

National 4
WAVES AND RADIATION
Study Guide



1.1 Waves

At the end of the section you should be able to :

- ☐ 1 State that a wave transfers energy.
- ☐ 2 State the difference between a transverse and longitudinal wave and give examples of each.
- ☐ 3 Use the following terms correctly in context: frequency, wavelength, speed, amplitude.
- ☐ 4 Carry out calculations involving the relationship between distance, time and speed in waves.
- ☐ 5 Carry out calculations involving the relationship between speed, wavelength and frequency for waves.

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1.2 Sound

At the end of the section you should be able to :

- ☐ 1 State that sound can pass through solids, liquids and gases.
- ☐ 2 State that sound cannot pass through a vacuum.
- ☐ 3 Give an example which shows that the speed of sound in air is less than the speed of light in air.
- ☐ 4 Describe a method for measuring the speed of sound in air using the relationship between distance, time and speed.
- ☐ 5 State that the speed of sound changes as it moves from one material to another.
- ☐ 6 Carry out calculations involving the speed of sound.
- ☐ 7 State that the higher the pitch of a sound the larger the frequency.
- ☐ 8 State that the louder the volume of a sound the greater the amplitude.
- ☐ 9 Identify from oscilloscope traces the signal which would produce:
 - (a) the louder sound
 - (b) the higher frequency.
- ☐ 10 State that if two sounds are one octave apart, the frequency of one is double the other.

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- ☐ 11 State that the frequency produced by a vibrating string can be increased by shortening the length of the string and increasing the tightness of the string.
- ☐ 12 State that the frequency produced by a vibrating air column can be increased by shortening the length of the air column.
- ☐ 13 State that the normal range of human hearing is from 20 hertz to 20,000 hertz.
- ☐ 14 State that high frequency sounds beyond the range of human hearing are called ultrasounds.
- ☐ 15 Give one example of a use of ultrasound in medicine.
- ☐ 16 Give one example of a non-medical use of ultrasound.
- ☐ 17 State that sound levels are measured in decibels.
- ☐ 18 Give two examples of noise pollution.
- ☐ 19 State that excessive noise can damage hearing.
- ☐ 20 State that hearing can be protected by ear protectors.
- ☐ 21 State that some ear protectors rely upon noise cancellation.
- ☐ 22 State that the output signal from an amplifier has the same frequency but a bigger amplitude than the input signal.
- ☐ 23 State the function of each of the three major components needed to amplify speech (microphone, amplifier, loudspeaker).

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1.3 Light

At the end of the section you should be able to :

- ☐ 1 State that light can be reflected.
- ☐ 2 State that all visible objects give out, or reflect, light to the eye.
- ☐ 3 Use correctly in context the terms: angle of incidence, angle of reflection and normal when a ray of light is reflected from a plane mirror.
- ☐ 4 Describe one practical use of optical fibres.
- ☐ 5 State what is meant by the refraction of light.
- ☐ 6 Draw diagrams to show the change in direction as light passes from air to glass and glass to air.
- ☐ 7 Describe the shapes of converging and diverging lenses.
- ☐ 8 Describe the effect of a converging and a diverging lens on parallel rays of light.
- ☐ 9 Describe, in words or using a diagram, the eye defects called long and short sight.
- ☐ 10 State that a converging lens can correct long sight and a diverging lens can correct short sight.
- ☐ 11 State that white light is made up of many different colours: red, orange, yellow, green, blue, indigo and violet.

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- 12 State that this range of colours is known as the visible light spectrum.

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1.4 Electromagnetic Spectrum

At the end of the section you should be able to :

- ☐ 1 State in order of frequency, the members of the electromagnetic spectrum: TV and radio, microwaves, infrared, visible light, ultraviolet, X-rays, gamma rays.
- ☐ 2 All waves of the electromagnetic spectrum travel at 300 000 000 metres per second (the speed of light).
- ☐ 3 State that all other forms of radiation in the spectrum, apart from visible light, are invisible to the naked eye.
- ☐ 4 State that infrared radiation is called heat radiation.
- ☐ 5 Describe one use of infrared radiation in medicine.
- ☐ 6 Describe one non-medical use of infrared radiation.
- ☐ 7 Describe one use of ultraviolet radiation in medicine.
- ☐ 8 States that some chemicals glow ie fluoresce when they absorb ultraviolet radiation.
- ☐ 9 Describe how ultraviolet radiation can be used in identifying security markings.
- ☐ 10 State that photographic film may be used to detect X-rays.
- ☐ 11 Describe one use of X-rays in medicine.

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- ☐ 12 Describe one use of X-rays in industry.
- ☐ 13 State that X-rays are dangerous since they can damage living cells.
- ☐ 14 State that gamma radiation can kill living cells or change the nature of living cells.
- ☐ 15 State that gamma radiation can pass through most materials.
- ☐ 16 Describe how gamma radiation can be used as a tracer in both medicine and industry.
- ☐ 17 State that the strength of a source of gamma radiation decreases with time.
- ☐ 18 Describe the hazards associated with the radiations of the spectrum.
- ☐ 19 Describe the safety precautions which need to be taken when dealing with the radiations of the spectrum.

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1.5 Nuclear Radiation

At the end of the section you should be able to :

- ☐ 1 Describe a simple model of the atom which includes protons, neutrons and electrons.
- ☐ 2 State that there is radiation present in our surroundings known as background radiation.
- ☐ 3 Identify natural sources of background radiation.
- ☐ 4 Identify artificial sources of background radiation.
- ☐ 5 State that radiation can kill living cells or change the nature of living cells.
- ☐ 6 Describe medical uses of radiation based on the fact that radiation can destroy cells.
- ☐ 7 Describe uses of radiation based on the fact that radiation is easy to detect.
- ☐ 8 State that electricity can be generated from nuclear fuel.
- ☐ 9 State the advantages and disadvantages of using nuclear power for the generation of electricity.