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**Exercise- 6(A) “Spectrum” Selina Physics Solutions**

**Question 1**

Name three factors on which the deviation produced by a prism depends and state how does it depend on the factors stated by you.

**Answer 1**

The deviation produced by the prism depends on the following four factors:

(a)The angle of incidence – As the angle of incidence increases, first the angle of deviation decreases and reaches to a minimum value for a certain angle of incidence. By further increasing the angle of incidence, the angle of deviation is found to increase.

(b)The material of prism (i.e., on refractive index) – For a given angle of incidence, the prism with a higher refractive index produces a greater deviation than the prism which has a lower refractive index.

(c)Angle of prism- Angle of deviation increases with the increase in the angle of prism.

(d)The colour or wavelength of light used- Angle of deviation increases with the decrease in wavelength of light.

**Question 2**

How does the deviation produced by a triangular prism depend on the colour (or wavelength) of light incident on it?

**Answer 2**

The deviation caused by a prism increases with the decrease in the wavelength of light incident on it.

**Question 3**

How does the speed of light in glass change on increasing the wavelength of light?

**Answer 3**

Speed of light increases with increase in the wavelength

**Question 4**

Which colour of white light travels (a) fastest  (b) slowest, in glass?

**Answer 4**

Red colour travels fastest and Blue colour travels slowest in glass.

**Question 5**

Name the subjective property of light related to its wavelength.

**Answer 5**

Colour of light is related to its wavelength.

**Question 6**

What is the range of wavelength of the spectrum of white light in (i)   and (ii) nm?

**Answer 6**

(i) 

(ii) 400 nm to 800 nm

**Question 7**

(a) Write the approximate wavelengths for (i) blue and (ii) red light.

(b) The wavelengths of violet and red light are 4000 respectively. Which of the two has the higher frequency?

**Answer 7**

(a)

(i)For blue light, approximate wavelength=4800

(ii)For red light, approximate wavelength=8000

(b) violet has high frequency.

**Question 8**

Write  the seven prominent colours present in white light spectrum in order of their increasing wavelength.

**Answer 8**

Seven prominent colours of the white light spectrum in order of their increasing frequencies:

Red, Orange, Yellow, Green, Blue, Indigo, Violet

**Question 8**

Name the seven prominent colours of the white light spectrum in order of their increasing frequencies.

**Answer 8**

The seven colours in the order of increasing frequencies are red, orange, yellow, green, blue, indigo and violet.

**Question 10**

Name four colours of the spectrum of white light which have wavelength longer than blue light.

**Answer 10**

Green, Yellow orange and red have wavelength longer than blue light.

**Question 11**

Which colour of white light is deviated by a glass prism (i) the most and, (ii) which the least?

**Answer 11**

A glass prism deviates the violet light most and the red light least.

**Question 12**

The wavelengths for the light of red and blue colours are roughly 7.8 x 10-7m and 4.8 x 10-7 m respectively.

(a)Which colour has the greater speed in vacuum?

(b)Which colour has the greater speed in glass?

**Answer 12**

(a)In vacuum, both have the same speeds.

(b)In glass, red light has a greater speed

**Question 13**

Define the term dispersion of light.

**Answer 13**

The phenomenon of splitting of white light by a prism into its constituent colours is known as dispersion of light.

**Question 14**

Explain the cause of dispersion of white light through a prism.

**Answer 14**

When white light is incident on the first surface of a prism and enters in glass, light of different colours due to different speeds in glass, is refracted or deviated through different angles. Thus the dispersion of white light into its constituent colours takes place at the first surface of prism. Thus the cause of dispersion is the change in speed of light with wavelength or frequency.

**Question 15**

Explain briefly, with the help of a neat labelled diagram, how white light gets dispersed by a prism.

on Which surface of prism, there is both the dispersion and deviation of light, and on which surface of prism, there is only the deviation of light?

**Answer 15**

When white light is incident on the first surface of a prism and enters in glass, light of different colours due to different speeds in glass, is refracted or deviated through different angles. Thus the dispersion of white light into its constituent colours takes place at the first surface of prism.



On the second surface, only refraction takes place and different colours are deviated through different angles. As a result, the colours get further separated on refraction at the second surface (violet being deviated the most and red the least).

**Question 16**

What do you understand by the term spectrum?

**Answer 16**

The colour band obtained on a screen on passing white light through a prism is called the spectrum.

**Question 17**

A ray of white light is passed through a glass prism and spectrum is obtained on a screen.

(a)Name the seven colours of the spectrum in order.

(b)Do the colours have the same width in the spectrum?

(c)Which of the colour of the spectrum of white light deviates (i) the most? (ii) the least?

**Answer 17**

(a)Violet, Indigo, Blue, Green, Yellow, Orange, Red.

(b)No, different colours have different widths in the spectrum.

(c)(i) Violet colour is deviated the most. (ii) Red colour is deviated the least.

Question 18

The diagram shown below shows the path taken by a narrow beam of yellow monochromatic light passing through an equiangular glass prism. Now the yellow light is replaced by a narrow beam of white light incident at the same angle. Draw another diagram to show the passage of the beam through the prism and label it to show the effect of prism on the white light.



**Answer 18**



**Question 19**

Figure shows a thin beam of white light from a source S striking on one face of a prism.



(a) Complete the diagram to show the effect of prism on the beam and to show what is seen on the screen.

(b) A slit is placed in between the prism and the screen to pass only the light of green colour. What will you then observe on the screen?

(c) What conclusion do you draw from the observation in part (b) above?

**Answer 19**

(a)Constituent colours of white light are seen on the screen after dispersion through the prism.



(b)When a slit is introduced in between the prism and screen to pass only the light of green colour, only green light is observed on the screen.

(c)From the observation, we conclude that prism itself produces no colour.

**Question 20**

(a) A beam of monochromatic light undergoes minimum deviation through an equiangular prism, how does the beam pass through the prism, with respect to its base?

(b) If white light is used in same way as in part (a) above, what change is expected in the emergent beam?

(c) What conclusion do you draw about the nature of white light in part (b)?

**Answer 20**

(a) If a monochromatic beam of light undergoes minimum deviation through an equi-angular prism, then the beam passes parallel to the base of prism.

(b) White light splits into its constituent colours i.e., spectrum is formed.

(c) We conclude that white light is polychromatic.

**Multiple Choice Type – 6(A) “Spectrum” Selina Concise ICSE Class-10 Physics Solution**

**Question 1**

When a white light ray falls on a prism, the ray at its first surface suffers:

(a) No refraction

(b) Only dispersion

(c) Only deviation

(d) Both deviation and dispersion

**Answer 1**

Both deviation and dispersion.

Hint: When a white light ray falls on the first surface of a prism, light rays of different colours due to their different speeds in glass get refracted (or deviated) through different angles. Thus, the dispersion of white light into its constituent colours takes place at the first surface of prism.

**Question 2**

In the spectrum of white light by a prism, the colour of the extreme end opposite to the base of prism is:

(a) Violet

(b) Yellow

(c) Red

(d) Blue

**Answer 2**

The colour of the extreme end opposite to the base of the prism is red.

Hint: The angle of deviation decreases with the increase in wavelength of light for a given angle of incidence. Since the red light has greatest wavelength, it gets deviated the least and is seen on the extreme end opposite to the base of prism.

**Question 3**

The wavelength range of white light is:

(a) 4000 nm to 8000 nm

(b) 40 nm to 80 nm

(c) 400 nm to 800 nm

(d) 4 nm to 8 nm

**Answer 3**

The wavelength range for white light is 400 nm to 800 nm or 4000 Å to 8000 Å.

**NUMERICALS – 6(A),“Spectrum” ICSE Class-10**

**Question 1**

Calculate the frequency of yellow light of wavelength 550 nm. The speed of light is 3 x 108 ms-1.

**Answer 1**



**Question 2**

The frequency range of visible light is from 3.75 x 1014Hz to 7.5 x 1014Hz. Calculate its wavelength range. Take the speed of light =3 x 108m/s.

**Answer 2**

Speed of light, c= 3x 108m/s

Frequency range=3.75 x 1014Hz to 7.5 x 1014Hz.

Speed of light = frequency x wavelength

For frequency=3.75 x 1014Hz

For frequency =7.5 x 1014Hz

**Exercise 6 (B) “Spectrum” Concise Physics Solutions Selina Publishers**

**Question 1**

(a) Give a list of at least five radiations, in the order of their increasing wavelength, which make up the complete electromagnetic spectrum.

(b) Which of the radiation mentioned by you in part (a) has the highest penetrating power.

**Answer 1**

(a) Five radiations , in the order of their increasing frequencies are:

Infrared waves, Visible light, Ultraviolet, X-rays and Gamma rays.

(b) Gamma rays have the highest penetrating power

**Question 2**

(a) Arrange the following radiations in the order of their increasing wavelength:

X-rays, infrared rays, radio waves, gamma rays and micro waves.

(b) Which radiation is used for satellite communication?

**Answer 2**

 (a) Gamma rays, X-rays, infrared rays, micro waves, radio waves.

(b) Microwave is used for satellite communication.

**Question 3**

A wave has a wavelength of 10-3 nm. (a) Name the wave. (b) State its one property different from light.

**Answer 3**

(a) Gamma ray.

(b) Gamma rays have strong penetrating power.

**Question 4**

A wave has wavelength 50Å. (a) Name the wave. (b) State the speed in vacuum. (c) State its one use.

**Answer 4**

 (a) The wavelength of the wave is 50 Å. Therefore, it is a X-ray.

(b) The speed of the wave will be 3 × 108 m/s in vacuum.

(c) X-rays are used to study atomic arrangement in crystals as well as complex molecules.

**Question 5**

(a) Name the high energetic invisible electromagnetic wave which helps in the study of structure of crystals.

(b) State one more use of the wave named in part (a).

**Answer 5**

(a) X-rays are used in the study of crystals.

(b) It is also used to detect fracture in bones.

**Question 6**

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

**Answer 6**

The electromagnetic waves beyond the red end of the spectrum are known as infrared radiations.

Range: 8000 Å to 107Å (or 800 nm to 1 mm)

**Question 7**

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

**Answer 7**

The three radiations beyond the violet end of the visible spectrum are:

1) Ultraviolet radiations – 100 Å to 4000 Å

2) X-rays – 0.1 Å to 100 Å

3) Gamma rays – <0.1 Å

**Question 8**

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

**Answer 8**

4000  to 8000.

**Question  9**

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

**Answer  9**

(i)Infrared

(ii)Ultraviolet

**Question 10**

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What do you understand by the invisible spectrum?

**Answer 10**

The part of spectrum beyond the red and the violet ends is called the invisible spectrum as our eyes do not respond to the spectrum beyond the red and the violet extremes.

**Question 11**

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

**Answer 11**

(a) infrared radiation

(b) ultra violet radiation

**Question 12**

State the approximate range of wavelength associated with (i) the ultraviolet rays (ii) the visible light and (iii) infrared rays.

**Answer 12**

(i)Ultraviolet rays-wavelength range 100   to 4000 

(ii)Visible light-wavelength range 4000   to 8000 

(iii)Infrared radiations-wavelength range 8000   to 107 

**Question 13**

Name the radiations of wavelength just (i) longer than 8 x 10-7m . (ii) shorter than 4 x 10-7 m.

**Answer 13**

(i)Infrared radiations are longer than 8 x 10-7m.

(ii) ultraviolet radiations are shorter than 4 x 10-7 m.

**Question 14**

Name two electromagnetic waves of wavelength smaller than that of violet light. State one use of each.

**Answer 14**

1) Ultraviolet radiations – 100 Å to 4000 Å

Use: For detecting purity of gems, eggs, ghee, etc.

2) X-rays – 0.1 Å to 100 Å

Use: For detecting fracture in bones, teeth, etc.

**Question 15**

Give one use each of (i) microwaves (ii) ultraviolet radiations (iii) infrared radiations (iv) gamma rays.

**Answer 15**

(i)Microwaves are used for satellite communication.

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

(iii)Infrared radiations are used in remote control of television and other gadgets.

(iv)Gamma rays are used in medical science to kill cancer cells

**Question 16**

Name the 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.

**Answer 16**

Lowest wavelength= gamma rays

Waves used for taking photographs= infrared rays

and waves produced by the changes in the nucleus of an atom= gamma rays

while waves having wavelength 0.1nm= X-rays

**Question 17**

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

(a)Name the two waves.

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

**Answer 17**

(a)A- Gamma rays, B-infrared radiations

(b)Ratio of speeds of these waves in vacuum is 1:1 as all electromagnetic waves travel with the speed of light in vacuum.

**Question 18**

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

**Answer 18**

All heated 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.

**Answer 19**

Infrared radiations are the electromagnetic waves of wavelength in the range of 8000  to 107.

Detection: If a thermometer with a blackened bulb is moved from the violet end towards the red end, it is observed that there is a slow rise in temperature, but when it is moved beyond the red region, a rapid rise in temperature is noticed. It means that the portion of spectrum beyond the red end has certain radiations which produce a strong heating effect, but they are not visible. These radiations are called the infrared radiations.

Use: The infrared radiations are used for therapeutic purposes by doctors.

**Question 20**

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

**Answer 20**

The electromagnetic radiations of wavelength from 100 to 4000 are called the ultraviolet radiations.

Detection: If the different radiations from the red part of the spectrum to the violet end and beyond it, are made incident on the silver-chloride solution, it is observed that from the red to the violet end, the solution remains unaffected. However just beyond the violet end, it first turns violet and finally it becomes dark brown. Thus there exist certain radiations beyond the violet end of the spectrum, which are chemically more active than visible light, called ultraviolet radiations.

Use: Ultraviolet radiations are used for sterilizing purposes.

**Question 21**

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

**Answer 21**

(a)Ultraviolet radiations travel in a straight line with a speed of 3 x 108 m in air (or vacuum).

(b)They obey the laws of reflection and refraction.

(c)They affect the photographic plate.

**Question 22**

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

**Answer 22**

(a)Ultraviolet radiations produce fluorescence on striking a zinc sulphide screen.

(b)They cause health hazards like cancer on the body.

**Question 23**

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

**Answer 23**

(a)Infrared radiations travel in straight line as light does, with a speed equal to 3 x 108m/s in vacuum.

(b)They obey the laws of reflection and refraction.

(c)They do not cause fluorescence on zinc sulphide screen.

**Question 24**

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

**Answer 24**

They do not affect the ordinary photographic film.

**Question 25**

Name the material prism required for obtaining the spectrum of (a) ultraviolet light, (b) infra red radiation.

**Answer 25**

(a) Ultraviolet light is obtained by passing radiations through a quartz prism.

(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.

**Answer 26**

Water vapour, carbon dioxide, methane and ozone are the major greenhouse gases present in the Earth’s atmosphere.

These greenhouse gases absorb the infrared radiations in the Earth’s atmosphere.

**Question 27**

State one harmful effect each of the ultraviolet and infrared radiation.

**Answer 27**

Ultraviolet radiation: It causes health hazards like skin cancer.

Infrared radiation: It 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 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.

**Answer 28**

(i)Infrared radiations are used in photography in fog because they are not much scattered by the atmosphere, 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 since they do not affect the photographic film chemically, but they provide some visibility.

(iv)Infrared spectrum can be obtained only with the help of a rock-salt prism since the rock-salt prism does not absorb infrared radiations whereas a glass prism absorbs them.

(v)A quartz prism is used to obtain the spectrum of the ultraviolet radiations as they are not absorbed by 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 glad absorbs the ultraviolet light.

**Selina Physics Solutions “Spectrum” Multiple choice type – 6(B)**

**Question 1**

The most energetic electromagnetic radiations are:

(a) Microwaves

(b) Ultraviolet waves

(c) X-rays

(d) Gamma rays

**Answer 1**

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

**Answer 2**

Carbon arc-lamp

**Question 3**

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

(a) Infrared radiation

(b) Visible light

(c) Ultra-violet radiation

(d) X-rays

**Answer 3**

Infrared radiation

Hint: Infrared radiations produce strong heating effect.

**Selina Concise Physics Solutions “Spectrum” Numericals – 6(B)**

**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.

**Answer 1**

(a) Frequency =500MHz =500 x 106Hz

Wavelength= 60 cm=0.6 m

Velocity of wave= frequency x wavelength

=500x 106 x 0.6=3 x 108m/s

(b) Electromagnetic wave is travelling through air.

**Question 2**

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

**Answer 2**

Wavelength = 0.01   = 0.01 x 10-10 m

Speed of X-rays =3 x 108m/s

Speed of light = frequency x wavelength



**Selina Physics Solution “Spectrum” Exercise – 6(C) ICSE Class-10**

**Question 1**

What is meant by scattering of light?

**Answer 1**

When white light from sun enters the earth’s atmosphere, the light gets scattered i.e., the light spreads in all directions by the dust particles, free water molecules and the molecules of the gases present in the atmosphere. This phenomenon is called scattering of light.

**Question 2**

How does the intensity of scattered light depend on the wavelength of incident light? State conditions when this dependence holds.

**Answer 2**

The intensity of scattered light is found to be inversely proportional to the fourth power of wavelength of light. This relation holds when the size of air molecules is much smaller than the wavelength of the light incident.

**Question 3**

When sunlight enters the earth’s atmosphere, state which colour of light is scattered the most and which the least.

**Answer 3**

Violet colour is scattered the most and red the least as the intensity of scattered light is found to be inversely proportional to the fourth power of wavelength of light

**Question 4**

A beam of blue, green and yellow light passes through the the Earth’s atmosphere. Name the colour which is scattered (a) the least (b) the most

**Answer 4**

(a) Yellow light has the highest wavelength out of the three radiations. Hence, it gets scattered the least.

(b) Blue light has the lowest wavelength out of the three radiations. Hence, it gets scattered the most.

**Question 5**

Which colour of white light is scattered the least? Give reason.

**Answer 5**

The light having the largest wavelength is scattered the least. Hence, red coloured light is scattered the least.

**Question 6**

The danger signal is red. Why?

**Answer 6**

Since the wavelength of red light is the longest in the visible light, the light of red colour is scattered the least by the air molecules of the atmosphere and therefore the light of red colour can penetrate to a longer distance. Thus red light can be seen from the farthest distance as compared to other colours of same intensity. Hence it is used for danger signal so that the signal may be visible from the far distance

**Question 7**

How would the sky appear when seen from the space (or moon)? Give reason for your answer.

**Answer 7**

On the moon, since there is no atmosphere, therefore there is no scattering of sun light incident on the moon surface. Hence to an observer on the surface of moon (space), no light reaches the eye of the observer except the light directly from the sun. Thus the sky will have no colour and will appear black to an observer on the moon surface.

**Question 8**

What characteristic property of light is responsible for the blue colour of the sky?

**Answer 8**

Scattering property of light is responsible for the blue colour of the sky as the blue colour is scattered the most due to its short wavelength.

**Question 9**

The colour of the sky, in direction of the sun is blue. Explain.

**Answer 9**

As the light travels through the atmosphere, it gets scattered in different directions by the air molecules present in its path. The blue light due to its short wavelength is scattered more as compared to the red light of long wavelength. Thus the light reaching our eye directly from sun is rich in red colour, while the light reaching our eye from all other directions is the scattered blue light. Therefore, the sky in direction other than in the direction of sun is seen blue.

**Question 10**

Why does the sun appear red at sunrise and sunset?

**Answer 10**

At the time of sunrise and sunset, the light from sun has to travel the longest distance of atmosphere to reach the observer. The light travelling from the sun loses blue light of short wavelength due to scattering, while the red light of long wavelength is scattered a little, so is not lost much. Thus blue light is almost absent in sunlight reaching the observer, while it is rich in red colour.

**Question 11**

The sky at noon appears white. Give reason.

**Answer 11**

At noon, the sun is above our head, so we get light rays directly from the sun without much scattering of any particular colour. Further, light has to travel less depth of atmosphere; hence the sky is seen white.

**Question 12**

The clouds are seen white. Explain.

**Answer 12**

The clouds are nearer the earth surface and they contain dust particles and aggregates of water molecules of sizes bigger than the wavelength of visible light. Therefore, the dust particles and water molecules present in clouds scatter all colours of incident white light from sun to the same extent and hence when the scattered light reaches our eye, the clouds are seen white.

**Question 13**

Give reason why the smoke from fire looks white.

**Answer 13**

The smoke from the fire looks white because the size of the particle is bigger than the wavelength of light and hence it scatters light of all wavelength which makes it look white.

**Concise Selina Physics Solution “Spectrum” – MCQ – 6(C)**

**Question 1**

In the white light of Sun, maximum scattering by the air molecules present in the Earth’s atmosphere is for:

(a) Red colour

(b) Yellow colour

(c) Green colour

(d) Blue colour

**Answer 1**

Blue colour

Hint: When light of certain frequency falls on that atom or molecule, this atom or molecule responds to the light, whenever the size of the atom or molecule comparable to the wavelength of light. The sizes of nitrogen and oxygen molecules in atmosphere are comparable to the wavelength of blue light. These molecules act as scattering centers for scattering of blue light. This is also the reason that we see the sky as blue.

**Question 2**

To an astronaut in a space-ship, the earth appears:

(a) White

(b) Red

(c) Blue

(d) black

**Answer 2**

To an astronaut in a space-ship, the earth appears blue due to the large scattering of blue colour of the sunlight by the atmosphere.