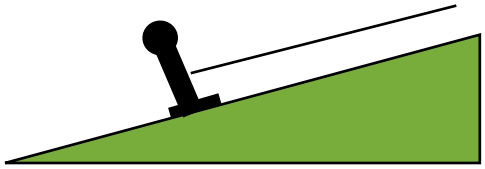
Pulling a skier up a slope

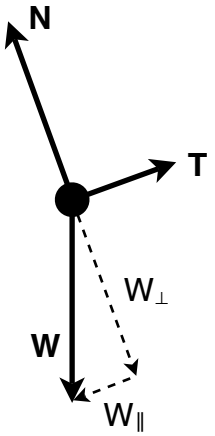
A 50 kg skier is pulled up a frictionless ski slope that makes an angle of 8° with the horizontal, by holding onto a ski rope that moves parallel to the slope. Determine the magnitude of the force of the rope on the skier at an instant when:

a) the rope is moving with constant speed of 2.0 ms^{-1}, and

b) the rope is moving with a speed of 2.0 ms^{-1}, but that speed is increasing at a rate of 0.10 ms^{-2}.



Solution: The free-body diagram for the skier is



Resolve into components perpendicular and parallel to the slope:

perpendicular to slope $W_\perp = W \cos 8° = 50 \times 9.8 \times \cos 8° = 485$ N

parallel to slope $W_\parallel = W \sin \theta = 50 \times 9.8 \times \sin 8° = 68$ N

No net force perpendicular to the slope, so

$N - W_\perp = 0$

so $N = W_\perp = 485$ N

(a) Constant velocity means no net force parallel to slope

so $T - W_\parallel = 0$

Hence $T = W_\parallel = 68$ N

(b) If rope is accelerating, then

$F_{net} = T - W_\parallel = ma = 50 \times 0.1 = 5$N

so $T = W_\parallel + 5$ N = 73 N