The image formed by rays that appear to come from the image point behind the mirror—but never really do—is called a **virtual image.** As shown in **Figure 8(a),** a flat mirror always forms a virtual image, which always appears as if it is behind the surface of the mirror. For this reason, a virtual image can never be displayed on a physical surface.

virtual image

an image from which light rays appear to diverge, even though they are not actually focused there; a virtual image cannot be projected on a screen

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Image location can be predicted with ray diagrams

Ray diagrams, such as the one shown in **Figure 8(b),** are drawings that use simple geometry to locate an image formed by a mirror. Suppose you want to make a ray diagram for a pencil placed in front of a flat mirror. First, sketch the situation. Draw the location and arrangement of the mirror and the position of the pencil with respect to the mirror. Construct the drawing so that the object and the image distances (p and q, respectively) are proportional to their actual sizes. To simplify matters, we will consider only the tip of the pencil.

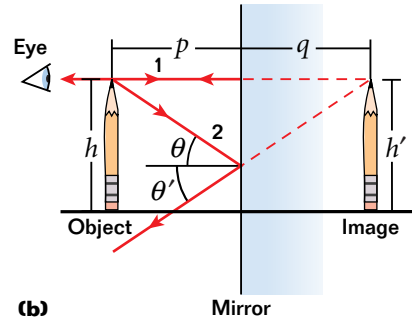
To pinpoint the location of the pencil tip's image, draw two rays on your diagram. Draw the first ray from the pencil tip perpendicular to the mirror's surface. Because this ray makes an angle of 0° with a line perpendicular (or *normal*) to the mirror, the angle of reflection also equals 0°, causing the ray to reflect back on itself. In **Figure 8(b),** this ray is denoted by the number **1** and is shown with arrows pointing in both directions because the incident ray reflects back on itself.

Draw the second ray from the tip of the pencil to the mirror, but this time place the ray at an angle that is not perpendicular to the surface of the mirror. The second ray is denoted in **Figure 8(b)** by the number **2.** Then, draw the reflected ray, keeping in mind that it will reflect away from the surface of the mirror at an angle, θ', equal to the angle of incidence, θ.

Next, trace both reflected rays back to the point from which they appear to have originated, that is, behind the mirror. Use dotted lines when drawing these rays that appear to emerge from behind the mirror to distinguish them from the actual rays of light (the solid lines) in front of the mirror. The point at which these dotted lines meet is the image point, which in this case is where the image of the pencil's tip forms.

By continuing this process for all of the other parts of the pencil, you can locate the complete virtual image of the pencil. Note that the pencil's image appears as far behind the mirror as the pencil is in front of the mirror ($p = q$). Likewise, the object height, h, equals the image height, h'.

(a)



(b)

Figure 8
The position and size of the virtual image that forms in a flat mirror **(a)** can be predicted by constructing a ray diagram **(b).**