Shadow Formation

A. Fill in the Blanks

Complete the sentences with the correct word from the word bank.

screen umbra opposite opaque rectilinear propagation

1. The principle that light travels in straight lines is called _____.
2. A shadow is always formed on the _____ side of the object from the light source.
3. A shadow needs a surface, or _____, to be formed upon.
4. The darkest, central region of a shadow where light is completely blocked is the _____.
5. A book is an example of an _____ object because it completely blocks light.

B. Match the Following;

Match the term in Column A with the best description or example in Column B.

Column A (Structure)	Column B (Function)
1. Umbra	A. An object that allows some, but not all, light to pass through.
2. Penumbra	B. The principle that light travels in a straight path.
3. Opaque	C. The completely dark central region of a shadow.
4. Translucent	D. An object that completely blocks light from passing through.
5. Rectilinear Propagation	E. The partially shaded, lighter outer region of a shadow.

C. Practice Problems

Apply your knowledge to answer these questions.

1. If you move an object closer to a light source, what happens to the size of its shadow on a screen?
2. If you move the screen further away from an opaque object, what happens to the size of the shadow?
3. A red ball is placed in the path of a white light. What will be the color of its shadow?

4. Describe the difference between the shadow formed by an opaque object and a translucent object.
5. What is the darkest part of a shadow called?
6. What is the fainter, outer part of a shadow called?
7. You are standing outside on a sunny day. On which side of your body will your shadow be formed?
8. If a circular plate is held in the path of light, what will be the shape of its shadow?
9. Why is a penumbra more likely to be seen when the light source is large or extended?
10. If you want to make a shadow smaller without moving the object, what should you do to the light source?

D. Warm-up Questions

Answer the following basic questions.

1. What is a shadow?
2. List the three things that are absolutely necessary to form a shadow.

i. _____ ii. _____ iii. _____

3. What is an opaque object? Give one example.
4. Light travels in a _____ line.
5. Will a clear glass pane form a dark shadow? Why or why not?

E. Challenge Questions

Think critically to answer these more difficult questions. (2 marks each)

1. Imagine you are in a dark room with two different colored lights (e.g., one red, one blue) shining on a ball from different angles. What would you observe on the wall behind the ball? Explain your reasoning.
2. A solar eclipse occurs when the Moon passes between the Sun and Earth. Explain how this is a large-scale example of shadow formation, identifying the light source, the object, and the screen.
3. What would happen to shadows if light did not travel in a straight line and could bend around objects?
4. You are given a flashlight, a tennis ball, and a wall. Describe two distinct methods to make the shadow of the tennis ball on the wall LARGER.
    - Method 1: _____ Method 2: _____
5. Why does your shadow have fuzzy, blurred edges (a large penumbra) on a cloudy day compared to a sharp, distinct shadow on a bright sunny day?

F. Word Problems & Application

Read the scenarios and answer the questions.

1. The Sundial: An ancient sundial uses a gnomon (a fixed stick) to cast a shadow onto a marked dial to tell the time. How does the position and length of the gnomon's shadow change from morning to noon to evening?
2. Shadow Puppets: Maria is putting on a shadow puppet show. She wants her rabbit puppet to look very large and scary on the screen. Should she hold the puppet closer to the flashlight or closer to the screen? Explain why.
3. The Detective: A detective is examining a photo taken outdoors. In the photo, a person's shadow is very short and directly underneath them. What can the detective infer about the time of day the photo was taken?
4. The Football Game: During a night game, a football player stands near one of the giant stadium lights. He notices he casts multiple shadows on the field. Why does this happen?
5. The Pinhole Camera: A simple pinhole camera works because light travels in straight lines. If you look at a tree through a pinhole camera, the image formed inside is inverted (upside down). How does this relate to the way shadows are formed?

G. True or False

1. The color of a shadow depends on the color of the object casting it. _____
2. A transparent object casts a very dark shadow. _____
3. Moving an object closer to a screen (away from the light) makes its shadow larger. _____
4. A shadow is a form of matter that has mass. _____
5. The size of a shadow remains constant throughout the day. _____