TOPIC 14 Electromagnetic Spectrum

1 A VHF radio station broadcasts at a frequency of 90 MHz (9.0×10^7 Hz). The speed of radio waves is 3.0×10^8 m/s.

What is the wavelength of the waves broadcast by the station?

A	0.30 m	D	12×10^{15} m
B	3.3 m	E	27×10^{15} m
C	6.0 m		J90/I/20

2 Which of the following properties applies to X-rays, γ-rays, infra-red, ultra-violet and visible light?

A They are all damaging to health.
B They all have similar wavelengths.
C They all travel with the same speed in a vacuum.
D They are all affected by magnetic fields.
E They can all be detected by the human eye.   N90/I/20

3 Which of the following waves will best penetrate fog or low cloud?

A	infra-red	D	ultra-violet
B	radio	E	violet light
C	red light		N91/I/22

4 X and Y are different wave motions. In air, X travels much faster than Y but has a much shorter wavelength.

Which types of wave motion could X and Y be?

	X	Y
A	microwaves	red light
B	radio	infra-red
C	red light	sound
D	sound	ultraviolet
E	ultraviolet	radio

J93/I/22

5 A radio transmitter uses an aerial whose length is a quarter of a wavelength.

If electromagnetic waves travel at a speed of 3×10^8 m/s and the frequency of the signal is 200 MHz, what is the length of the aerial?

A	0.17 m	D	1.5 m
B	0.38 m	E	6.0 m
C	0.67 m		N93/I/19

6 The diagram shows different regions of the electromagnetic spectrum.

radio waves			visible light		P	gamma radiation

What region does P represent?

A microwaves
B sound waves
C ultraviolet radiation
D X-radiation   N94/I/21

7 Which of the following is a property of all electromagnetic waves?

A They are deflected by magnets.
B They are positively charged.
C They travel at the speed of sound.
D They travel through a vacuum.   J95/I/20

8 Which waves pass through fog and low cloud most easily?

A	infra-red	C	radio
B	light	D	ultra-violet J97/I/21

9 Which pair of emissions travel with the same speed in air?

A α-particles and γ-rays
B γ-rays and infra-red waves
C infra-red waves and sound waves
D sound waves and α-particles   N97/I/23

10 Which row shows parts of the electromagnetic spectrum in order of increasing frequency?

A	radio waves	X-rays	visible light
B	radio waves	visible light	X-rays
C	X-rays	radio waves	visible light
D	X-rays	visible light	radio waves

J98/I/20

11 Which type of electromagnetic radiation has the longest wavelength?

A	infra-red rays	C	ultraviolet rays
B	radio waves	D	X-rays N98/I/19

12 X-rays, visible light and radio waves are all part of the electromagnetic spectrum.

What is the correct order of increasing wavelength?

	shortest ⟶ longest		
A	radio waves	X-rays	visible light
B	radio waves	visible light	X-rays
C	X-rays	radio waves	visible light
D	X-rays	visible light	radio waves

N2000/I/17

13 Infra-red radiation, gamma radiation, radio waves and ultra-violet radiation are all types of electromagnetic radiation.

From the above list select the radiation which

(a) can be detected by the fluorescence it causes and is absorbed by a sheet of glass,

(b) can pass readily through several centimetres of iron,

(c) is usually detected by its action on a thermopile,

(d) has the longest wavelength.   J79/I/8

14

Gamma Rays	X-rays	R	visible	Infra-Red
Radio Waves				

Name the radiation labelled R on this chart of the electro-magnetic spectrum

State **two** properties of radiation R which differ from those of infra-red radiation.

State one property which is common to all forms of electromagnetic radiation.

N80/I/9

15

Gamma	P	Ultra violet	Visible	Q	Radio

The diagram represents the range of radiations in the electromagnetic spectrum.

(a) Name the two radiations labelled P and Q.

(b) Describe briefly with the aid of a diagram one method of detecting radiation Q.

(c) A beam of radiation of type P is incident on an aluminium plate 2 mm thick. Suggest how you might detect whether any of this radiation passes through the aluminium.

(d) Complete the following: compared to radio waves, gamma radiation has

(i) .... frequency,

(ii) .... wavelength,

(iii) .... speed *in vacuro*.

J82/II/4

16 Infra-red and ultra-violet radiation are both said to be electromagnetic waves.

State **one** other property they both possess

State **one** difference between the two radiations.

N82/I/6

17 In each of (a) to (d) below, which part of the electromagnetic spectrum has the properties described''

(a) Its wavelengths are longer than those of visible light it can pass through fog but is absorbed by glass.

(b) Its wavelengths are longer than those of visible light; it can be reflected by layers in the upper atmosphere.

(c) Its wavelengths are shorter than those of visible light; it passes readily through glass but is strongly absorbed by a lead screen several centimetres thick.

(d) Its wavelengths are shorter than those of visible light; it is absorbed by glass; it can produce fluorescence.

J84/II/7

18 Fill the gaps indicated by .... in the paragraph below. (More than one word may be needed to fill some gaps.)

Infra-red, ultra-violet and *gamma* radiations all travel in a vacuum. Their speed is ....

than that of sound in air. They are all ....

waves, infra-red having a much ....

wavelength than gamma radiation. Infra-red may be

detected using a .... whilst a

suitable detector for gamma radiation is ....

Of the three radiations only ....

will penetrate 0.5 cm of lead. J87/I/7

19 (a) Complete the gaps in the diagram of the electro-magnetic spectrum.

RADIO					GAMMA

(b) Very short wavelength radio waves can be used to determine the distance of the Moon from the Earth, by measuring the time taken for radio-waves to travel from the Earth to the Moon and back again. Calculate the delay between the transmission and reception of the signal when the Moon is 3.9×10^8 m from the Earth. (Speed of electromagnetic waves = 3.0×10^8 m/s.)   [5]

J91/II/5

20 The chart in Fig. 1 shows the main parts of the electro-magnetic spectrum.
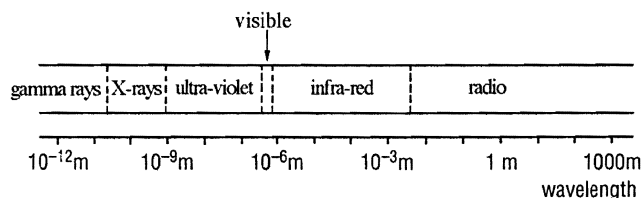

Fig. 1

(a) All of the different types of electromagnetic waves in the chart may be reflected. State three other properties common to all electromagnetic waves.   [3]

(b) Microwaves travel at a speed of 3.0×10^8 m/s in a vacuum and have a frequency of 1.5×10^{10} Hz.

(i) Calculate the wavelength of these microwaves.

(ii) On the chart in Fig. 1, mark a line to represent the position of these microwaves in the electro-magnetic spectrum.   [3]

J99/II/3

ANSWERS

1. **B** 2. **C** 3. **A** 4. **C** 5. **B**

6 **D** 7. **D** 8. **A** 9. **B** 10. **B**

11. **B**   12. **D**

13. *(a)* U-V radiation

    (b) Gamma radiation

    (c) Infra-red radiation

    (d) radio waves.

14. Ultra-violet

15. *(a)* P – x-ray

    Q – Infra-red

    (d) (i) higher   (ii) shorter   (iii) same

19. *(a)*

RADIO	Infra-red	Visible-light	Ultra-violet	X-rays	GAMMA rays

(b) 2.6 s

20. *(b)* 2×10^{-2} m