ForwardThinking

HELPING STUDENTS RE-ENGAGE WITH SCIENCE

N5 Physics Learning Outcomes

Unit 1 – Electricity and Energy

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 (=)
- 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 the units of voltage and potential difference are the Volt(V) or Joules per Coulomb(JC-1)
- State that like charges repel each other
- State that opposite charges attract each other
- 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 o Carry out calculations involving resistors connected in parallel

Ohm's law

- State that V/I for a resistor remains constant for different currents o Carry out calculations involving the relationship between potential difference (voltage), current and resistance

Electrical power

- State that power is the electrical energy transferred each second
- State that the P= IV
- Carry out calculations involving the relationships between, power, energy, time, current and potential difference
- Explain the equivalence between IV, I2R and $v2\ R$
- Carry out calculations involving the relationships between power, current, voltage and resistance

Conservation of energy

- Give examples of devices where an energy 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 resistor in series with an LED is there to limit the
- current to protect the LED
- Be able to draw an n-channel enhancement MOSFET
- Be able to draw an NPN Transistor
- State that transistors can be used as electronic switches o 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 strength, 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
- Carry out calculations involving pressure, force and area
- Describe how the kinetic model accounts for the pressure exerted by a gas
- 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 volume is directly proportional to its temperature measured in kelvins (K)

- 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 general 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 Electro Magnetic spectrum: Radio, television, microwaves, infra-red, 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)?
- Can I carry out calculations involving the relationship between distance, time and average speed (d=vt)?
- Can I describe how to measure an instantaneous speed?
- Can I calculate the instantaneous speed of an object?
- 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 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:

  a) a straight line

  b) at right angles?
- 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 you 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 (Ew = F s)?
- 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 Nkg-1.
- Can I carry out calculations involving the relationship between weight, mass and gravitational field strength during interplanetary rocket flight?
- 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 satellite?
- How does the period of a satellite depend on the height of its orbit?
- How does the height of orbit of a geostationary satellite compare with other satellites?
- At what speed do radio (or microwave) signals travel during satellite communication?
- Can I use the relationship between distance, speed and time when applied to satellite communications?
- Can I name at least 3 applications of satellites?
- Can I describe how parabolic (curved) reflectors are used in satellite communication to:

  a) transmit and

  b) receive signals?
- Can I explain how satellites have developed our understanding of the global impacts of our actions?
- How can a satellite be used to monitor environmental changes on the Earth?

- Can I explain how projectile motion can be treated as two independent motions?
- Can I carry out calculations of projectile motion using:
    a) appropriate formulae;
    b) graphs?
- Can I explain how a satellite 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 measure distance in space?
- Can I calculate 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 exo – 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 in the electromagnetic spectrum have in common?
- Can I list the waves of the electromagnetic spectrum in order of
    a) frequency;

b) 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 line spectra to identify the elements present in stars?
- Do I know that radiation from space is received in a variety of forms?

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 and

  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 on our everyday lives?
- Can I list some of the benefits associated with space exploration?
- Can I show by calculation that the same mass of different materials requires different quantities of energy to raise their temperature of unit mass by 1 degree Celsius?
- 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 fusion?
- 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 for a spacecraft during re – entry?
- What happens to the temperature of a substance when it changes state?
- What happens to the energy of a substance when it changes state?
- Can I carry out 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 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?