

# Radio to gamma waves and digital signals

Grade 8 science (Year 9 · Class 8) · Test

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_ Mark: \_\_\_\_ / 20

This test covers the EM spectrum, the wave equation, uses and dangers of the waves, digital signals and binary numbers. Answer every question, show your working for calculations and include units.

**Level:** Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-PS4-3

Time: 45 minutes · 9 questions · Total: 20 marks · Calculator allowed

## Question 1 Ordering waves (2 marks)

Microwaves, X-rays and visible light are three types of EM wave.

- Put them in order of increasing frequency. (1 mark)
- State which has the longest wavelength. (1 mark)

## Question 2 Radio wave calculation (3 marks)

A radio wave has a wavelength of 2.0 m. The speed of EM waves in a vacuum is  $3.0 \times 10^8$  m/s.

- Write the equation linking speed, frequency and wavelength. (1 mark)
- Calculate the frequency in hertz. (2 marks)

## Question 3 Uses of waves (2 marks)

State one use of each type of wave.

- Infrared (1 mark)
- Ultraviolet (1 mark)

## Question 4 Danger of X-rays (2 marks)

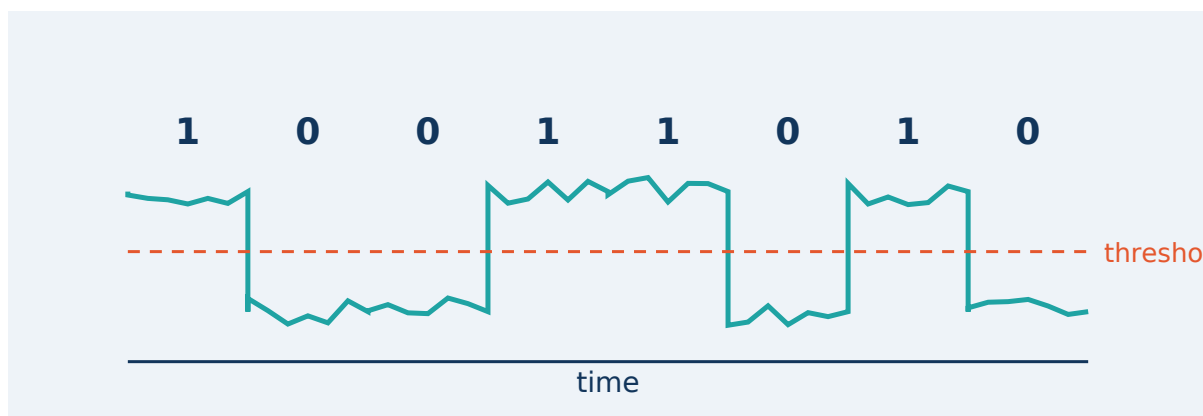
A radiographer stays behind a lead screen when taking X-ray images.

- Explain why X-rays can be dangerous to living cells. (1 mark)
- Suggest why lead is used for the screen. (1 mark)

**Question 5 Noisy digital signal** (3 marks)

A phone receives the signal shown, where a pulse above the dashed line is a 1.

- Write down the eight bits received. (1 mark)
- Explain why the noise does not change the message. (1 mark)
- State one advantage of digital signals over analogue signals. (1 mark)



*A noisy digital signal received at a phone. The dashed line is the threshold.*

**Question 6 Binary** (3 marks)

- Convert 1001 to decimal. (1 mark)
- Convert 14 to binary. (1 mark)
- State how many different values 3 bits can store. (1 mark)

**Question 7 Speed of gamma rays** (2 marks)

A student says that gamma rays travel faster than radio waves in a vacuum. Explain why the student is wrong. (2 marks)

**Question 8 Radar pulse** (2 marks)

A radar pulse is reflected from an aircraft 15 km away. Calculate the time between sending the pulse and receiving the echo. Use  $3.0 \times 10^8$  m/s. (2 marks)

**Question 9 Mobile signal** (1 mark)

State the part of the EM spectrum used by mobile phones to send signals. (1 mark)