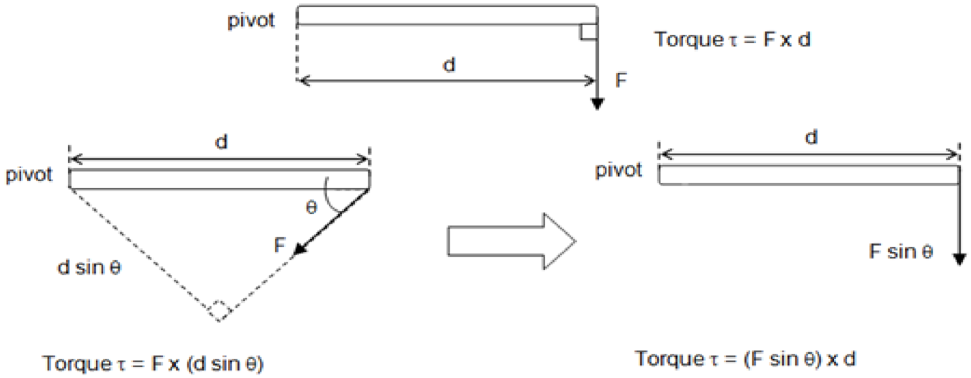
FORCES

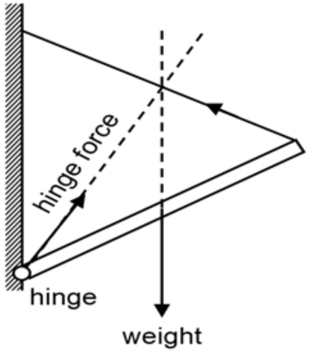
Moment or torque τ

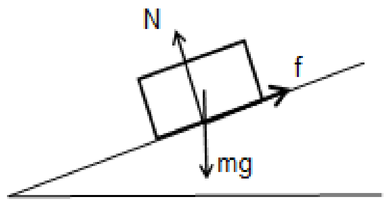
- $\tau = F\,d$ (find *perpendicular* distance *or* force)
- *Torque of a couple* is product one of the forces and the perpendicular distance between the lines of action of the forces



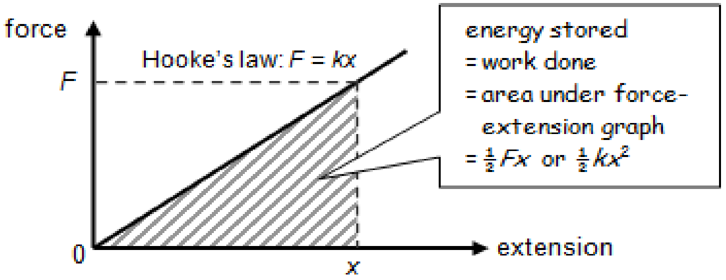
Free Body Diagram (FBD)

- Draw **<u>all</u>** forces acting **<u>on</u>** the body.
- Length & direction of arrow ⇒ Magnitude & direction of force
- Arrow starts from correct point/surface of contact
- **Concurrent point**: three non-parallel forces acting on body in equilibrium





Spring/Elastic force (for extension and compression)



Conditions for (static) equilibrium

1) Resultant force in any direction is zero (translational equilibrium, $\sum F = 0$)
2) Resultant torque about any point is zero (rotational equilibrium, $\sum \tau = 0$)

<u>Problem solving</u>

- Draw FBD
- Use **vector diagram** (closed vector triangle) to represent forces in equilibrium **or resolve forces** (horiz & vert *or* perpendicular & along slope)
- Take moments about *appropriate* point (e.g. where unknown force acts)
- Apply $F_{net} = 0$ & $\tau_{net} = 0$
- Calculate from vector diagram or from resolved components

Pressure due to fluid

$p = \rho g h$, $p_{total} = p_{atm} + \rho g h$

H2 only:

Upthrust (buoyant force)

$U = m_f g$ (wt of fluid displaced) $= \rho_f V_f g$

Principle of flotation

Object floating in equilibrium: wt of object = upthrust

Drag / Viscous force

- Force resisting a body moving relative to a fluid (e.g. air resistance)
- Always oppose motion
- Magnitude depends on speed of the body, density of the fluid, cross-sectional area, the shape of the body