Types of Forces

Contact forces:

Normal Force & Friction

Tension

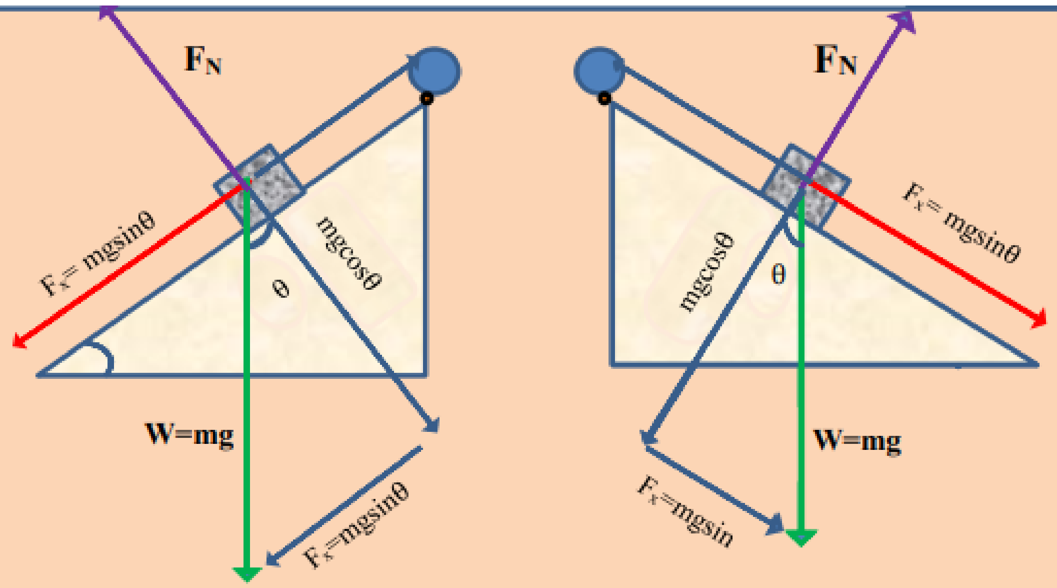
Strings & Springs

Gravitational Force - non contact

Contact Forces

Contact forces: these are forces that arise due to of an interaction between the atoms in the surfaces of the bodies in contact.

<u>في حالة وجود الشد في الحبل او الخيط</u>



$$\sum Fy = ma$$

$$Fy = FN - mgcos\theta$$

$$ma = FN - mgcos\theta$$

$$\sum Fy = 0$$

$$Fy = FN - mgcos\theta$$

$$ma = FN - mgcos\theta$$

$$\sum Fx = ma$$

$$Fx = T - mgsin\theta$$

$$ma = T - mgsin\theta$$

$$\sum Fx = ma$$

$$Fx = mgsin\theta - T$$

$$ma = mgsin\theta - T$$

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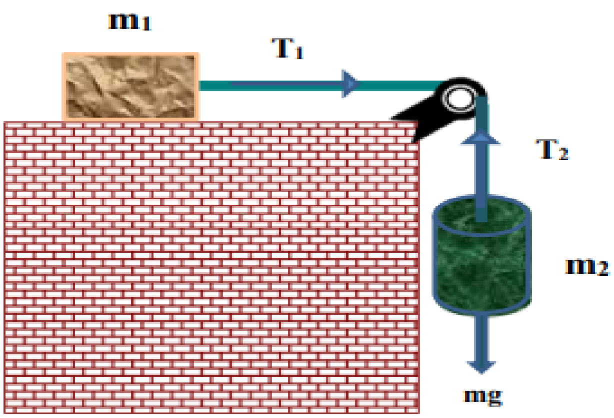
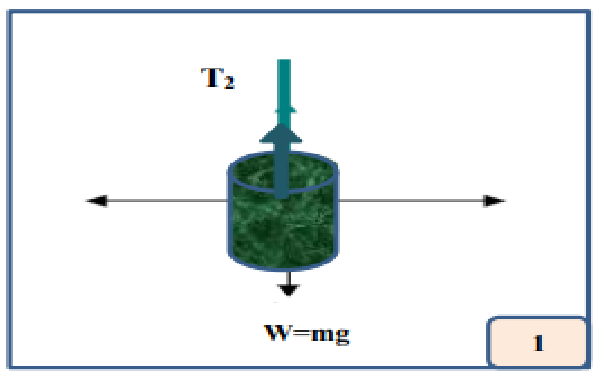
Lecture 11: The Newton's laws (Normal **force; tension force)**

في حالة الشد في الخيط

عندما تكون حركة الجسم للاسفل فان الوزن W=mg يكون موجب والشد T سالب.



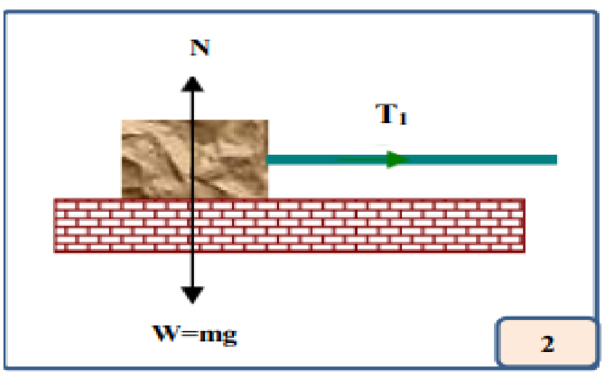


نعزل الجسمين عن بعضهما وبما ان m_2 اكبر من m_1 فأن حرك الجسم في الشكل 1 تكون الى الاسفل أي ان الوزن موجب والشد سالب لذلك يكون قانون نيوتن الثاني كما يلي :

$$\sum Fy = ma$$

$$Fy = mgsin\theta - T$$

$$ma = mgsin\theta - T$$



في الشكل (2) نأخذ القوة التي تؤثر على حركة الجسم وهي قوة الشد في اتجاه محور x لان الوزن لا يؤثر على حركة الجسم

$$\sum Fx = ma$$

$$Fx = T$$

$$T = ma$$

Worked Examples

Newton's Second Law

1. A $3.0\,\mathrm{kg}$ mass undergoes an acceleration given by $\mathbf{a} = (2.0\mathbf{i} + 5.0\mathbf{j})\,\frac{\mathrm{m}}{\mathrm{s}^2}$. Find the resultant force F and its magnitude.

Newton's Second Law tells us that the resultant (net) force on a mass m is $\sum \mathbf{F} = m\mathbf{a}$. So here we find:

$$\begin{aligned} \mathbf{F}_{\mathrm{net}} &= m\mathbf{a} \\ &= (3.0\,\mathrm{kg})(2.0\mathbf{i} + 5.0\mathbf{j})\,\frac{\mathrm{m}}{\mathrm{s}^2} \\ &= (6.0\mathbf{i} + 15.\mathbf{j})\,\mathrm{N} \end{aligned}$$

The *magnitude* of the resultant force is

$$F_{\mathrm{net}} = \sqrt{(6.0\,\mathrm{N})^2 + (15.\,\mathrm{N})^2} = 16.\,\mathrm{N}$$

2. While two forces act on it, a particle of mass $m = 3.2\,\mathrm{kg}$ is to move continuously with velocity $(3\,\frac{\mathrm{m}}{\mathrm{s}})\mathbf{i} - (4\,\frac{\mathrm{m}}{\mathrm{s}})\mathbf{j}$. One of the forces is $\mathbf{F}_1 = (2\,\mathrm{N})\mathbf{i} + (-6\,\mathrm{N})\mathbf{j}$. What is the other force?

Newton's Second Law tells us that if **a** is the acceleration of the particle, then (as there are only two forces acting on it) we have:

$$\mathbf{F}_1 + \mathbf{F}_2 = m\mathbf{a}$$

But here the *acceleration* of the particle is *zero*!! (Its velocity does not change.) This tells us that

$$\mathbf{F}_1 + \mathbf{F}_2 = 0 \qquad \Longrightarrow \qquad \mathbf{F}_2 = -\mathbf{F}_1$$

$$\mathbf{F}_2 = -\mathbf{F}_1 = (-2\,\mathrm{N})\mathbf{i} + (6\,\mathrm{N})\mathbf{j}$$