# Mechanics

## Contents

# Constant Acceleration

## *Formulae*

Constant acceleration (like free-fall under gravity) can be modelled using *suvat*. $s$ is displacement, $u$ is initial velocity, $v$ is final velocity, $a$ is acceleration, and $t$ is time taken. You almost always have one of these variables missing or not relevant, so use the equation that doesn't include that variable to find the one that you do care about.

**Formula Book**

$$s \implies v = u + at$$
$$u \implies s = vt - \frac{1}{2}at^2$$
$$v \implies s = ut + \frac{1}{2}at^2$$
$$a \implies s = \frac{1}{2}(u + v)t$$
$$t \implies v^2 = u^2 + 2as$$

**Remember**

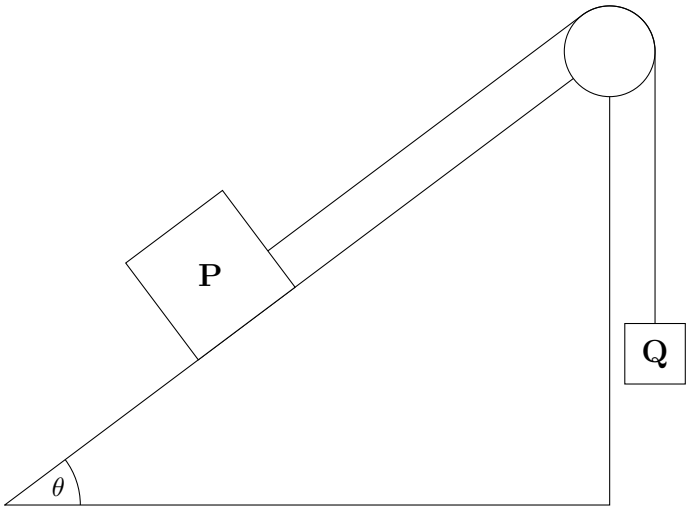
If a question doesn't specify the value of $g$, use 9.8 $\text{ms}^{-1}$

# Forces

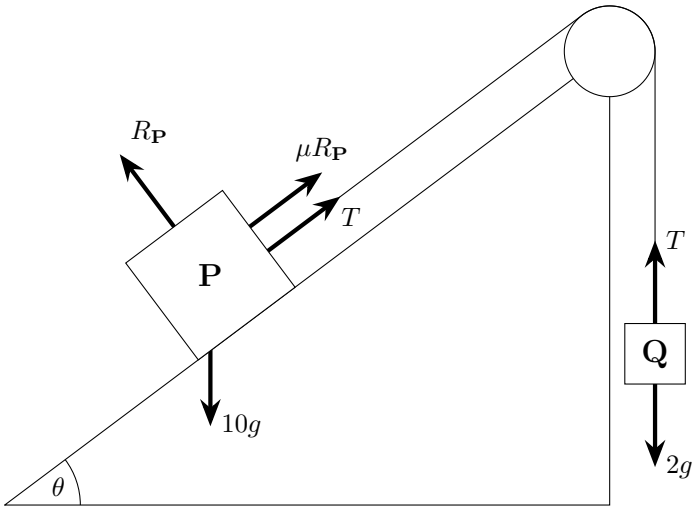
## *Tackling a question*

When tackling a question, start by saying '**R**ight, **W**hat **A**re **T**he **F**orces?' This stands for **R**eaction forces, **W**eight, **A**cceleration, **T**ension, and **F**riction.

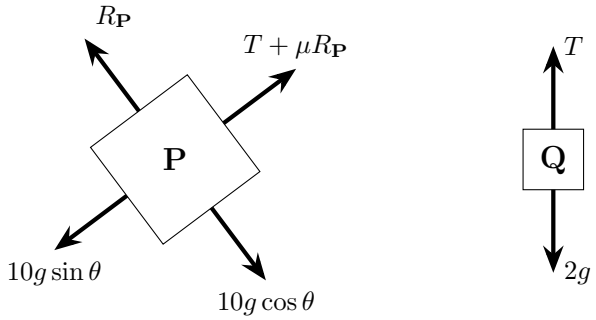
Then label all these things on a large, clear diagram. Imagine a situation like the following, where we have a block **P** of mass 10 kg on an inclined plane at angle $\theta$ where $\tan\theta = \frac{3}{4}$, with coefficient of friction $\mu$, attached via a pulley to a block **Q** of mass 2 kg. The block **P** is on the point of slipping down the slope. Find $\mu$.



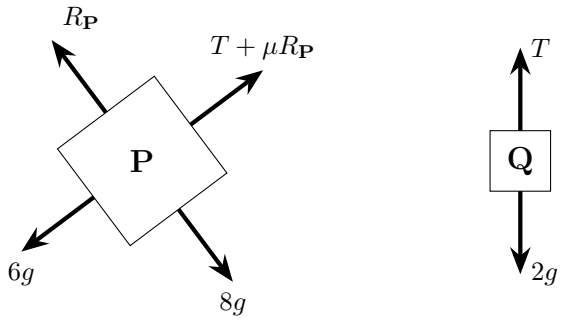

We can label this diagram with force arrows and other information using the mnemonic from above.




We can then convert this diagram into free-body diagrams for **P** and **Q** and resolve the forces on **P** parallel and perpendicular to the plane.




We know that $\tan\theta = \frac{3}{4}$, so we can find $\sin\theta$ and $\cos\theta$. We also know that both blocks are at rest:




Thus, we get the following set of the equations:

$$R_{\mathbf{P}} = 8g \tag{1}$$
$$6g = T + 8g\mu \tag{2}$$
$$T = 2g \tag{3}$$

From which we can easily derive $6g = g(2 + 8\mu) \implies 4 = 8\mu$ and find that $\mu = \frac{1}{2}$.