



## 2022 Sec 4 Physics Notes Answers

### Chapter 10 Electromagnetic Spectrum

#### 10.2

- (a) energy
- (b) transverse
- (c) vacuum
- (d) light
- (e) reflection, refraction
- (f) velocity; frequency; wavelength

#### 10.21

Refer textbook p. 284

#### 10.32

Refer textbook p. 289 & 290

- You are not required to memorize actual range of wavelength or frequency but it is good to have some idea of the relative order of magnitudes
- E.g. wavelength of radio waves: a few cm to 100 000 m
- E.g. wavelength of visible light: 400 nm (violet) to 700 nm (red)

Component of e.m. spectrum	Range of wavelength / m	Range of frequency / Hz	Key properties	Common sources/ applications
radio waves	$10^{-1}$ to $10^5$	$10^6$ to $10^9$	Longest wavelength. Produced by oscillating electric currents in a transmitting aerial or antenna.	Telecommunications
microwaves	$10^{-3}$ to $10^{-1}$	$10^9$ to $10^{11}$	Are short wavelength radio waves. Produced by electronic devices such as klystron tubes. Strongly absorbed by water molecules.	Radar communications; microwave cooking.
infra-red radiation	$10^{-7}$ to $10^{-3}$	$10^{11}$ to $10^{14}$	Emitted by objects above absolute zero in temp.	Infra-red photography, Radiant heater, remote control of appliances
visible light	$10^{-7}$	$10^{14}$ to $10^{15}$	Can be detected by human eye; laser also falls into this category.	Photosynthesis, telecommunications (optical fibres)
ultraviolet rays	$10^{-8}$ to $10^{-7}$	$10^{15}$ to $10^{18}$	From sunlight, causes tanning and stimulates our bodies to produce vitamin D.	Kill bacteria and viruses. Sterilisation. Fluorescence effect.
X-rays	$10^{-13}$ to $10^{-8}$	$10^{18}$ to $10^{20}$	High energy electrons losing their energy after striking a metal target. Can destroy living tissues. Should limit exposure.	Diagnostic imaging. Treatment of cancer. Checking welds. Airport security scanning.
Gamma rays	$10^{-14}$ to $10^{-10}$	$> 10^{20}$	From decay of radioactive nuclei. Very penetrative and can cause serious damage.	Treatment of cancer. Sterilisation of equipment etc. Similar uses to X-rays but carries a lot more energy.

#### 10.4

- X-rays, gamma rays
- frequencies, wavelengths
- ionization
- destruction, modification

#### Exercise

1.

- (a) a beam of **protons** – not EM waves
- (b) a laser beam from a laser pointer – visible light
- (c) heat from a camp fire – infra-red rays
- (d) information transmitted through an optical fibre – visible light
- (e) colour of a flame from a Bunsen burner – visible light
- (f) gamma rays from a radioactive material – gamma rays
- (g) **electrons** emitted in a cathode ray tube in a conventional television – not EM waves