Definitions and Concepts for OCR (B) Physics A-level

Module 3: Physics in Action

3.1: Communication

3.1.1: Imaging and Signalling

Bit: The basic unit of information used for the representation of digital signals in computing and digital communication. It can take one of two values: 1 or 0.

Bit Rate: The rate of transmission of digital information.

Byte: A string of 8 bits, represents a group of 8 digital signals.

Converging Lens: A convex lens (thicker in the middle) which focuses the direction of rays that pass through closer together.

Curvature: A property used to describe wavefronts or surfaces. Wavefronts that appear more curved (radius from the source of the wave is small) have larger curvatures.

Digital Signals: Discrete signals that represent data as square waves as opposed to continuous sine waves.

Digitisation: Converting analogue information into a digital format where it is organised into bits.

Focal Length: The distance from the centre of the lens to the focal point.

Lens Power: The inverse of the focal length. It is the change of curvature of wavefronts produced by the lens.

Noise: Unwanted disruption or interference within a signal.

Pixel: Pixels are the smallest units that make up digital images or displays. They store charge when light falls on them. The charge stored is proportional to the light it illuminates with.

Polarisation: The restriction of a wave so that it can only oscillate in a single plane. This can only occur for transverse waves.

Real Image: Occurs where rays converge (are directed towards a fixed point). They can be produced by converging lenses or concave (converging) mirrors if the object viewed is placed outside the focal length. These images are always inverted and can be formed on a surface, such as a piece of paper.

Wave-front: Wave-fronts lie perpendicular to the direction of motion of a given wave.

3.1.2: Sensing

Ammeter: A device that measures the current at a certain point in a circuit. This is connected in series.

Charge Carrier Number Density: Number of charge carriers per unit volume of a given material.

Conductance: The inverse of resistance. A measure of how well an object conducts electricity.

Current: The rate of flow of charged particles.

Electrical Charge: A property of matter which causes things to feel a force when placed in an electric field. Charge is current times time but you can think of -1 C as a discrete number, $1/(1.6 \times 10^{-19})$, of electrons.

Electrical Conductivity: The inverse of electrical resistivity. A measure of how easily a material conducts electricity. A low conductivity means that the material resists electric current.

Electrical Resistivity: A measure of how easily a material resists electricity. A low resistivity means that the material readily allows electric current.

Electromotive Force (e.m.f): The energy supplied by a source per unit charge passing through the source, measured in volts. This is equal to the voltage across the source when no charge is flowing.

Insulators: A material that has no free charge carriers and so doesn't allow the flow of electrical charge.

Internal Resistance: The resistance to the flow of charge within a source. Internal resistance results in energy being dissipated within the source.

Kirchhoff's First Law: A consequence of the conservation of charge. The total current entering a junction must equal the total current leaving it.

Kirchhoff's Second Law: A consequence of the conservation of energy. The voltage rises must be equal to the voltage drops in a closed loop. This means that the sum of the voltages in any closed loop must equal zero.

Light Dependent Resistor (LDR): A resistor with a resistance that decreases as light intensity increases.

Load: A weight or gravitational force exerted on a surface or body.

Ohm's Law: In ohmic conductors held under constant physical conditions, current is directly

proportional to the potential difference, with resistance being the constant of proportionality: V=IR.

Parallel: Components are said to be connected in parallel when they are connected across each other (separate loops). If a component in parallel breaks, only that branch of the circuit would no longer be active, the rest of the circuit would still work.

Potential Difference: Is also called voltage. Energy per unit charge.

Potential Divider: A method of splitting a potential difference, by connecting two or more resistors in series. The total potential difference is split in the ratio of their resistances.

Power dissipation: A loss of energy in electric circuits from unwanted resistance. Particles in the metal wire provide resistance against the flow of charge, causing energy to be wasted (lost) as heat. Also known as joule heating.

Resistance: A measure of how difficult it is for current to flow through a material.

Semiconductors: A material that has the ability to change its number density of mobile charge carriers, and so its ability to conduct electricity. Light dependent resistors and thermistors are both examples.

Series: Components are said to be connected in series when they are connected end to end (in one loop). If a component in series breaks, the whole circuit would be broken (no charge would flow anywhere).

Thermistor: A resistor with a resistance that changes with temperature. Usually this refers to NTC thermistors where the resistance decreases as temperature rises. This property allows it to be used as a sensor.

Voltmeter: A device used to measure the potential difference across two points. This is connected in parallel.

3.2: Mechanical Properties of Materials

Brittle: Undergoes little/no plastic deformation before fracture.

Chain Entanglement: Where long polymer chains get tangled and cause the unfolding of the chains to be difficult. This causes polymers to be stiff.

Chain Unravelling: The unfolding of polymer chains from entanglement. Unravelling is made even more difficult if crosslinks are formed because they reduce the rotation of the chains.

Compression: The result of two coplanar forces acting into an object. Compression usually results in a reduction in the length of the object.

Dislocations: Mobile defects (gaps) in the crystalline structure which can shift through the lattice allowing one atom to be deformed at a time. This makes metals and other crystalline materials more easily deformed.

Ductile: Can be drawn out into wires.

Elastic Deformation: If a material deforms with elastic behaviour, it will return to its unstretched form when the deforming forces are removed. The limit of proportionality has not yet been reached.

Elastic Potential Energy: The energy stored in an object when it is stretched. It is equal to the work done to stretch the object and can be determined from the area under a force-extension graph.

Extension: The increase of an object's length.

Force-Extension Graph: A plot showing how an object extends as the force applied increases. For an elastic object, the gradient should be linear up to the limit of proportionality. The gradient gives the spring constant.

Fracture: When an object or material breaks into pieces after being deformed beyond its elastic limit due to strain.

Fracture Stress: The stress at which fracture occurs.

Hard: Resists indentation on impact.

Hooke's Law: The extension of an elastic object will be directly proportional to the force applied to it (F=ke) up to the object's limit of proportionality.

Mobile: Able to move.

Plastic Deformation: If a material deforms with plastic behaviour, it will not return to its original shape when the deforming forces are removed. The object will be permanently deformed.

Polymer: Long chains of repeating monomers.

Stiff: Has a small extension per unit force (a high Young modulus).

Strain: The ratio of an object's extension to its original length. It is a ratio of two lengths and so has no units.

Stress: The amount of force acting per unit cross-sectional area on a material. Measured in Pascals (Pa).

Stress-Strain Graph: A plot showing how an object extends as the force applied per cross-sectional area increases. For an elastic object, the gradient should be linear up to the limit

of proportionality. The gradient gives the Young Modulus.

Spring Constant: The constant of proportionality for the extension of a given spring under a force. The higher the spring constant, the greater the force needed to achieve a given extension.

Strong: Can withstand high stresses.

Tension: The pulling force applied on an object by a rope, string or wire.

Tough: Absorbs a lot of energy (deforms plastically) before fracture.

Yield Stress: The value of stress at the yield point.

Young Modulus: The ratio of stress to strain for a given material. It is a property significant to the type of material and is measured in Pascals (Pa).