

"Exercise 2.2-1": Quizzes to [Li Ion Battery](#)

Illustration

Quiz 1: How much energy is contained in **1 liter** of gasoline?
Find out approximately by using data you know about your car.

- Consider what you know about your car or some average car: Mileage (let's say **10 km/l**), how far you get on this (**500 km**), engine power (**100 kW**), engine efficiency (??? - think) how long it takes you to go the **500 km** and how much percent of the engine power you use for this on average (you are not always going full throttle!).
- Energy, by the way, is power times time.

Quiz 2: How large or small are **10 kWh /l** - in comparison to known energy (densities).

- How far up do you have to drag your body to gain **10 kWh**? Potential energy, by the way, is $E_{\text{pot}} = mgh$.
- You store energy by pulling up a ball of lead in your (now unused) chimney (diameter = **20 cm**). How far up do you have to pull it to store the **10 kWh**? (Specific density of lead = **11,4 g/cm³**).
- How much water can you bring from **10 °C** to a boil? The specific heat capacity of water is **4.2 kJ/kgK**. A Joule **J**, as we know, is equal to **1 Nm** or **1 Ws**.
- Your power output on a bicycle for some length of time is **??? kW**. Mine is at best \approx **100 W**. How far and / or how long do you have to ride your bike before you used up **10 kWh**? How many Big Mac's have you worked off then (a Big Mac of about **120 g** contains **2071,74 kJ = 494,94 kcal**).
- How much energy do you convert into heat if you wrap your car around a tree at **100 km/h**. In other words: $\frac{1}{2}mv^2 = \text{??? kWh}$ (without the gasoline burning). Your car weighs about **1 500 kg** + passengers.
- How fast do you need to hit the tree so that the kinetic energy contained in **50 l \approx 50 kg** of gasoline equal the kinetic energy?

Quiz 3: This and That

- Why do you have plenty of room in an electric car for the battery?
- Why do you want your batteries not to be extremely light weight in a submarine?
- Why is the current collector in a powerful battery not to be sneered at? Hint: Your electric car has a **100 kW** motor; a battery cell has a voltage of about **3 V**.
- You want to be able to run your **100 kW** electric motor car for **5 hours** at half the capacity? What is the required battery size? How long does it take you to recharge that battery from your standard outlet (**230 V AC; 16 A**)?
- Take a **1 kWh Li ion** battery with a voltage of **3V**. How much charge **Q** must be stored in it when it is fully loaded?
- How much **Li** atoms would that be? What is their weight? Compare to the [energy density figure](#) and discuss.

Quiz 4:

- --- To be written ---

Solutions are found in the [Li Ion Battery](#) module