

Solutions

2.1 Answer: B. $1/s' = 1/12 - 1/8 = -1/24$; $M = -(-24)/8 = +3$, virtual and upright.

Compare the rejected options: $s' = 24$ cm, $M = -3$; $s' = -4.8$ cm, $M = +0.6$; $s' = 4.8$ cm, $M = -0.6$; Image at infinity. Use the stated model and conditions.

2.2 Answer: C. $s' = 15$ cm and $M = -1/2$; a positive real mirror image is in front of the mirror.

Compare the rejected options: Virtual, behind, upright; Real, behind, upright; Virtual, in front, inverted; At the focus regardless of s . Use the stated model and conditions.

2.3 -10. $1/s' = -1/15 - 1/30 = -1/10$; $M = +1/3$.

2.4 True. $1/s' = 1/f - 1/f = 0$; the ideal image is at infinity.

3.1 First image has $s'_1 = 15$ cm and $M_1 = -1/2$. The second lens intercepts converging rays headed to $x = 15$ cm, so $s_2 = -5$ cm: a virtual object. $1/s'_2 = 1/10 - 1/(-5) = 3/10 \text{ cm}^{-1}$, hence $s'_2 = 10/3$ cm. Final coordinate $x = 10 + 10/3 = 40/3$ cm; $M_2 = -s'_2/s_2 = 2/3$; total $M = -1/3$. Award first image, signed second object, second image, final coordinate and magnification. The final image is real and inverted.