Topic 1 – Motion

- Recall vector and scalar quantities, including:
    a) displacement/distance (vector/scalar)
    b) velocity/speed (vector/scalar)
    c) acceleration (vector)
    d) force (vector)
    e) weight/mass (vector/scalar)
    f) momentum (vector)
    g) energy (scalar
- Recall that velocity is speed in a stated direction
- Recall and use the equations:
    - speed = distance ÷ time
    - distance travelled = average speed × time
- Recall and use the equation: acceleration = change in velocity ÷ time taken
- Recall some typical speeds encountered in everyday experience for:
    - wind (5 m/s)
    - sound (330 m/s)
    - walking (2 m/s)
    - running (5 m/s),
    - cycling (10 m/s)
- Recall that the acceleration, g, in free fall is 10 m/s^2

Topic 2 - Motion and forces

- Recall Newton's first law "objects with balanced forces acting on them will stay at rest or stay in constant motion."
- Recall and use Newton's second law as: force = mass × acceleration, F = m× a
- Recall and use the equation: weight = mass × gravitational field strength, W = m× g
- Recall Newton's third law: "Every action has an equal and opposite reaction."
- Recall and use the equation: momentum = mass × velocity, p = m × v
- Recall that the stopping distance of a vehicle is made up thinking distance + braking distance

Topic 3 – Conservation of energy

- Recall and use the equation to calculate the change in gravitational potential energy when an object is raised above the ground:
  change in gravitational potential energy = mass × gravitational field strength × change in height, $\Delta GPE = m \times g \times \Delta h$
- Recall and use the equation to calculate kinetic energy:
- kinetic energy = ½ × mass × $(speed)^2$, $KE = ½ \times m \times v^2$
- Recall and use the equation:
  Efficiency = (useful energy transferred by the device) ÷ (total energy supplied to the device)
- Recall the main energy sources available for use on Earth (fossil fuels, nuclear fuel, bio-fuel, wind, hydroelectricity, the tides and the Sun),
- Recall the definitions of **renewable** and **non-renewable**

Topic 4 – Waves

- Recall that waves transfer energy and information without transferring matter
- Define and the terms
    - frequency (the number of waves produced by a source each second)
    - wavelength (the distance between a crest on one wave and a crest on the next wave)
- Recall and use both the equations below for all waves:
    - wave speed (metre/second, m/s) = frequency (hertz, Hz) × wavelength (metre, m), $v = f \times \lambda$
    - wave speed (metre/second, m/s) = distance (metre, m) ÷ time, (second, s), $v = d \div t$
- Recall that different substances may absorb, transmit, refract or reflect waves in ways that vary with wavelength

Topic 5 – Light and the electromagnetic spectrum

- Recall that all electromagnetic waves are transverse, that they travel at the same speed in a vacuum
- Recall the electromagnetic spectrum in order radio waves, microwaves, infrared, visible (including the colours of the visible spectrum), ultraviolet, x-rays and gamma rays
- Recall that our eyes can only detect a limited range of frequencies of electromagnetic radiation
- Recall that different substances may absorb, transmit, refract or reflect electromagnetic waves in ways that vary with wavelength
- Recall that the potential danger associated with an electromagnetic wave increases with increasing frequency
- Describe the harmful effects on people of excessive exposure to electromagnetic radiation, including:
    - microwaves: internal heating of body cells
    - infrared: skin burns
    - ultraviolet: damage to surface cells and eyes, leading to skin cancer and eye conditions
    - x-rays and gamma rays: mutation or damage to cells in the body
- Describe some uses of electromagnetic radiation
    - radio waves: broadcasting, communications and satellite transmissions
    - microwaves: cooking, communications and satellite transmissions
    - infrared: cooking, thermal imaging, short range communications, optical fibres, television remote controls and security systems
    - visible light: vision, photography and illumination
    - ultraviolet: security marking, fluorescent lamps, detecting forged bank notes and disinfecting water
    - x-rays: observing the internal structure of objects, airport security scanners and medical x-rays
    - gamma rays: sterilising food and medical equipment, and the detection of cancer and its treatment

Topic 6 – Radioactivity

- Describe an atom as a positively charged nucleus, consisting of protons and neutrons, surrounded by negatively charged electrons
- Recall the typical size (order of magnitude) of atoms (0.1 nm) and small molecules (0.5 nm)
- Describe the structure of nucleus using the terms:
    - atomic (proton) number
    - mass (nucleon) number
- Recall that the nucleus of each element has a positive charge, but that isotopes of an element differ in mass by having different numbers of neutrons
- Recall the relative masses and relative electric charges of
    - Protons (mass = 1 , charge = +1)
    - Neutrons (mass = 1, charge = 0)
    - electrons (mass = 1/1800, charge = -1)
    - positrons (mass = 1/1800, charge = +1)
- Recall that in an atom the number of protons equals the number of electrons and is therefore neutral
- Recall that in each atom its electrons orbit the nucleus at different set distances from the nucleus
- Recall that alpha, β– (beta minus), β+ (positron), gamma rays and neutron radiation are emitted from unstable nuclei
- Recall that radioactive decay is a random process and that it cannot be predicted when an unstable nucleus will decay
- Recall that alpha, β– (beta minus), β+ (positron) and gamma rays are ionising radiations
- Describe the origins of background radiation:
    - Cosmic rays – radiation that reaches the Earth from space
    - Rocks and soil – some rocks are radioactive and give off radioactive radon gas
    - Living things – plants absorb radioactive materials from the soil and these pass up the food chain
- Recall that an alpha particle is equivalent to a helium nucleus, a beta particle is an electron emitted from the nucleus and a gamma ray is electromagnetic radiation
- Recall that nuclei that have undergone radioactive decay often undergo rearrangement of their neutrons and protons and lose energy as gamma radiation
- Recall that the unit of activity of a radioactive isotope is the Becquerel, Bq
- Recall that the half-life of a radioactive isotope is the time taken for half the undecayed nuclei to decay or the activity of a source to decay by half

Topic 8/9 - Forces doing work, and Forces and their effects

- Recall and use the equation:
    - work done (joule, J) = force (newton, N) × distance moved in the direction of the force (metre, m)
    - $E = F \times d$
- Recall and use the equation to calculate the change in gravitational PE when an object is raised above the ground:

    - change in gravitational potential energy (joule, J) = mass (kilogram, kg) × gravitational field strength (newton per kilogram, N/kg) × change in vertical height (metre, m),
    - $\Delta GPE = m \times g \times \Delta h$
- Recall and use the equation to calculate kinetic energy:
    - kinetic energy (joule, J) = ½ × mass (kilogram, kg) × (speed)2 ((metre/second)2, (m/s)2)
    - $KE = ½ \times m \times v^2$
- Define power as the rate at which energy is transferred
- Recall and use the equation:
    - power (watt, W) = work done (joule, J) ÷ time taken (second, s)
    - P = Et
- Recall that one watt is equal to one joule per second, J/s
- Recall and use the equation:
    - Efficiency = (useful energy transferred by the device) / (total energy supplied to the device) efficiency