

## 3.1

**Q3.1.1 Short Answer:** What is psychopharmacology, and why do we study it?

*Answer:* The scientific study of the effects of drugs on the nervous system and behavior; to learn about psychotherapeutic drugs and gain a better understanding of how these things work. (This answer needs work. IF you have a better one, please let me know and I'll update this document.)

**Q3.1.2 Multiple Choice:** Which of the following is NOT a function of psychopharmacology?

- (A) Study the effects of drugs on the nervous system
- (B) Study the effects of drugs on behavior
- (C) Study the effects of drugs on the immune system
- (D) Study the effects of drugs on neurotransmitter systems

*Answer:* C.

**Q3.1.3 Fill in the Blank:** The location at which a drug interacts with the body to produce its effects is called the \_\_\_\_\_.

*Answer:* Site of action.

**Q3.1.4 Short Answer:** What is the difference between an agonist and an antagonist?

*Answer:* An agonist mimics or enhances the effects of a neurotransmitter, while an antagonist blocks or inhibits the effects of a neurotransmitter.

**Q3.1.5 True or False:** Drugs directly create effects in the body.

*Answer:* False. They modulate ongoing cellular activity.

**Q3.1.6 Multiple Choice:** Which of the following is an example of a drug that acts as an agonist?

- (A) Naloxone
- (B) Morphine
- (C) Curare
- (D) Atropine

*Answer:* B.

**Q3.1.7 Short Answer:** What is selective action?

*Answer:* The ability of a drug to affect only certain types of receptors or neurotransmitter systems, minimizing side effects.

**Q3.1.8 Multiple Choice:** What is a precursor?



- (A) A substance that inhibits neurotransmitter release
- (B) A substance that enhances neurotransmitter release
- (C) A substance from which another substance is formed
- (D) A substance from which a neurotransmitter is broken down

*Answer:* C.

**Q3.1.9 Short Answer:** What is an example of how an agonistic effect can become antagonistic?

*Answer:* If a drug increases the release of a neurotransmitter and also blocks its re-uptake, it can lead to an excess of the neurotransmitter, which may inhibit further release.

**Q3.1.10 Fill in the Blank:** The process of creating a neurotransmitter from its precursors is called \_\_\_\_\_.

*Answer:* Synthesis.

**Q3.1.11 Fill in the Blanks:** A(n) \_\_\_\_\_ agonist binds to the same receptor as the neurotransmitter and \_\_\_\_\_ its effects, while a(n) \_\_\_\_\_ agonist binds to a different site on the receptor and \_\_\_\_\_ the effects of the neurotransmitter. *Answer:* Direct, mimics, indirect, enhances.

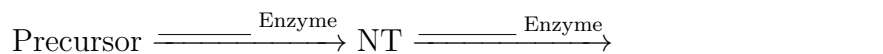
**Q3.1.12 Fill in the Blanks:** A(n) \_\_\_\_\_ antagonist binds to a different site on the receptor and \_\_\_\_\_ the effects of the neurotransmitter, while a(n) \_\_\_\_\_ antagonist binds to the same receptor as the neurotransmitter and \_\_\_\_\_ its effects. *Answer:* Indirect, blocks, direct, inhibits.

**Q3.1.13 Multiple Choice:** Drugs that cause the action potential to stay in a depolarized state are called:

- (A) Agonists
- (B) Depolarizing agents
- (C) Antagonists
- (D) Inverse agonists

*Answer:* B

**Q3.1.14 Fill in the Blanks:** In the following diagram, label the specific enzyme for each arrow, and identify the outcome:



*Answer:* Synthetic; Metabolic; Inactive Metabolite

**Q3.1.15 Long(-ish) Answer:** Describe the difference between a neurotransmitter and a neuromodulator.

*Answer:* A neurotransmitter is a chemical messenger that transmits signals across a synapse from one neuron to another, while a neuromodulator is a substance that modulates the activity of neurotransmitters, often affecting a larger area of the brain and influencing the overall tone of neural activity.



**Q3.1.16 Matching:** Match the following examples with them either being an antagonist or an agonist.

### Choices

- (a) *Curare*
- (b) *Atropine*
- (c) *Morphine*
- (d) *Naloxone*
- (e) *Botulinum Toxin*
- (f) Interfering with docking proteins
- (g) Blocking the reuptake of a neurotransmitter
- (h) *Sarin*
- (i) Interfering with vesicles
- (j) Blocking receptors
- (k) Black widow spider venom
- (l) Cobra and krait venom
- (m) Parathion
- (n) DFP
- (o) *Physostigmine*

- (1) Direct antagonist ..... \_\_\_\_\_
- (2) Indirect antagonist ..... \_\_\_\_\_
- (3) Direct agonist ..... \_\_\_\_\_
- (4) Indirect agonist ..... \_\_\_\_\_

*Answer:* (1): a, b, d, l; (2): e, f, i, j; (3): c, k; (4): g, h, m, n, o.

## 3.2

**Q3.2.1 Multiple Choice:** Which of the following neurochemicals does NOT transmit information (according to our notes)?



- (A) Dopamine      (B) Glutamate      (C) GABA      (D) Glycine

*Answer: A.*

**Q3.2.2 Fill in the Blank:** Peptides are short chains of \_\_\_\_\_. *Answer: Amino acids.*

**Q3.2.3 Fill in the Blanks:** The difference between opioids and opiates are that opioids are \_\_\_\_\_ and opiates are \_\_\_\_\_.

*Answer: endogenous; exogenous.*

**Q3.2.4 Short Answer:** What is the pain pathway for the face? What about from the neck down? (Generally speaking.)

*Answer: From the face (specifically the trigeminal nerve); A-delta fibers (myelinated) fast conducting, C-fibers (unmyelinated) slow conducting fibers*

**Q3.2.5 Fill in the Blanks:** The three types of opioid receptors are \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

*Answer: Mu, Kappa, Delta.*

**Q3.2.6 Long Answer:** What are each of the three opioid receptors responsible for, and what neurochemicals bind to each the most?

*Answer: Mu: Analgesia and euphoria, Endorphins; Delta: Analgesia, Enkephalins; Kappa: Colocalized with certain catecholamines, learning and memory, emotional control, stress response, and analgesia, Dynorphins.*

**Q3.2.7 Multiple Choice:** Prostaglandins become active during

- (A) Resting-and-Digesting      (B) Crying  
(C) Daydreaming      (D) Bleeding

*Answer: D.*

**Q3.2.8 True or False:** *Celecoxib (Celebrex)*, a COX-2 Inhibitor, was removed from the market because it causes heart attacks and stroke.

*Answer: False; Rofecoxib (Vioxx) is the actual COX-2 inhibitor.*

**Q3.2.9 Fill in the Blank:** *Cylooxygenase (COX)* is an enzyme that converts inactive \_\_\_\_\_ to its active state.

*Answer: Prostaglandins*

**Q3.2.10 Long Answer:** List the characteristics for the direct pain pathway and the indirect pain pathway.

*Answer: Direct: Sharp and well localized pain, immediate and brief, mechanical (strong) and thermal (extreme temperature); Indirect: Slow pain, throbbing, aching and dull pain, takes longer, but lingers, chemical (inflammatory) pain,*



**Q3.2.11 Fill in the Blanks:** Pain arrives at the \_\_\_\_\_, then travels to the \_\_\_\_\_. Once there, it is processed by several brain regions. First, the \_\_\_\_\_ contributes to arousal. Then, the \_\_\_\_\_, particularly the anterior cingulate cortex (ACC), processes the emotional aspects of pain. When the pain is overwhelming, the \_\_\_\_\_ activates and releases endogenous opioids to reduce the sensation—this allows a person, for example, to escape danger despite a severe injury. Finally, the \_\_\_\_\_ and other areas help interpret and associate the pain with context.

*Answer:* Brain stem reticular formation (BSRF); Thalamus; Thalamus; Limbic system (ACC); Periaqueductal gray region; Frontal lobes

**Q3.2.12 Matching:** Match the following drugs with their respective NSAID class.

**Choices**

- (a) Ibuprofen
- (b) Aspirin
- (c) Diflunisal
- (d) Naproxen
- (e) Salsalate
- (f) Ketoprofen

- (1) Propionic Acid Derivatives ..... \_\_\_\_\_
- (2) Salicylates ..... \_\_\_\_\_

*Answer:* (1): a, d, f; (2): b, c, e

**Q3.2.13 Long Answer:** Some studies show that both the placebo effect and acupuncture can be blocked by Naloxone, an opioid antagonist. What does this suggest about the mechanism of acupuncture's pain-relieving effects? Does this prove that acupuncture is not entirely a placebo?

*Answer:* This suggests that acupuncture's pain-relieving effects may be mediated by the body's endogenous opioid system, similar to the placebo effect. However, this does not prove that acupuncture is entirely a placebo; it only indicates that placebo-like mechanisms (such as expectation-induced opioid release) may contribute to its effects. Other mechanisms may also be involved.

**Q3.2.14 Short Answer:** What are some of the functions of opioids? (List the main effects and the side effects.)

*Answer:* Prevents diarrhea, gives euphoria, analgesia, changes the stress response, body temperature, emotion, feeding motivation, sexual behavior, learning, drowsiness, and promotes pro-social behavior in some cases.



**Q3.2.15 True or False:** The term *colocalized* means two or more neurotransmitters are released from two separate neurons at the same time.

*Answer:* False; from the same neuron.

**Q3.2.16 Short Answer:** What is the definition of pain? (DO NOT say this exam!!!!!!!)

*Answer:* Unpleasant sensory and emotional experience associated with actual or potential tissue damage.

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### 3.3

**Q3.3.1 True or False:** The amines (monoamines) are derived from amino acids.

*Answer:* True.

**Q3.3.2 Fill in the Blank:** The two indolamines are \_\_\_\_\_ and \_\_\_\_\_.

*Answer:* Serotonin and Melatonin.

**Q3.3.3 Multiple Choice:** What amino acid are indolamines derived from?

(A) Tryptophan      (B) Tyrosine      (C) Thymine      (D) Phenylalanine

*Answer:* A.

**Q3.3.4 Fill in the Blank:** The precursor to glutamate is \_\_\_\_\_, and the enzyme that synthesizes glutamate from it is \_\_\_\_\_.

*Answer:* The precursor is glutamine; the enzyme is glutaminase.

**Q3.3.5 Short Answer:** What receptor does ketamine bind to, and what is its effect?

*Answer:* Ketamine binds to the NMDA receptor and acts as a dissociative anesthetic, which is being studied as a treatment for depression.

**Q3.3.6 Fill in the Blank:** The enzyme \_\_\_\_\_ deactivates anandamide.

*Answer:* Fatty acid amide hydrolase (FAAH)

**Q3.3.7 True or False:** The most common excitatory neurotransmitter in the brain is GABA.

*Answer:* False; it is glutamate.

**Q3.3.8 Short Answer:** What transporters are responsible for glutamate reuptake, and why is this process important?

*Answer:* Excitatory amino acid transporters (EAATs); it prevents excitotoxicity, which can lead to brain damage (e.g., in stroke or ALS).

**Q3.3.9 Multiple Choice:** Which receptor is closely associated with glutamate and is important for synaptic plasticity and memory formation?

(A) GABA receptor      (B) NMDA receptor  
(C) Serotonin receptor      (D) Dopamine receptor



*Answer:* B.

**Q3.3.10 Short Answer:** What enzyme converts glutamate into GABA, and what type of neurotransmitter is GABA?

*Answer:* Glutamic acid decarboxylase (GAD); GABA is the most common inhibitory neurotransmitter in the brain.

**Q3.3.11 Fill in the Blanks:** The three catecholamine neurotransmitters are \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

*Answer:* Dopamine (DA), Norepinephrine (NE), Epinephrine (Adrenaline).

**Q3.3.12 Fill in the Blank:** The drug \_\_\_\_\_ is a direct antagonist of the NMDA receptor and can cause hallucinations and dissociation.

*Answer:* Phencyclidine (PCP).

**Q3.3.13 Multiple Choice:** What does DA, NE, and Adrenaline all contain, and what amino acid are they derived from?

- (A) Catechol and are derived from tryptophan
- (B) Catechol and are derived from tyrosine
- (C) Indole and are derived from tryptophan
- (D) Indole and are derived from tyrosine

*Answer:* B.

**Q3.3.14 Fill in the Blank:** The enzyme \_\_\_\_\_ converts tyrosine into L-DOPA.

*Answer:* Tyrosine hydroxylase.

**Q3.3.15 Short Answer:** Explain how botox interferes with emotional expression.

*Answer:* Botox blocks the release of ACh at the neuromuscular junction, preventing muscle contraction and thus inhibiting facial expressions associated with emotions.

**Q3.3.16 Fill in the Blank:** The orbicularis oculi muscle influences \_\_\_\_\_.

*Answer:* Happiness.

**Q3.3.17 True or False:** Tyrosine is the precursor for serotonin.

*Answer:* False; it is the precursor for catecholamines. (The answer can also be tryptophan.)

**Q3.3.18 Short Answer:** What are the names of the systems that use dopamine, norepinephrine, and epinephrine? *Answer:* Dopaminergic, Noradrenergic, and Adrenergic systems

**Q3.3.19 Fill in the Blanks:** Melatonin is synthesized from \_\_\_\_\_ and is involved in regulating \_\_\_\_\_.

*Answer:* Serotonin; sleep-wake cycles (circadian rhythms).

**Q3.3.20 Short Answer:** What is another name for peptides in the context of neurotransmitters, and give an example.

*Answer:* Neuropeptides; example: Endogenous opioids



**Q3.3.21 Multiple Choice:** What is the name of the endogenous cannabinoid neurotransmitter whose name means “bliss” in Sanskrit?

- (A) Anandamide (B) Cannabidiol  
(C) Tetrahydrocannabinol (THC) (D) 2-Arachidonoylglycerol (2-AG)

*Answer:* A.

**Q3.3.22 Short Answer:** How are lipid-based neurotransmitters synthesized and stored?

*Answer:* They are synthesized on demand and not stored in synaptic vesicles.

**Q3.3.23 Fill in the Blank:** The gaseous neurotransmitter that is required for an erection is \_\_\_\_\_.

*Answer:* Nitric Oxide (NO).

**Q3.3.24 Long Answer:** Describe the study that addressed the question, “Does Botox decrease emotional experience?” Describe the sample, the method, and the results

*Answer:* The study involved participants receiving Botox injections and then received either botox or restylane (dermal filler) injected. Everyone then was shown emotion evoking movies. The results are that the Botox group reported less emotional experience than the restylane group.

**Q3.3.25 Short Answer:** Name one neurotransmitter that is a nucleoside. What is its function?

*Answer:* Adenosine; it is involved in sleep regulation and has inhibitory effects on neurotransmission.

**Q3.3.26 Fill in the Blanks:** Fill in the following spaces that describe the process of dopamine metabolism:

DA is broken down by \_\_\_\_\_ into \_\_\_\_\_. Then, \_\_\_\_\_ converts it into \_\_\_\_\_.

*Answer:* Monoamine oxidase (MAO); Dihydroxyphenylacetic acid (DOPAC); Catechol-O-methyltransferase (COMT); Homovanillic acid (HVA).

**Q3.3.27 Short Answer:** What were the results of the study into depression that asks “Can Botox be used as a good thing?”

*Answer:* 15% of placebo had a decrease in depression, while 52% of the Botox group had a decrease in depression.

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## 3.4:

**Q3.4.1 Short Answer:** What does cholinergic mean?

*Answer:* Cholinergic refers to the neurotransmitter acetylcholine (ACh) and its receptors.





**Q3.4.2 Short Answer:** What are the four main functions of acetylcholine in the central nervous system?

*Answer:* Learning and alertness, memory, REM sleep generation, and reward system.

**Q3.4.3 Multiple Choice:** Who first discovered acetylcholine in 1921?

(A) Otto von Loewy

(B) James Olds

(C) Neal Miller

(D) Peter Milner

*Answer:* A.

**Q3.4.4 Fill in the Blanks:** The following describes the experiment of the scientist that discovered acetylcholine.

He took a(n) \_\_\_\_\_, put it in \_\_\_\_\_, and stimulated the \_\_\_\_\_ part of the vagus nerve, which slowed it. When he put the solution into another \_\_\_\_\_, it also slowed down, showing a chemical (ACh) was released.

*Answer:* frog heart; saline solution; parasympathetic; frog heart.

**Q3.4.5 Fill in the Blanks:** The \_\_\_\_\_ runs parallel to the spinal cord. This is why when you get anxious, \_\_\_\_\_ of your body responds at once.

*Answer:* Sympathetic chain; ALL

**Q3.4.6 Fill in the Blank:** The original name given to acetylcholine by its discoverer was \_\_\_\_\_.

*Answer:* Vagusstoff.

**Q3.4.7 Short Answer:** What are the two types of ACh receptors?

*Answer:* Nicotinic and muscarinic receptors.

**Q3.4.8 True or False:** Acetylcholine is the primary neurotransmitter used in the parasympathetic branch of the autonomic nervous system.

*Answer:* True.

**Q3.4.9 Multiple Choice:** Which of the following is NOT a function of ACh in the CNS?

(A) Learning and alertness

(B) Memory

(C) REM sleep generation

(D) Pain modulation

*Answer:* D.

**Q3.4.10 Fill in the Blanks** The following describes the synthesis and metabolism process of acetylcholine.

\_\_\_\_\_ attaches to an acetate ion, of which is derived from \_\_\_\_\_. Then, \_\_\_\_\_ transfers the acetate from the first chemical to choline, which forms acetylcholine. When it is time to be broken down, ACh is broken down by \_\_\_\_\_ into acetate and \_\_\_\_\_. The acetate is then broken down and eliminated, while the latter chemical is taken back up by \_\_\_\_\_ and reused. *Answer:* Acetylcoenzyme-A (Acetyl-CoA); acetic acid; choline acetyltransferase (ChAT); acetylcholinesterase (AChE); choline; active transport.



**Q3.4.11 Multiple Choice:** Which type of ACh receptor is ionotropic?

- (A) Nicotinic receptors
- (B) Muscarinic receptors
- (C) Both nicotinic and muscarinic receptors
- (D) Neither nicotinic nor muscarinic receptors

*Answer:* A.

**Q3.4.12 Short Answer:** Explain what the sympathetic chain is, and identify where it is located.

*Answer:* Its a series of ganglia located along the spinal cord that connects the sympathetic nervous system to the spinal nerves. It allows for the rapid transmission of signals throughout the body.

**Q3.4.13 Fill in the Blank:** The drug \_\_\_\_\_ is a direct antagonist of nicotinic receptors, causing paralysis.

*Answer:* Curare.

**Q3.4.14 True or False:** Atropine blocks nicotinic receptors and is derived from the plant known as belladonna alkaloids (deadly nightshade).

*Answer:* False; it blocks muscarinic receptors.

**Q3.4.15 Short Answer:** How does Botulinum Toxin interfere with acetylcholine function?

*Answer:* It interferes with  $\text{Ca}^{2+}$  influx channels, preventing the release of ACh.

**Q3.4.16 Fill in the Blanks:** Black widow spider venom causes \_\_\_\_\_ of ACh, while (cobra and) krait venom \_\_\_\_\_ ACh receptors.

*Answer:* Continual release; blocks.

**Q3.4.17 Multiple Choice:** Which of the following is a reversible AChE blocker used to treat myasthenia gravis?

- |  |  |
|--|--|
| (A) <i>Deprenyl</i> ( <b>Eldepryl</b> )        | (B) <i>Tetrabenazine</i> ( <b>Xenazine</b> ) |
| (C) <i>Physostigmine</i> ( <b>Antilirium</b> ) | (D) <i>Neostigmine</i> ( <b>Prostigmin</b> ) |

*Answer:* D.

**Q3.4.18 True or False:** *Xanomeline* (**Cobenfy**) crosses the blood-brain barrier and is used to treat the cognitive symptoms of Alzheimer's disease.

*Answer:* False; *Donepezil* (**Aricept**)

**Q3.4.19 True or False:** Nicotinic receptors are antagonists at low doses, but agonists at high doses.

*Answer:* False; they are agonists at low doses and antagonists at high doses.

**Q3.4.20 Multiple Choice:** In the PNS, where are nicotinic receptors predominantly located?



- (A) Brain and spinal cord
- (B) Neuromuscular junctions
- (C) Autonomic ganglia
- (D) None of the above

*Answer:* B.

**Q3.4.21 Fill in the Blanks:** The \_\_\_\_\_ is the synapse between a motor neuron and a muscle fiber, where ACh is released to stimulate muscle contraction. The \_\_\_\_\_ is part of the sympathetic nervous system, located near the spinal cord, where preganglionic neurons synapse with postganglionic neurons.

*Answer:* The neuromuscular junction is the synapse between a motor neuron and a muscle fiber, where ACh is released to stimulate muscle contraction. The paravertebral ganglion is part of the sympathetic nervous system, located near the spinal cord, where preganglionic neurons synapse with postganglionic neurons.

**Q3.4.22 Multiple Choice:** In the sympathetic nervous system, which neurotransmitter is used at the neuromuscular junction with smooth muscles and glands?

- (A) Acetylcholine
- (B) Norepinephrine
- (C) Dopamine
- (D) Serotonin

*Answer:* B.

**Q3.4.23 Short Answer:** Compare the neurotransmitters used in the parasympathetic nervous system versus the sympathetic nervous system.

*Answer:* In the parasympathetic nervous system, ACh is used at both the preganglionic and postganglionic synapses. In the sympathetic nervous system, ACh is used at the preganglionic synapse, while NE is used at the postganglionic synapse (except for sweat glands, which use ACh).

**Q3.4.24 Multiple Choice:** Which of the following statements about acetylcholine in the autonomic nervous system is FALSE?

- (A) ACh is the primary neurotransmitter in the parasympathetic branch
- (B) ACh is used at preganglionic synapses in both sympathetic and parasympathetic branches
- (C) ACh is used at postganglionic synapses to sweat glands in the sympathetic branch
- (D) ACh is the primary neurotransmitter at the neuromuscular junction with smooth muscles in the sympathetic branch

*Answer:* D.

**Q3.4.25 Fill in the Blank:** In the somatic nervous system, ACh \_\_\_\_\_ the neuromuscular junction.

*Answer:* Excites.



**Q3.4.26 Multiple Choice:** Which structure in the basal forebrain that uses ACh is primarily responsible for activating the cortex and facilitating learning?

- (A) Nucleus Basalis (B) Medial Septal Nucleus  
(C) Nucleus of Diagonal Band (D) Pedunculopontine nucleus

*Answer:* A.

**Q3.4.27 True or False:** The Medial Septal Nucleus, which uses ACh, primarily modulates the amygdala.

*Answer:* False. It primarily modulates the hippocampus.

**Q3.4.28 Fill in the Blanks:** For one of the four functions in the CNS, acetylcholine facilitates \_\_\_\_\_ generation through the actions of the \_\_\_\_\_ and \_\_\_\_\_. These cholinergic structures project to the pons and thalamus, activating brain regions for this time period.

*Answer:* REM sleep; Pedunculopontine nucleus (PPT); Laterodorsal Tegmental Nucleus (LDT).

**Q3.4.29 Fill in the Blanks:** The \_\_\_\_\_ and \_\_\_\_\_ are structures that use acetylcholine and project to the hippocampus through the fornix. This is important for learning and memory.

*Answer:* Medial Septal Nucleus; Nucleus of Diagonal Band.

**Q3.4.30 Multiple Choice:** Which of the following correctly describes the neurotransmitter pathway in the parasympathetic nervous system?

- (A) ACh at preganglionic synapse, ACh at postganglionic synapse  
(B) ACh at preganglionic synapse, NE at postganglionic synapse  
(C) NE at preganglionic synapse, ACh at postganglionic synapse  
(D) NE at preganglionic synapse, NE at postganglionic synapse

*Answer:* A.

**Q3.4.31 Short Answer:** How did vikings and Koryaks engage with ACh?

*Answer:* Vikings and Koryaks used ACh to make a hallucinogenic drink from Amanita muscaria mushrooms. [NOT REQUIRED FOR FULL CREDIT:] The drink was used in rituals and ceremonies, and the effects were similar to those of ACh (e.g., hallucinations, altered perception).





### 3.5:

**Q3.5.1 Fill in the Blanks:** The three catecholamines are \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

*Answer:* Dopamine (DA); Norepinephrine (NE); Epinephrine (Adrenaline).

**Q3.5.2 Short Answer:** How does *deprenyl* (**Eldepryl**) (also called selegiline (**Jumex**)) work?

*Answer:* It is a selective MAO-B inhibitor that increases dopamine levels in the brain and is used to treat Parkinson's disease.

**Q3.5.3 Multiple Choice:** What is the precursor for dopamine?

- (A) Tyrosine                      (B) L-DOPA                      (C) Tryptophan                      (D) Choline

*Answer:* A.

**Q3.5.4 Fill in the Blank:** The rate-limiting enzyme in the synthesis of catecholamines is \_\_\_\_\_.

*Answer:* Tyrosine Hydroxylase.

**Q3.5.5 Short Answer:** Describe the pathway of dopamine synthesis from its amino acid precursor.

*Answer:* Tyrosine is converted to L-DOPA by tyrosine hydroxylase, then L-DOPA is converted to dopamine by DOPA decarboxylase.

**Q3.5.6 True or False:** The word "tyrosine" is derived from the word British variation of the word "tire" (spelled "tyre") for its circular shape.

*Answer:* False; it is derived from "cheese" for its discovery in cheese.

**Q3.5.7 Multiple Choice:** Which pathway is involved in movement and motor control?

- (A) Nigrostriatal system                      (B) Mesocortical system  
(C) Mesolimbic system                      (D) Tuberoinfundibular system

*Answer:* A.

**Q3.5.8 Fill in the Blanks:** The following describes the nigrostriatal system for movement:

We start at the \_\_\_\_\_, which then sends an inhibitory \_\_\_\_\_ signal to the \_\_\_\_\_, who sends a reciprocal inhibitory \_\_\_\_\_ signal back. Then, the first system sends an inhibitory \_\_\_\_\_ signal to the \_\_\_\_\_. Then, that system excites the \_\_\_\_\_, who then excites the \_\_\_\_\_, which causes voluntary movement.

*Answer:* Striatum; GABA; substantia nigra; DA; GABA; globus pallidus; thalamus; primary motor cortex.

**Q3.5.9 Short Answer:** List four symptoms of Parkinson's disease.

*Answer:* Any four of: weakness, tremor at rest, muscle rigidity, problems with balance, abnormal gait, trouble learning.



**Q3.5.10 Short Answer:** What is a drug that was used to lower blood pressure, but gave Parkinson's-like symptoms as a side effect?

*Answer: Reserpine (Raudixin)*

**Q3.5.11 Fill in the Blank:** The misfolded proteins found in the brains of people with Parkinson's disease are called \_\_\_\_\_.

*Answer: Lewy Bodies.*

**Q3.5.12 True or False:** In Huntington's Chorea, there is too much GABA from the Striatum to the Substantia Nigra.

*Answer: False. In Huntington's Chorea, there is too little GABA from the Striatum to the Substantia Nigra.*

**Q3.5.13 Long Answer:** Explain how the MPTP incident in 1982 contributed to our understanding of Parkinson's disease.

*Answer: In 1982, young California heroin users thought they were using synthetic heroin (MPPP), but were actually exposed to MPTP. They instantly developed Parkinson's-like symptoms. MPTP is converted to MPP+ by the enzyme MAO, which damaged dopaminergic cells in the substantia nigra. This led to the development of animal models for Parkinson's research and potential treatment approaches, including MAO inhibitors like deprenyl (selegiline).*

**Q3.5.14 Fill in the Blank:** *Methylphenidate (Ritalin)* increases levels of \_\_\_\_\_ and \_\_\_\_\_ in the brain.

*Answer: Dopamine (DA); Norepinephrine (NE).*

**Q3.5.15 Multiple Choice:** Which system is primarily responsible for reward and reinforcement?

(A) Nigrostriatal system

(B) Mesocortical system

(C) Mesolimbic system

(D) Tuberoinfundibular system

*Answer: C.*

**Q3.5.16 Short Answer:** What neuropeptide, also called orexin, is involved in the regulation of sleep and wakefulness?

*Answer: Hypocretin.*

**Q3.5.17 Multiple Choice:** What neurotoxin led to the development of an animal model for Parkinson's disease?

(A) MPTP

(B) MPPP

(C) MPP+

(D) MAO

*Answer: A.*

**Q3.5.18 Fill in the Blank:** The drug \_\_\_\_\_ is an orexin receptor antagonist used to treat insomnia.

*Answer: Suvorexant (Belsomra).*



**Q3.5.19 True or False:** The mesocortical system is involved in short-term memory, planning, and problem-solving.

*Answer:* True.

**Q3.5.20 Multiple Choice:** Which researchers discovered that electrical stimulation of certain brain areas could be rewarding rather than aversive?

(A) Otto von Loewy

(B) James Olds and Peter Milner

(C) Neal Miller and Delgado

(D) Lateral hypothalamus researchers

*Answer:* B.

**Q3.5.21 Short Answer:** What structure within the limbic system is considered the “pleasure center” of the brain?

*Answer:* Nucleus accumbens.

**Q3.5.22 Fill in the Blanks:** The following is a paragraph that describes dopamine synthesis: Tyrosine is converted to \_\_\_\_\_ by the enzyme \_\_\_\_\_. This converted form is then used to create dopamine by the enzyme \_\_\_\_\_.

*Answer:* L-DOPA; Tyrosine Hydroxylase; DOPA Decarboxylase.

**Q3.5.23 Multiple Choice:** Which of the following is NOT a function of dopamine in the CNS?

(A) Movement and motor control

(B) Reward and reinforcement

(C) Learning and memory

(D) Sleep-wake cycles and REM sleep

*Answer:* D.

**Q3.5.24 Short Answer:** Describe the metabolism of dopamine.

*Answer:* Dopamine is metabolized by the enzyme monoamine oxidase (MAO) into Dihydroxyphenylacetic acid (DOPAC), which is further metabolized by catechol-O-methyltransferase (COMT) into Homovanillic acid (HVA).

**Q3.5.25 Short Answer:** Define choreoathetotic movements.

*Answer:* Choreoathetotic movements refer to excessive movement disorders.

**Q3.5.26 Fill in the Blanks:** The term \_\_\_\_\_ refers to slow, continuous writhing movements, while \_\_\_\_\_ (from the Greek word for “dance”) refers to rapid, purposeless, involuntary movements.

*Answer:* Athetosis; Choreic

**Q3.5.27 True or False:** Both athetosis and choreic movements are characterized by too little movement.

*Answer:* False. Both are characterized by too much movement.

**Q3.5.28 Short Answer:** Where in the brain is hypocretin produced?

*Answer:* In the lateral hypothalamus.



**Q3.5.29 Multiple Choice:** Which drug is an orexin agonist and can be used to treat narcolepsy?

- (A) *Suvorexant* (**Belsomra**)                      (B) *Methylphenidate* (**Ritalin**)  
(C) TAK-994    (D) Hypocretin

*Answer:* C.

**Q3.5.30 Short Answer:** Explain the difference between athetosis and choreic movements.

*Answer:* Athetosis involves slow, continuous writhing movements, while choreic movements are rapid, purposeless, involuntary movements (like dancing).

**Q3.5.31 Fill in the Blank:** \_\_\_\_\_ is a neuropeptide involved in the regulation of sleep and wakefulness that is also known as orexin.

*Answer:* Hypocretin

**Q3.5.32 Short Answer:** What is the role of adenosine in the body?

*Answer:* Adenosine is a nucleoside that plays a role in sleep regulation and has inhibitory effects on neurotransmission. It accumulates in the brain during wakefulness and promotes sleepiness.

**Q3.5.33 True or False:** Nucleosides and neuropeptides are the same thing.

*Answer:* False. Nucleosides are not the same as neuropeptides.

**Q3.5.34 Multiple Choice** Spinal nerves leave the spinal cord and synapses in the paravertebral ganglion. This action is part of the \_\_\_\_\_ system.

- (A) Sympathetic    (B) Parasympathetic  
(C) Somatic    (D) Central Nervous System (CNS)

*Answer:* A.

**Q3.5.35 Fill in the Blank** What type of neurotransmitter was used in the previous problem?

*Answer:* Acetylcholine (ACh).