

Equilibrium of a particle

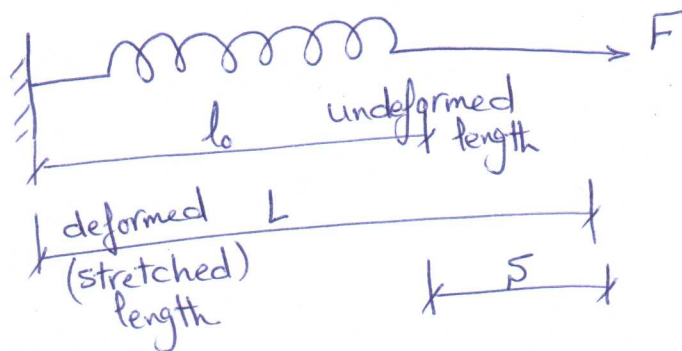
lect. # 3

* equilibrium = { at rest or move with a Const. vel.
 $\sum \vec{F} = 0 \Rightarrow \sum F_x = 0 \text{ \& } \sum F_y = 0$

* Free body diagram

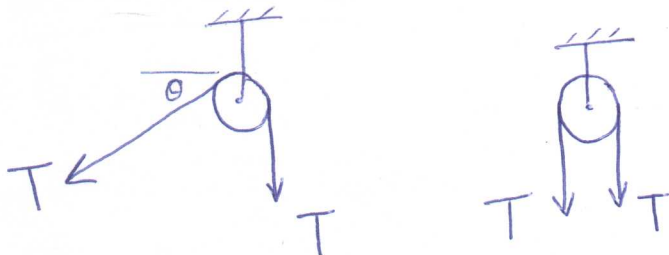
اسم مخطط يوضح الجسيم بدون المحيط به وبكل القوى المحيط به particle

* springs



stiffness elongation
as $F = k s$

* Cables & pulleys



كل هذه المراحل

① يتم اختيار الجسيم أولاً (على + من النقطه التي بها أكبر عدد من القوى)

② Free body diagram

③ تحليل القوى

* weight

$W = mg$
Newton $\rightarrow m^2/sec$
kg

④ + اتزان
 $\sum F_x = 0$
 $\sum F_y = 0$

$\sin^2 \theta + \cos^2 \theta = 1$

$\sin 2\theta = 2 \sin \theta \cos \theta$

$\cos 2\theta = \cos^2 \theta - \sin^2 \theta$

check

ex. 3-2

$$T_{AB} = ??, T_{AD} = ??$$

$$\rightarrow \sum F_x = 0$$

$$T_{AB} \cos 30 - T_{AD} = 0 \longrightarrow (1)$$

$$\uparrow \sum F_y = 0$$

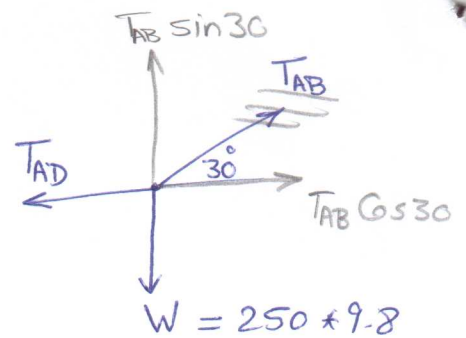
$$T_{AB} \sin 30 - 250 \times 9.8 = 0$$

$$T_{AB} = 4900 \text{ Newton}$$

$$= 4.9 \text{ KN}$$

$$\text{sub. in (1)} \quad T_{AD} = T_{AB} \cos 30 = 4.9 \cos 30$$

$$T_{AD} = 4.24 \text{ KN}$$



ex. 3-3

$$W = ??$$

equilibrium

* particle at E

$$\sum F_x = 0$$

$$T_{EG} \sin 30 - T_{EC} \cos 45 = 0$$

$$T_{EG} = \sqrt{2} T_{EC} \longrightarrow (1)$$

$$\sum F_y = 0$$

$$T_{EG} \cos 30 - 20 - T_{EC} \sin 45 = 0$$

$$\sqrt{2} T_{EC} \cos 30 - T_{EC} \sin 45 = 20$$

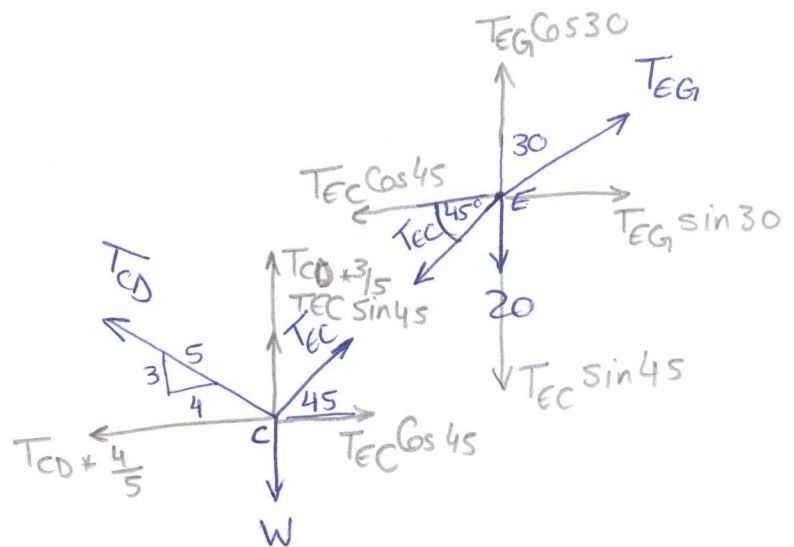
$$T_{EC} = 38.64 \text{ Newton}$$

$$\text{sub. in (1)} \quad T_{EG} = 54.64 \text{ Newton}$$

* particle at C

$$\sum F_x = 0$$

$$T_{EC} \cos 45 - T_{CD} \cdot \frac{4}{5} = 0$$



$$T_{CD} + \frac{4}{5} = T_{EC} \cos 45$$

$$T_{CD} = 34.2 \text{ Newton}$$

$$\sum F_y = 0$$

$$T_{CD} + \frac{3}{5} + T_{EC} \sin 45 - W = 0$$

$$W = T_{CD} + \frac{3}{5} + T_{EC} \sin 45$$

$$= 47.8 \text{ Newton}$$

ex. 3-4

$$l_{AC} = ??$$

$$l_{0AB} = 0.4 \text{ m}, K_{AB} = 300 \text{ N/m}$$

$$\rightarrow \sum F_x = 0$$

$$F - T_{AC} \cos 30 = 0$$

$$F = T_{AC} \cos 30 \rightarrow \textcircled{1}$$

$$\uparrow \sum F_y = 0$$

$$T_{AC} \sin 30 - 8 \times 9.8 = 0$$

$$T_{AC} = \frac{8 \times 9.8}{\sin 30} = 156.8 \text{ Newton}$$

$$\text{sub. in } \textcircled{1} F = 156.8 \cos 30 = 135.8 \text{ Newton}$$

$$F = K \Delta$$

$$135.8 = 300 \times \Delta$$

$$\therefore \Delta = 0.453 \text{ m}$$

$$\Delta = L_{AB} - l_{0AB}$$

$$0.453 = L_{AB} - 0.4$$

$$\therefore L_{AB} = 0.853 \text{ m}$$

$$l_{AC} + L_{AB} = 2$$

$$l_{AC} = 2 - L_{AB} = 2 - 0.853 = 1.15 \text{ m}$$

