Example
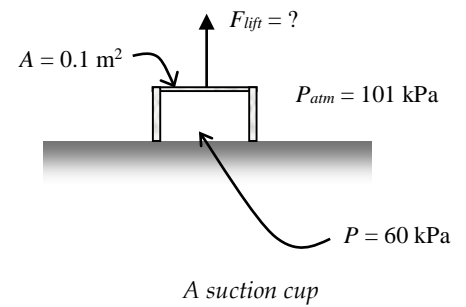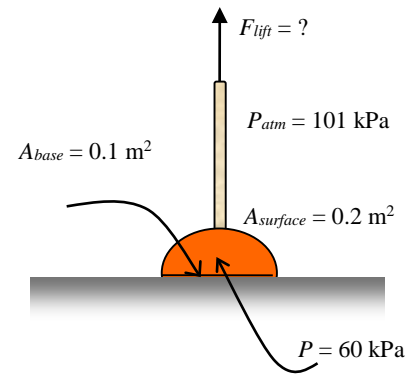
A suction cup sits on a smooth surface. If the pressure of the air under the cup is $P = 60$ kPa and atmospheric pressure is $P_{atm} = 101$kPa, calculate the force needed to remove the cup from the surface. You may neglect the weight of the plunger.

$F_{lift} = ?$

$A = 0.1$ m^2

$P_{atm} = 101$ kPa

$P = 60$ kPa

A suction cup

Example

Let's say the suction cup in the last example is actually a plunger with the ellipsoid-like shape shown in the figure below. The total outer surface area of the plunger is 0.2 m². The cross sectional area at the bottom of the plunger is 0.1 m². Other conditions are the same as in the last example. What is the required force to lift the plunger now?

$F_{lift} = ?$

$P_{atm} = 101$ kPa

$A_{base} = 0.1$ m²

$A_{surface} = 0.2$ m²

$P = 60$ kPa

A more realistic suction cup