Chapter 11- Light - Textbook Exercise -(Solved)

1.Fill in the blanks

(a) An image that cannot be obtained on a screen is called virtual.

- **Answer- Virtual**
- **Explanation-** A virtual image is the kind of image formed in plane mirrors or by lenses where the light rays appear to come from a certain point but don't actually converge there. This means you can't catch this image on a screen because it's not real in the same way a picture on a screen is.

(b) Image formed by a convex mirror is always virtual and smaller in size.

- **Answer- Mirror**
- **Explanation-** Convex mirrors bulge outwards and always form images that are smaller than the actual object and virtual, which means you cannot project these images onto a screen.

(c) An image formed by a plane mirror is always of the same size as that of the object.

- **Answer- Plane**
- **Explanation-** A plane mirror, which is a flat mirror, always forms an image that is of the same size as the object being reflected. The image appears to be the same distance behind the mirror as the object is in front of it.

(d) An image which can be obtained on a screen is called a real image.

- **Answer- Real**
- **Explanation-** A real image is formed when light rays coming from an object meet or converge at a point after being reflected or refracted. This type of image can be captured on a screen, like in a projector or a camera.

(e) An image formed by a concave mirror cannot be obtained on a screen.

- **Answer- Mirror**
- **Explanation-** A concave mirror can form both real and virtual images. However, when it forms a virtual image (like when the object is very close to the mirror), this image can't be obtained on a screen because the light rays don't actually meet or converge.

Also Check -Rapid Revision – Class 7 Science -Chapter 15- Light- Complete Notes

2. Mark ‘T’ if the statement is true and ‘F’ if it is false

(a) We can obtain an enlarged and erect image by a convex mirror. (T/F)

- **Answer- False (F)**
- **Explanation-** A convex mirror, which bulges outward, always forms images that are smaller than the actual object and virtual. It does not produce enlarged images.

(b) A concave lens always form a virtual image. (T/F)

- **Answer- True (T)**
- **Explanation-** A concave lens, which curves inward, always forms a virtual image. This means the image appears to diverge from a point and cannot be captured on a screen.

(c) We can obtain a real, enlarged and inverted image by a concave mirror. (T/F)

- **Answer- True (T)**
- **Explanation-** A concave mirror can form a real, enlarged, and inverted image, especially when the object is placed between the focal point and the mirror.

(d) A real image cannot be obtained on a screen. (T/F)

- **Answer- False (F)**
- **Explanation-** A real image is exactly the type of image that can be obtained on a screen. It is formed when light rays converge at a point after being reflected or refracted.

(e) A concave mirror always form a real image. (T/F)

- **Answer- False (F)**
- **Explanation-** A concave mirror does not always form a real image. It can form a real image under certain conditions (like when the object is beyond the focal point), but it can also form a virtual image when the object is very close to the mirror.

Also Check -Class 7 Science -Chapter 15- Light- Definition and Explanation of Important Keywords

Also Check -Class 7 Science -Chapter 15 – Light- Complete Notes

3.Question- Match the items given in Column I with one or more items of Column II.

Column I	Column II
(a) A plane mirror	(i) Used as a magnifying glass.

(b) A convex mirror	**(ii) Can form image of objects spread over a large area.**
(c) A convex lens	**(iii) Used by dentists to see enlarged image of teeth.**
(d) A concave mirror	**(iv) The image is always inverted and magnified.**
(e) A concave lens	**(v) The image is erect and of the same size as the object.**
	(vi) The image is erect and smaller in size than the object.

Answers with Explanations-

- **(a) A plane mirror**
  - **Match- (v) The image is erect and of the same size as the object.**
  - **Explanation-** A plane mirror forms an image that is erect and of the same size as the object being reflected.
- **(b) A convex mirror**
  - **Match- (ii) Can form image of objects spread over a large area.**
  - **Explanation-** Convex mirrors, bulging outward, are used to provide a wider view, making them ideal for seeing images spread over a large area, like in car side mirrors.
- **(c) A convex lens**
  - **Match- (i) Used as a magnifying glass.**
  - **Explanation-** Convex lenses are thicker in the centre and used in magnifying glasses to enlarge the appearance of objects.
- **(d) A concave mirror**
  - **Match- (iii) Used by dentists to see enlarged image of teeth, (iv) The image is always inverted and magnified.**
  - **Explanation-** Concave mirrors, curving inward, are used by dentists for enlarged images. They can also form inverted and magnified images under certain conditions.
- **(e) A concave lens**
  - **Match- (vi) The image is erect and smaller in size than the object.**
  - **Explanation-** Concave lenses, thinner in the centre, spread out light rays, making objects appear smaller than they are.

4. State the characteristics of the image formed by a plane mirror

Answer-The image formed by a plane mirror, which is a flat mirror, exhibits several distinct characteristics-

- **Erect Image-** The image produced by a plane mirror is erect, meaning it is upright. This implies that the top of the object will be at the top in the image, and the bottom of the object will be at the bottom.
- **Virtual Image-** The image is virtual, indicating that it cannot be projected onto a screen. Virtual images are formed because the light rays appear to diverge from behind the mirror, but they do not actually meet or converge there.
- **Lateral Inversion-** The image undergoes lateral inversion, where the left side of the object appears as the right side in the image and vice versa. This is why text like "AMBULANCE" is written inversely on vehicles for correct viewing in a mirror.
- **Same Size as the Object-** The image is of the same size as the object being reflected. There is no magnification or reduction in size.
- **Same Distance Behind the Mirror-** The distance of the image from the mirror is equal to the distance of the object from the mirror. It appears as if the image is located behind the mirror at the same distance as the object in front of it.
- **Laterally Inverted-** Each point of the object is laterally inverted in the image. This means the right side of the object appears on the left side in the image and vice versa.

5. Find out the letters of the English alphabet or any other language known to you in which the image formed in a plane mirror appears exactly like the letter itself. Discuss your findings.

Answer-

The task is to identify letters in the English alphabet whose images in a plane mirror appear exactly the same as the letters themselves. In a plane mirror, images undergo lateral inversion, which means the left side of the object appears as the right side in the image and vice versa. However, some letters remain unchanged even after this inversion. These letters are symmetrical along the vertical axis.

Upon examination, the following letters in the English alphabet meet this criterion-

- **A-** The letter 'A' is symmetrical along its vertical axis. Therefore, its mirror image looks identical to the letter itself.
- **H-** Similar to 'A', 'H' is also vertically symmetrical, making its mirror image appear exactly as the letter.
- **I-** The letter 'I' remains unchanged in the mirror image due to its vertical symmetry.
- **M-** 'M' is another letter that is symmetrical along the vertical axis, so its mirror image looks the same.
- **O-** Owing to its circular shape, the letter 'O' appears identical in the mirror image.
- **T-** The letter 'T' is symmetrical along the vertical axis, thus its mirror image matches the letter itself.
- **U**- 'U' has vertical symmetry, making its mirror image identical to the letter.
- **V**- Similar to 'U', 'V' is symmetrical vertically, so its mirror image is the same as the letter.
- **W**- 'W', being vertically symmetrical, has a mirror image that looks exactly like the letter.
- **X-** The letter 'X' is symmetrical both vertically and horizontally, so its mirror image is identical.

Discussion of Findings-

The common characteristic among these letters is their symmetry along the vertical axis. This symmetry means that the lateral inversion caused by the plane mirror does not alter the appearance

of the letters. Understanding this concept is crucial in fields such as design and typography, where mirror reflection can be a critical element.

6. What is a virtual image? Give one situation where a virtual image is formed.

Answer- A virtual image is a type of image that is formed by the divergence of light rays. In a virtual image, the light rays appear to come from a point behind the mirror or lens, but they do not actually converge or meet at that point. Therefore, a virtual image cannot be captured on a screen since it doesn't exist at a location in space where the light rays converge.

Characteristics of a Virtual Image-

- Not Real- It cannot be projected onto a screen as the light rays do not actually come from the image's apparent location.
- Erect- Virtual images are upright relative to the object.
- Location- Appears to be located behind the mirror or lens.

Situation Where a Virtual Image is Formed-

One common situation where a virtual image is formed is when using a flat (plane) mirror. When we look into a plane mirror, we see a virtual image of ourselves. This image appears to be the same distance behind the mirror as we are in front of it. The image is also erect and of the same size as us, but it undergoes lateral inversion (the right side of the object appears as the left side in the image and vice versa).

In this situation, the light rays reflecting off the mirror diverge. Our eyes trace these rays back as if they are coming from a point behind the mirror, thus forming a virtual image. This is a daily life example of a virtual image that is easy to observe and understand.

Also Check -Convex Lenses- Principles, Applications, and Insights

7. State two differences between a convex and a concave lens.

Answer-

Shape and Functionality-

- **Convex Lens-** A convex lens is thicker at the centre and thinner at the edges, curving outward. This type of lens converges (brings together) light rays that pass through it. Because of this converging property, a convex lens can create real images when the object is placed at a certain distance, and it is also used as a magnifying glass.
- **Concave Lens**- In contrast, a concave lens is thinner at the centre and thicker at the edges, curving inward. This lens diverges (spreads out) light rays that pass through it, which means it always forms virtual images that are smaller in size than the object.

Types of Images Formed-

- **Convex Lens-** Convex lenses can form real, inverted images when the object is placed beyond the focal point and virtual, erect images when the object is very close to the lens. This versatility allows for varied applications like in cameras or magnifying glasses.
- **Concave Lens-** A concave lens, however, always forms a virtual, erect, and diminished (smaller) image, regardless of the object's position relative to the lens. This consistent image type limits its applications to specific uses like in peepholes of doors or in glasses for correcting certain vision problems.

Also Check -Difference Between a Convex and Concave Lens

8- Give one use each of a concave and a convex mirror.

Answer-

- **Concave Mirror-** One use of a concave mirror is in vehicle headlights. The concave shape of the mirror helps in focusing the light into a strong, directed beam, increasing the visibility range of the headlights and making night driving safer.
- **Convex Mirror-** A convex mirror is commonly used as a rearview mirror in vehicles. Its outward curve gives drivers a wider field of view, allowing them to see more of the road behind them, which is crucial for driving safety.

9-Which type of mirror can form a real image?

Answer-A concave mirror can form a real image. When the object is placed beyond the focal point of a concave mirror, it forms a real, inverted image. This is because the concave mirror converges the light rays to a point where they meet to form the image.

10-Which type of lens always forms a virtual image?

Answer-A concave lens always forms a virtual image. Regardless of the position of the object in relation to the lens, a concave lens causes the light rays to diverge, making it seem as though the rays are coming from a point behind the lens. As a result, the image formed is always virtual, erect, and smaller than the object.

Also Check -Chapter 11- A Detailed Guide to the Light Activities for Class 7 Students

11-A virtual image larger than the object can be produced by a

(i) concave lens (ii) concave mirror

(iii) convex mirror (iv) plane mirror

Answer- (ii) concave mirror

Explanation-A concave mirror can produce a virtual image larger than the object when the object is placed very close to the mirror, within its focal length. In such a position, the concave mirror forms an enlarged, virtual, and erect image.

12-David is observing his image in a plane mirror. The distance between the mirror and his image is 4 m. If he moves 1 m towards the mirror, then the distance between David and his image will be

(i) 3 m (ii) 5 m

(iii) 6 m (iv) 8 m

Answer- (iii) 6 m

Explanation-In a plane mirror, the image appears to be at the same distance behind the mirror as the object is in front of it. Initially, David and his image are 4 m apart (2 m each from the mirror). When David moves 1 m towards the mirror, he is now 1 m from the mirror, but his image is still 2 m from the mirror on the other side, making the total distance 3 m (David to the mirror) + 3 m (mirror to image) = 6 m.

13-The rear view mirror of a car is a plane mirror. A driver is reversing his car at a speed of 2 m/s. The driver sees in his rear view mirror the image of a truck parked behind his car. The speed at which the image of the truck appears to approach the driver will be

(i) 1 m/s (ii) 2 m/s

(iii) 4 m/s (iv) 8 m/s

Answer-(ii) 2 m/s

Explanation- In a plane mirror, the image appears to move at the same speed as the object. Since the car is moving at 2 m/s, the distance between the car (and hence the driver) and the image of the truck in the mirror decreases at the same rate. Therefore, the image of the truck appears to approach the driver at a speed of 2 m/s.

Extended Learning — Activities and Projects

1.Play with a mirror- Write your name with a sketch pen on a thin sheet of paper, polythene, or glass. Read your name on the sheet while standing in front of a plane mirror. Now look at your image in the mirror.

Answer-

Activity Description and Observation-

- Step 1- Write your name on a thin sheet of paper, polythene, or glass using a sketch pen.
- Step 2- Stand in front of a plane mirror and hold the sheet with your name in a way that you can read it.
- Step 3- Observe how your name appears in the mirror.

Expected Observation-

- When you look at the sheet directly, you can read your name as it is. However, when you look at the reflection of this sheet in the plane mirror, you will notice that your name appears laterally inverted. This means the right side of the letters appears on the left and the left side on the right in the mirror image.
- For example, if your name is "ANNA," it will still appear as "ANNA" in the mirror because it is symmetrical. But if your name is "DAVID," it will appear as "DIVAD" in the mirror.

Understanding the Observation-

- This activity demonstrates the concept of lateral inversion, which is a characteristic feature of images formed by plane mirrors. The mirror reverses the image laterally (left becomes right and vice versa), but it does not flip the image upside down. This is why words and letters look reversed in mirrors.

Conclusion-

This simple yet effective activity with a mirror helps in understanding the concept of lateral inversion in a fun and interactive way. It provides a clear demonstration of how plane mirrors reflect images and how this affects the way we see written text in mirrors.

2. A burning candle in water- Take a shoe box, open on one side. Place a small lighted candle in it. Place a clear glass sheet (roughly 25 cm × 25 cm) in front of this candle (Fig. 11.33). Try to locate the image of the candle behind the glass sheet. Place a glass of water at its position. Ask your friends to look at the image of the candle through the sheet of glass. Ensure that the candle is not visible to your friends. Your friends will be surprised to see the candle burning in water. Try to explain the reason.

Answer-

Activity Description and Observation-

- Setup- Place a lit candle inside an open shoe box. Position a clear glass sheet (approximately 25 cm × 25 cm) in front of the candle.
- Initial Observation- Locate the image of the candle reflected on the glass sheet. Place a glass of water in line with this image.
- Experiment- Have friends view the image of the candle through the glass sheet, ensuring the actual candle is hidden from their view.

Expected Observation-

- Friends observing the setup will see what appears to be a candle burning inside the glass of water. This surprising visual is due to the reflection of the candle's image on the glass sheet, coinciding with the location of the water glass.

Understanding the Observation-

- Reflection and Refraction- The phenomenon observed here is a combination of reflection and refraction. The glass sheet acts as a reflector, creating an image of the candle. When viewed from a specific angle, this image aligns with the glass of water. The water in the glass, due to its refractive properties, distorts the view, making it seem as if the candle is burning within the water.
- Optical Illusion- This setup creates an optical illusion. The refractive index of water alters the path of light rays, which, combined with the reflection from the glass sheet, creates the illusion of the candle burning in water.

Conclusion-

This experiment is a fascinating demonstration of how light interacts with different materials, such as glass and water, to create optical illusions. It showcases the principles of reflection and refraction in a simple yet intriguing way. Understanding these optical phenomena helps explain how light can be manipulated to create surprising visual effects.

Question-

3. Make a rainbow- Try to make your own rainbow. You can try this project in the morning or in the evening. Stand with your back towards the Sun. Take a hosepipe or a water pipe used in the garden. Make a fine spray in front of you. You can see different colours of a rainbow in the spray.

Answer-

Activity Description and Procedure-

- Objective- The goal of this activity is to create a personal rainbow using simple materials.
- Materials Needed- A hosepipe or a water pipe, preferably with a nozzle to create a fine spray.
- Best Time- Early morning or late evening, when the Sun is not too high in the sky.
- Setup- Stand outdoors with your back facing the Sun.
- Action- Turn on the hosepipe or water pipe and adjust it to create a fine mist or spray of water in the air, in front of you.

Expected Observation-

- As you spray the water, look at the mist against the background of the sky. You should be able to see a rainbow formed in the spray.
- The rainbow will display various colours, typically in the order of red, orange, yellow, green, blue, indigo, and violet.

Understanding the Observation-

- Formation of Rainbow- This phenomenon occurs due to the dispersion of sunlight by the water droplets in the spray. Each water droplet acts like a tiny prism that disperses the sunlight.
- Dispersion and Reflection- Sunlight is composed of different colours. When it passes through the water droplets, these colours bend (refract) by different amounts and then reflect off the inside surface of the droplet. When this light exits the droplet, it refracts again. The combined effect of refraction and reflection in each droplet separates the sunlight into its component colours, forming a rainbow.

- Viewing Angle- The specific angle at which you see the rainbow is critical. The Sun needs to be behind you, and the water droplets should be in front of you at the correct angle for the rainbow to appear.

Conclusion-

This simple and enjoyable experiment not only creates a beautiful rainbow but also demonstrates the scientific principles of light dispersion and refraction. It's an excellent practical example of how natural phenomena like rainbows occur and provides hands-on experience in observing and understanding these concepts.

4. Visit a laughing gallery in some science centre or a science park or a village mela. You will find some large mirrors there. You can see your distorted and funny images in these mirrors. Try to find out the kind of mirrors used there.

Answer-

Activity Description and Observation-

- Objective- The aim is to observe and understand the type of mirrors used in laughing galleries that create distorted and amusing images.
- Location- Visit a laughing gallery at a science centre, science park, or village fair where large mirrors are displayed.
- Observation- Stand in front of these mirrors and notice how your reflection changes. You might see yourself appearing taller, shorter, wider, or thinner than you actually are.

Types of Mirrors Used and Their Effects-

- **Concave Mirrors-**
    - Characteristics- These mirrors curve inward, like the inside of a spoon.
    - Effect on Image- In some positions, concave mirrors can magnify parts of your body, making them appear larger than normal. If you move closer or further from the mirror, the image may become inverted.
- **Convex Mirrors-**
    - Characteristics- These mirrors bulge outward, like the back of a spoon.
    - Effect on Image- Convex mirrors tend to make images appear smaller and wider. The reflection is diminished, making your body parts look comically short and broad.

Understanding the Observation

- The distortion of images is due to the way these mirrors curve. The curved surfaces bend light rays differently than flat mirrors, stretching or compressing the image in various directions.
- This activity demonstrates the principles of reflection in curved mirrors and how the shape of a mirror can drastically alter the way an image is perceived.

Conclusion-

The mirrors used in laughing galleries are primarily concave and convex mirrors, each creating unique and amusing distortions of our reflections. This experience not only provides entertainment but also offers a practical insight into the behaviour of light when interacting with differently shaped reflective surfaces.

5. Visit a nearby hospital. You can also visit the clinic of an ENT specialist, or a dentist. Request the doctor to show you the mirrors used for examining ear, nose, throat, and teeth. Can you recognize the kind of mirror used in these instruments?

Answer-

Activity Description and Objective-

- **Objective-** The purpose of this activity is to identify and understand the type of mirrors used in medical settings for examining the ear, nose, throat, and teeth.
- **Visit-** Go to a nearby hospital, an ENT specialist, or a dentist's clinic.
- **Interaction**- Politely request the doctor to show you the mirrors used in their examination tools.

Observation and Recognition-

- **Type of Mirror Observed-** In these medical settings, you are likely to see small, curved mirrors.
- **Analysis-** Based on their appearance and usage, these mirrors are typically concave mirrors.

Explanation of the Choice of Mirror-

- **Concave Mirrors in Medical Use-** Concave mirrors are chosen in medical instruments because they have the ability to magnify and focus light.
    - **For ENT and Dental Examinations**- In the case of ENT and dental examinations, the concave mirror's magnifying effect allows doctors to see enlarged images of small areas like the inside of an ear, nose, or mouth.
    - **Illumination**- These mirrors also help to focus light onto the specific area being examined, providing better visibility in the typically small and hard-to-see regions of the ear, nose, throat, and mouth.

Conclusion-

The mirrors used in medical instruments for examining ear, nose, throat, and teeth are concave mirrors. Their selection is due to their magnifying and light-focusing properties, which are essential for detailed and accurate medical examinations. This visit not only provides practical exposure to the application of concave mirrors but also deepens the understanding of their significance in medical tools.

6. Role play- Here is a game that a group of children can play. One child will be chosen to act as the object and another will act as the image of the object. The object and the image will sit opposite to each other. The object will make movements, such as raising a hand, touching an ear, etc. The image will have to make the correct movement following the movement of the object. The rest of the group will watch the movements of the image. If the image fails to make the correct movement, she/he will be retired. Another child will take her/his place and the game will

continue. A scoring scheme can be introduced. The group that scores the maximum will be declared the winner.

Answer-

Activity Description and Rules-

- **Objective-** The game is designed to simulate how images are formed in mirrors, particularly focusing on the concept of lateral inversion.
- **Participants-** The game requires at least three children – one to act as the object, one as the image, and others to observe and judge.
- **Setup-** The child acting as the object and the one acting as the image will sit facing each other.
- **Game Play-**
    - **Object's Role-** The child acting as the object will make various movements like raising a hand, touching an ear, etc.
    - **Image's Role-** The child acting as the image must mirror these movements accurately. For example, if the object raises their right hand, the image should raise their left hand, imitating how a mirror would reflect the action.
    - **Observation-** The rest of the group will observe the image's movements to ensure they correctly mirror the object's actions.
- **Scoring and Winning-** Points are awarded for accurate mirroring. If the image fails to mirror correctly, they are replaced by another child. The child or group that accurately mirrors the most actions wins.

Game Objective and Learning Outcome-

- This role-play game is not only entertaining but also educational. It helps children understand the concept of lateral inversion seen in plane mirrors, where the left side of the object appears as the right side in the image and vice versa.
- It's a practical way to learn about mirror images and how they behave differently from the actual object, in a fun and engaging manner.

Conclusion-

This role-play game is an excellent way for children to actively engage with and understand the properties of reflections and lateral inversion, reinforcing their learning about light and mirrors in a playful and interactive setting.

Also Check NCERT Exemplar Solutions- Class 7 Science- Chapter 15- Light

Also Check Chapter 15- Light Class 7 science- Very Short Question and Answers

Also Check Chapter 15- Light Class 7 science- Question and Answers

Also Check Chapter 15- Light Class 7 science- Question and Answer (True or False)

Also Check Chapter 15- Light Class 7 science- Question and Answer (Fill in the Blanks)

Also Check Chapter 11- A Detailed Guide to the Light Activities for Class 7 Students