66. (a) The net horizontal force is $F$ since the batter is assumed to exert no horizontal force on the bat. Thus, the horizontal acceleration (which applies as long as $F$ acts on the bat) is $a = F/m$.

(b) The only torque on the system is that due to $F$, which is exerted at $P$, at a distance $L_o - \frac{1}{2}L$ from $C$. Since $L_o = 2L/3$ (see Sample Problem 16-5), then the distance from $C$ to $P$ is $\frac{2}{3}L - \frac{1}{2}L = \frac{1}{6}L$. Since the net torque is equal to the rotational inertia ($I = \frac{1}{12}mL^2$ about the center of mass) multiplied by the angular acceleration, we obtain

$$\alpha = \frac{\tau}{I} = \frac{F\left(\frac{1}{6}L\right)}{\frac{1}{12}mL^2} = \frac{2F}{mL} \ .$$

(c) The distance from $C$ to $O$ is $r = L/2$, so the contribution to the acceleration at $O$ stemming from the angular acceleration (in the counterclockwise direction of Fig. 16-11) is $\alpha r = \frac{1}{2}\alpha L$ (leftward in that figure). Also, the contribution to the acceleration at $O$ due to the result of part (a) is $F/m$ (rightward in that figure). Thus, if we choose rightward as positive, then the net acceleration of $O$ is

$$a_O = \frac{F}{m} - \frac{1}{2}\alpha L = \frac{F}{m} - \frac{1}{2}\left(\frac{2F}{mL}\right)L = 0 \ .$$

(d) Point $O$ stays relatively stationary in the batting process, and that might be possible due to a force exerted by the batter or due to a finely tuned cancellation such as we have shown here. We assumed that the batter exerted no force, and our first expectation is that the impulse delivered by the impact would make all points on the bat go into motion, but for this particular choice of impact point, we have seen that the point being held by the batter is naturally stationary and exerts no force on the batter's hands which would otherwise have to "fight" to keep a good hold of it.