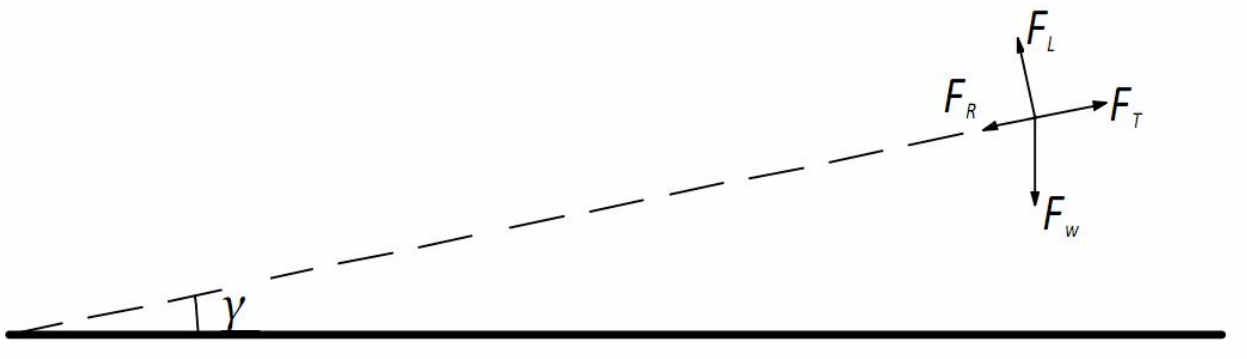
A plane is flying with a constant speed along a straight line at an angle of 30° with the horizontal. The weight of the plane is 80,000 N and its engine provides a thrust of 100,000 N in the direction of flight. Two additional forces are exerted on the plane: the lift force perpendicular to the plane's 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.



Solution: as you can see on the force diagram above, the plane is affected to such forces as weight force F_w = 80,000 N, force of the air resistance F_R, wings lifting force F_L, and the moving thrust force F_T = 100,000 N. All these forces are in the equilibrium, according to the third Newton's law.

The lifting force balances the part of the weight force, so if we'll compare their projections on the plane vertical axis, they are equal: $\vec{F}_L = \vec{F}_W^{vert}$, $F_L = F_w \cdot \cos\gamma = 80{,}000 \cdot \cos 30° = 69{,}282$ N

And the thrust force balances the air resistance force and the rest of the weight force, so that the sum of their projections on the plane horizontal axis are equal: $\vec{F}_T = \vec{F}_W^{hor} + \vec{F}_R$, $F_T = F_w \cdot \sin\gamma + F_R$

$F_R = F_T - F_w \cdot \sin\gamma = 100{,}000 - 80{,}000 \cdot \sin 30° = 60{,}000$ N

Answer: The lift force of the plain wings is 69,282 N, and the force of the air resistance is 60,000 N.