Solved Problems on Newton's Laws

(1) An airplane has a mass of 3.1×10^4 kg and takes off under the influence of a constant net force of 3.7×10^4 N. What is the net force that acts on the plane's 78-kg pilot?

Solution:

According to Newton's second law, the acceleration is $a = \Sigma F/m$. Since the pilot and the plane have the same acceleration, we can write

$$\left(\frac{\Sigma F}{m}\right)_{PILOT} = \left(\frac{\Sigma F}{m}\right)_{PLANE} \quad \text{or} \quad (\Sigma F)_{PILOT} = m_{PILOT}\left(\frac{\Sigma F}{m}\right)_{PLANE}$$

Therefore, we find

$$(\Sigma F)_{PILOT} = (78\,\text{kg})\left(\frac{3.7\times10^4\ \text{N}}{3.1\times10^4\ \text{kg}}\right) = \boxed{93\ \text{N}}$$

---

(2) A boat has a mass of 6800 kg. Its engines generate a drive force of 4100 N due west, while the wind exerts a force of 800 N due east and the water exerts a resistive force of 1200 N due east. What are the magnitude and direction of the boat's acceleration?

Solution:

Newton's second law of motion gives the relationship between the net force ΣF and the acceleration a that it causes for an object of mass m. The net force is the vector sum of all the external forces that act on the object. Here the external forces are the drive force, the force due to the wind, and the resistive force of the water.