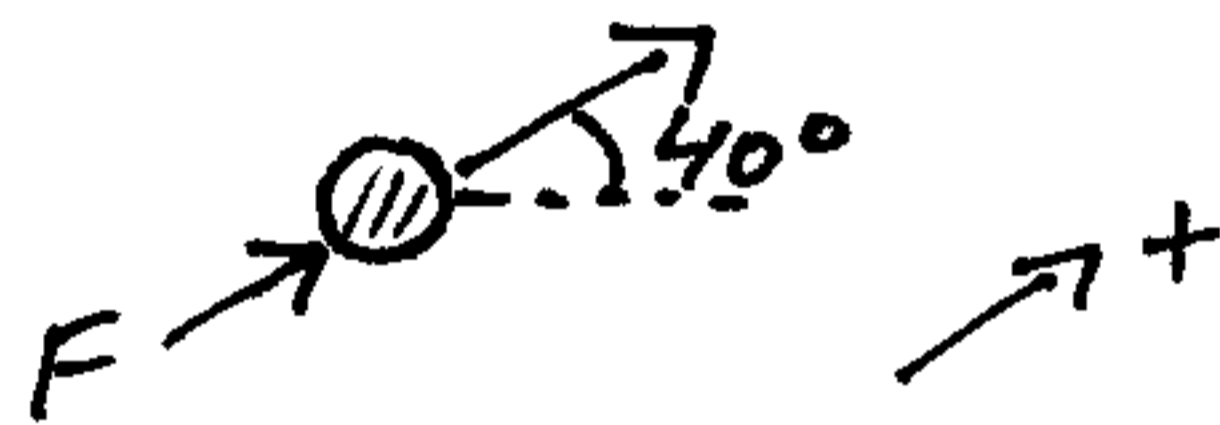


This is a problem involving momentum.

A golfer hits a golf ball, giving it an initial velocity of  $60 \text{ m/s}$  with a launch angle of  $40^\circ$  above the horizontal. The club and ball are in contact for  $1.9 \text{ ms}$ , and the mass of the ball is  $45 \text{ g}$ . Determine, (a) the impulse acting on the ball and the club, (b) the average force acting on the ball, and (c) the work done on the ball.

Solution:



$$J = m(v_f - v_i)$$

$$J = (0.045 \text{ kg})(60 \text{ m/s} - 0 \text{ m/s})$$

$$\vec{J} = 2.7 \text{ kg}\cdot\text{m/s} \quad (\text{answer for part (a)})$$

$$\bar{F} = \frac{J}{\Delta t} = \frac{2.7 \text{ kg}\cdot\text{m/s}}{0.0019 \text{ s}} = 1421 \text{ N} \quad (\text{answer for part (b)})$$

Apply principle of work and energy:

$$T_1 + \sum U_{1-2} = T_2$$

$$\Rightarrow 0 + \sum U_{1-2} = \frac{1}{2} m v_f^2$$

$$\Rightarrow \sum U_{1-2} = \frac{1}{2} (0.045) (60)^2 = 81 \text{ J} \quad (\text{answer for part (c)})$$