ForwardThinking

HELPING STUDENTS RE-ENGAGE WITH SCIENCE

N5 Physics Learning Outcomes

Unit 1 - Energy and Electricity

Electrical charge carriers and electric fields

- State that there are 2 types of charge: positive (+) and negative (-)
- State that charges that are the same are called like charges
- State that charges that are not the same are called opposite charges
- State that like charges repel each other
- State that opposite charges attract each other
- Describe a simple model of an atom that includes: protons (+), electrons (-) and neutrons (0)
- Be able to draw electric fields for; point charges, pairs of charges, parallel plates.
- State that in an electric field, charged objects and particles experience a force
- Carry out calculations involving the relationship between charge, current and time
- State that electrons are free to move in a conductor
- State that electrical current is a flow of charges around a circuit or through a conductor

Potential difference (voltage)

- State that the voltage of a supply is a measure of the energy given to each charge in the circuit
- State that hte units of voltage and potential difference are the volt(B) or joules per coulomb
- State that like charges repel eachother
- State that opposite charges attract eachother
- Explain both DC and AC in terms of current and voltage

Practical electrical and electronic circuits

- Draw and identify circuit symbols for: a cell, battery, resistor, fuse, switch, lamp, ammeter and voltmeter in a circuit
- Draw circuit diagrams to show the correct positions of an ammeter and voltmeter in a circuit
- State that in a series circuit current is the same at all points
- State that the sum of the voltages across the components in a series circuit is equal to the supply voltage
- State that the sum of the currents in a parallel circuit is equal to the supply current
- State that the potential difference (voltage) across components connected in parallel is the same for each component
- Carry out calculations involving resistors connected in series

Ohm's law

- State that V/I for a resistor remains constant for different currents
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Electrical Power

- State that power is the electrical energy transferred each second
- State that the power, $P = IV$
- Carry out calculations involving the relationships between power, energy, time, current and potential difference
- Explain the equivalence between IV, I^2 and v^2R
- Carry out calculatins involving relationships between power, current, voltage and resistance.

Conservation of energy

- Give examples of devices where conversion takes place and state the conversion
- State that the resistance of a thermistor decreases with increasing temperature
- State that the resistance of an LDR decreases with increasing light level
- Carry out calculations involving $V = IR$ for a thermistor and LDR
- Be able to draw the symbol for an LED
- State that an LED only lights when current flows through it in a specific direction
- Draw a working circuit containing an LED
- State that the reesistor in series with an LED is there to limit the current to protect the LED
- Be able to draw an n-channel enhancement MOSFET
- State that transistors can be used as electronic switches to explain the operation of a transistor switching circuit
- State that work done is a measure of the energy transferred
- Carry out calculations involving the relationship between work done, force and distance
- Carry out calculations involving the relationship between change in gravitational potential energy, gravitational field stregnth, mass and height
- Carry out calculations involving the relationship between kinetic energy, mass and velocity
- Carry out calculations involving the relationship between work done, power and time

Specific heat capacity

- Use the following terms correctly in context: temperature, heat, celsius
- State that the temperature of a substance is a measure of the average kinetic energy of the particles in the substance
- State that heat is transferred from high temperature objects to low temperature objects by: conduction, convection and radiation
- State that the heat loss every second from a hot object is dependent on the temperature difference between the object and its surroundings
- State that the same mass of different materials requires different quantities of energy to change their temperature by 1 degree Celsius
- Carry out calculations involving: energy, mass, specific heat

capacity and temperature change

- State that energy is gained or lost by a material when its state changes
- State that a change in state of a material does not involve a change in the materials temperature
- Carry out calculations involving energy, mass and specific latent heat
- Use the following terms correctly in context: specific heat capacity, change of state, latent heat of fusion, latent heat of vaporisation.

Gas laws and the kinetic model

- State that pressure if the force per unit area, when a force acts at right angles to a surface.
- State that 1 Pascal is equal to 1 Newton per metre squared
- State that the pressure exerted by a fixed mass of gas at constant temperature is inversely proportional to its volume
- State that the pressure exerted by a fixed mass of gas at constant
- Carry out calculations involving pressure, force and area volume is directly proportional to its temperature measured in kelvins
- Describe how the kinetic model accounts for the pressure exerted by (K) a gas
- State that the volume of a fixed mass of gas at constant pressure is directly proportional to its temperature measured in kelvins (K)
- Carry out calculations to convert temperatures in 0C to K and vice versa
- State the ideal gas equation
- Carry out calculations involving pressure, volume and temperature
- of a fixed mass of gas using the general gas equation
- Explain what is meant by absolute zero of temperature
- Explain the pressure-volume, pressure-temperature and volume-temperature laws in terms of the kinetic model.

Unit 2 - Waves and Radiation

Wave parameters and behaviour

- State that a wave is a transfer of energy
- State the difference between a transverse and longitudinal wave
- State that the Amplitude is a measure of a waves energy
- State that in a given medium wave speed is constant
- State that frequency of a wave is dependent on its source
- Use the following terms correctly and in context: wave, crest, trough, frequency, wavelength, speed, amplitude, period
- Carry out calculations involving the relationship between frequency and period
- Carry out calculations involving the relationship between frequency, wavelength and speed
- State what is meant by diffraction
- Know how wavelength and gap width affect diffraction

EM spectrum

- State in order of wavelength the members of the electromagnetic spectrum: Radio, television, microwaves, infrared, visible light, ultra violet, x-rays, gamma rays
- State that all members of the electromagnetic spectrum are transverse waves.
- State that all members of the electromagnetic spectrum travel through a vacuum or air at a speed of 3x108m/s
- State that the energy of a photon in the electromagnetic spectrum is proportional to the photons frequency

Light

- State what is meant by reflection of light
- Draw diagrams showing reflection taking place
- Use in the correct context the terms: incident ray, reflected ray, normal, angle of incidence, angle of reflection
- State what is meant by Total Internal Reflection
- Draw diagrams showing total internal reflection taking place
- State a practical application for total internal reflection
- State what is meant by refraction of light
- Draw diagrams showing refraction from one medium to another
- Use in the correct context the terms: incident ray, refracted ray, normal, angle of incidence, angle of refraction

Nuclear radiation

- Describe a simple model of an atom including protons, neutrons and electrons
- State what is meant by the terms alpha particle, beta particle and gamma ray
- State that radiation can be absorbed by materials
- State the approximate range through air and absorbers of alpha, beta and gamma radiation
- Explain the term ionisation
- State that alpha is the most ionising type of radiation
- Describe how detectors of radiations work
- State that radiation can kill living cells or change the nature of living cells
- State that absorbed dose is the energy absorbed per unit mass of the absorbing material
- Carry out calculations using the relationship between absorbed dose, energy absorbed and mass of absorber.
- State that a radiation weighting factor s given to each radiation as a measure of its biological effect
- State equivalent dose is the product of absorbed dose and radiation weighting factors
- Carry out calculations using the relationship between absorbed dose, weighting factor and equivalent dose.
- State that the equivalent dose rate is the equivalent dose per unit time
- Carry out calculations using the relationship between equivalent dose rate, equivalent dose and time

- State that the risk of biological harm from exposure to radiation depends on: the absorbed dose, the type of radiation, the type of tissue exposed
- Describe factors that affect background radiation
- Describe safety procedures for handling radioactive materials
- State that exposure to radiation is reduced by: shielding, limiting exposure time and increasing distance from the source.
- State one medical use of nuclear radiation
- State one non-medical use of nuclear radiation
- State that the activity of a source is how a measure of how many nuclei decay in 1 second
- Carry out calculation involving the relationship between, activity, number of nuclei decaying and time
- State that activity of a source decreases over time o State the meaning of the term half-life
- Carry out calculations involving half- life
- Describe a method for measuring the half life of a source
- State advantages and disadvantages of using nuclear power in the generation of electricity.
- Describe the process of Fission: A heavy nucleus splitting into 2 lighter nuclei and releasing neutrons
- Explain in simple terms a chain reaction
- Describe the process of Fusion: 2 light nuclei combine to form 1 heavier nucleus
- Describe the principles of operation of a nuclear reactor in terms of: fuel rods, moderator, control rods, coolant, containment vessel
- Describe the problems associated with the disposal and storage of nuclear waste.

Unit 3 - Dynamics and Space

Motion

- What is meant by the term speed?
- Can I carry out calculations involving the relationship between distance, time and average speed (d=vt)?
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- Can I identify the scalar and vector quantities from the following? Force, speed, velocity, distance, displacement, mass, time and energy.
- What is the difference between distance and displacement?
- What is the difference between speed and velocity?
- Can I calculate the resultant of two vectors in:
- Can I describe how to measure an instantaneous speed? a) a straight line
- Can I calculate the instantaneous speed of an object? b) at right angles?
- Can I describe one example where the average speed of an object is measured in everyday life?
- Can I describe one example where the instantaneous speed of an object is measured in everyday life?
- Can I identify situations where average speed and instantaneous speed are different?
- What is meant by a scalar quantity?
- What is meant by a vector quantity?
- Can I carry out calculations involving the relationship between displacement, time and average velocity (s=vt)?
- What is meant by the term acceleration?
- Can I carry out calculations involving the relationship between initial velocity, final velocity, time and uniform (constant) acceleration?
- From a speed-time graph, can I identify when an object has:
  (a) increasing speed
  (b) decreasing speed
  (c) constant speed
- From a speed-time graph can I calculate the distance travelled by an object?
- Can I plot a velocity-time graph given a set of data?
- From a velocity-time graph, can I identify when an object has:
  (a) increasing velocity

(b) decreasing velocity

(c) constant velocity

- From a velocity–time graph involving more than one constant acceleration, can I calculate the acceleration of an object?
- From a velocity–time graph involving more than one constant acceleration, can I calculate the displacement of an object?

Forces

- When a force is applied to an object, what effect will it have on it? (i.e. what will it change?)
- Can I describe how to measure a force using a Newton Balance?
- Can I define the Newton?
- Is force a vector or a scalar quantity?
- In which direction does friction act in relation to the motion of an object?
- Can I describe and explain situations in which attempts are made to increase or decrease the force of friction?
- What is meant by the term balanced forces?
- Can I use free body diagrams to analyse the forces on an object?
- What is meant by the resultant of a number of forces?
- Can I explain how an object travels at a constant speed? (Think of Newton's first law of motion and frictional forces)
- Can I apply Newton's first law of motion to explain constant velocity?
- Can I predict what will happen to the acceleration of an object if only the mass changes?
- Can I predict what will happen to the acceleration of an object if only the force changes?
- Can I use the equation F=ma when only one force is acting?
- Can I use the equation F=ma when more than one force is acting?
- Can I use Newton's laws to explain:
  (a) the motion of an object during free-fall and
  (b) why it reaches terminal velocity?
- What is work done a measure of?
- Can I carry out calculations involving the relationships between work done, force and displacement? ($E = Fs$)
- What is weight an example of?

- What does weight mean?
- Do I know the difference between weight and mass and what is the unit of each quantity?
- Can I explain what is meant by gravitational field strength?
- Can I carry out calculations involving the relationship between weight, mass and gravitational field strength including situations where g is not equal to $10\frac{N}{kg}$?
- Can I state Newton's 3rd law of motion?
- Can I apply Newton's 3rd law of motion to explain motion resulting from a reaction force?

Satellites and Projectiles

- What is meant by the period of a sattelite?
- How does the period of a sattelite depend on the height of its orbit?
- How does the height of orbit of a geostationary sattelite compare with other sattelites?
- At what speed do radio (or microwave) signals travel during sattelite communication?
- Can I use the relationship between distance, speed and time when applied to sattelite communications?
- Can I name at least 3 applications of sattelites?
- Can I describe how parabolic (curved) reflectors are used in sattelite communication to
  (a) transmit signals?
  (b) recieve signals?
- Can I explain how sattelites have developed our understanding of the global impact of our actions?
- How can a sattelite be used to monitor environmental changes on the Earth?
- Can I explain how projectile motion can be treated as two independant motions?
- Can I carry out calculations of projectile motions using:
  1. appropriate formulae?
  2. graphs?
- Can I explain how a sattelite orbits in terms of projectile motion?

cosmology

- What is a star?
- What is a planet?
- What is a galaxy?
- What is a solar system?
- What is a moon?
- What is an exo-planet?
- What is the universe?
- What does a light year measure?
- How many metres are in 1 light year?
- Can I explain why we use the light year to measrue distance in space?
- Can I calclate the number of metres in 1 light year?
- What is the distance in light years from the earth to
  (a) The sun?
  (b) The next nearest star?
  (c) The next galaxy?
  (d) The edge of the universe?
- What conditions are required for an exp-planet to sustain life?
- What is the name of the theory of the origin of the universe?
- Can I describe what happened when the universe began?
- What evidence is there to support the hot big bang model of the universe?
- How old do we think the universe is? What evidence is there to suggest the age of the universe?
- What is the electromagnetic spectrum?
- What do all the waves of the electromagnetic spectrum have in common?
- Can I list the waves of the electromagnetic spectrum in order of
  1. Frequency?
  2. Wavelength?
- Can I name an example of a detector for each of the waves in the electromagnetic spectrum?
- Why have astronomers developed telescopes to detect different parts of the electromagnetic spectrum?
- What information have astronomers obtained from using these telescopes?
- Can I identify a continuous spectrum from a picture?
- Can I identify a line emission spectrum from a picture?

- Can I use a line spectrum to identify the elements present in stars?

Space exploration

- What have we learned about planet Earth as a result of space exploration?
- What have we learned about the universe as a result of space exploration?
- How has our model of the universe changed over time/
- What evidence is there to support our understanding of the universe now?
- Can I apply Newton's second law ($F = ma$) to describe the motion and the forces acting on a space rocket during
  (a) launch?
  (b) motion in space?
  (c) landing?
- Can I list at least 4 technologies that were developed as a result of space exploration?
- Can I describe how some of the technologies developed as a result of space exploration impact our daily lives?
- Can I list some of hte benefits associated with space exploration?
- Do I know that radiation from space is recieved in a variety of forms?
- Can I show by calculation that the same mass of different materials requires different quantities of energy to raise their temperature by 1 degree Celsius per unit mass?
- What is meant by the term 'specific heat capacity'?
- What is meant by the term 'change of state'?
- What is meant by the term 'specific latent heat of vaporisation'?
- Can I carry out calculations involving heat, mass, specific heat capacity and temperature change fora spacecraft during re-entry?
- What happens to the temperature of a substance when it changes state?
- Can I carry oyt calculations involving heat, mass and specific latent heat for a spacecraft during re-entry?
- What are the challenges faced by a space craft when re-entering a planet's atmosphere?
- Can I identify which materials could be used on the thermal protection system on a space craft to protect it on re-entry and state why they should be used.

- Can I describe the need for thermal protection systems to protect a spacecraft during re-entry?
- Can I describe the challenges of re-entry to the Earth's atmosphere?
- Can I list some of the risks associated with space exploration?