

## Work in Thermodynamic Systems

What **work** is can depend on the system you are looking at.

- For a 3-D thing,  $-pdV$
- For a 2-D thing,  $\sigma dA$
- For a 1-D thing,  $\tau dL$
- For a dielectric material,  $-\vec{E} \cdot d\vec{P}$ , for a paramagnet  $-\vec{B} \cdot d\vec{M}$  etc...

With this in mind, determine if in the following scenarios work is either done *by* or *on* the system (i.e. does the system lose or gain energy by working?).

1. A gas in a piston that is being compressed. *Does it matter if it's a liquid instead?*
2. A balloon in a box (of vacuum) that is popped. *What if the air is the system? What if the balloon & the air together form the system?*
3. A gas in a piston that is expanded.
4. Ice in a piston that is being compressed.
5. A rubber band that is being stretched.
6. A soap bubble that is being blown.
7. A piece of iron that is being magnetized.
8. A rubber band that is snapped shut in a vacuum.