Monday, 20 July 2026

Connect

Title
SI Units – Energy equations

Today's Targets

Identify equations for energy

Select which equations from a given list would be used for a specified engineering product or project

Connect:

Hydraulics	**Kilo** - wei **Metre** - m lifting dist in machin
Gears	**Metre** - s
Pulleys	**Kilo** - wei **Metre** - le

Aircraft	**Ampere** - the workings of all elect **Metre** - aircraft sizes, stopping and runways **Kilo** - ensure the craft will fly and **Second** - journey times
Space vehicles	**Ampere** - when calculating the wo parts **Metre** - vehicle sizes, planning orb **Kilo** - vehicle sizes for transportati **Second** - to calculate battery life
Missiles	**Metre** - missile sizes and distances **Kilo** - weight to thrust ratios **Second** - time from launch to impa

Pharmaceuticals	**Mole** - production of medicines **Kilo** - body mass to substance ratios **Time** - reaction times of substances
Fossil Fuels	**Kilo** - weights in refining **Kelvin** - temperatures in mining and refining **Mole** - chemical processing, testing and sampling
Food & Drinks	**Mole** - use of chemicals in production **Kilo** - nutritional information and breakdown, weights and ratios for food combinations **Time** - life span, reaction time to degradation

NCFE Level 1 / 2 Technical Award in Engineering

CA2 - Applied science and mathematics in engineering

2.2.1 SI Units of Measurement - equations
Energy
Lesson 3

Monday, 20 July 2026

Today's title: SI units – energy equations

Today's Targets

Identify equations for forces & motion

Select which equations from a given list would be used

Today's Learning:

You must be able to:

Define power, work done, and efficiency.

Recall the formula for power, work done, and efficiency.

Identify and apply the correct equation for engineering problems.

You may also be able to:

Discuss whether an electric appliance is efficient.

Prior Learning

CA1 Engineering disciplines

Future Learning

CA3

Reading engineering drawings

Literacy

International System (SI) Equation

Energy Efficiency Power Work done

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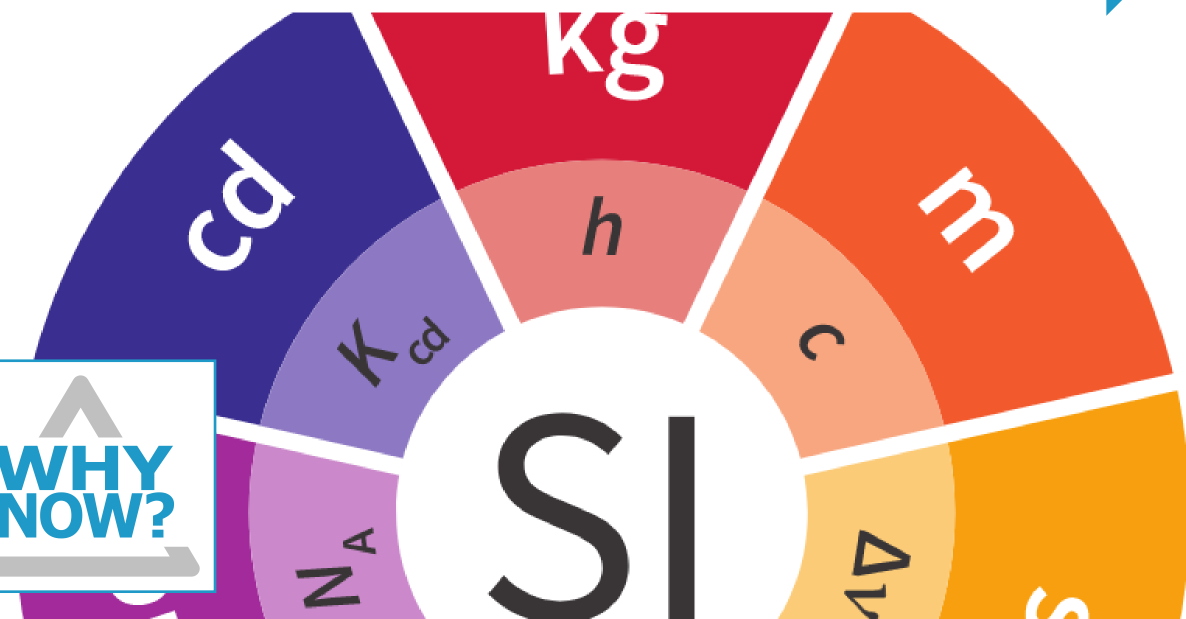
Today's title: 2.2: Engineering equations 1

Your target	Steps to success	Path to progress
• Identify equations for energy • Select which equations from a given list would be used for a specified engineering product or project	• Apply data to a selected equation to complete a calculation for a specified engineering product or project	• Justify the selection of the equation • Assess whether the correct calculation has been used

Key terms

International System (SI)
Equation
Energy

WHY NOW?



Activate

Introduction

It is important to understand how mathematical and scientific equations are used in engineering disciplines to calculate the properties of:

- Energy

In the development of products and projects.

The equations provided are not exhaustive, however, they are the ones most relevant to this level of study.

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Energy

Energy is the ability to do work and comes in different forms

- Heat (thermal)
- Light (radiant)
- Motion (kinetic)
- Electrical
- Chemical
- Nuclear energy
- Gravitational

We are specifically interested in the equations we use to calculate these different forms of energy.

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Energy: Efficiency

efficiency (%)
= (useful energy out ÷ total energy in) x 100%

Efficiency is a measure of how much work or energy is conserved in a process. In many processes, work or energy is lost, for example as waste heat or vibration.

There are many different way we calculate energy efficiency in engineering. **Consider electrical appliances** such as ovens, dishwashers, dryers and fridges all have to carry an Energy Label which indicates how efficient (or inefficient) they are. Appliances are graded from A to G on their efficiency, with A being the most efficient and G being the least.

Efficiency calculations are also used to demonstrate the fuel consumption and CO_2 data in **automotive engineering** for cars and motorcycles.

$$Efficiency\ \% = \frac{\text{Useful energy out}}{\text{Energy in}} \times 100$$

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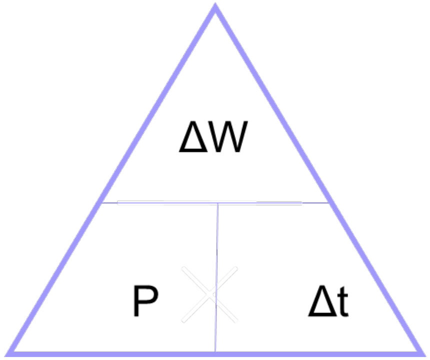
Energy: Power

power = energy (or work done) ÷ time
p = e ÷ t

Power is a measure of how quickly work is being done. The more energy that is transferred in a certain time, the greater the power.

One easy way to think about this equation in use is to consider the **performance of cars**. The Ferrari F12 Berlinetta can do work (energy) quicker, travelling faster over the same distance than a Vauxhall Corsa. Travelling from A to B the Ferrari is higher performance and do more work over a shorted period of time than the Corsa, as the Ferrari has more power.



$$\text{Power} = \frac{\text{Work done}}{\text{Time}}$$

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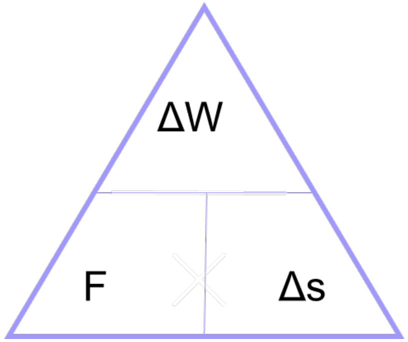
Energy: Work done (in joules)

work done = force x distance
w = f x d

Whenever 'work' is done energy is transferred, so whenever a force moves something from one place to another. The amount of work done is dependent upon the size of the force on the object and the distance the object is being moved.

Think of a simple one **wheel pulley system**. To calculate the work done we would multiply the force of the object by the distance we need it to move.



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Equations for properties

energy:

- efficiency efficiency (%) = (useful energy out ÷ total energy in) x 100
- power $P = E \div t$ power = energy ÷ time
- work done $W = F \times d$ work done = force x distance

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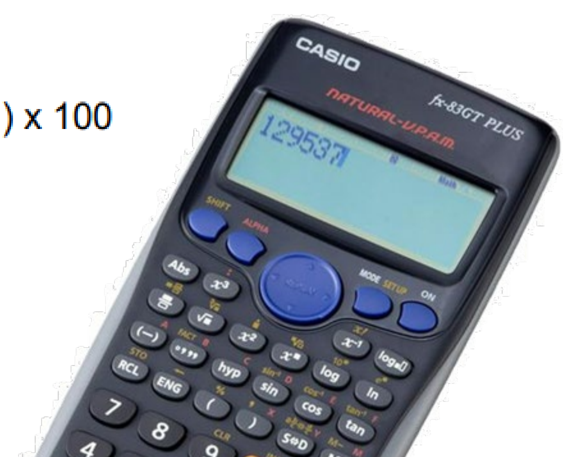
Time to be efficient

In your pairs, can you solve the following problems:

1. 5000J of electrical energy are put into a motor. The motor converts this into 100J of movement energy. How **efficient** is it?
2. A laptop can convert 400W of electrical power into 240W of light and sound power. What is its **efficiency**? Where does the rest of the energy go?

energy:

○ efficiency	efficiency (%) = (useful energy out ÷ total energy in) x 100	
○ power	P = E ÷ t	power = energy ÷ time
○ work done	W = F x d	work done = force x distance



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Activate

Time to be efficient - *answers*

In your pairs, can you solve the following problems:

1. 100/5000x100 = **2%** efficient
2. 240/400x100 = **60%** efficient
   The rest of the energy is lost.

energy:

- efficiency — efficiency (%) = (useful energy out ÷ total energy in) x 100
- power — P = E ÷ t — power = energy ÷ time
- work done — W = F x d — work done = force x distance

Demonstrate

1. A client wants to know the **efficiency** of their conveyor belt system.
Calculate the efficiency of the conveyor belt system using the following data:
Total energy consumption = 50 watts/hour
Useful energy out = 42.5 watts/hour
Show your working. [2 marks]

2. A train uses 100 000 joules of energy to move in one hour.
Calculate the average **power** used by the train in one second.
Show your working. [2 marks]

3. Engineers are testing a motorcycle. It produces 372 W of usable power for every 400 W of input during the charging process. Calculate the motorcycle's **efficiency**.

Show your working. [2 marks]

4. The motorcycle and rider require a force of 350 N to move.
Calculate the **work done** to move them 0.6km

Show your working. [2 marks]

25 minutes!

*A buffing machine uses 230 volts and the current is 11 amps. Calculate the **power** of the buffing machine.*
Show your working. [2 marks]

- efficiency — efficiency (%) = (useful energy out ÷ total energy in) x 100
- power — P = E ÷ t — power = energy ÷ time
- work done — W = F x d — work done = force x distance

Monday, 20 July 2026

Consolidate

Progress check

Complete this short quiz:

1. Joules are used to measure:
- Work done
- Power
- Energy

2. Power is measured in
- Joules
- Amperes
- Watts

3. True or false? The formula for calculating efficiency is Efficiency = (useful energy in / energy out) x 100.

Consolidate

Can you now?

- Define power, work done, and efficiency?
- Recall the formula for power, work done, and efficiency?
- Identify and apply the correct equation for engineering problems?
- Discuss whether an electric appliance is efficient?

Next lesson…

We will learn about…

…how science and mathematics is applied in engineering and the equations which are used to describe and calculate forces and motion.