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## Weight and Apparent Weight

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### Weight

- Weight is the near earth gravitational force.
- It is always directed straight down towards the Earth.
- Weight and mass are NOT the same thing.
- Weight varies with location (i.e., weight on the moon is different than weight on Earth)
- Mass is constant (i.e., mass on Earth is the same as mass on the moon)

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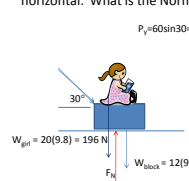
### Weight vs Normal Force

- A scale does not physically measure weight.
- It measures the Support /Normal force.
- The Normal Force is a force directed upward perpendicular to the surface.
  - A horizontal surface means a vertical Normal force and equal to the sum of the downward forces.
  - An incline surface means the Normal force is perpendicular to that surface and is equal to the sum of all the forces or components of forces directed opposite but still perpendicular to the surface.

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### Horizontal Force Problems

- A 12 kg block is pushed along a floor at a constant speed. A 20 kg girl is sitting on top of the block as it is being pulled. A force of 60 N is applied at an angle of 30 degrees below the horizontal. What is the Normal force on the block?



$P_y = 60 \sin 30 = 30 \text{ N}$

$$\Sigma F_y = F_N - (P_y + W_{\text{block}} + W_{\text{girl}}) = 0$$

$$F_N - (30 + 117.6 + 196) = 0$$

$$F_N - 343.6 = 0$$

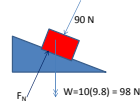
$$F_N = 343.6 \text{ N}$$

$W_{\text{girl}} = 20(9.8) = 196 \text{ N}$   
 $W_{\text{block}} = 12(9.8) = 117.6 \text{ N}$

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### Normal Force on an Incline

- What is the Normal force when a 10 kg block is held on a 30 degree incline by a force of 90 N perpendicular to the incline?



$F = W \cos \theta = 98 \cos 30 = 84.9 \text{ N}$

$$\Sigma F_{\text{perpendicular}} = F_N - (F + 90) = 0$$

$$F_N - (84.9 + 90) = 0$$

$$F_N - 174.9 = 0$$

$$F_N = 174.9 \text{ N}$$

$W = 10(9.8) = 98 \text{ N}$

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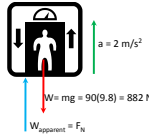
### Apparent Weight

- Once an object starts accelerating, the apparent weight is no longer equal to the actual weight.
- You must take into account the physical acceleration of the object.
- When an object accelerates up, its apparent weight increases.
- When an object accelerates down, its apparent weight decreases.

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### Upward Accelerating Object

- A 90 kg man standing in an elevator accelerates upwards at  $2 \text{ m/s}^2$ . What is his apparent weight?



$$\begin{aligned}\Sigma F_y &= F_n - W = ma \\ F_n &= 882 + 90(2) \\ F_n &= 882 + 180 \\ F_n &= 1062 \text{ N}\end{aligned}$$