A centrifugal pump with a 12 in. diameter impeller requires a power input of 60 hp when the flowrate is 3200 gpm against a 60 ft head. The impeller is changed to one with a 10 in. diameter. Determine the expected flowrate, head, and input power if the pump speed remains the same.

SOLUTION:
Since the pump speed remains the same and assuming geometrically similar pumps, the pump scaling laws are,

$$\frac{Q_1}{Q_2} = \left(\frac{D_1}{D_2}\right)^3 \qquad \frac{H_1}{H_2} = \left(\frac{D_1}{D_2}\right)^2 \qquad \frac{\dot{W}_1}{\dot{W}_2} = \left(\frac{D_1}{D_2}\right)^5$$

Using the given parameters,

Q_1 = 3200 gpm,
D_1 = 12 in,
D_2 = 10 in,
H_1 = 60 ft,
$\dot{W}_1$ = 60 hp,

Q_2	=	1850 gpm
H_2	=	41.7 ft
$\dot{W}_2$	=	24.1 hp

If the empirical (and more accurate) scaling laws are used,

$$\frac{Q_1}{Q_2} = \left(\frac{D_1}{D_2}\right)^2 \qquad \frac{H_1}{H_2} = \left(\frac{D_1}{D_2}\right)^2 \qquad \frac{\dot{W}_1}{\dot{W}_2} = \left(\frac{D_1}{D_2}\right)^4$$

Q_2	=	2220 gpm
H_2	=	41.7 ft
$\dot{W}_2$	=	28.9 hp