National 5 Physics
Learning Outcomes

Contents

0 Units, Prefixes and Scientific Notation

☐ Use SI units appropriately and the prefixes nano (n), micro (μ), milli (m), kilo (k), mega (M), giga (G).

Prefix	Symbol	Scientific Notation	Action
Giga	G	x10^9	x 1 000 000 000
Mega	M	x10^6	x 1 000 000
Kilo	k	x10^3	x 1 000
Centi	c	x10^{-2}	÷ 100
Milli	m	x10^{-3}	÷ 1 000
Micro	μ	x10^{-6}	÷ 1 000 000
Nano	n	x10^{-9}	÷ 1 000 000 000

- The SI unit of mass is kilograms (kg) so there is no need to convert this to grams (g).
- Watch out for ms; this is milliseconds, not metres per second (ms^{-1}).

☐ Use the appropriate number of significant figures in final answers. This means that the final answer can have no more significant figures than the value with the least number of significant figures used in the calculation.

- E.g. consider the following question: If a rocket motor produces 4570 N of thrust to a rocket with a mass of 7.0 kg, what is the acceleration of the rocket?

  The calculated answer to this question would be 652.8571429 ms^{-2}. However, the least accurate value we are given in the question is the value of the mass (which is only given to 2 significant figures). Our answer cannot exceed the value with the least number of significant figures, so therefore also has to be to 2 significant figures: 650 ms^{-2}. (Note: The 0 here is not counted as a significant figure).

☐ Use scientific notation appropriately.

- E.g. 5000000 can be written as 5x10^6 in scientific notation (5 multiplied by 10, six times).
  Another way of looking at this is to firstly insert a decimal point after the first number, then move the decimal point to the right six places.
- Similarly, 0.000005 can be written as 5x10^{-6} in scientific notation (5 divided by 10, six times).
  This time the decimal point is moved to the left six places.

1 Waves

1.1 Wave Parameters and Behaviours

- ☐ Know that waves transfer energy.
- ☐ Define transverse and longitudinal waves.
- ☐ Know that sound is an example of a longitudinal wave and electromagnetic radiation and water waves are examples of transverse waves.
- ☐ Determine the frequency, period, wavelength, amplitude and wave speed for longitudinal and transverse waves.
- ☐ Use appropriate relationships to solve problems involving wave speed, frequency, period, wavelength, distance, number of waves and time.

$$d = vt \quad ; \quad v = f\lambda \quad ; \quad T = \frac{1}{f} \quad ; \quad f = \frac{N}{t}$$

- ☐ Know that diffraction occurs when waves pass through a gap or around an object.
- ☐ Compare long wave and short wave diffraction.
- ☐ Draw diagrams using wavefronts to show diffraction when waves pass through a gap or around an object.

1.2 Electromagnetic Spectrum

- ☐ Know the relative frequency and wavelength of bands of the electromagnetic spectrum.
- ☐ Know of typical sources, detectors and applications for each band in the electromagnetic spectrum.
- ☐ Know that all radiations in the electromagnetic spectrum are transverse and travel at the speed of light.

1.3 Refraction of Light

- ☐ Know that refraction occurs when waves pass from one medium to another.
- ☐ Describe refraction in terms of change of wave speed, change in wavelength and change of direction (where the angle of incidence is greater than 0°), for waves passing into both a more dense and a less dense medium.
- ☐ Identify the normal, angle of incidence and angle of refraction in ray diagrams showing refraction.

2 Radiation

2.1 Nuclear Radiation

- ☐ Know the nature of alpha (α), beta (β) and gamma (γ) radiation.
- ☐ Know the term 'ionisation' and the effect of ionisation on neutral atoms.
- ☐ Know the relative ionising effect and penetration of alpha, beta and gamma radiation.
- ☐ Define activity in terms of the number of nuclear disintegrations and time.
- ☐ Use an appropriate relationship to solve problems involving activity, number of nuclear disintegrations and time.

$$A = \frac{N}{t}$$

- ☐ Know sources of background radiation.
- ☐ Know the dangers of ionising radiation to living cells and of the need to measure exposure to radiation.
- ☐ Use appropriate relationships to solve problems involving absorbed dose, equivalent dose, energy, mass and weighting factor.

$$D = \frac{E}{m} \quad ; \quad H = Dw_R$$

- ☐ Use an appropriate relationship to solve problems involving equivalent dose rate, equivalent dose and time.

$$\dot{H} = \frac{H}{t}$$

- ☐ Compare equivalent dose due to a variety of natural and artificial sources.
- ☐ Know equivalent dose rate and exposure safety limits for the public and for workers in the radiation industries in terms of annual effective equivalent dose.
  - Average annual background radiation in UK: 2·2 mSv.
  - Annual effective dose limit for member of the public: 1 mSv.
  - Annual effective dose limit for radiation worker: 20 mSv.
- ☐ Have awareness of applications of nuclear radiation: electricity generation, cancer treatment and other industrial and medical uses.
- ☐ Define half-life.

- ☐ Use graphical or numerical data to determine the half-life of a radioactive material.
- ☐ Describe an experiment to measure the half-life of a radioactive material.
- ☐ Qualitatively describe fission, chain reactions, and their role in the generation of energy.
- ☐ Qualitatively describe fusion, plasma containment, and their role in the generation of energy.