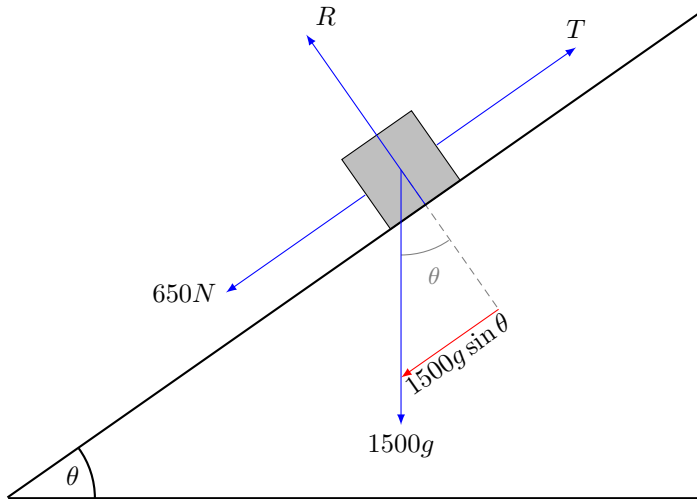


# Dynamics

## Dynamics Example - $F=ma$ on a slope

A car of mass  $1500 \text{ kg}$  is moving up a straight road, which is inclined at an angle  $\theta$  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  $650 \text{ N}$ . The car's engine is working at a rate of  $30 \text{ kW}$ . Find the acceleration of the car at the instant when its speed is  $15 \text{ ms}^{-1}$ .

**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**

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

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