

Q1 Journey of Automotive

1672 - Invention of the first steam-powered vehicle

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1769 - Steam-powered automobile capable of human transportation

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1826 - Samuel Brown tested first industrially applied IC engine

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1826 - Thomas Parker invented first EV

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1886 - large scale production of EV

1840 - Morrison Carriage (8 people carriage vehicle) was invented by William Morrison

1906 - Advanced EV

1910 - EV started declining due to several reasons like
→ ~~Ass~~invention of Assembly line production
→ World war, Oil lobby

1967 - California Air Resource Board Established (CARB)

1991 - LEV 1 (Low-Emission Vehicle program) regulations by CARB to control pollution, requiring automobile manufacturers to introduce progressively cleaner light- and medium-duty vehicles with more durable emission controls from 1994 to 2003.

2003 - LEV 2 - introduced 0 LEV - 10-15% less emission

② ULEV - 70-80% less emission

③ PZEV - 0% emission

2006 - Tesla Roadster introduced

2010 - First affordable EV, Nissan Leaf launched.

a) Invention of Electric Motor

The first commutator DC electric motor capable of turning machinery was invented by British scientist William Sturgeon in 1832.

b) Golden Era of EV

Early 1900s was known as the golden era of EVs. During golden age of EV, they made up more than $\frac{1}{3}$ rd of the car sales in US.

c) Domination of EV by Gasoline Cars

Gasoline cars started dominating after the invention of Assembly line production of IC engines which helps to decrease the price of engines in turn reduce in the overall price of the gasoline vehicles. And the self-starting mechanism of IC engine (1912) also boosted this.

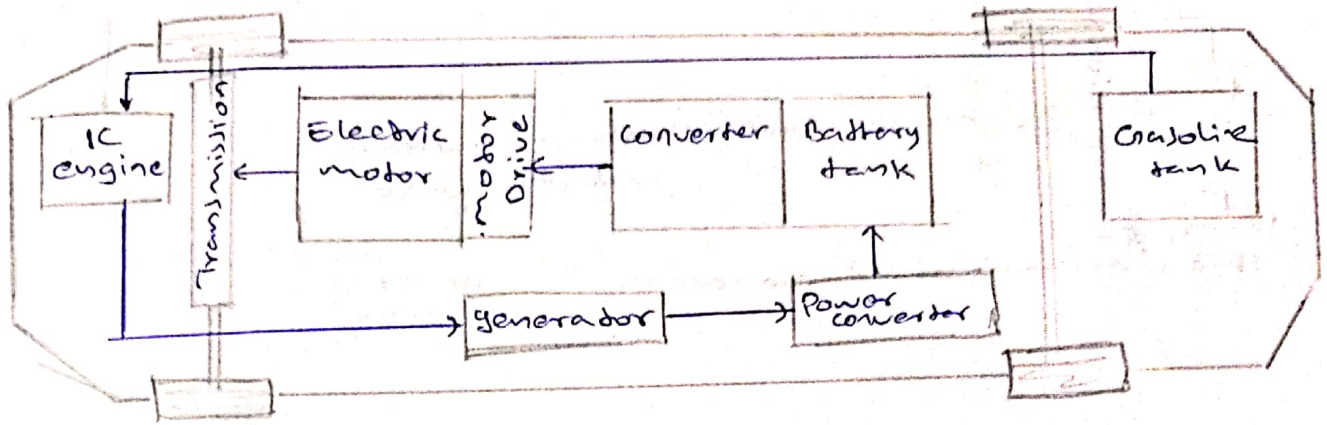
d) Coming of New Era in EV

New era of EV was started with CARB. CARB adopted LEV1 and LEV2 programs, which enhanced the EV production.

e) Introduction to Hybrid Vehicles

Introduction of hybrid vehicles started a new era in the vehicle market. These are more efficient than other vehicles.

② series Hybrid vehicle



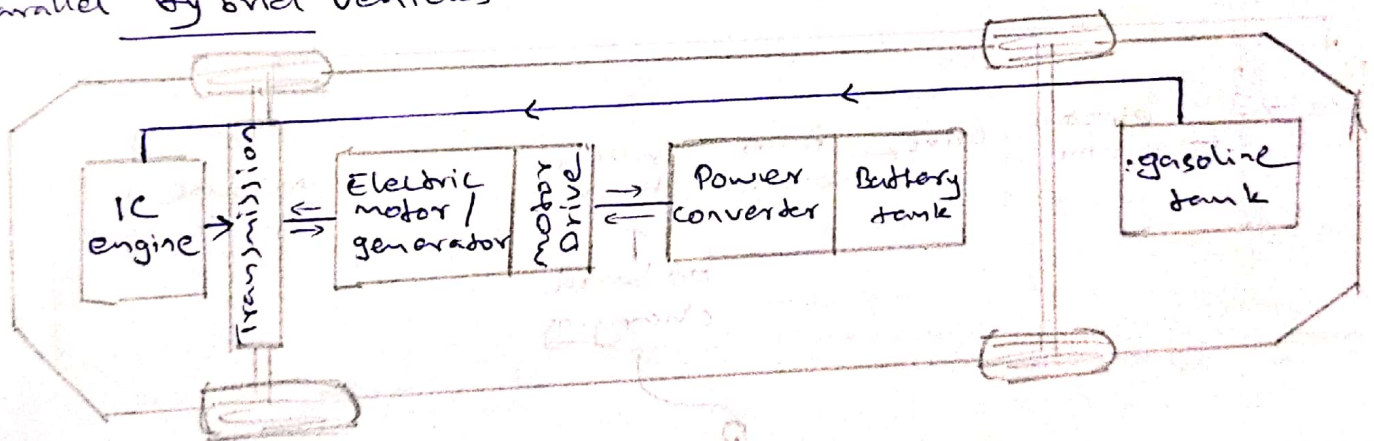
Advantages

- smaller and efficient engine
- reduced harmful gas emission

Disadvantages

- require 3 machines with similar power ratings
- no. of energy conversions results in loss.

③ Parallel Hybrid Vehicles



Advantages

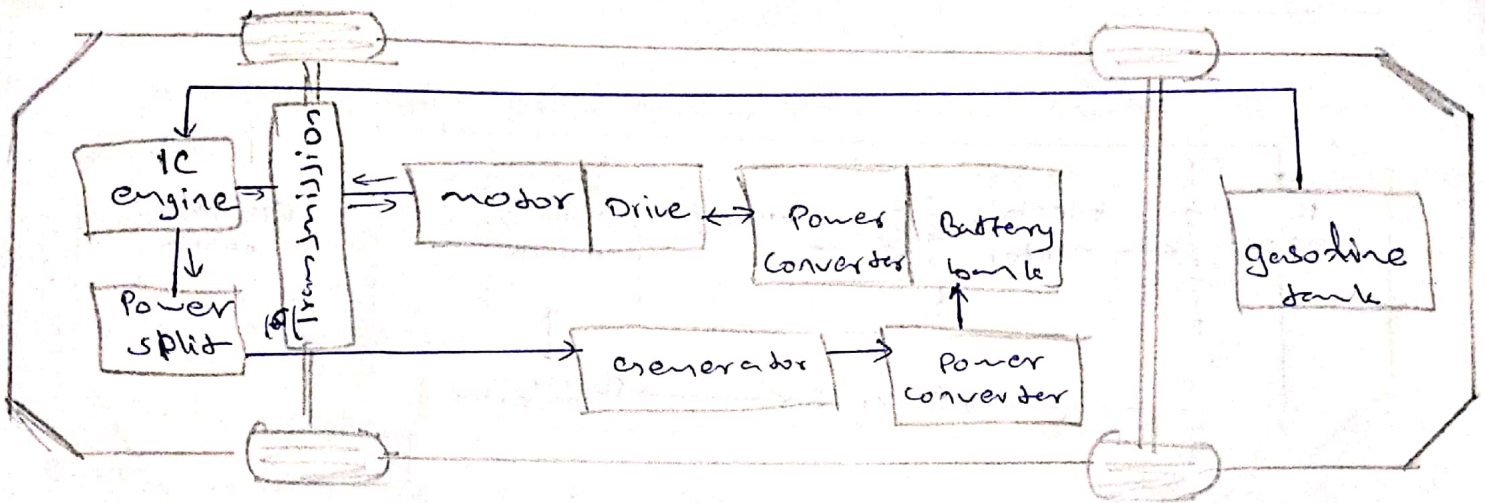
- use smaller battery pack
- relying on regenerative braking to recharge battery
- engine noise less

Disadvantages

- high cost
- high weight

Eg: Honda Civic

① series-parallel Hybrid vehicle



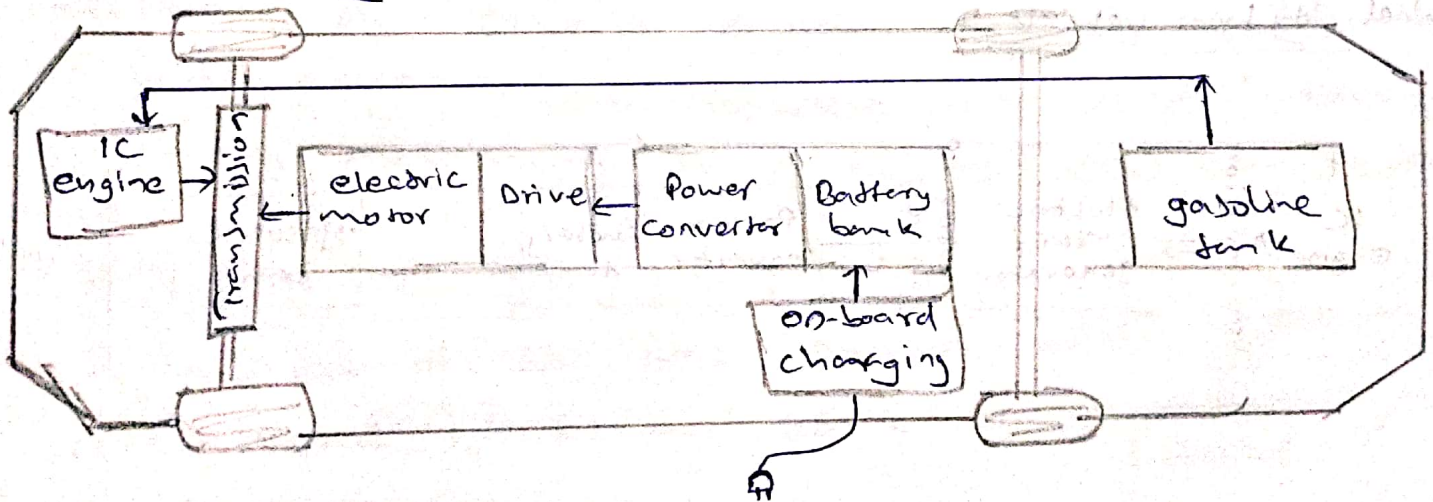
advantages

- high efficiency

Disadvantages

- larger battery, motor & generator
- high cost

② Plug in hybrid EV



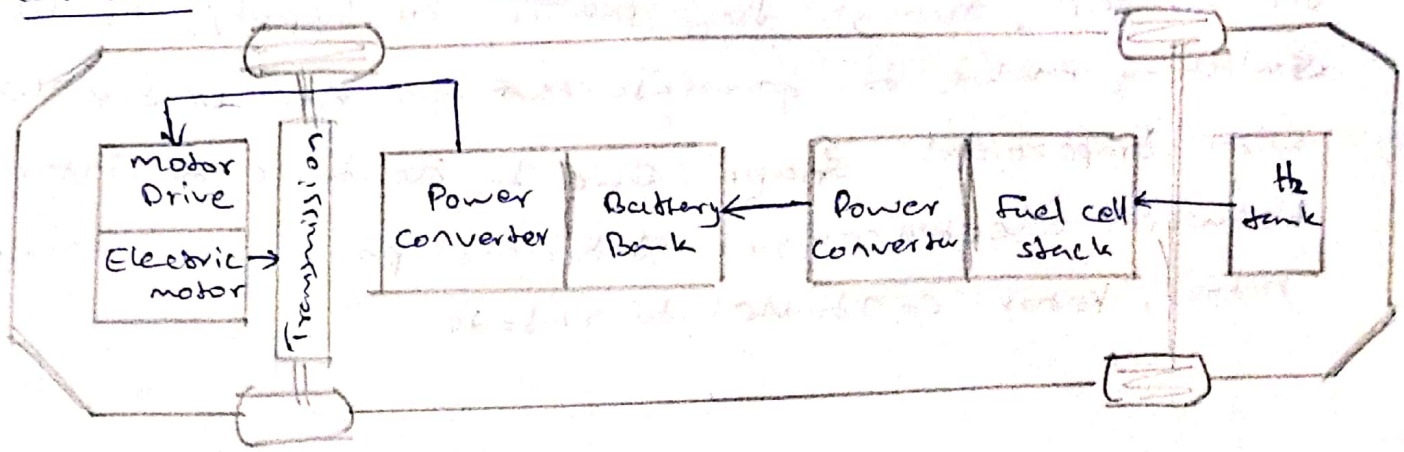
advantages

- less green house gas emission
- lower fuel cost

Disadvantages

- Recharging taking time
- higher vehicle cost

③ Fuel cell EV



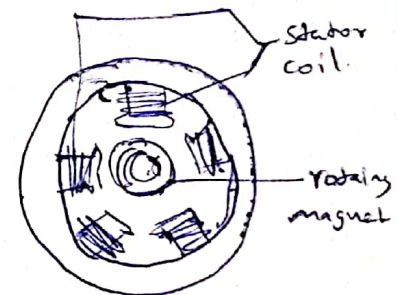
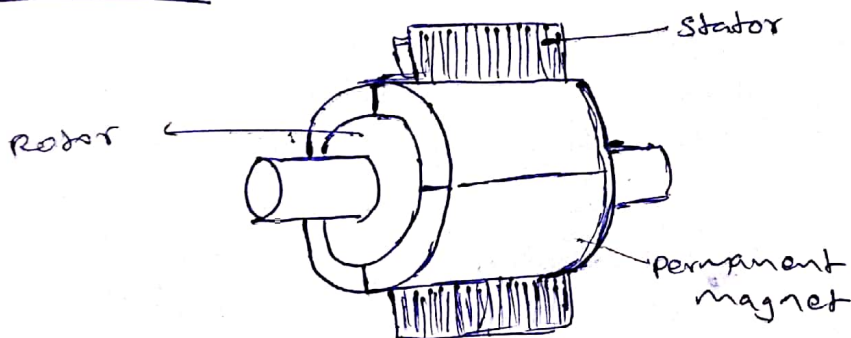
Advantages

- no harmful tailpipe emission
- highly efficient
- Renewable & Readily available fuel

Disadvantages

- Storage and transportation of hydrogen.
- Fuel cell efficiency

Q. BLDC motor



Construction & working principle

BLDC motor works on the principle similar to that of a Brushed DC motor. The Lorentz law, which states that whenever a current carrying conductor placed in a magnetic ~~the~~ field experiences a force, As a consequence, of reaction force, the magnet will experience an equal and opposite force. In BLDC, current carrying conductor is stationary & permanent magnet is moving.

When stator coils get supply from source, it becomes electromagnet and starts producing the uniform field in

The air gap. Though the source of supply is DC, switching makes to generate ~~and~~ an AC voltage waveform with trapezoidal shape. Due to the force of interaction between electromagnet stator and permanent magnet rotor, rotor continues to rotate.