AP PHYSICS 2 • EXERCISE SHEET

# 14.4 Electromagnetic Waves

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

**KEY WORDS** electromagnetic wave 电磁波 • speed of light 光速 • electromagnetic spectrum 电磁波谱 • wave 波 • frequency 频率

## Objective

Build the skills to answer exam questions on **electromagnetic waves**.

**You must be able to:**

- describe an **electromagnetic wave** 电磁波 as oscillating electric and magnetic fields
- state that all EM waves travel at the **speed of light** 光速 $c$ in a vacuum
- order the regions of the **electromagnetic spectrum** 电磁波谱 by wavelength and frequency

## 1 Worked examples

Study these first. Each one shows the method for a question type used later.

### ■ What an EM wave is

An electromagnetic wave is oscillating electric and magnetic fields, at right angles to each other and to the direction of travel. It needs **no** medium.

### ■ Speed

Every EM wave travels at $c = 3.0 \times 10^8$ m s$^{-1}$ in a vacuum.

### ■ The spectrum (increasing frequency)

radio → microwave → infrared → **visible** → ultraviolet → X-ray → gamma.

## 2 Practice

**2.1** State the speed of all electromagnetic waves in a vacuum. [1]

**2.2** State what oscillates in an electromagnetic wave. [1]



**2.3** Order these by increasing frequency: X-rays, radio waves, visible light. [2]

## 3 Exam-style questions

**3.1** All electromagnetic waves in a vacuum have the same [1]

**A** frequency
**B** wavelength
**C** speed
**D** amplitude

**3.2** Which of these has the highest frequency? [1]

**A** radio waves
**B** infrared
**C** visible light
**D** gamma rays

**3.3** A radio wave has a frequency of $1.0 \times 10^8$ Hz (take $c = 3.0 \times 10^8$ m s$^{-1}$).

(a) Find its wavelength. [2]

(b) State whether X-rays have a longer or shorter wavelength than this. [1]