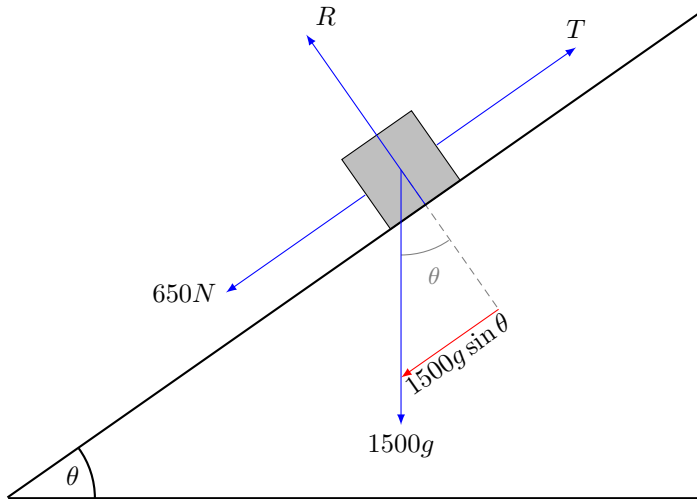


Dynamics

Dynamics Example - $F=ma$ on a slope

A car of mass 1500 kg is moving up a straight road, which is inclined at an angle θ to the horizontal, where $\sin \theta = \frac{1}{14}$. The resistance to the motion of the car from non-gravitational forces is constant and is modelled as a single constant force of magnitude 650 N . The car's engine is working at a rate of 30 kW . Find the acceleration of the car at the instant when its speed is 15 ms^{-1} .

Draw a diagram to represent the question



Apply Newton's Second Law ($F=ma$)

$$T - 650 - 1500g \sin \theta = 1500a$$

Use $\text{Power} = \text{Force} \times \text{Velocity}$

$$30,000 = T \times 15$$

$$T = \frac{30,000}{15} = 2000$$

Solve, substituting power result into Newton's Second Law result

$$2000 - 650 - 1500 \times 9.8 \times \frac{1}{14} = 1500a$$

$$a = \frac{2000 - 650 - 1500 \times 9.8 \times \frac{1}{14}}{1500} = 0.2$$