Understanding the Terms and Specifications

Ram = Piston = Plunger
The plunger is the part of the jack that rises out of the housing (cylinder body). The plunger is also referred to as a "Piston" or "Ram".

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Hand Operated Hydraulic Jack

Problem adapted from example 3-5 of Esposito 7th edition (and units changed from Imperial to Metric)
A hand operated hydraulic jack has the following parameters:

- pump cylinder diameter = 2.5 cm
- load cylinder diameter = 8.5 cm

Human force that is applied = 120 N

![Lever Diagram]

\[ \text{Required distance for the load to be lifted} = 25 \text{ cm} = 0.25 \text{ m} \]

The pump cylinder has a stroke of 5 cm

The efficiency of the system is 80%.

How much load can be lifted?

How many cycles are needed at the pump cylinder end?

The force at the pump cylinder is:

\[ F_{\text{human}} \cdot \text{distance human} = F_{\text{pump}} \cdot \text{distance pump} \]

\[ (120 \text{ N})(0.2) = F_{\text{pump}} \cdot 0.05 \]

\[ 0 \]
F_{pump} = 480 \text{ N}

using Pascal's law:

\[
\frac{F_{cyl.}}{\text{Area}} = \text{pressure}
\]

\[
\frac{480}{\pi (0.025)^2} = 977.85 \text{ kPa}
\]

Force at the load cylinder =

\[
F_{load} = P \times A_{loadcyl} = 977.85 \text{ kPa} \times \pi \left(\frac{0.083}{2}\right)^2
\]

\[= 5290 \text{ N}\]

Taking efficiency into consideration

\[
F_{load} = (0.8)(5290) = 4232 \text{ N}
\]

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assume no. of cycles is \(n\)

\[
(\text{stroke}_{pump}) (n) (\text{Area}_{pump}) = (\text{stroke}_{load})(1) (\text{Area}_{loadcyl})
\]

\[
(0.05) (n) \left(\frac{(0.025)^2}{2}\right) = (0.25) (\pi \left(\frac{0.083}{2}\right)^2)
\]

\[n = 55.112 \text{ times}\]

\[\text{(2)}\]