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VIDEO | EXAM Q&A

Topic 1. Energy

Video: **Energy changes in a system**

- To understand the ways in which energy can be stored in a system and can be transferred from one energy store to another within a system
- To understand that energy transfers will occur when a system is changed by heating, the doing of work, or the flow of an electric current
- To be able to perform calculations involving changes in the kinetic energy, elastic potential energy, gravitational potential energy, and thermal energy of an object within a system

Video: **Power**

- Explain what is meant by power
- Recall that the amount of work done by a system is equal to the amount of energy transferred by it
- Recall and apply both general equations for power
- Learn how to experimentally determine the specific heat capacity of a material

Video: **Conservation and dissipation of energy**

- Understand the meaning of the Principle of Conservation of Energy
- Describe a number of ways in which unwanted energy transfers ('wasted' energy) within a system can be minimised
- Describe and explain the ways in which thermal energy is lost from a building, and the steps which can be taken to minimise such losses
- Explain what is meant by the 'thermal conductivity' of a material
- Recall and apply both forms of the equation for the efficiency of an energy transfer
- Plan and interpret the results of an experiment in which the effectiveness of a number of different thermal insulators is investigated

Video: **National and global energy resources**

- Describe the main energy resources available for use on Earth
- Explain the difference between renewable and non-renewable energy resources
- Discuss the advantages and disadvantages of the main energy resources with reference to their use in transport, electricity generation and heating

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Topic 2. Electricity

Video: **Circuit Symbols**

- To learn the common circuit symbols
- To know and understand the uses to which common components are put in an electric circuit

Video: **Introduction to Electricity**

- Understand that an electric current is the flow of electric charge
- Learn and apply the equation linking charge, current and time (Q = I t)
- Understand the effect of increasing the potential difference across a component (in terms of energy transfer)
- Learn and apply the equation linking the potential difference (p.d.) across a component, the current flowing through it, and its resistance (V = IR)
- Use a circuit diagram to set up a circuit so that some of the factors which affect its resistance can be investigated

Video: **Resistors**

- Explain how to measure the resistance of a component (using a voltmeter and an ammeter)
- Draw a circuit diagram of and explain the operation of a circuit which allows for the I-V behaviour of a component to be investigated
- Describe and explain the I-V behaviour of an ohmic conductor, a filament bulb, a diode, an LDR and a (negative temperature coefficient) thermistor
- Explain the difference between ohmic and non-ohmic components

Video: **Series and Parallel Circuits**

- Understand the difference between connecting components in series and in parallel
- Identify series and parallel circuits (or sections of circuits)
- Recall, understand and apply the rules for current and potential difference when components are connected in series or in parallel
- Recall, understand and apply the equation for the total resistance of two resistors which are connected in series
- Describe and explain the effect on the total resistance of both resistors of connecting two resistors in parallel

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Video: **Investigating resistance in circuits**

- Recall how to carry out an experiment in which the effect of the length of a piece of wire on its resistance is investigated
- Recall and apply the meanings of the terms independent, dependent and control variable
- Understand some of the reasons for the collection of anomalous data in an experimental investigation
- Draw circuit diagrams and describe the carrying-out of experiments to help determine how the way in which resistors are connected in a circuit (whether in series or in parallel) affects their total resistance

Video: **Domestic uses and safety**

- Recall that mains electricity is an ac supply of electrical energy (which has a frequency of 50 Hz and an 'average' potential difference of 230 V in the UK)
- Explain the difference between direct and alternating potential difference (and current)
- Draw and interpret potential difference-time graphs for both dc and ac supplies
- Identify and explain the purpose of the live, neutral and earth wires in a three-core cable
- Explain the danger of providing an electrical connection between the live wire and earth
- Explain the operation of earth wires, fuses and double insulation

Video: **Power and energy transfers**

- Recall and apply the equations linking power, current, potential difference and resistance
- Recall and apply the equation linking energy transfer, power and time (E = P t)
- Recall and apply the equation linking energy transfer, charge flow and potential difference (E = Q V)
- Understand that work is done ON charge (energy is transferred TO it) when it flows through a cell, battery or other power supply
- Understand that work is done BY charge (energy is transferred FROM it) when it flows through any circuit component which has an electrical resistance

Video: **The National Grid**

- Explain the function of the National Grid (or any large-scale electricity distribution network)
- Describe the main components of the National Grid and explain their function
- Understand and explain the need to transmit electrical energy across the country at a high potential difference ('high voltage') and appreciate the dangers involved with doing so
- Perform energy calculations on the transfer of electrical energy via the National Grid

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Topic 3. Particle model of matter

Video: **Density**

- Recall and apply the equation for the density of an object to solids, liquids and gases of fixed mass
- Explain how to measure the density of a solid or liquid

Video: **Solids, liquids and gases**

- Use the particle model to explain the differences between solids, liquids and gases
- Explain the meaning of the term 'internal energy', and explain how the internal energy of a sample of a substance changes as changes from one state to another
- Recall and describe the various changes of state which can occur between the solid, liquid and gas states
- Explain the meaning of the term 'physical change'

Video: **Specific heat capacity and specific latent heat**

- Understand that increasing the internal energy of a system (through heating) can both increase its temperature and cause it to change state (from solid to liquid or from liquid to gas)
- Understand that decreasing the internal energy of a system (through cooling) can have the opposite effects
- Explain what is mean by the specific heat capacity of a substance
- Apply the equation for the specific heat capacity of a substance to a range of problems
- Explain the concept of latent heat and the meanings of the specific latent heat of fusion and specific latent heat of fusion of a substance
- Apply the equation for the latent heat of fusion and latent heat of vaporisation of a substance to a range of problems
- Describe a range of experimental methods by which the specific heat capacity and specific latent heat of fusion and specific latent heat of vaporisation of a substance can be determined

Video: **Particle model and pressure**

- Use the particle model to explain why a gas exerts a pressure on the walls of its container
- Explain why changing the temperature of a fixed mass of gas (which is held at constant volume) causes the pressure exerted by it to increase
- Use the particle model to explain why decreasing the volume of a gas (at constant temperature) leads to an increase in pressure (and vice versa)
- Apply the equation which relates the pressure and volume of a gas at constant temperature (p V = constant) to a range of problems
- Explain why the temperature of a gas increases when work is done on it (and vice versa)

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Topic 4. Atomic structure

Video: **Atoms and isotopes**

- Describe the basic structure of the atom and the properties of protons, neutrons and electrons
- Recall the radius of a typical atom
- Recall that most of the mass of an atom is located in its positive nucleus (where its protons and neutrons are located)
- Use atomic notation and know and understand the terms mass number and atomic number
- Understand that a neutral atom becomes a charged ion when it loses or gains electrons
- Explain the meaning of the term isotope

Video: **The development of the model of the atom**

- Describe the plum pudding model
- Describe the Geiger-Marsden alpha scattering experiment (often called the Rutherford experiment)
- Describe the results of the Geiger-Marsden experiment
- Explain how the results of the Geiger-Marsden experiment disproved the plum pudding model of the atom, and what they told us about the structure of the atom
- Describe the Bohr model of the atom, and explain how it can be used to explain the fact that a given element will only emit electromagnetic radiation of certain wavelengths (or 'colours')

Video: **Radioactive Decay**

- Describe what is meant by the term 'unstable nucleus' and explain the random nature of radioactive decay
- Explain the meaning of the term 'activity' as applied to a radioactive source
- Understand the meaning of the term 'count rate' and recall that the count rate from a source may be measured using a Geiger-Muller (GM) tube
- Recall that the radiation which is emitted from the nucleus in a nuclear decay event may take the form of an alpha particle, a beta particle, a gamma ray or a neutron
- Be aware of the nature of each of these types of nuclear radiation, describe their properties (including their penetration through materials, their range in air and their ionising power)
- Complete balanced nuclear equations to describe the processes of alpha, beta, gamma and neutron decay

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Video: **Half-life**

- Explain what is meant by the half-life of a radioactive isotope
- Determine the half-life of a radioactive isotope from information on the way in which its activity, mass, number of nuclei or the count rate recorded from it change with time
- Interpret graphs which describe the decay of a radioactive substance with time
- (HT) Express as a ratio the decline in the radioactive emission from a substance after a given number of half-lives

Video: **Radioactive contamination**

- Explain the difference between the irradiation and the contamination of an object
- Recall and discuss the factors which affect the level of risk posed by an object which has been contaminated with a radioactive substance
- Compare the hazards between objects or substances which have been contaminated with those which have been irradiated
- Describe the precautions which should be taken to protect against the hazards of irradiation

Topic 5. Forces

Video: **Scalars and vectors**

- Explain the difference between a scalar and a vector quantity
- Perform simple calculations on the addition of two or more vectors which are acting in the same plane
- Give examples of both scalar and vector quantities

Video: **Contact and non-contact forces**

- Explain the effects which the action of one or more forces can have on an object
- Recall that force is a vector quantity, and use simple force diagrams to describe the effect which one or more forces will have on an object
- Understand the difference between contact and non-contact forces, and give examples of each

Video: **Gravity**

- Explain the difference between the mass on an object (in kilograms) and its weight (in newtons)
- Describe the factors which affect the gravitational force exerted between any two massive objects (objects with mass)
- Recall and apply the equation for the weight of an object (W = mg)
- Explain the meaning of the term ‘centre of mass’

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Video: **Resultant forces**

- Explain what is meant by a resultant force
- Calculate the resultant of two or more collinear forces which are acting on object (forces which are acting along a single line)
- (HT) Draw a free body (force) diagram to demonstrate how two or more forces can lead to a resultant force on an object (including situations in which the forces acting on the object are in equilibrium/balanced)
- (HT) Resolve a single force into two components which are at right angles to one another, and understand that these two components have the same overall (resultant/net) effect as the single force
- (HT) Use a scale (vector) diagram to determine the magnitude and direction of the resultant force acting on an object (to include cases where all of the forces are not necessarily acting along the same line or perpendicular to one another)

Video: **Work done and energy transfer**

- Understand that, when a force causes an object to move through a distance, work is done by the force
- Recognise that the work done by a force is equal to the amount of energy transferred by it
- Recall and apply the equation for the work done by a force on an object (W = F s)
- Understand that, when work is done against the frictional forces which are acting on an object, its temperature may rise

Video: **Forces and elasticity**

- Describe the effects which the action of two or more forces can have on the shape of an object
- Explain the difference between elastic and inelastic deformation
- Investigate experimentally the relationship between the force applied to a spring and its extension
- Interpret data from an investigation into the force applied to an object and its extension
- Understand that, as long as its limit of proportionality has not been exceeded, the force applied to an elastic object (such as a spring) is proportional to its extension
- Recall and apply the equation linking the force applied to an object and its extension (F = k e) which applies so long as the limit of proportionality of an object has not been exceeded
- Explain the relationship between elastic potential energy and the work which is done on (or by) a spring
- Apply the equation for the elastic potential energy of an object

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Video: **Distance and Displacement, Speed and Velocity**

- Know that distance and speed are scalar quantities and displacement and velocity are vector quantities
- Perform simple calculations with regard to distances traveled and the displacement of an object from a given position
- Recall and apply the equation for the distance travelled by an object which is travelling at uniform speed (s = v t)
- Recall typical the speeds of walking, running, cycling, driving and a number of different common modes of transportation
- Calculate average speed for non-uniform motion
- (HT) Explain (with examples) how the motion of an object in a circular path can occur at uniform speed but with constantly changing velocity

Video: **Distance-time graphs**

- Understand that the motion of an object can be described in a convenient and easy-to-understand manner using a distancetime graph
- Plot a distance-time graph
- Interpret a distance-time graph
- Calculate the speed at which an object is travelling at a given point in time by measuring the gradient (slope) of its distancetime graph at that point
- (HT) When the speed of an object is changing (in other words, when it's accelerating or decelerating) calculate its speed by measuring the gradient of the tangent to its distance-time graph at a given point

Video: **Acceleration**

- Understand that the velocity of an object which is accelerating is increasing with time
- Understand that the velocity of an object which is decelerating is decreasing with time (and that a deceleration can be thought of as a negative acceleration)
- Recall and apply the equation for acceleration based on its change and velocity and the time taken
- Apply the equation for the acceleration of an object which relates its acceleration to its final and initial velocities and the distance over which the acceleration occurred

Video: **Velocity-time graphs**

- Understand the use of velocity-time graphs in describing the uniform and non-uniform motion of an object
- Plot a velocity-time graph from given data
- Interpret a velocity-time graph
- Calculate the acceleration of an object at a given point in time from the gradient of its velocity-time graph at that point
- (HT) Calculate the distance travelled by an object (or displacement of the object) from the area under its velocity-time graph
- (HT) Determine the area under a velocity-time graph by using the 'counting squares' method (as appropriate)

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Video: **Falling objects**

- Understand that an object which is falling through a fluid (a liquid or a gas) will initially accelerate due to gravity
- Understand that as the velocity of a falling object increases, the resistive force acting in a direction opposite to its direction of motion (either air resistance of fluid drag) will increases in magnitude, and that this will decrease the resultant force acting on the object in its direction of motion
- Understand that, when the resistive force acting on a falling object increases to the point at which it becomes equal to its weight, it will no longer accelerate (it will have reached its terminal velocity)
- Draw and interpret velocity-time graphs for a falling object which reaches terminal velocity
- Explain the changing motion of a falling object in terms of the forces which are acting on it

Video: **Newton's laws of motion**

- Recall and explain the meaning of Newton's first law and apply it to a range of situations
- (HT) Understand why Newton's first law of sometimes referred to as the 'law of inertia'
- Recall and explain the meaning of Newton's second law and apply it to a range of situations
- Recall and apply the equation for Newton's second law (F = m a)
- (HT) Calculate the inertial mass of an object from its acceleration and the resultant force which is acting on it and explain what is meant by the inertial mass of an object
- Investigate experimentally the factors which affect the acceleration of an object
- Recall and explain the meaning of Newton's third law and apply it to a range of situations

Video: **Forces and braking**

- Understand what is meant by the stopping, thinking and braking distances of a vehicle, and the relationship between each of these measurements
- Describe the factors which affect the reaction time of a driver
- Describe a simple method by which the reaction time of a person can be investigated
- Estimate how the distance over which a vehicle can stop in an emergency varies over a range of initial speeds of the vehicle
- Interpret graphs relating the speed at which a vehicle is travelling to its stopping distance for a range of vehicles, road conditions and driver
- Identify and explain the factors which affect the braking distance of a vehicle
- Explain that, when a force is applied to the brakes of a vehicle, work is done by the frictional force between its brake pads and the wheel, and that this reduces the kinetic energy of the vehicle and causes the temperature of the brakes to increase
- (HT) Estimate the typical forces involved with the deceleration of a vehicle based on given data

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Video: **Momentum 1**

- (HT) Recall and apply the equation for the momentum of an object (p = m v)
- (HT) Explain what is meant by a closed system
- (HT) Explain what is meant by the idea of the conservation of momentum in a closed system
- (HT) Describe and explain examples of the transfer and conservation of momentum in a closed system (such as what happens in a collision or explosion)

Topic 6. Waves

Video: **Transverse and longitudinal waves**

- Describe what is meant by a wave
- Explain the difference between transverse and longitudinal waves
- Give examples of both transverse and longitudinal waves

Video: **Properties of waves**

- Describe the meaning of the amplitude, wavelength, frequency and period of a wave, and measure any one of these quantities from a suitable wave diagram
- Recall and apply the wave equation which links the speed of a wave to its frequency and wavelength
- Apply the equation linking the period of a wave to its frequency
- Describe experimental methods for measuring the speed of sound waves in air, water waves in a ripple tank and waves on a vibrating string, and interpret data relating to each of these experiments
- Use wavefront diagrams to describe the motion of a wave
- Understand and apply the concept that the wavelength of a wave is proportional to its speed, but that its frequency remains constant when it travels from one medium into another

Video: **Electromagnetic waves 1**

- Describe the electromagnetic (EM) spectrum, and recall the order of the main types of EM waves (from the shortest to the longest wavelength)
- Recall the properties which all EM waves have in common
- Explain what is meany by the reflection and refraction of an EM wave
- Draw and interpret ray diagrams to describe the reflection and refraction of an EM wave
- (HT) Explain how the colour of an object depends on the fact that EM waves which strike its surface will be transmitted, absorbed and reflected by different amounts when they strike its surface
- Describe and explain the results of an experiment in which the reflection of light from a plane mirror is investigated
- Describe and explain the results of an experiment in which the refraction of light as it travels from one medium to another is investigated
- (HT) Use wavefront diagrams to describe motion of an EM wave from one medium into another

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Video: **Electromagnetic waves 2**

- Describe the uses and hazards of each of the seven main types of electromagnetic (EM) waves
- (HT) Explain why the properties of EM waves from a given part of the EM spectrum mean that it is suitable for particular applications
- Understand the meaning of the term 'ionising radiation' and interpret dose data related to the extent to which gamma rays, x-rays and short-wavelength ultraviolet waves can lead to the damaging ionisation of the atoms that make up cells within the body
- (HT) Explain the production, transmission and receiving of radio waves using radio antennae
- Know how to perform and interpret the results of an experiment in which the factors that affect the amount of infrared radiation absorbed or radiated (emitted) by a surface is investigated

Topic 7. Magnetism and electromagnetism

Video: **Magnetism**

- Describe the attractive and repulsive forces between the poles of two magnets which are brought close to one another
- Explain the difference between permanent and induced magnets
- Describe a test to check whether a magnet is permanent or induced
- Describe how to determine the magnetic field pattern around a bar magnet using a plotting compass
- Sketch the magnetic field pattern around a bar magnet
- Describe the behaviour of a navigational compass which is placed into a given point in the magnetic field of the Earth

Video: **The motor effect**

- Understand that when a current flow through a wire, a magnetic field will be produced around the wire
- Describe and sketch the magnetic field pattern around a straight current-carrying wire
- Describe and sketch the magnetic field pattern around a solenoid
- (HT) Use Fleming's left-hand rule to determine the direction of the force exerted on a current-carrying conductor which is at right angles to a magnetic field
- (HT) Understand and apply the equation for the force exerted on a current-carrying conductor which is at right angles to a magnetic field
- (HT) Describe the construction and explain the operation of an electric motor
- (HT) Describe the construction and explain the operation of moving-coil loudspeakers and headphones