Contact and non-contact forces

4.5.1.2 · Forces · revision notes

A force is a push or a pull that acts on an object because of its interaction with another object. You need to sort forces into contact and non-contact forces, name the forces acting in a situation, and describe how interacting objects exert forces on each other.

Key facts

- Force = push or pull due to an interaction between objects; unit newton (N)
- Contact forces: friction, air resistance (drag), tension, normal contact force, upthrust
- Normal contact force acts at 90° to the surface
- Interacting objects: equal and opposite forces, acting on different objects
- Force is a vector
- Non-contact forces: gravitational, electrostatic, magnetic
- Friction and air resistance oppose motion

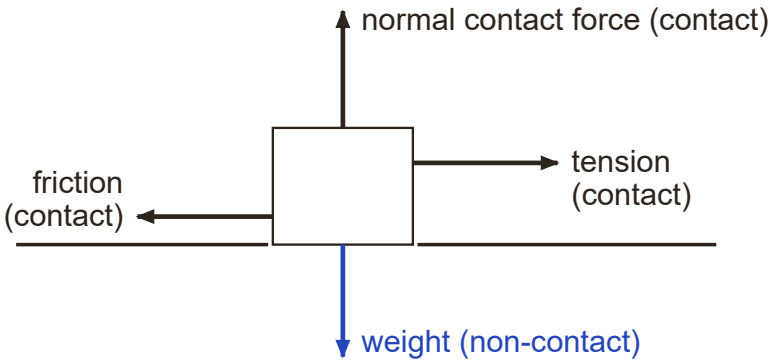
Notes

What a force is

- A **force** is a push or a pull that acts on an object due to its **interaction** with another object.
- Force is measured in newtons (N). It is a **vector** quantity: it has size and direction.
- Forces can change an object's speed, its direction of motion or its shape.

Contact forces: the objects are touching

- **Friction**: opposes motion when two surfaces slide, or try to slide, over each other.
- **Air resistance** (drag): opposes the motion of an object moving through air. Water also exerts drag.
- **Tension**: the pulling force in a stretched rope, string, cable or spring.
- **Normal contact force**: the push of a surface on an object resting on or against it, acting at right angles (normal) to the surface.



The forces on a crate pulled along a rough floor.

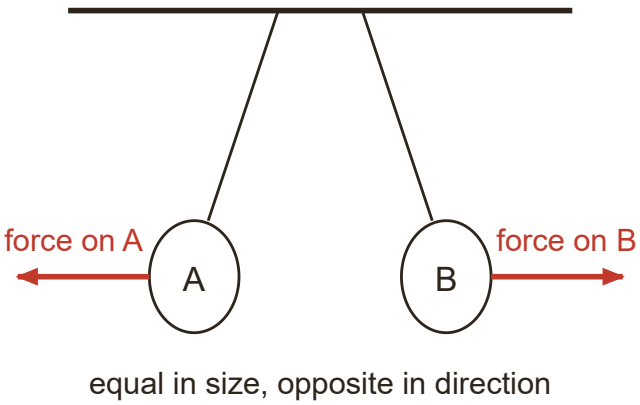
- Upthrust, the upward push of a liquid or gas on an object in it, is also a contact force.

Non-contact forces: the objects are physically separated

- **Gravitational force**: the attraction between masses, e.g. the Earth pulling you down (your weight).
- **Electrostatic force**: the force between electric charges. Like charges repel; unlike charges attract.
- **Magnetic force**: the force between two magnets, or between a magnet and a magnetic material such as iron.

Forces come in pairs

- When two objects interact, each object exerts a force on the other.
- The two forces are equal in size and opposite in direction, and each acts on a **different** object.



Each balloon exerts an electrostatic force on the other: a pair of equal and opposite forces.

- Example: the Earth pulls you down with a force equal to your weight, and you pull the Earth up with a force of the same size.

How to answer each type of question

Classify forces as contact or non-contact

1 to 2 marks | Grade 3

1. Ask whether the objects must touch for the force to act.
2. Touching: contact force. Not touching: non-contact force (gravitational, electrostatic or magnetic).

Example. (a) Which of these is a non-contact force?
air resistance / friction / magnetic force / tension
(b) Give one other example of a non-contact force.

Model answer.

(a) magnetic force (1)

(b) gravitational force (weight) **or** electrostatic force (1)

Name the forces acting on an object

2 to 4 marks | Grade 5

1. Start with weight (down), then look for anything touching the object.
2. A surface gives a normal contact force; a rope gives tension; sliding gives friction; moving through air gives air resistance.
3. Give the direction of each force if asked.

Example. A crate is pulled at a steady speed across a rough, level floor by a horizontal rope.
Name the four forces acting on the crate and give the direction of each.

Model answer.

weight, downwards (1)

normal contact force from the floor, upwards (1)

tension in the rope, forwards (1)

friction, backwards (opposite to the motion) (1)

Describe the interaction between two objects

2 to 3 marks | Grade 5

1. Say that each object exerts a force on the other.
2. Say that the forces are equal in size.
3. Say that they act in opposite directions, and name the type of force.

Example. Two balloons are given the same type of charge. They are hung from threads close together and move apart.
Describe the forces between the balloons.

Model answer.

Each balloon exerts an electrostatic (non-contact) force on the other balloon (1).
The two forces are equal in size (1).
They act in opposite directions, pushing the balloons apart (repulsion) (1).

Don’t lose marks

- Calling weight a contact force. Weight is caused by gravitational attraction, a non-contact force.
- Labelling a force arrow 'gravity'. Write 'weight' or 'gravitational force'.
- Saying the two forces in an interacting pair act on the same object. They act on different objects.
- Drawing friction in the direction of motion. Friction acts opposite to the motion (or attempted motion).

More tips

Memory tricks

- Non-contact forces are GEM: Gravitational, Electrostatic, Magnetic.
- Contact test: would the force stop if you moved the objects slightly apart? If yes, it is a contact force.
- 'Normal' means 'at right angles': the normal contact force is always perpendicular to the surface.

Exam technique

- Use the exact names: friction, air resistance, tension, normal contact force, weight, electrostatic force, magnetic force.
- On force diagrams, draw each arrow starting on the object, pointing the way the force acts, with lengths that show the relative sizes.
- In 'describe the interaction' questions, say that each object exerts a force on the other and that the forces are equal and opposite.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3 **Define a force as a push or pull**
A force acts on an object because of its interaction with another object, and is measured in newtons (N).

Grade 3 **Name examples of contact forces**
Friction, air resistance, tension and normal contact force act when objects are touching.

Grade 4

Name examples of non-contact forces

Gravitational, electrostatic and magnetic forces act even when the objects are physically separated.

Grade 5

Identify the forces acting in a situation

For example, a book on a table has its weight acting down and a normal contact force acting up.

Grade 5

Show forces as vector arrows

Draw each arrow from the object, in the direction of the force, with its length showing the size.

Grade 5

Describe the forces between interacting objects

Each object exerts a force on the other; the two forces are equal in size and opposite in direction.

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