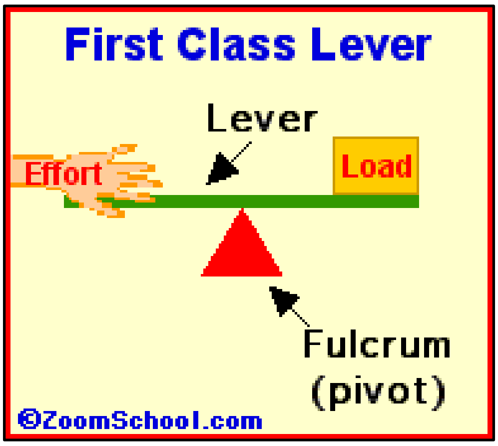
# TECHNOLOGY

# TERM 1 MECHANICAL SYSTEMS AND CONTROL




# Contents

# Unit 1: What is Technology?

Technology is the use of **knowledge, skills, values and resources** to meet people's needs and wants by developing practical solutions to problems, taking into consideration, social and environmental factors. These solutions usually take the form of products. Almost everything we use, from a pencil to a computer, is a product of technology.

## Scope -Technology and the world of work

Technological skills and knowledge help to create different career paths and job opportunities for people. Anyone who designs a product as part of their job does Technology. For example, a chef who creates a new recipe is doing Technology. A dressmaker who designs and makes a dress for weddings does Technology. We all use technology. Many people use technology in the world of work. Examples of people who work in Technology are artisans, engineers, surveyors, architects, graphic designers and scientists.

Engineers

Scientists

Artisans

Graphic Designers

Architects

Surveyors

**KEY WORDS:**

- Technology – meeting people's needs and wants.
- Design brief – a short statement that describes a need or problem.
- Design specifications – details about the product, such as its function and appearance.
- Constraints – things that limit your choices.

# DEFINITIONS

*An engineer is a practitioner of engineering, applying scientific knowledge and mathematics to develop solutions for technical problems.*

*Artisan is a worker in a skilled trade, especially one that involves making things by hand.*

*An Architect is a person who plans, designs, and oversees the construction of buildings.*

*A Scientist is a person who is trained in science and whose job involves doing scientific research or solving scientific problems.*

*A Graphic designer creates and combines words, symbols and images to create a visual representation of ideas and messages through visual art.*

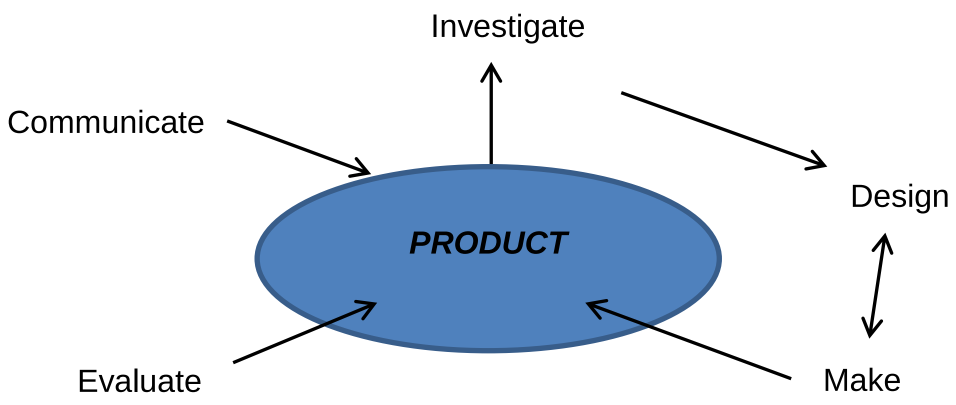
*A land surveying professional is called a land surveyor. They determine the three-dimensional position of points and the distances and angles between them, like measurements on a road.*

# The Design Process

The design process is a set of steps we use when we plan how to make a product. The steps in the design process enable you to develop solutions that solve problems. There are five focus areas in the design process.

These steps are:

1) Investigate
2) Design
3) Make
4) Evaluate
5) Communicate




The diagram above shows the design process. The arrows show you that you can work through the different focus areas in different ways and at different times. They also show that you can return to a focus area after evaluating the technology.

**Activity 1: Moveable toy or friendship card using templates and also split pins.**

**INVESTIGATE and make a MOVEABLE TOY/ CARD using a template and split pins**

**Requirements:** Cardboard, scissors, glue, split pins, colouring pencils and any other materials, e.g. stickers.

Look carefully at the templates and images of TOYS AND CARDS. Follow the instructions on Worksheet 1 and then draw a toy, on cardboard, using the templates. Make sure you have enough cardboard left over to cut out parts of the toy that will be assembled using split pins.

- Decorate your moveable toy or card.


In our design process we are going to design a moveable card with an object using split pins and cardboard to cut out templates. We need to follow certain steps to design a moveable card. Use Worksheet 1 to complete this activity.

## Step 1: INVESTIGATE

When you investigate, you gather information. You collect all the information you need to solve a problem. Then, you sort through the information and decide how you are going to use it. This process is called accessing (finding), processing (sorting) and using information. When you investigate, you need to keep a record of how and where you obtained your information. We call this acknowledging the information or referencing.

## Step 2: DESIGNING

Once you understand a problem, you can start drawing up your design brief. A design brief is a short, clear statement that explains the problem and how to solve the problem.
A design brief should include the following:

- What will you be making?
- How will it solve the problem?
- Any materials or resources needed

After you have written your design brief, you should also list the specifications and constraints for the project.

For example: Priyanka has nothing to hold her beautiful flowers. Using creative thinking, a pair of scissors and some paint, she changes a plastic bottle into a vase. The specifications of a technology project list the requirements that the solution must meet.

In our example, Priyanka would need to list the following specifications for her solution:

- It needs to be able to hold a bunch of flowers.
- It should be stable.
- It needs to be waterproof.
- It needs to be attractive to look at.

Constraints refer to anything that limits the designer when finding a solution to a problem. Priyanka's constraints could have been:

- tools to make the vase
- limited materials
- no skills
- time to make it


## Step 3: MAKING

After finalising your two initial rough freehand drawings, you should choose the best design. Now, you do a detailed drawing of the product - this is your third drawing and 3D design. Your final drawing should be neat, colourful, detailed and labelled.
The final design should include all details needed to make the product, including:

- instructions
- Dimensions/ measurements
- materials needed
- reasons for the choice you made

Remember to draw up a step-by-step plan of how you intend on making your final product. You also need to list all the materials that you will need.

## Step 4: EVALUATING

You should continually evaluate the design process to ensure a successful outcome. To evaluate means to consider or test something. You should evaluate whether you have identified the problem correctly. You should evaluate your design ideas. Here, you will make sure that your ideas meet all the specifications and constraints.

## Step 5: COMMUNICATING

- You communicate through the design process.
- This includes writing notes or making sketches.
- Keep careful records of the components.
- You may want to present your work on a poster or a presentation in your book.

Another very useful way is a project report which contains all the notes and drawings for each step of the design process.

# Design considerations

**KEY WORDS:**

- Fitness for purpose – a check that is performed on a product ensuring that it will meet the purpose for which it was designed.

Everything that has ever been made was designed by someone. The first people on Earth were designing, even when they were making simple tools or shelter.

Today, people make a career out of designing products and systems. When designing something, you need to consider a number of factors, which we refer to as design considerations. Let's take a closer look at some of the design considerations you should keep in mind when designing a product or system.

## *WHO IS IT FOR?*

This includes who will use it as well as who will buy it. These people are called the target market of the product. For example, if you design a new chocolate –flavoured breakfast cereal, your target group might be children under 5. Or, if you design a new kind of beauty cream, your target might be women.

## *WILL IT DO THE JOB?*

What is the product expected to do? And will it do it? You need to evaluate your product or system to ensure that it does what it is set out to do. In other words, does it solve the problem or meet the need that you originally identified?

## *WHAT IS IT FOR?*

You have to consider the purpose of the system or product. This will ensure that you can produce something that does what it is meant to do.

## *IS IT COST EFFECTIVE?*

*Cost –effective does not mean cheap.* It means that the product is worth the amount it will cost to make. The cost of resources, including the time it takes to make the product, determines the final cost of making it.

## *IS IT EASY TO USE?* (Ergonomics)

Ergonomics is how easy something is to use and how comfortable it is to use. For example, some people sit for long hours in front of a computer. Therefore, they will want to sit in an office chair that is as comfortable as possible, but still suitable for computer work., so the office chair must have rotating wheels or an adjustable seat, for comfort.

## *DOES IT LOOK GOOD?*

**Aesthetics is the study of how pleasing things are to look at.**

What something looks like is often more important than what you think. Not only does a product have to look like it will work properly, and last well, it also has to look attractive to the target market.

## IS IT SAFE?

A product should be safe to use and should not harm the user, society or the environment. Some products are not safe, and cannot be safe. In these cases, additional products must be designed to reduce the risk of injury. A product may have to have special instructions to ensure its safe use.

## Activity 2

Read the pet shop owner's problem below. Then answer the questions that follow.

| Step 1 – Design problem |
| --- |
| The local pet shop owner has carried out a survey in which she found and saw a need for automatic pet feeders when their owners go away on holiday or away for the weekend. |

| Step 2 – Design brief |
| --- |
| Kaylee Naidoo is a pet shop owner who has been asked by her local customers to supply an automatic animal /pet feeder. Some customers have holiday homes and go away on weekends. They don't always want to take their small pets such as dogs, cats, birds, hamsters or mice with them because this is inconvenient. Small animals need very little personal attention and can be left for short periods, as long as they are fed and sufficient water is given. |

### Questions

1. Name the product that needs to be designed. (2)
2. Who is it for? (2)
3. What is its purpose going to be? (1)
4. Suggest three things to ensure the product will be safe for the animals. (3)
5. Why is it important to ensure that the product looks good? (2)

**Total: 10**

## *Activity 3*

In groups, discuss who does the work in the fields of technology listed below and write two possible answers in your workbook.

| Field of Technology | Who does the work? |
|---|---|
| Medical | |
| Construction | |
| Farming | |
| Education | |
| Sports | |
| Mining | |

# Unit 2: Introduction to graphical communication

Drawing your ideas is an important stage in the design process. You can use these drawings to develop your ideas and tell others how to make the product you are designing. This is known as graphical communication. Remember that a drawing needs to communicate your ideas on paper. People who look at your drawings need to understand what it is that you drew and why you drew it. So graphical communication is like a drawing language.

What do we use graphics for?

Graphical communication involves sharing information and ideas using graphics. It's easier to explain an idea using a drawing than using words. We use drawings to jot down our initial ideas - often as freehand sketches. These can be developed into working drawings, 3D (three-dimensional) oblique drawings, or even 3D artistic drawings.

## Drawing conventions

**KEY WORDS:**

- Outlines – Thick, dark, bold lines to give the basic shape of an object.
- Construction lines – Thin, faint and not visible in the final illustration.
- Dimensions – The height, width and length of something.
- Hidden lines – Aspects which are not visible, drawn as short dashes.

Drawing provides a graphical language for communicating ideas and sharing information. Designers use a standard set of rules called conventions when making drawings so that they can be easily understood by everyone. Using these conventions, drawings are described using lines, dimensions and angles.

# *Types of Lines*

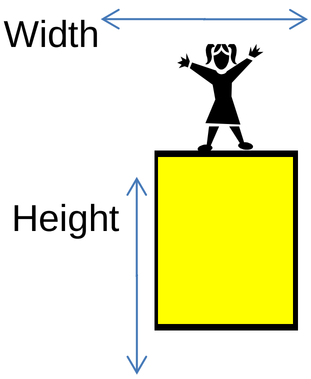
Designers use different types of lines to produce detailed line drawings of the products they are designing.

These drawings can be free-hand sketches or 2D (two-dimensional) views. They are drawn using accurate measurements so that engineers can use them to construct and manufacture the items.

By convention, line drawings use three kinds of lines – outlines, construction lines and hidden detail lines.

## Outlines

- In 2D drawings, your outlines need to be thick and dark.
- They indicate the outline of an object, as well as all the parts that are visible from the outside.
- Outlines can be straight or curved.
- You can use a dark 2H or 3H pencil or a black pen for outlines.
- Thick lines are normally used to show when one side of a 3D drawing is visible.




*A 3-D pencil case*

## Construction Lines

- Construction lines are thin, continuous lines that are used to help construct other lines. In 2D and 3D drawings, these construction lines need to be thin and feint, which means they are lighter in colour than outlines.
- Lines that join surfaces are also drawn using thin lines and construction lines can be straight or curved.

## Hidden Lines- dashes

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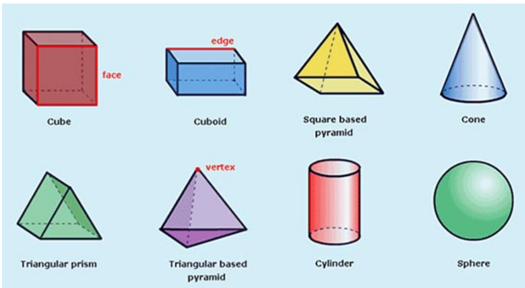
- Hidden detail lines are dashed lines. These lines are used to show the parts of the product that are out of sight or hidden from view.

## Dimensioning

Dimensioning means including all the aspects in a drawing that will be needed to construct the product. Dimension lines are thin, continuous lines.

- The three main dimensions in a drawing are the width, depth and height.
- At either side of the dimension lines are arrowheads.
- The dimensions are written above the dimension line.
- All measurements are in millimetres (mm).
- You can also draw two-dimensional (2D) drawings.
- These show the height and length of a shape or object.




You can also have drawings that are three dimensional (3D). Three-dimensional drawings have height, length and depth as in the examples below.

## Scale

Scale is the relationship between the size of something in a drawing and its actual size. When you draw an object, no matter how small or big, you need to draw it with the same proportions as the original object. Often it is not practical to draw an object life-sized, especially if the object is very big, like a car or a house. If the object is very small, such as a microchip, drawing it life-sized means that the detail won't be seen easily. So we need to draw some objects bigger to see the details, or smaller to fit onto a page. The method of sizing up or sizing down is called a **scaled drawing.**

When someone sees your scale drawing, they will understand that you have:

- Measured the size of the real object.
- Reduced the measurements if it is a large object or enlarged them from small objects.

**WE WRITE SCALE AS A RATIO:**

Here is a 2D front view scale drawing of a car. In real life, the length of this car is 3 600mm, but the scale drawing is 20 times smaller. To show that it is 20 times smaller than the real object, you write:

Scale 1 : 20

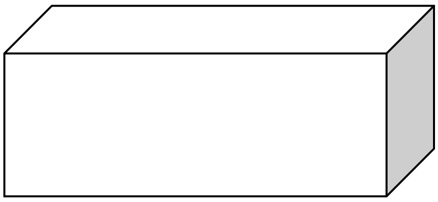
Length of the drawing — Length of the actual, real-life object

In a scale drawing:

- The real size (dimension) of the object is shown on the drawing.
- The measurements are used in millimetres (mm).
- The scale is always shown on the drawing. (Refer to worksheet of car)

# Graphic techniques: What is an oblique drawing?

Oblique drawings are basic 3-dimensional drawings. Oblique drawings are a simple way of showing the depth of an object. An oblique projection is a way of drawing a 3D object (showing the front view, the side view and the top view) in which the object is drawn with the front view facing directly towards the observer, showing the true shape of the object. To show the 3D effect, parallel lines are drawn from the front face at an angle of 45º and are joined to create the 3D shapes. (Refer to Platinum textbook, page 20)



## Activity 4

Drawing oblique drawings

You will need an H or HB pencil, 30 cm ruler, and a sheet of squared (quadrant) paper. Use the given worksheet to draw a cube by following the steps below.

Follow these steps to make an oblique drawing:

- Measure the object that you will draw.
- Choose a scale for your object, e.g. 10 mm: 1 block (on the quadrant paper)
- Draw the front view of the object. Count out the correct number of blocks.
- Using the lines on the oblique paper, draw feint 45° lines to the back.
- These lines give your object depth.
- In oblique drawings, measure the depth lines to half their size.
- Count out half the squares for the depth of the object. Mark it.
- Complete the drawings by joining all horizontal lines.

## *Practical Activity 5*

Free-hand sketches

As you begin to design a product or system, it is often helpful to make a few simple free-hand sketches. Free-hand sketches can be 2D or 3D.

Follow these steps when making free-hand sketches:

Step 1: Use sharp pencils (HB) and paper

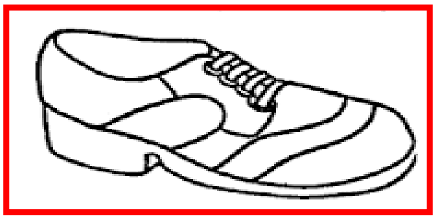
Step 2: Never push a pencil – always pull it.

Step 3: Keep your wrist and arm in contact with the paper or table at all times.

Step 4: Draw lines from left to right if you are right-handed. Draw lines from the right to the left if you are left-handed.

Practise free-hand sketching by copying 2 of these drawings in your book enlarging it first and then reducing its size.

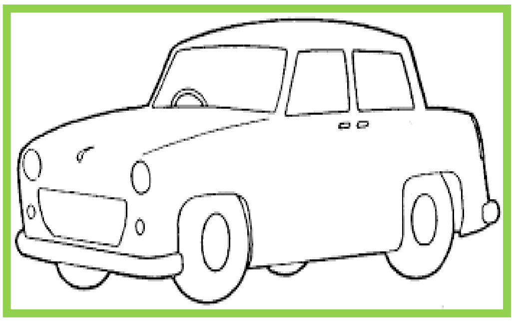
Drawing 1: A shoe



Drawing 2: A television

Drawing 3: A doll

Drawing 4: A car



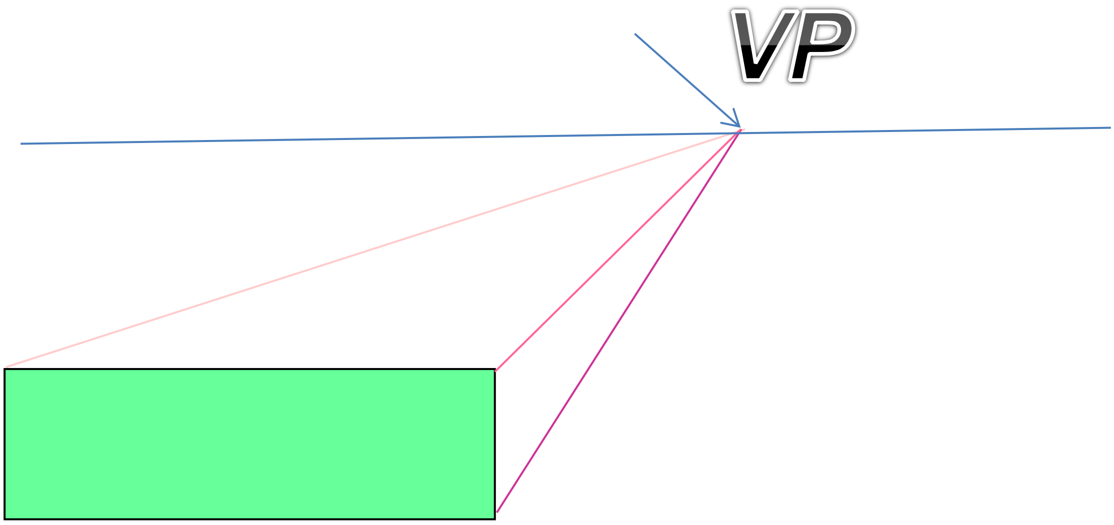
# Single vanishing point perspective

The vanishing point in a drawing is the point in the distance at which parallel lines meet. When things are further away from us, they seem smaller and closer together. Single vanishing point perspective drawings make an object look more realistic. In these drawings, the objects become smaller along lines called vanishing lines. These lines finally meet at a point in the distance. This point is called the vanishing point (VP).

Single VP drawings use one vanishing point. The VP is always at eye level to the left or right. Vertical lines are always drawn vertically.

## *Activity 6*

Use the worksheet (Platinum book page 23 and Spot on page 21), to draw a square with a single VP. Follow instructions on given worksheets.




# Simple mechanisms: What are mechanisms?

**KEY WORDS:**

- Mechanism – a set of moving parts that are used to make work easier.
- Lever – a simple mechanism made of a bar that turns around a fixed point.
- Fulcrum – the point of movement or pivot on which the arm of a lever moves.

A mechanism consists of a set of moving parts that are used to make work easier so that we use less energy. Machines all contain mechanisms. For example, a bicycle is a machine that uses mechanisms such as wheels and axles and gears to make it easier for us to ride from one place to another.

## What is a lever?

Think about when you used to play on the see-saw in the park when you were little. This is an example of a simple machine called a lever.

A pair of scissors in figure 1, a stapler in figure 2, a pair of tweezers in figure 3 and a wheelbarrow in figure 4 are familiar examples of levers. All of these levers are machines that help to make our lives simpler.

**Figure 1**

**Figure 2**

**Figure 3**

**Figure 4**

**How a lever works**

- The fulcrum (pivot): This is the part where the lever will balance or turn.
- Load: This is the object that is being moved or lifted.
- Effort: This is the force that is used to move the load or the resistance with a board, a handle or a bar that you can push or pull.
- When you push down with a force on one end of the lever, you are putting in effort. The effort you put in will cause the other side of the lever to lift up, causing whatever was on the other side to lift or move. The weight of the object you are trying to move is the load. A small effort can move a large load when you use a lever.

First class levers: The fulcrum is between the effort and the load e.g. in a crowbar or a see-saw. **(E-F-L)**

***Figure 5***

***Figure 6***

Second class levers: The load is now in the middle of the fulcrum and the effort, e.g. a paper cutter and wheelbarrow. **(F-L-E OR E-L-F)**

***Figure 7***

***Figure 8***

Third class levers: The effort is in the middle of the load and fulcrum e.g. a rake and an ice hockey stick. **(L-E-F)**

***Figure 9***

***Figure 10***

Mechanisms are not freestanding, but are found within structures. Mechanisms can only work if one form or another of energy is exerted upon them. We call this energy the input, which gets the process underway, and results in an output.

| INPUT | PROCESS | OUTPUT |
|---|---|---|

Example:

Let's investigate the above with an example. Pick up your scissors. While you just look at them, they can do nothing for you, but if you

exert a force on them and push the two handles together, you can cut paper. The power/ force that you use to push the handles together is the input. The process is that the blades of the scissors move towards one another and the output is the paper that is cut.

# Mechanical advantage

The reason we use levers is that they may give us mechanical advantage (MA).
This means that, by using a lever, we increase the force available to do useful work. This makes it easier to perform the task.

The screwdriver acts as a lever that can take a lid off a tin of paint. If you use a short screwdriver to open a very tight lid and then use a longer screwdriver, what do you think the difference will be?

The screwdriver lever helps you to open the tin because it multiplies the force or effort that you place on the screwdriver. A lever multiplies the force it applies to a load through something called mechanical advantage. A mechanism gives us a mechanical advantage by multiplying the input force applied to a mechanism into a much greater output force.

## *Activity 7:*

How to work out the mechanical advantage (MA):

MA = load ÷ force

In this example:

MA = 600N ÷ 100N

= 6 The mechanical advantage is 6. The greater the mechanical advantage, the more the lever helps you.

# *Linkage systems*

**KEY WORDS:**

- Linkage – two or more levers that are joined.
- Paired link lever – two levers that are joined, and work together.
- Complex linkage – a number of levers joined together.

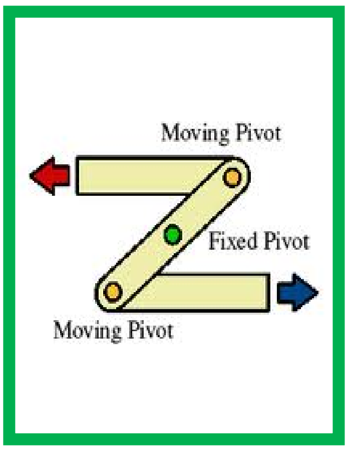
A linkage is made of two or more levers that are joined. We call two levers that are joined paired or linked levers. With a linkage system, one or more of the rods will have a fixed pivot around which it moves and the other rods will be joined with moving pivots. Linkages are used to:

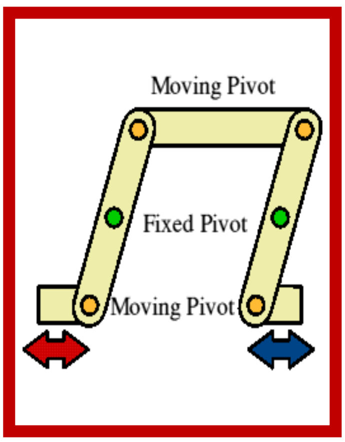
1. Change the direction of movement;
2. Change the distance of movement;
3. Allow parts to move parallel to one another;
4. Allow two or more items to move at the same time.

Examples where linkages are used:

Linkages are used as indicated below:

To view more linkages and mechanisms and how they work, type the following hyperlink: www.technologystudent.com/cams/link1.htm



# First- class levers

The fulcrum is in the centre of a first- class lever system. A fulcrum is a pivot or support. Examples are: a pair of scissors (figure 1) pair of pliers (figure 2), a hedge-trimming shears (figure 3)

***Figure 1***

***Figure 2***

***Figure 3***

# Second-class levers

The hole or paper punch has been around for many years. Benjamin Smith patented and improved the hole punch in 1885. The single hole punch made only one hole. Single hole punches are still used today and are very useful, especially for technology.

Images of a single- hole punch.

Many years later, the punch you find in schools and offices was developed. This is a double punch, designed to punch two holes at once. The paper can then easily be filed into a ring-binder file.

Image of a double- hole punch

# Third -class levers

Third-class levers are quite common. Remember, a third-class lever cannot give you mechanical advantage. This means that the force that you apply is always going to be greater than the load. You can use third-class levers to pick up objects. For example, tweezers are used to pick up really small objects. Another example of a third-class lever is

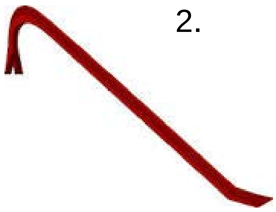
the staple remover. If you have ever tried taking a staple out of a thick book, the staple remover helps you to do this job more easily.

## *Activity 8: Identify the class of lever*

Carefully study the pictures of different levers below and write the answers in your book.

1.

2.



3.

4.

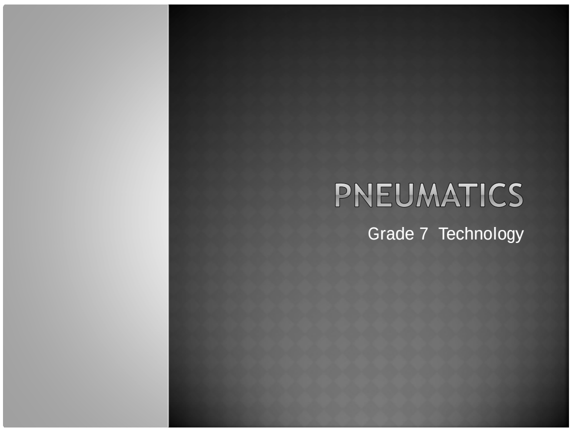
5.

6.

7.

1) Identify where the load, the effort/ force and the fulcrum is in each picture.
2) Write this in the format as shown above using arrows to show how the lever works. For example: load → effort/force → fulcrum / (L-E-F)
3) Now identify the class of lever in each case.
4) Make a symbolic drawing for each. Use a symbol, e.g. a triangle.

**View the power point presentation on Hydraulics and pneumatics and how this works**



# Pneumatics

Pneumatics or pneumatic systems are machines that are compressed air or gas. The air in pneumatic systems is compressed with a pump. When you push on the handle of a bicycle pump, for example, you are compressing the air and forcing it into a smaller space. Compressed air enter the base of a pneumatic cylinder it pushes on the piston and makes the piston rod extend. Air on the other side of the piston escapes into the atmosphere. When compressed air enters the rod end of a pneumatic cylinder it makes the rod retract.

Click on the following hyperlink to watch a video explaining more about hydraulics and pneumatics: www.youtube.com/watch?v=YlmmRa-9zDF8

# Hydraulics

Hydraulic systems use liquids such as oil and water, to work machinery. Liquids are used because theyare incompressible and can't be squashed. In a hydraulic system oil replaces compressed air to transmit motion and force. On any construction site or repair centre you will see hydraulically worked machinery in the form of bulldozers, front-end loaders, forklifts and a car lift.

# Using pneumatics and hydraulics

Pneumatics and hydraulic systems do the same thing as levers- it makes the work easier for us by multiplying a force. Many of them are able to lift incredible loads with just small effort.

A hydraulic car jack can lift a heavy car.

Hydraulic and pneumatic systems basically work in the same way. The only difference is that hydraulics uses an incompressible liquid (such as oil), while pneumatics uses compressed air.

As you prepare to design and make your Jaws-of-Life system, you will need to practically investigate how pneumatic and hydraulic systems give us a mechanical advantage.

The following investigations on how pneumatic and hydraulic systems work will be done practically.

## *PRACTICAL ASSESSMENT TASK: PAT TERM 1*


**KEY WORDS:**

- Pneumatic system – a mechanical system that uses compressed air to do tasks such as make things move.
- Hydraulic system – a mechanical system that uses liquids under pressure to do tasks such as make things move.
- Force – an influence that can move an object, usually a push or pull.

### *The problem scenario*

The motor car is an invention that has had major influence on society. People are able to travel greater distances than before, and are able to do so faster and far more comfortably.

But the motor car has also had a negative effect on society. In South Africa, more than 14 000 people die in car accidents every year.

In our holiday seasons, many South Africans travel on our major highways to holiday destinations. They set off excited and enthusiastic about a few days of holiday and rest. Sadly, because of the number of cars on the road, accidents happen. Sometimes, people are trapped in a car and cannot get out. A useful machine that helps us to rescue people in this situation is the Jaws-of –Life system.

Have you ever tried to cut through 8-10 sheets of paper or a thick piece of cardboard? If you have, you will know how difficult this is to do. You need to apply a lot of force to the scissors to cut through these objects because they are so thick. Cardboard is very thick and not easy to cut at all.

Emergency rescue workers often need to cut through the frame of a car or twisted wreckage to free victims of accidents. A car frame is extremely thick, so they need very special tools. They usually use special hydraulic cutters called Jaws-of-Life. These cutters look like metal jaws. The Jaws-of-life is made of several types of piston-rod and hydraulic parts, such as cutters, spreaders and reams. One of the uses is to force open vehicles involved in accidents.

The hydraulic cutter consists of two basic parts: the lever system at the front and the hydraulic system at the back. The blades of the cutter are linked levers.

A black rubber protective sheath covers the moving parts to make it safe for the operator to use. Underneath the sheath are more linked levers. These, push the blades closed, at the front of the hydraulic cutter.
Use the following links to find more information or images.
www.jawsoflife.com/
www.howstuffworks.com/car-driving-safety/accidents
www.youtube.com/watch?v=OmWncPNzmv4

Requirements for the Jaws-of-Life system:
- Base it on levers and linkages.
- It should be powered by a hydraulic-syringe system.

- Make the system using available materials, such as cardboard or wooden ice-cream sticks, new syringes (without needles), tubing and nuts and bolts.
- The linkages should be able to move smoothly. The effort to move the linkages should come from the hydraulic system.

**Something interesting**

*The first Jaws-of-Life tool was first used in 1963 to rescue racing car drivers. It was transported on the back of a pick-up truck because it was so big! Since then, these tools have been refined and improved, but we continue to use this name to refer to all hydraulic rescue tools.*

**Designing a rescue system**

Write a design brief, by using a list of questions, to list the specifications and constraints for your jaws-of-life system. Make a simple scaled working model using available materials.

Questions can include:

- What is it that I have to make?
- What is it used for?
- How big does it need to be?
- What will it be made from?
- What tools do I need to be able to make it?
- How much will it cost to make the model?

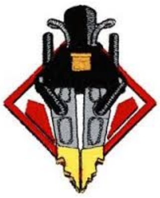
Before you write your design brief, write down exactly what it is you have to do to solve the problem. Constraints are the things that limit your choices for solving the problem. They include the things that you must do or use when you make the solution, as well as the things that you may not do or use to make the solution. For instance, constraints could be:

- The materials you may or may not use
- The tools you may or may not use
- The time you have to complete the task.

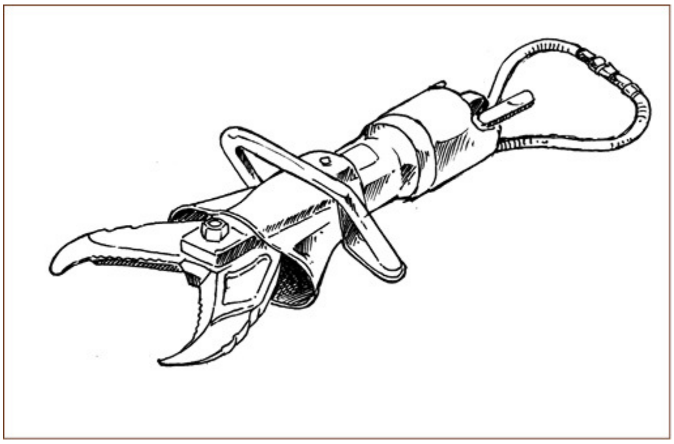
Now, plan and write a design brief for your model.

After drawing two freehand (rough) sketches, you need to make a clear and precise 3D drawing in oblique projection to show how you will design your hydraulic rescue tool. Make sure you use the correct conventions, especially dark and feint lines where necessary.

Make working drawings in 2D that show one view of your hydraulic rescue tool. Include the dimensions to scale.



- Make a list of all the materials you will need.
- Make a list of all the tools you will need.
- Make notes on your decisions.
- List any safety precautions you might need to consider when making your Jaws-of-life system.



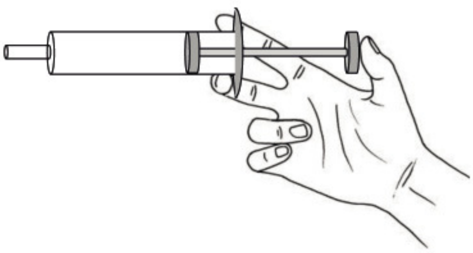
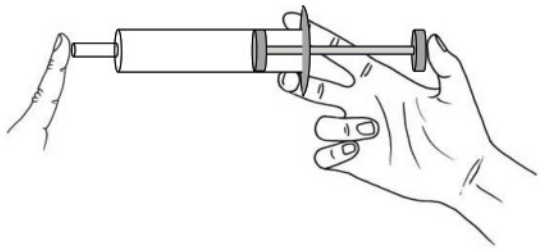
***How to make a pneumatic system***

You will need three plastic syringes without needles – two of equal volume and one smaller one; a short length of plastic tubing which fits snugly over the ends of each syringe; a bowl of water, a matchbox filled with a few stones; a ruler.

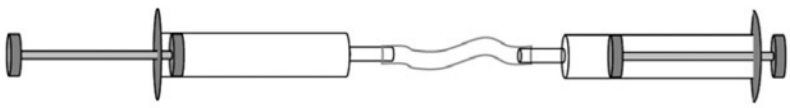
Pull out the plungers from the two equal-sized syringes until they are both halfway up the syringe chambers. Connect the syringes using the plastic tubing. This is a pneumatic system, because the syringes are both filled with air.

**Investigate:**

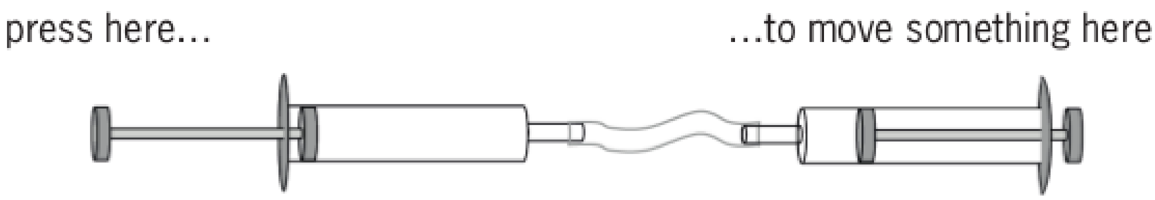
1. Hold your thumbs on both plungers, and apply pressure to one of the plungers. This is the input plunger.  What do you feel? Repeat this using the other plunger as the input plunger. Record your results in your workbook.

2. Place the matchbox on your measuring sheet, to the right of the line. Align the edge of the matchbox with this line. Push the plunger of one of the syringes all the way in, and place its plunger against the right hand edge of the matchbox. The other syringe will have its plunger out.



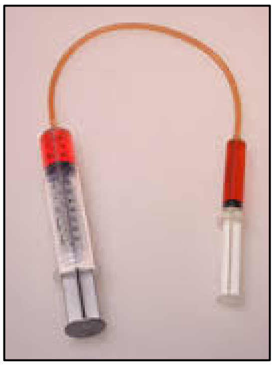
3. Push the plunger that is out. That is the input syringe. Observe what happens when you do this.




4. When you push down the plunger, force is transferred from the input syringe to the output syringe. It should move the matchbox leftwards, over the line.

## How to make a hydraulic system

Pull out the plungers from the two equal-sized syringes. Place them in a bowl of water, so that the syringe chambers fill up with water. Working under water, push the plungers into the syringes until they are halfway up the syringe chambers. Put the tubing under the water, and connect the ends to both syringes, making sure that there is no air in the system. This is a hydraulic system, because both syringes and tubing are filled with water.



Now, have fun designing your own Jaws-of-life simple model and the drawing of the images for your first PAT (Practical Assessment Task). Use the printed worksheets and rubrics to complete the activities.