PROPERTIES OF NERVE

- EXCITABILITY
- CONDUCTIVITY
- UNFATIGUABILITY
- REFRACTORY PERIOD
- ALL OR NONE RESPONSE
- ACCOMMODATION

(I)EXCITABILITY:

- The ability to respond to a stimulus.
- Two types of response:
- *Non propagated potential:*

  synaptic potential

  end plate potential

  receptor potential

  generator potential
- *Propagated potential:*

  Action potential /Nerve impulse

Graded potential	Action potential
Subthreshold stimulus	Threshold stimulus
Depolarisation/hyperpolarisation	Depolarisation
Conducted over short distance	conducted along the axon
Does not obey all or none phenomenon	obeys all or none phenomenon
Can be summated	Cannot be summated

- **FACTORS AFFECTING THE EXCITABILITY:**

(a)Strength and duration of the stimulus:
(Strength –duration curve)

(b)Temperature: α excitability

(c)Ions: Ca+2,Mg+ α 1/excitability

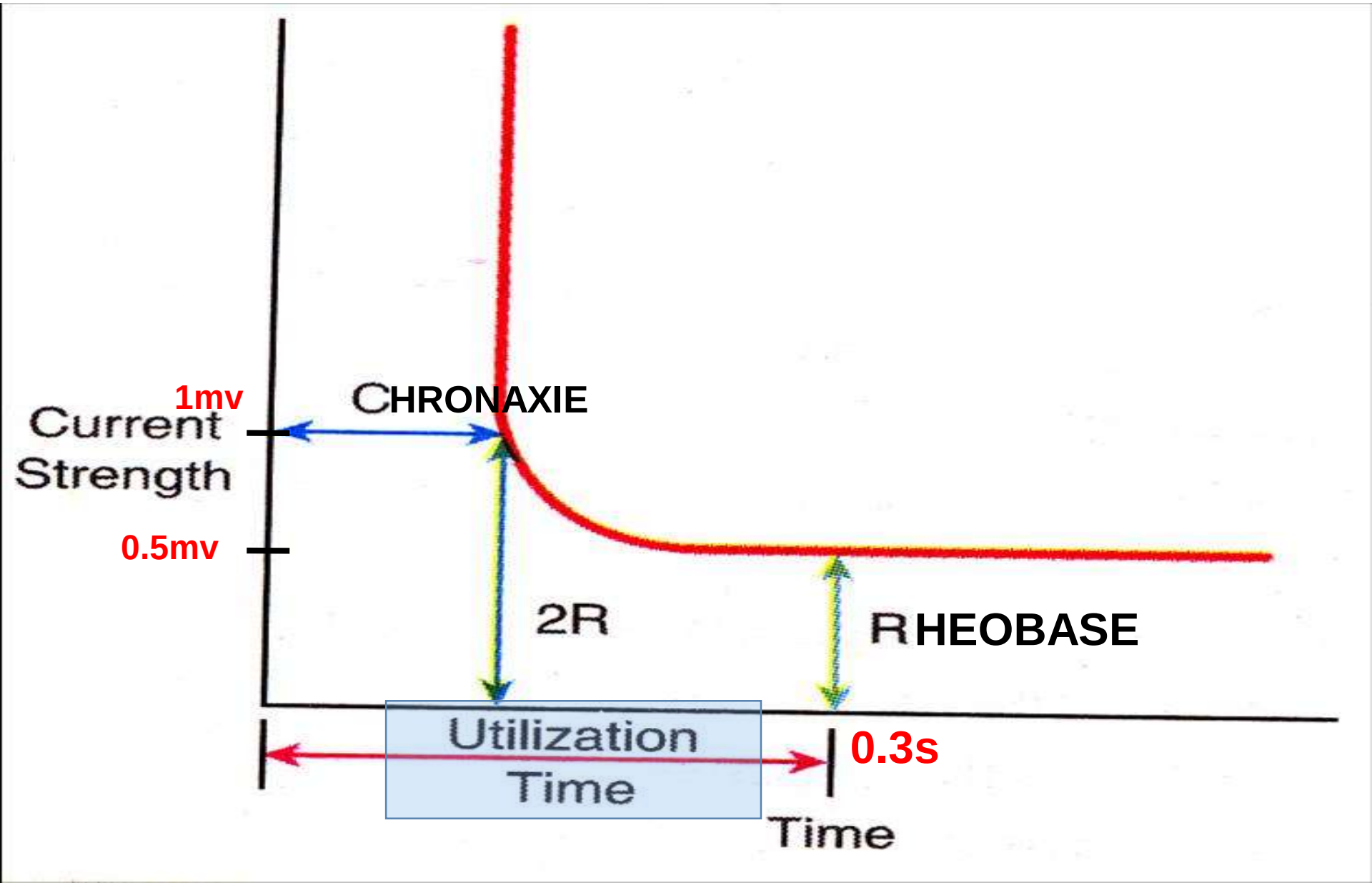
(d)Drugs: Anesthetics, abolish excitability

(e)Toxins: Tetanus & Rabies increase excitability

(f)Oxygen supply:decreases excitability

(h)pH: alkaline :increases
acidic :decreases

- **STRENGTH DURATION CURVE:**



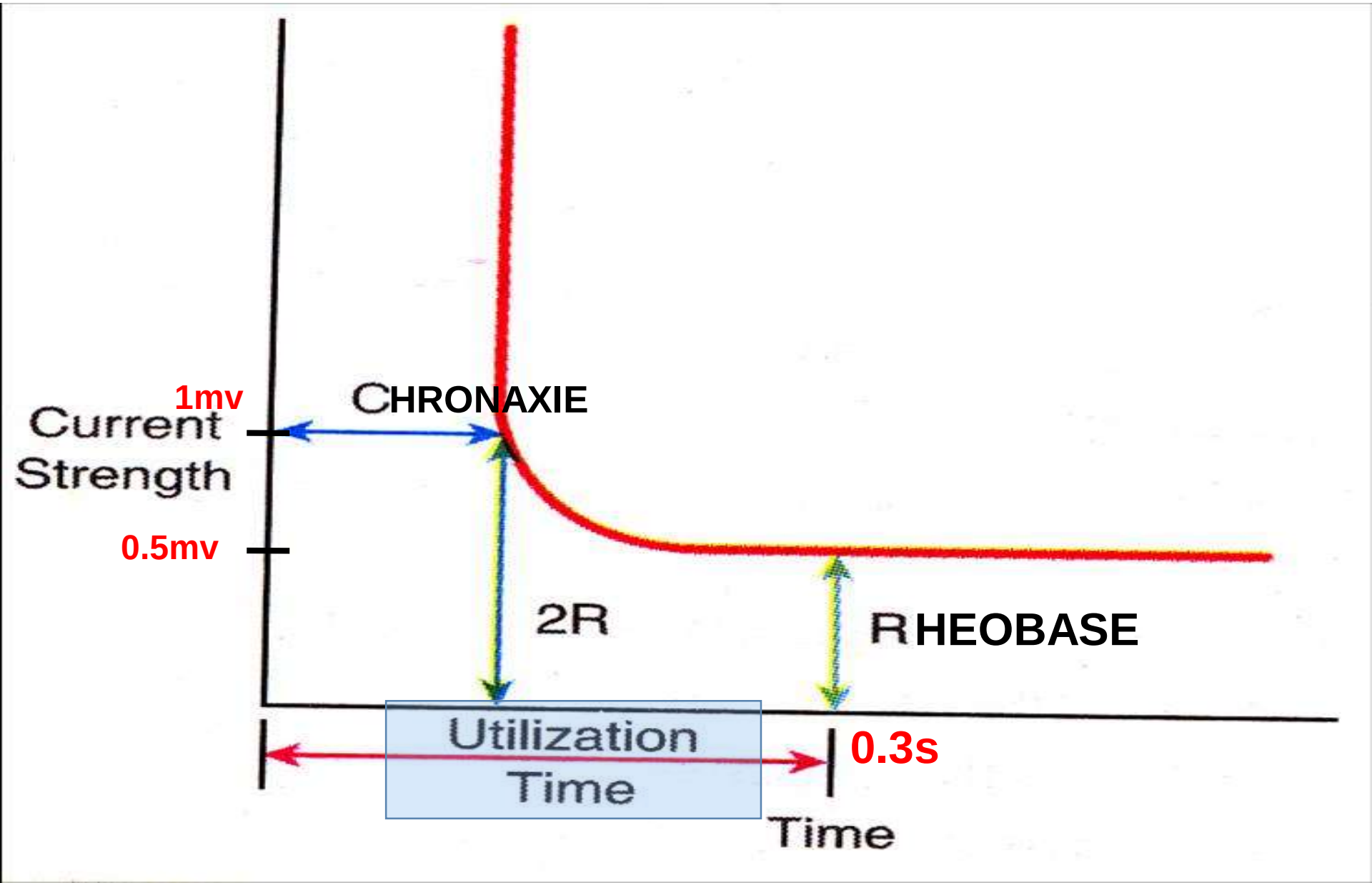
- **<u>Strength duration curve/graph:</u>**
- It is the graphical representation of the relationship between strength of stimulus and the duration it has to be applied to get a response

- Has 3 components:
- Rheobase

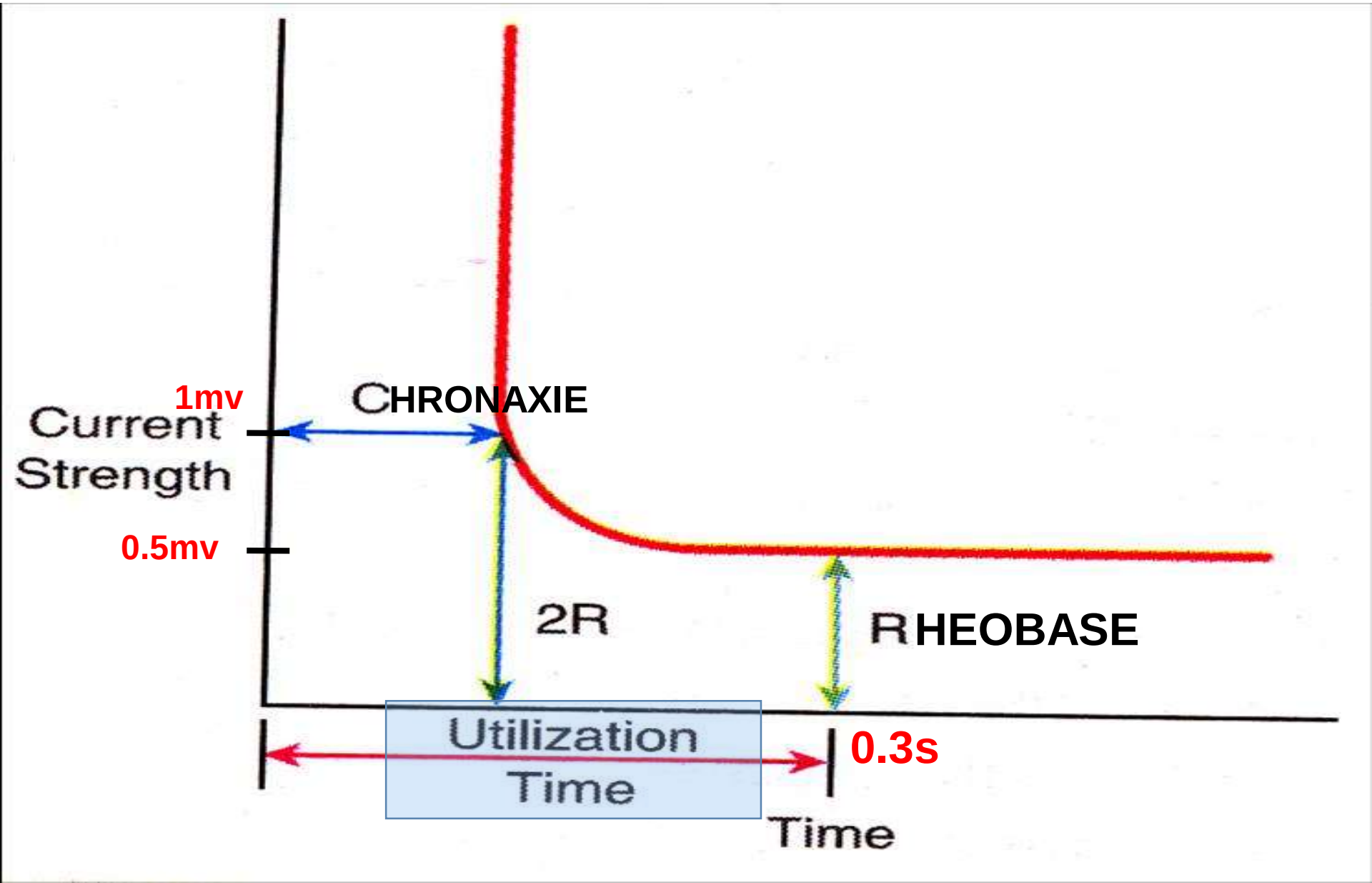
- Utilization time

- Chronaxie

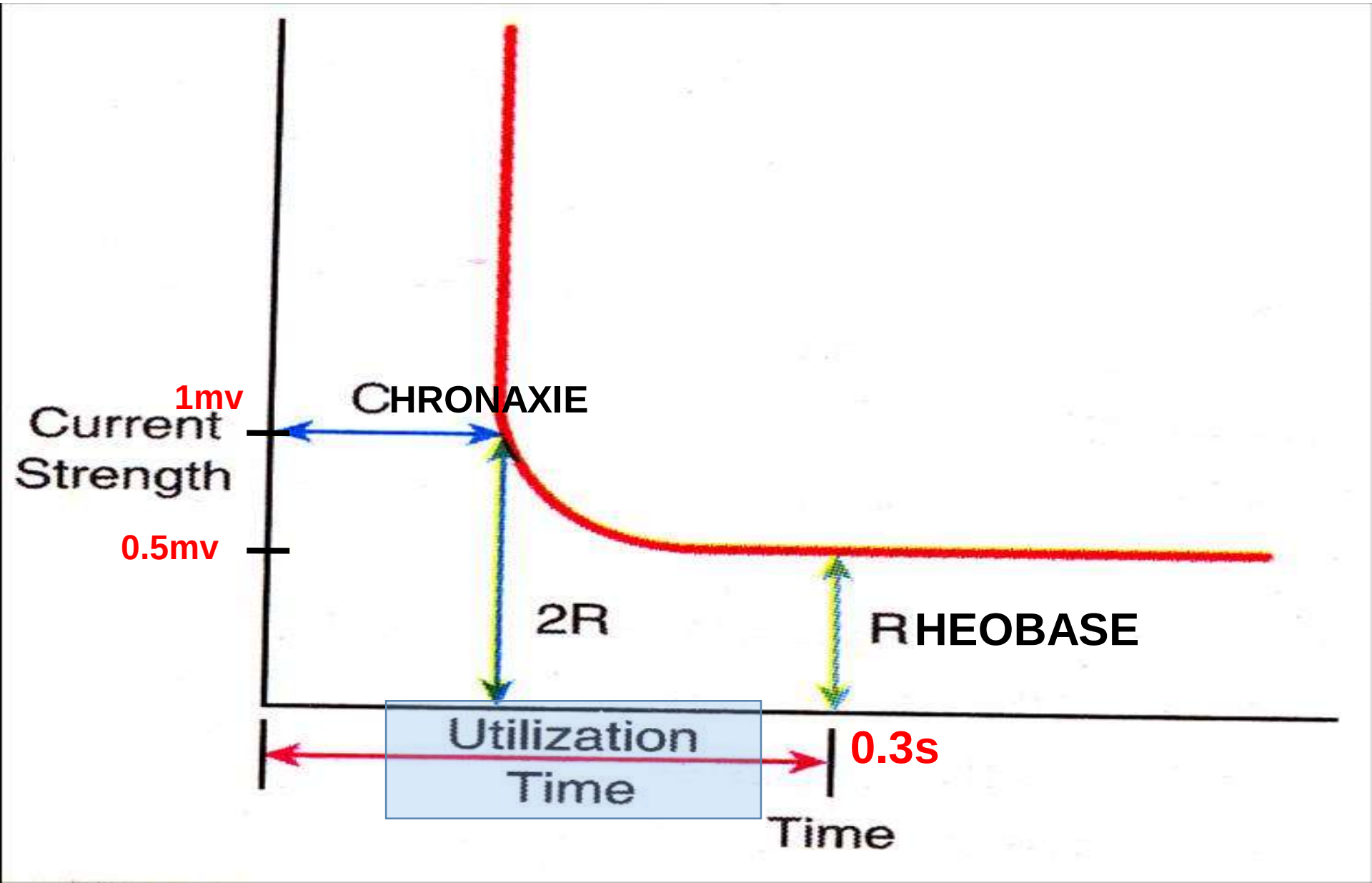
RHEOBASE:The minimum intensity of stimulus which if applied for adequate time produces a response.



UTILIZATION TIME:The minimum time required to have a response is called utilization time.



CHRONAXIE: The minimum duration for which the stimulus of double the rheobase intensity must be applied to produce a response.



Clinical application

- Diagnosis of nerve injuries

(II)CONDUCTIVITY:

- Propagation of nerve impulse along the nerve fiber.
- Active ,self propagating process
- Impulse moves along the nerve at a constant amplitude

- **Factors affecting conductivity:**
- (a)Myelination: Myelinated nerve :faster
- (b)Temperature: α conductivity
- (c)Thickness of nerve fiberα conductivity
- (d)Length of nerve fiber α1/coductivity

  (e)Oxygen supply: hypoxia decreases conduction
- (f)Drugs: Tetradotoxin,saxitoxin: block voltage gated sodium channels
- Tetra Ethyl Ammonium (TEA):block voltage gated potassium channels

ANTIDROMIC AND ORTHODROMIC CONDUCTION

- ***ANTIDROMIC CONDUCTION***

  An axon can conduct in either direction. When an axon is stimulated in the middle impulses travel on either side of the initial current sink.

- ***ORTHODROMIC CONDUCTION***

  In a synapse impulse pass only in one direction.

- (A)Unmyelinated axon:
- Not covered by myelin sheath
- Continuous conduction of impulses

- **Myelinated neurons:**
- Myelin sheath

- Insulation

- Saltatory conduction

- **ADVANTAGE OF SALTATORY CONDUCTION:**
  - Provides rapid conduction of impulses
  - 50 times faster than the fastest Unmyelinated nerve fibers
  - Conserves energy for the cell

(III)All or none phenomenon:

“When a stimulus is applied, nerve responds to its maximum extent by giving rise to an action potential which activates the entire nerve fiber, or it does not respond at all.”

- **ALL OR NONE LAW:**

- Threshold stimulus: **ACTION POTENTIAL**

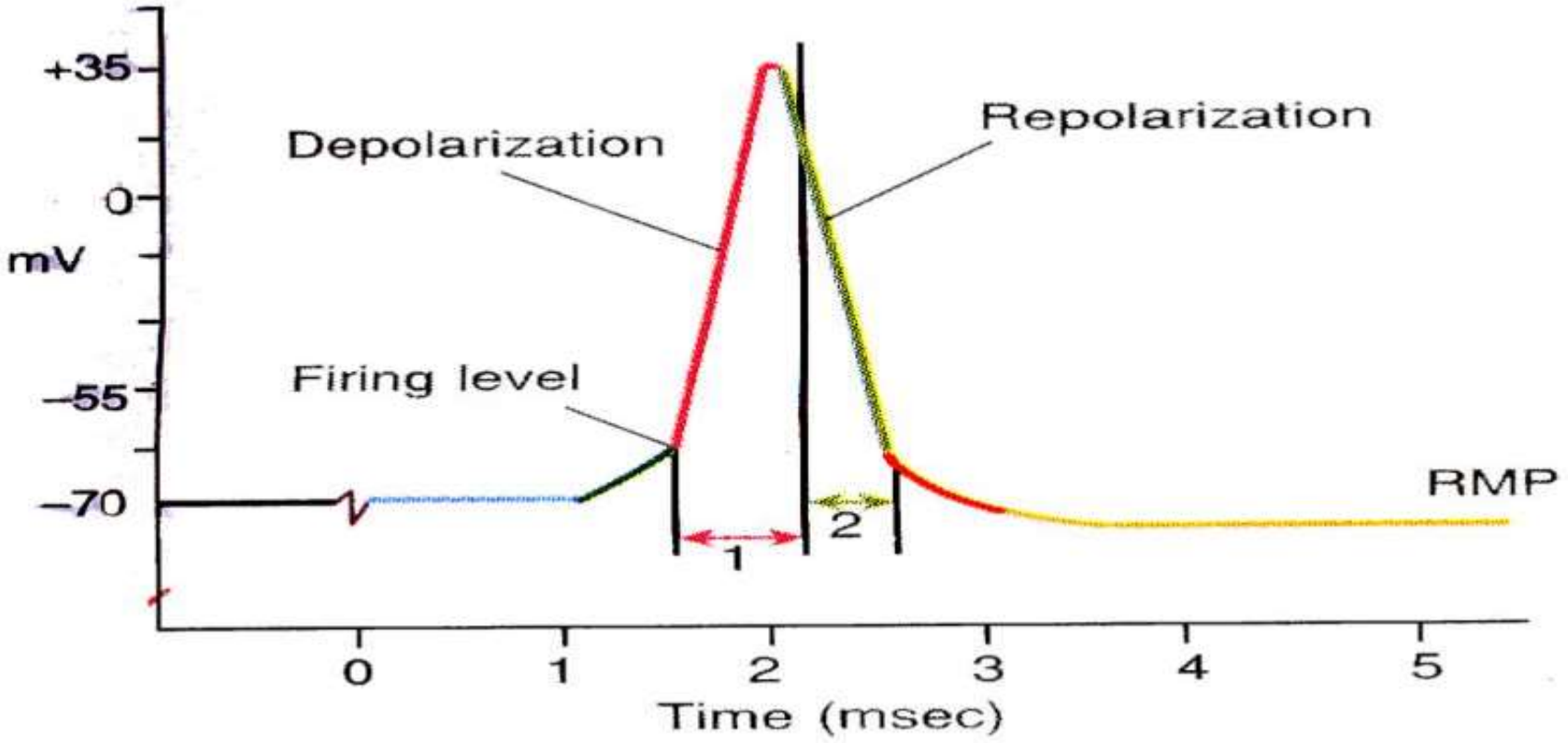
- Sub threshold stimulus: **NO ACTION POTENTIAL**

- Supra threshold stimulus:

NO CHANGE IN THE AMPLITUDE OF A.P

- **(III) Refractory period:**
- Non responsive
- **“It is the period of excitation during which the nerve fiber fails to respond to a second stimulus.”**
- 0.3- 1 ms
- Two parts :
- Absolute refractory period
- Relative refractory period

- **Absolute refractory period:**
- It is the period of excitation during which the nerve fibers fail to respond even to the strongest stimulus.



- **Relative refractory period:**
- **“It is the period of excitation during which a second stronger stimulus can elicit a response.”**
- Latter 2/3 repolarisation+hyperpolarisation
- Resting sodium channels
- Few sodium channels :inactive state
- Why stronger stimulus?
- K+ ions are moving out which will oppose depolarization

(IV)Unfatiguability/Indefatiguability:

- Nerve fibers do not show fatigue.
- Nerve fibers respond to a high frequency stimuli for prolonged periods without showing fatigue.
- But Why?

- Production of impulse
- Na^+ channels ,K^+ channels
- Energy utilized is less

(V)ADAPTATION/ACCOMMODATION:

- “when a nerve is stimulated by a slowly rising current strength, the normal threshold may be passed without the generation of action potential.”

- **Classification of nerve fibers:**
- **(I)ERLANGER AND GASSER'S CLASSIFICATION**
- **(II)NUMERICAL CLASSIFICATION**
- **(III)PHYSIOCLINICAL CLASSIFICATION**

Erlanger - Gasser classification

Based on nerve fiber diameter and conduction velocity

Fiber type	Diameter (μm)	Conduction velocity (m/s)	Function
A α	12 – 20	70 – 120	**Proprioception Somatic motor**
A β	5 – 12	30 - 70	**Pressure Touch**
A γ	3 - 6	15 - 30	**Motor to muscle spindles**
Aδ	2 - 5	12 - 30	**Pain Touch Cold**
B	< 3	3 – 15	**Preganglionic autonomic**
C	0.4-1.2	0.5 – 2.0	**Dorsal :pain ,temperature**
	0.3-1.3	0.7-2.3	**Sympathetic:Post ganglionic**

- **II)NUMERICAL CLASSIFICATION:**

(Used for sensory neurons)

NUMBER	ORIGIN	FIBER TYPE
Ia	Muscle spindle, Annulospiral ending	Aα
Ib	Golgi tendon organ	Aα
II	Muscle spindle, Flower spray ending, Touch, pressure	Aβ
III	Pain, Touch, Cold receptor	Aδ
IV	Pain receptor, Temperature receptor	C

(III)Physioclinical classification:

Susceptibility to	Most susceptible	Intermediate susceptible	Least susceptible
Pressure	**A**	**B**	**C**
Hypoxia	**B**	**A**	**C**
Local anesthetics	**C**	**B**	**A**