Mechanics
ANSWERS

Motion

Velocity
STOP AND CHECK (PAGE 8)

- Velocity is a slightly more technical term for 'speed', which is typically used in physics. Velocity is different to speed as it takes into account the direction of travel, as well as the motion.
- Instantaneous velocity describes the velocity at a specific moment in time. Average velocity involves a velocity describing an entire journey, or phase of a journey.
- Velocity is calculated using the formula:

$$v = \frac{\Delta d}{\Delta t}$$

where d is the distance travelled, and t is the time taken to travel this distance.

Acceleration
STOP AND CHECK (PAGE 10)

- Acceleration describes a change in speed or direction. The greater the value for acceleration is, the faster an object is able to change its speed or direction. It is calculated using the formula:

$$a = \frac{\Delta v}{\Delta t}$$

Distance-time Graphs

STOP AND CHECK (PAGE 11)

- The velocity of an object can be determined by calculating the gradient on its distance-time graph.
- On a distance-time graph, the x-axis represents time, whilst the y-axis represents the distance travelled.
- A gradient of 0 tells you that the object is not moving. So, it has a velocity of 0.
- Section a on the graph:
    - d = 30m
    - t = 30s
    - a = 10ms^{-2}

Velocity-time Graphs

STOP AND CHECK (PAGE 13)

- The acceleration of an object can be determined by calculating the gradient on its velocity-time graph.
- On a velocity-time graph, the x-axis represents time, whilst the y-axis represents the velocity.
- A gradient of 0 tells you that the object is not accelerating, so has an acceleration of 0.
- The distance travelled can be calculated on a velocity-time graph by calculating the area under the graph.

Motion

QUICK QUESTIONS (PAGE 13)

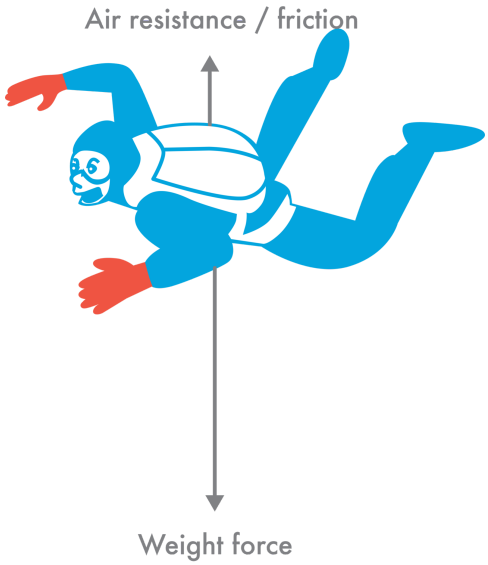
- Speed and velocity describe how quick an object is able to travel a distance. They are calculated by dividing the distance travelled by the time taken to travel it.
- Acceleration describes how quickly an object is able to change its velocity or direction. It is calculated by dividing the change in velocity of an object by the time taken for this change to occur.

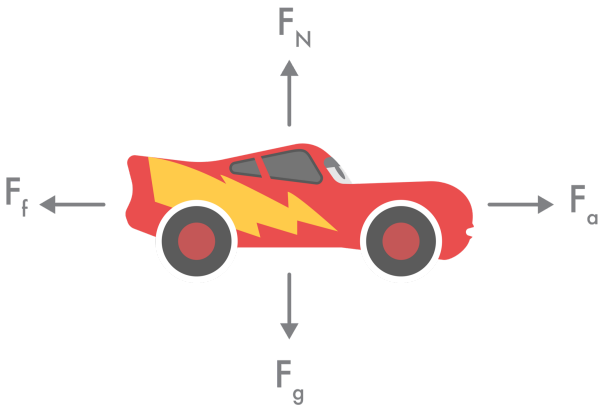
- The gradient of a distance-time graph tells you the velocity of the object. The gradient of a velocity-time graph tells you the acceleration of the object.

Force

Mass and Weight

STOP AND CHECK (PAGE 16)





- Weight force states how much force is needed to pull an object towards the ground.

Balanced and Unbalanced Forces

STOP AND CHECK (PAGE 18)

- Balanced forces involve forces of the same amplitude operating in opposite directions. This allows them to cancel each other out. Unbalanced forces involve a force acting in one direction, which is not completely cancelled out by opposing forces.

- Net force (F_{net}) describes the value of the force that is not cancelled out by oppositional forces acting in the other direction
- When forces are balanced, there is no acceleration on the object, so it continues in its state of motion (either stationary or at a constant speed). When forces are unbalanced, the object accelerates in the direction of the unbalanced force.

Force and Acceleration

STOP AND CHECK (PAGE 19)

- Newton's first law states that, when the forces acting on an object are balanced, the object will continue in its state of rest or constant velocity. Newtons' second law states that, when an unbalanced force acts on an object, it will accelerate in the direction of the unbalanced force.
- Acceleration is the result of an unbalanced force. Therefore, the greater the value of the unbalanced force, the greater the acceleration will be.

Work and Power

STOP AND CHECK (PAGE 22)

- Work is calculated by multiplying the force applied on an object by the distance the force is applied over. Power is calculated by dividing the work completed by the time taken to complete the work.
- Work describes the energy transferred from one object to another when a force is applied to it. Power describes the rate of this energy transfer.
- The more work is completed over a time frame, or the quicker the work is completed, the greater the power will be.

Pressure

STOP AND CHECK (PAGE 23)

- Pressure describes the stress placed on an object due to a force acting on it. It is the amount of force applied per unit of surface area. It is calculated by

dividing the total force applied on an object by the surface area that the force is spread over.

- A sharp knife cuts faster and easier because the surface area of the sharp blade is much less than the blunt knife. This means that, if the same amount of force is applied to both blades, the pressure exerted by the sharp knife will be greater.
- When people climb onto a floatie, the weight force it is exerting on the water increases. Eventually, this weight force becomes greater than the opposing buoyancy force supplied by the water. The unbalanced forces cause the floatie to accelerate downwards and sink into the water.

Forces

QUICK QUESTIONS (PAGE 24)

- A force diagram needs to include arrows and words to describe each of the forces acting in a particular scenario. The direction and relative lengths of the arrows are important.
- According to Newton's second law, an unbalanced force (called a net force), causes an object to accelerate in the direction of the force.
- Balanced force describes equal forces acting in opposite directions and therefore cancelling out. This results in no acceleration. Unbalanced force describes forces that are not cancelled out by oppositional forces, resulting in an acceleration in the direction of the unbalanced force.
- Work describes the energy transferred between two bodies. Power describes the rate at which this energy transfer occurs. The more efficiently work occurs, the greater the power is.
- The surface area of the bean bag is much greater than the combined surface area of the four chair legs. This means that, if the same amount of force is applied on both seats, the pressure will be more concentrated in the chair legs compared to the bean bag. The increased pressure will result in the chair sinking into the ground and leaving deep marks on the carpet.

Energy

Kinetic Energy

STOP AND CHECK (PAGE 26)

- Kinetic energy (E_K) is energy due to motion.
- Kinetic energy depends on the velocity of the motion, as well as the mass of the object completing the motion.

Gravitational Potential Energy

STOP AND CHECK (PAGE 27)

- Gravitational potential energy (E_g) is energy due to the gravitational force acting on an object towards the earth. It is termed potential force, as it describes the potential for an object to move towards the earth. The magnitude of the gravitational potential energy depends on the mass of the object, and the height that it is above the earth's surface.

Energy Conversions

STOP AND CHECK (PAGE 26)

- The first law of thermodynamics states that energy cannot be created or destroyed. It can only be transferred between bodies or transformed into different forms of energy.
- Energy can be 'lost' due to friction and air resistance. It is converted into heat energy, which is transferred into the environment.

Energy Conversions

QUICK QUESTIONS (PAGE 29)

- Kinetic energy is energy due to motion. It is dependent on the velocity of the motion, as well as the mass of the object completing the motion.

- As a ball is thrown into the air, its gravitational potential energy increases. As it falls back to the ground, its' gravitational potential energy decreases.
- Energy cannot be created. This means that all energy is a result of energy either being transferred from another object, or transformed from a different form of energy. Energy is 'lost' when it is transformed into forms of energy such as heat energy by events such as friction.