9P1 Forces Knowledge Organiser

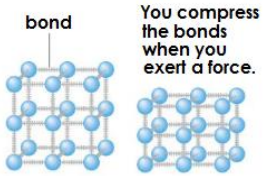
Week 1: Forces Recap

What are non-contact forces?

Every object is interacting in some way with another object even when the 2 objects are not touching via non-contact forces:

- Electrostatics
- Magnetism
- Gravity

These forces arise because charges, magnets and masses can interact over great distances. Electric charges and magnets can repel and attract. Gravity can only attract. These forces are the result of fields. A field is a region where an electrical charge, a magnetic material or a mass experiences a force. Forces are vectors so they need a number and an arrow to show their direction. We call these **force arrows**. You usually draw force arrows for non-contact forces from the centre of the object.




When a tennis ball hits a racquet it is deformed

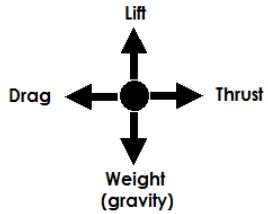
What are contact forces?

When you stand on a diving board the board pushes up on you. Solid surfaces can exert a force on objects that exert a force of them. However this is easy to forget because we don't always see them. E.g. when we sit on a chair, we don't see the chair pushing up on us. This is because the bonds between atoms behave like springs so the movement can be very small. Sometimes the movement happens so fast we don't see it either, like this tennis racquet hitting a ball.

Example of contact force	The interaction pair	The mechanism that produces it
friction on a sliding box	• the force of the box on the surface • the force of the surface on the box	The atoms that make up the surfaces interact when rough surfaces slide over each other.
drag on a falling leaf (drag is air resistance or water resistance)	• the force of the falling leaf on the air • the force of the air on the leaf	The particles of the liquid or gas collide with the object, and the object pushes them away.
normal contact force acting on an elephant	• the force of the elephant on the ground • the force of the ground on the elephant	Solid objects deform slightly when you exert a force on them (Figure 3). The bonds between the particles are compressed.
upthrust on a floating boat	• the force of the boat on the water • the force of the water on the boat	Gravity produces pressure differences in a fluid. The pressure produces a net upwards force.
tension in the cord of a bungee jumper	• the force of the bungee jumper on the bungee cord • the force of the bungee cord on the bungee jumper	Solid objects deform slightly when you exert a force on them (Figure 4). The bonds between the particles are stretched.

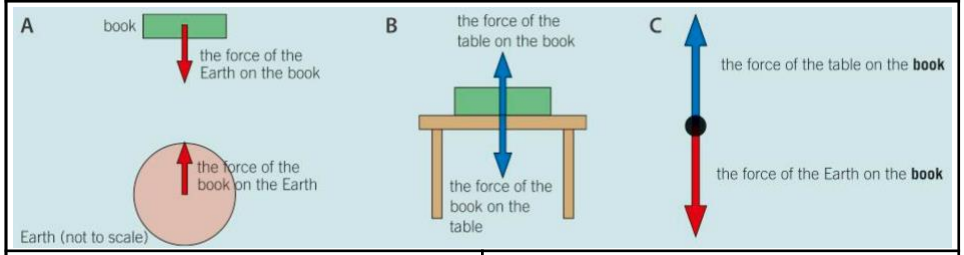
Week 2: Effects of forces

In KS3, we showed which forces were acting on a plane by drawing a plane. However now you are older, we realise trying to draw a fancy plane is a waste of time so we replace the plane (and any other object we are investing) with a dot and then draw the force arrows accordingly. This new method of representing forces is called a **free body diagram**.



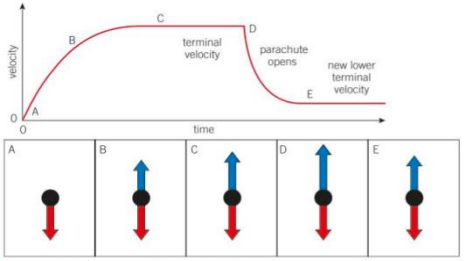
Drawing free body diagrams

Step 1: Focus on a single object.
Step 2: Identify all the non-contact paired forces acting on it
Step 3: Identify all the contact paired forces acting on it.
Step 3: Draw a small circle to represent that object and add the force arrows WITH LABELS. Remember the bigger the arrow, the bigger the size of the force.



Terminal velocity

When you jump out of a plane you accelerate because the force of the air pushing against you is not as strong as gravity. As you accelerate, the force of the air pushing against you increases. Eventually, the force of air resistance is equal to the force of gravity. You stop accelerating. You have reached terminal velocity. When you pull your parachute, the air resistance becomes the larger force and so you slow down.



Newton's Laws of Motion

Newton's First Law of Motion
"An object will continue to stay at rest, or move with a uniform velocity, unless a force acts on it."

Newton's Second Law of Motion
"The acceleration that the resultant force produces on an object depends on the size of the force and the mass of the object." (In other words F = ma)

Newton's Third Law of Motion
"For every action, there is an equal and opposite reaction." (This means forces always come in pairs).

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Week 3: KEYWORDS

component (of a force)
one of two forces that you can use to make up a resultant
contact force
a force that only acts when objects are in contact
drag
a force that acts opposite to the direction of motion of a body
equilibrium
an object is in equilibrium if all the forces cancel – the resultant force is zero
force arrow
a way to model forces
free body diagram
a diagram that shows the forces acting on a single object
friction
a contact force. It occurs because the atoms that make up the surfaces interact when rough surfaces slide over each other
inertia
the measure of how difficult it is to change an object's velocity
net force
the force when two or more forces are added together as vectors
Newton's First Law
the motion (speed and direction) of an object does not change when the resultant force is zero
Newton's Second Law
if the resultant force is not zero the motion of an object (speed or direction) changes
Newton's Third Law
forces come in pairs: the force of *X* on *Y* and the force of *Y* on *X*
non-contact force
a force produced because an object is in a field; the objects do not need to be in contact for the force to act
normal contact force
a force that is exerted by a solid surface on an object. Solid objects deform slightly when you exert a force on them, and the bonds between the particles are compressed
resultant force
the force when two or more forces are added together as vectors
tension
solid objects deform slightly when you exert a force on them, and the bonds between the particles are stretched
terminal velocity
the velocity that a moving object achieves when the resultant force in zero
upthrust
the force of an object in a fluid due to the difference in pressure in the fluid acting on the area of the object
weight
the force due to gravity that acts on an object
work
the transfer of energy. Work is commonly done against gravity or friction. It can be calculated by multiplying force and distance