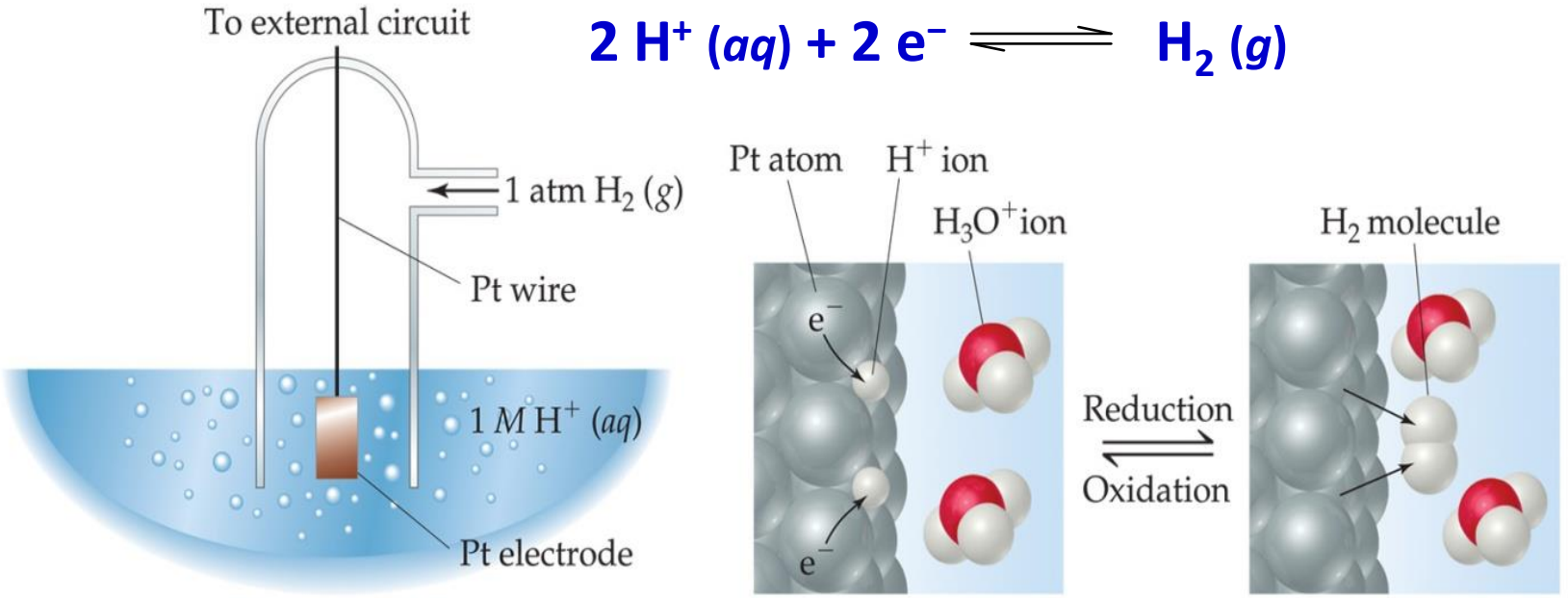
STANDARD HYDROGEN ELECTRODE

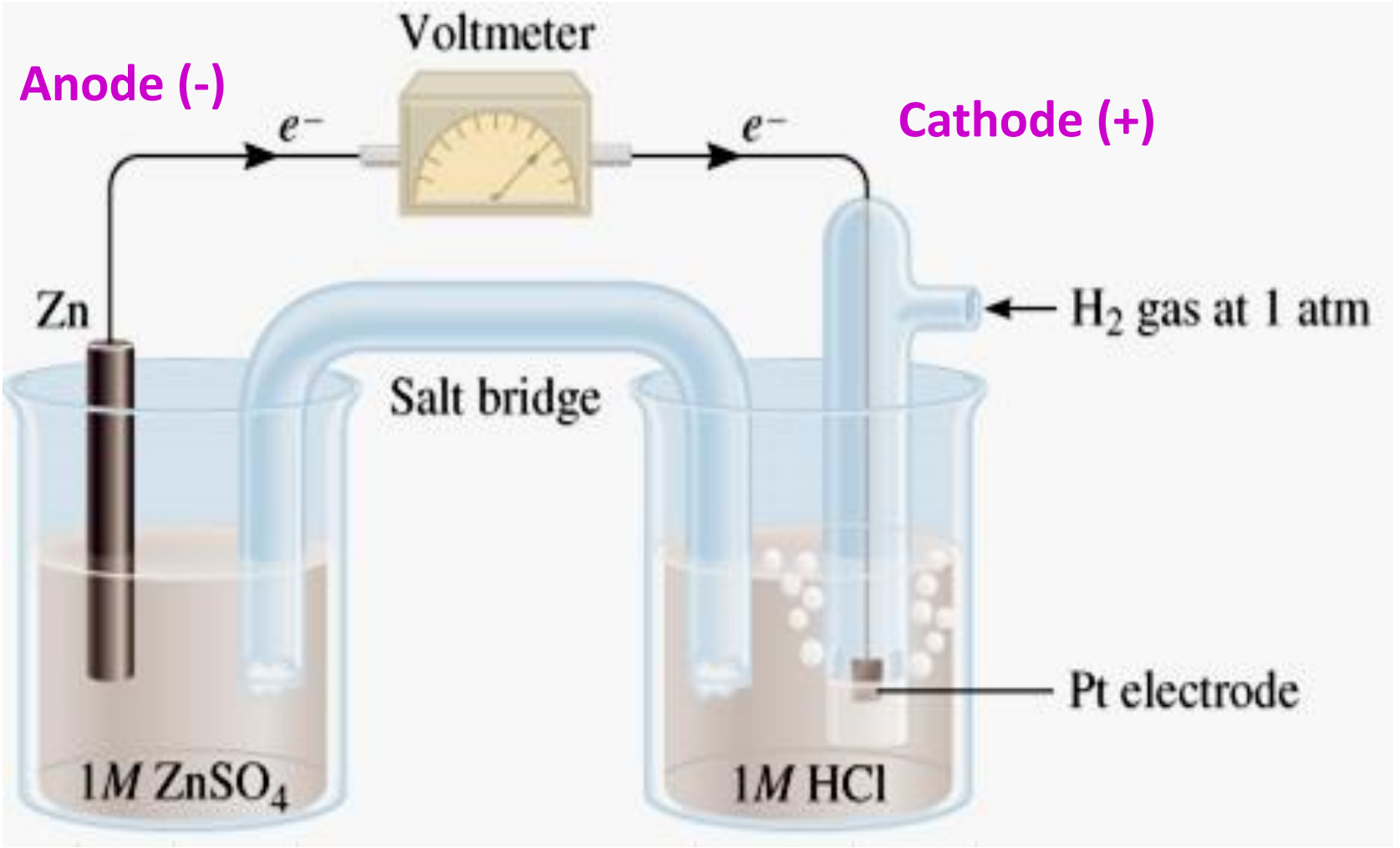
A **standard hydrogen electrode (*SHE*)** consists of a **platinised platinum electrode** immersed in a solution of **1 mol dm^{-3} H$^+$ ions.** **Hydrogen gas** at a **pressure of 1 atm and 25 °C** is bubbled over the platinum electrode.



The platinum electrode has a large surface area so that it can establish an **equilibrium between H_2(g) and H^+ (aq)** as rapidly as possible.

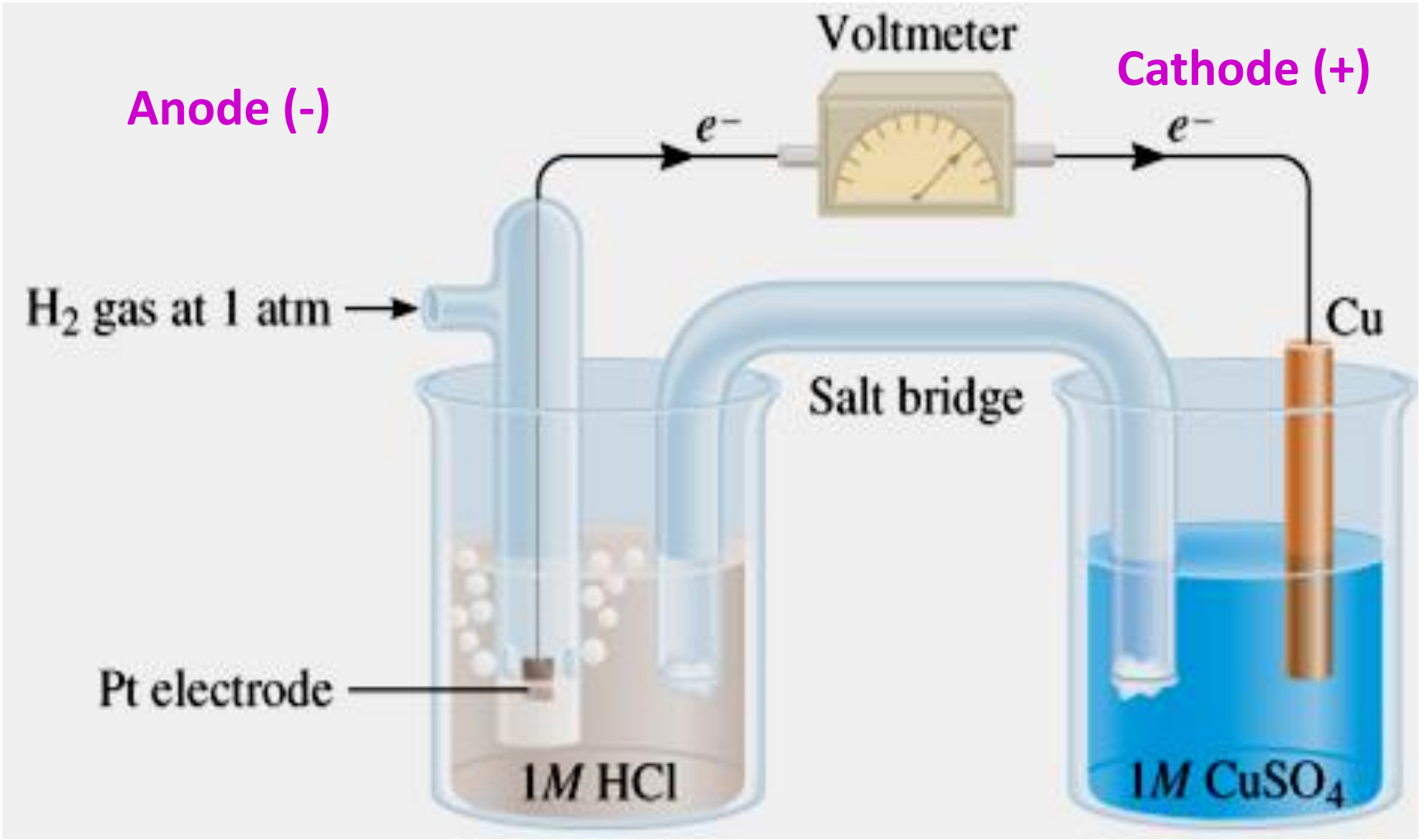
- **Standard reduction potential (or standard electrode potential)** is the voltage associated with a **reduction reaction** at an electrode when all solutions are 1 M and all gases are at 1 atm.
- It is impossible to obtain the standard electrode potential of a single half cell because only differences in potentials are measureable.
- **Standard reduction potential** (S.R.P) values or E^{o}_{red} of half-cells are referenced to a Standard Hydrogen Electrode (SHE).
- **The standard reduction potential for hydrogen is 0 V:**
  $2H^{+}$ (*aq*, 1*M*) + 2 e^{-} $\longrightarrow$ H_2 (*g*, 1 atm)
- SHE acts as either cathode or anode when connected to other half-cells.

Determination of E^{o}_{red} of $Zn^{2+}(aq)/Zn(s)$ half-cell



$Zn^{2+}(aq)/Zn(s)$ half-cell is is anode and SHE is cathode.

Determination of E^o_{red} of $Cu^{2+}(aq)/Cu(s)$ half-cell



SHE is anode and $Cu^{2+}(aq)/Cu(s)$ half-cell is cathode.

E^{o}_{red} of $Cu^{2+}(aq)/Cu$ half-cell and $Zn^{2+}(aq)/Zn$ half-cell can be calculated by substituting the cell voltage (or standard cell potential) measured by the voltmeter into the following formula:

$$E^{o}_{cell} = E^{o}_{cathode} - E^{o}_{anode}$$

$$+ 0.76V = E^{o}_{H^+/H_2} - E^{o}_{Zn^{2+}/Zn}$$

$$+ 0.76V = 0.00\ V - E^{o}_{Zn^{2+}/Zn}$$

$$E^{o}_{Zn^{2+}/Zn} = - 0.76V$$

$$E^{o}_{cell} = E^{o}_{cathode} - E^{o}_{anode}$$

$$+ 0.34\ V = E^{o}_{Cu^{2+}/Cu} - E^{o}_{H^+/H_2}$$

$$+ 0.34\ V = E^{o}_{Cu^{2+}/Cu} - 0.00\ V$$

$$E^{o}_{Cu^{2+}/Cu} = + 0.34\ V$$

$E^{o}_{H^+/H_2} = 0.00\ V$

$E^{o}_{Zn^{2+}/Zn} = -0.76V$

$E^{o}_{Cu^{2+}/Cu} = +0.34\ V$

Standard reduction potential (S.R.P) or standard electrode potential

$2H^+(aq) + 2e^- \longrightarrow H_2(g)$ $E^o = 0.00\ V$

$Zn^{2+}(aq) + 2e^- \longrightarrow Zn(s)$ $E^o = -0.76\ V$

$Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$ $E^o = +0.34\ V$