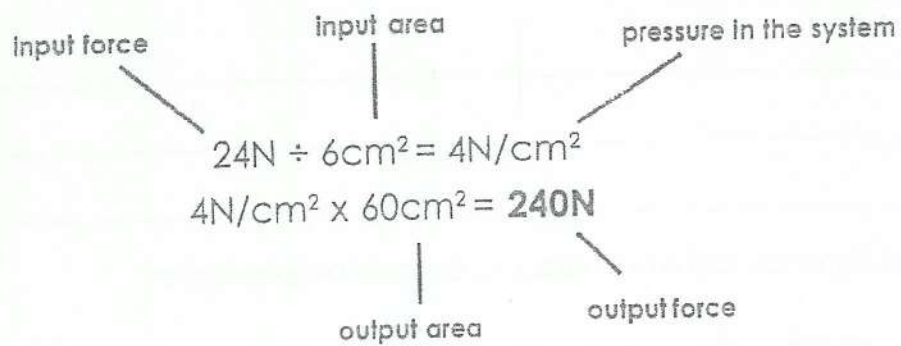
Two-Piston Hydraulic System

Pistons act like plungers pushing (putting pressure) on the fluid in a hydraulic system. The pressure spreads through the fluid and hits the output piston and pushes it up with the input pressure combined with the pressure built up in the fluid. How much pressure in total depends on the input force and the size of the pistons.

If, in the diagram above, the input force is 24N, the area of the input piston is 6cm², and the area of the output piston is 60cm², the calculation to find output force involves finding the missing number in a set of equivalent fractions (they are equivalent because pressure is equally shared in fluids).

$$\frac{F_{input}}{A_{input}} = \frac{F_{output}}{A_{output}} \quad \frac{24N}{6cm^2} = \frac{?}{60cm^2}$$

To find the missing number, divide the numbers in the complete fraction and then multiply to find the missing number.



Do you notice how much more of a mechanical advantage a hydraulic system gives you? 24 Newtons of input force gives you 240 Newtons output force – ten times the amount!

Use the information on the previous page to help you answer the following questions.

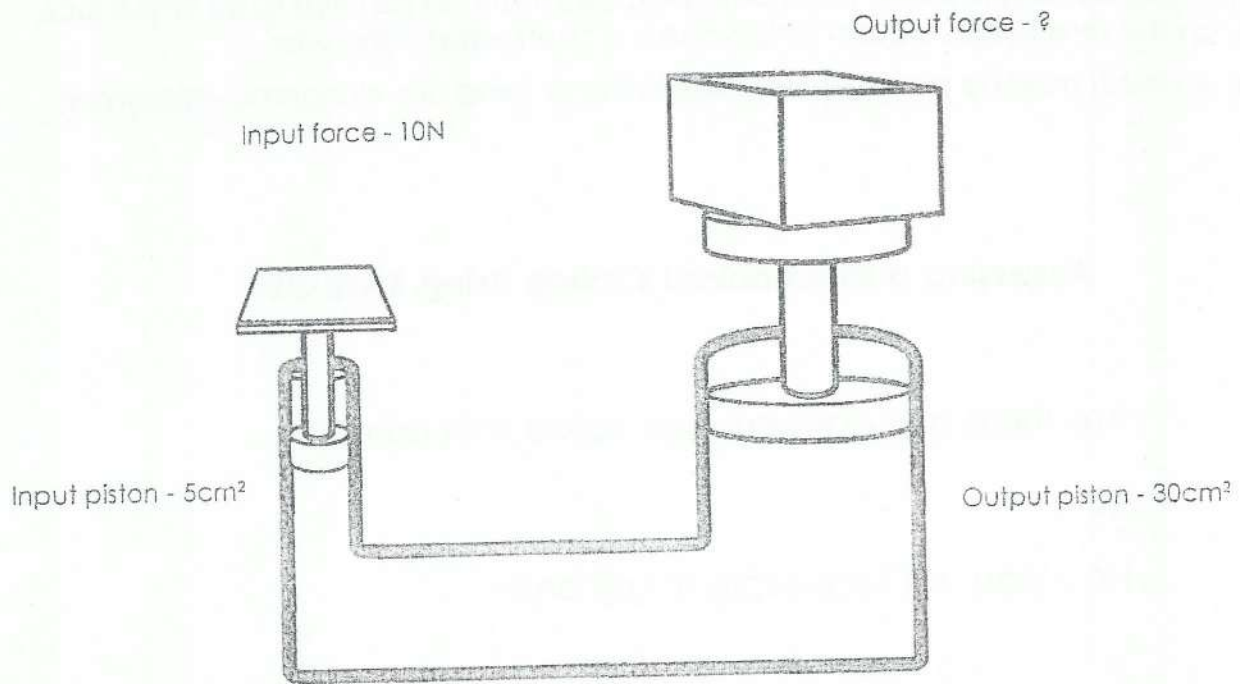
1. What is a hydraulic system?

2. What is the difference between input force and output force?

3. How is pressure built in a hydraulic system?

4. How helpful are hydraulic systems? How do you know?

5. Calculate the pressure and the output force of this hydraulic system.



Part I: How do you know when it's worth it?

Use the following SAFE-DEE list to help you assess (evaluate) two different mechanical devices found in your home or school that can be used to do similar jobs. Then, on the next page, explain which one is a "better bet" and why.

Note: An adult must be present when examining or using any dangerous equipment.

Assessing a Mechanical Device Using SAFE-DEE

S
Are there any dangers associated with using it?

A
How easy is it for people to get one?

F
What job does it do? How important is that job?

E
How much easier does it make the task?

D
Is it well made?

E
How well does it do its job?

E
How much does it cost? Is the cost reasonable?

Name: _____

Date: _____

7. Define Effort Arm:

8. Define Load Arm:

9. Consider the diagram that you had to draw for question #3. Why would using the lever system make it easier to move the load, than simply lifting it with your arm?

10. If you use a lever system properly, should you require more or less effort force to move a load?

11. Consider the diagram you drew again... Do you think using the lever system would make lifting quicker? Explain your answer

12. What determines which class a lever belongs to?

Name: _____

Date: _____

13. Define and draw the diagram for a Class 1 Lever:

14. Define and draw the diagram for a Class 2 Lever:

15. Define and draw the diagram for a Class 3 Lever:

16. Draw each of the three examples on page 271 for type of lever. Then, label the separate parts of the diagram, showing each part of the lever

17. Your body has many examples of lever systems. What is the role of a bone and joint in a lever system?

Name: _____

Date: _____

18. What is the role of a tendon within your body?
19. Explain what must happen within your body in order for you to lift an object
20. Draw an example of each lever system that can be found in your body
21. Based on what you have learned... Why would a torn tendon in your arm stop you from lifting an object? (What part of the lever system would fail?)
22. Based on what you have learned... Why would a broken bone in your arm stop you from lifting an object? (What part of the lever system would fail?)
23. Decide the class of each lever system in diagrams 4.5A-4.5C on the bottom of page 274

Name: _____

Date: _____

Science Eight
Module Four – Mechanical Systems
WS #2

Begin by reading page 276 of your textbook:

1. What is your definition of work? (Yes, I actually want to know)
2. What is the actual definition of Work?
3. What is the formula for calculation work?
4. Define Joule:
5. Within the work formula, force and distance are used. What units are both of these measured in?
6. Write down the example calculation from page 276 of your textbook

Name: _____

Date: _____

4. Read through "Easy does it" on page 277 of your text:

- Look at the picture... What is the only thing that will change in this experiment?

- As the height of the ramp is lifted, what happened to the amount of force required to pull the car?

- As the angle of the ramp increased, what happened to the amount of force required to pull the car?

- Which would take more force, lifting the car straight up or using the ramp?

- Why would the amount of work needed to lift the car decrease when using the ramp... Consider both force required and distance travelled

5. Define Input Work:

6. Define Output Work:

Name: _____

Date: _____

7. What does a machine never do?

8. What do machines make work easier?

9. Define Mechanical Advantage:

10. What is the formula and unit for mechanical advantage?

11. Consider diagram 4.8 in your textbook:

- What class of lever are the people using in order to move the truck?

- What is the total amount of force (EFFORT FORCE) put out by the two people?

- Suppose the two people used the _____ N of effort force on the back of the truck and pushed. Do you think this would be enough to move the truck?

Name: _____

Date: _____

- By using the lever, what was the actual force (LOAD FORCE) applied to the back of the truck?

- This is a hard question... why do you think the Effort force of 500 N turned into a Load force of 2500 N simply by using the lever? (just give your best guess)

- Using the formula... what is the mechanical advantage of this situation?

- In other words... by how many times did their Effort force increase, simply by using a machine?

12. State the rule about machines that have a mechanical advantage greater than one

13. In general, as the mechanical advantage increases... what happens to the amount of EFFORT force required to do any work?

Name: _____

Date: _____

14. State an example when you would find a mechanical advantage less than one

15. Based on your textbook (top of page 279)... what is the advantage of having a bicycle with a mechanical advantage that is less than one?

16. State an example when you would find a mechanical advantage equal to one

17. Based on your textbook (bottom of page 279)... what is the advantage of having a flagpole with a mechanical advantage equal to one?

Name: _____

Date: _____

Science Eight
Module Four – Mechanical Systems
WS #4

Being with some review questions:

1. Classify the levers in the illustrations on page 284 of your textbook
2. How much work, in joules, must you do to lift an elephant weighing 60000N up 1.5 m onto the back of a truck?
3. You have found a ramp to lead up to the back of the truck. Will you need to exert more or less force as you did in questions #2? Explain
4. If you exert a force of 100N on a hockey stick, and the stick exerts a force of 20N on the puck, what is the mechanical advantage of the stick? Show your work

Name: _____

Date: _____

Move onto and read page 285 of your textbook:

5. Define Winch:

6. Draw (as best you can) the diagram of a winch from your textbook. Be sure to label all the parts

7. Match items from a winch with the common terms used in describing levers:

Handle =

Radius of Wheel =

Force on cable =

8. Define Radius:

Name: _____

Date: _____

9. Why is using a winch just like using a simple lever, except you keep using it over and over again?

10. Define Wheel and Axel:

11. Think of using a door knob. A door knob is an example of a wheel and axel. Explain why this system is an example of a wheel and axel

12. Define Gear:

13. Draw an example of a gear system. Be sure to label the gear system

Name: _____

Date: _____

14. Define Gear Train:

15. Based on your textbook, how does a gear train work?

16. Define Driving Gear:

17. Why does a driving gear turn?

18. What is the most common example of a driving gear that you have used?

19. Define Driven Gear:

Name: _____

Date: _____

20. What causes a driven gear to turn?

21. You are putting together a bike. You have two gears. One is small and the other is large. Which one would you want to be the "driving gear" if you wanted the bike to move faster than you were pedalling? Tell me why this would work???

22. You are putting together a bike. You have two gears. One is small and the other is large. Which one would you want to be the "driving gear" if you wanted the bike to move slowly, but require little effort to move up a hill? Tell me why this would work???

Name: _____

Date: _____

Science Eight
Module Four – Mechanical Systems
WS#4

Begin by reading page 292 of your textbook:

1. Define Pulley:
2. Your textbook states that a pulley is similar to a Class 1 Lever. Describe the similarities
3. Define Fixed Pulley:
4. Draw a simple example of fixed pulley:
5. Explain how a fixed pulley allows you to raise a flag

Name: _____

Date: _____

6. Define Movable Pulley:

7. Draw a simple example of a movable pulley:

8. Describe how a movable pulley is attached

9. Define a block and tackle pulley:

10. How can a large mechanical advantage be obtained using a block and tackle pulley?

11. Define compound pulley:

Name: _____

Date: _____

Science Eight
Module Four – Mechanical Systems
WS #6

Begin on page 296 of your textbook:

1. According to your textbook, what is WORK?
2. Define Kinetic Energy:
3. List three other examples of kinetic energy that you can see on a daily basis:
4. List the energy transfers from your feet to movement of a bike, according to your textbook:
5. Kinetic energy can be measured... Assume a car is travelling at 30 km/h. What can you do as a driver to increase the kinetic energy of the car?
6. In regards to kinetic energy, what role do brakes on a car play?

Name: _____

Date: _____

7. There is an "energy" law informally stated on page 296... What is it?

8. List three common forms of energy used to power machines:

9. Define Potential Energy:

10. Why / how is your body full of potential energy?

11. What happens to the amount of potential energy in your car as you drive after filling up with gas? Explain your answer

12. Imagine two books. One resting 2m above the ground, and the other 4m above the ground? Which book has greater potential energy? Why?

Name: _____

Date: _____

13. According to your text, what is gravitational potential energy?

14. Assume a person is resting on a bookshelf. The bookshelf breaks underneath the person. The person falls to the floor...

- Before the shelf broke... What kind of energy was stored within the person?

- As the person began to fall, what type of energy does the person gain? And what type of energy do they begin to lose?

- At the exact midway of the fall, what must be equal?

- At the point just before the person hits the ground, they are falling at the fastest speed. Describe how much potential and kinetic energy the person has at this point in time?

15. Imagine a person eats way too much food. The person will turn this food into fat. What type of energy is fat? If the person starts working out, what type of energy will this fat be turned into?

Name: _____

Date: _____

16. I realize that this is not in your book... Suggest why your body is so good at turning extra food into fat or potential energy...

17. Define Transmission:

18. Give two example of energy transmitters:

19. According to your textbook, what would an "ideal" machine be able to do?

20. How do "real" machines differ from ideal machines?

21. Define efficiency:

22. In your own words, or according to your text, what is efficiency when speaking about machines?

Name: _____

Date: _____

23. What is the formula for efficiency of a machine?

24. Imagine a machine uses 150 units of energy in, but transfers 95 units of energy into useful work... Is this machine 100% efficient? Explain

25. Consider a car driving by you on the street. The gas in the car is supposed to make the car move, and that is all. But, you can hear the engine in the car. Based on this example, is a car 100% efficient? Explain

26. A normal light bulb can use 100 units of energy. 5 units of energy are used to create light. The other 95 units are transferred into heat energy? Is this an example of an efficient system? Explain why

27. Why are normal light bulbs seen as bad for the environment?

Name: _____

Date: _____

28. In moving objects, why are lubricants used to improve efficiency? (look at figure 4.28)
29. The effort force of a crane is 5600 J. The work done on the load is 3400 J. Calculate the efficiency of the crane system
30. The fuel system in a car provides 1000 J of energy into the engine of a car. The then produces 200 J of energy to move the tires. Calculate the efficiency of the car engine
31. If the typical car is only _____% efficient, where does all the lost energy go???

Name: _____

Date: _____

Science Eight
Module Four – Mechanical Systems
WS #7

Begin on page 304 of your textbook:

1. Define Force:
2. Define Area:
3. Define Pressure:
4. What is the formula for calculating pressure? (Include all units)
5. A balloon has an area of 4.5 m^2 . A person applies a force of 650 N to the balloon. Determine the pressure on the balloon. (Show work and required units)
6. A gas line experiences a pressure of 2500 Pa. The area of the line is 360 m^2 . Determine the force applied to the gas line

7. Imagine a person is walking on a fresh layer of snow in the mountains...

- The person is walking in bare feet. She applies a force 400 N on an area of 0.15 m^2 (her feet). Calculate the pressure that she will exert on the snow

- The same person now puts on a pair of snowshoes. The force applies remains 400 N. The area is 2.5 m^2 . Calculate the pressure that she will exert on the snow

- What is the only variable that changed between the two previous calculations?

- In which situation will the person sink into the snow, and in which will she be able to walk on top of the snow?

- Why will she sink in one and not in the other? (Check you answer with Blum)

Name: _____

Date: _____

Science Eight
Module Four – Mechanical Systems
WS #8

Begin on page 307 of your text:

1. Define Pascal's Law:
2. Define Hydraulic Lift:
3. Define closed system:
4. Consider figure 4.32A... Why is it important for this system to be CLOSED?
5. Consider figure 4.32A... Imagine that you push down on point F1. Your goal is to move point F2 up. Suppose there was a small hole in the wall of the right cylinder... How would this change the hydraulic system?
6. Your circulatory system is based on hydraulics... Imagine that you were cut in a main artery... How would this affect your hearts ability to move blood??? (answer based on blood pressure)



