What is a typical size of an atom? Choose from the following.

10^{-15} \text{ m} \quad 10^{-12} \text{ m} \quad 10^{-10} \text{ m}

The size of an atom is of the order of $10^{-10}$ m.

What is the difference between the specific heat capacity and the specific latent heat of a material?

Specific heat capacity is the energy needed to raise the temperature of 1 kg of the material by 1 °C, with no change of state. Specific latent heat is the energy needed to change the state of 1 kg of the material, with no change in temperature.

A gas is contained at constant volume. Explain what happens to the pressure of the gas if the gas is heated.

The pressure of the gas increases with increasing temperature, because at a higher temperature the particles in the gas move faster. They bombard the walls of the container harder and more frequently.

State the equation for calculating the kinetic energy of a moving object, and give the unit of each quantity.

Kinetic energy

$= 0.5 \times \text{mass} \times (\text{speed})^2$

Unit of kinetic energy: joule (J)
Unit of mass: kilogram (kg)
Unit of speed: metres per second (m/s)

Which equation is a statement of Newton’s second law?

Force = mass $\times$ acceleration is a statement of Newton’s second law.
What is meant by work in physics?

Work is done on an object when a force causes the object to move through a distance.

Work done = force × distance (along the line of action of the force)

The work done is equal to the energy transferred.

What is the difference between elastic deformation and plastic deformation?

Elastic deformation: forces make an object change shape, but it returns to its original shape when the forces are removed.

Plastic deformation: forces make an object change shape, and the object keeps its new shape when the forces are removed.

The moment of a force about a pivot is given by $M = Fd$.

Describe fully what $d$ represents.

d is the perpendicular (shortest) distance from the pivot to the line of action of the force.

What is meant by an electric field?

An electric field is a region around an electrically charged object in which another electrically charged object will experience a force.

What is the relationship between the potential difference across, the current through and the resistance of a component in a circuit?

Potential difference = current × resistance
State the equation for calculating the electrical power of a device in terms of its resistance and the current through it, and state the unit of power.

\[ \text{Power} = (\text{current})^2 \times \text{resistance} \]

The unit of power is the watt, W (equivalent to J/s).

An electromagnet is a coil of wire of many turns wound on an iron core. When current is passed through the coil, a strong magnetic field is set up through the core and around the coil.

A current-carrying coil in a magnetic field experiences force. The direction of the force depends on the direction of the current relative to the magnetic field. The result is a pair of oppositely directed forces on opposite sides of the coil, which cause rotation.

The two coils of a transformer are not connected. A varying current in one coil produces a varying magnetic field, which induces a varying voltage and hence a varying current in the other coil.

A constant direct current in the first coil produces a static magnetic field. This does not induce a voltage in the second coil.

A wavelength is the distance from one point on a wave to the equivalent point on the next wave. Its unit is metre (m).
One type of seismic wave is a **transverse** wave that cannot travel through a liquid. Another type of seismic wave is a **longitudinal** wave. Give the names of each of these types of seismic wave.

List the types of radiation in the **electromagnetic spectrum**, in order of **increasing frequency**.

Describe the difference between a **convex** lens and a **concave** lens.

Choose the correct word to complete this sentence. **Isotopes** of an element contain the same number of ... **neutrons** ... **protons**

Which type of radioactive emission is **least penetrating**, and why? **alpha** **beta** **gamma**

**Isotopes** of an element contain the same number of **protons**. They have different numbers of **neutrons**.

Alpha radiation is **least penetrating** because it loses its energy in the shortest distance, by strongly **ionising** the atoms of a material.
Define the **half-life** of a **radioactive** material, and explain why radioactive decay can be considered **random**.

The **half-life** of a radioactive material is the time taken for the number of undecayed nuclei in a sample of the material to reduce by half. The decay of a particular nucleus is unpredictable, so the decay is described as **random**.

During **fission**, a large nucleus splits into two smaller ones and a few **neutrons** are emitted with kinetic energy. Fission can be initiated by a large nucleus absorbing a neutron. So the neutrons emitted from the first fission can go on to cause fission of other nuclei, and so the process continues and escalates.

True or false? If all of the electrical energy supplied to an efficient kettle is used to heat the water, this equation determines the change in temperature of the water:

\[ \text{potential difference} \times \text{current} \times \text{time} = \text{mass of water} \times \text{specific heat capacity of water} \times \text{change in temperature} \]

True. The electrical energy supplied to the kettle is **potential difference \times charge** = **potential difference \times current \times time**.

The rise in temperature of the water depends on the mass and the **specific heat capacity** of the water. The thermal energy change of water is **mass \times specific heat capacity \times change in temperature**.

Energy is said to be wasted when the useful output energy of a device is less than the input (supplied) energy. This does not contravene the **law of conservation of energy** because the ‘wasted’ energy is **dissipated** to the surroundings, raising the temperature.

On a very cold day, a hut with thin metal walls will cool down very quickly because of the metal’s **low thermal conductivity**.

... **low thermal conductivity**

... **high thermal conductivity**

On a very cold day, a hut with thin metal walls will cool down very quickly because of the metal’s **high thermal conductivity**.

The higher the thermal conductivity of a material, the higher the **rate of energy transfer** by conduction through the material.
A typical speed for a cyclist on a clear flat road is 10 m/s.
A person walking slowly would have a speed of about 1 m/s.
A plane, or an extremely fast train, might have a speed of 100 m/s.

Types of bio-fuel include: wood; oils and ‘bio-diesels’ from crops such as rape and palm; also ‘bio-ethanol’ from crops such as sugar cane.
Bio-fuels are renewable energy resources, because we can plant more trees and crops.

Transformers are used in the national grid to increase (step up) the generated voltage to a high value for transmission around the country, because there is then less energy loss from the cables. Transformers are then used to reduce (step down) the voltage to a safer and more convenient voltage for the user.

Light from all distant galaxies shows red shift – an increase in wavelength – which tells us they are all moving away from us. More distant galaxies have greater red shift, which means they are moving away with greater speed. This agrees with the Big Bang model, which proposes that the universe began from a very small, hot and dense region.

The initial gravitational collapse made the inner material of the Sun so hot that nuclear fusion began. The Sun is now in the stable part of its lifecycle. There is equilibrium (a balance) between its inward gravitational collapse and outward expansion due to energy radiated from nuclear fusion in the core.