

| Name | What is it/are they though? | Where is it/are they used? | Types/varieties | Calculations/Considerations etc? | Need to know... |
|--------------------|---|---|--|---|--|
| Levers | Devices that give you a mechanical advantage, i.e. they make life easier by allowing you to move something heavy or apply a much greater force or increase the movement of something. | Bicycle brakes, nut-cracker, tweezers, spanner, scissors, crow-bar. | <ul style="list-style-type: none"> •Class 1: Effort-Fulcrum-Load •Class 2: Effort-Load-Fulcrum •Class 3: Load-Effort-Fulcrum •Bell-crank | <p>Moment (measured in Newton meters Nm) = Force (measured in Newtons N) X Distance (measured in Meters m)</p> <p>Distance is always the horizontal distance to the fulcrum or pivot.</p> | Moment is a measure of the twisting force or torque. Remember the demo where Anna Cook held a pot of paint and was fine whilst it was by her side when the horizontal distance to the pivot (her shoulder) was small. As soon as she lifted the pot up it created a turning force that caused her to struggle. The pot hadn't increased in weight; it was exerting a greater torque. |
| Linkages | Usually ways of connecting levers together to transmit force/motion. | Pedal bin, silicone sealant gun, mechanical grabber, can crusher | | | Linkages are almost always attached to levers by pivots so that they can move. Common ways of doing this are by using a rivet or a nut and bolt in which the nut is not fully tightened and prevented from undoing by a Nyloc. |
| Gears | Toothed gears that mesh together to transmit rotary motion. | Car gear-boxes, drills, children's toys, food blenders. Most things that have an electric motor, in fact. | <ul style="list-style-type: none"> •Gear train •Compound gear train •Bevel gear •Worm gear •Helical | <p>Velocity Ratio = No. Teeth Driven / No. Teeth Driver</p> <p>N.B. VR does not have units.</p> <p>Speed of Driven = (No. Teeth Driver / No. Teeth Driven) X Speed of Driver</p> <p>Answer is usually rotations per minute or rpm.</p> | Idler gear doesn't affect the speed or torque. It simply keeps input and output turning in the same direction. Worm gear has one continuous tooth so ratio is always <u> </u> :1. Gears require lubrication - oil or grease - to make them run smoothly. You don't get something for nothing. By speeding up the mechanism you are decreasing the torque and <i>vice versa</i> . |
| Chain and Sprocket | Toothed sprockets that are connected by a chain | Bicycles, motorbikes, car engines. | Derailleur is a mechanism that moves the chain from one sprocket to another on a bicycle (go and have a look). | As above. | Good transmission of power but noisy and require lubrication (as above). Input/Driver rotates in the same direction as Output/Driven |
| Pulley and belt | Pulley wheel is a wheel with a groove in its circumference in which a rubber belt runs. | Pillar drills, children's toys. | <ul style="list-style-type: none"> •Vee-belt, flat belt, toothed belt. •Pulley cone | As above but using the diameter \varnothing of the pulley rather than the number of teeth. | Can slip (although not the toothed belt). Easy to change ratio. Smooth relatively quiet. No lubrication because friction here is a good thing. Sometimes use a jockey wheel to keep the belt tight (in tension). |
| Crank | Used to describe a point connected off-centre to a drive-shaft. | Pedals on a bike, handle on a whisk. | Crank and slider; rotary to oscillating | The closer the crank is to the centre of rotation, the less the movement. | Used to convert rotary to reciprocating motion or <i>vice versa</i> . |
| Rack and Pinion | Straight set of teeth that engage with a toothed gear. | Mechanism to lower drill on pillar drill | | | Used to convert rotary to linear motion or <i>vice versa</i> . |
| Cams and followers | Odd shaped discs that rotate whilst the follower, essentially a rod, is in contact with it. | Automaton, car engines. | <ul style="list-style-type: none"> •Lots of different shaped cams, eccentric, snail-shell, pear-shaped etc. •Followers can have rollers that are in contact with the cam for smoother operation. | <p>Stroke = Distance from centre of cam to furthest point - Distance from centre of cam to closest point.</p> <p>This is how far the follower will move each rotation of the cam.</p> <p>Dwell is the angle for which the follower isn't in motion.</p> | Used to convert rotary to reciprocating motion. |

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|------------------|---|--|---|--|--|
| Springs | Erm, springy things. | Anything where you want something to return to its original position. | <ul style="list-style-type: none"> •Compression; think pogo •Tension; think trampoline •Torsion; think clothes peg | | |
| Couplings | Devices to directly connect one rotating shaft to another. This allows some movement between the two shafts whilst still transmitting rotation. | Driveshaft on a car's wheel. | <ul style="list-style-type: none"> •Plain and flexible coupling •Spline | | Just to get your head around what this is, imagine taking two pens and connecting them together with a short length of rubber tubing. If you twist one pen, the other will twist because the rubber tube acts like a flexible coupling. Try it! |
| Ratchet and Pawl | The ratchet is a mechanism where the teeth are shaped to allow the pawl to bounce over them in one direction and engage in the other. | Handbrake mechanism; see if your parents will let you have a go. Don't try this without asking! Freewheel mechanism in a bike. | | | Just think about my fabulous demonstration aid. |
| Bearings | Devices that allow a shaft to rotate smoothly. | Wheel hubs, heavy duty machines. | <ul style="list-style-type: none"> •Plain; Nylon or Brass •Ball bearings •Roller bearings | | Ball and roller bearings are only really required for precision and high quality items. Plain bearings are suitable for smaller applications. |
| CNC Machines | Computer numerically controlled machines that cut material to shape. | Used to cut shapes that have been drawn out on a computer using CAD. | <ul style="list-style-type: none"> •CNC Milling machine •CNC Router •CNC Lathe •CNC Laser cutter | Can adjust the cutting tool rotational speed, the number of times the cutter passes over the material. Material needs to be clamped down or held securely for all except laser cutter. | Milling machines and routers use cutting tools that spin and wear away the material to create the required shape. Lathe spins the material whilst the cutter stays still. You all know what the laser does. All of these machines generate waste so are not suitable for mass production. |
| Clutches | Used to connect/disconnect the drive from one shaft to another. | Car gearboxes, agricultural machines. | <ul style="list-style-type: none"> •Dog clutches •Friction plate clutches •Centrifugal clutches | | Surely you'll never forget these particular demonstration aids? |
| Brakes | Used to slow down mechanisms. | Cars, bikes etc. | <ul style="list-style-type: none"> •Disc •Drum •Cable or hydraulically operated | Cable brakes are usually connected to a brake lever, so you may need to calculate the force generated by the brake lever. When the cable is pulled that force is transmitted to the brake. The brake itself is usually mounted on a lever. | Disc brakes cool down quicker - remember that the kinetic energy is converted to heat - but are vulnerable to water. Drum brakes are better protected but are worse at losing heat. Cables will eventually stretch or fray. Hydraulic systems are better at transmitting the force because the hydraulic fluid is contained in a flexible tube |