

Radio waves to gamma rays: uses and risks

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Worksheet

Name: _____ Date: _____ Class: _____

These 20 problems cover the order of the spectrum, the wave equation $c = f \times \lambda$, the uses of each type of wave and the hazards of ionising radiation. They build from naming and ordering to unit conversions, multi-step calculations and evaluating technology choices.

The set suits GCSE, IGCSE, O Level, CBSE Class 9-10 and NGSS high school physics students. Write answers in standard form where needed and state units.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS4-4, HS-PS4-5

Problem 1 Order of the spectrum (easy)

Write these seven waves in order of increasing frequency: gamma rays, visible light, radio waves, X-rays, infrared, ultraviolet, microwaves.

Problem 2 Shared properties (easy)

All electromagnetic waves share some properties.

1. State their speed in a vacuum.
2. State whether they are transverse or longitudinal.
3. State whether they need a medium to travel.

Problem 3 Match the use (easy)

Chiamaka in Lagos lists six devices. Name the type of wave each one uses.

1. TV remote control
2. Cancer treatment machine that kills tumour cells
3. Bone scan at a clinic
4. Satellite dish link
5. Torch
6. Tanning lamp

Problem 4 FM radio wavelength (easy)

Wanjiru in Nairobi listens to a station broadcasting at 91.5 MHz. Radio waves travel at 3.0×10^8 m/s.

1. Convert 91.5 MHz to hertz.
2. Calculate the wavelength.

Problem 5 Unit conversions (easy)

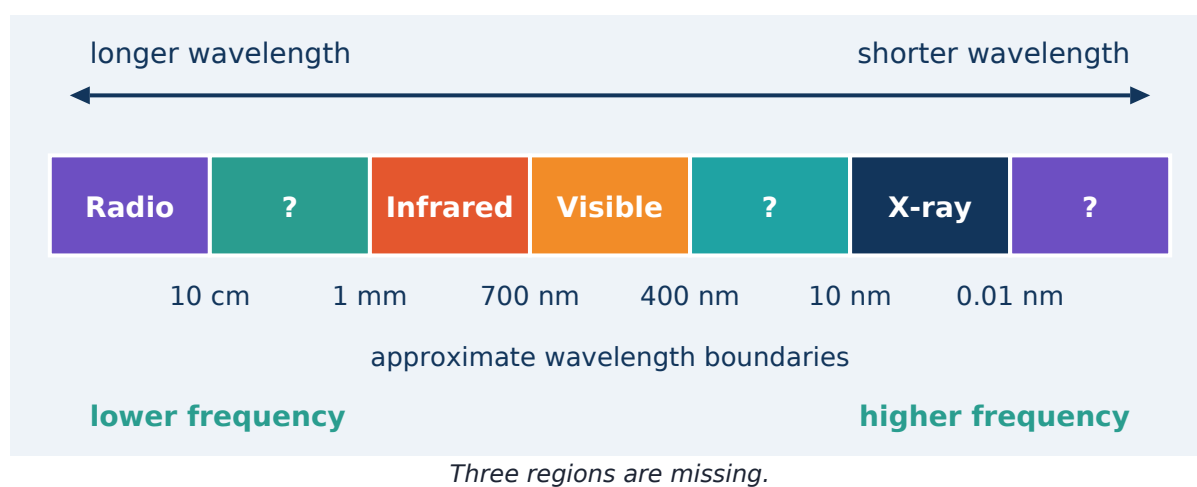
Convert each value to base SI units and write it in standard form.

1. 2.4 GHz
2. 550 nm
3. 0.12 nm

Problem 6 Name the regions (easy)

The bar shows the spectrum with three regions left blank.

1. Name the regions marked ? (from left to right).
2. State which end has the highest frequency.
3. State which region the second blank region borders on the right.

**Problem 7 Colour of a sodium lamp** (medium)

Bilal in Lahore reads that a sodium street lamp gives yellow light of wavelength 590 nm.

1. Convert the wavelength to metres.
2. Calculate the frequency of the light.

Problem 8 Mobile network bands (medium)

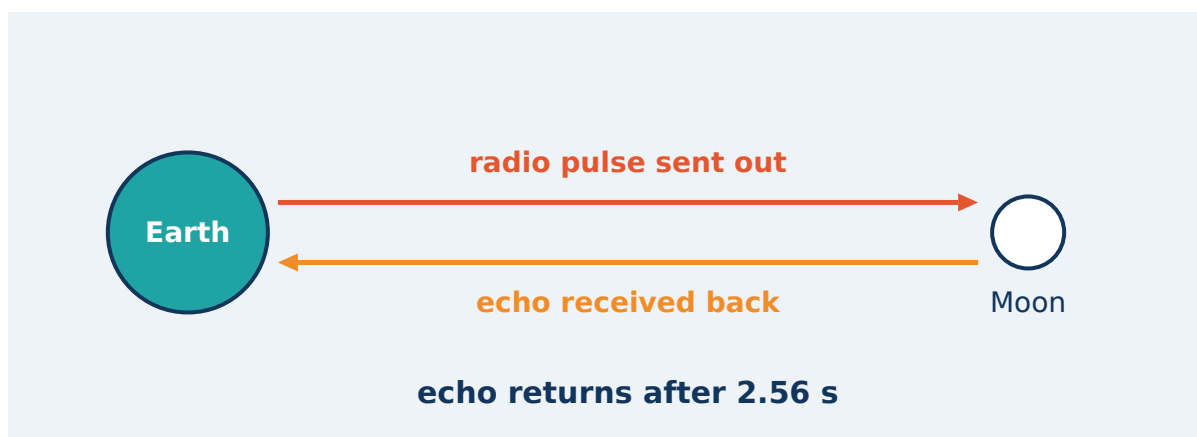
A phone network uses two frequencies: 1.8 GHz and 3.5 GHz.

1. Calculate the wavelength of each.
2. State which has the shorter wavelength and by how many times the two wavelengths differ (to 2 significant figures).

Problem 9 Radar echo from the Moon (medium)

A radio pulse sent from Earth returns from the Moon after 2.56 s (see figure).

1. State the distance the pulse travels in total.
2. Calculate the distance from Earth to the Moon.



A radio pulse travels to the Moon and back.

Problem 10 Holes in the microwave door (medium)

The window of a microwave oven has a metal mesh with holes about 2 mm across. The microwaves have wavelength about 12 cm.

1. Convert the wavelength to millimetres.
2. Explain why the microwaves stay inside while visible light, wavelength 500 nm, can pass out.

Problem 11 Waves and frequencies (medium)

Complete the table, using $c = 3.0 \times 10^8$ m/s, and name the region of each wave using the table in the lesson.

Wave	Frequency (Hz)
A	1.0×10^8
B	1.0×10^{12}
C	1.0×10^{16}
D	3.0×10^{18}

Problem 12 Sunburn at midday (medium)

Mei in Singapore gets sunburnt even on a cloudy day.

1. Name the part of sunlight that causes sunburn.
2. Explain how it damages skin cells.
3. Suggest two ways she can reduce the risk.

Problem 13 Ionising or not (medium)

Compare X-rays with the microwaves used in a mobile phone.

1. State which type is ionising.
2. Explain, in terms of frequency, why the other type cannot ionise atoms.

Problem 14 Vet checks cattle (medium)

A vet in Lahore uses a camera that makes pictures from infrared radiation to find cattle with a fever.

1. Explain why hotter animals appear brighter in the picture.
2. State why a normal camera would not work in a dark shed.

Problem 15 Spot the errors (medium)

Aarav wrote three statements. Identify the mistake in each.

1. "X-rays travel faster than radio waves in a vacuum."
2. "Gamma rays have the longest wavelength."
3. "Microwaves are ionising because they cook food."

Problem 16 Antenna length (hard)

A simple antenna for a 900 MHz phone signal is one quarter of a wavelength long.

1. Calculate the wavelength.
2. Calculate the antenna length in centimetres.
3. Predict how the length changes at 1800 MHz.

Problem 17 Light from the Sun (hard)

Sunlight travels 1.50×10^{11} m to Earth. The speed of light is 3.00×10^8 m/s.

1. Calculate the travel time in seconds.
2. Convert it to minutes and seconds.
3. A solar storm sends X-rays and charged particles at the same time. X-rays arrive first; explain why.

Problem 18 Chest X-ray and background (hard)

One chest X-ray gives a dose of 0.020 mSv. A person in Kenya receives 2.4 mSv per year from natural background radiation.

1. Calculate the average background dose per day (365 days).
2. Calculate how many days of background radiation equal one chest X-ray.
3. Explain why doctors still limit the number of X-rays a patient has.

Problem 19 Sterilising with gamma rays (hard)

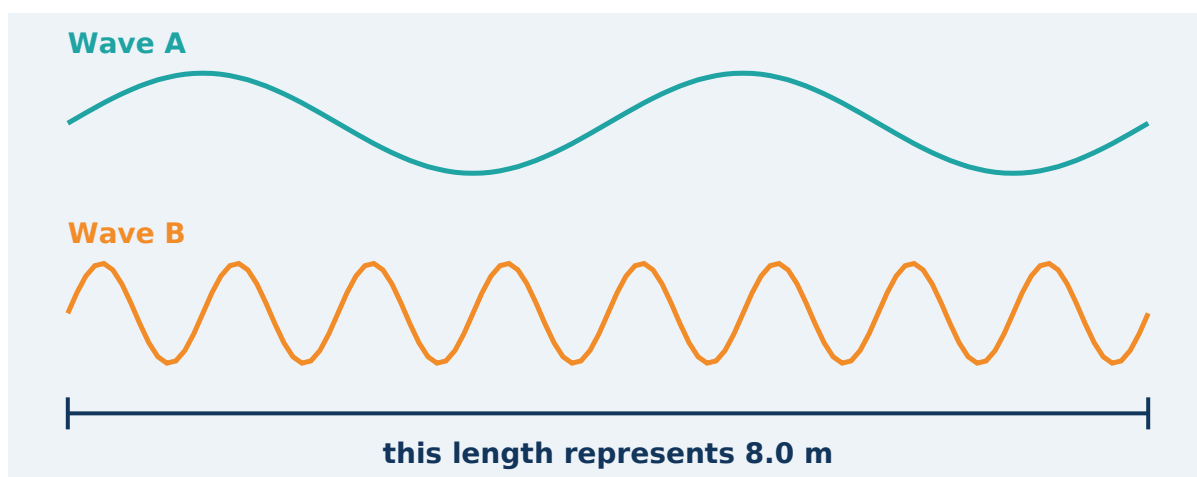
A hospital in Texas sterilises sealed packs of surgical gloves using gamma rays. Evaluate this method.

1. Explain how gamma rays kill bacteria.
2. Give two advantages of sterilising after sealing.
3. Suggest one safety precaution for the workers.

Problem 20 Two radio waves (hard)

The diagram shows two radio waves that both fit along an 8.0 m stretch. Use $c = 3.0 \times 10^8$ m/s.

1. Determine the wavelength of each wave.
2. Calculate the frequency of each wave.
3. A hill blocks the path to a house. State which wave bends more around the hill and explain why.



Two radio waves drawn along the same 8.0 m stretch.