Year 9 – Mechanical Systems & Movement

Term 1 – Revision

Introduction to Mechanical Systems

Mechanical systems are everywhere around us. They help us perform tasks more easily and efficiently. In this unit, we will explore various types of mechanical movements, how levers and linkages work. This knowledge is essential for designing and making our own mechanical devices.

Objectives

Learning Objectives:

- Name the four different forms of movement that can take place in a mechanism
- Understand how each type of motion moves in different mechanisms
- Recognise the role levers play in mechanisms to make work easier
- Understand how an input motion can be changed by a linkage in a mechanism.

- Identify and understand what a cam and follower do
- Understand why different cams and followers are used
- Be able to apply the terms rise, dwell and fall
- Understand how cams and followers can be used when designing mechanisms

Content

Structures & Mechanisms

An artefact is considered a mechanism when it has a moving part.

Examples:

- A fork is a structure
- A penknife that opens to show or conceal the blade is a mechanism.
- A seesaw is a mechanism as it moves around a central pivot or fulcrum.

Forms of Motion

There are four main forms of motion in mechanical systems:

1. **Linear Motion**: Movement in a straight line. Example: A car driving down a road.

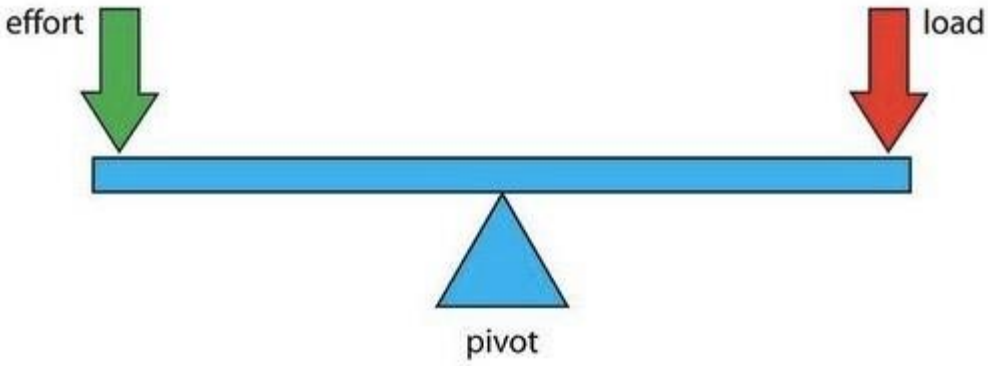
2. **Rotary Motion**: Circular movement around an axis. Example: The wheels of a bicycle.

3. **Reciprocating Motion**: Back-and-forth movement. Example: A piston in an engine moving up and down.

4. **Oscillating Motion**: Movement back and forth in a regular rhythm. Example: A swing moving back and forth.

Understanding Levers

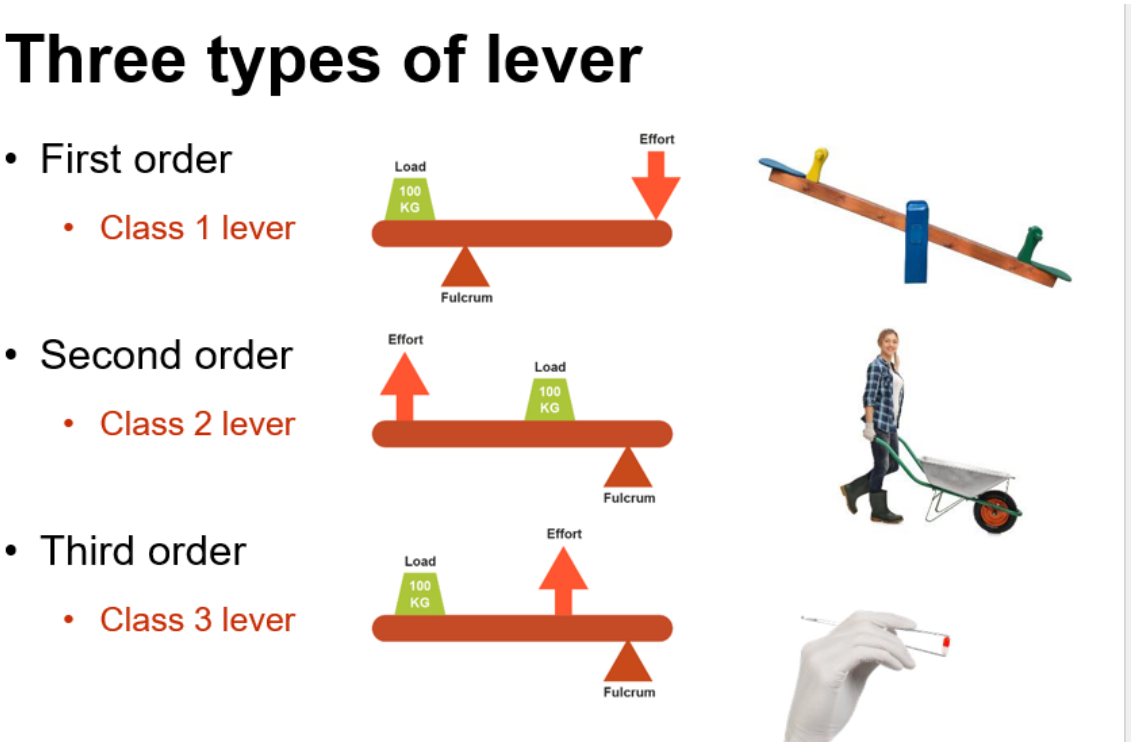
A lever is a simple machine that helps lift or move loads. It works by rotating around a point called the fulcrum. There are three classes of levers:



- The **load** is the weight being moved, lifted or squeezed
- The **effort** is the energy used to move the load
- The **fulcrum** is the point at which the lever balances, grips or pivots around

There are 3 different class of lever

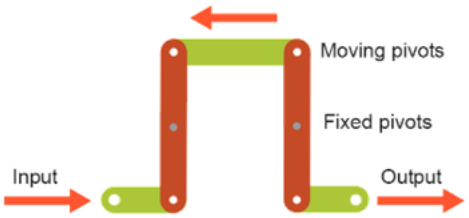
- **Class 1**: The fulcrum is between the effort and the load. Example: A seesaw.
- **Class 2**: The load is between the fulcrum and the effort. Example: Wheelbarrow.
- **Class 3**: The effort is between the fulcrum and the load. Example: A pair of tweezers.



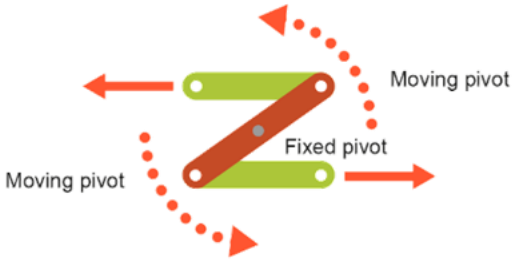
Linkages

Linkages connect parts of a mechanism and allow movement. There are different types of linkages, such as:

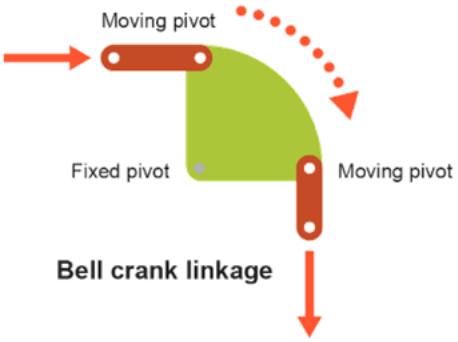
- **Parallel Motion Linkages**: Used in tools like cantilever toolboxes.
- **Reverse Motion Linkages**: Found in door mechanisms.
- **Bell Crank Linkages**: Used in steering and braking systems.
- **Crank and Slider Linkages**: Commonly found in pumps and compressors.



Parallel motion linkage



Reverse motion linkage



Bell crank linkage

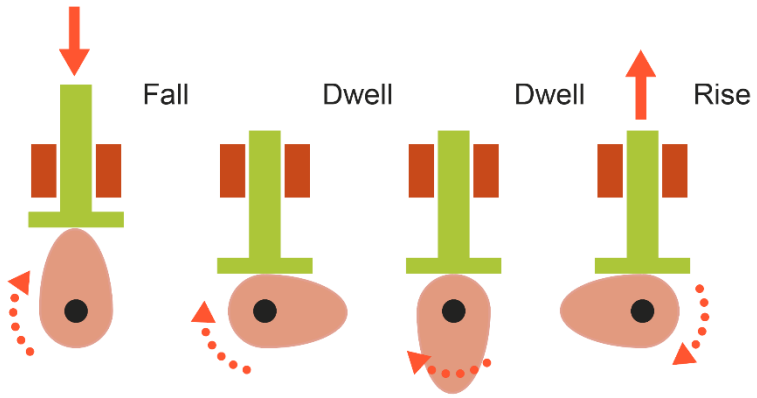
Crank and slider

Cams and Followers

Cams are rotating disks that convert rotary motion into linear motion. Followers are attached to cams and move up and down as the cam rotates. There are different types of cams, including:

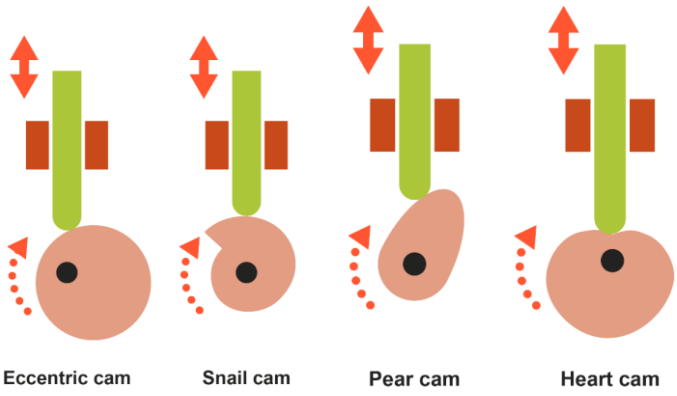
A cam in movement

- The lift it is known as the **rise**
- When it lowers it is known as the **fall**
- The **dwell** phase is the point at which the follower does not move



Types of Cams

- **Eccentric Cam**: Has a steady rise and fall.
- **Snail Cam**: Has a long dwell, then a sudden drop.
- **Pear Cam**: Rapid rise and fall with a long dwell.
- **Heart-shaped Cam**: Slight rise and fall with no dwell.



Understanding how cam and follower mechanisms work is essential for designing automated systems.

Health & Safety

Health and Safety in the Design and Technology Workshop

Safety is a top priority in any workshop. Establishing clear rules and guidelines helps to protect everyone involved. Here are some important workshop rules to keep in mind:

1. You must never enter the Design Technology room unless there is a teacher present.
2. All bags should be placed under the table at all times.
3. You must treat all workshop equipment with respect and leave the room tidy.
4. Horseplay and any unruly or inattentive behaviour will not be tolerated in the workshop.
5. Machines, tools and equipment must be used in the correct manner and never misused.
6. Aprons must be worn and fastened correctly.
7. Protective goggles, ear defenders and/or masks must be worn when the warning signs specify or when the teacher instructs you to.
8. Students MUST always walk around the D&T Room with caution when carrying materials, tools or projects.
9. All sharp objects MUST be carried with points facing down. (e.g. Chisels, saws etc.)
10. When operating machinery, loose jewellery (Necklaces, earrings, bracelets, rings, watches etc.) must be removed or made safe.
11. Long hair must be restrained (Either tied back, under a hairnet or pinned back) at all times.
12. Machines must not be left unattended at any time during operation, unless instructed to do so.
13. Machinery is to be operated by only one person at a time.
14. Protective guarding must be used if fitted to the machine.
15. Ensure trolley wheels are locked before using any machines.
16. You must not distract another student whilst a machine is in operation.
17. When a machine or piece of equipment is operational, never attempt to touch any of the moving parts. In an emergency, power should be switched off first.
18. Never touch sharp items (Even if the machine is not operational)
19. All spillages must be attended to and cleared immediately.
20. All breakages/damage must be reported to the teacher immediately.
21. Exhaust/dust fume extractors must be used at all times when appropriate.
22. You must put away all equipment and leave the room as you would like to find it

Personal Protective Equipment (PPE)

PPE is crucial in minimising exposure to hazards in the workshop. It includes various protective gear that helps prevent injuries. Below are some types of PPE commonly used in Design and Technology:

- **Dust Masks**: Used when sanding or sweeping to prevent inhalation of dust.
- **Respirators**: Protect against inhaling toxic fumes.
- **PVC Aprons:** Protect clothing and skin from chemicals.
- **Earmuffs and Earplugs**: Safeguard ears from excessive noise.
- **Gloves**: Protect hands from sharp edges and rough materials.
- **Safety Glasses/Goggles:** Protect eyes and face when using tools.

Safety Symbols and Colours

Recognizing safety symbols and colours is essential for maintaining a safe workshop environment. Be aware of these symbols and their meanings:

- Red: Danger or stop.
- Yellow: Caution or warning.
- Green: Safety or go.
- Blue: Mandatory action.

SAFETY COLOUR	MEANING	SHAPE	EXAMPLE
RED	• Fire-fighting equipment		
	• Prohibition		
YELLOW	• Hazard • Caution • Possible Danger		
GREEN	• First-Aid • No danger • Safe condition • Positive action		
BLUE	• Mandatory • Information		

Approach to Safety

When working in the workshop, always take your 'TIME' to assess the situation:

- **Task:** Look at the job you are doing.
- **Individual:** Consider your own safety and well-being.
- **Machine**: Understand the equipment and tools you are using.
- **Environment:** Be aware of the surroundings and potential hazards.

Workshop Safety Features

Workshops are equipped with safety features to protect users:

- **Electrical Safety Features:** Isolation switches and emergency stop buttons.
- **Dust Extraction:** Reduces the risk of inhaling harmful dust.
- **Machine Guards:** Protect users from moving parts.
- **Fire Extinguishers:** Ensure a quick response to fires.