Q- A block of weight 150 lb is placed on a rough horizontal surface and a horizontal force $\mathrm{P}=60 \mathrm{lb}$ is acting on it as in figure. The friction is sufficient to prevent sliding. Find the horizontal distance between the line of action of the weight of the block and the normal reaction of the surface.


The horizontal surface will apply two forces on the block the Normal Reaction N and the friction F .
As the friction is unknown, taking torque about the right lower edge A of the block the torque (or moment of the force) due to the friction will be zero.

As the vertical forces are to be balance the normal reaction N must have magnitude equal to the weight of the block 150 lb .

Now the force P and the weight of the block will try to rotate the block in anticlockwise (positive moment) while the normal force N will try to rotate it clockwise (negative moment) direction about A and as the block is in rotational equilibrium, writing equation for the moments of all forces acting on the block we get
(Moment of a force $=$ force $*$ Perpendicular distance)

$$
-\mathrm{N} * \mathrm{~d}+\mathrm{W} * 2+\mathrm{P} * 3+\mathrm{F} * 0=0
$$

Or $\quad-150 * d+150 * 2+60 * 3=0$
Gives $d=480 / 150=3.2 \mathrm{ft}$
Hence the distance between the weight and the normal force will be

$$
\mathrm{X}=3.2-2=1.2 \mathrm{ft}
$$

