Crewe Engineering & Design UTC

Curriculum Summary - Physics (Year 10)

Autumn

P4: Electric circuits

In this chapter the students will describe the structure of an atom in terms of charged particles and the process of charging by friction resulting in ions and the transfer of electrons. This leads to the concept of an electric field surrounding charged objects causing attractive or repulsive forces between them.

The students will then describe electric circuits and the components used to construct them using the concept of current as the rate of charge flow through components due to a potential difference between points in the circuit. Resistance was introduced and the cause of a heating effect and corresponding energy transfer. Students will investigate the factors affecting the resistance of a wire and the corresponding current-potential difference graphs. Further investigations of the components and analysis of the current-potential difference graphs will show ohmic and non-ohmic behaviours for wires, filaments, and diodes. The relationship between the resistance of a thermistor and its temperature along with the relationship between the resistance of a light-dependent resistor and light level have been investigated.

Finally, the students will investigate and analyse a range of series and parallel circuits describing the path of current at junctions, the potential difference across branches and components, and the effect on resistance of series and parallel branches.

P5: Electricity in the home

In this chapter the students will compare direct and alternating currents in terms of current direction. An oscilloscope will be used to analyse changes in the potential difference causing the current and to measure the peak voltage, period and frequency of a low voltage sinusoidal AC signal.

The students will describe the UK mains supply and the wires used within it, outlining the National Grid and the high voltages associated with it. Understanding of mains circuits, including the function of the neutral and earth wires, will be applied to three pin plugs and a simple ring main circuit. The choice of materials used for construction of mains circuits such as wires, cables and plugs will be discussed along with the need for a fuse to prevent overheating and insulation for protection from short circuits.

Students will mathematically analyse circuits to determine the power supplied by a current and the relationship between power and the resistance of components. This will be linked back to the charge transfer in a circuit and the concept of electrical heating as charges move within or through components.

Finally, students will consider the importance of efficiency within mains powered electrical devices, linking this concept back to energy transfer by a current and to the simplified system of energy efficiency ratings used when considering the purchase of an appliance.

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Curriculum Summary - Physics (Year 10)

Spring

P1: Energy and energy resources

In this chapter, students will continue to develop their understanding of energy and energy transfer begun in Key Stage 3. This includes development of an energy stores model and the processes, such as forces and electrical currents, through which energy can be transferred. Students will learn how to measure the work done by a force acting over a distance and how this concept can be used to analyse energy changes in gravitational stores, through lifting and falling, and elastic potential stores during stretching using the relevant mathematical relationships. The conservation of energy through changes in the gravitational, kinetic, and elastic stores will also be discussed.

They will consider the dissipation of energy during transfers such as those caused by friction or electrical heating, leading to the idea of efficiency during different energy changes and its calculation. The concept of efficiency will then be applied to the selection of electrical devices.
Finally, the students will learn about the rate of energy transfer in different systems through the concept of power and how this power rating can be used to determine total energy change over time.

P2: Energy transfer by heating

In this chapter the students will develop their understanding of the heating and cooling processes, which transfer energy within a material or from one object to another. They will investigate thermal conductivity and the differences in the processes of thermal conduction in metals and non-metals.

All students will analyse the changes in temperature when a material is heated, leading to the experimental determination of specific heat capacity along with corresponding calculations. The concept of specific heat capacity will then be used to explain the choice of materials used in heating systems.

Finally, the reduction of energy transfers to the surroundings by insulation, such as loft or cavity wall insulation, will be studied and applied to the context of reducing energy loss in buildings to reduce heating costs including the idea prioritising home improvements in line with payback time.

P3: Energy resources

In this chapter the students will examine the different sources of energy that are used to generate electricity or provide heating for homes. They will consider the effect of the production and use of biofuels on the environment along with the concept of carbon-neutrality before outlining the use of nuclear power in comparison to fossil fuels.

Students will describe and evaluate renewable resources such as wave power, wind power, hydroelectricity and tidal technology and how these can be used to generate electricity in specific locations. In addition, students will describe the operation of geothermal power stations and their links to radioactive decay. The principles of solar cells and both small-scale and large-scale solar heating systems have been outlined.

The students will compare all the energy resources in terms of local environmental impacts such as pollution and global environment impacts such as acid rain and contribution to global warming. Finally, the students will describe how the different resources could be applied in combination to meet the base load and changing energy demands throughout a single day before finally considering the capital costs and operating cost over the operational lifetime of the resource.

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Summer

P6: Molecules and matter

In this chapter the students will increase their understanding of the concept of density as a property of a material or object by measuring and calculating the density of solids and liquids. This leads to a discussion of the states of matter, solid liquid and gas, the properties of matter in these states and the changes which occur as a material changes from one state to another. The changes in the properties of matter will be used to introduce the kinetic theory and to analyse the changes in temperature occurring during heating and the concept of latent heat.

The students move on to discuss the concept of internal energy in more detail; analysing the behaviour of particles in a solid, liquid or gas as the temperature changes. Students will describe latent heat of fusion and vaporisation mathematically, calculating energy changes during the appropriate phase changes and attempt to measure the latent heat of fusion for ice using electrical heating.

The students will analyse the relationships between the pressure and temperature of a fixed mass of gas, determining that the pressure is proportional to the absolute temperature. They described the cause of pressure in terms of random particle behaviour and impact between the particles and the container, explaining the changes in pressure in terms of changes in the motion of the gas particles as the temperature decreases.

P7: Radioactivity

In this chapter the students will describe how the structure of the nucleus was discovered by the radiation emitted during nuclear decay and how experimentation and developments in our understanding of subatomic particles have led to changes in the model used to describe the atom from the plum pudding model, through to the Rutherford model and then Bohr model.

The students will describe the changes in the nucleus which occur during alpha, beta, and gamma decay along with neutron emission in terms of atomic (proton) number and mass number using the appropriate nuclear notation for isotopes. The properties of alpha, beta, and gamma radiation will be demonstrated leading to a discussion of their use in thickness monitoring and then the safety measures required when using radioactive materials.

Students will then move on to discuss the concepts of activity, count rate, and the patterns in radioactive decay that explain half-life and the associated graphs despite the random nature of individual decays. Higher tier students will perform calculations involving the relationship between the initial activity, current activity, and half-life.