Hougang Secondary School
SEC 3/4 PURE PHYSICS

14 Light – Excluding Total Internal Reflection

WORKSHEET 1

Steps for Drawing a Ray Diagram

Draw the Ray Diagram for **Figure 1**.

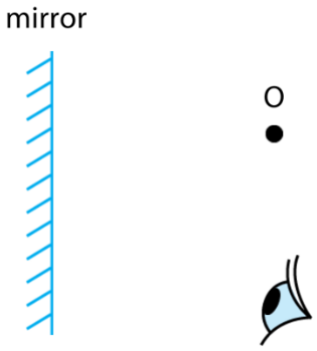
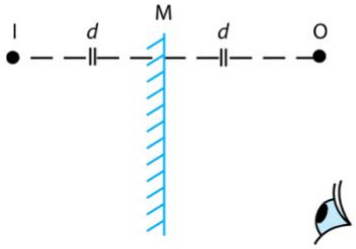


Figure 1

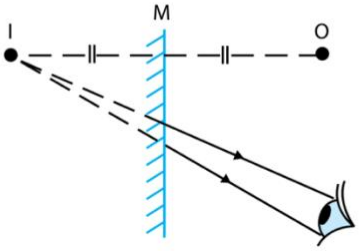
Step 1:
Locate the position of the image I behind the mirror.



distance of mirror image behind mirror = distance of object in front of mirror

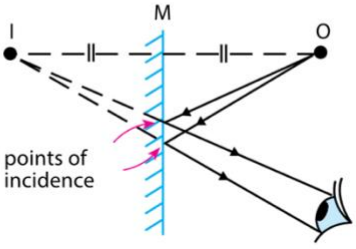
- Draw a dashed line at 90 ° to the mirror, extending beyond the expected position of the image.
- Measure *d* and use it to locate the position of image I.

Step 2:
Draw the reflected rays.



- Draw lines to join I to the eye. Use dashed lines behind the mirror and solid lines for rays reflected into the eye.
- Insert arrowheads to indicate the direction at which the light travels.

Step 3:
Draw the incident rays.



- Draw solid lines from object O to the points of incidence on the mirror. These are the incident rays.
- Insert arrowheads to indicate the direction at which the light travels.

1 Tom, who is 1.5 m tall, wants to mount a mirror on a wall so that he can get a full view of himself. What is the minimum vertical length of the mirror that is needed?

2 Fill in the blanks.

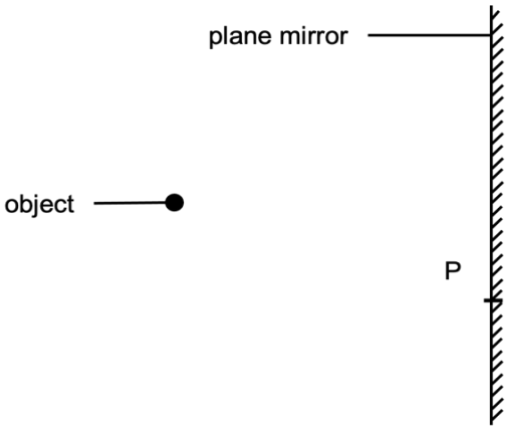
1 The equation $n = \frac{c}{v}$ gives the refractive index n of any medium. If the medium is a vacuum, then the value of n for a vacuum must be = _____.
2 Since light travels fastest in a vacuum, the refractive index, $n = \frac{c}{v}$, of any material must always be greater than the number _____.
3 The greater the slow-down in speed when a light ray enters a medium from air or a vacuum, the _____ will be the n for the medium.

4 A swimming pool is illuminated at night with lights installed at the vertical sides of the pool. The light rays emerge in the directions shown in Figure 14.70.

Figure 14.70

(a) Given that the refractive index of water is 1.33, determine the critical angle in water.
(b) When the water surface is still, the man by the side of the pool cannot see the light from the opposite side. Suggest a reason for this.
(c) Explain why installing the lights at the bottom of the pool is not as effective in lighting up the pool.

4 (a) The following shows a small object in front of a vertical plane mirror.



On the diagram:

(i) Mark with a clear cross, labelled I, where the image of the object is located;

(ii) Draw the path of a ray from the object to point P on the mirror, and its path after the ray is incident on the mirror; and

(iii) Mark clearly the angle of incidence i and the angle of reflection r at P.

(b) When we look into the mirror, we see an image of our face. State two characteristics of the images we see.

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(c) If we look into a thick glass window in a brightly lit room when it is dark outside, we can see two images of our face. Suggest why there are two images.

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