



Non-contact Forces

1. A force is a push or pull that acts on an object due to the interaction with another object.
2. All forces between objects are either **contact** forces or **non-contact** forces.
3. A contact force acts when the objects are **physically touching**
4. A non-contact forces acts when the objects are **physically separated**.
5. Friction, air resistance, tension and normal contact force are examples of contact forces.
6. **Gravitational force, electrostatic force and magnetic force** are examples of non-contact forces.
7. Force is a **vector** quantity, so should have a magnitude and direction.

Gravity, Mass and Weight

8. **Weight** is the force acting on an object due to **gravity**.
9. The force of gravity close to the Earth is due to the gravitational field around the Earth.
10. The weight of an object depends on the gravitational field strength at the point where the object is.
11. The weight of an object can be calculated using the equation:
weight = mass × gravitational field strength

$$W = m g$$

weight, W, in newtons, N

mass, m, in kilograms, kg

gravitational field strength, g, in newtons per kilogram, N/kg

12. The weight of an object may be considered to act at a single point referred to as the object's centre of mass.

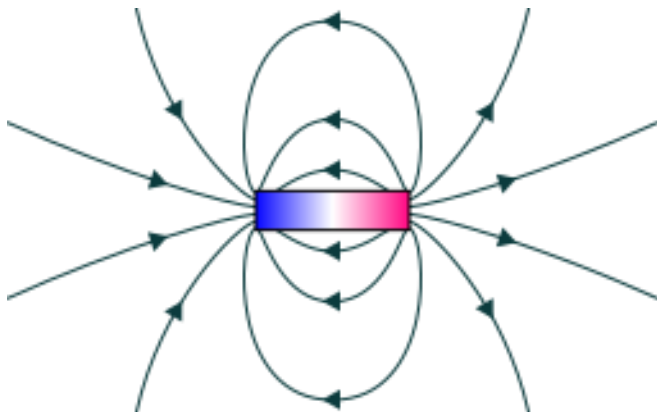
13. The **weight** of an object and the **mass** of an object are **directly proportional**.
14. Weight is measured using a calibrated spring-balance (a Newtonmeter)

Magnetism

15. Magnetism is a non-contact force.
16. The **poles** of a magnet are the places where the **magnetic forces** are **strongest**.
17. When two magnets are brought close together they exert a force on each other.
18. **Two like poles repel** each other.
19. **Two unlike poles attract** each other.
20. Attraction and repulsion between two magnetic poles are examples of non-contact force.
21. A permanent magnet produces its **own magnetic field**. An induced magnet is a material that becomes a magnet when it is placed in a magnetic field.
22. Induced magnetism always causes a force of **attraction**.
23. When removed from the magnetic field an induced magnet loses most/all of its magnetism quickly.
24. The **region around a magnet** where a force acts on another magnet or on a magnetic material (iron, steel, cobalt and nickel) is called the **magnetic field**.
25. The force between a magnet and a magnetic material is always one of attraction.
26. The **strength** of the **magnetic field** depends on the **distance** from the magnet.
27. The field is strongest at the **poles** of the magnet.
28. The direction of the magnetic field at any point is given by the direction of the force that would act on another north pole placed at that point.



29. The direction of a **magnetic field line** is from the **north** (seeking) pole of a magnet to the **south** (seeking) pole of the magnet.



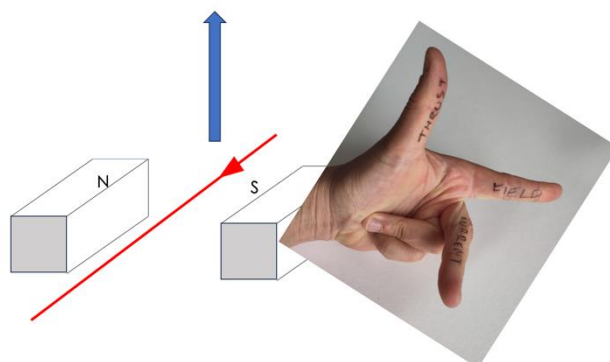
30. A magnetic compass contains a small bar magnet.
31. The Earth has a magnetic field, which acts like a bar magnet.
32. The compass needle points in the direction of the Earth's magnetic field.

Electromagnets

33. When a **current** flows through a conducting **wire** a **magnetic field** is produced around the wire.
34. The strength of the magnetic field depends on the **current** through the wire and the **distance** from the wire.
35. Shaping a wire to form a **solenoid** increases the strength of the magnetic field created by a current through the wire.
36. The magnetic field inside a solenoid is strong and uniform.
37. The magnetic field around a solenoid has a similar shape to that of a bar magnet.
38. Adding an **iron core** increases the strength of the magnetic field of a solenoid.
39. An electromagnet is a **solenoid** with an **iron core**.

The Motor Effect and Fleming's Left-Hand Rule

40. When a conductor carrying a current is placed in a magnetic field the magnet producing the field and the conductor **exert a force** on each other. This is called the **motor effect**.
41. Fleming's left-hand rule represents the relative orientation of the force, the current in the conductor and the magnetic field.



42. For a conductor at right angles to a magnetic field and carrying a current:

$\text{force} = \text{magnetic flux density} \times \text{current} \times \text{length}$

$$F = BIL$$

Force, F , in Newtons, N
magnetic flux density, B , in Tesla, T
current, I , in amperes, A
length, l , in metres, m

43. A coil of wire carrying a current in a magnetic field tends to rotate. This is the basis of an **electric motor**.
44. The force on a conductor in a magnetic field causes the **rotation** of the coil in an electric motor.





Physics Only

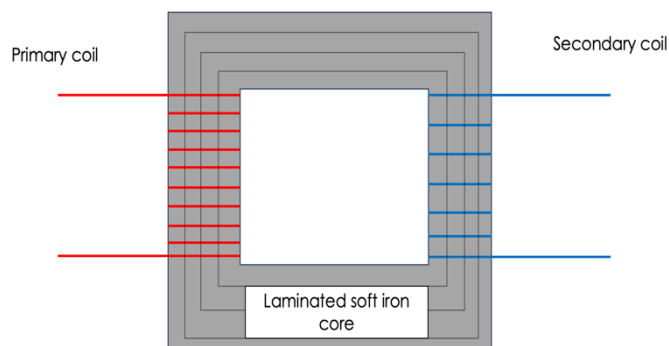
45. **Loudspeakers** and **headphones** use the **motor effect** to convert variations in **current** in electrical circuits to the pressure variations in **sound waves**.

The Generator Effect

46. If an electrical conductor **moves relative** to a **magnetic field** or if there is a change in the magnetic field around a conductor, a **potential difference is induced** across the ends of the conductor.
47. If the conductor is part of a **complete circuit**, a **current is induced** in the conductor. This is called the **generator effect**.
48. An induced current generates a magnetic field that opposes the original change, either the movement of the conductor or the change in magnetic field.
49. To increase the induced voltage, the magnet can be **moved faster**, **more turns** can be added to the coil or the **strength of the magnet** can be **increased**.
50. The generator effect is used in an **alternator** to **generate ac** and in a **dynamo** to **generate dc**.
51. **Microphones** use the generator effect to convert the pressure variations in sound waves into variations in current in electrical circuits.

Transformers

52. A transformer is a device that can



- change** the **potential difference** of an alternating current power supply.
53. A basic transformer consists of a **primary coil** and a **secondary coil** wound on a laminated iron core.
54. Iron is used as it is easily magnetised.
55. The iron core is laminated to minimise eddy currents.
56. The ratio of the potential differences across the primary and secondary coils of a transformer V_p and V_s depends on the ratio of the number of turns on each coil, n_p and n_s .
57. In a step-up transformer $V_s > V_p$
58. In a step-down transformer $V_s < V_p$
59. If transformers were 100% efficient, the electrical power output would equal the electrical power input:

$$\frac{V_p}{V_s} = \frac{n_p}{n_s}$$

60. Potential difference, V_p and V_s , in Volts, V
61. Where $V_s \times I_s$ is the power output of the secondary coil and $V_p \times I_p$ is the power input to the primary coil
62. Power input and output in Watts, W





Electric Fields

- 63. When certain **insulating materials** are rubbed against each other they become electrically **charged**.
- 64. Negatively charged **electrons** are **rubbed off** one material and on to the other.
- 65. The material that gains electrons becomes negatively charged.
- 66. The material that loses electrons is left with an equal positive charge.
- 67. When **two electrically charged** objects are brought close together they **exert a force on each other**.
- 68. Two objects that carry the **same type of charge repel**.
- 69. Two objects that carry **different types of charge attract**.
- 70. Attraction and repulsion between two charged objects are examples of **non-contact force**.
- 71. A charged object creates an **electric field** around itself.
- 72. The **electric field** is **strongest close** to the charged object.
- 73. The further away from the charged object, the weaker the field.
- 74. A second charged object placed in the field experiences a force.
- 75. The force gets stronger as the distance between the objects decreases.

Space

- 76. Within our **solar system** there is one star, the Sun, plus the eight planets and the dwarf planets that orbit around the Sun.
- 77. Natural satellites, the moons that orbit planets, are also part of the solar system.
- 78. Our solar system is a small part of the **Milky Way galaxy**.

- 79. The Sun was formed from a cloud of dust and gas (nebula) pulled together by **gravitational attraction**.
- 80. At the start of a star's life cycle, the dust and gas drawn together by gravity causes **fusion reactions**.
- 81. Fusion reactions lead to an equilibrium between the gravitational collapse of a star and the expansion of a star due to fusion energy.
- 82. **Gravity** provides the force that allows planets and satellites (both natural and artificial) to maintain their circular orbits.
- 83. For **circular orbits**, the force of gravity can lead to **changing velocity** but **unchanged speed**.
- 84. For a stable orbit, the radius must change if the speed changes.
- 85. A star goes through a **life cycle**. The life cycle is determined by the **size** of the star.
- 86. Stars the **size of the Sun** after their main sequence phase become **red giants**, then **white dwarves**, then **black dwarves**.
- 87. Stars much **more massive than the Sun** after their main sequence phase become **red super giants**, then **supernovae**, then either **neutron stars** or **black holes**.
- 88. Fusion processes in stars produce all of the naturally occurring elements.
- 89. Elements heavier than iron are produced in a supernova.
- 90. The explosion of a massive star (supernova) distributes the elements throughout the universe.

