# Abraham Darby Academy

# KS3 Physics | Forces

Knowledge Series |Study Booklet | 2017

# Key terms

- **A force**: is an action that makes something or someone move.
- **Force**: = mass × acceleration. Force is measured in Newtons (N). Mass (m) is measured in kilograms (kg). Acceleration is measured in metres per second squared, ($M/S^2$).
- **A Moment**: is a turning effect of a force.
- **A spring**: usually of coil type that is used to offer resistance to a force tending to compress or extend the spring.
- **Elasticity**: is the ability of a material to return to its original shape after being stretched or compressed. When an elastic material is stretched or compressed, it exerts elastic force.
- **Electrostatic force:** is a force that acts between two charges.
- **Friction**: is a force that opposes motion.
- **Centrifugal force**: is a force, arising from the body's inertia, which appears to act on a body moving in a circular **path and is** directed away from the centre around which the body is moving.
- **Centripetal force:** is a force which acts on a body moving in a circular path and is directed towards the centre around which the body is moving.
- **Torque:** is a measure of how much a force acting on an object causes that object to rotate.
- **Pivot or Fulcrum:** is a fixed point (e.g. a seesaw) supporting something that turns or balances.
- **Pressure:** stress or force acting in any direction against resistance. Force applied uniformly over a surface, measured as force per unit of area.
- **Permanent magnet:** a magnet that retains its magnetic properties in the absence of an inducing field or current.
- **Electromagnet:** a soft metal core made into a magnet by the passage of electric current through a coil surrounding it. This magnet can be switched off and on.
- **Magnetic:** A metal that comprises of a majority iron (i.e. steel alloy) that can be magnetized, or attracted to a magnet.
- **Gravity:** The force of attraction between all objects. The more mass an object has, the larger the force of gravity it exerts.
- **Mass:** The amount of matter an object contains. Mass is measured in kilograms (kg).
- **SI:** Standard International System of Units.

**Task**: Identify which of these Olympic sports uses pushes and which use pulls?

| Sport | Push or pull? |
|---|---|
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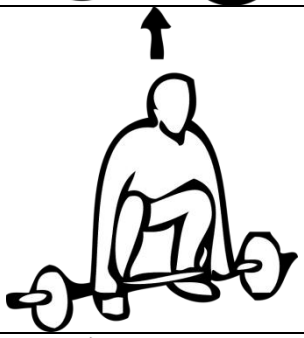
|  | |
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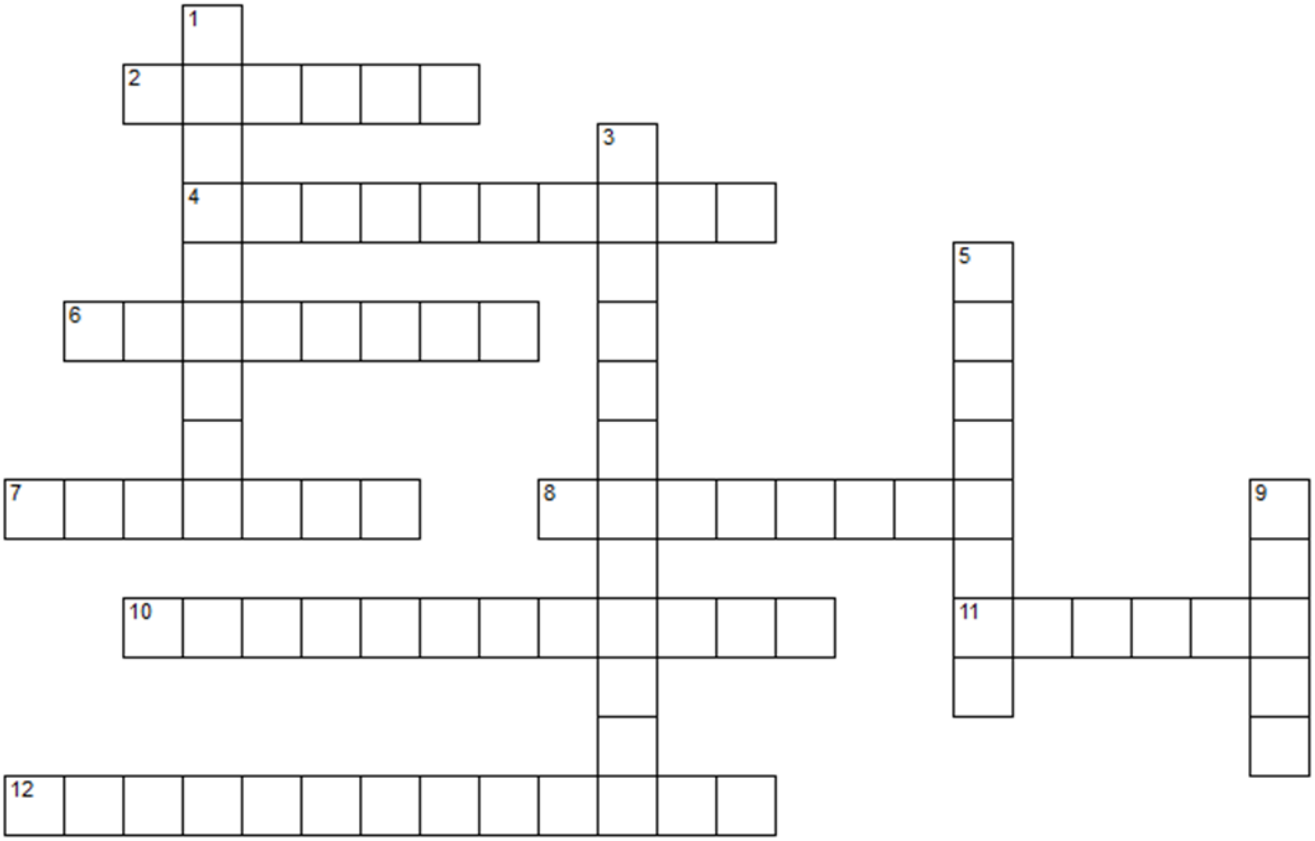
A **force** is an action that makes something or someone move.

**Task:** Sketch common examples of three types of forces you regularly experience.

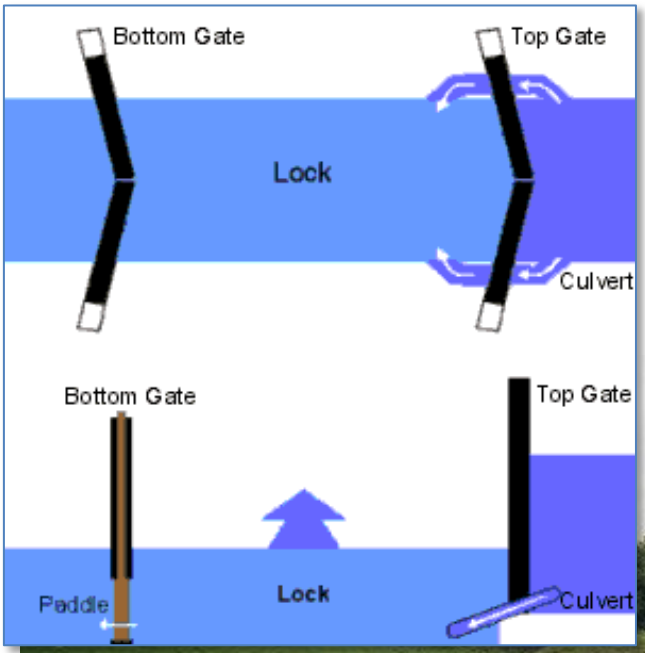
| Force | Example |
|---|---|
| **Push** | |
| **Pull** | |
| **Twist** | |

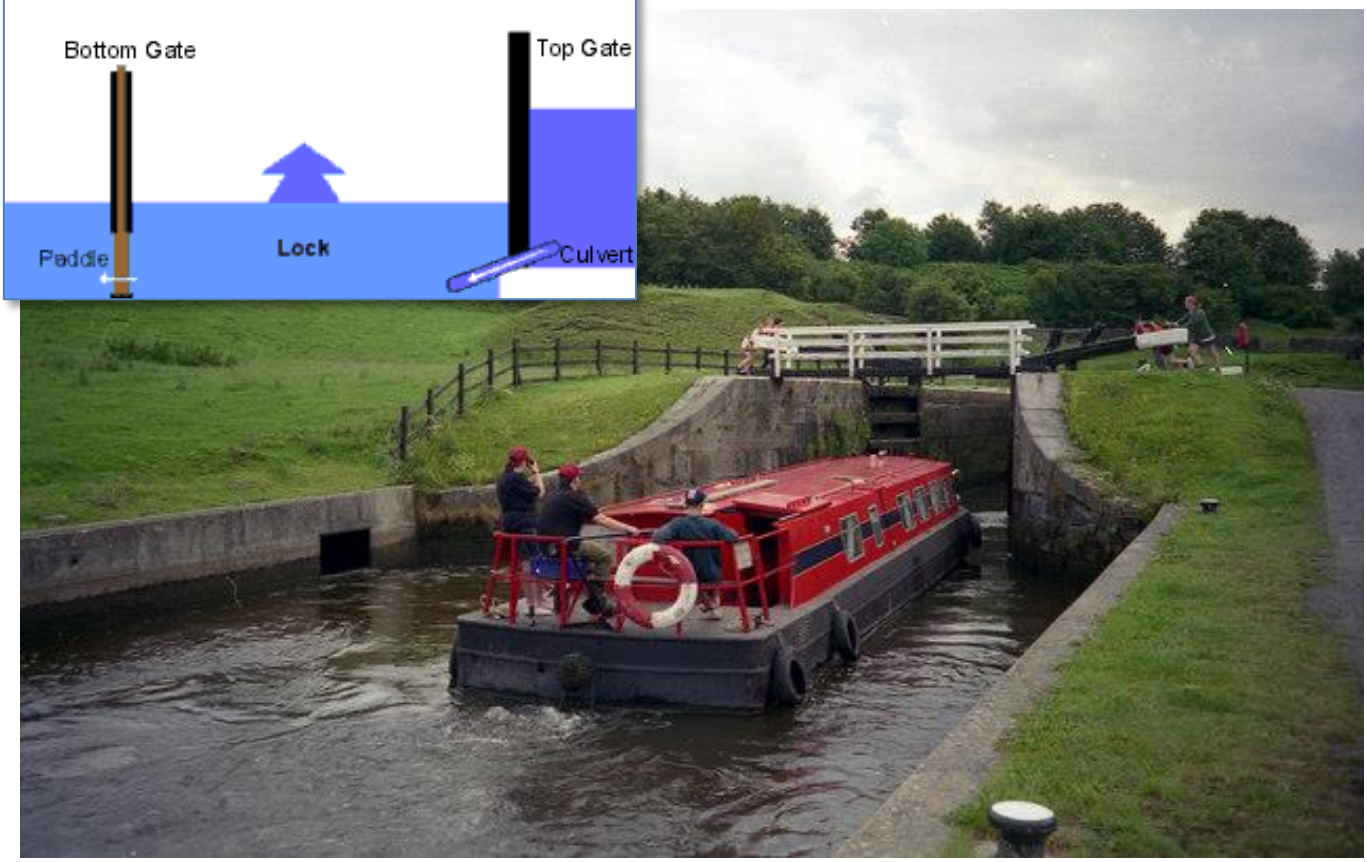
**Task**: Complete the crossword on forces using the clues at the bottom.




| ACROSS | DOWN |
|---|---|
| 2 This force always pulls downwards.<br><br>4 Two forces in opposite directions, but NOT the same size are called…..<br><br>6 The force from water pushing up<br><br>7 The unit we use to measure forces.<br><br>8 A force from the **ground** that pushes back against the way you are going.<br><br>10 Slowing down.<br><br>11 The force from this pushes a car forwards.<br><br>12 This force pushes back against cars **and** aeroplanes | 1 The total force acting on me.<br><br>3 How quickly you are speeding up.<br><br>5 Two forces the same size, but opposite directions are called….<br><br>9 Distance ÷ time |

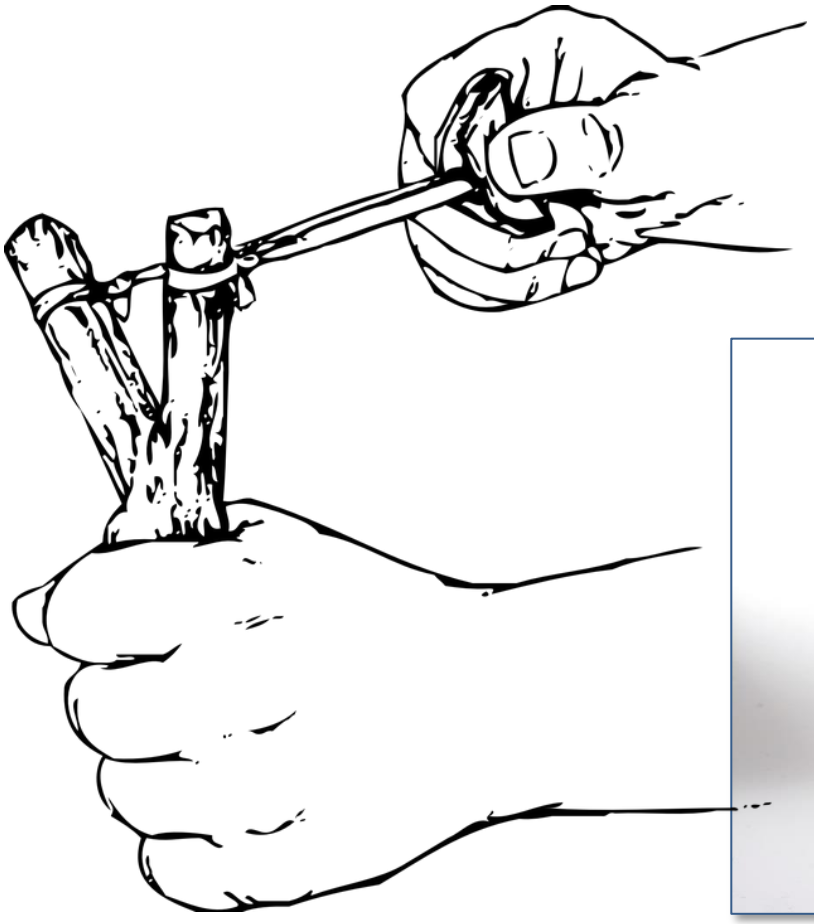
**Task**: Identify and label the different forces used to propel the narrow boat towards the lock gates. Identify and label the forces that are required to move the boat through the locks (open and close the gates) through to higher ground.

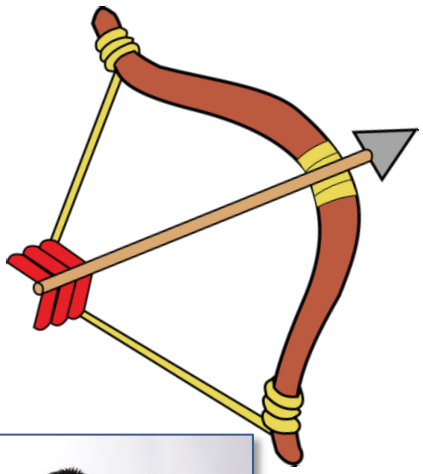


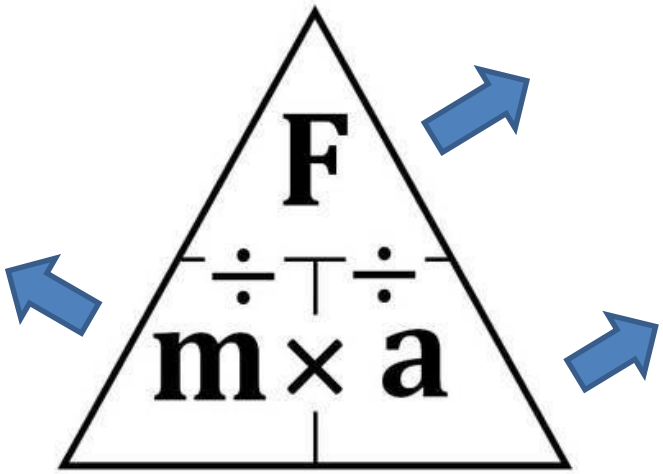
**Elasticity** is the ability of a material to return to its original shape after being stretched or compressed. When an elastic material is stretched or compressed, it exerts **elastic** force.

**Task:** These three objects all exploit elastic force. Explain how each makes use of elasticity, and list the typical materials for each.

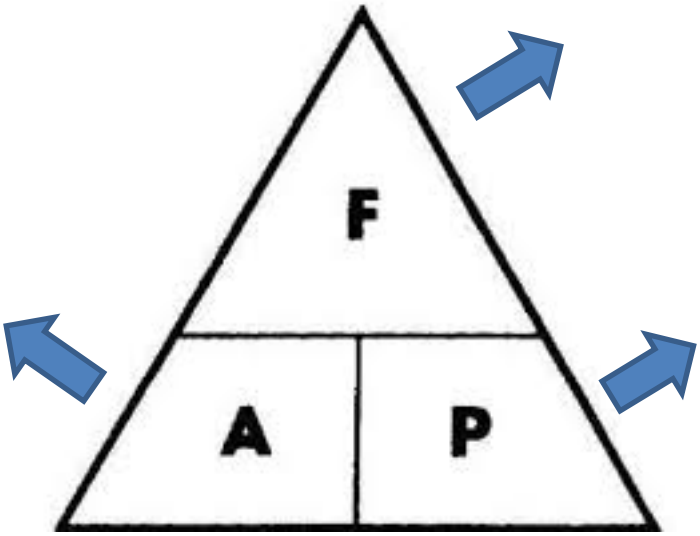




**Task**: Label the three primary parts of this force equation triangle. Ensure you add the SI units for each.



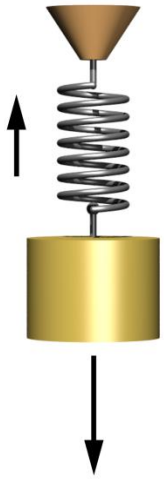

**Task**: Label the three main components of the pressure equation triangle below. Ensure you add the SI units for each.

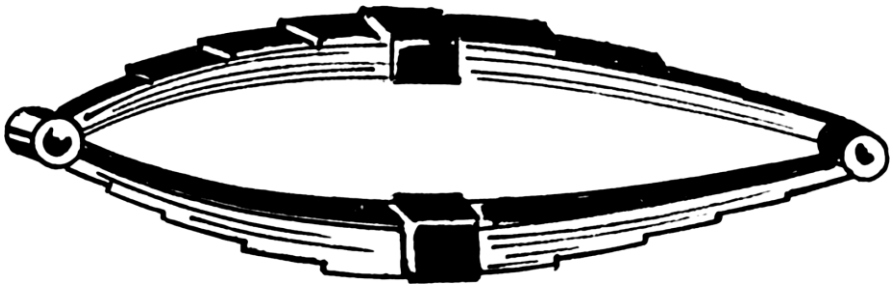


We know exactly how much some springs move when under load, and so they are used for measuring force/weight/movement, etc. Springs can also just hold something firmly in place to stop it moving – whilst also being part of an electric circuit. Springs make use of elastic force to operate effectively.

**Task**: Identify two different uses for each spring type in the table below, and correctly label the three spring types below.

| Leaf spring uses | Compression spring uses | Extension spring uses |
|---|---|---|
| | | |
| | | |





**Task**: How many examples of springs or suspension can you identify on this mountain bike? Explain how each one uses elastic force.


**Task**: How do the gears and the chain help to transmit the forces from the rider's legs into forward motion?

**Task:** Fill in the blanks for the following magnetic force statements. Use the words in bold below.

**steel** **copper winding** **magnetic** **iron** **steel**
**non-magnetic** **ferrous** **stronger** **electric**

- Closer lines indicate _____ magnetic fields, whereas lines further apart are weaker.
- A magnet is made out of _____, which is a blend of _____and other elements.
- All _____ metals are magnetic and all non-metals are _____.
- A compass needle is_____. You can make a compass using a _____needle and a magnet.
- You can make an electromagnet, using a core of steel, _____, and a small _____ charge.

**Task:** Which of the following materials would be attracted by a magnet?

| Materials | Magnetic – yes or no? |
|---|---|
| iron filings | |
| cooking tin foil | |
| steel bolts | |
| pencil rubber | |
| plastic pen tops | |
| Play Doh | |
| hardened steel chisel | |
| steel flooring nails | |
| brass door knocker | |


The earth has a strong magnetic field due to its molten core of iron. Compasses always point to magnetic north.

**Task:** Draw in the line of **true** north<>south, and the line indicating **magnetic** north<>south on the globe below. Then draw in lines (with direction arrows) around the globe to show how the magnetic fields flow around the earth.

**Task:** Find the forces by following the clues on the left.

| Clues | Answers |
|---|---|
| A force which pulls you down. | _____ |
| This force helps to hold things to fridge doors. | _____ |
| Type of force needs to touch something to affect it. | _____ |
| This force rubs things away. | _____ |
| This force helps a ship float. | _____ |
| A form of electricity which can attract things. | _____ |

**Task:** Now try to find the words in the word search below. Mark all the contact forces in **red** and the non-contact forces in **blue**.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| W | F | R | I | C | T | I | O | N |
| S | R | A | O | P | D | Y | Q | L |
| A | F | C | H | R | T | Y | U | M |
| S | T | E | O | I | U | F | S | J |
| I | S | I | V | N | P | I | T | P |
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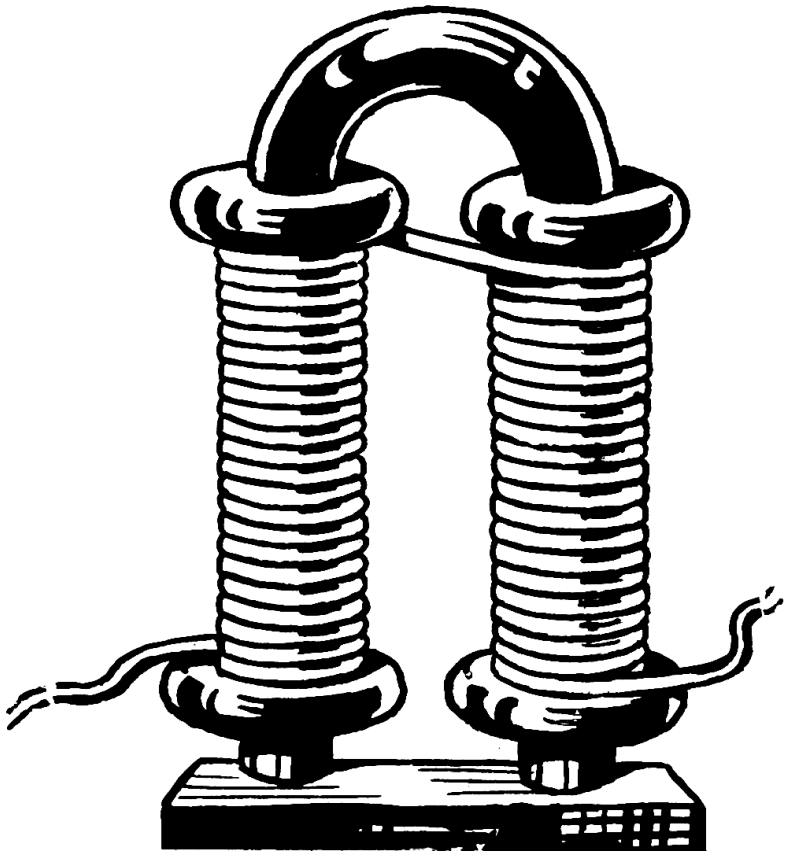
| B | R | N | I | E | H | A | I | E |
| G | I | K | N | O | R | U | C | L |
| R | C | G | D | I | U | E | M | T |
| S | A | I | B | O | S | K | F | U |
| M | F | S | T | A | T | I | C | Z |

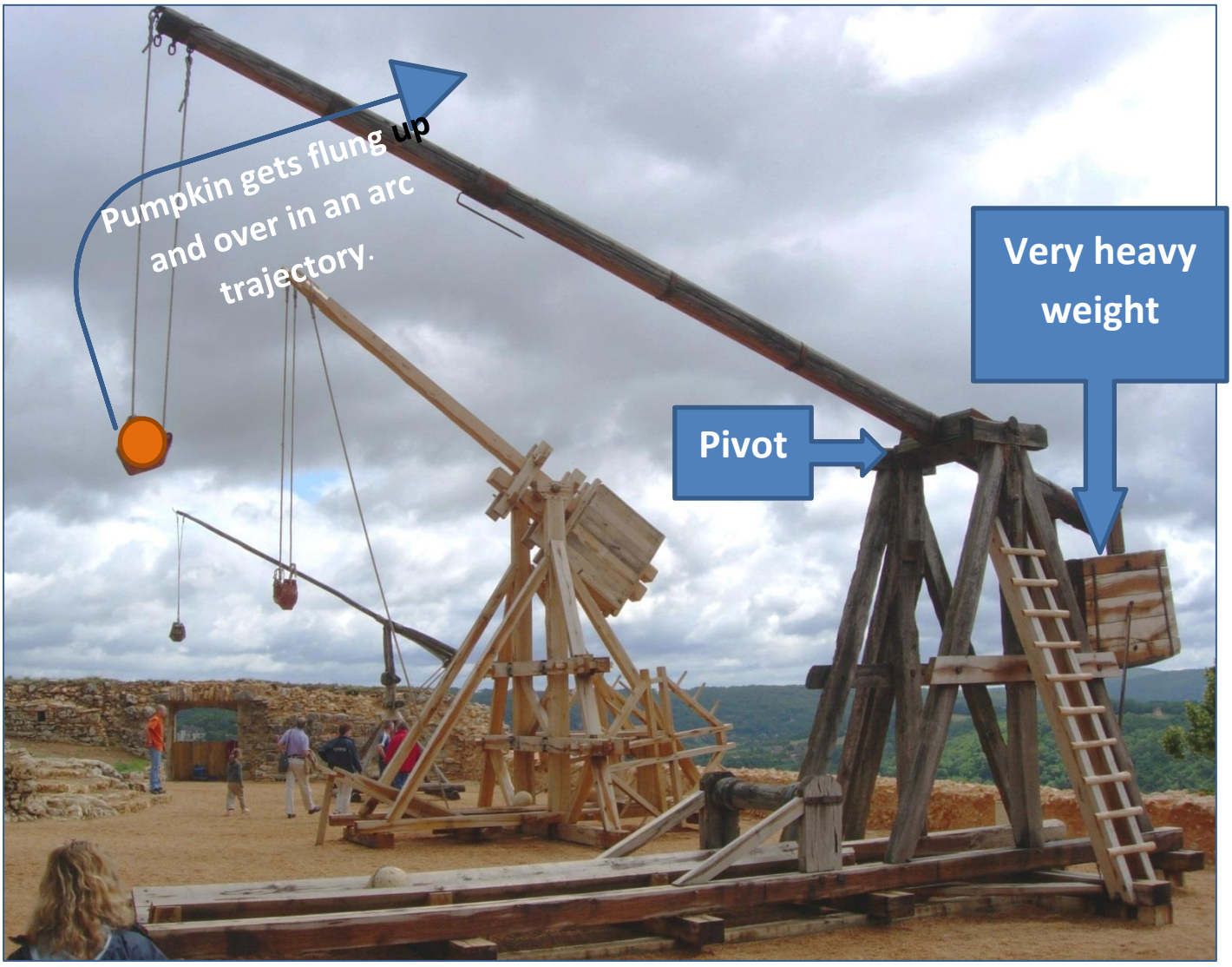
**Task:** Label the two primary parts of this crude electromagnet. Next, draw in a complete circuit with power cell. Using standard symbols, indicate how the current would flow.



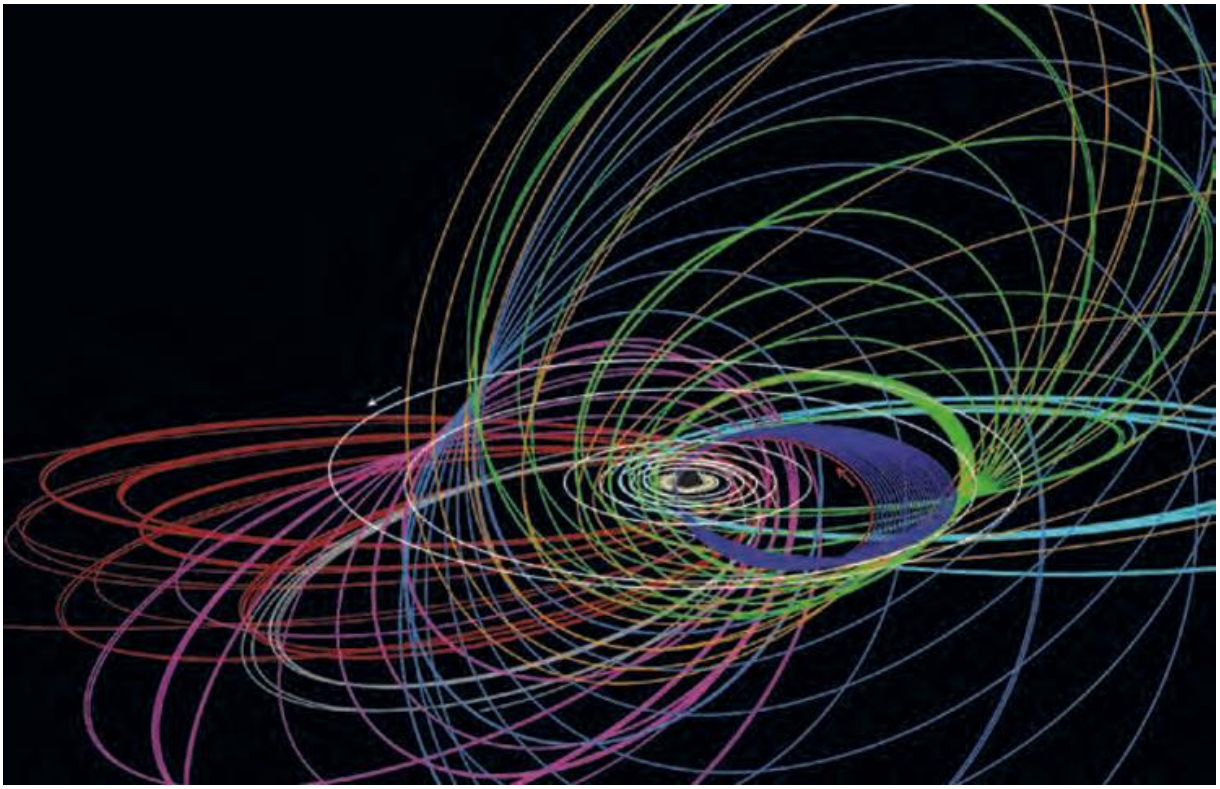
**Task:** Explain how you could take advantage of the properties of an electromagnet in an industrial/work setting.

**Scene**: These homemade trebuchets are used to fling pumpkins over huge distances.

**Task:** What forces are at work on the pumpkin to make it shoot off so far? Label the diagram with the different forces you can think of.

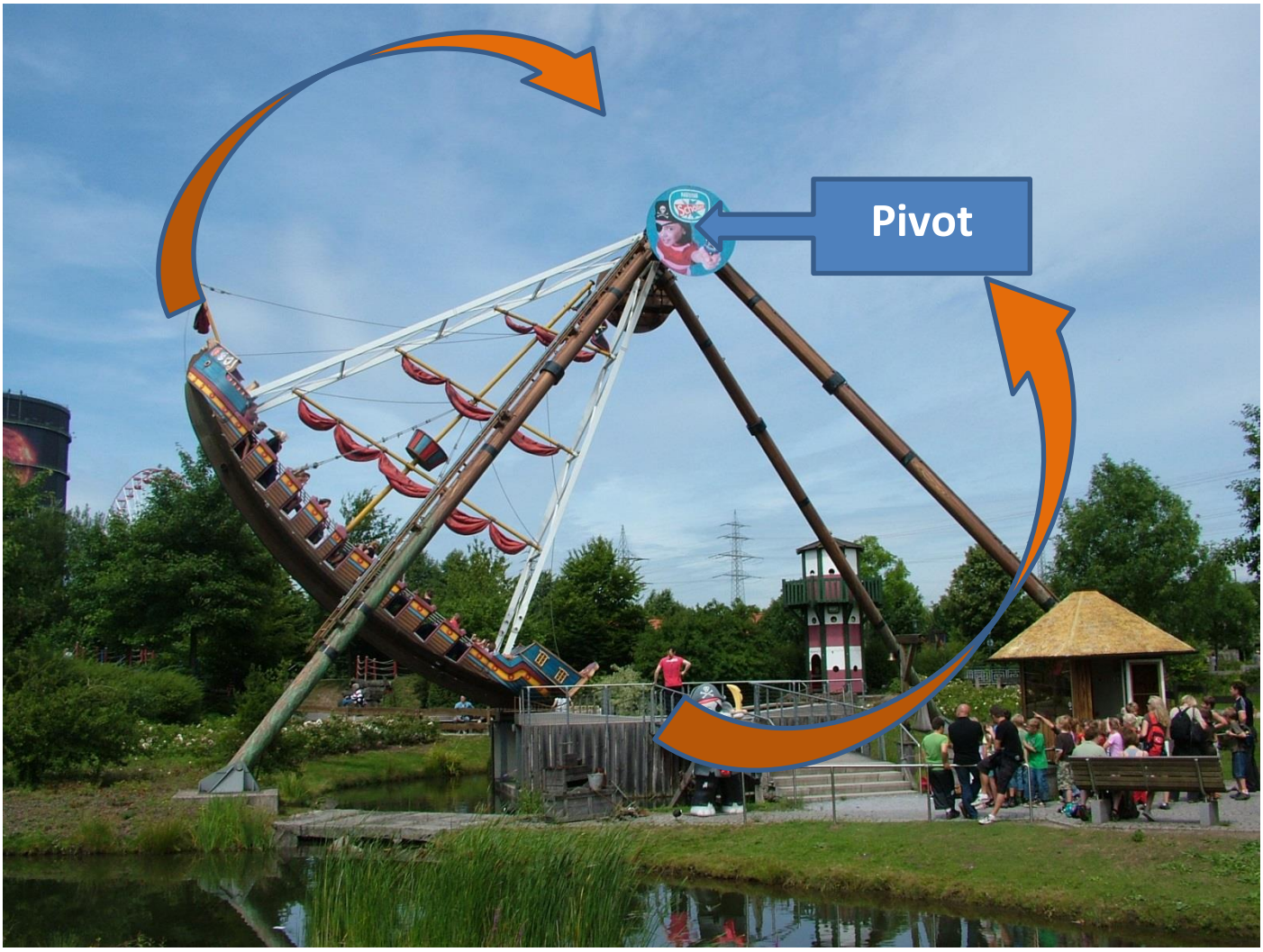


**Task:** What force/s makes the planets in our solar system travel around the sun in an ellipsis shaped path?



**Task:** What force enables the riders on this fairground attraction to be pushed outwards on the suspended swings as the central pillar spins faster?

**Task:** What forces are at work with this pirate ship ride? Why do you feel lighter as the boat reaches the highest point, than you do at the bottom of the swing?



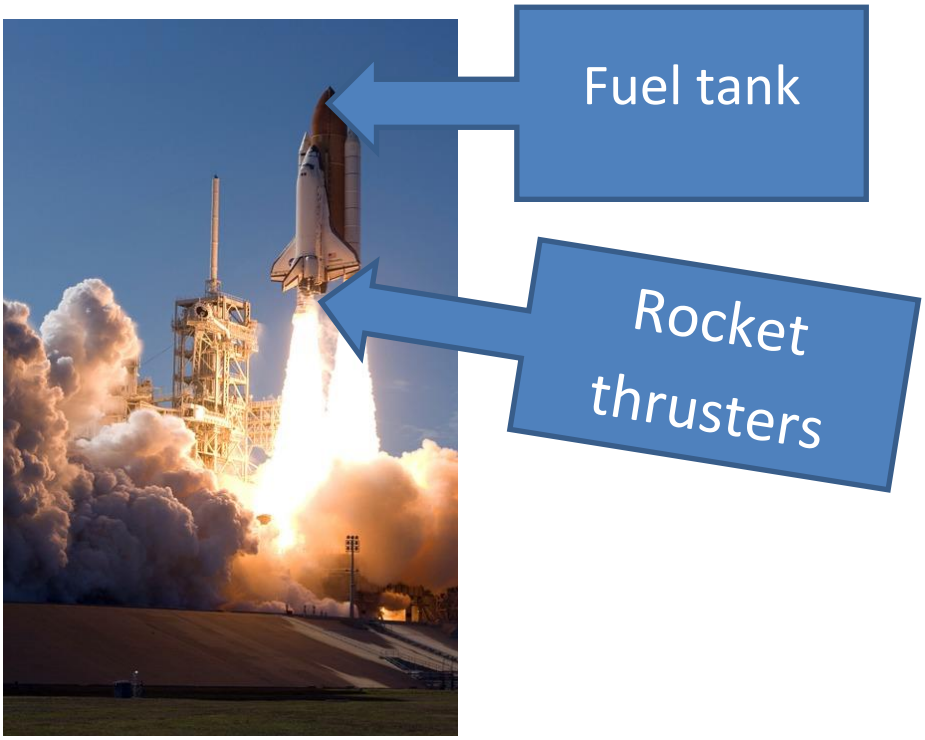

**Task:** If the pirate ship ride was able to spin a full 360 degrees, what force would help you from falling out if you were upside down?

**Task:** What are the forces at play, when this motocross rider speeds: 1) around the bends, 2) over hills and 3) down slopes? 4) How is he pulled back down to earth after jumping high over the mud ramps?

| Activity | Force type |
|---|---|
| Uphill | |
| downhill | |
| Round an inside corner (berm) | |
| Round an outside corner | |
| Down to ground | |

**Task:** What are the forces that are at play in this "*endo*" scenario (back wheel over front)? Name the forces that lead to this accident and those at play during the accident.

**Task**: The space shuttle needs huge tanks of fuel to lift off into space. Why is this?



**Task**: List two examples for each type of force listed below:

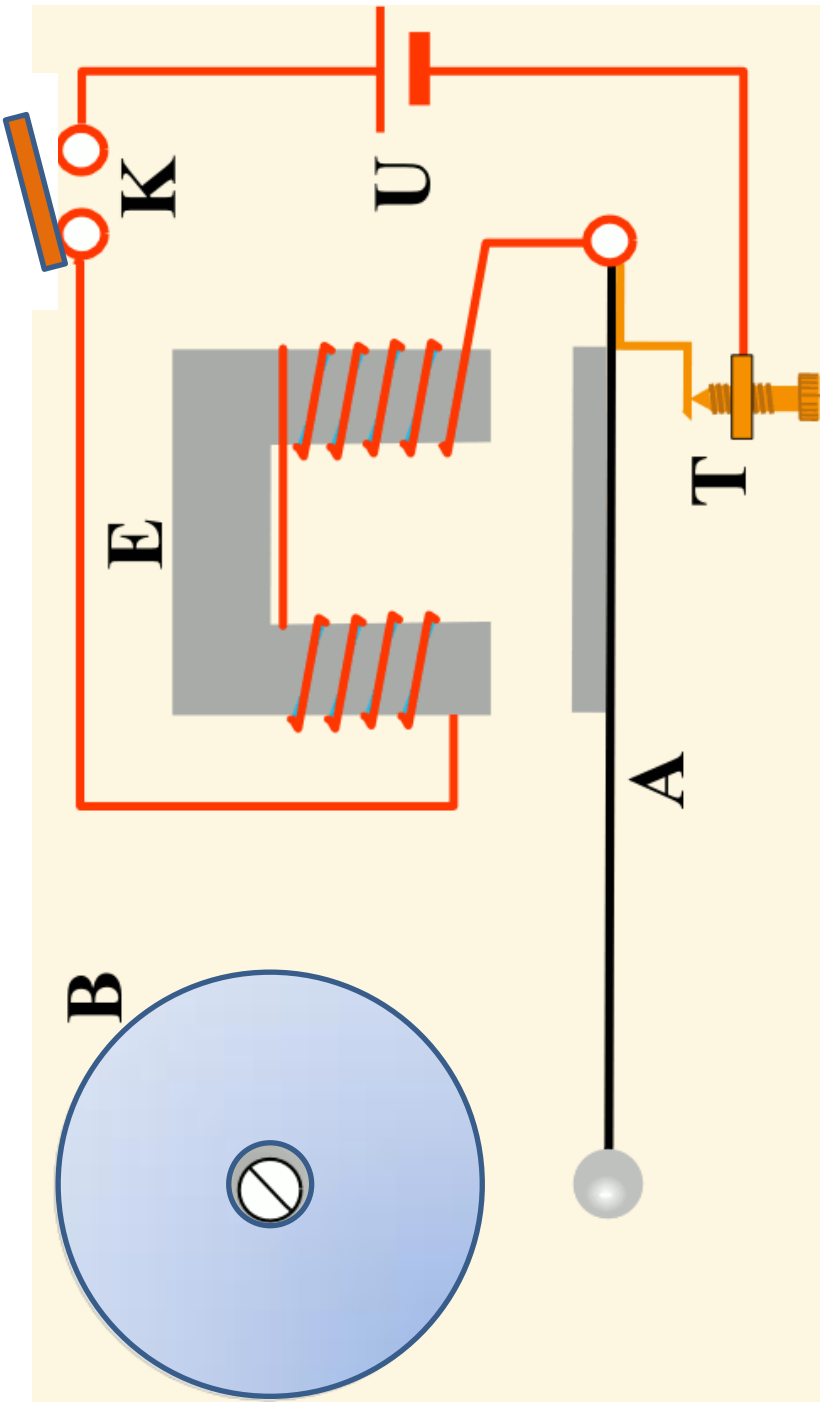
- **Pressure:**_____
- **Low friction:**_____
- **High friction:**_____
- **Elastic:**_____
- **Gravitational:**_____
- **Torque:**_____
- **Magnetic:**_____

**Task**: What is the standard unit of force? _____

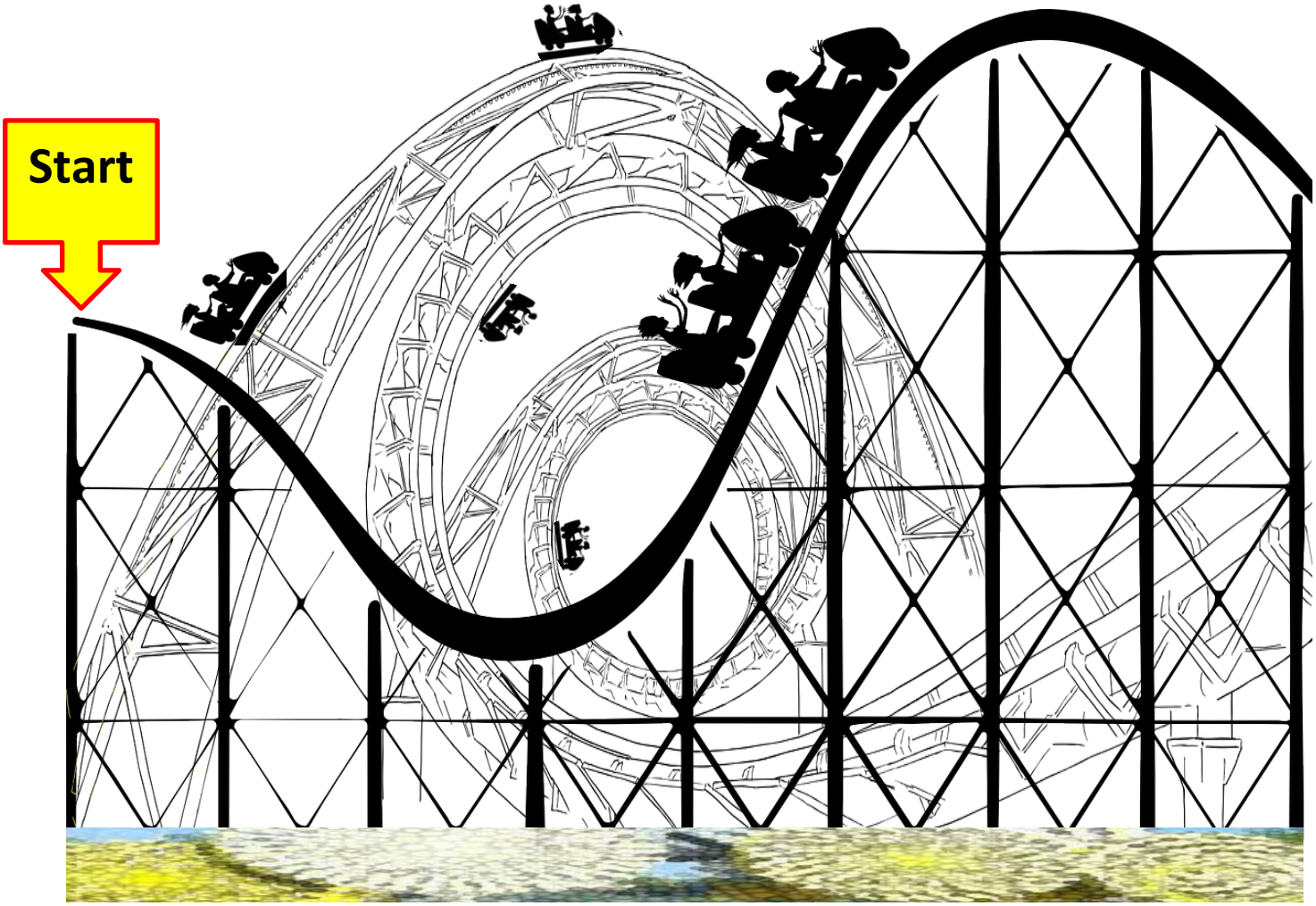
**Task:** Fill in the blanks for this statement about fidget spinners.

You apply a **t**_____ force to begin the spin, and the central bearing helps to reduce **f**_____ to keep it spinning. The three bearings add extra **w**_____.

**Task:** Label all of the parts (A, B, E, K, T, U) on the diagram of the electric door-bell circuit below. Explain how the bell works, and what force is being used.

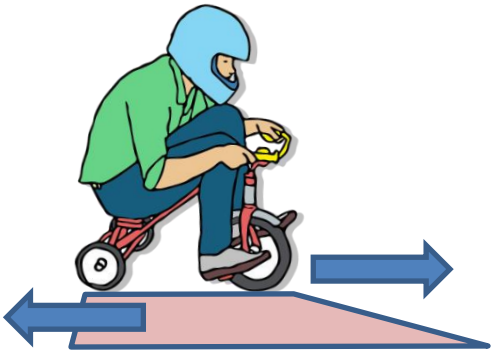


**Task:** Label the diagram with any forces that exist at different parts of this rollercoaster ride. Begin with the initial (slow) climb on the first uphill slope. Why do rollercoasters start so high up, and are made of wide swooping curves rather than sharp corners?



**Scene:** A strong man is pulling a van along the road.

**Task:** What force is he using to do this, and why is it so hard to begin with, but gets slightly easier after he begins? What are the (force) similarities with this lorry and riding a bike?

# NOTES

## Image attribution