AQA GCSE Physics and Combined Energy Questions and answers

We have changed the Energy section of the specification into question and answers.

The specification is the bottom line of what needs to be revised so the document provides a ideal and full aid for your examination preparation.

Energy stores and systems

What is a system?

A system is an object or a group of objects that are connected and interact with one another.

Describe the energy changes in

- an object projected upwards
- a moving object hitting an obstacle

- an object accelerated by a constant force
- a vehicle slowing down
- bringing water to a boil in an electric kettle.

Object projected upwards:

As an object is projected upwards, it gains potential energy due to its increased height. At the same time, its kinetic energy decreases as it slows down at the highest point of its trajectory. As the object falls back down, its potential energy is converted back to kinetic energy, which increases as the object accelerates downwards.

Moving object hitting an obstacle:

When a moving object hits an obstacle, its kinetic energy is transferred to the obstacle, causing it to deform or move. This results in a decrease in the object's kinetic energy, as well as an increase in the energy stored in the obstacle due to its deformation or movement.

Object accelerated by a constant force:

When an object is accelerated by a constant force, the force does work on the object and increases its kinetic energy. As the object gains speed, its potential energy may also increase if it gains height. The amount of work done on the object is equal to the change in kinetic energy.

Vehicle slowing down:

When a vehicle slows down, its kinetic energy is converted into other forms of energy, such as heat and sound, due to friction between the brakes and the wheels. As a result, the vehicle's kinetic energy decreases, while the energy lost due to friction is transferred to the environment in the form of heat and sound.

Bringing water to a boil in an electric kettle:

When water is heated in an electric kettle, the electrical energy from the power source is converted into thermal energy in the water. This increases the temperature of the water and its internal energy, which is the sum of its kinetic and potential energy. When the water reaches boiling point, the additional energy is used to turn the water into steam.

Changes in energy

What is the equation used to calculate the kinetic energy of a moving object?

The equation used to calculate the kinetic energy of a moving object is $E_k = 0.5 \times m \times v^2$, where E_k is the kinetic energy in joules (J), m is the mass of the object in kilograms, and v is the speed of the object in metres per second.

What is the equation used to calculate the elastic potential energy stored in a stretched spring?

The equation used to calculate the elastic potential energy stored in a stretched spring is $E_e = 0.5 \times k \times e^2$, where E_e is the elastic potential energy in joules (J), k is the spring constant in newtons per metre, and e is the extension of the spring in metres.

How can the amount of gravitational potential energy gained by an object raised above ground level be calculated?

The amount of gravitational potential energy gained by an object raised above ground level can be calculated using the equation $E_p = mgh$, where E_p is the gravitational potential energy in joules (J), m is the mass of the object in kilograms, g is the gravitational field strength in newtons per kilogram (which is given), and h is the height above ground level in metres.

What is the unit of measurement for kinetic energy, elastic potential energy, and gravitational potential energy?

The unit of measurement for kinetic energy, elastic potential energy, and gravitational potential energy is the joule (J).

Energy changes in systems

What is the equation used to calculate the amount of energy stored in or released from a system as its temperature changes?

The equation used to calculate this is $\Delta E = m\ c\ \Delta\theta$, where ΔE is the change in thermal energy in joules (J), m is the mass of the system in kilograms, c is the specific heat capacity of the substance in joules per kilogram per degree Celsius (J/kg°C), and $\Delta\theta$ is the temperature change in degrees Celsius (°C).

What is specific heat capacity?

Specific heat capacity is the amount of energy required to raise the temperature of one kilogram of a substance by one degree Celsius.

What are the units of measurement for mass, specific heat capacity, temperature change, and thermal energy?

Mass is measured in kilograms (kg), specific heat capacity is measured in joules per kilogram per degree Celsius (J/kg°C), temperature change is measured in degrees Celsius (°C), and thermal energy is measured in joules (J).

How can the equation for calculating thermal energy change be applied?

The equation can be used to calculate the amount of thermal energy stored or released by a system as its temperature changes, given the mass of the system, the specific heat capacity of the substance, and the temperature change.

Power

How is power defined?

Power is defined as the rate at which energy is transferred or the rate at which work is done.

What are the equations used to calculate power?

The two equations used to calculate power are P = E/t, where P is the power in watts (W), E is the energy transferred in joules (J), and t is the time in seconds (s); and P = W/t, where P is the power in watts, W is the work done in joules, and t is the time in seconds.

What are the units of measurement for power, energy transferred, time, and work done?

Power is measured in watts (W), energy transferred and work done are measured in joules (J), and time is measured in seconds (s).

How is an energy transfer of 1 joule per second related to power?

An energy transfer of 1 joule per second is equal to a power of 1 watt.

Energy transfers in a system

What is meant by the conservation of energy?

Energy can be transferred usefully, stored, or dissipated, but cannot be created or destroyed.

What is the concept of a closed system with regard to energy transfers?

A closed system is one where there are energy transfers but there is no net change to the total energy.

How is energy dissipated during system changes?

Energy is dissipated during all system changes, so that it is stored in less useful ways. This energy is often described as being ‘wasted’. Students should be able to explain this concept with examples.

How can unwanted energy transfers be reduced?

You should be able to explain ways of reducing unwanted energy transfers, such as through the use of lubrication and thermal insulation.

How does the thickness and thermal conductivity of a building's walls affect the rate of cooling?

Students should be able to describe how the rate of cooling of a building is affected by the thickness and thermal conductivity of its walls. The higher the thermal conductivity of a material, the higher the rate of energy transfer by conduction across the material. Therefore, thicker walls with lower thermal conductivity will result in slower cooling of the building.

Efficiency

What is the equation used to calculate energy efficiency?

The energy efficiency for any energy transfer can be calculated using the equation: efficiency = useful output energy transfer / total input energy transfer.

What is the alternate equation used to calculate efficiency?

An alternate equation used to calculate efficiency is: efficiency = useful power output / total power input.

What do the terms "useful output energy transfer" and "total input energy transfer" refer to in the equation for efficiency?

"Useful output energy transfer" refers to the amount of energy transferred to perform the intended task or work, while "total input energy transfer" refers to the total amount of energy input into the system to complete the task, including any wasted energy.

What are the units of measurement for energy efficiency?

Energy efficiency is typically expressed as a decimal or a percentage, representing the fraction or percentage of energy that was useful in the energy transfer.

What are some ways to increase the efficiency of an intended energy transfer?

To increase the efficiency of an intended energy transfer, one can reduce the amount of wasted energy by improving the design of the system, reducing friction or resistance, improving the insulation, or using more efficient energy sources. Other methods include recycling waste energy

and converting it into a useful form, as well as employing energy-saving practices, such as turning off lights and appliances when not in use.

National and global energy resources

What are the main energy resources available for use on Earth?

The main energy resources available for use on Earth include fossil fuels (coal, oil and gas), nuclear fuel, bio-fuel, wind, hydroelectricity, geothermal, the tides, the Sun and water waves.

What is a renewable energy resource?

A renewable energy resource is one that is being (or can be) replenished as it is used. Examples of renewable energy resources include wind, solar, hydro, and geothermal energy.

What are some of the uses of energy resources?

The uses of energy resources include transport, electricity generation and heating. Energy resources are used to power various forms of transportation, such as cars, buses, trains, and airplanes. They are also used to generate electricity to power homes, businesses, and industries, and to provide heat for buildings and homes.

What are some advantages and disadvantages of using fossil fuels as an energy resource?

One advantage of using fossil fuels is that they are readily available and have a high energy density, making them efficient and cost-effective for many applications. However, they are non-renewable and their use contributes to air and water pollution, climate change, and other

environmental problems. They also pose risks to health and safety during extraction, transport, and use.

What are some advantages and disadvantages of using renewable energy resources?

One advantage of using renewable energy resources is that they are renewable and sustainable, and they do not produce the same levels of pollution and environmental harm as non-renewable resources. However, they can be less reliable and more expensive than traditional energy sources, and their use may require significant infrastructure and technological development. Additionally, certain renewable energy sources, such as wind turbines and solar panels, can pose challenges related to land use and environmental impact.