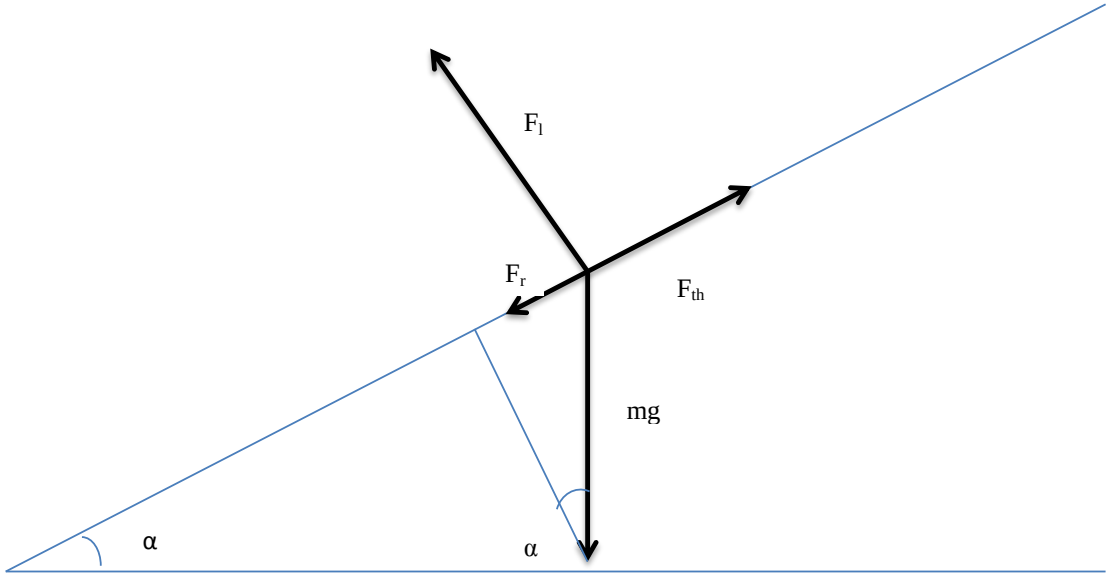
A plane is flying with a constant speed along a straight line at an angle of 30° with the horizontal. The weight of the plane is 80, 000 N and its engine provides a thrust of 100, 000 N in the direction of flight. Two additional forces are exerted on the plane: the lift force perpendicular to the plane's wings, and the force due to air resistance opposite to the direction of motion. Draw the free-body diagram showing all forces on the plane. Determine the lift force and the force due to air resistance



$\alpha = 30$

$mg = 80{,}000\ H$

$F_{th} =$ of $100,000$ N - force of thrust

$F_r -$ force of air resistance

$F_l -$ the lift force

From Newton's first law of motion:

If there is no net force on an object, then its velocity is constant.

So, vector sum of forces equals 0.

Therefore:

$F_r + mg \sin\alpha = F_{th} \quad => \quad F_r = F_{th} - mg \sin\alpha$

and:

$mg \cos\alpha = F_l \quad => \quad F_l = mg \cos\alpha = \frac{\sqrt{3}}{2}\ 80{,}000\ H = \ 69{,}282\ H$

$F_r = 100{,}000 \text{ N} - \frac{1}{2} 80{,}000\ H = 60{,}000\ H$

Answer: the lift force equals $69{,}282\ H$ and the force due to air resistance equals $60{,}000\ H$