

The Abnormal Normal Force

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9:47 AM

Normally $F_n = mg \cos \theta$

BUT not when additional vertical forces exist.

The diagrams show a block of mass m on an inclined plane at angle θ . In the first diagram, only gravity F_g acts. In the second, an applied force F_{applied} acts up the incline. In the third, F_{applied} acts down the incline. The calculations show how the normal force F_n changes due to the vertical component of the applied force.

Diagram 1: Normal force with only gravity

$$F_n = mg \cos \theta$$

Diagram 2: Normal force with applied force up the incline

$$F_n = F_g \cos \theta + F_{\text{component vertical}}$$

Diagram 3: Normal force with applied force down the incline

$$F_n = mg \cos \theta - F_{\text{vertical comp.}}$$

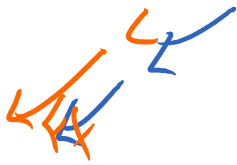
Example Calculations:

For $m = 8.0 \text{ kg}$, $\theta = 30^\circ$, $F_{\text{app}} = 50 \text{ N}$:

- $F_g = 78.4 \text{ N}$
- $F_{\text{up}} = F_{\text{down}} = 34.1 \text{ N}$ (from $F_g \sin \theta$)
- Case 2 (Applied force up):** $F_n = 78.4 + 25 = 103.4 \text{ N}$
- Case 3 (Applied force down):** $F_n = 78.4 - 25 = 53.4 \text{ N}$
- Friction force:** $F_f = \mu F_n$
 - For $F_n = 103.4$, $F_f = 33.9 \text{ N}$
 - For $F_n = 53.4$, $F_f = 17.6 \text{ N}$
- Net force and acceleration:**
 - Case 2: $F_{\text{net}} = 43.4 - 34.1 = 9.3 \text{ N}$, $a = \frac{9.3}{8} = 1.15 \text{ m/s}^2$ right
 - Case 3: $F_{\text{net}} = 43.4 - 17.6 = 25.7 \text{ N}$, $a = \frac{25.7}{8} = 3.2 \text{ m/s}^2$ right

Handwritten notes:

- $F_n = F_g \pm F_{\text{vert comp}}$
- $F_{\text{up}} = F_{\text{down}}$
- $F_{\text{net}} = W - L$
- $\mu = 0.33$
- $a = \frac{F_{\text{net}}}{m}$
- 3 of you
- $F_n = ?$



$$V_f^2 = V_0^2 + 2ad$$

$$0 = 7.5^2 + 2(-)d$$

$$F_{net} = F_{down} + F_f$$

$$\cancel{ma} = \cancel{mg \sin \theta} + \cancel{\mu mg \cos \theta}$$

$$2ad = 7.5^2$$