Static forces

When objects experience zero net force, there are two options for what is happening because the acceleration is zero. 1) The object moves at constant velocity until acted upon by an outside force, (Already dealt with in Dynamics Unit) or 2) The object will be motionless in a state of equilibrium. This second situation is the focus of our next studies.

* Resolving forces into components along any two perpendicular planes, we get:
* ΣFx = 0 and ΣFy = 0

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| * A load supported by two lengths of rope. Since the system is at equilibrium, 2(FT) = Fw. Here the ropes distribute the load the way the legs of a table do. The force on each ceiling hook is 150 N. * There are no forces in the x-direction |  |

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| * Again the two ropes each supply half of the upward force. The hand applies   150 N and the ceiling hook supplies the other.  Σ Fx = 0 and  Σ Fy = 0 = 2T – W = 2T – 300 |  |
| Combinations of pulleys allow for smaller loads on each rope. Here there are 4 ropes supporting the load, each with tension 100 N. The far left rope is bent over the top pulley, remaining at 100 N, which is supplied by the hand. |  |

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| We also frequently encounter situations that involve three or more forces that are not parallel or perpendicular but act at the same point in space, or concurrently. These must be resolved into both x and y components in order to solve for the forces. |
| An engine, 800 N, hangs from a rope that is suspended from another rope attached to two hooks in the wall. If Θ = 20 ° find the tension in each rope and the force pulling the hooks out of the wall. |
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| * T1 = 800 N because W = 800 N * At knot, because of symmetry, T2 and T3 must be equal to each other. * Σ Fx = FT2 cos Θ – FT3 cos Θ = 0 * Σ Fy = FT2 sin Θ + FT3 sin Θ – Fw  = 0   2 FT2 sin 20° = 800 N ; FT2 = 1170 N  At each wall pin, Frp = FT2cos 20 = 1100 N |

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| Find the FT3 and the angle Θ.  ΣFx = FT2 cos 20 – FT3cos Θ = 0; FT3cos Θ = 188 N  ΣFy = FT2 sin 20 + FT3 sin Θ – 150 N = 0  = FT3 sin Θ = 150 N – 68 N = 82 N  FT3 sin Θ = 82 N = Tan Θ = 0.434  FT3cos Θ = 188 N Θ = 23 ° and FT3 = 205 N | | |
| * A 400 N object is suspended from a 2.0 m horizontal bar of negligible mass which is attached to the wall via a pivot. The bar is held up by a rope making an angle of 50 ° with the bar.   T= 0.7 kN the rope is attached 0.5m from the end of the bar. | |  |

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| There must be a force that the wall puts back on the bar and it should have a horizontal and vertical part or component. |
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| ΣFy = FT sin 50 – Fw – FRV =0  ΣFx = FT cos 50 –FRH =0  Knowing FT = 700 N, FRH = 450 N and FRV = 136 N |