

36.9 The piston in the master cylinder of a car with a hydraulic clutch system has a diameter that is double the diameter of the slave cylinder piston. If the driver presses the clutch pedal with an input force of $50N$, what is the reaction force at the slave cylinder piston?

- A. $13N$
- B. $25N$
- C. $100N$
- D. $200N$

The key principle for hydraulics problems is that the pressure is equal throughout the system. The force applied and the reaction force may vary according to the diameter/area, but the pressure is equal. Start this problem by recognizing that the pressure applied at the master cylinder is equal to the pressure exerted on the slave cylinder.

$$P_m = P_s$$

Next apply the definition of pressure as a force applied over an area. Substitute for the both sides of the equation.

$$P = \frac{F}{A}$$
$$\frac{F_m}{A_m} = \frac{F_s}{A_s}$$

Since the applied force at the master cylinder is known, isolate the reaction force F_s .

$$F_s = F_m \left(\frac{A_s}{A_m} \right)$$

The ratio of the areas is a the square of the ratio of the diameters. The master cylinder diameter was given as double the slave cylinder diameter.

$$\frac{A_s}{A_m} = \left(\frac{1}{2} \right)^2 = 0.25$$

Solve for the reaction force at the slave cylinder.

$$F_s = (50N)(0.25) = 12.5N$$

Answer A