

# Comparison of Energy Stored in 6x1.5V AA-Batteries and a 9V Battery



# Power versus Energy – Are they the same?

Energy and power are closely related but are **not** the same physical quantity.



Energy is the ability to cause change;

Power is the rate energy is used.

Lifting a box requires a specific amount of **energy**, no matter how quickly the box is picked up.

Lifting faster will change the amount of **power** but not the amount of energy.

# What is electrical power?

Electrical power is the rate at which electrical energy is converted to another form, such as motion, light, heat etc.

The common symbol for power is the uppercase letter **P**.

The standard unit is the watt, symbolized by **W**.

Practical units: **mW, kW, MW, GW, TW**



# What is electrical energy?

Electrical energy is the energy derived from electric potential energy (e.g. battery) or kinetic energy (e.g. electric generator) of the charged particles.

The common symbol for energy is the uppercase letter E.

The standard unit is Joule (J) or watt-second (Ws)

Practical units: kWh, MWh, GWh, TWh



# What is Battery Ampere-Hour (Ah) ?

**An ampere hour (Ah), indicates the amount of current a battery can supply for exactly one hour.**

$$\text{Amp hour (Ah)} = \text{Current (I)} \times \text{Discharge time (T)}$$

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$$\text{Discharge time (T)} = \frac{\text{Amp hour (Ah)}}{\text{Current (I)}}$$

A laptop computer that draws 2A of DC current has a battery capacity of 4400 mAh.

Without an AC adapter, how many hours can you use the laptop before the fully-charged battery needs to be recharged?

$$\begin{aligned}\text{Discharge time (T)} &= \frac{\text{Amp hour (Ah)}}{\text{Current (I)}} \\ &= \frac{4400 \text{ mAh}}{2\text{A}} = 2.2 \text{ h} = \mathbf{2 \text{ h } 12 \text{ min}}\end{aligned}$$



# Energizer Eveready Super Heavy Duty 1.5V AA Battery



## Specifications

Chemistry: Zinc Carbon

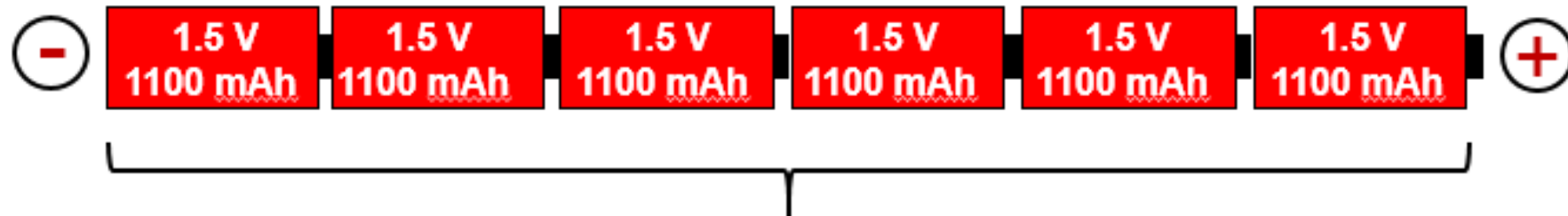
Diameter: 14.50 mm

Voltage: 1.5V

Height: 50.50 mm

Capacity: 1100 mAh

Weight: 23 grams



Equivalent to

**6 x 1.5 V = 9 V**  
**1100 mAh**

Energy stored in the battery  
 $= 9 \text{ V} \times 1100 \times 10^{-3} \times 3600 \text{ As}$   
 $= 35\,640 \text{ Joules}$



# Energizer Eveready Super Heavy Duty 9V Battery

## Specifications

**Chemistry:** Zinc-Manganese Dioxide ( $\text{Zn/MnO}_2$ )    **Voltage:** 9V

**Capacity:** 400 mAh    **Volume:** 20.3 cm<sup>3</sup>    **Weight:** 45.6 grams



Energy stored in the battery  
 $= 9 \text{ V} \times 400 \times 10^{-3} \times 3600 \text{ As}$   
 $= 12\,960 \text{ Joules}$

**Total energy stored in 6 nos.  
of 1.5V AA battery = 35 640 Joules**



**Total capacity = 1 100mAh**

**Energy stored in a 9V  
battery = 12 960 Joules**

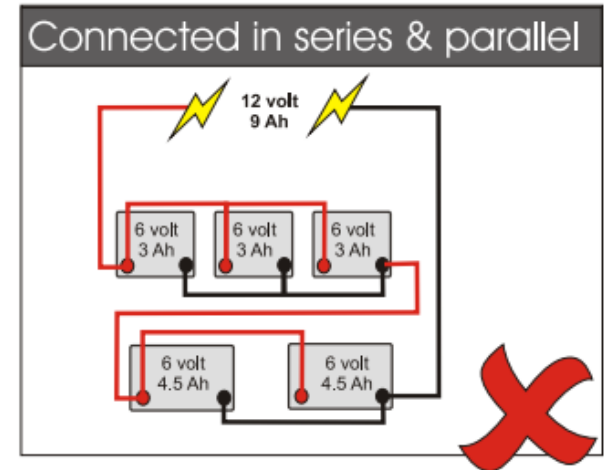
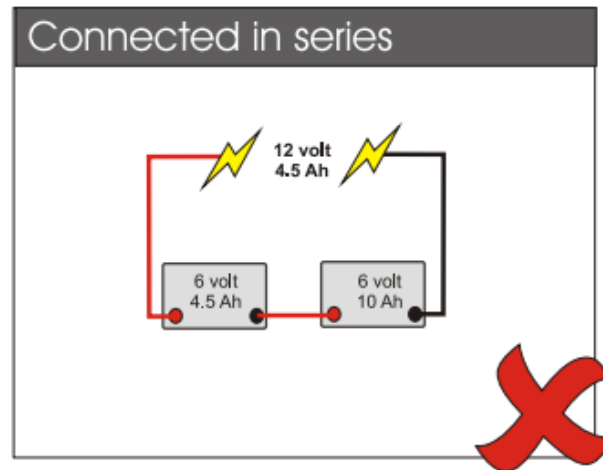
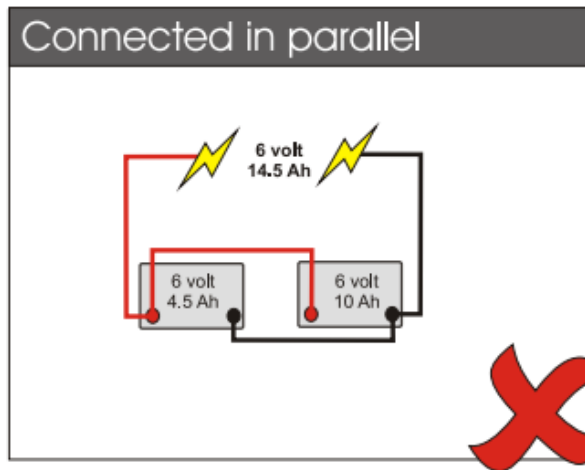
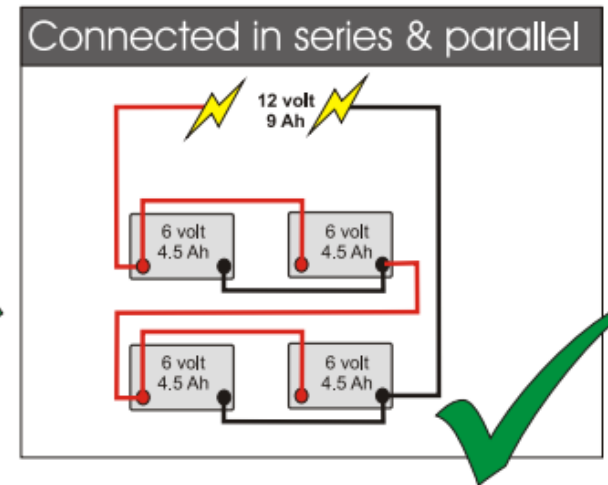
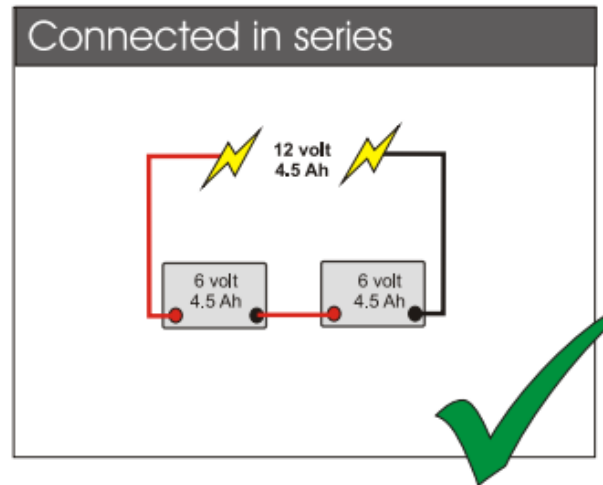
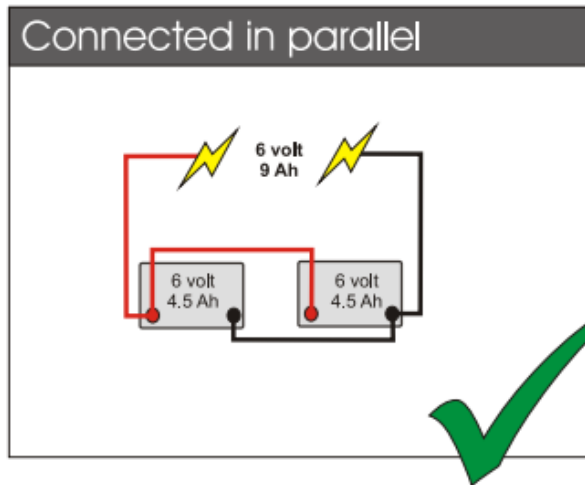


**Total capacity = 400 mAh**

$$35\,640\text{ J} / 12\,960\text{ J} = \mathbf{2.75}$$

$$1\,100\text{ mAh} / 400\text{ mAh} = \mathbf{2.75}$$

# Building A Battery Bank



**Layouts marked with a red cross may work but will shorten the individual battery life**

*Thank You*