

EM Waves – Practice 1 [ANS]

MCQ

1. (A)

2. (D)

3. (C)

4. (C)

"Ultra" means *higher*. Thus, *ultra-violet* has higher frequency than visible light.

"Infra" means *lower*. Thus, *infra-red* has lower frequency than visible light.

5. (A)

6. (D)

R has *lower frequency* than and next to visible light. Thus, R is *infra red*.

7. (A)

8. (A)

9. (C)

Concept: The frequency of a wave does not change as it moves from one medium to another.

Concept:

$$v = f\lambda$$

Since velocity decreases and frequency remains the same, wavelength will decrease.

10. (D)

Gamma rays are used in medical treatment: True.

Infra-red waves are used in sunbeds: **False**, ultraviolet rays are used in sunbeds.

Microwaves are used in satellite television: True.

X-rays are used in intruder alarms: **False**, infrared waves are used in intruder alarms.

11. (B)

Concept: EM waves with longer wavelength has lower energy.

Among the list, microwave has the longest wavelength. Thus, it has the lowest energy.

12. (D)

Beside violet light is ultra-violet. Thus, C is ultra-violet.

Thus, B is X-ray and X-ray is used to diagnose fracture of broken bones.

13. (D)

Structured

1. (a)

shortest wavelength \longrightarrow longest wavelength



5054 Mark[®] Scheme

X-rays, ultra-violet, infra-red, microwaves in each box
allow one mark if moving one box gives correct order

B2

(b)

Remote controllers / Intruder alarms.

(c)

5054 Mark[®] Scheme

transverse, same speed, will diffract / reflect / refract etc. (allow only 1)
travel in a vacuum (accept need no medium)

any 2

B2



2. (a)

0525 Mark[®] Scheme

left box **infra-red**

OR IR

B1

right box **gamma**

OR γ

B1

(b)

(i) at the end L of the visible spectrum, red

(ii) at the end M of the visible spectrum. violet

(c) (i)

0625 Mark[®] Scheme: **infra-red** OR IR

B1

(ii)

Radio / television broadcasting.



3. (a) (i)

Radio waves {1}.

(ii)

Since electromagnetic waves have the **same velocity {1}** and $v = f\lambda$ {1}, a wave with longer wavelength will have lower frequency.

5054 Report

Full marks in were awarded either for using the formula $v=f\lambda$ and stating that speed is constant for all electromagnetic waves, or by realising that, with a constant speed, an increased wavelength must increase the time for one oscillation. Only good candidates stated the need for **constant velocity** in their answers to this question.

(b)

(i)

To prevent obstruction of signals by buildings {1}.

Reason: Microwaves transmission need **unobstructed line of sight** between transmitter and receiver.

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Only simple answers were required, showing that candidates realised that **high buildings reflect or obstruct waves.**

(ii)

Waves **decrease in strength** over distance {1}. Repeaters are needed to strengthen the signal.

Reason: Balloon analogy.

Info

Compared with copper cable, **relay of signals using microwave:**

- can be installed quickly to meet demand immediately
- has lower installation cost
- has higher annual operating cost

Nowadays, fibre optics has taken over this role due to higher bandwidth and lower cost per bit.

5054 Report

Radio waves **decrease in strength** or **spread out** or even that a booster station can increase the strength of the signal received. Some candidates produced confused ideas, which included microwaves experiencing interference from other types of waves, sound messages dying away, or a repeater station sending out a signal if the first one was lost.

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4. (a)

Microwave {1}.

$$v = f\lambda$$

$$3 \times 10^8 = 12 \times 10^9 \times \lambda$$

$$\lambda = 0.025 \text{ m}$$

$$\text{Dist} = v \times t$$

$$35000 \times 10^3 \times 2 = 3 \times 10^8 \times t$$

$$t = 0.233$$

$$t = 0.23 \text{ s}$$

(b)

The dish has a large surface area to receive more signal.

Its **curved surface reflects the signal to a single point** {1}.

The **detector placed at that point** is able to pick up a strong signal {1}.

