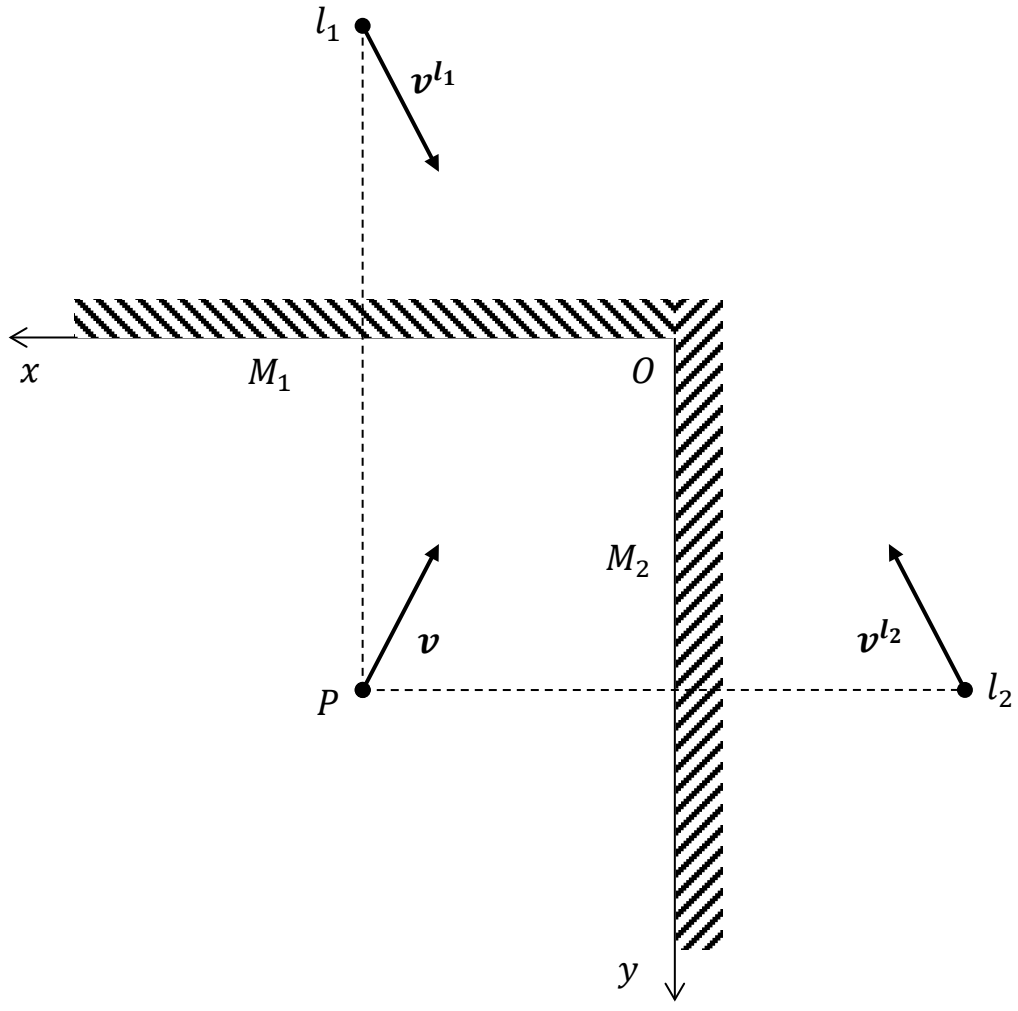
Answer on Question#52005 - Physics - Optics

A particle 'P' moves with velocity 10m/sec towards the intersection point 'O' of the 2 plane mirror kept at right angle to each other. I1&I2; are the images formed due to direct reflection from mirror M1 and mirror M2 respectively. Then the relative speed of I1 with respect to I2 will be

(1) 20m/sec
(2) 12m/sec
(3) 10√2m/sec
(4) 16m/sec

Solution:



If the velocity of particle P is

$$\boldsymbol{v} = (-v_x, -v_y),$$

then velocities of images l_1 and l_2 are

$$\boldsymbol{v^{l_1}} = (-v_x, v_y)$$

$$\boldsymbol{v}^{\boldsymbol{l_2}} = (v_x, -v_y)$$

The relative velocity of I1 with respect to I2 is

$$\boldsymbol{v}^{\boldsymbol{l_1 l_2}} = \boldsymbol{v}^{\boldsymbol{1}} - \boldsymbol{v}^{\boldsymbol{l_2}} = (-v_x, v_y) - (v_x, -v_y) = (-2v_x, 2v_y)$$

Then the relative speed of I1 with respect to I2 is

$$\left|\boldsymbol{v}^{\boldsymbol{l_1 l_2}}\right| = \sqrt{(-2v_x)^2 + (2v_y)^2} = 2\sqrt{v_x^2 + v_y^2} = 2|\boldsymbol{v}|$$

Since $|\boldsymbol{v}| = 10\,\frac{\mathrm{m}}{\mathrm{s}}$, we obtain

$$\left|\boldsymbol{v}^{\boldsymbol{l_1 l_2}}\right| = 2|\boldsymbol{v}| = 2 \cdot 10\,\frac{\mathrm{m}}{\mathrm{s}} = 20\,\frac{\mathrm{m}}{\mathrm{s}}$$

So the correct answer is (1).

Answer: (1).