JAYPEE

2nd Edition

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for Tamil Nadu PG Entrance Examination

Volume 1

Anatomy, Physiology, Biochemistry, Forensic Medicine, Microbiology, Pathology, Pharmacology, Preventive and Social Medicine, ENT, and Ophthalmology

- **Last 15 years original TNPG questions from 2001 to 2015.**
- **Written/Reviewed by 20 different subject specialists.**
- **100 percent authenticated points.**
- **Highly recommended for AIPG also.**

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CHAPTER 2

Physiology

Rajamahendran

GENERAL PHYSIOLOGY–HIGH YIELD TOPICS

The Nobel Prize in Physiology or Medicine

2014	John O'Keefe, May-Britt Moser and Edvard I. Moser	"For their discoveries of cells that constitute a positioning system in the brain"
2013	James E. Rothman, Randy W. Schekman and Thomas C. Südhof	"for their discoveries of machinery regulating vesicle traffic, a major transport system in our cells"
2012	Sir John B. Gurdon and Shinya Yamanaka	"for the discovery that mature cells can be reprogrammed to become pluripotent"

Homeostasis

The Foundation of Physiology

- Normal cell function depends on the constancy of **interstitial component of the ECF**
- To describe "the various physiologic arrangements which serve to restore the normal state, once it has been disturbed," **W.B. Cannon** coined the term **homeostasis.**
- **Claude Bernard**-concept of ***milieu intérieur***
- **Steady state and equilibrium** *are* **both stable** conditions, but **energy is required** *to* maintain a **steady state**

Control Systems and Feedback

- Basically designed to maintain a controlled variable at a set point
- Effectiveness of a control system assessed using Gain
- **Gain=Correction/Error**
- Higher the gain, higher the accuracy of regulation.
- For body temperature control system, **gain is -33**

Negative feedback	Positive feedback
• A pathway in which response opposes or removes the signal • Most control systems of the body act by negative feedback • Stabilize the variable being regulated • Examples- ACTH secretion, Aldosterone-potassium, Glucose regulation, Growth hormone secretion, BP regulation	• Response reinforces rather than decrease or removes it. Leads to vicious cycle. • Examples-**C**lotting,**C**alcium entry into sarcoplasmic reticulum, **L**H surge during ovulation, **A**ction potential (Hodgkin's cycle), **P**arturition (Ferguson reflex), **S**hock (Mnemonic: CLAPS**)**

Feedforward Control

- Allows the body to anticipate change and maintain stability
- Example-Salivation reflex-sight,smell,thought of food leads to salivation-anticipation of food

The Body As Organised "SOLUTIONS"

Total Body Water (60% of body weight)- 42 liters		
Intracellular Fluid	Extracellular Fluid	
$2/3^{rd}$ of TBW i.e., 40% body weight (28 liters)	$1/3^{rd}$ of TBW .i.e., 20% body weight (14 liters)	
	Interstitial Fluid	PLASMA
	75% or $3/4^{th}$ of ECF or 15% of body weight (10.5 litres)	25% or $1/4^{th}$ of ECF or 5%of body weight (3.5 litres)

In the average young adult male, **18%** of the body weight is **protein** and related substances, **7%** is **mineral**, and **15%** is **fat**

- Daily intake of water-2300 ml
- Output:
  - Insensible—skin 350 ml
  - lungs 350 ml
  - Others - Sweat 100 ml
    Feces 100 ml
    Urine 1400 ml
- ECF
  - Most abundant cation-**Na^+**
  - Most abundant anion-**Cl^-**
- *I*CF
  - Most abundant cation-**K^+**
  - Most abundant anion-**Phosphates > Proteins**
- Transcellular fluid(1-2L)- synovial, peritoneal, pericardial,intraocular spaces,cerebrospinal fluid

Measurement of Body Fluid Volumes:

Measurement of Fluid Volumes in the Different Body Fluid Compartments is by **The Indicator-Dilution Principle: Volume = Amount/concentration**

Compartment	Indicator used
Total body water	^{2}H2O (Deuterium oxide), $^{3}H_2O$ (Tritium Oxide),Antipyrine
Extracellular fluid	^{22}Na,^{125}I-iothalamate, Thiosulfate, Inulin,Sucrose
Intracellular fluid	Calculated as Total body water – Extracellular fluid volume.
Plasma volume	^{125}I-Albumin, Evans blue dye (T-1824) (Mn:PIE)
Blood volume	^{51}Cr-labeled red blood cells, or calculated as Blood volume = Plasma volume/(1 - Hematocrit)
Interstitial fluid	Calculated as Extracellular fluid volume - Plasma volume

Osmosis

- The diffusion of **solvent** molecules into a region in which there is a higher concentration of a solute to which the membrane is impermeable
- The pressure necessary to prevent solvent migration to the more concentrated solution is the **osmotic pressure** of the solution
- Osmotic pressure depends on the number rather than the type of particles in a solution(colligative property)
- Other examples of colligative property-Freezing point depression,Vapour pressure lowering,boiling point elevation
- The concentration of osmotically active particles is usually expressed in **osmoles and milliosmoles**

Osmolarity and Osmolality

- A mole is the gram molecular weight of a substance or molecular weight of a substance in grams
- Each mole consists of 6×10^{23} molecules

- One osmole equals the gram molecular weight of a substance divided by the number of freely moving particles that each molecule liberates in solution
- Osmola**R**ity-number of osmoles per lit**R**e of solution
- Osmolality-number of osmoles per kg of solvent.Serum osmolality-285-295mOsm/kg H_2O
- Osmolality is not affected by changes in volume of solution or by temperature.
- Most accurate way of finding out osmolality is by **Freezing point depression**
- Approximate formula is **Osmolality (mOsm/L) = 2[Na+] (mEq/L) +0.55[Glucose] (mg/dL) + 0.36[BUN](mg/dL)**
- Vant Hoff Law-used to calculate osmotic pressure-
  $\Pi = \sigma(nCRT)$
  σ – Reflection coefficient
  Π – osmotic pressure
  n= number of dissociable particles
  R = Gas constant
  T = Temperature (K)

Tonicity

- Used to describe the osmolality of a solution relative to plasma
- Same osmolality as plasma-**isotonic**(0.9% Nacl)

Plasma Protein	Molecular Weight (Dalton)	Concentration	Contribution to osmotic pressure
ALBUMIN	69,000	3.5–5 g%	80%
GLOBULIN	1,40,000	2 g%	20%
FIBRINOGEN	4,00,000	0.3 g%	0%

Non-ionic diffusion-
- Substances cannot cross the membrane in charged form but cross in undissociated form
- Example-Ammonia transport in GIT/Kidney

Cellular Physiology-High yield topics

Electrophysiology of the Cell

Resting Membrane Potential

- Every cell shows a potential difference with the inside being negative.
- Due to diffusion of K^+ and sodium potassium ATPase(5-10%) Some important resting membrane potentials

Structure	RMP(mv)
Neuron	-70
Skeletal Muscle	-90
SA node	-30 to -40
Ventricle	-90
Smooth Muscle	-30 to -40
RBC	-10

Equilibrium Potential

- Membrane potential at which there is no net flux of that ion

Ion	Equilibrium Potential (mv)
Sodium	+ 60
Potassium	– 90
Chloride	– 70

Ecl^- is close to RMP

- To calculate equilibrium potential of a single ion: **Nernst Equation**

$$E_x = -\frac{61.5\ mV}{Z_x} \log\frac{[X]_I}{[X]_o}$$

E_x is the Nernst Equilibrium potential
Z_x is the valence of the ion
$[X]_I$ is the concentration of X inside the cell
$[X]_o$ is the concentration of X outside the cell

Goldman-Hodgkin-Katz Equation:

- Involves multiple ions
- Depends on concentration gradient and permeability of ions

Gibbs Donnan Effect:

- The presence of non-diffusible ions across the cell membrane affects the concentration of diffusible ions. The negatively charged proteins and phosphates which are present inside the cell cannot diffuse across the membrane. This results in a greater permeability of chloride (a diffusible anion).

Important constituents and normal values of Extracellular Fluid

Oxygen	35 - 45 mmHg
Carbon dioxide	35 - 45 mmHg
Sodium	138 - 146 mmol/L
Potassium	3.8 - 5.0 mmol/L
Calcium	1.0 - 1.4 mmol/L
Chloride	103 – 112 mmol/L
Bicarbonate	24 – 32 mmol/L
Glucose	75 – 95 mg/dl
Body temperature	98 – 98.8 °F or 37 °C
Ph	7.3 – 7.5

Functions of Cell Organelles

Cell organelle	Function
Nucleolus	• Site of synthesis of ribosomes
Ribosomes	• Site of protein synthesis
Rough / granular endoplasmic reticulum	• Synthesis of proteins
Smooth / agranular endoplasmic reticulum	• Synthesis of lipids and steroid
Golgi bodies	• Processing/packaging of proteins, • Synthesizing certain carbohydrates that cannot be formed by ER(eg;hyaluronic acid and chondroitin sulphate), • Lysosome formation

Contd...

Contd...

Cell organelle	Function
Lysosomes	• Formed by breaking off from the Golgi apparatus • Also called Intracellular digestive system • Contains hydrolases to digest proteins, carbohydrates, lipids • Contains bactericidal agents lysozyme and lysoferrin
Peroxisomes	• Physically similar to lysosomes, but contain oxidases instead of hydrolases • Proteins are directed to peroxisomes by protein chaperones called peroxins
Mitochondria	• Formation of ATP

Cell Membrane

Current concepts of membrane physiology is based on Fluid and Mosaic model proposed by **Singer and Nicolson,1972**

Membrane Lipids

- Has both hydrophilic and hydrophobic properties(Amphipathic)
- Phospholipids-Phosphatidylcholine,Phosphatidylethanolamine, Phosphatidylserine Phosphatidylinositol,Sphingo myelin
- Glycolipids-Cerebrosides,Gangliosides
- Sterols-Cholesterol
- Membrane fluidity changes with temperature: Temperature at which the membrane undergoes ordered to disordered(melts) is the transition temperature (Tm)
- Saturated FA- Increase in Tm, decrease in fluidity
- Unsaturated FA- Decrease in Tm, Increase in fluidity
- Cholesterol modifies fluidity: Below Tm-Increases fluidity, Above Tm-Limits fluidity and that's why is called as FLUIDITY BUFFER
- Membrane lipids are asymmetrically distributed: Outer Membrane-Lecithin and sphingomyelin
- Inner leaflet- Phosphotidyl serine, phosphotidylethanolamine

Membrane Proteins

- Integral proteins (Glycophorins in RBC): distributed asymmetrically. Has a transmembrane region (Having a stretch of hydrophobic aminoacids and hydrophilic regions at the ends.
- Peripheral proteins (Spectrin in RBC): attaches by glycosylphosphatidylinositol (GPI) anchors
- Examples of GPI anchored proteins:Alkaline Phosphatase,CAMs,proteins that Combat Cell lysis by complement
- Proteins may be myristoylated,palmitoylated or prenylated
- Functions as 1. CAMs 2. Pumps 3. Carriers 4. Receptors 5. Enzymes (Mn:PCR-E.Coli)

Composition of Cell Membrane

Component	Percentage
Protein	55
Phospholipids	25
Cholesterol	13
Glycolipid	4
Carbohydrate	3

Ratio of Protein to Lipids in Different Membranes

Inner mitochondrial membrane	3.2
Sarcoplasmic Reticulum	2.0
Outer mitochondrial membrane	1.1
Myelin	0.23

Apoptosis

- Programmed cell death
- Initiated by activation of a family of proteases called caspases

Cell Cycle

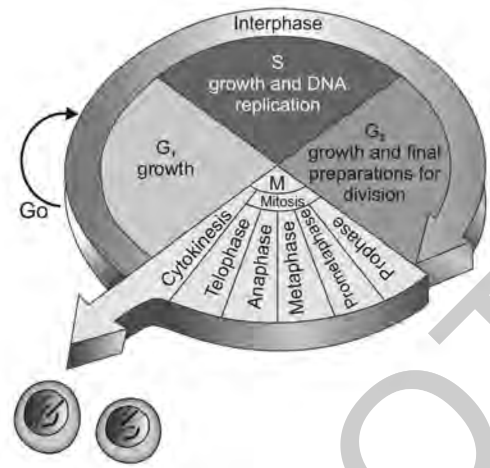

Fig. 1

- G1 (first gap) phase- cells grow in size and synthesise RNAs and proteins required for DNA synthesis
- S (synthesis) phase- cells actively replicate their chromosomes
- G2 (second gap) phase- after progressing through a second gap phase, the cells enter the M (mitotic) phase
- Interphase- G1, S, G2 phase together are called interphase
- Most nonproliferating cells in vertebrates leave the cell cycle in G1 and enter G0 phase (resting phase). Some G0 cells can return to the cell cycle and resume replicating

Transport Across Cell Membrane

Passive Processes

Diffusion

- No energy is expended directly to mediate the transport process
- Net flux of solute particles from areas of high to areas of low concentration
- The time required for equilibrium by diffusion is proportional to the square of the diffusion distance
- Fick's law of diffusion: $J= -DA\ \Delta C/\Delta X$,where J is the net rate of diffusion, D is the diffusion coefficient, A is the area, and $\Delta c/\Delta x$ is the concentration gradient

Facilitated Diffusion

- Carrier proteins move substances in the direction of their chemical or electrical gradients, no energy input is required.
- Has a transport maximum (it is saturable),can be inhibited competitively and non competitively
- Example-glucose transport by GLUT

Active Processes

Primary active transport:

- Energy is used and substances transported against gradient.
- Energy derived directly by hydrolysis of ATP(Na^+ K^+ ATPase)

Sodium potassium ATPase pump

- discovered by Jens Skou-1997 nobel prize in chemistry
- Accounts for about 24% of the energy utilized by cells, and in neurons it accounts for 70%

- Has an alpha and beta subunit
- Alpha subunit:
- Intracellular-Na^+ binding site,Phosphorylation site,ATP binding site
- Extracellular-K^+ binding site,ouabain binding site
- Beta subunit:
- Extra cellular glycosylation site
- Extrude three Na^+ from the cell and take two K^+ into the cell for each molecule of ATP hydrolyzed (electrogenic)
- Activity is inhibited by ouabain,digitalis

REGULATION OF Na, K ATPase

- Agents Increasing pump activity-Throid hormones, Aldosterone, Insulin (MN:ThAI)
- Agents Decreasing Pump activity-Dopamine. Causes natriuresis

Secondary Active Transport

- Active transport of Na^+ is coupled to the transport of other substances
- Examples:$Na^+K^+Cl^-$,Na-Glucose,Na-aminoacids.Na-bile salts,Na-choline uptake

Exocytosis

- For vesicles containing material for export,mediated through v-SNARE and t-SNARE
- Non constitutive(regulated) pathway-extensive processing occurs before exocytosis.Ex-insulin release
- Constitutive pathway-little or no processing,no storage.Ex-mucus release into GI lumen

Endocytosis

- Various types namely phagocytosis, pinocytosis, clathrin-mediated endocytosis, caveolae-dependent uptake, and nonclathrin/noncaveolae endocytosis
- Pinocytosis-cell drinking and phagocytosis-cell eating
- Clathrin mediated endocytosis:
- Involves clathrin(triskelion),GTP binding protein Dynamin
- Examples-internalisation of receptors for nerve growth factor,low density lipoprotein receptor, Transferrin(Iron)
- Caveolae mediated endocytosis:
- Involves Rafts-rich in cholesterol and sphingolipids and caveolae (flask-shaped membrane depression) and caveolin.
- Examples-Folate receptor (Folate)
- Emeiocytosis-Insulin release from stored granules, requires calcium

Transcytosis

- Combines both exocytosis and endocytosis.
- The transport mechanism makes use of coated vesicles that appear to be coated with caveolin
- Otherwise called as cytopempsis

Coats and vesicle proteins

- Assembly protein 1 (AP-1)-Vesicles from Trans golgi to lysosomes
- Assembly protein 2-Endocytic vesicles to endosomes
- COP I and COP II-Vesicles that transport between the endoplasmic reticulum and the Golgi

Ion Channels

- Specific for K^+, Na^+, Ca^{2+}, and Cl as well as nonselective
- Examples-Amiloride sensitive epithelial sodium channels (ENaC),
- Cl^- channels-$GABA_A$, Glycine receptors, Cystic fibrosis transmembrane conductance regulator (CFTR)

Cytoskeleton

- Maintains structure,allows the cells to change shape and move
- Made up of microtubules, intermediate filaments, and microfilaments

Microtubules (25 nm)

- Dynamic portion of cytoskeleton,provide the tracks that moves transport vesicles, organelles
- made up of alpha,beta and gamma tubulins
- **γ-tubulin-production of microtubules by centrosomes(Microtubule Organising centres(MTOCs)**
- Microtubule assembly is prevented by colchicine and vinblastine

Paclitaxel (Taxol) binds to microtubules and makes them so stable that organelles cannot move

Intermediate Filaments (8–14 nm)

- Form a flexible scaffolding for the cell and help it resist external pressure
- Keratin(epithelia), Vimentin (fibroblasts), Desmin (muscle), GFAP,Peripherin, Neurofilaments, Nestin, Lamin (Mn:DVL-GP-KPN)

Microfilaments (4–6 nm)

- Made up of ACTIN-most abundant protein in mammalian cells
- Found in microvilli(GIT) and lamellipodia(Crwaling)
- Involves in cytokinesis during cell division

MOLECULAR MOTORS

There are three super families of molecular motors: **kinesin, dynein,** and **myosin.**

Types	Properties
Kinesin	move its cargo toward the "+" ends of microtubules
Dyneins	move particles and membranes to the "–"end of the microtubules.
Myosin	for contraction of muscle and cell migration

Axonal Transport

Transport type	Speed (mm/day)	Material transported	Mechanism
Fast anterograde	200- 400	Golgi-derived vesicles containing peptides, enzyme, neurotransmitter	Kinesin (ATP dependent)
Fast retrograde	200-400	Endosomes, lysosomes (Endocytic pathway –membrane receptor, absorbed exogenous material)	Dynein (ATP dependent)
Slow anterograde	~0.2-8	Neurofilaments, microtubule subunits (actin, tubulin, dynein, tau protein etc)	Not clear
Bidirectional	50-100	Mitochondria	Kinesin, dynein

Cell Adhesion Molecules (CAMs)

- Cells are attached to the basal lamina and to each other by **CAMs**
- Four broad families:
  (1) **integrins**
  (2) **IgG superfamily** of immunoglobulins
  (3) **cadherins,**Ca 2+ -dependent molecules
  (4) **selectins-**lectin-like domains-bind carbohydrates.
- Transmit signals into and out of the cell

Intercellular Connections

- Hold cells together: tight junctions (zonula occludens), gap junction, desmosome and zonula adherens
- Attach cells to their basal lamina-hemidesmosome and focal adhesions

Tight junctions	Gap junctions
• Intestinal mucosa, the walls of the renal tubules, and the choroid plexus • Proteins-occludin, junctional adhesion molecules (JAMs), and claudins • Helps maintain cell polarity-prevent the movement of proteins in the plane of the membrane • Determines the degree of leakiness(paracellular pathway	• 3 nm gaps lined up with CONNEXONS (Cx) • 6 subunits of connexins=1 connexon • Permit the rapid propagation of electrical activity from cell to cell • Diseases:X-linked Charcot-Marie-Tooth disease (Cx32),cataract (Cx46 and Cx50), Clouston Syndrome (Cx 30), myoclonic epilepsy (Cx36), arteriosclerosis (Cx37), idiopathic atrial fi brillation (Cx40), erythrokeratoderma variabilis (Cx30.3 and Cx31), inherited deafness (Cx26, Cx30, Cx31)

- **Zonula adherens-**major site of attachment for intracellular microfilaments,contains cadherins
- **Hemidesmosomes-**connected to intermediate filaments. Contains cadherins

Aging (Senescence)

- Progressive deteriorative changes,during the adult period of life,which underlie an increasing vulnerability to challenges and thereby decrease the ability of the organism to survive
- Cellular and molecular mechanisms of aging:
  - oxidative stress(Free radical theory)-widely accepted theory of aging.Damage to the macromolecules by H202,0H,superoxide anion radical
  - Glycation hypothesis of aging-due to formation of advanced glycation end products from Amadori product
  - Mitochondrial theory of aging-damage to mitochondria leads to reduced synthesis of ATP
  - DNA damage theory of aging-accumulated DNA damage interferes with DNA replication and transcription
  - DNA repair theory of aging-DNA repair declines with advancing age
  - Hayflick limit-cells could divide only a limited number of times

Extra Points

- Vesicular traffic in golgi – controlled by small G proteins and SNAREs
- Patch clamp method – for recording ion current flow through single channels

Boyles law	At constant temperature, the volume of a given mass of gas is inversely proportional to the pressure exerted on it
Charle's law	At constant pressure, the volume is proportional to the absolute temperature i.e., V ∞ T
Avogadro's law	Equal volumes of different gases at the same temperature and pressure contain the same number of molecules
Ideal gas law	PV= nRT P = the pressure in atmospheres, V = volume in liters, n = number of gram-moles of a gas, R = universal gas constant, T = temperature in Kelvin
Dalton's law	In a mixture of gases, the total pressure exerted is equal to the sum of the partial pressures of the individual component gases
Henry's law	At constant temperature, the amount of gas dissolved in a liquid will be directly proportional to the partial pressure of the gas with which the liquid is in equilibrium
Graham's law	In a gas phase, the rate of diffusion of a gas is inversely proportional to its molecular weight
Fick's law of diffusion	The net diffusion rate of a gas through a membrane is proportional to the tissue area and the difference in partial pressure between the two sides, and is inversely proportional to the thickness
Laplace law	The tension (T) in the wall of a cylinder is equal to the product of the transmural pressure(P) and the radius(r) divided by the wall thickness (h) T = Pr/h,

Last Minute Revision

- **Gain=Correction/Error**
- Most control systems of the body act by negative feedback
- A mole is the gram molecular weight of a substance or molecular weight of a substance in grams
- Vant Hoff Law-used to calculate osmotic pressure
- **Gibbs Donnan Effect:** The presence of non-diffusible ions across the cell membrane affects the concentration of diffusible ions
- To calculate equilibrium potential of a single ion: **Nernst Equation**
- **Mitochondria** contain DNA similar to that found in the cell nucleus
- Transcription - assembly of the RNA chain from activated nucleotides using the DNA strand as template
- Translation – the process by which the genetic information of the messenger RNA is used to make proteins in the ribosome
- The sodium potassium pump moves 3 sodium ions to the exterior for every 2 potassium ions to the interior
- Total blood volume

$$= \frac{\text{plasma volume}}{1 - \text{hematocrit}}$$

QUESTIONS

1. **An adult male has a hematocrit of 40% and plasma volume 3L.His total blood volume will be** *(2013)*
   a. 4L b. 5L
   c. 6L d. 7L
2. **Ideal characteristic of simple and facilitated diffusion** *(2012)*
   a. They need a carrier protein for transport
   b. Blocked by specific inhibitors
   c. ATP is not needed for their functioning
   d. Shows statuation kinetics
3. **The major determinant of colloid osmotic pressure in humans is** *(2007 and 2012)*
   a. Fibrinogen
   b. a-2 macroglobulin
   c. Albumin
   d. Globulin
4. **Sucrose space is** *(2010)*
   a. Intracellular space
   b. Extracellular space
   c. Plasma volume
   d. Glomerular filtrate
5. **The effect of diffusible ions on the resting membrane potential in the presence of non diffusible ions is best explained by** *(2002and2010)*
   a. Nernst potential
   b. Gibbs Donnan
   c. Goldman equation
   d. Hesselbach equation
6. **Widely accepted theory of ageing is** *(2008)*
   a. Cross linkage theory
   b. Free radical theory
   c. Collagen theory
   d. Random mutation theory
7. **The microfilament in cytoskeleton is** *(2008)*
   a. Actin
   b. Calcineurin
   c. Desmin
   d. Vimentin
8. **The normal range of plasma osmolality is** *(2007)*
   a. 120-150 mOsm/L
   b. 20-30 mOsm/L
   c. 270-285 mOsm/L
   d. 500-600 mOsm/L
9. **Mallory body is a** *(2006)*
   a. Vimentin
   b. Keratin
   c, Neurofilament
   d. Lipid
10. **Regarding active transport true-A/E** *(2004)*
    a. Requires energy
    B. Energy is provided by the hydrolysis of ATPs
    C. Transport against concentration or electrical gradients
    D. Glucose transporter is an example

11. The cell membrane is most impermeable to *(2004)*
- a. Na+
- b. K+
- c. Cl-
- d. Water

12. At constant temperature, the volume of a given mass of gas varies inversely with its absolute pressure. This law is *(2003)*
Bernoulli's principle
Boyle's law
Charles law
Laplace law

13. The magnitude of equilibrium potential is calculated from *(2003)*
- a. Nernst equation
- b. Goldman equation
- c. Gibbs donnan equation
- d. Avogadro's equation

ANSWERS AND EXPLANATIONS

1. Answer (b) 5L *(Guyton, 11th ed, p-296)*
Blood Volume=Plasma volume/ (1 – hematocrit)

2. Answer (c) ATP is not needed for their functioning *(Ganong, 24th ed, p-51)*
No energy is expended directly to mediate the passive transport process.ATP is required only for active processes

3. Answer (c) Albumin *(Guyton, 12th ed, p-52)*
Albumin with low molecular wight contributes more to oncotic pressure

4. Answer (b). Extracellular space *(Guyton, 12th ed, p-289)*
Substances used to measure ECF volume are ^{22}Na,^{125}I-iothalamate, Thiosulfate,Inulin,Sucrose

5. Answer (b) Gibbs Donnan *(Ganong, 24th ed, p-9)*
- Gibbs-Donnan Equilibrium:
- Effect of Presence of impermeant ion on the distribution of permeant ions and this leads to asymmetric distribution of permeant ion across membrane.

6. Answer (c) Free radical theory *(Boron, 2nd ed,P-1284)*
This states that there is Imbalance between the production and removal of ROS.Free radicals have an unpaired electron in outer orbital

7. A. Actin *(Ganong 24th ed, P-40)*
Actin and myosin are the microfilaments in cytoskeleton

8. Answer (c) 270-285 mOsm/L (Ganong 24th ed, P-7)
- Osmolality-no. of moles of a solute per Kg of solvent.Osmolality is the best measure since it is not affected by temperature

9. Answer (b) Keratin patho
- These are the intracytoplasmic keratin inclusion in liver cells

10. Answer (d) Glucose transporter is an example *(Ganong, 24th ed, p-51)*
GLUT transporters are examples of facilitated diffusionwhich follows the saturation kinetics

11. A. Na+ *(Ganong, 24th ed, p-36)*
In the resting state, the cell membrane is quite permeable to K+.Permeability of K+ is 100 times more than that of sodium (Na+)

12. B. Boyle's law *(Best and Taylor 13th ed p-139, Guyton 12th ed p-313)*

Bernoulli principle	the sum of the kinetic energy of flow and the potential energy—is constant
Boyles law	At constant temperature, the volume of a given mass of gas is inversely proportional to the pressure exerted on it
Charle's law	At constant pressure, the volume is proportional to the absolute temperature i.e, $V \propto T$
Laplace law	The tension (T) in the wall of a cylinder is equal to the product of the transmural pressure(P) and the radius(r) divided by the wall thickness (h) T = Pr/h,

13. Answer (a) *Nernst equation(Guyton, 12th ed, p-57)*
Nernst equation is useful to calculate equilibrium potential of a single ion.If it involves multiple ions,Goldman equation is useful.

NERVE MUSCLE PHYSIOLOGY-HIGH YIELD TOPICS

GLIAL CELLS

- Meaning-Glue, continue to undergo cell division in adulthood
- Two types- microglia and macroglia
- Microglia-Derived from macrophages, physiologically and embryologically unrelated to other neural cell types
- Macroglia: oligodendrocytes,Schwann cells, and astrocytes
- Oligodendrocytes-myelin formation around axons in the CNS
- Schwann cells are involved in myelin formation around Axons in peripheral nervous system
- Astrocytes-two types namely fibrous and protoplasmic.

Functions of Astrocytes

- Formation of blood brain barrier
- Produce substances that are tropic to neurons
- Help maintain the appropriate concentration of ions and neurotransmitters by taking up K + and the neurotransmitters glutamate and γ-aminobutyrate (GABA).

Neurons

- The human central nervous system (CNS) contains about 10^{11}(100 billion) neurons
- Site of action potentials generation-the initial segment in spinal motor neurons, the initial node of Ranvier in cutaneous sensory neurons

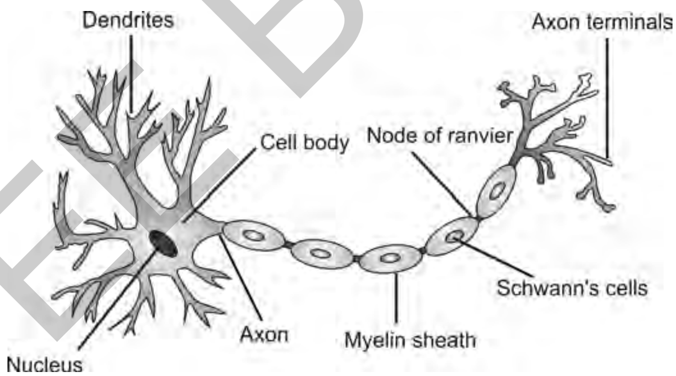

Fig. 2: Structure of a typical neuron

- Location of cell body: Dendritic zone end of the axon(most common).Within the axon (eg. auditory neurons), Attached to the side of the axon (eg. cutaneous neurons)
- Based on the number of processes that emanate from their cell body, neurons can be classified as unipolar, bipolar, and multipolar
- The number of Na^+ channels per square micrometer of membrane in myelinated mammalian neurons is 50-75 in the cell body, 350-500 in the initial segment, less than 25 on the surface of the myelin, 2000-12,000 at the nodes of Ranvier, and 20-75 at the axon terminals.
- Along the axons of unmyelinated neurons, the number is about 110.
- Action potentials can be recorded in dendrites
- Dendritic spines-dynamic structures,produce proteins, which alters the effects of input from individual synapses. Implicated in motivation, learning, and long-term memory

KONCPT 20 Authors

for Tamil Nadu PG Entrance Examination

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- The most important speciality of this book is that the subjects are written or reviewed by 20 different subject specialists. Hence, the points and contents in this book are 100 percent authentic.
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