BEST PG MEDICAL ENTRANCE COACHING
(1). Which of the following conditions leads to tissue hypoxia without alteration of oxygen content of blood:-

a. CO poisoning
b. Methemoglobin
c. Cyanide poisoning
d. Respiratory acidosis

Solution. (c) Cyanide poisoning
Ref: Read the text below
Sol:
Hypoxia has been divided into four types. The four categories are :
(1) Hypoxic hypoxia (anoxic anoxia), in which the PO2 of the arterial blood is reduced.
(2) Anemic hypoxia, in which the arterial PO2 is normal but the amount of hemoglobin available to carry O2 is reduced. e.g. CO poisoning.
(3) Stagnant or ischemic hypoxia, in which the blood flow to a tissue is so low that adequate O2 is not delivered to it despite a normal PO2 and hemoglobin concentration.
(4) Histotoxic hypoxia, in which the amount of O2 delivered to a tissue is adequate but, because of the action of a toxic agent, the tissue cells cannot make use of the O2 supplied to them. e.g. Cyanide poisoning.

Correct Answer. c

(2). Systolic BP is highest at which site :-

a. Aorta
b. Renal artery
c. Right atrium
d. Pulmonary artery

Solution. (b) Renal artery
Ref: Read the text below
Sol:
- Pressure in arterial sides are always higher. Systolic BP is more in downstream arteries than aorta because of reflection of pressure waves at branch points.
- The pressure in any vessel below heart level is increased and that in any vessel above heart level a decreased by the effect of gravity.

Correct Answer. b
(3). True statements about the kidney include:

a. The blood flow accounts for 75% of the total cardiac output.

b. The blood flow is greater in the renal medulla than in the cortex.

c. Over 99% of filtered water is reabsorbed by the kidney.

d. Antidiuretic hormone decreases the water permeability of the collecting duct.

**Solution.** (c) Over 99% of filtered water is reabsorbed by the kidney  
Ref: Read the text below  
Sol:  
- The kidneys receive about 1.2 liters of blood per minute which is about 25% of the cardiac output  
- The blood flow is 20 times greater in the renal cortex than the renal medulla. Over 99% of the filtered water is reabsorbed by the kidney.  
- Antidiuretic hormone increases the water permeability of the collecting duct and hence increases water retention.  
- Kidney secretes erythropoietin which is essential for red blood cell production.

**Correct Answer.** c

(4). The most important choleretic is

a. Bile salt

b. CCK

c. Secretin

d. Gastrin

**Solution.** (a) Bile salt  
Ref: Read the text below  
Sol:  
- Cholagogue is the one which causes gall bladder contraction, thereby increasing flow (eg) CCK – PZ  
- Choleretic increases secretion of bile(eg) Bile salt

**Correct Answer.** a

(5). Regarding cytoskeleton true is,

a. Microtubules and microfilaments are the two types of cytoskeleton

b. Microtubules are are the components of mitotic spindle.

c. Centriole has a central doublet surrounded by nine doublets of tubulin

d. F actin polymerises to form G actin

**Solution.** (b) Microtubules are are the components of mitotic spindle  
Ref: Read the text below  
Sol:  
Cytoskeleton is of three types:  
a. Microtubules:  
- 25nm in diameter  
- They are of two types α1 β tubulin  
- They are the components of mitotic spindle  
- They take part in intracellular transportation  
- Microbule based molecular motor includes  
b. Intermediate filament : Keratin,Vimentin,Neurofilament  
c. Microfilament:  
- Non muscle acts β,y polymerise to form F actin  
- Microfilament based molecular motor:- Myosin I, Myosin II

**Correct Answer.** b
(6). All of the following effects can occur if vagus is stimulated, except:

   a. Reduction in blood pressure
   b. Increase in secretions of the intestine
   c. Reduction in heart rate
   d. Bronchial musculature relaxation

**Solution.** (d) Bronchial musculature relaxation

Ref: Ganong’s Physiology-238

Sol:
- Activation of the vagus nerve typically leads to a reduction in heart rate, blood pressure, or both.
- This occurs commonly in the setting of gastrointestinal illness such as viral gastroenteritis or acute cholecystitis, or in response to other stimuli, including carotid sinus massage, Valsalva maneuver, or pain from any cause, in particular, having blood drawn. When the circulatory changes are great enough, *vasovagal syncope* results. Relative dehydration tends to amplify these responses.

**Correct Answer.** d

(7). True statement regarding alpha wave is:

   a. They are often slightly higher in amplitude on the dominant side
   b. Alpha activity appears normally with attention
   c. In most instances, it is regarded as a normal waveform
   d. They tend to be present anteriorly more than posteriorly

**Solution.** (c) In most instances, it is regarded as a normal waveform

Ref: Ganong’s Physiology-234

Sol:
- Alpha waves generally are seen in all age groups but are most common in adults.
- They occur rhythmically on both sides of the head but are often slightly higher in amplitude on the nondominant side, especially in right-handed individuals.
- A normal alpha variant is noted when a harmonic of alpha frequency occurs in the posterior head regions.
- They tend to be present posteriorly more than anteriorly and are especially prominent with closed eyes and with relaxation.
- Alpha activity disappears normally with attention (eg, mental arithmetic, stress, opening eyes).
- In most instances, it is regarded as a normal waveform.
- An abnormal exception is alpha coma, most often caused by hypoxic-ischemic encephalopathy of destructive processes in the pons (eg, intracerebral hemorrhage).
- In alpha coma, alpha waves are distributed uniformly both anteriorly and posteriorly in patients who are unresponsive to stimuli.

**Correct Answer.** c

(8). Vomiting centre is situated in the:

   a. Hypothalamus
   b. Midbrain
   c. Pons
   d. Medulla

**Solution.** (d) Medulla

Ref: Ganong’s Physiology, 23rd ed., p.-474

Sol:
- Vomiting is believed to be controlled by two distinct brain centres-the vomiting centre and the chemoreceptor trigger zone-both located in the medulla oblongata.
- The vomiting centre initiates and controls the act of emesis, which involves a series of contractions of the smooth muscles lining the digestive tract.

**Correct Answer.** d
(9). Optic nerves:

- a. 1st order neuron
- b. 2nd order neuron
- c. 3rd order neuron
- d. 4th order neuron

**Solution.** (b) 2nd order neuron

Ref: Read the text below

Sol:
- In the case of the optic nerve and tracts there are three separate neurons linked together, extending from the retina to the occipital cortex.
- The sensory end-organ consists of the rods and cones.
- The first neuron begins in the outer plexiform or granular layer, and ends in the inner plexiform or granular layer. The cell-body governing the nutrition of this fibre is the bipolar cell, which cells forms the inner nuclear layer.
- This neuron, although extremely short is the true optic nerve in the physiological sense, and corresponds to the long fibre with runs from the sole of the foot up into the spinal cord.
- The second neuron in the retina begins in the inner nuclear layer and runs from here up to the primary optic ganglia, i.e. chiefly the external geniculate body.
- This is the anatomical optic nerve.
- The cell governing the nutrition of this fibre is the ganglion cell.

**Correct Answer.** b

(10). Less O₂ saturation in blood is seen in:

- a. R-L shunt
- b. LV obstruction
- c. RV obstruction
- d. L-V shunt

**Solution.** (a) R-L shunt

Ref: Ganong’s Physiology-620

Sol:
- Shunting of blood from the right side to the left side of the circulation (right-to-left shunt) is powerful cause of hypoxemia.
- The shunt may be intracardiac or may be intrapulmonary.
- It has been traditionally thought that this cause could be readily distinguished from the others as the only cause that cannot be corrected by the administration of 100% oxygen.

**Correct Answer.** a
(11). During moderate exercise, blood flow is maintained in which of the following organs?

- **a.** Kidney
- **b.** Skeletal muscle
- **c.** Skin
- **d.** Heart

**Solution.** (c) Skin
Ref.: Read the text below
Sol:
- During moderate exercise, blood flow is maintained in Brain and Skin
- During moderate exercise blood flow is

![Diagram]

**Correct Answer.** c

(12). Which among the following tissues has maximum oxygen consumption in ml/100gm/min?

- **a.** Kidney
- **b.** Liver
- **c.** Skeletal muscle
- **d.** Heart

**Solution.** (d) Heart
Ref.: Read the text below
Sol:
- Maximum oxygen consumption in ml/100gm/min is for Heart.
- \( O_2 \) consumption of resting heart is 2 ml/100gm/min
- \( O_2 \) consumption of beating heart is 9 ml/100gm/min

**Correct Answer.** d
(13). Which of the following is a metabolic function of endothelial cells?

a. Formation of angiotensinogen
b. Activation of bradykinin
c. Production of type III collagen
d. Synthesis of plasminogen activator

Solution. (d) Synthesis of plasminogen activator.
Ref- Read the text below
Sol:
- Endothelial cells synthesize a number of antithrombogenic factors including plasminogen activator and prostacyclin.
- Prostacyclin functions through cyclic AMP to inhibit thromboxane production by platelets. Endothelial cells synthesize the basal lamina including types IV, V, and VIII collagens, fibronectin, and laminin. Secretion of A and B blood group antigens also occurs in endothelial cells.
- Angiotensin converting enzyme on the endothelial cell surface converts angiotensin I to angiotensin II (a potent vasoconstrictor), but also serves as an inactivation enzyme (bradykininase) for bradykinin, a vasodilator.
- The endothelium produces nitric oxide, also known as endothelium-derived relaxing factor (EDRF), and endothelin, the most potent vasoconstrictor in the body. Endothelial cells also synthesize plasminogen inhibitor, a coagulant and von Willebrand factor (factor VIII) which is found in Weibel-Palade granules in endothelial cells of vessels larger than capillaries.
- A deficiency of factor VIII leads to decreased platelet aggregation and hemophilia.

Correct Answer. d

(14). Tip Links are concerned with:

a. Hearing
b. Taste
c. Smell
d. Vision

Solution. (a) Hearing
Ref.: Read the text below
Sol :
- Tip links are very fine processes which are present in the hair cells of inner ear, concerned with hearing.

Correct Answer. a
(15). Sleep is controlled by
a. Ventromedial nucleus

b. Dorsomedial hypothalamic nucleus
c. Ventrolateral preoptic nucleus

d. Arcuate nucleus

Solution. (c) Ventrolateral preoptic nucleus

Ref: Read the text below

Sol:
The “switch” for sleep is considered to be the ventrolateral preoptic nucleus (VLPO) of the anterior hypothalamus. This area becomes active during sleep and uses the inhibitory neurotransmitters GABA and galanin to initiate sleep by inhibiting the arousal regions of the brain. The VLPO innervates and can inhibit the wake-promoting regions of the brain including the tuberomammillary nucleus, lateral hypothalamus, locus coeruleus, dorsal raphe, laterodorsal tegmental nucleus, and pedunculopontine tegmental nucleus.

<table>
<thead>
<tr>
<th>Region</th>
<th>Area</th>
<th>Nucleus</th>
<th>Function</th>
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<tbody>
<tr>
<td>Anterior</td>
<td>Medial</td>
<td>Medial preoptic nucleus</td>
<td>- urinary bladder contraction</td>
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<tr>
<td></td>
<td></td>
<td>Supraoptic nucleus (SO)</td>
<td>- Decreased heart rate</td>
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<td>- Decreased blood pressure</td>
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<td></td>
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<td>- oxytocin release</td>
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<tr>
<td>Lateral</td>
<td>Medial</td>
<td>Suprachiasmatic nucleus (SC)</td>
<td>- vasopressin release</td>
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<td></td>
<td></td>
<td></td>
<td>- Circadian rhythms</td>
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<tr>
<td>Tuberal</td>
<td>Lateral</td>
<td>Lateral preoptic nucleus</td>
<td>- thirst and hunger</td>
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<td>Lateral nucleus (LT)</td>
<td>- vasopressin release</td>
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<td></td>
<td>Part of supraoptic nucleus (SO)</td>
<td>- GI stimulation</td>
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<td>Dorsomedial hypothalamic nucleus (DM)</td>
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<td>- satiety</td>
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<td>- neuroendocrine control</td>
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<td>- Luteinizing Hormone R.H. release</td>
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<td>- Follicle Stimulating Hormone Releasing Factor</td>
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<td>- GHRH</td>
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<td>Mammillary nuclei (part of mammillary bodies) [MB]</td>
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<td>Posterior nucleus (PN)</td>
<td>- increase blood pressure</td>
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<td>- pupillary dilation</td>
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<td>- shivering</td>
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<td>Lateral nucleus (LT)</td>
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</tr>
</tbody>
</table>

Correct Answer. c
(16). Which ganglion cell is related to linear response & respond differently to different wavelength:

a. P cell  
b. M cell  
c. W cell  
d. Z cell

Solution. (a) P cell  
Ref: Read the text below  
Sol:  
In primates retinal ganglion cell are of 3 types:—  
1. P cell - project to parvocellular layer of LGN. Controlled by bipolar cell. Show linear summation of responses and are more sensitive to wavelength.  
3. W cell - Mainly have diffuse extensive receptive field. Controlled by amacrine cells. Respond poorly to visual stimuli.

Properties of retinal ganglion cells:

<table>
<thead>
<tr>
<th>Properties</th>
<th>P cell</th>
<th>M cells</th>
<th>W cells</th>
</tr>
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<tbody>
<tr>
<td>Cell body and axon</td>
<td>Medium sized</td>
<td>Large</td>
<td>Small</td>
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<tr>
<td>Dendritic tree</td>
<td>Restricted</td>
<td>Extensive</td>
<td>Extensive</td>
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<tr>
<td>Receptive field</td>
<td>Small</td>
<td>Medium</td>
<td>Large</td>
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<td>Size</td>
<td>Center</td>
<td>Center</td>
<td>Diffuse</td>
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<td>Organization</td>
<td>surround</td>
<td>surround</td>
<td>poorly</td>
</tr>
<tr>
<td>Adaptation</td>
<td>Tonic</td>
<td>Phasic</td>
<td>responsive</td>
</tr>
<tr>
<td>Linearity</td>
<td>Linear</td>
<td>Nonlinear</td>
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<tr>
<td>Wavelength</td>
<td>Sensitive</td>
<td>Insensitive</td>
<td>Insensitive</td>
</tr>
<tr>
<td>Luminance</td>
<td>Insensitive</td>
<td>Sensitive</td>
<td>Sensitive</td>
</tr>
</tbody>
</table>

Correct Answer. a

(17). Cortical colour blindness is due to lesions in the:

a. Occipital lobe  
b. Lateral geniculate body  
c. Middle temporal lobe  
d. Inferior temporal lobe

Solution. (d) Inferior temporal lobe  
Ref: Read the text below  
Sol:  
Bilateral lesions of inferotemporal cortex can result in cortical colour blindness (achromatopsia) or inability to recognise faces of even close family members. (Prosopagnosia).  
Mechanism: P pathway originates with P cell which functions in recognition of form & colour. Cortical structures in P pathway include 4Cβ of striate cortex, area V4 & several areas in inferotemporal region.  
A lesion in middle temporal (MT) & middle superior temporal (MST) region interfere with motion detection & with eye movements.  
Mechanism: M pathway originate with M cell function in motion detection & control of eye movements.  
Cortical structures include layers 4B & 4Ca of striate cortex, MT (middle temporal) & MST (middle superior temporal) regions & 7a area of parietal lobe.

Correct Answer. d
(18). The light reflex of the pupil:

a. Involves the superior colliculus.

b. Involves the occipital cortex.

c. Is impaired in patients with unilateral cataract.

d. None.

**Solution.** (a) Involves the superior colliculus
Ref: Read the text below
Sol:
- The afferent fibers of the pupillary light reflex travel along the optic nerves, chiasm and tracts and leave the posterior portion of the optic tract and enter the midbrain where they synapse with the pretectal nuclei.
- The axons from the pretectal nuclei then project bilaterally to the Edinger-Westphal nuclei.
- The parasympathetic fibres that control the light reflex arise from the Edinger-Westphal cell group of the oculomotor nucleus and synapse within the ciliary ganglion. From here, nerve fibers reach the iris via the short ciliary nerves.
- Cataract does not impair the pupillary light reflex.

**Correct Answer.** a

(19). Vagal stimulation causes all of the following except:


b. A fall in heart rate.

c. Increased atrial contractility.

d. Decreased stroke volume.

**Solution.** (c) Increased atrial contractility
Ref: Read the text below
Sol:
- Vagal stimulation increases the parasympathetic activities resulting in slowing of the heart rate with delayed A-V conduction and decreased stroke volume.
- The atrial and ventricular activities are decreased.

**Correct Answer.** c
Unlike the systemic circulation, the pulmonary circulation is a:

a. Low-pressure and low-resistance system
b. Low-pressure and high-resistance system
c. High-pressure and low-resistance system
d. High-pressure and high-resistance system

Solution. (a) Low-pressure and low-resistance system
Ref: Read the text below
Sol:

Unlike the systemic circulation, the pulmonary circulation is a low-pressure and low-resistance system. Pulmonary circulation is characterized as normally dilated, while the systemic circulation is characterized as normally constricted. Pressures are given in mm Hg; a bar over the number indicates mean pressure.

Correct Answer. a
(21). Negative-feedback control systems

a. Would not apply to the regulation of PaCO2  
b. Give the best control when most sensitive  
c. Are ineffective if the properties of the controlled system change  
d. Are not necessarily stable

**Solution.** (d) Are not necessarily stable

Ref: Read the text below

Sol:  
- Negative-feedback systems are not necessarily the most stable.

**Correct Answer.** d

(22). Parkinson's disease occurs as a result of loss of neurons in :-

a. Globus pallidus  
b. Putamen  
c. Pars compacta of substantia nigra  
d. Pars reticularis of substantia nigra

**Solution.** (c) Pars compacta of substantia nigra

Ref: Read the text below  
Sol:  
Parkinson's disease is a common disorder that is characterised by rigidity, Tremor & bradykinesia. This is due to loss of neurons in pars compacta of substantia nigra. Loss of dopamine diminishes both. This ultimately result in greater inhibition in neurons of VA (ventral anterior) & VL (ventral lateral) nuclei & less pronounced activation of motor cortical areas. Consequence is slowed movements (bradykinesia).

**Correct Answer.** c

(23). In a patient with medullary carcinoma of thyroid severe hypocalcemia was found. A decrease in extracellular Ca++ increase excitability of nerve & muscle by :-

a. Prolonged depolarization of cell membrane  
b. Hyperpolarization of membrane  
c. By decreasing threshold for action potential  
d. Stabilization of cell membrane

**Solution.** (c) By decreasing threshold for action potential

Ref: Read the text below  
Sol:  
A decrease in extracellular calcium concentration increases the excitability of nerve & muscle cell by decreasing the amount of depolarization necessary to initiate the changes in Na+ & K+ conductance i.e. by decreasing the threshold.

**Correct Answer.** c
(24). The frequency of predominant EEG wave present in cerebral sleep or deep sleep is :-

a. 8-12 Hz  
b. 18-30 Hz  
c. 4-7 Hz  
<4 Hz>d.

Solution. (d) <4 Hz  
Ref: Read the text below  
Sol:
Awake state - Beta wave dominates. EEG is said to be desynchronised, it displays low voltage, high frequency activity (18-20 Hz)  
Relaxed individual with eyes closed - Alpha wave predominates frequency 8-12 Hz & 50-100 V amplitude. Most marked in parieto-occipital area.  
Stage I NREM sleep - Alpha waves interspersed with low frequency (4-7 Hz) theta waves. Theta waves are generated in hippocampus.  
Stage II NREM sleep - EEG slows further, but slow wave activity interrupted by sleep spindles (12-14 Hz) & by large K complexes (large, low potentials)  
Stage III - Delta wave with occasional sleep spindles.  
Stage IV - Deep sleep or cerebral sleep delta wave (<4 Hz)  
REM sleep - EEG again become desynchronized. Low voltage, fast activity of REM sleep resembles that seen in aroused subject. Muscle tone is completely lost; but phasic contractions occur in number of muscles, most notably eye muscles.

Correct Answer. d

(25). Lowest threshold for origin of action potential in a motor neuron is at :-

a. Dendrites  
b. Nissl bodies  
c. Axon-hillock alone  
d. Axon hillock + Initial segment of axon

Solution. (d) Axon hillock + Initial segment of axon  
Ref: Read the text below  
Sol:
- The region of the axon which gives rise to axon is called axon-hillock. The beginning of axon is called its initial segment.  
- The axon hillock-initial segment region of motor neuron has lowest threshold & thus axon potential originate there when threshold is exceeded.

Correct Answer. d

(26). All of the following are true for gap-junctions except :-

a. They can be found in both electrical as well as chemical synapse.  
b. There is no synaptic delay.  
c. Usually conduction is in both directions.  
d. At gap junctions connexons of coupled cells are aligned to form connexon channels.

Solution. (a) They can be found in both electrical as well as chemical synapse.  
Ref: Read the text below  
Sol:
- Gap junction join the two cells that participate in electrical synapses. Through this change in membrane potential of one cell is transmitted to other cell by direct flow of current & so there is no synaptic delay.  
- Usually electrical synapse allow conduction in both directions, so differ from chemical synapse, which are unidirectional.  
- Electrical synapses are particularly useful in reflex pathways in which rapid transmission between cells is necessary.

Correct Answer. a
(27). All of the following occur as a result of acclimatization, except :-

a. Polycythemia

b. Vasodilation in pulmonary vessel

c. Increased diffusion capacity of lung

d. Increase in pulmonary ventilation

Solution. (b) Vasodilation in pulmonary vessel
Ref: Read the text below
Sol :
Acclimatization refers to changes in body tissues in response to long term exposure to hypoxia (i.e. at high altitude for days, weeks or years) -
1. Great increase in pulmonary ventilation.
2. A in RBC - polycythemia
3. Increased diffusion capacity of lungs
4. Pulmonary HT - due to vasoconstriction in pulmonary vessels.
5. Capillary density increases in skeletal & cardiac muscle.
6. Increased ability of cell to use O2, despite low PO2.

Correct Answer. b

(28). Which of the following is true when considering the control of temperature

a. It involves afferent input from cutaneous cold receptors

b. The central control is in the hippocampus

c. Vasoconstriction occurs at a core temperature of >37 C

d. All of above.

Solution. (a) It involves afferent input from cutaneous cold receptors
Ref: Read the text below
Sol :
Humans are homeothermic: their core body temperature is controlled within narrow limits.
Control of thermoregulation involves:
(a) Thermal receptors (central and peripheral)
   Peripheral receptors
   - Help by providing information on how hot or cold the body part is
   - Present in skin, mucous membrane and some viscera
TYPES
   - Cold thermoreceptors fire maximally over a range of 25–30 C
   - Innervated by type Ad fibres
   - Respond both to long-term gradual increase or decrease and sudden changes in environmental temperature.
   - Warm thermoreceptors have a maximum discharge rate at 45–50 C
   - Innervated by type C nerve fibres
Central receptors
   - regulate body temperature by influencing neural and hormonal changes
   - sites: hypothalamus, spinal cord, abdominal viscera
   - impulses from
   - Peripheral thermoreceptors; fibres ascend in the lateral spinothalamic tract
   - Head and neck – V cranial nerve
(b) Central regulation, via hypothalamic pre-optic nuclei
Heat-sensitive neurones
Cold-sensitive neurones
Anterior hypothalamus integrates afferent thermal information, particularly warmth leading to sweating, and vasodilatation
Posterior hypothalamus controls the descending pathways to effectors in response to cold, leading to shivering
(c) Effectors
   - Altered behaviour, quantitatively the most effective mechanism
   - Vasomotor response
   - Too cold: vasoconstriction and piloerection
   - Too hot: vasodilatation and sweating

Correct Answer. a
(29). Activation of receptors for ANP increases target cell

a. GTP
b. IP3
c. Protein kinase A activity
d. Guanylate cyclase activity

Solution. (d) Guanylate cyclase activity

Ref: Read the text below

Sol:

Atrial natriuretic peptide (ANP) is released by myocytes in response to atrial stretch. There are a variety of forms. The original peptides isolated from the brain are smaller than the forms subsequently isolated from human heart.

Actions:
- Reduction of ADH-induced water reabsorption in the collecting ducts
- Relaxation of renal arterioles
- Modulatory effects on the GFR
- Inhibition of aldosterone-mediated sodium reabsorption in the distal tubule (natriuretic effect)
  - There is massive ANP activity in end-stage renal failure and congestive cardiac failure.
  - High-affinity binding sites for ANP are present in the renal collecting ducts.
  - Binding results in increased intracellular cyclic guanine monophosphate concentrations and inhibition of sodium transport.

Correct Answer. d

(30). During the cardiac cycle,

a. The aortic and mitral valves are never open at the same time
b. The first heart sound is caused by the rapid ejection of blood from the ventricles
c. The mitral valve is open throughout diastole
d. Left ventricular pressure is always less than aortic pressure

Solution. (a) The aortic and mitral valves are never open at the same time

Ref: Read the text below

Sol:
- The aortic and mitral valves are never open at the same time. This is the basic principle of the cardiac pump.
- The first heart sound is caused by closure of the mitral and tricuspid valves. The mitral valve is open throughout diastole except isovolumetric relaxation.
- Left ventricular pressure is less than aortic pressure during diastole and isovolumetric contraction but is greater than aortic pressure during a substantial period of ventricular ejection.
- Ventricular filling occurs during diastole.

Correct Answer. a
Drug A causes a 33% increase in stroke volume and no change in systolic aortic blood pressure. Starting with the same baseline, drug B causes a 33% increase in systolic and mean aortic blood pressure and no change in stroke volume. Neither drug changes heart rate.

a. Drug A increases the external work of the left ventricle more than drug B
b. Drug B increases the internal work of the left ventricle more than drug A
c. Drug A increases the oxygen consumption of the heart more than drug B
d. The “double product” is greater for drug A than for drug B

Solution. (b) Drug B increases the internal work of the left ventricle more than drug A

Ref.: Read the text below
Sol.: Read the text below
- Drug B increases the internal work of the left ventricle more than drug A because it increases external work by increasing pressure.
- Drug A increases the external work of the left ventricle the same as drug B.
- External work is stroke volume multiplied by mean arterial pressure, so equivalent increases in stroke volume and pressure yield equivalent increases in stroke work.
- Because drug B increases internal work more than drug A, total work is more increased. For this reason, drug B increases the oxygen consumption of the heart more than drug A. The “double product” (aortic pressure times heart rate) is greater for drug B than for drug A.
- Cardiac efficiency is higher with drug A than with drug B because efficiency is a measure of the oxygen cost of external work. Because of the greater internal work, drug B increases oxygen consumption more than drug A.
- The ratio of external work to oxygen consumption would be higher for drug A than drug B.

Correct Answer. b

Purkinje cells cerebellar cortex are excited by:

a. Stellate cells
b. Basket cells
c. Granule cells
d. Golgi cells

Solution. (c) Granule cells

Ref: Read the text below
Sol: Purkinje cells are inhibited by all other cortical interneurons (A, B, D).
- Purkinje neurons project to deep nuclei; they do not receive input from them.

Correct Answer. c
Caisson's disease is due to

a. Gas embolism
b. Fat embolism
c. Amniotic fluid
d. Tumor embolism

Solution. (a) Gas embolism
Ref: Ref: Guyton- 548-549
Sol:
- Caisson’s disease (synonyms- Decompression sickness, bends, Compressed air sickness, Diver’s paralysis, Dysbarism)- symptoms of caisson’s disease are caused by gas bubbles blocking many blood vessels in different tissues (gas embolism) seen during sudden decompression in divers and even pilots.
- If a diver has been beneath the sea long enough that large amounts of nitrogen have dissolved in his or her body and the diver then suddenly comes back to the surface of the sea, significant quantities of nitrogen bubbles can develop in the body fluids either intracellularly or extracellularly and can cause minor or serious damage in almost any area of the body, depending on the number and sizes of bubbles formed; this is called decompression sickness.
- Most common symptom of decompression sickness, affecting 85 to 90% of patients is ‘bends’ or pain in the joints and muscles of legs and arms. In 5 to 10% of the patient nervous system symptoms occur ranging from dizziness to paralysis or collapse and unconsciousness. 2% of patients develop “the chokes” caused by gas embolism in the capillaries of the lungs; patient complains of dyspnoea followed by severe pulmonary edema and occasionally, death.

Correct Answer. a
Which of the following is not absorbed in PCT

a. Na+
b. HCO3
c. PO4
d. H+

Solution. (d) H+
Ref: Ganong's - 648
Sol:

<table>
<thead>
<tr>
<th>Site</th>
<th>Apical Transporter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proximal tubule</td>
<td>Na/glucose Cotransporter</td>
<td>Na+ uptake, glucose uptake</td>
</tr>
<tr>
<td></td>
<td>Na+/P₃ Cotransporter</td>
<td>Na+ uptake, Pi uptake</td>
</tr>
<tr>
<td></td>
<td>Na+ amino acid Cotransporter</td>
<td>Na+ uptake, amino acid uptake</td>
</tr>
<tr>
<td></td>
<td>Na/lactate Cotransporter</td>
<td>Na+ uptake, lactate uptake</td>
</tr>
<tr>
<td></td>
<td>Na/H exchanger</td>
<td>Na+ uptake, H⁺ extrusion</td>
</tr>
<tr>
<td></td>
<td>Cl/base exchanger</td>
<td>Cl⁻ uptake</td>
</tr>
<tr>
<td>Thick ascending limb</td>
<td>Na–K–2Cl Cotransporter</td>
<td>Na+ uptake, Cl⁻ uptake, K⁺ uptake</td>
</tr>
<tr>
<td></td>
<td>Na/H exchanger</td>
<td>Na+ uptake, H⁺ extrusion</td>
</tr>
<tr>
<td></td>
<td>K⁺ channels</td>
<td>K⁺ extrusion (recycling)</td>
</tr>
<tr>
<td>Distal convoluted tubule</td>
<td>NaCl Cotransporter</td>
<td>Na+ uptake, Cl⁻ uptake</td>
</tr>
<tr>
<td>Collecting duct</td>
<td>Na⁺ channel (ENaC)</td>
<td>Na⁺ uptake</td>
</tr>
</tbody>
</table>

Correct Answer. d
(35). Which of the following occurs after 24 hours of fasting:

a. Lipolysis.
b. Muscle break-down.
c. Hepatic gluconeogenesis.
d. All of above.

Solution. (d) All of above
Ref: Read the text below
Sol:
- After 24 hours of fasting, the liver undergoes gluconeogenesis as the storage of glycogen is usually insufficient to maintain the blood glucose level.
- Lipolysis also occurs.
- Muscle break-down does not occur until much later. The blood glucose concentration is usually maintained.
- The brain switches from using glucose to ketone bodies which are derived from fatty acid oxidation in the level.

Correct Answer. d

(36). Pulmonary alveoli are kept dry by factors that include the

a. Phagocytic activity of alveolar macrophages
b. Negative interstitial fluid pressure
c. Low vapor pressure of water in inspired air
d. Secretion of surfactant

Solution. (b) Negative interstitial fluid pressure
Ref: Read the text below
Sol:
- The forces tending to remove fluid from the alveoli are the negative interstitial fluid pressure and the osmotic pressure exerted at the alveolar membrane by ions and crystalloid molecules in the interstitial fluid.
- Fluid movement into pulmonary capillaries, however, is a function of plasma oncotic pressure.
- The pulmonary capillaries are actually more permeable than those in the systemic circulation; that is, they have a higher hydraulic conductivity.
- Alveolar phagocytes do not take up significant amounts of water, and very little water from the alveoli goes into inspired air because the air is well humidified by the upper airways.
- Surfactant lowers the surface tension in the alveoli but does not affect fluid movement

Correct Answer. b

(37). Which is responsible for respiratory drive:

a. O₂
b. CO
c. CO₂
d. Bicarbonate ions

Solution. (c) CO₂
Ref: Ganong’s Physiology-516
Sol:
- Although the body requires oxygen for metabolism, low oxygen levels do not stimulate breathing. Rather, respiratory centre is directly stimulated by higher carbon dioxide levels or excess hydrogen ions in the blood.
- As a result, breathing low-pressure air or a gas mixture with no oxygen at all (such as pure nitrogen) can lead to loss of consciousness without ever experiencing air hunger.
- The respiratory centers try to maintain an arterial CO2 pressure of 40 mm Hg. With intentional hyperventilation, the CO₂ content of arterial blood may be lowered to 10-20 mm Hg (the oxygen content of the blood is little affected), and the respiratory drive is diminished.

Correct Answer. c
(38). During the physical examination of a newborn child, it was observed that the genitalia were female, but masculinized. The genotype was determined to be 46,XX. Which of the following is the most likely cause of this condition?

a. Androgen insensitivity  
b. Decreased blood ACTH levels  
c. Atrophy of the zona reticularis  
d. A defect in the cortisol pathway

**Solution.** (d) A defect in the cortisol pathway.

Ref- Read the text below

Sol:
- The newborn described is genotypically female and suffers from adrenogenital or congenital virilizing hyperplasia in which there is a deficiency in the pathway that leads to cortisol synthesis.
- The inability to synthesize cortisol in turn leads to production of high levels of ACTH and ACTH-releasing factor from the hypothalamus. The result is hypertrophy of the fetal adrenal cortex, which is a critical fetal structure that produces dehydroepiandrosterone.
- The excessive production of androgens by the fetal adrenal leads to masculinization of the female genitalia. Increased secretion of cortisol cannot occur because of the metabolic defect in this pathway; therefore, negative feedback control is not functional.
- The fetal cortex is part of maternal-feto-placental unit because the dehydroepiandrosterone is used by the placenta to produce estradiol. The fetal adrenal cortex involutes following birth, causing an overall reduction in the size of the adrenal.
- The adult cortex (zona glomerulosa, zona fasciculata, and zona reticularis) replaces the fetal adrenal cortex. The zona fasciculata and zona reticularis produce androgens after birth. Vasopressin [AVP; also known as antidiuretic hormone (ADH)] is released by the posterior pituitary and regulates fluid balance.
- ADH increases the permeability of the collecting duct through an aquaporin-mediated mechanism. Androgen insensitivity is the cause of testicular feminization and is not a factor in the adrenogenital syndrome.

**Correct Answer.** d

(39). Which of the following occurs when acetylcholine binds to muscarinic receptors?

a. Heart rate slows  
b. Cardiac conduction velocity rises  
c. Norepinephrine release from sympathetic nerve terminals is enhanced  
d. Nitric oxide release from endothelial cells is inhibited

**Solution.** (a) Heart rate slows.

Ref- Read the text below

Sol:
- The release of acetylcholine from parasympathetic nerves to the sinoatrial node results in a slowing of diastolic depolarization of pacemaker cells and a slowing of the heart rate.
- ACh slows conduction velocity, inhibits NE release from sympathetic terminals, enhances NO release from endothelial cells, and dilates blood vessels of the external genitalia (via NO)— all by binding to muscarinic receptors.

**Correct Answer.** a

(40). Which of the following is true with respect to peripheral chemoreceptors?

a. Activation is important in inhibiting the diving response  
b. Activity is increased by increased pH  
c. They are located in the medulla oblongata, but not the hypothalamus  
d. Activation is important in the cardiovascular response to hemorrhagic hypotension

**Solution.** (d) Activation is important in the cardiovascular response to hemorrhagic hypotension.

Ref- Read the text below

Sol:
- Peripheral chemoreceptor activation plays a significant role in enhancing the diving response by enhancing peripheral vasoconstriction and bradycardia.
- Activation is increased by a decrease in pH and by a lowering of arterial PO2, not oxygen content.
- Peripheral chemoreceptors are located in the aortic and carotid bodies.

**Correct Answer.** d
(41). A 39-year-old man with an enlarged head, hands, and feet, osteoarthritic vertebral changes and hirsutism presents with a complaint of gynecomastia and lactation. The patient is most likely suffering from a tumor in which of the following locations?

a. Hypothalamus
b. Anterior pituitary
c. Posterior pituitary
d. Adrenal cortex

Solution. (b) Anterior pituitary.
Ref- Read the text below
Sol:
- Tumors of the somatotropes of the anterior pituitary gland secrete large amounts of growth hormone, leading to acromegaly in adults.
- When the epiphyses have not yet fused to the long bones, growth is stimulated by excess growth hormone leading to gigantism in children. Once the epiphyses have closed, linear growth is no longer possible, and growth hormone produces the pattern of bone and soft tissue abnormalities typical of acromegaly.
- Hypersecretion of growth hormone is accompanied by hypersecretion of prolactin in up to 40% of patients with acromegaly.
- Human growth hormone also has intrinsic lactogenic activity. Acromegaly can be caused by hypothalamic tumors that secrete growth hormone-releasing hormone (GRH), but these are rare.

Correct Answer. b

(42). A 22-year-old woman presents with a recurrent vaginal candidiasis that is refractory to nystatin treatment. Diabetes screening shows elevated fasting blood glucose, and the patient is started on 25 units of insulin per day. Which aspect of glucose transport is enhanced by insulin?

a. Transport into adipocytes
b. Transport across the tubular epithelium of the kidney
c. Transport into the brain
d. Transport through the intestinal mucosa

Solution. (a) Transport into adipocytes.
Ref- Read the text below
Sol:
- Insulin increases glucose uptake by adipocytes.
- Transport of glucose into cells is by facilitated diffusion. Insulin increases the number of transporters available for glucose uptake in many cells, including adipocytes, skeletal, and cardiac muscle, and some smooth muscle. Insulin does not enhance glucose transport into brain cells, intestinal mucosal cells, or renal tubular epithelial cells.
- Diabetics have increased susceptibility to infections due to decreased efficacy of granulocytes despite a normal number.
- Type 1 diabetes mellitus patients must use insulin.
- They cannot use oral hypoglycemic agents because they do not have any functional pancreatic b cells.

Correct Answer. a
(43). In a healthy, alert adult, with the eyes closed, the dominant EEG rhythm observed over the occipital lobes is

- a. alpha (8–13 kHz)
- b. delta (0.5–4 Hz)
- c. beta (18–30 Hz)
- d. theta (4–7 Hz)

**Solution.** (a) alpha (8–13 kHz).

**Ref-** Read the text below

Sol:

- EEG
- The dominant waves that occur with the eyes closed but awake are alpha waves recorded over the parietal-occipital area of the brain.
- Alpha waves are associated with partial eye closing.
- Beta waves are recorded from the frontal area and occur normally in infants, to be replaced by alpha waves in the adult.
- Delta waves are slow and found in children and during sleep.
- Theta waves are large, regular waves found normally in children.
- Fast low-voltage activity occurs when the eyes are open.

**Correct Answer.** a

(44). Choose the incorrect statement regarding “excitability of nerves”

- a. Is increased by a decrease in extracellular calcium ion concentration
- b. Is dependent on the resting membrane potential is reduced by an influx of chloride ions
- c. Is increased by reducing the extracellular sodium ion concentration
- d. Is increased by increasing the extracellular potassium ion concentration

**Solution.** (c) Is increased by reducing the extracellular sodium ion concentration.

**Ref-** Read the text below

Sol:

- There is an electric charge across the resting cell membrane with the inside of the cell being 70–80 mV negative compared to the outside of the cell.
- This membrane potential is caused by (a) the differential permeability of the cell membrane to different ions, e.g. most cell membranes are not permeable to sodium ions, (b) different concentrations of ions on the inside and the outside. Active pumps help to maintain this uneven distribution.
- Only a very small number of potassium ions have to move from outside to inside to produce the resting potential.
- The action potential is an all-or-nothing event which occurs when there is an increase in membrane conductance for sodium. If the external sodium decreases the action potential is smaller or does not occur.
- Hyperkalaemia and hypokalaemia are both associated with reduced muscle and nerve function as repolarisation is slowed.

**Correct Answer.** c

(45). Increased afferent input discharge by the baroreceptors

- a. Increases vagal stimulation
- b. Causes peripheral vasoconstriction
- c. Increases heart rate
- d. Increases sympathetic stimulation

**Solution.** (a) Increases vagal stimulation.

**Ref-** Read the text below

Sol:

- Baroreceptors are found in the carotid sinus, as well as the atra, aorta and pulmonary circulation.
- They are stretch receptors that detect low pressures. With stretch due to an increase in blood pressure the afferent discharge increases, leading to reduced sympathetic discharge, reduced vasoconstriction and bradycardia, cardiac output falls, as does peripheral vascular resistance.
- At normal blood pressure the baroreceptors fire slowly. A fall in discharge would increase renin production.
- Chemoreceptors in the carotid sinus respond to hypoxaemia by increasing sympathetic activity.

**Correct Answer.** a
(46). A 72-year-old woman is known to have severe ischaemic heart disease. On examination, she has bibasal crepitation, a raised jugular venous pulse and bilateral pitting oedema up to her waist. An echocardiogram shows a left ventricular ejection fraction of 25% and a dilated right heart. Which one of the following is a consequence of this clinical picture?

a. Increased sympathetic outflow to the failing heart.

b. Decreased activity of the renin-angiotensin-aldosterone system

c. Decreased venous pressure

d. Shift of salt and water from the interstitial space

**Solution.** (a) Increased sympathetic outflow to the failing heart.

**Reference – Read the text below**

Sol
- The reduced cardiac output stimulates the sympathetic system via the baroreceptors.
- The decreased renal perfusion stimulates the renin-angiotensin-aldosterone system, which increases vasoconstriction.
- The starling curve moves downwards when the heart fails.

**Correct Answer.** a

(47). Which one of the following statements is true of erythropoiesis and erythropoietin?

a. Hypoxia is the main stimulus to erythropoietin production

b. Erythropoietin increases the maturation time for red cell precursors

c. Erythropoietin levels are found to be low in secondary polycythaemia

d. Bilateral nephrectomy completely abolishes erythropoietin production

**Solution.** (a) Hypoxia is the main stimulus to erythropoietin production.

**Reference – Read the text below**

Sol
- Hypoxia is the chief stimulus to erythropoiesis. Around 85% of erythropoietin (166 amino acids) is produced by the kidneys and 15% is produced by the liver.
- The rate-controlling enzyme for porphyrin and haem synthesis is ALA-S. Its synthesis is inhibited by haemoglobin in polycythemia rubra vera.
- Genetically engineered erythropoietin is now available for the treatment of anaemia caused by renal failure.

**Correct Answer.** a

(48). Hypertension was observed in a young boy since birth. Which of the following disorders may be present?

a. Bartter’s syndrome

b. Gitelman’s syndrome

c. Liddle’s syndrome

d. Nephrogenic diabetes insipidus

**Solution.** (c) Liddle’s syndrome.

**Reference – Read the text below**

Sol
- Liddle’s syndrome is due to excessive activity of the Na+ channel in collecting duct principal cells, leading to salt retention and hypertension.
- Bartter and Gitelman syndromes are salt-wasting disorders; blood pressure would tend to be low, not high.
- Diabetes insipidus and renal glucosuria produce excessive fluid loss and would not be likely causes of the patient’s hypertension.

**Correct Answer.** c
(49). In a person with severe central diabetes insipidus (deficient production or release of AVP), urine osmolality and flow rate is typically about

- a. 50 mOsm/kg H2O, 18 L/day
- b. 50 mOsm/kg H2O, 1.5 L/day
- c. 300 mOsm/kg H2O, 1.5 L/day
- d. 300 mOsm/kg H2O, 18 L/day

**Solution.** (a) 50 mOsm/kg H2O, 18 L/day.
Reference – Read the text below
Sol
- In the absence of arginine vasopressin, the kidneys produce a large volume of osmotically dilute urine.

**Correct Answer.** a

(50). Which of the following leads to decreased Na\(^+\) reabsorption by the kidneys?

- a. An increase in central blood volume
- b. An increase in colloid osmotic pressure in the peritubular capillaries
- c. An increase in GFR
- d. An increase in plasma aldosterone level

**Solution.** (a) An increase in central blood volume.
Reference – Read the text below
Sol
- An increase in central blood volume will stretch the atria, cause the release of atrial natriuretic peptide, and result in diminished Na\(^+\) reabsorption.
- All other choices produce increased tubular Na\(^+\) reabsorption.

**Correct Answer.** a

(51). The nephron segment that reabsorbs the largest percentage of filtered Mg\(^2+\) is the

- a. Proximal convoluted tubule
- b. Thick ascending limb
- c. Distal convoluted tubule
- d. Cortical collecting duct

**Solution.** (b) Thick ascending limb.
Reference – Read the text below
Sol
- The loop of Henle (mostly the thick ascending limb) reabsorbs about 65% of the filtered Mg\(^2+\).

**Correct Answer.** b
(52). Which of the following causes decreased renin release by the kidneys?

a. Decreased fluid and solute delivery to the macula densa
b. Hemorrhage
c. Intravenous infusion of isotonic saline
d. Narrowing (stenosis) of the renal artery

Solution. (c) Intravenous infusion of isotonic saline.
Reference – Read the text below
Sol
- Infusion of isotonic saline tends to raise blood pressure, decrease renal sympathetic nerve activity, and increase fluid delivery to the macula densa; all of these changes suppress renin release.
- All other choices result in increased renin release.

Correct Answer. c

(53). Intravenous infusion of 2.0 L of isotonic saline (0.9% NaCl) results in increased

a. Intracellular fluid volume
b. Plasma aldosterone level
c. Plasma arginine vasopressin (AVP) concentration
d. Plasma atrial natriuretic peptide (ANP) concentration

Solution. (d) Plasma atrial natriuretic peptide (ANP) concentration.
Reference – Read the text below
Sol
- Isotonic saline does not change cell volume.
- The plasma AVP level will fall because of volume expansion and cardiovascular stretch receptor inhibition of its release.
- The plasma aldosterone level will be low because of inhibited release of renin and less angiotensin II formation.
- The plasma ANP level will be increased from stretch of the cardiac atria. A large part of the infused isotonic saline will be filtered through capillary walls into the interstitial fluid.

Correct Answer. d

(54). The kidneys of a person with congestive heart failure avidly retain Na⁺. The best explanation for this is that the

a. Effective arterial blood volume is decreased
b. Extracellular fluid volume is decreased
c. Extracellular fluid volume is increased
d. Total blood volume is decreased

Solution. (a) Effective arterial blood volume is decreased.
Reference – Read the text below
Sol
- ECF volume and blood volume are increased, but these should promote Na⁺ excretion, not lead to Na⁺ retention by the kidneys.
- A decrease in effective arterial blood volume is the best explanation for renal Na⁺ retention.

Correct Answer. a
(55). The following are associated with hyperventilation

a. Increase in PaCO2
b. Increase in PaO2
c. Increase in ionised calcium
d. Decrease in CSF bicarbonate

Solution. (d) Decrease in CSF bicarbonate

Ref.: Read the text below

Sol:
Hyperventilation is an abnormally increased pulmonary ventilation. This results in a reduction of carbon dioxide tension and, if persistent, can lead to the development of an alkalosis. Respiratory alkalosis leads to an increased binding of plasma calcium and reduced ionised calcium (effective hypocalcaemia).

Possible causes of hyperventilation in the presence of a normal chest X-ray and no abnormal lung signs include:
- Psychiatric illness, e.g. Hysteria
- Pulmonary emboli
- Initial stages of pulmonary oedema
- An interstitial lung disease
- Hyperthyroidism
- Fever
- Metabolic acidosis, for example diabetic ketoacidosis
- Weakness of the respiratory muscles
- Lymphangitis carcinomatosis

Prolonged hyperventilation will lower the PCO2. This in turn will reduce cerebral blood flow and lactate production. It will also shift the oxygen dissociation curve to the left and may cause vasoconstriction. Renal compensation for this lower PCO2 will involve reabsorption of bicarbonate and excretion of Hp in the urine. Active hyperventilation may be associated with a decreased mixed-venous PO2 since this depends on oxygen demand, oxygen delivery and tissue oxygen extraction.

Correct Answer. d

(56). The physiological effects of pregnancy include

a. Increased functional residual volume
b. A shift of the oxygen dissociation curve to the right
c. Anaemia due to a fall in red cell mass
d. An increase in plasma fibrinogen concentration

Solution. (d) An increase in plasma fibrinogen concentration

Ref.: Read the text below

Sol:
(a) Cardiovascular system
- Cardiac output increases by 30%-40% above normal by 32 weeks.
- Aortocaval compression is sufficient to reduce cardiac output from 20 weeks
- Heart rate increases by 15%, stroke volume increases by 30%. SVR falls resulting in no change in BP
- Cardiac hypertrophy and dilation cause ECG changes of left axis deviation, ST depression and flattening/inversion of T wave in III
- Albumin is diluted, reducing plasma oncotic pressure and predisposing to pulmonary oedema at lower pressures
- Aortocaval compression is significant from mid-pregnancy

(b) Respiratory system
- Increased minute volume by 40%, tidal volume by 15% and respiratory rate. A mild respiratory alkalosis gives a shift of the oxygen dissociation curve to the left. An increase in P50 facilitates
- oxygen unloading across the placenta
- Increased tidal volume with reduced FRC
- Increased closing capacity which may exceed FRC
- Increased O2 consumption

(c) Gastrointestinal system
- Uterine pressure increases intragastric pressure and distorts lower oesophageal sphincter, causing incompetence of the sphincter
- Delayed gastric emptying and increased acid production
(d) Blood
- Increased red cell mass by 20%-30% and increased plasma volume by 40%-50% at term, causing dilutional anaemia
- Hypercoagulable state with increased fibrinolytic systems

(e) Renal system
- Increase in GFR of 60% reduces plasma urea and creatinine by 40%

(f) Metabolism
- Increased volume of distribution of intravenous agents prolongs their elimination half-lives
- Serum cholinesterase levels fall by 25% during the first trimester and then fall further by 33% during the first 7 days postpartum

Correct Answer. d
(57). Which of the following sources of cholesterol is most important for sustaining adrenal steroidogenesis when it occurs at a high rate for a long time?

a. Cholesterol in LDL particles
b. Cholesterol in the plasma membrane
c. Cholesterol in lipid droplets within adrenal cortical cells
d. Cholesterol from the endoplasmic reticulum

Solution. (a) Cholesterol in LDL particles.
Reference – Read the text below
Sol
- Cholesterol esters in LDL are the most important source of cholesterol for sustaining adrenal steroidogenesis when it occurs at a high rate over a long time.
- This cholesterol can be used directly after release from LDL and not stored. De novo synthesis of cholesterol from acetate is a minor source of cholesterol in humans.
- Cholesterol from the plasma membrane or endoplasmic reticulum is not used for steroidogenesis.
- Cholesterol esters in lipid droplets within adrenal cortical cells would be used first and depleted during periods of high adrenal steroid hormone synthesis.

Correct Answer. a

(58). A 7-year-old boy comes to the pediatric endocrine unit for evaluation of excess body weight. Review of his growth charts indicates substantial weight gain over the previous 3 years but little increase in height. To differentiate between the development of obesity and Cushing’s disease, blood and urine samples are taken. Which of the following would be most diagnostic of Cushing’s disease?

a. Increased serum ACTH, decreased serum cortisol, and increased urinary free cortisol
b. Decreased serum ACTH, increased serum cortisol, and increased serum insulin
c. Increased serum ACTH, increased serum cortisol, and increased serum insulin
d. Increased serum ACTH, decreased serum cortisol, and decreased serum insulin

Solution. (c) Increased serum ACTH, increased serum cortisol, and increased serum insulin.
Reference – Read the text below
Sol
- The increase in body weight with little linear growth suggests that the patient has Cushing’s disease rather than general obesity because linear growth usually continues in obesity syndromes.
- Laboratory findings in Cushing’s disease include elevated ACTH, serum cortisol, urinary cortisol, and serum insulin (as a result of the cortisol-induced resistance to insulin action in skeletal muscle and adipose tissue).

Correct Answer. c
(59). Congenital adrenal hyperplasia is most likely a result of

a. Defects in adrenal steroidogenic enzymes

b. Addison’s disease

c. Defects in ACTH secretion

d. Defects in corticosteroid-binding globulin

Solution. (a) Defects in adrenal steroidogenic enzymes.

Reference – Read the text below
Sol – Congenital adrenal hyperplasia is the result of genetic defects that affect adrenal steroidogenic enzymes, producing an impaired formation of cortisol. Low serum cortisol is a stimulus for ACTH release from the hypothalamus.

- The increase in ACTH has a proliferative effect on the adrenal gland, resulting in hyperplasia. Addison’s disease is the result of pathological destruction of the adrenal glands by microorganisms or autoimmune disease and would, therefore, not result in adrenal hyperplasia.

- ACTH stimulates the growth of the adrenal gland. A reduction in ACTH in the blood would result in atrophy of the adrenal gland.

- Corticosteroid-binding globulin noncovalently binds steroid hormones in plasma; defects in this protein are not associated with adrenal hyperplasia. Cushing’s disease results from a pituitary ACTH-secreting tumor; adrenal hyperplasia is secondary, not congenital, in this disease.

- Aldosterone synthesis is regulated by the renin-angiotensin system. Defective aldosterone synthesis would, therefore, not lead to increased ACTH and adrenal hyperplasia.

Correct Answer. a

(60). A patient complains of generalized weakness and fatigue, anorexia, and weight loss associated with gastrointestinal symptoms (nausea, vomiting). Physical examination notes hyperpigmentation and hypotension. Laboratory findings include hyponatremia (low plasma sodium) and hyperkalemia (high plasma potassium). The most likely diagnosis is

a. Cushing’s disease

b. Addison’s disease

c. Primary hypoadosteronism

d. Congenital adrenal hyperplasia

Solution. -NA-

Correct Answer. b

(61). Slow, high voltages on an electroencephalogram are associated with

a. Deep anaesthesia

b. Cerebral hypoxia

c. Hypertension

d. Hypothermia

Solution. (a) Deep anaesthesia.

Ref- Read the text below
Sol: - Slow, high-amplitude waves are seen in deep anaesthesia.
- High amplitude waves are seen in hypoxia but as the hypoxia continues slow waves with reduced amplitude are seen.

Correct Answer. a
(62). Which of the following is most likely to cause an increase in the glomerular filtration rate?

a. Contraction of mesangial cells  
b. Blockage of the ureter  
c. Release of renin from the juxtaglomerular apparatus  
d. Dilation of the afferent arterioles

**Solution.** (d) Dilation of the afferent arterioles.  
**Ref-** Read the text below  
**Sol:**  
- The GFR is proportional to the glomerular capillary hydrostatic pressure, the renal plasma flow, and the surface area and hydraulic conductivity of the diffusion barrier between the glomerular capillary and Bowman’s space.  
- Dilating the afferent arteriole causes an increase in glomerular capillary pressure and, therefore, an increase in GFR.  
- Volume depletion causes a release of renin from the juxtaglomerular cells, leading to an increase in angiotensin II (AII) that causes constriction of the glomerular capillaries and contraction of the mesangial cells.  
- Contraction of the mesangial cells causes a decrease in the surface area of the diffusion barrier between the glomerular capillary and Bowman’s space.  
- Blockage of the ureter causes an increase in tubular pressure that retards the filtration of water from the capillary to the nephron.

**Correct Answer.** d

(63). If a substance appears in the renal artery but not in the renal vein, which of the following is true?

a. It must be filtered by the kidney  
b. It must be reabsorbed by the kidney  
c. Its clearance is equal to the glomerular filtration rate  
d. Its clearance is equal to the renal plasma flow

**Solution.** (d) Its clearance is equal to the renal plasma flow.  
**Ref-** Read the text below  
**Sol:**  
- If a substance disappears from the circulation during its passage through the kidney, it usually indicates that it has been totally secreted into the nephron.  
- In this case, its clearance will be equal to the RPF. If the substance is bound to plasma proteins, it can be secreted without being filtered.  
- Even if it is entirely secreted by the kidney, its urinary concentration may be less than its plasma concentration if the urinary flow rate is very high.

**Correct Answer.** d

(64). Interruption of the cervical sympathetic chain results in

a. Dilation of the pupil; on the affected side  
b. Loss of taste sensation over the anterior two-thirds of the tongue  
c. Partial ptosis on the same side  
d. Dryness of the mouth

**Solution.** (c) Partial ptosis on the same side.  
**Ref-** Read the text below  
**Sol:**  
- A block of the cervical sympathetic chain can be due to a therapeutic block or by tumour in the superior mediastinum or lung apex.  
- A Horner’s syndrome results in: miosis, ptosis, anhidrosis, enophthalmos (and nasal stuffiness, which is not defined within Horner’s syndrome).  
- Dilatation of the pupil is due to sympathetic stimulation. Salivation is due to parasympathetic stimulation.

**Correct Answer.** c
(65). Specialized cardiac muscle cells that control the rate of the heartbeat are found in which of the following sites?

a. In the muscular wall of the interventricular septum
b. In the arch of the aorta
c. In the wall of the left atrium between openings of the pulmonary veins
d. In the wall of the right atrium near the opening of the superior vena cava

Solution. (d) In the wall of the right atrium near the opening of the superior vena cava.

Ref: Read the text below

Sol:
- Specialized cardiac muscle cells, which form the sinoatrial (SA) node, are the pacemakers of the heartbeat.
- They have the fastest-paced autorhythmicity of all cardiac muscle cells and are located in the wall of the right atrium near the opening of the superior vena cava. Specialized cardiac muscle cells forming the atrioventricular node are also located in the wall of the right atrium but near the interatrial wall and the opening of the coronary sinus.
- The left atrium contains no known nodes of pacing cells. Large specialized cardiac muscle cells are the Purkinje’s cells, which make up the bundle of His.
- These cells are found in the subendocardial portion of the interventricular wall and conduct impulses to the ventricular myocytes of both ventricles.
- The aortic arch contains baroreceptors that control heart rate through a reflex arc connected to parasympathetic ganglia on the surface of the heart.

Correct Answer. d

(66). Regarding lung volumes, which of the following is true:

a. Functional residual capacity accounts for 75% of total lung capacity
b. Residual volume keeps alveoli inflated between breaths
c. The air inspired with a maximal inspiratory effort in excess of the tidal volume is 1500 ml
d. Residual volume is about 500 ml

Solution. (b) Residual volume keeps alveoli inflated between breaths

Ref: Ganong’s -474

Sol:
- The amount of air that moves into the lungs with each inspiration (or the amount that moves out with each expiration) is called the tidal volume (500 ml)
- The air inspired with a maximal inspiratory effort in excess of the tidal volume is the inspiratory reserve volume. (3000 ml)
- The volume expelled by an active expiratory effort after passive expiration is the expiratory reserve volume (1200 ml), and the air left in the lungs after a maximal expiratory effort is the residual volume (1200 ml).

Correct Answer. b
(67). Major contribution to plasma osmolality is by which ion:

a. Sodium
b. Potassium
c. Glucose
d. Calcium

**Solution.** (a) Sodium
Ref: Ganong’s -6
Sol:
- All but about 20 of the 290 mosm in each liter of normal plasma are contributed by Na+ and its accompanying anions, principally Cl- and HCO3-. Other cations and anions make a relatively small contribution.
- Although the concentration of the plasma proteins is large when expressed in grams per liter, they normally contribute less than 2 mosm/L because of their very high molecular weights.
- The major nonelectrolytes of plasma are glucose and urea, which in the steady state are in equilibrium with cells.
- Their contributions to osmolality are normally about 5 mosm/L each but can become quite large in hyperglycemia or uremia.
- Hyperosmolality can cause coma (hyperosmolar coma).

Correct Answer. a

(68). Repolarization of a nerve is due to:

a. Hydrogen ions
b. Potassium ions
c. Sodium ions
d. Calcium ions

**Solution.** (b) Potassium ions
Ref: Ganong’s.-85
Sol:
- The Na+ channels rapidly enter the inactivated state and remain in this state for a few milliseconds before returning to the resting state.
In addition, the direction of the electrical gradient for Na+ is reversed during the overshoot because the membrane potential is reversed, and this limits Na+ influx.
- A third factor producing repolarization is the opening of voltage-gated K+ channels.
- The net movement of positive charge out of the cell due to K+ efflux at this time helps complete the process of repolarization.
- The slow return of the K+ channels to the closed state also explains the after-hyperpolarization.

Correct Answer. b

(69). With glucose which of the following is transported:

a. Hydrogen ions
b. Potassium ions
c. Calcium ions
d. Sodium ions

**Solution.** (d) Sodium ions
Ref: Ganong’s Physiology-318
Sol:
- Sodium-dependent glucose cotransporters (SGLT) are a family of glucose transporter found in the intestinal mucosa (enterocytes) of the small intestine (SGLT1) and the proximal tubule of the nephron (SGLT2 in PCT and SGLT1 in PST).
- They contribute to renal glucose reabsorption. In the kidneys, 100% of the filtered glucose in the glomerulus has to be reabsorbed along the nephron (98% in PCT, via SGLT2).
- In case of too high plasma glucose concentration (hyperglycemia), glucose is excreted in urine (glucosuria); because SGLT are saturated with the filtered monosaccharide. One must know that glucose is never secreted by the nephron

Correct Answer. d
(70). In which one of the following conditions will the diffusing capacity of the lung increase?

a. Formation of pulmonary emboli

b. Fibrotic lung disease

c. Polycythemia

d. Congestive heart failure

**Solution.** (c) Polycythemia

Ref: Read the text below

Sol: - In the tissues, the diffusing capacity is the volume of gas transported across the lung per minute per mmHg partial pressure difference.
- It is determined by the surface area and the thickness of the alveolar-capillary interface.
- Increases in the diffusing capacity can be produced by opening pulmonary capillaries, expanding the surface area of the pulmonary capillaries, optimizing the V/Q ratio within the lung, or by increasing the concentration of hemoglobin within the blood (polycythemia).
- It can be decreased by mismatching of ventilation and perfusion, pulmonary edema, or pulmonary emboli, all of which interfere with gas diffusion.

**Correct Answer.** c

(71). The anion gap will increase with an increase in the plasma concentration of

a. Sodium

b. Chloride

c. Bicarbonate

d. Lactate

**Solution.** (d) Lactate

Ref: Read the text below

Sol: - The anion gap is the difference between the concentration of Na+ and the concentration of the major plasma anions, Cl and HCO₃⁻.
- The minor ions, lactate, phosphate, sulfate, comprise the anion gap.
- Increases in lactate, as in lactic acidosis, will cause an increase in the anion gap because the lactic acid reduces the plasma bicarbonate concentration.
- Increases in sodium normally are associated with an increase in Cl and therefore do not increase the anion gap.
- Similarly, increases in bicarbonate typically are associated with a corresponding decrease in Cl and do not increase the anion gap.

**Correct Answer.** d

(72). If 600 mL of water is ingested rapidly, plasma volume will increase by approximately

a. 400 mL

b. 200 mL

c. 100 mL

d. 50 mL

**Solution.** (d) 50 mL

Ref: Read the text below

Sol: - When water is ingested from the intestine, it enters the plasma and rapidly achieves osmotic equilibrium with the interstitial and intracellular compartments.
- Since the plasma volume is approximately 8% (1/12) of the total body water volume, only 8% of the ingested water will remain in the plasma.
- Therefore, of the 600 mL of water ingested, approximately 50 mL remains in the plasma, 150 mL enters the interstitium, and 400 mL enters the intracellular space.

**Correct Answer.** d
(73). Renin secretion by the kidney is increased by

a. Increasing mean blood pressure
b. Increasing glomerular filtration rate
c. Increasing sympathetic nerve activity
d. Increasing angiotensin II synthesis

Solution. (c) Increasing sympathetic nerve activity
Ref: Read the text below
Sol: - Renin secretion is stimulated by the sympathetic nerves innervating the juxtaglomerular apparatus. Increasing mean blood pressure decreases sympathetic activity.
- Changes in GFR are detected by the macula densa.
- Decreases in GFR lead to an increase in renin release and the secretion of a mediator, perhaps adenosine, that contracts the afferent arteriole.
- ANF and angiotensin II will decrease renin release.

Correct Answer. c

(74). Glomerular filtration rate would be decreased by

a. Constriction of the efferent arteriole
b. An increase in afferent arteriolar pressure
c. Compression of the renal capsule
d. A decrease in the concentration of plasma protein

Solution. (c) Compression of the renal capsule
Ref: Read the text below
Sol: - Glomerular filtration rate (GFR) will decrease if there is a decrease in the net glomerular capillary pressure or the flow of fluid through the glomerulus.
- The net glomerular capillary pressure (for Starling forces) is equal to the glomerular capillary pressure minus the sum of the plasma oncotic pressure and intrarenal pressure.
- Compression of the renal capsule increases the intrarenal pressure and therefore decreases the net capillary filtration pressure.
- Constriction of the efferent arteriole increases glomerular capillary pressure.
- Decreasing the concentration of plasma protein will decrease the plasma oncotic pressure and lead to an increase in GFR.

Correct Answer. c

(75). The most important renal defense against respiratory alkalosis is:

a. Increased excretion of H+
b. Decreased excretion of N+
c. Increased excretion of NaHCO3
d. Decreased production of NH3

Solution. (c) Increased excretion of NaHCO3
Ref: Read the text below
Sol: - Respiratory alkalosis usually induced by hyperventilation is characterized by a reduced PCO2 and increased HCO3/PCO2 ratio.
- Hydrogen ions are released from the intracellular buffers as well as from the hemoglobin in the RBCs.
- This causes a decrease in extracellular HCO3 concentration.
- Renal compensation during persistent hyperventilation (and hypocapnia) occurs because of the decrease tubular H+ secretion and increased excretion of NaHCO3. Plasma HCO3 concentration decreases, and the HCO3/PCO2 ratio shifts forward normal with pH at around 7.5

Correct Answer. c
(76). CO₂ is primarily transported in the arterial blood as

a. Dissolved CO₂
b. Carbonic Acid
c. Carbamino-hemoglobin
d. Bicarbonate

**Solution.** (d) Bicarbonate

Ref: Read the text below

Sol:
- CO₂ is transported as dissolved CO₂ (5%), as carbamino compounds (5%) and as bicarbonates (90%)

**Correct Answer.** d

(77). In the standing position, venous return to the heart is not affected by

a. Competent valves
b. Deep fascia
c. Arterial pressure
d. Contraction of calf muscles

**Solution.** (c) Arterial pressure

Ref: Read the text below

Sol:
Factors affecting venous return from lower limbs:
- Muscle contraction - Venous return from lower limb depends largely on muscular activity, especially contraction of the calf muscles, known as the 'calf pump'
- Deep fascia - Efficiency of muscular pump is aided by the tight sleeve of deep fascia (deep fascia prevents outward bulge of the contracting muscles thus aiding in more effective compression of the veins)
- Valves - Valves are of great importance in maintaining unidirectional flow as blood is moved towards the heart by intermittent muscular contractions - valves prevent the reverse flow.
- Negative intrathoracic pressure made more negative during inspiration
e. Arterial pulsation of the arteries accompanying veins.

**Correct Answer.** c

(78). Equilibrium potential for an ion is calculated using

a. Gibbs Donnan equation
b. Goldman equation
c. Nernst equation
d. Henderson Hesselbach equation

**Solution.** (c) Nernst equation

Ref: Read the text below

Sol:
- In **electrochemistry**, the Nernst equation is an equation that can be used (in conjunction with other information) to determine the **equilibrium reduction potential** of a **half-cell** in an **electrochemical cell**. It can also be used to determine the total **voltage** (electromotive force) for a full electrochemical cell. It is named after the German physical chemist who first formulated it, **Walther Nernst**.
- The Nernst equation gives a formula that relates the numerical values of the **concentration gradient** to the **electric gradient** that balances it. For example, if a concentration gradient was established by dissolving KCl in half of a divided vessel that was originally full of H₂O, and then a membrane permeable to K⁺ ions was introduced between the two halves—empirically, an equilibrium situation would arise where the chemical concentration gradient (that would normally cause ions to move from the region of high concentration to the region of low concentration) could be balanced by an electrical gradient that opposes the movement of charge.

**Correct Answer.** c
(79). Which of the following statements regarding the muscle response to exercise is incorrect?

a. Endurance training (submaximal, sustained efforts), like marathon running, mainly results in an increased oxidative metabolic capacity of the motor units involved

b. Endurance training places an increased load on the cardiovascular and respiratory systems and increases the capacity of the heart and respiratory muscles

c. Strength training (brief, maximal efforts), like weightlifting, causes hypertrophy and enhanced glycolytic capacity of the motor units involved

d. Strength training causes hyperplasia of muscle fibres

Solution. (d) Strength training causes hyperplasia of muscle fibres
Ref: Read the text below
Sol:
- The formation of new muscle fibres is hyperplasia and is infrequent in skeletal muscle.
Correct Answer. d

(80). PCT absorbs all except:

a. Sodium

b. Glucose

c. Hydrogen ions

d. Amino acids

Solution. (c) Hydrogen ions
Ref: Read the text below
Sol:
- The proximal convoluted tubular cells have the appearance of being highly metabolic cells, having large numbers of mitochondria to support extremely rapid active transport processes; true enough, one finds that about 65 per cent of the glomerular filtrate normally is reabsorbed before reaching the loops of Henle.
- The most important substances that are specifically absorbed by secondary active transport in the proximal tubules are glucose and amino acids.
- The most important substance that is secreted by secondary active transport is hydrogen ions.
Correct Answer. c

(81). Mean arterial pressure changes if

a. Heart rate increases, with no changes in cardiac output or systemic vascular resistance

b. Stroke volume changes, with no changes in heart rate or systemic vascular resistance

c. Arterial compliance changes, with no changes in cardiac output or systemic vascular resistance

d. Heart rate doubles and systemic vascular resistance is halved, with no change in stroke volume

Solution. (b) Stroke volume changes, with no changes in heart rate or systemic vascular resistance
Ref: Read the text below
Sol:
- A stroke volume change with no change in heart rate means that cardiac output is changed.
- If we assume that mean arterial pressure is determined by CO and SVR and SVR is constant, then mean arterial pressure must have changed. Heart rate changes with no changes in cardiac output or SVR will have no effect on mean arterial pressure.
- A doubling of heart rate with no change in stroke volume gives a doubling of cardiac output; if SVR is halved at the same time, then mean arterial pressure will not change.
- Arterial compliance influences pulse pressure but not mean arterial pressure.

Correct Answer. b
During pregnancy, deficiency of which vitamin in women causes neural tube defect in the newborn:

- Thiamine
- Pyridoxine
- Folic acid
- Cyanocobalamin

**Solution.** (c) Folic acid  
Ref: Ganong’s-465  
Sol:  
Deficiency of:  
- Thiamine causes Beri Beri, neuritis  
- Pyridoxine causes Convulsion, hyperirritability  
- Folic acid causes sprue, anemia and neural tube defect in the newborn to folate-deficient mothers  
- Cyanocobalamin causes pernicious anemia, loss of vibration and position sense, dementia, abnormal gait.

**Correct Answer.** c

**Main content of bilayer cell membrane is:**

- Glycerol
- Cholesterol
- Cholesterol ester
- Triacyl glycerol

**Solution.** (b) Cholesterol  
Ref: Harper’s Biochemistry, 28th ed., p-408  
Sol:  
- Biological membranes typically include several types of lipids other than phospholipids.  
- A particularly important example in animal cells is cholesterol, which helps strengthen the bilayer and decrease its permeability.  
- Cholesterol also helps regulate the activity of certain integral membrane proteins.  
- Integral membrane proteins function when incorporated into a lipid bilayer.  
- Because bilayers define the boundaries of the cell and its compartments, these membrane proteins are involved in many intra-and intercellular signaling processes.

**Correct Answer.** b

When lipid-soluble molecules pass through a capillary wall, they primarily cross through:

- The lipid component of cell membranes
- The water-filled spaces between cells
- The specialized transport proteins of the cell membranes
- The pinocytotic-exocytotic vesicles formed by endothelial cells

**Solution.** (a) The lipid component of cell membranes  
Reference - Read the text below  
Sol:  
- Lipids are not particularly water-soluble and must primarily diffuse through the lipid layers of cell membranes.  
- A small amount of lipid does move through water-filled channels.

**Correct Answer.** a
(85). Venules function to collect blood from the tissue and

a. Act as a substantial source of resistance to regulate blood flow
b. Serve as a reservoir for blood in the cardiovascular system
c. Are virtually impermeable to both large and small molecules
d. Are about the same diameter as arterioles

Solution. (b) Serve as a reservoir for blood in the cardiovascular system

Reference – Read the text below
Sol
- The cardiovascular system is designed to support a much higher metabolic rate than exists at rest.
- Only a fraction of the available blood flow is necessary for functioning at rest, and the remainder moves slowly through the venules and smallest veins.

Correct Answer. b

(86). Radiation treatment for a pituitary tumor in an 8-year-old boy results in the complete loss of pituitary function. As a result, the child is likely to experience which of the following symptoms?

a. Hypothyroidism and goiter
b. Absent sexual maturation
c. Accelerated growth spurts
d. Increased ACTH

Solution. (b) Absent sexual maturation

Reference – Read the text below
Sol
- Radiation treatment likely produced panhypopituitarism in the young child. Sexual maturation and growth during development will not occur because of low levels of GH, FSH, LF, IGF1, TSH and thyroid hormones, and gonadal hormones.
- The cortisol response to stress is decreased due to low ACTH levels. A goiter cannot develop in the absence of TH.

Correct Answer. b

(87). A pituitary adenoma is likely to result in which of the following clinical conditions?

a. Cushing’s syndrome
b. Deficiency in T₃ and T₄
c. Diabetes insipidus
d. Osteoporosis

Solution. (a) Cushing’s syndrome

Reference – Read the text below
Sol
- Pituitary adenomas are anterior pituitary specific.
- A corticotroph-adenoma would cause increased levels of ACTH and stimulate excessive production of corticosteroids from the adrenal cortex (Cushing’s syndrome). LH and FSH-producing gonadotrophs occur but tend to result in hypogonadism. Somatotropic tumors produce GH and cause gigantism.
- Prolactinomas are the most common form of pituitary adenoma resulting in infertility, galactorrhea (excessive production of milk), and amenorrhea.
- Diabetes insipidus is caused by absence of vasopressin [arginine vasopressin (AVP)], leading to excretion of a large quantity of dilute fluid (hypotonic polyuria). Overproduction of parathyroid hormone (PTH) leads to osteoporotic changes, but PTH is not regulated by the anterior pituitary.

Correct Answer. a
(88). Which of the following are characteristic of the secretory phase of the menstrual cycle?

a. It precedes ovulation

b. It depends on progesterone secretion by the corpus luteum

c. It coincides with the development of ovarian follicles

d. It coincides with a rapid drop in estrogen levels

Solution. (b) It depends on progesterone secretion by the corpus luteum

Reference – Read the text below

Sol
- The secretory phase of the menstrual cycle depends on progesterone secretion and follows the proliferative (follicular) phase.
- The menstrual phase occurs after the secretory phase. During the follicular phase (approximately days 4 to 16), estrogen produced by the ovaries drives cell proliferation in the base of endometrial glands and the uterine stroma. The proliferative phase culminates with ovulation.
- The secretory phase (approximately days 16 to 25) is characterized by high progesterone levels from the corpus luteum, a tortuous appearance of the uterine glands, and apocrine secretion by the gland cells. During this phase, maximum endometrial thickness occurs.
- The menstrual phase (approximately days 26 to 30) is characterized by decreased glandular secretion and eventual glandular degeneration because of decreased production of both progesterone and estrogen by the theca lutein cells.
- Contraction of coiled arteries and arterioles leads to ischemia and necrosis of the stratum functionale.

Correct Answer. b

(89). Which of the following statements concerning erection, emission, and ejaculation in the male is correct?

a. Contraction of the urethra is under control of the sympathetic nervous system

b. The parasympathetic nerves stimulate closure of the sphincter of the urinary bladder

c. Sympathetic neurons stimulate the helicine arteries to dilate and increase blood flow to the corpora cavernosum

d. Contraction of the bulbospongiousus and ischiocavernosus muscles impedes the drainage of blood from the corpora cavernosa

Solution. (d) Contraction of the bulbospongiousus and ischiocavernosus muscles impedes the drainage of blood from the corpora cavernosa

Reference – Read the text below

Sol
- The bulbospongiousus and ischiocavernosus muscles are innervated by the pudendal nerve (S2–S4).
- Concomitant with dilation of the helicine arteries under parasympathetic innervation, which allows blood to flow into the cavernous spaces, contraction of the bulbospongiousus and ischiocavernosus muscles at the base of the cavernous bodies prevents blood from leaving, resulting in engorgement and penile erection.
- Contraction of the smooth muscle of the urethra (ejaculation) is a parasympathetic function, whereas closure of the sphincter of the urinary bladder is under sympathetic control. Emission of seminal fluid and prostatic secretions is due to contraction of smooth muscle under sympathetic control.

Correct Answer. d
(90). Sympathetic and parasympathetic nerves reach the pelvic plexus by different pathways. If, during surgical resection of the rectum, the sympathetic nerves were excised bilaterally, which of the following complications would ensue?

- **a.** A dilated and neurogenic bladder
- **b.** Loss of control of the external urethral sphincter
- **c.** Impotence (inability to obtain erection)
- **d.** Inability to ejaculate

**Solution.** (d) Inability to ejaculate

Reference - Read the text below

Sol - Loss of sympathetic innervation to the pelvic plexus results in an inability to ejaculate.
- Parasympathetic innervation in this region mediates penile erection, without which ejaculation probably cannot occur.
- The afferent and efferent limbs of the detrusor reflex, which controls reflex emptying of the bladder, also travel in the nervi erigentes with the parasympathetics.
- Thus, injury to this pathway would result in a dilated bladder. Voluntary control of the external anal sphincter and levator ani muscles is mediated through branches of the pudendal nerve.

**Correct Answer.** d

(91). Paraplegic patients with spinal cord transaction at T6 for more than 1 year manifest

- **a.** Hypoventilation
- **b.** Causalagia
- **c.** Mass autonomic reflex
- **d.** Hypokalaemia after intravenous succinylcholine

**Solution.** (c) Mass autonomic reflex

Reference - Read the text below

Sol - The effects of spinal shock
- (a) Initially
  - All spinal reflex responses are profoundly depressed (flaccid). This effect usually lasts for a minimum of 2 weeks up to 4 weeks. This leads to:
    - Hypotension; the effect increases if the lesion is above T6
    - Hypothermia
    - Bradycardia; the effect increases if the lesion is above T1
    - Bladder stasis
    - Paralytic ileus
    - Oedema
    - Flaccid paralysis
- (b) Recovery
  - New nerve endings may sprout in the cord. This leads to
  - Spasticity as the stretch reflex is first to return
  - Autonomic hyper-reflexia; most if the lesion is above T5
  - Increased blood pressure
  - Increased heart rate
  - Increased sweating

**Correct Answer.** c
Compared to an unacclimatized person, one who is acclimatized to cold has

a. Higher metabolic rate in the cold, to produce more heat
b. Lower metabolic rate in the cold, to conserve metabolic energy
c. Higher blood flow in the hands and feet in the cold, to preserve their function
d. Various combinations of the above, depending on the environment that produced acclimatization

**Solution.** (d) Various combinations of the above, depending on the environment that produced acclimatization

References – Read the text below

Sol
- Acclimatization to cold produces several different (and contrasting) sets of changes, depending on the acclimatizing environment (and, perhaps, on characteristics of the population being acclimatized).

**Correct Answer.** d

In older adults at risk for falls, osteoporosis, and fractures, a program of weight-bearing exercise

a. Increases the risk of hip fracture
b. Decreases bone mineral density
c. Leaves gait, coordination, proprioception, and reaction time unaltered
d. Reduces the risk of osteoporosis, falls, and fractures

**Solution.** (d) Reduces the risk of osteoporosis, falls, and fractures

Reference – Read the text below

Sol
- Weight-bearing exercise and increased muscle strength reduce osteoporosis by increasing the forces applied to bone.
- These changes are augmented by exercise-linked improvements in motor coordination that reduce the risk of falls. These factors in combination sharply reduce the incidence of hip fracture in older persons.
- Activities that decrease gravitational forces on bone (e.g., water immersion), while valuable, decrease forces applied to bone and are less useful in the prevention of osteoporosis.

**Correct Answer.** d

A high-school football player injures a knee early in the season. The knee requires immobilization for six weeks, after which time the athlete undergoes rehabilitation before joining the team. Immediately after rehabilitation begins, the individual notices that the flexors and extensors of the knee are much weaker than before the injury because during contraction at a fixed force

a. Fewer motor units are involved
b. There is a relative excess of contractile protein
c. Muscle cells are small, so more cells are required to perform the same work
d. Oxidative energy-producing systems are up-regulated

**Solution.** (c) Muscle cells are small, so more cells are required to perform the same work

Reference – Read the text below

Sol
- Motor unit rotation allows frequent rest and recovery for activated cells, delaying fatigue.
- Inactive muscle cells undergo atrophic changes that reduce cell cross-sectional area, reducing strength and increasing the number of mobilized cells and motor units required for a fixed external force development.

**Correct Answer.** c
(95). At which of the following sites in the cardiovascular system does the blood flow lose the greatest amount of energy?

a. Mitral valve  
b. Large arteries  
c. Arterioles  
d. Capillaries  

**Solution.** (c) Arterioles  
Reference – Read the text below  
Sol:  
- The energy imparted to the blood by ventricular systole is dissipated as the blood flows through the circulation.  
- The greatest energy loss occurs where the resistance to blood flow is greatest. This would also be the site of the greatest pressure change.  
- The arteriolar vessels produce the largest resistance to blood, and thus the greatest energy loss and pressure drop occur as the blood passes through them.  

**Correct Answer.** c

(96). Which one of the following causes vasodilatation of the peripheral arterial blood vessels?

a. Endothelin  
b. Prostaglandins  
c. Angiotensin  
d. Adenosine diphosphate  

**Solution.** (b) Prostaglandins  
Reference – Read the text below  
Sol:  
- Endothelin is a vasoconstricting peptide synthesized by endothelial cells and by neurons in the paraventricular nucleus of the hypothalamus.  
- Nitric oxide is a potent vasodilator which is synthesized from L-arginine in vessel walls by NO synthases.  
- In addition, inspired NO may be clinically useful as a vasodilator of pulmonary arteries. Iloprost (a prostacyclin PGI2 analogue) may be beneficial in the treatment of the critically ischaemic limb.  
- Both thromboxane A2 and adenosine diphosphate cause vasoconstriction. Other factor which cause arteriolar dilatation include decreased sympathetic activity, increased Pco2, decreased pH and Po2, lactic acid, histamine, and increased local temperature.  

**Correct Answer.** b

(97). A 53-year-old woman presents with tiredness. The results show: TSH 20.5 mU/l, free thyroxine (FT4) 1.1 pmol/l, prolactin 1020 U/l. Which of the following is most likely diagnosis?

a. Pituitary adenoma  
b. Hypothyroidism  
c. Sick euthyroid syndrome  
d. Pregnancy  

**Solution.** (b) Hypothyroidism  
Reference – Read the text below  
Sol:  
- The patient has both symptoms and a biochemical profile consistent with hypothyroidism.  
- A raised prolactin is a well-recognised association. The mechanism of this is not entirely clear but probably involves an increased prolactin response to the rise in thyrotrophin-releasing hormone (TRH). Apart from a pituitary prolactinoma, other pathological causes of a raised prolactin include: hypothalamic/pituitary disease, renal impairment (reduced prolactin excretion) and drugs such as dopamine antagonists (bromocriptine).  
- Physiological causes are sleep, pregnancy, exercise, stress and puberty in girls.  

**Correct Answer.** b
(98). During the cardiac cycle, when does the highest coronary blood flow per gram of left ventricular myocardium occur.

a. When left ventricular pressure is highest  
b. At the beginning of isovolumic contraction  
c. When aortic blood flow is highest  
d. At the beginning of diastole  

Solution. (d) At the beginning of diastole  
Reference – Read the text below  
Sol  
- Blood flow through the coronary vessels of the left ventricle is determined by the ratio of perfusion pressure to vascular resistance.  
- The perfusion pressure is directly related to the aortic pressure at the ostia of the coronaries. Myocardial vascular resistance is significantly influenced by the contractile activity of the ventricle.  
- During systole, when the ventricle is contracting, vascular resistance increases substantially.  
- Flow is highest just at the beginning of diastole because, during this phase of the cardiac cycle, aortic pressure is still relatively high and vascular resistance is low due to the fact that the coronary vessels are no longer being squeezed by the contracting myocardium.  

Correct Answer. d

(99). The gastric acid hypersecretion can be explained by an increase in the plasma concentration of which of the following?  

a. Somatostatin  
b. Histamine  
c. Gastrin  
d. Secretin  

Solution. (c) Gastrin  
Reference – Read the text below  
Sol  
- Increases in basal and maximal acid output are suggestive of inflammation or removal of the proximal small intestine. Intestinal receptors monitor the composition of chyme and elicit feedback mechanisms that regulate gastric acid secretion and gastric emptying. Absence of feedback leads to an increased presence of excitatory mediators of gastric function.  
- Gastrin is the primary stimulus of meal-induced acid secretion by the parietal cells. Somatostatin (paracrine), secretin (endocrine), and enterogastrone (endocrine) inhibit gastric acid secretion by the parietal cells. Histamine is an excitatory paracrine mediator of parietal cell acid secretion.  

Correct Answer. c

(100). A drug that raises the heart rate from 70 to 100 beats per minute could  

a. Cause the opening of acetylcholine-activated K⁺ channels  
b. Be a cholinergic receptor agonist  
c. Be an adrenergic receptor agonist  
d. Cause the closing of voltage-gated Ca²⁺ channels  

Solution. (c) Be an adrenergic receptor agonist  
Reference – Read the text below  
Sol  
- The drug could act on adrenergic receptors to increase the rate of depolarization of sinoatrial nodal cells.  
- An adrenergic receptor antagonist would have the opposite effect, as would a cholinergic receptor agonist and the closing of voltage-gated Ca²⁺ channels.  
- Opening of acetylcholine-activated K⁺ channels would slow pacemaker depolarization by keeping the membrane potential closer to the K⁺ equilibrium potential.  

Correct Answer. c
Most of the following GI secretions have a basal output during the interdigestive period (between meals). However, the sight and smell of a tasty meal stimulates GI secretions. Of the various GI secretions, which is the most stimulated?

a. Gastric secretion  
b. Intestinal secretion  
c. Pancreatic secretion  
d. Salivary secretion

**Solution.** (d) Salivary secretion

**Reference – Read the text below**

Sol
- Salivary secretion is exclusively under neural control. The others need both neural and hormonal stimulation and are, therefore, only partially stimulated by the sight, smell, and chewing of food (cephalic phase).
- The sight, smell, and chewing of food stimulate the parasympathetic nervous system, which stimulates salivary secretion.

**Correct Answer.** d

Which of the following is not a characteristic of the myenteric ganglia of the enteric nervous system?

a. Contains most of the motor neurons to circular and longitudinal muscles of the intestinal tract  
b. It is smaller than the submucosal ganglia and most prominent in the small and large intestine  
c. It is interconnected with the submucosal ganglia.  
d. Contains both excitatory and inhibitory motor nerves to the smooth muscle fibers.

**Solution.** (b) It is smaller than the submucosal ganglia and most prominent in the small and large intestine

**Reference – Read the text below**

Sol
- Auerbach’s plexus and the myenteric plexus are one and the same and contains most of the motor neurons to circular and longitudinal muscles of the intestinal tract.
- The submucosal plexus contains fewer neurons than the myenteric plexus. The submucosal plexus is most prominent in the small and large intestines. Both plexuses are continuous around the GI tract and along its length. The two plexuses are distinct; however, interconnections bind the network into a functionally unified nervous system.
- Efferent vagal innervation may excite or inhibit GI effectors. Efferent sympathetic stimulation suppresses motility and secretion, decreases blood flow to intestinge and contracts sphincter muscles.

**Correct Answer.** b

An older gentleman’s speech did not make sense now even though he talked a lot and the words themselves were clear. He had most likely suffered a stroke that damaged

a. Broca’s area  
b. The hippocampus  
c. The arcuate fasciculus  
d. Wernicke’s area

**Solution.** (d) Wernicke’s area

**Reference – Read the text below**

Sol
- Wernicke’s area is responsible for the recognition and construction of words and language; when it is damaged, the individual speaks but the content is nonsensical.
- Damage to Broca’s area results in an inability to speak clearly because it controls the motor patterns required to speak; the little speech that is produced is grammatically and syntactically correct.
- The hippocampus and corpus callosum are not involved in the generation of speech.
- Damage to the arcuate fasciculus would result in a loss of speech because language generated in the Wernicke’s area would not be conveyed to Broca’s area.

**Correct Answer.** d
(104). At a constant blood flow, an increase in the number of perfused capillaries improves the exchange between blood and tissue because of

a. Greater surface area for the diffusion of molecules
b. Faster flow velocity of plasma and red blood cells in capillaries
c. Increased permeability of the microvasculature
d. Decreased concentration of chemicals in the capillary blood

Solution. (a) Greater surface area for the diffusion of molecules
Reference – Read the text below
Sol
- More capillaries in use at a constant blood flow actually slows the flow velocity in individual capillaries.
- The distances between capillaries are decreased. The perfusion of additional capillaries does not influence the permeability of the individual capillaries.

Correct Answer. a

(105). Venous blood returning from the following organ is likely to have an oxygen content more than mixed-venous oxygen content

a. Heart
b. Liver
c. Brain
d. Kidney

Solution. (d) Kidney
Reference – Read the text below
Sol
- The usual mixed-venous oxygen content of blood is 15 ml/dl compared with 20 ml/dl for arterial blood.
- Tissues that extract more than 5 ml/dl are the heart and brain.
- The oxygen content of blood leaving the liver is less than in mixed-venous blood because 65% of the blood supply to the liver is venous blood from the gut, via the hepatic portal vein.
- Skeletal muscle and the kidney are relatively well perfused for the metabolic demands of the organs. The venous oxygen content is therefore higher than in mixed-venous blood.

Correct Answer. d

(106). Which of the following substances will be more concentrated at the end of the proximal tubule than at the beginning of the proximal tubule?

a. Glucose
b. Creatinine
c. Sodium
d. Bicarbonate

Solution. (b) Creatinine
Reference – Read the text below
Sol
a) Sodium is isosmotically reabsorbed from the proximal tubule; that is, when sodium is reabsorbed, water flows out of the proximal tubule to maintain a constant osmolarity.

b) Thus, the concentration of sodium does not normally change as the filtrate flows through the proximal tubule.

c) Because creatinine cannot be reabsorbed from the tubule, its concentration rises as water is reabsorbed.

d) The concentration of glucose, bicarbonate, and phosphate are all less at the end of the proximal tubule than at the beginning.

Correct Answer. b
(107). Which of the following statements about aldosterone is correct?

a. It produces its effect by activating cAMP.

b. It produces its effect by increasing distal tubular permeability to sodium.

c. It causes an increased reabsorption of hydrogen ion.

d. It has its main effect on the proximal tubule.

Solution. (b) It produces its effect by increasing distal tubular permeability to sodium.

Reference – Read the text below

Sol
- Aldosterone binds to an intracellular receptor that causes an increased synthesis of a variety of proteins, including K⁺ and Na⁺ ion channels and Na⁺-K⁺-ATPase, which together act to increase Na⁺ reabsorption and K⁺ secretion by the tubular cells of the distal nephron.
- The secretion of H⁺ is also enhanced by aldosterone.
- Aldosterone secretion is stimulated by a decrease in blood volume (through the renin-angiotensin system) and by increased plasma K⁺ concentrations.

Correct Answer. b

(108). Hypoxic pulmonary vasoconstriction

a. Acts reflexly via the central nervous system.

b. Improves matching of ventilation and blood flow in some lung diseases.

c. Requires a PO₂ of less than 40 Torr in mixed venous blood.

d. Is not important in the perinatal period.

Solution. (b) Improves matching of ventilation and blood flow in some lung diseases.

Reference – Read the text below

Sol
- Although the mechanism of hypoxic pulmonary vasoconstriction is not fully understood, we know that central nervous connections are not required because the phenomenon can be demonstrated in isolated lungs.

Option B
- Suppose a lobe or lobule of lung is poorly ventilated because of partial bronchial obstruction. The resulting alveolar hypoxia will reduce the blood flow through the mechanism of hypoxic pulmonary vasoconstriction. The result is improvement in the matching of ventilation and blood flow.

Option C
- Reducing the PO₂ of the blood entering the lung results much less vasoconstriction than reducing the PO₂ of alveolar gas.

Option C
- Hypoxic pulmonary vasoconstriction is important in the perinatal period. When the newborn baby makes the transition from placental to air breathing, it is important for pulmonary vascular resistance to fall precipitously within a few seconds. As a consequence, pulmonary blood flow dramatically increases from its value of only about 15% of the cardiac output in utero. The increase in pulmonary blood flow is assisted by closure of both the ductus arteriosus and the foramen ovale.

Correct Answer. b
(109). Which of the following would cause a decrease in stroke volume, compared with the normal resting value?

a. Reduction in afterload

b. An increase in end-diastolic pressure

c. Stimulation of the vagus nerves

d. Electrical pacing to a heart rate of 200 beats/min.

**Solution.** (d) Electrical pacing to a heart rate of 200 beats/min.

**Reference** – Read the text below

Sol

- Electrical pacing to a heart rate of 200 beats/min would decrease time for filling and reduce end-diastolic volume.
- A reduction in afterload would make it easier for the ventricle to eject blood and would raise stroke volume.
- An increase in end-diastolic pressure will increase end-diastolic fiber length and increase the force of contraction and stroke volume.
- Stimulation of the vagus nerves slows the heart, increases the time for ventricular filling, and increases stroke volume.
- Stimulation of sympathetic nerves to the heart increases heart rate and contractility.
- Despite the decreased filling accompanying an increase in heart rate, stroke volume will stay the same or increase because of the increased contractility.

**Correct Answer.** d

(110). If a person has an arterial blood pressure of 125/75 mm Hg,

a. The pulse pressure is 40 mm Hg

b. The mean arterial pressure is 92 mm Hg

c. Diastolic pressure is 80 mm Hg

d. Systolic pressure is 120 mm Hg

**Solution.** (b) The mean arterial pressure is 92 mm Hg.

**Reference** – Read the text below

Sol

By convention, the first of the two numbers is the systolic pressure and the second is the diastolic pressure.

Pulse pressure = 125 - 75 mm Hg
= 50 mm Hg

Mean arterial pressure = 75 mm Hg + 50 mm Hg/3
= 92 mm Hg

**Correct Answer.** b

(111). A patient with congestive heart failure is given the loop diuretic, furosemide, along with the potassium sparing diuretic, spironolactone. Which of the following comparisons between the distal nephron and the proximal tubule is correct?

a. The distal nephron is more permeable to hydrogen ion than the proximal tubule.

b. The distal nephron is less responsive to aldosterone than the proximal tubule.

c. The distal nephron has a more negative intraluminal potential than the proximal tubule.

d. The distal nephron secretes less potassium than the proximal tubule does.

**Solution.** (c) The distal nephron has a more negative intraluminal potential than the proximal tubule.

**Reference** – Read the text below

Sol

- The distal nephron has a negative luminal potential because it is poorly permeable to negatively charged ions.
- Therefore, when Na+ is reabsorbed, negatively charged ions, primarily Cl-, lag behind, producing a negative intraluminal potential.
- Although a similar situation occurs in the proximal tubule, the proximal tubule has a higher permeability to Cl- and, therefore, does not develop as large a negative intraluminal potential.
- The distal nephron is less permeable to hydrogen than the proximal tubule.
- Aldosterone increases Na+ reabsorption from the distal nephron but has no effect on the proximal tubule. K+ is reabsorbed from the proximal tubule and secreted by the distal nephron.
- Although the amount of H+ excreted each day is determined by the amount of H+ secreted into the distal nephron, the proximal tubule secretes much more H+ than the distal nephron.
- However, almost all of the H+ secreted in the proximal tubule is reabsorbed in association with the reabsorption of HCO3-

**Correct Answer.** c
(112). Aldosterone secretion is increased when there is a decrease in the plasma concentration of which of the following?

a. Renin
b. Angiotensin II
c. ACTH
d. Sodium

**Solution.** (d) Sodium.
Reference – Read the text below
Sodium
- A decrease in plasma sodium increases aldosterone secretion. Aldosterone secretion increases in response to an increase in all of the other answer choices.
- The effects of sodium on aldosterone secretion are mediated via the reninangiotensin system.
- Hyponatremia, as may occur with a low-sodium diet, is associated with a decrease in extracellular volume, which increases rennin secretion, probably due to a reflex increase in renal sympathetic nerve activity.

**Correct Answer.** d

(113). Choose the incorrect statement regarding stretch reflex

a. Consists of only one synapse within the central nervous system
b. Involves gamma motor fibres as the efferent link
c. Causes jerkiness of body movements
d. Involves glutamate as a neurotransmitter at the central synapse

**Solution.** (c) Causes jerkiness of body movements.
Reference – Read the text below
Glutamate
- When a muscle is stretched, primary sensory fibres (group Ia afferent neurones) of the muscle spindle respond to both the velocity and the degree of stretch, and send this information to the spinal cord. Likewise, secondary sensory fibres (group II afferent neurones) detect and send information about the degree of stretch (but not the velocity thereof) to the CNS.
- This information is transmitted monosynaptically to an alpha efferent motor fibre; it activates extrafusal fibres of the muscle to contract, thereby reducing stretch, and polysynaptically through an interneurone to another alpha motoneurone, which inhibits contraction in opposing muscles.
- Neurotransmitters
  - At the central synapse is glutamate
- The stretch reflex is a monosynaptic reflex

**Correct Answer.** c

(114). A 45-year-old man complains of nausea, vomiting, and a tingling feeling in his extremities. He had taken seafood the night before. Which of the following is the most likely cause of his problem?

a. Chronic demyelinating disorder
b. Ingestion of a toxin that activates sodium channels
c. Ingestion of a toxin that blocks sodium channels
d. Ingestion of a toxin that blocks nerve-muscle transmission

**Solution.** (b) Ingestion of a toxin that activates sodium channels.
Reference – Read the text below
Glutamate
- The acute onset of symptoms suggests food poisoning and not a chronic disorder or a stroke.
- A toxin that blocked nerve-muscle transmission would produce muscle paralysis or weakness and no sensory disturbances.
- The tingling feeling suggests abnormally high excitability and firing of sensory nerves.
- Ciguatera toxin, the product of a dinoflagellate that sometimes contaminates red snapper and other reef fishes, is probably the cause of the sensory abnormality and gastrointestinal symptoms.
- Ciguatera toxin binds to voltage-gated sodium channels and results in their persistent activation.

**Correct Answer.** b
(115). Asummated (compound) action potential is recorded from the affected peripheral nerve of a patient with a demyelinating disorder. Compared to a recording from a normal nerve, the recording from the patient will have a

a. Greater amplitude
b. Increased rate of rise
c. Lower conduction velocity
d. Shorter duration afterhyperpolarization

**Solution.** (c) Lower conduction velocity.

**Reference – Read the text below**

Sol
- Loss of myelin will result in a lower conduction velocity because the action potential will no longer “jump” from node to node.
- The compound action potential (the sum of many individual action potentials) will be more spread out and will have a slower rate of rise than normal.
- The afterhyperpolarization will last longer.

**Correct Answer.** c

(116). A syndrome of muscle weakness associated with lung cancer is caused by antibodies against components of the cancer plasma membrane that cross-react with voltage-gated calcium channels. The interaction of the antibodies impairs ion channel opening and would cause

a. Decreased nerve conduction velocity
b. Delayed repolarization of axon membranes
c. Impaired release of acetylcholine from motor nerve terminals
d. More rapid upstroke of the nerve action potential

**Solution.** (c) Impaired release of acetylcholine from motor nerve terminals.

**Reference – Read the text below**

Sol
- Release of transmitter depends on opening of voltage-gated calcium channels and entry of extracellular calcium into the nerve terminals.
- Deficient acetylcholine release by motor nerve terminals could explain muscle weakness. Nerve conduction velocity is not dependent on calcium channels.
- The repolarization phase of the nerve action potential depends on voltage-gated potassium channels. The upstroke of the nerve action potential depends on voltage-gated sodium channels.
- Nerve excitability (and, hence, nerve firing) is affected by extracellular calcium concentration (hypocalcemia results in increased excitability), but this is because of an effect on sodium channels, not calcium channels.

**Correct Answer.** c
(117). Gap junctions are responsible for

a. Cellular polarity
b. Transmission of action potentials from one fibre to another in skeletal muscle
c. Rapid transmission of action potentials by purkinje fibres
d. None

Solution. (c) Rapid transmission of action potentials by purkinje fibres.

Reference – Read the text below

Sol - The gap junction is a specialised channel of transport and communication for small molecules and ions between the cytoplasm of two closely apposed cells.
- Electron microscopy reveals the two cell membranes to be separated by only 1–2nm at the point where the gap junctions are sited.
- Each membrane has a large number of small protein channels termed connexons. Individual connexons of both cells are joined to each other to create a communicating tunnel, which spans the membrane gap.
- The internal diameter of the passage is about 2 nm.
- Each connexon on each membrane is made up of six polypeptide chain subunits, which span the membrane.
- Electrophysiological studies have shown low electrical resistance for the cell when there are abundant gap junctions. Injection of low-molecular-weight dyes results in rapid spread between cells.
- Therefore, gap junctions provide a pathway by which small molecules and ions can rapidly move down concentration gradients between cells.
- Gap junctions are evident in epithelia and smooth muscle. They permit all of the cells to act as a syncytium.
- However, if continued passive transport is detrimental to the syncytium, individual gap junctions can be rapidly closed.

Correct Answer. c

(118). In addition to increasing the permeability of the collecting duct to water, ADH increases the permeability of the collecting duct to which of the following?

a. Hydrogen
b. Ammonium
c. Potassium
d. Urea

Solution. (d) Urea.

Reference – Read the text below

Sol - ADH increases the permeability of the distal nephron to urea as well as to water.
- The increased urea permeability increases the urea concentration and osmolarity of the interstitial fluid surrounding the loop of Henle and the distal nephron.
- The high interstitial urea concentration helps to increase the osmolarity of the fluid within the descending limb of the loop of Henle, the reabsorption of Na⁺ from the ascending limb of the loop of Henle, and the reabsorption of water from the distal nephron.

Correct Answer. d
The renal clearance of phosphate is increased by which of the following hormones?

   a. Aldosterone
   b. Parathyroid hormone
   c. Norepinephrine
   d. Vasopressin

**Solution.** (b) Parathyroid hormone.
Reference - Read the text below
Sol
- Between 85 and 90% of the filtered phosphate is reabsorbed in the proximal tubule by a sodium-dependent secondary active transport system.
- The transporter is electrically neutral, requiring two Na⁺ molecules for every HPO₄⁻ molecule that it transports.
- The transporter is inhibited by parathyroid hormone (PTH). The decreased reabsorption of phosphate results in an increased clearance from the plasma.
- PTH is released from the parathyroid gland in response to lowered plasma Ca²⁺ concentrations.
- In addition to inhibiting the reabsorption of phosphate from the proximal tubule, PTH increases the reabsorption of Ca²⁺ from the loop of Henle.

**Correct Answer.** b

Stimulation of the parasympathetic nerves to the normal heart can lead to complete inhibition of the SA node for several seconds. During that period

   a. P waves would become larger
   b. There would be fewer T waves than QRS complexes
   c. There would be fewer P waves than T waves
   d. There would be fewer QRS complexes than P waves

**Solution.** (c) There would be fewer P waves than T waves.
Reference - Read the text below
Sol
- When stimulation of the parasympathetic nerves to the normal heart leads to complete inhibition of the SA node for several seconds, nodal escape usually occurs.
- In this situation, pacemaker activity usually is taken over by cells in the AV node or bundle of His.
- QRS complexes are normal because the pacemaker activity is high enough in the conducting system to lead to a normal pattern of ventricular excitation.
- T waves would be normal for the same reason. Because at least one beat begins without atrial excitation, there would be fewer P waves than either QRS complexes or T waves.

**Correct Answer.** c

Oily substance secreting gland is:

   a. Sweat gland
   b. Meibomian gland
   c. Salivary gland
   d. Lacrimal gland

**Solution.** (b) Meibomian gland
Ref: Internet resources
Sol:
- The meibomian glands (or tarsal glands) are a special kind of sebaceous glands at the rim of the eyelids inside the tarsal plate, responsible for the supply of meibum, an oily substance that prevents evaporation of the eye’s tear film, prevents tear spillage onto the cheek, makes the closed lids airtight and acts as a blockade for tear fluid, trapping tears between the oiled edge and eyeball.

**Correct Answer.** b
(122). Beta waves have a frequency:

a. 8-12 Hz
b. 12 and 30 Hz
c. 2 and 8 Hz
d. 30 and 40 Hz

**Solution.** (b) 12 and 30 Hz

Ref: Ganong's Physiology-233

Sol:
Beta wave, or beta rhythm, is the term used to designate the frequency range of human brain activity between 12 and 30 Hz (12 to 30 transitions or cycles per second). Beta waves are split into three sections: High Beta Waves (19 Hz+); Beta Waves (15–18 Hz); and Low Beta Waves (12–15 Hz). Beta states are the states associated with normal waking consciousness.

**Correct Answer.** b

(123). Blood pressure measured using a sphygmomanometer

a. May be falsely low with too narrow a cuff
b. May be falsely low in patients with badly stiffened arteries
c. May be falsely high in obese patients
d. Gives a direct reading of mean arterial pressure

**Solution.** (c) May be falsely high in obese patients

Ref: Read the text below

Sol:
- If the cuff is too small, it takes a falsely high pressure in the cuff to transmit sufficient pressure to the vessel wall for total occlusion of the artery.
- Blood pressure may be falsely high in patients with badly stiffened arteries because of the extra pressure needed to compress the arteries.
- The measurement gives an indirect reading of systolic and diastolic pressure; mean arterial pressure must be calculated.
- The measurement depends on the appearance of sound to signal systolic pressure.

**Correct Answer.** c
In the normal ECG the

a. Q wave is normally present in lead V6
b. Q wave is normally present in V1
c. R wave is larger than the S wave in V1
d. QRS duration depends on the recording electrode

Solution. (a) Q wave is normally present in lead V6

Ref: Read the text below

Sol:

In the normal ECG:

- standard speed 25 mm/s
- one small square represents 0.04 s
- one large square represents 0.2 s
- two large squares vertically = 1 mV
- P–R interval = 0.12–0.21 s
  = 3–5 small squares
- P wave max height = 2.5 mm
- mean frontal QRS axis →−30° to +110° and maximum duration 0.1 s
- normal QRS complex = 0.08–0.15 s
- maximum QT interval < 0.42 s

- Not all Q waves are indicators of myocardial infarction. There is a Q wave in lead aVR.
- Small ‘septal’ Q waves are normally seen in the left chest leads (V4 to V6) and in one or more of leads I, aVL, II, III, and aVF.
- Normally septal Q waves are characteristically narrow and of low amplitude (less than 0.04 s). However, Q waves in leads V1 and V2 may be the only evidence of anterior septal myocardial infarction.
- Between V1 and V6 as you move across the chest (in the direction of the electrically predominant left ventricle) the R wave tends to become relatively large and the S wave relatively small. This increase in height of the
- R wave, which usually reaches a maximum around lead V4 or V5, is called normal R wave progression.
- The normal T wave in lead aVR is always negative, while in lead II it is always positive in left-sided chest leads, such as V4 to V5, which normally show a positive T wave.
- The duration of the QRS complex is constant, no matter which lead is used for the recording.

Correct Answer. a

Tissue with least chronaxie is:

a. Smooth muscle
b. Cardiac muscle
c. Skeletal muscle
d. Ocular muscle

Solution. (c) Skeletal muscle

Ref: Read the text below

Sol:
- Chronaxie is the shortest duration for a stimulation to excite tissue with a current strength twice the Rheobase voltage.
  - In newborn babies, tissues have chronaxie’s 10 times greater than adults.
  - Chronaxie of Skeletal muscle is shorter than that of cardiac and smooth muscles.
  - Cold lengthens chronaxie, whereas vagal stimulation shortens chronaxie.

Correct Answer. c
Fastest conduction in heart occurs in the Purkinje fibres. What is the speed of conducting?

a. 50 cm/s  
b. 40 m/s  
c. 4 m/s  
d. 100 cm/s

**Solution.** (c) 4 m/s  
Ref.: Read the text below  
Sol:

<table>
<thead>
<tr>
<th>Tissue</th>
<th>Conduction rate (m/s)</th>
<th>Rate of impulse generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA node</td>
<td>0.05</td>
<td>70-80 / minute (highest)</td>
</tr>
<tr>
<td>Atrial pathway</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>AV node</td>
<td>0.02-0.05 (least)</td>
<td>40-60 / minute</td>
</tr>
<tr>
<td>Bundle of His</td>
<td>1</td>
<td>40 / minute</td>
</tr>
<tr>
<td>Purkinje system</td>
<td>4 (Highest)</td>
<td>24/ minute</td>
</tr>
<tr>
<td>Ventricular muscle</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Correct Answer.** c
(127). QT segment is said to be prolonged if it is:

a. >0.36ms

b. >0.44ms

c. >0.5ms

d. >0.6ms

Solution. (b) >0.44ms
Ref.: Read the text below
Sol:

Correct Answer. b

<table>
<thead>
<tr>
<th>Intervals</th>
<th>Duration in sees</th>
<th>Represents</th>
</tr>
</thead>
<tbody>
<tr>
<td>P wave</td>
<td>0.1 sec</td>
<td>Atrial depolarization</td>
</tr>
<tr>
<td>PP interval (onset of 'P' wave to onset of 'Q' wave)</td>
<td>0.12-0.20 (Avg-0.18)</td>
<td>The time interval from SA node to ventricle (conduction through AV Node)</td>
</tr>
<tr>
<td>QRS interval</td>
<td>0.08-0.1 (Avg-0.08)</td>
<td>Ventricular depolarization</td>
</tr>
<tr>
<td>QT interval (onset of 'Q' wave to end of 'T' wave)</td>
<td>0.40-0.43 (Avg-0.40)</td>
<td>Ventricular depolarization &amp; ventricular repolarization (ventricular action potential)</td>
</tr>
<tr>
<td>ST interval [end of 'S' wave to onset of 'T' wave]</td>
<td>0.32</td>
<td>Plateau phase of the ventricular action potential</td>
</tr>
<tr>
<td>T wave</td>
<td></td>
<td>Ventricular repolarization</td>
</tr>
</tbody>
</table>

(128). “Penis-at-12 syndrome” is due to:

a. Testosterone deficiency

b. Congenital 5α-reductase deficiency

c. Growth hormone deficiency

d. 17α-hydroxylase deficiency

Solution. (b) Congenital 5α-reductase deficiency
Ref.: Read the text below
Sol:
- “Penis-at-12 syndrome” is due to Congenital 5α-reductase deficiency.

Correct Answer. b
(129). True regarding velocity of blood flow in various vessels:

a. Vena Cava > Aorta

b. Veins > venules

c. Capillaries > arterioles

d. Velocity drops to zero in descending aorta during diastole

**Solution.** (b) Veins > venules

Ref.: Read the text below

Sol:
The velocity of blood is inversely proportional to the total cross-sectional area at that point

**Order of cross-sectional area**

Capillaries (max) > Arteriole > Artery > Venules > Veins > Vena > Cava > Aorta

**Order of velocity of blood**

Aorta > vena cave > Artery > Arteriole > Capillary

**Correct Answer.** b

(130). Transection at the level of mid-pons with intact vagus leads to:

a. Rapid & shallow breathing

b. Slow & deep breathing

c. Apneusis

d. Irregular breathing

**Solution.** (b) Slow & deep breathing

Ref.: Read the text below

Sol:
- Transection at the level of mid-pons leads to slow and deep breathing.
- Effects on respiration due to transaction at various levels:
  - Transaction at A – Above pons: Normal tidal respiration but voluntary control is lost. If vagus is also cut, slow & deep breathing will occur because vagal inhibition of apneustic centre will be lost.
  - Transaction at B – At Mid pons: Due to loss of inhibitory action of pneumotaxic centre on apneustic centre there is stimulation of inspiratory neurons by apneustic centre resulting in slow and deep breathing. If vagus is also cut, apneusis will occur.
  - Transaction at C – B/w Pons and Medulla: Spontaneous respiration continues with irregularity and gasping because respiration is produced by medulla but made rhythmic & regular by pontine centres.
  - Transaction at D – Below Medulla: No respiration

**Correct Answer.** b
(131). Which of the following is used for the measurement of plasma volume?
   a. Tritium oxide
   b. 51Cr labeled RBC
   c. Evan’s blue
   d. Inulin

   Solution. (c) Evan’s blue
   Ref.: Read the text below
   Sol:
   - Evan’s blue is used for the measurement of plasma volume.

   Correct Answer. c

(132). The repolarization phase of the action potential is due to
   a. increase in sodium influx
   b. decrease in sodium influx
   c. increase in sodium efflux
   d. decrease in sodium efflux

   Solution. B
   The repolarization phase of the action potential is due to closure of sodium channels and opening of potassium channels resulting in a decrease in sodium influx and increase in potassium efflux.

   Correct Answer. b

(133). All of the following are transported by retrograde axoplasmic transport except
   a. Tetanus toxin
   b. neuropeptides
   c. nerve growth factors
   d. neurotropic viruses

   Solution. B
   Neuropeptides are produced by the cell body and are therefore, transported by anterograde transport. Tetanus toxin, neurotropic peptides, nerve growth factors are transported by a retrograde transport.

   Correct Answer. b

(134). If the duration of the contraction period in a muscle fiber is 5 milliseconds, the stimulation frequency required to produce a complete tetanus (tetanizing frequency) is
   a. 20 per second
   b. 200 per second
   c. 2000 per second
   d. 20000 per second

   Solution. B
   Tetanizing frequency = 1 / contraction period in seconds.
   = 1000 / 5
   = 200 / sec

   Correct Answer. b
(135). All of the following are present on the α subunit of the Na⁺ K⁺ ATPase pump jexcept

a. sodium binding site
b. potassium binding site
c. phosphorylation site
d. glycosylation site

Solution. d
Na⁺ K⁺ ATPase has two subunits, α and β. α subunit is the larger and has five binding sites- three on the inside (for sodium, ATP and a phosphorylation site) and two on the outside (for potassium and ouabain). The β subunit of the Na⁺ K⁺ ATPase is a glycosylated protein and has a glycosylation site.

Correct Answer. d

(136). The incisura on the aortic pressure curve coincides with which heart sound?

a. first
b. second
c. third
d. fourth

Solution. b
The incisura on the aortic pressure curve (also k/a dicrotic notch in the peripheral arteries) coincides with closure of the aortic valve or the second heart sound.

Correct Answer. b

(137). In which of the following zones in the lung is the waterfall effect seen in the standing position?

a. Zone 1
b. Zone 2
c. Zone 3
d. Zone 4

Solution. B
Zone 2, which is at the apex of the lung, has a ‘pulsatile’ or intermittent blood flow during standing. This is also k/a the ‘waterfall effect’.

Correct Answer. b

(138). Which is the first source of energy during exercise

a. ATP stores
b. ATP from creatine phosphate
c. Anerobic metabolism
d. Aerobic metabolism

Solution. a
The first source of energy during exercise are the ATP stores. But these stores can sustain exercise only for the first 1-2 seconds.

Correct Answer. a
A 23-year-old male presents with complaints of polydipsia and frequent, large-volume urination. Laboratory testing does not demonstrate any evidence of diabetes; however, a reduced urine osmolality of 120 mOsm/L is measured. Which of the following findings on a desmopressin test would be most consistent with a diagnosis of central diabetes insipidus?

a. Reduction in urine osmolality to 60 mOsm/L following vasopressin administration
b. Reduction in urine osmolality to 110 mOsm/L following vasopressin administration
c. Increase in urine osmolality to 130 mOsm/L following vasopressin administration
d. Increase in urine osmolality to 400 mOsm/L following vasopressin administration

Solution. D
This patient is suffering from diabetes insipidus (DI). In a standard desmopressin test, an increase in urine osmolality of greater than 10% is highly suggestive of a diagnosis of central DI. Central DI is characterized by the failure of the hypothalamic-pituitary axis to produce and secrete sufficient levels of the hormone vasopressin (ADH). A desmopressin test is a highly useful diagnostic tool to differentiate between central (described above) and nephrogenic (resistance to ADH action in the kidneys) DI. The test involves injection of exogenous vasopressin. In central DI, injection of exogenous vasopressin will act to rectify the inappropriately low levels of endogenous ADH, leading to an increase in urine osmolality towards the normal range. In contrast, injection of ADH in the setting of nephrogenic ADH will not have any notable effect, as increasing ADH levels will not overcome the disease mechanism of renal resistance to ADH action.

Correct Answer. d

An important step in the formation of thyroid hormones is the formation of I2 via oxidation of I-. Which of the following molecules is responsible for this reaction?

a. Thyroid deiodinase
b. Thyroid peroxidase
c. 5'-deiodinase
d. Perchlorate

Solution. B
Thyroid peroxidase (TPO) is responsible for the oxidation of I- to I2. In addition, thyroid peroxidase catalyzes the organification of I2 into thyroglobulin and the coupling of formed DIT/MIT molecules.

Correct Answer. b

An inhibitory post synaptic potential:

a. depolarizes the post synaptic membrane by opening sodium channels
b. depolarizes the post synaptic membrane by opening potassium channels
c. hyperpolarizes the post synaptic membrane by opening calcium channels
d. hyperpolarizes the post synaptic membrane by opening chloride channels.

Solution. D
IPSP or a hyperpolarizing local potential can be produced either increasing the efflux of potassium or by an increase in chloride influx.

Correct Answer. d
(142). During the upstroke of the action potential there is

a. net outward current and the cell interior becomes more negative
b. net outward current and the cell interior becomes less negative
c. net inward current and the cell interior becomes more negative
d. net inward current and the cell interior becomes less negative

**Solution. D**
The upstroke or the depolarization phase of the action potential is due to opening of sodium channels resulting in an influx of sodium and the inside of the cell becomes less negative.

**Correct Answer.** d

(143). Which of the following neuronal properties is most likely to decrease as a direct result of demyelination?

a. threshold
b. temporal summation
c. spatial summation
d. length constant

**Solution. D**
In neurobiology, the length constant is mathematical constant used to quantify the distance that a graded electric potential will travel along a neuron via passive electrical conduction. The greater the value of the length constant, the farther the potential will travel. The length constant is an index of how well a subthreshold potential will spread along an axon as a function of distance.

Length constant \( \lambda = \sqrt{dR_m/R_a} \) where \( d \) is the diameter of the axon, \( R_m \) is the membrane resistance and \( R_a \) is the axoplasmic resistance.

If the membrane resistance (\( R_m \)) is high, less will leak out and relatively more will move along the axon.

**Correct Answer.** d

(144). At the motor end plate, Ach causes opening of

a. sodium channels and depolarization towards the equilibrium potential of sodium
b. potassium channels and depolarization towards the equilibrium potential of potassium
c. calcium channels and depolarization towards the equilibrium potential of calcium
d. sodium and potassium channels and depolarization to a value halfway between the equilibrium potential of sodium and potassium

**Solution. D**
Acetylcholine receptors are ligand gated sodium and potassium channels. Binding of Ach with its receptors will cause opening of these channels, leading to influx of sodium and efflux of potassium and depolarization of the membrane to a value halfway between the equilibrium potential of sodium and potassium.

**Correct Answer.** d
(145). The correct sequence for excitation contraction coupling in skeletal muscle is:

- a. increased intracellular calcium; action potential in the muscle membrane; cross bridge formation
- b. action potential in the muscle membrane; depolarization of T-tubules; release of calcium from sarcoplasmic reticulum
- c. action potential in the muscle membrane; splitting of ATP; binding of calcium to troponin C
- d. release of calcium from SR; depolarization of T-tubules; binding of calcium to troponin C

**Solution. B**

Depolarization of the muscle membrane spreads into the T-tubules. There is a conformational change in the dihydropyridine receptors on the T-tubule membrane. A physical interaction between the DHPR and the Ryanodine receptor on the sarcoplasmic reticulum membrane causes release of calcium from the sarcoplasmic reticulum into the sarcoplasm.

**Correct Answer. b**

(146). In contraction of the GI smooth muscle which of the following events occurs after binding of calcium to calmodulin?

- a. depolarization of the sarcolemma membrane
- b. Ca$^{2+}$ induced Ca$^{2+}$ release
- c. Increased myosin-light-chain-kinase
- d. Increased intracellular Ca$^{2+}$ concentration

**Solution. C**

Calcium binds with calmodulin to form calcium-calmodulincomplex which activates a myosin light chain kinase. MLCK phosphorylates myosin light chains in the myosin head. Phosphorylation of the myosin light chains activates myosin ATPase which in turn causes actin-myosin cross bridge formation and starts the muscle contraction.

**Correct Answer. c**

(147). Which of the following is shared by both skeletal and smooth muscle?

- a. Thick and thin filaments arranged in sarcomeres
- b. Troponin
- c. Elevation of intracellular calcium for excitation-contraction coupling
- d. Spontaneous depolarization of the membrane potential

**Solution. C**

In both skeletal and smooth muscle increase in sarcoplasmic calcium triggers muscle contraction.

**Correct Answer. c**

(148). 300mg of a dye is injected intravenously and at equilibrium, the concentration in the plasma was 0.05mg/mL. The volume of the compartment that contained the dye will be

- a. 3000mL
- b. 4000mL
- c. 5000mL
- d. 6000mL

**Solution. D**

To calculate the volume of different body fluid compartments the formula to be used is:-

\[ V = Q - e/C \]

where \( V \) is the volume to be determined, \( Q \) is the known quantity of the dye to be used, \( e \) is the amount which is metabolized or excreted and \( C \) is the concentration of the dye in a sample withdrawn after mixing has taken place.

\[ V = 300 - 0/0.05 = 6000mL \]

**Correct Answer. d**
(149). In a hospital error, a 60-year old woman is infused with large volumes of a solution that causes lysis of her RBCs (intracellular osmolality in RBCs is 300mOsm/L). The solution was most likely

a. 150mM/L NaCl
b. 300mM/L Mannitol
c. 350mM/L Mannitol
d. 300mM/L Urea

**Solution.**

To cause lysis RBCs have to be placed in a hypotonic solution. 150mM of NaCl is 300mOsm of NaCl, which is isotonic. 300mM of mannitol is isotonic. 350mM is hypertonic. Urea is a slowly diffusing substance and can easily cross cell membranes by facilitated diffusion. The urea transporter present on RBCs is UT-

**Correct Answer.** d

(150). A neutral particle X has a concentration (C₁) of 40 on one side of a membrane with an area of “A’ and a thickness of ‘d’ and a concentration on the other side (C₂) of 20. The effect of simultaneously doubling C₁, A and d on the flux of X (C₂ remains unchanged)

a. Cannot be determined
b. Would result in no change
c. Would double the flux
d. Would triple the flux

**Solution.**

Flux or transport across a cell membrane is directly proportional to the diffusion coefficient, surface area, concentration gradient and is inverse proportional to the thickness of membrane. By doubling C₂, the concentration gradient increases by three times. Therefore, flux will also increase by three times.

**Correct Answer.** d

(151). Solutions A and B are separated by a semi permeable membrane that is permeable to Ca⁺⁺ but impermeable to Cl⁻. Solution A contains 10mM CaCl₂ and solution B contains 1mM of CaCl₂. Assuming 2.3 RT/F = 60mV, Ca⁺⁺ will be at electrochemical equilibrium when

a. solution A is +30 mV
b. solution B is +30mV
c. solution A is -60mV
d. solution B is -60mV

**Solution.**

Ca⁺⁺ moves from solution A (which has a higher concentration of Ca⁺⁺) to B (which has a lower concentration of Ca⁺⁺). Solution B gains positive charge. This leads to a positive potential in solution B with respect to A. Equilibrium potential (mV) = 2.3 RT/FZ log C₁/C₂ where Z is the valency and C₁ and C₂ are the concentration on the two sides of the cell membrane.

E (mV) = 60/2 log 10/1 = +30mV

**Correct Answer.** b
(152). Electrophysiologists conduct a study in which they record the membrane potential changes of atrial cells while exposing them to various agents. A tracing from one of the experiments is shown below:

Which of the following substances are most likely applied to the cells at the point indicated by the arrow?

a. Adenosine  
b. Aldosterone  
c. Angiotensin II  
d. Norepinephrine  

**Solution.** a  
Adenosine acts on A1 receptors on pacemaker cells which causes opening of potassium channels in phase 4 of the pacemaker potential, this leads to a decrease in slope of phase 4 decreasing the heart rate. The effect here is similar to that of a vagal stimulation.  

**Correct Answer.** a

(153). During a cardiac catheterization the catheter initially records periodic pressure changes with a maximum of 27 mmHg and minimum of 2 mmHg. The catheter is advanced further, and then shows periodic pressure changes with a maximum of 26 mmHg and a minimum of 10 mmHg. The initial readings were most likely obtained from which of the following locations?

a. Right atrium  
b. Right ventricle  
c. Pulmonary artery  
d. Left atrium  

**Solution.** B; the pressures in different parts of the circulation are as follows: -  

<table>
<thead>
<tr>
<th>Chamber/area</th>
<th>Maximum pressure (mmHg)</th>
<th>Minimum pressure (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right atrium</td>
<td>4-6</td>
<td>0-3</td>
</tr>
<tr>
<td>Right ventricle</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Pulmonary artery</td>
<td>25</td>
<td>9</td>
</tr>
<tr>
<td>Left atrium</td>
<td>6-8</td>
<td>0-3</td>
</tr>
<tr>
<td>Left ventricle</td>
<td>120</td>
<td>0</td>
</tr>
<tr>
<td>Aorta</td>
<td>120</td>
<td>80</td>
</tr>
</tbody>
</table>

**Correct Answer.** b

(154). If the ejection fraction increases, there will be a decrease in

a. cardiac output  
b. end systolic volume  
c. heart rate  
d. pulse pressure  

**Solution.** B; ejection fraction = stroke volume/ end-diastolic volume; an increase in stroke volume will result in an increase in ejection fraction. An increase in stroke volume will decrease the end-systolic volume.  

**Correct Answer.** b
If ejection fraction is 0.4, heart rate is 95 beats/minute and cardiac output is 3.5L/min. What is the end-diastolic volume?

a. 14 mL
b. 37 mL
c. 55 mL
d. 92 mL

**Solution.**
d; Cardiac output = heart rate X stroke volume; 3500 mL/min = 95 X stroke volume or stroke volume = 3500/95 mL = 36.84 mL

Ejection fraction = stroke volume/ end diastolic volume

0.4 = 36.84/ EDV

EDV = 36.84/ 0.4 = 92 mL

**Correct Answer.** d

The left ventricular pressure-volume loop changes from a solid to a dashed line as shown below.

Which of the following parameters is most likely to increase as a result of this change?

a. end-diastolic pressure
b. end-systolic volume
c. stroke volume
d. ventricular afterload

**Solution.** c

The width of the loop in a pressure-volume loop is equal to the stroke volume. Increase in width of the loop causes an increase in stroke volume.

**Correct Answer.** c
Study the diagram given below

Curves A and B represent

a. aortic pressure and ventricular volume
b. ventricular pressure and ventricular volume
c. atrial pressure and aortic pressure
d. ventricular volume and aortic pressure

Solution. A
Taking the ECG as the reference, QRS complex (ventricular depolarization) is followed by ventricular contraction. This is seen as a rapid rise in the aortic pressure curve. A simultaneous decrease in ventricular volume is seen as a fall in the ventricular volume curve. After the rapid rise there is a fall in the aortic pressure curve - this is because of the slow ejection phase of the left ventricle and a forward movement of blood from the aorta to the peripheral arteries. The “incisura” on the aortic pressure curve coincides with closure of the aortic valve and marks the onset of ventricular diastole. Diastole is a phase of filling of the ventricles and this increase in ventricular volume can be seen as a rise in the ventricular volume curve. The P wave of ECG, which is due to atrial depolarization, is followed by atrial systole. Atrial systole causes a further increase in ventricular volume towards the end of ventricular diastole.

Correct Answer. a
Given below are a normal left ventricular pressure-volume and an abnormal loop in red. Which valvular condition produces the abnormal loop?

a. Mitral stenosis
b. Mitral regurgitation
c. Aortic stenosis
d. Aortic regurgitation

**Solution.**
c
LV pressure volume loop in Aortic stenosis
- Peak systolic pressure in the LV increases- “tall loop”
- Increase in left ventricular wall stress (afterload), a decrease in stroke volume and an increase in ESV.
- Stroke volume decreases because the velocity of fiber shortening is decreased by the increased afterload.
- Because the ESV volume is increased the excess residual volume is added to the incoming venous return causing the EDV to increase-this increase in preload activates the FS mechanism to increase the force of contraction and helps the ventricle to overcome the increased outflow resistance. In mild AS this may be adequate to maintain normal stroke volume. But in moderate AS or severe AS the stroke volume may fall considerably because the ESV increases more than the EDV increases.
- Fall in stroke volume can lead to a reduction in arterial pressure. Stroke volume decreases even further if the ventricle begins to exhibit systolic and diastolic dysfunction. Compensatory increases in EDV will be limited by LVH. Hypertrophy will lead to large increases in end diastolic pressure that is associated with reduced EDV because of the increased stiffness of the ventricle prevents normal ventricular filling.

**Correct Answer.** c
(159). Given below is the blood flow pattern through a organ:-

[Graph showing blood flow pattern with ECG]

The blood flow curve was most likely obtained from which of the following tissues?

a. adrenal medulla  

b. brain cortex  

c. left ventricular myocardium  

d. renal cortex  

Solution. c
In the image, blood flow and ECG can be seen. The blood flow decreases during ventricular systole. Left ventricular myocardium receives its blood supply only during diastole. During systole, the coronary vessels, especially on the left, are compressed reducing flow.

Correct Answer. c

(160). The greatest difference in PO\textsubscript{2} will most likely be between the aorta and which of the blood vessels?

a. Brachial vein  

b. Coronary sinus  

c. Internal jugular vein  

d. Portal vein  

Solution. B
Blood supply to the heart is via the right and left coronary arteries arising directly from the root of the aorta. Most of the coronary blood drains into the RA via the coronary sinus and the remainder drains directly into the LA.

The metabolism in the heart is oxidative and the major fuel for the heart is fatty acids. Hence, the heart has a very high oxygen demand. The basal oxygen consumption is 2 mL/min/100g of tissue. There is a very high oxygen demand when one compares it with that of skeletal muscle at rest, which has an oxygen demand of 0.2 mL/min/100g of tissue. The oxygen demand by a beating heart at rest is even greater at 9 mL/min/100g of tissue. This results in a very high oxygen extraction even at rest. A resting heart extracts almost 60-75% of oxygen from the blood. The organ with the maximum arterio-venous oxygen difference is, therefore, the heart.

Correct Answer. b
(161). Which of the following will cause an increase in myocardial consumption?

a. decreased aortic pressure
b. decreased heart rate
c. decreased contractility
d. increased size of heart

Solution. D
Myocardial oxygen consumption increases with increase in
(i) heart rate
(ii) duration of systole
(iii) intramyocardial tension. Intramyocardial tension is a determined by distending pressure and radius \(T = P \times r\). More the radius, more is the tension and more will be the myocardial oxygen demand.
(iv) Work done by the heart. Work done = stroke volume X MAP

Correct Answer. d

(162). The greatest pressure decrease occurs across the arterioles because

a. they have the greatest resistance
b. they have the greatest cross sectional area
c. the velocity of blood flow through them is the highest
d. the velocity of blood flow through them is the lowest

Solution. A
Arterioles are site of peripheral resistance and known as resistance vessels. The greatest drop in pressure occurs across the arterioles because the pressure is the highest in these vessels. Greater the resistance, greater the decrease in pressure. Arterioles have a high content of smooth muscle in their walls and have a very good sympathetic innervation.

Correct Answer. a

(163). In order to maintain constant fluid flow through a tube with varying diameters, which of the following would be true (where \(A_1\) and \(A_2\) represent cross- sectional areas, and \(V_1\) and \(V_2\) represent the corresponding flow velocities)?

a. \(V_1 = V_2\)
b. \(V_1 = A_1 \times V_2\)
c. \(A_2 = A_1 \times V_1 / V_2\)
d. \(V_1 = A_1 \times A_2 / V_2\)

Solution. C
Velocity of blood flow is inverse to the cross sectional area. Therefore, \(A_1 \times V_1 = A_2 \times V_2\)

Correct Answer. c
The tendency of the blood flow to be turbulent is increased by

a. increased viscosity
b. increased hematocrit
c. partial occlusion of a blood vessel
d. decreased velocity of blood flow

Solution. C
Tendency of turbulence is determined by the Reynold’s number. 
Re = \( \rho Dv/\eta \); where \( \rho \) is the density, \( D \) is the diameter, \( v \) is the velocity of flow and \( \eta \) is the viscosity. The most important factor in determining the tendency for turbulence is the velocity of blood flow. A decrease in diameter results in an increase in velocity of blood flow. Increase in velocity increases the Reynold’s number. More the Reynold’s number greater the tendency for turbulence.

Correct Answer. c

Cardiac output of the right side is what percentage of the left side of heart?

a. 25%
b. 50%
c. 75%
d. 100%
e. 125%

Solution. D
Output of the right side of the heart is equal to the output of the left side.

Correct Answer. d

In which of the following conditions is the pulmonary blood flow more than the systemic blood flow

a. normal individual
b. fetus
c. right-to-left shunt
d. left-to-right shunt

Solution. D
In a left-to-right shunt (eg., VSD), blood flows from the left ventricle to the right ventricle through the defect. This “shunted” fraction of left ventricular blood is added to the output of the right ventricle, making the pulmonary blood flow higher than the systemic blood flow. In a normal adult the systemic blood flow is 1-2% more than the pulmonary blood flow because of ‘physiological shunting’. A small fraction of venous blood from the coronary and bronchial circulation drains directly into the left atrium thereby increasing the left ventricular output and the systemic blood flow.

Correct Answer. d
(167). In a patient with hypovolemia and hypotension immediate infusion of 2L of normal saline is expected to increase

a. total peripheral resistance

b. ventricular muscle conduction velocity

c. end-diastolic sarcomere length

d. heart rate

Solution. D
Infusion of saline will increase the circulating blood volume, venous return and cardiac output. Increase in venous return will increase the end diastolic sarcomere length.

Correct Answer. d

(168). The following measurements are obtained in a 30-year old male patient:

Heart rate: 70 beats per minute
Systemic arterial $O_2$: 0.24mL O$_2$/mL
Mixed venous $O_2$: 0.16mL O$_2$/mL
Whole body oxygen consumption: 500mL/min

What is the patient’s cardiac output?

a. 1.65L/min

b. 4.55L/min

c. 5.00L/min

d. 6.25L/min

Solution. D
The data given can be used to calculate the cardiac output by the Fick’s Principle, which states that

Cardiac output $= \frac{O_2 \text{ consumption by whole body in unit time}}{\text{arterio-venous } O_2 \text{ difference}}$

\[
\text{Cardiac output} = \frac{500\text{mL/min}}{240\text{mL/L} - 160\text{mL/L}} = \frac{500\text{mL/min}}{80\text{mL/L}} = 6.25\text{L/min}
\]

Correct Answer. d
(169). Study the cardiac output and venous return curves given below:

The dashed line in the figure illustrates the effect of:

a. increased total peripheral resistance

b. increased blood volume

c. increased contractility

d. negative inotropic agent

Solution. C
An upward shift of the cardiac output curve is associated with increased contractility. Increased myocardial contractility increases the stroke volume and cardiac output. Increase in total peripheral resistance will increase the slope of both the venous return and cardiac output curves. Increased blood volume and increase in mean systemic filling pressure causes a rightward shift of the venous return curve. A negative inotropic agent causes a downwards shift of the cardiac output curve.

Correct Answer. c

(170). At which site is the systolic blood pressure the highest?

a. Aorta

b. Central vein

c. Right atrium

d. Renal artery

Solution. D
Pressures on the arterial side of the systemic circulation will be higher than the pressures in the pulmonary circulation and the pressures on the arterial side of the systemic circulation will be more than the venous side. Out of the arteries, systolic pressure will be higher in a downstream artery (e.g., renal artery) than in the aorta because (i) aorta has a large amount of elastic tissue and is therefore, highly compliant, while a downstream artery is less compliant. Lesser the compliance or the distensibility of a vessel, more will be the systolic pressure (ii) reflection of pressure at branching points causes the systolic pressure to increase slightly in a downstream artery.

Correct Answer. d
(171). Pulse pressure is

a. the highest pressure measured in the arteries

b. the lowest pressure measured in the arteries

c. measured only during diastole

d. determined by stroke volume

Solution. D
Pulse pressure is the difference between the systolic and the diastolic blood pressures. The two determinants of blood pressure are:

(i) stroke volume- more the stroke volume, more is the pulse pressure
(ii) arterial compliance- more the arterial compliance, less the pulse pressure; less the compliance (eg., in atherosclerosis the arterial walls become stiff and their compliance decreases), more is the pulse pressure.

Correct Answer. d

(172). During exercise there is a decrease in the total peripheral resistance. This decrease is because of the effect of

a. sympathetic nervous system on splanchnic vessels

b. parasympathetic nervous system on skeletal muscle arterioles

c. local metabolites on skeletal muscle arterioles

d. local metabolites on cerebral arterioles

Solution. C
During exercise action of local metabolites on pre capillary sphincters and terminal arterioles decreases resistance and increases the blood flow into the skeletal muscle capillaries. This vasodilation of the skeletal muscle vasculature causes a decrease in total peripheral resistance.

Correct Answer. c

(173). At the peak of the exercise, which of the following parameters is the same in the systemic and pulmonary circulations?

a. arterial resistance

b. mean arterial pressure

c. diastolic blood pressure

d. blood flow per minute

Solution. D
In order to maintain continuous flow of blood to the body, the rate of blood flow per minute in both the systemic and pulmonary circulations must be identical. This is true for conditions of both rest and exercise.

Correct Answer. d
A healthy 65-year old man has a tidal volume of 0.45L and a respiratory rate of 16 breaths per minute. His arterial P$_{CO_2}$ is 41 mm Hg and the P$_{CO_2}$ in the expired air is 35 mm Hg. What is his alveolar ventilation?

a. 0.066L/min  
b. 0.38L/min  
c. 5.0L/min  
d. 6.14L/min

**Solution.** d

Alveolar ventilation = (Tidal volume - Dead space volume) X Respiratory Rate

To calculate the dead space we use the Bohr’s equation.

Dead space volume = tidal volume X (P$_{CO_2}$ - P$_{ECO_2}$)/ P$_{CO_2}$

= 0.45 X (41 - 35)/ 41

= 0.066L

Alveolar ventilation = (0.45 - 0.066) X 16 = 6.14L

**Correct Answer.** d

If an area of lung is not ventilated because of bronchial obstruction, the pulmonary capillary blood from that area will have a P$_{O_2}$ that is

a. equal to atmospheric air  
b. equal to arterial P$_{O_2}$  
c. equal to mixed venous P$_{O_2}$  
d. higher than inspired P$_{O_2}$

**Solution.** c

If an area is not ventilated the oxygenation of the blood leaving this area will be incomplete and the P$_{O_2}$ will be close to the mixed venous P$_{O_2}$.

**Correct Answer.** c

Shown below are the pulmonary volume curves of a patient in comparison with a normal individual.

Which of the following is increased in this patient?

a. FVC  
b. FEV$_1$  
c. TLC/ RV  
d. RV/ TLC

**Solution.** d

In the abnormal curve the TLC and RV are both increased but the increase in RV is more than the increase in TLC resulting in an increased RV/ TLC.

**Correct Answer.** d
(177). Which of the following is true during inspiration?

a. Intrapleural pressure is positive
b. Alveolar pressure equals atmospheric pressure
c. Alveolar pressure is higher than atmospheric pressure
d. Intrapleural pressure is more negative than it is during expiration

Solution. d
During a tidal inspiration the intrapleural pressure becomes more negative. The alveolar pressure is lower than the atmospheric pressure, causing the movement of air from the atmosphere to inside the lungs.

Correct Answer. d

(178). Regional variations in ventilation (V) and perfusion (Q) are measured in healthy individuals when they stand in the upright position. The results are graphed with x-axis denoting the position along the lung from the base to the apex.

Which of the curves is most likely to be observed?

a. A
b. B
c. C
d. D

Solution. A
During standing, from base to apex there is decrease in intrapleural pressure, ventilation and perfusion but the V/Q ratio increases from base to apex. Though both ventilation and perfusion decrease from base to apex but the relative decrease in perfusion is more than the decrease in perfusion resulting in an increase in the V/Q ratio. Graph A depicts a decrease in blood flow from base to apex but an increase in the V/Q ratio.

Correct Answer. a
(179). Which of the following curves best corresponds to the airway resistance pattern seen in normal lungs?

![Curves A to D]

a. a
b. b
c. c
d. d

**Solution. D**
The maximum airway resistance is seen in medium sized airways (between the 3<sup>rd</sup> and 5<sup>th</sup> generations). The airway resistance is the less in larger airways because of their large diameter (Resistance is inverse to the fourth power of radius). In smaller airways, the velocity of airflow decreases (velocity is inverse to the total cross sectional area). A lower velocity would favor a laminar flow. Laminar flow decreases resistance to airflow. In medium sized airways, airflow tends to be turbulent resulting in increased resistance to airflow.

**Correct Answer.** d

(180). In interstitial lung disease patient’s supernormal expiratory flow rates are best explained by an increase in which of the following parameters?

a. Lung compliance
b. Outward recoil of the chest wall
c. Physiological dead space
d. Radial traction on airway walls

**Solution. d**
Most interstitial lung diseases lead to pulmonary fibrosis with thickening and stiffening of the pulmonary interstitium. The increased outward pull by the surrounding tissue (radial traction) causes a decrease in airway resistance and supernormal expiratory flow rates.

**Correct Answer.** d
(181). Which of the following will occur as a result of living at high altitude?

a. hypoventilation
b. Arterial PO2 greater than 100 mm Hg
c. Decreased 2,3- DPG
d. Shift of the oxygen hemoglobin dissociation curve to the right

**Solution.** d
In high altitude there is an increase in 2,3- DPG production- this causes the shift of the OHDC to the right.
**Correct Answer.** d

(182). Which of the following types of hypoxia is characterized by a decreased arterial O₂ content and an increased A-a gradient?

a. hypoventilation
b. right-to-left shunt
c. anemia
d. carbon monoxide poisoning

**Solution.** b
In a right-to-left shunt mixing of the deoxygenated blood with the oxygenated blood causes a decrease in arterial \( P_{O2} \) increasing the A-a gradient. In hypoventilation and high altitude, though the alveolar \( P_{O2} \) is reduced, the A-a gradient is normal. In anemia and CO poisoning the \( O_2 \) carrying capacity of the blood is reduced, but the arterial \( P_{O2} \)and the A-a gradient is normal.
**Correct Answer.** b

(183). Hypoxia causes vasoconstriction in which of the following capillary beds?

a. coronary
b. cerebral
c. muscle
d. pulmonary

**Solution.** d
Pulmonary capillary smooth muscle cells have \( O_2 \) sensitive \( K^+ \) channels. Hypoxia causes these channels to close which causes positive charge to accumulate inside the cells producing a depolarization- this in turn result in vascular smooth muscle contraction.
**Correct Answer.** d

(184). Compared with the systemic circulation pulmonary circulation has

a. higher blood flow
b. lower resistance
c. higher arterial pressure
d. higher cardiac output

**Solution.** b
Systemic and pulmonary blood flow is the approximately the same, though systemic flow is 1-2% higher because of physiological shunting. Systemic circulation has a higher resistance and a higher pressure whereas the pulmonary circulation has a lower resistance and a lower pressure.
**Correct Answer.** b
(185). Use the values given below to answer the following question:
Glomerular capillary hydrostatic pressure = 47 mm Hg
Bowman’s space hydrostatic pressure = 10 mm Hg
Bowman’s space oncotic pressure = 0 mm Hg
At what value of glomerular capillary oncotic pressure would the filtration stop?

a. 57 mm Hg
b. 47 mm Hg
c. 37 mm Hg
d. 10 mm Hg

Solution. b
Net filtration pressure = PGC – πGC – PBC + πBC
0 = 57 - πGC – 10 + 0
πGC = 47 mm Hg

Correct Answer. b

(186). Effect of efferent arteriole constriction on GFR is

a. Increases
b. Decreases
c. Increases and then decreases
d. Decreases and then increases

Solution. C
Efferent arteriole constriction has a dual effect on GFR. Constriction of efferent arteriole increases the resistance to outflow from the glomerular capillaries. This raises the glomerular hydrostatic pressure and increases the GFR. However, because an increase in efferent arteriole resistance also decreases renal blood flow, renal plasma flow and filtration fraction, the glomerular colloid osmotic pressure increases as efferent arteriole resistance increases. Therefore, if the efferent arteriole constriction is severe (more than a three-fold increase in efferent arteriole resistance), the rise in colloid osmotic pressure exceeds the increase in glomerular capillary hydrostatic pressure caused by the efferent arteriolar constriction. When this occurs, the net filtration pressure actually decreases, causing a reduction in GFR.

Correct Answer. c

(187). The concentration of para amino hippuric acid is most likely to be the lowest in which of the following nephron segments?

a. ascending limb of loop of henle
b. bowman’s space
c. descending limb of loop of henle
d. PCT

Solution. B
In low concentration, PAH is freely filtered and complete secreted in the PCT. Lowest concentration will be in the Bowman’s capsule and highest at the end of PCT.

Correct Answer. b
(188). At a plasma concentration of more than 20mg/dL, there is a decrease in extraction ratio of PAH. Which of the following best explains the observed decrease in the PAH extraction ratio?

- a. maximal excretion rate is reached
- b. maximal reabsorption rate is reached
- c. carrier transport is saturated
- d. filtration fraction is decreased

**Solution.** c
In low concentration, PAH is freely filtered and completely secreted. PAH has an extraction ratio. Extraction ratio = (arterial concentration – venous concentration)/arterial concentration. For PAH the extraction ratio is near 90% at arterial plasma concentrations lower than 20mg/dL. Once the plasma concentration of PAH is increased above this level, the extraction ratio decreases progressively. This is because there is an incomplete secretion of PAH. Secretion of PAH is carrier mediated. At a high plasma concentration, the carrier protein gets saturated, resulting in an incomplete secretion of PAH.

**Correct Answer.** c

(189). Which of the following will cause a decrease in renal Ca\(^{++}\) clearance?

- a. Hypoparathyrodism
- b. treatment with chlorthiazide
- c. treatment with frusemide
- d. Hypermagnesemia

**Solution.** B
Clearance = \( U \times V / P \). A decrease in urinary calcium concentration will decrease its clearance. Thiazide diuretics increase calcium reabsorption, thereby decreasing Ca\(^{++}\) excretion and clearance. PTH increases calcium reabsorption- hypoparathyroidism will increase urinary loss and therefore, the clearance of Calcium. Frusemide decreases sodium and calcium reabsorption in TAL. Magnesium competes with calcium for reabsorption- hypermagnesemia will cause increased calcium clearance.

**Correct Answer.** b

(190). If a substance completely inhibits glucose transport in the PCT, clearance of glucose will best approximate the clearance of which of the following?

- a. Inulin
- b. PAH
- c. Urea
- d. Sodium

**Solution.** A
An agent which inhibits the absorption of glucose will cause all the filtered glucose to be excreted and glucose is not secreted. Inulin is a substance which is freely filtered, not reabsorbed, not secreted. Therefore, the clearance of glucose in this case will approximate the clearance of inulin.

**Correct Answer.** a
(191). Tubular fluid/Plasmaratio of several substances along the length of the proximal tubule are shown in the diagram:-

Which line represents Inulin?

a. Line 1 
b. Line 2 
c. Line 3 
d. Line 4 

Solution. Line 1
Line 1 is for a substance that is poorly reabsorbed or actively secreted in the PCT, such as creatinine, inulin, PAH.
Line 2 is indicative of the behavior of urea- urea is freely filtered and poorly reabsorbed from the PCT.
Line 3 represents no change in concentration along the length of the PCT.
Line 4 represents the behavior of bicarbonate. Almost 90% of bicarbonate is reabsorbed in the PCT, decreasing its TF concentration.
Line 5 represents solutes that are avidly and completely reabsorbed in the PCT, such as glucose.

Correct Answer. a

(192). In the absence of ADH, tubular fluid from which of the following sampling sites is most likely to have the highest osmolality?

a. PCT 
b. Descending thin segment 
c. Tip of loop of henle 
d. Thick ascending limb

Solution. C
Two thirds of the filtered water is reabsorbed in the PCT. This is know as obligatory reabsorption of water. In the descending thin segment, there is absorption of only water, so that tubular fluid at the tip of loop of henle will have the maximum osmolality.

Correct Answer. c
A patient undergoes a test in which bicarbonate concentration is measured from duodenal aspirates as hormone ‘X’ is infused intravenously. The data is plotted in the graph below:-

Hormone ‘X’ is most likely produced by which of the following cell types?

a. Duodenal S cells  
b. Gastric G cells  
c. Pancreatic alpha cells  
d. Parenchymal hepatocytes

**Solution. A**
With i/v infusion of hormone ‘X’ there is an increase in the bicarbonate level of the duodenal aspirate. This is likely to be produced by Secretin secreted by the S cells in the duodenum.

**Correct Answer.** a

Following intake of food, gastric acid secretion shows an initial rise, peak, and then decline in gastric acid. Which of the following helps most to down-regulate gastric secretion after a meal?

a. Basal secretion  
b. Cephalic phase  
c. Gastrin release  
d. Intestinal influences  
e. Receptive relaxation  
f. Post prandial alkaline tide

**Solution. D**
Intestinal influences are helpful in down regulating gastric acid secretion after a meal. The ileum and colon release peptide YY, which binds to the receptors on the endocrine, histamine-containing cells k/a ECL (enterochromaffin-like cells). Such binding counteracts the cephalic and gastric phases of acid secretion by inhibiting gastrin-stimulated histamine release from the ECLs. Other factors that inhibit acid secretion include somatostatin and prostaglandins.

**Correct Answer.** d
(195). Which of the following cells secrete a substance that controls iron storage and release by other cells involved in iron homeostasis?

a. Biliary lining cells  
b. Bone marrow macrophages  
c. Bone marrow stem cells  
d. Hepatic parenchymal cells  

**Solution. D**  
Hepcidin is an acute phase reactant secreted by hepatocytes that acts as a central regulator of iron homeostasis. High iron levels and inflammatory conditions increase the synthesis of hepcidin, whereas hypoxia and increased erythropoiesis act to lower hepcidin levels. Hepcidin influences body iron storage through its interaction with ferroportin, a transmembrane protein responsible for transferring intracellular iron into the circulation. Upon binding hepcidin, ferroportin is internalized and degraded, decreasing iron absorption and inhibiting the release of iron by macrophages.

**Correct Answer. d**

(196). Given in the diagram are movements of the GI tract occurring at regular intervals during fasting and completely inhibited by a meal. These are

![Diagram of GI tract movements](image_url)  

a. Peristalsis  
b. Segmentation contractions  
c. Mass action contractions  
d. Migrating motor complexes.

**Solution. d**  
Migrating motor complexes, initiated by motilin, occur in interdigestive periods in cycles of 100 minutes. These are rings of contraction which start from the body of the stomach till the distal ileum. MMCs migrate aborally at the rate of 5 cm/min.

**Correct Answer. d**

(197). Specific dynamic action (SDA) of food is least for

a. Proteins  
b. Carbohydrates  
c. Fats  
d. SDA is not related to the type of food  

**Solution. c**  
SDA of a food is the obligatory energy expenditure that occurs during its assimilation into the body. It takes 30 kcal to assimilate the amount of protein sufficient to raise the metabolic rate 100 kcal; 6 kcal to assimilate a similar amount of carbohydrates; 5 kcal to assimilate a similar amount of fats. The cause of SDA, which may last for up to 6 hours, is uncertain.

**Correct Answer. c**
The thalamic nucleus associated with olfaction is

a. mediodorsal

b. intralaminar

c. ventroposteromedial

d. lateral geniculate body

Solution. a
Intralaminar nucleus is non specific. Ventröposteromedial nucleus is thalamic relay nucleus for taste. LGB is the thalamic relay nucleus for the visual pathway.

Correct Answer. a

Which of the following is a medullary reflex

a. Head-on-body righting reflex

b. Body-on-body righting reflex

c. Visual righting reflex

d. Labyrinthine righting reflex

Solution. d
Head-on-body and body-on-body righting reflexes are integrated in the midbrain. Visual righting reflex is a cortical reflex. Vestibular or labyrinthine righting reflex is a medullary reflex.

Correct Answer. d

Decrease in the frequency of the alpha rhythm is seen in all of the following except

a. Hypoglycemia

b. Hypothermia

c. Hypocarbia

d. Hypocortisolism

Solution. c
Alpha rhythm has a frequency 8 and 12Hz and is recorded when one is awake, at rest, eyes closed and mind wandering. A decrease in the frequency of alpha rhythm is seen in the following conditions:-
- Decrease in blood sugar level
- Decreased secretion of glucocorticoids
- Decreased in body temperature
- Increase in P_{CO2}
- Alcohol intake
- Barbiturates, phenytoin
- Encephalopathy- toxic and metabolic

Correct Answer. c

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