

EXERCISE 6(B)

Solution:

The complete electromagnetic spectrum in the increasing order of their wavelength are

- (i) Gamma rays
 - (ii) X – rays
 - (iii) Ultraviolet rays
 - (iv) Visible light
 - (v) Infrared radiations
- (b) Gamma rays has the highest penetrating power.

(a) Solution:

(a) Radiations in the order of their increasing wavelength are

- (i) Gamma rays
 - (ii) X- rays
 - (iii) Infrared rays
 - (iv) Micro waves
 - (v) Radio waves
- (b) Microwaves are used for satellite communication

Solution:

- (a) Gamma rays has a wavelength of 10^{-3} nm
- (b) Gamma rays have large penetrating power

Solution:

- (a) An electromagnetic wave having wavelength 50 \AA is X - rays
(b) Speed of an electromagnetic wave in vacuum is $3 \times 10^8 \text{ m / s}$
(c) Since, they are stopped by bones, they are used for the detection of fracture in bones, teeth etc and for diagnostic purposes such as CAT scan in medical science.

Solution:

- (a) X-rays are used in the study of crystals
(b) It is also used in detection of fracture in bones, teeth.

Question: 6

State the name and the range of wavelength of the invisible electromagnetic waves beyond the red end of visible spectrum.

Solution:

The electromagnetic waves beyond the red extreme of the visible light has certain radiations which produce a strong heating effect, are known as infrared radiations.

Range of wavelength is 8000 \AA to 10^7 \AA

Question: 7

Name three radiations and their wavelength range which are invisible and beyond the violet end of the visible spectrum.

Solution:

The three rays which are invisible beyond the violet end of the visible spectrum are

- (i) Gamma rays
(ii) X-rays
(iii) Ultraviolet rays

Wavelengths

- (i) Gamma rays – below 0.01 nm
(ii) X-rays – 0.01 – 10 nm
(iii) Ultraviolet rays – 10 – 400 nm

Question: 8

Give the range of wavelength of the electromagnetic waves visible to us.

Solution:

The wavelength $4000 \overset{0}{\text{A}}$ to $8000 \overset{0}{\text{A}}$ of the electromagnetic waves visible to us.

Question: 9

Name the region beyond (i) the red end and (ii) the violet end, of the spectrum.

Solution:

(i) Beyond the red end of the spectrum lies the region known as infrared

(ii) Beyond the violet end of the spectrum lies the region known as ultraviolet

Question: 10

What do you understand by the invisible spectrum?

Solution:

The part of spectrum beyond the red extreme and the violet extreme to which our eyes do not respond is called the invisible spectrum

Question: 11

Name the radiation which can be detected by (a) a thermopile (b) a solution of silver chloride.

Solution:

(a) Infrared radiations can be detected by thermopile

(b) Ultraviolet radiations can be detected by silver chloride because in their presence silver chloride becomes dark.

Question: 12

State the approximate range of wavelength associated with (a) the ultraviolet rays, (b) the visible light, and (c) infrared rays.

Solution:

(a) Ultraviolet rays – wavelength range $100 \overset{0}{\text{A}}$ to $4000 \overset{0}{\text{A}}$

(b) Visible light – wavelength range $4000 \overset{0}{\text{A}}$ to $8000 \overset{0}{\text{A}}$

(c) Infrared radiations – wavelength range $8000 \overset{0}{\text{A}}$ to $10^7 \overset{0}{\text{A}}$

Question: 13

Name the radiations of wavelength just (a) longer than $8 \times 10^{-7} \text{ m}$, (b) shorter than 4

$\times 10^{-7} \text{ m}$

Solution:

- (i) Infrared radiation are longer than $8 \times 10^{-7} \text{ m}$
- (ii) Ultraviolet radiations are shorter than $4 \times 10^{-7} \text{ m}$

Question: 14

Name two electromagnetic waves of wavelength smaller than that of violet light.

State one use of each.

Solution:

Ultraviolet radiations and X-rays are the electromagnetic waves of wavelength smaller than that of violet light.

Wavelength of ultraviolet radiations – $100 \overset{0}{\text{A}}$ to $4000 \overset{0}{\text{A}}$

Wavelength of X-rays – $0.1 \overset{0}{\text{A}}$ to $100 \overset{0}{\text{A}}$

Ultraviolet radiations are used for detecting purity of gems, eggs, ghee etc.

X-rays are used for detecting fracture in bones, teeth, etc

Question: 15

Give one use each of (a) microwaves, (b) ultraviolet radiations, (c) infrared radiations, and (d) gamma rays.

Solutions:

- (a) Microwaves are used in radar communication
- (b) Ultraviolet radiations are used in producing vitamin D in food of plants and animals.
- (c) Infrared radiations are used in remote control of television and other gadgets.
- (d) Gamma rays are used in industry to check welding.

Question: 16

Name the two waves (a) of lowest wavelength, (b) used for taking photographs in dark, (c) produced by the changes in the nucleus of an atom, (d) of wavelength nearly 0.1 nm

Solution:

- (a) Gamma rays have lowest wavelength
- (b) Infrared rays are used for taking photographs in dark
- (c) Gamma rays are the waves produced by the changes in the nucleus of an atom
- (d) X-rays have wavelength nearly 0.1 nm

Question: 17

Two waves A and B have wavelength 0.01 \AA and 9000 \AA respectively.

(a) Name the two waves.

(b) Compare the speeds of these waves when they travel in vacuum.

Solution:

(a) Wave A – Gamma rays and Wave B – Infrared radiations

(b) All electromagnetic waves travel with the speed of light in vacuum. Thus ratio of speeds of these waves in vacuum is 1: 1

Question: 18

Name two sources, each of infrared radiations and ultraviolet radiations.

Solution:

All red hot bodies such as a heated iron ball, flame, fire, etc. are the sources of infrared radiations.

The electric arc and sparks give ultraviolet radiations.

Question: 19

What are infrared radiations? How are they detected? State one use of these radiations.

Solution:

The electromagnetic waves of wavelength in the range of 8000 \AA to 10^7 \AA are called infrared radiations

Detection:

If a thermometer with a blackened bulb is moved from the violet end towards the red end of the spectrum, it is observed that there is a very slow rise in temperature, but when it is moved beyond the red extreme, a rapid rise in temperature is noticed. It means that the region of spectrum beyond the red extreme has certain radiations which produce a strong heating effect which are invisible. These radiations are called the infrared radiations.

Infrared radiations are used as signals during the war as they are not visible and they are not absorbed much in the medium.

Question: 20

What are ultraviolet radiations? How are they detected? State one use of these radiations

Solution:

Ultraviolet radiations are electromagnetic radiations of wavelength from 100 \AA to 4000

0

A

Detection: If silver chloride solution is exposed to the electromagnetic waves starting from the red to the violet end and then beyond it. From the red end to the violet end it is observed that the solution remains almost unaffected. But beyond the violet end, the solution first turns violet and finally it becomes dark brown. Hence, there exist certain radiations beyond the violet extreme of the spectrum which are chemically more active than visible light. These radiations are called ultraviolet radiations.

Ultraviolet radiations are used for detecting the purity of gems, eggs, ghee etc.

Question: 21

Name three properties of ultraviolet radiations which are similar to the visible light.

Solution:

- (a) Ultraviolet radiations travel in a straight line with a speed of $3 \times 10^8 \text{ m s}^{-1}$ in air or vacuum
- (b) They obey the laws of reflection and refraction
- (c) They strongly affect the photographic plate as they are chemically more active than the visible light.

Question: 22

Give two properties of ultraviolet radiations which differ from the visible light.

Solution:

Two properties of ultraviolet radiations different from the visible light

- (a) Ultraviolet radiations can pass through quartz, but they are absorbed by glass.
- (b) They are usually scattered by the dust particles present in the earth's atmosphere

Question: 23

Mention three properties of infrared radiations similar to the visible light.

Solution:

- (a) Infrared radiations travel in straight lines like light, with a speed equal to $3 \times 10^8 \text{ m s}^{-1}$ in vacuum
- (b) They obey the laws of reflection and refraction
- (c) They are unaffected by electric and magnetic fields

Question: 24

Give two properties of infrared radiations which differ from the visible light.

Solution:

Two properties of infrared radiation different from the visible light

- (a) They are absorbed by glass, but they are not absorbed by rock salt.
- (b) They are detected by their heating property using a thermopile or a blackened bulb thermometer.

Question: 25

Name the material of prism required for obtaining the spectrum of (a) ultraviolet light, (b) infrared radiations

Solution:

- (a) A quartz prism is required for obtaining the spectrum of ultraviolet light.
- (b) Infrared radiations is obtained by passing radiations through a rock salt prism.

Question: 26

Name the radiations which are absorbed by the green house gases in the earth's atmosphere.

Solution:

Major green house gases which are present in the earth's atmosphere are water vapour, carbon dioxide, methane and ozone.

Infrared radiations are absorbed by the green house gases in the earth's atmosphere.

Question: 27

State one harmful effect each of the (a) ultraviolet and (b) infrared radiations.

Solution:

- (a) Ultraviolet radiations cause health hazards like skin cancer if human body is exposed to them for a long period.
- (b) Infrared radiations causes skin burns.

Question: 28

Give reason for the following:

- (i) Infrared radiations are used for photography in fog
- (ii) Infrared radiations are used for signals during the war.
- (iii) The photographic darkrooms are provided with infrared lamps.
- (iv) A rock salt prism is used instead of a glass prism to obtain the infrared spectrum.
- (v) A quartz prism is required for obtaining the spectrum of the ultraviolet light.
- (vi) Ultraviolet bulbs have a quartz envelope instead of glass.

Solution:

- (i) Infrared radiations are used for photography in fog because they are not much scattered, so they can penetrate appreciably through it.
- (ii) Infrared radiations are used as signals during the war as they are not visible and they

are not absorbed much in the medium.

(iii) Infrared lamps are used in dark rooms for developing photographs as they provide some visibility without affecting the photographic film.

(iv) Infrared spectrum can be obtained only by using a rock salt prism because the rock salt prism does not absorb the infrared radiations, whereas a glass prism absorbs them.

(v) A quartz prism is used for obtaining the spectrum of the ultraviolet light as they can pass through quartz whereas ordinary glass absorbs the ultraviolet light.

(vi) Ultraviolet bulbs have a quartz envelope instead of glass as they are not absorbed by quartz whereas ordinary glass absorbs the ultraviolet light.

MULTIPLE CHOICE TYPE

Question: 1

The most energetic electromagnetic radiations are:

- (a) microwaves
- (b) ultraviolet waves
- (c) X- rays
- (d) gamma rays

Solution:

The most energetic electromagnetic radiations are gamma rays

Question: 2

The source of ultraviolet light is:

- (a) electric bulb
- (b) red hot iron ball
- (c) sodium vapour lamp
- (d) carbon arc-lamp

Solution:

The source of ultraviolet light is carbon arc-lamp

Question: 3

A radiation P is focused by a proper device on the bulb of a thermometer. Mercury in the thermometer shows a rapid increase. The radiation P is

- (a) infrared radiation
- (b) visible light
- (c) ultraviolet radiation
- (d) X-rays

Solution:

The radiation P is infrared radiation

NUMERICALS

Question: 1

An electromagnetic wave has a frequency of 500MHz and a wavelength of 60cm.

(a) Calculate the velocity of the wave.

(b) Name the medium through which it is travelling.

Solution:

(a) Frequency = 500 MHz

$$= 500 \times 10^6 \text{ Hz}$$

Wavelength = 60 cm

$$= 0.6 \text{ m}$$

Velocity of wave = frequency \times wavelength

$$= 500 \times 10^6 \times 0.6$$

$$= 3 \times 10^8 \text{ m / s}$$

(b) Electromagnetic wave is travelling through air.

Question: 2

The wavelength of X-rays is 0.01 \AA . Calculate its frequency.

Solution:

Wavelength = 0.01 \AA

$$= 0.01 \times 10^{-10} \text{ m}$$

Speed of X-rays = $3 \times 10^8 \text{ m / s}$

Speed of light = frequency \times wavelength

$$c = v / \lambda$$

$$v = c\lambda$$

$$v = (3 \times 10^8 \text{ m / s}) / (0.01 \times 10^{-10} \text{ m})$$

$$v = 3 \times 10^{20} \text{ Hz}$$