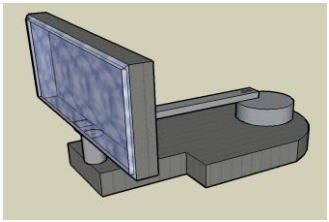
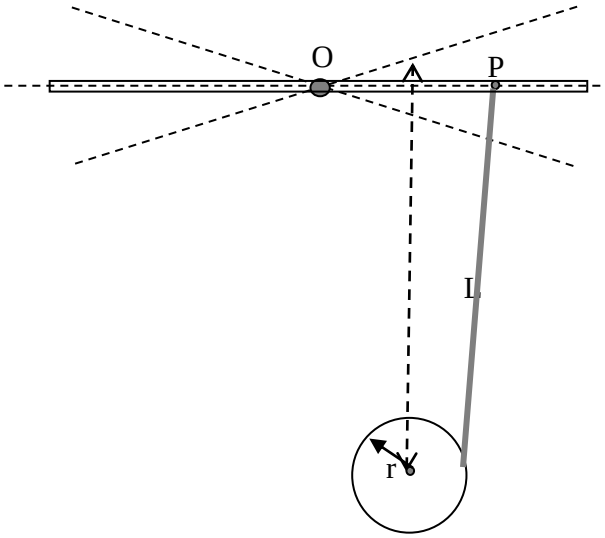
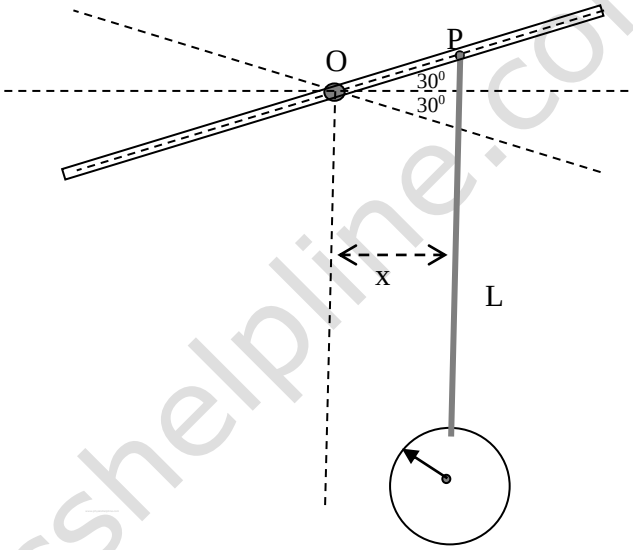


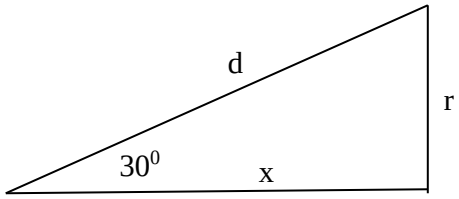
Q- A mirror is to be meant to oscillate at 10 cycles per minute and turns 30 degrees either side of the center line. The radius of the rotor is r and the length of the shaft L (considerably large). At what distance d from the center of the mirror the shaft is to be pinned and what is the distance of the rotor from the centreline of the mirror?

The rotor required must have the same frequency and thus we will choose a rotor of frequency 10 rpm. The shaft of length L is connecting the mirror and the rotor in such a way that when the mirror is at 30^0, the shaft is radial to the rotor as in the figure. The top view is shown in the diagrams





Let the pin is attached at Point P at a distance d from the axis of rotation of the mirror, in such a way that when the mirror is at 30^0 the shaft is straight (perpendicular to the mean position of mirror and in line with the center of the wheel). The length of the shaft must be equal to the distance of the center of the wheel from the mean position of the mirror and thus the pin will be at a distance equal to the radius r of the wheel (or the point of contact). In the deviated position the angle is 30^0 and OP will make hypotenuse of the right-angle triangle with perpendicular equal to r.



When the rotor turns by half rotation the point where the shaft is attached will be in opposite direction and the pin P will come down to the position in such a way that the mirror will make an angle 30^0 on the other side of the mean position.

Now from the right-angled triangle

$$\sin\theta = r/d$$

Gives $\sin 30^0 = r/d$

Or $0.5 = r/d$

Or $d = 2r$

Hence for maximum deviation of the mirror to be 30^0 the distance of the pin P from the axis of rotation of the mirror should be double of the radius of wheel.

The distance of the center of the rotor from the centreline of the mirror should be equal to

$$x = d \cos 30^0 = 0.866\ d$$