1 BASIC NEUROSCIENCE

QUESTION ONE

An excitatory signal is received at the dendrite of a pyramidal glutamate neuron. When the signal is released from the incoming presynaptic dopaminergic axon, it is received as an inhibitory signal. However, this signal is not integrated properly with other incoming signals to that neuron. Which is the most likely site at which the error of integrating this signal with other incoming signals occurred?

A. Dendritic membrane

B. Soma

C. Axonal zone

D. Presynaptic zone

Answer to Question One

The correct answer is B.

Choice	Peer answers
Dendritic membrane	23%
Soma	45%
Axonal zone	14%
Presynaptic zone	18%

A – Incorrect. Dendritic membrane is the site of signal detection; signal integration does not occur here.

B – Correct. Soma is the site that integrates chemical encoding of signal transduction from all incoming signals; improper signal integration is most likely at this site.

C – Incorrect. Axonal zone is the site of signal propagation; signal integration does not occur here.

D – Incorrect. Presynaptic zone is the site of signal output; signal integration does not occur here.

References

Stahl SM. *Stahl's essential psychopharmacology*, fourth edition. New York, NY: Cambridge University Press; 2013. (Chapter 1)

QUESTION TWO

A receptor synthesized with an erroneous amino acid sequence is sent via fast anterograde transport to its axonal destination. If you want to find the original site of error, which organelle would you elect to observe?

A. Free polysome

B. Golgi apparatus

C. Mitochondria

D. Rough endoplasmic reticulum

Answer to Question Two

The correct answer is D.

Choice	Peer answers
Free polysome	4%
Golgi apparatus	12%
Mitochondria	13%
Rough endoplasmic reticulum	72%

A – Incorrect. Free polysomes, or non-membrane-bound ribosomes, are the site of peripheral protein (e.g., microtubules, neurofilaments) synthesis.

B – Incorrect. Golgi apparatus is the place to which integral proteins are sent for modification after synthesis.

C – Incorrect. Mitochondria, the cell's "powerhouses," are important energy sources to fuel cellular transport but will not reveal underlying causes of errors in protein synthesis.

D – Correct. The rough endoplasmic reticulum, or membrane-bound ribosomes, is the site of integral protein (e.g., receptors, enzymes, ion channels) synthesis; such proteins are destined for membrane insertion and travel via fast transport.

References

Stahl SM. *Stahl's essential psychopharmacology*, fourth edition. New York, NY: Cambridge University Press; 2013. (Chapter 1)

QUESTION THREE

Which of the following are involved in regulating neurotransmission via excitation–secretion coupling?

A. Voltage-sensitive sodium channels

B. Voltage-sensitive calcium channels

C. Both A and B

D. Neither A nor B

Answer to Question Three

The correct answer is C.

Choice	Peer answers
Voltage-sensitive sodium channels	10%
Voltage-sensitive calcium channels	15%
Both A and B	74%
Neither A nor B	1%

A – Partially correct.

B – Partially correct.

C – Correct. Propagation of an action potential to the axon terminal is mediated by voltage-sensitive sodium channels. Influx of sodium through voltage-sensitive sodium channels at the axon terminal leads to opening of voltage-sensitive calcium channels, also at the axon terminal. Influx of calcium through the open voltage-sensitive calcium channels leads to docking of synaptic vesicles and secretion of neurotransmitter into the synapse.

D – Incorrect.

References

Stahl SM. *Stahl's essential psychopharmacology*, fourth edition. New York, NY: Cambridge University Press; 2013. (Chapter 3)

QUESTION FOUR

Agonists cause ligand-gated ion channels to:

A. Open wider

B. Open for longer duration of time

C. Open more frequently

D. A and B

E. A and C

Answer to Question Four

The correct answer is C.

Choice	Peer answers
Open wider	3%
Open for longer duration of time	12%
Open more frequently	39%
A and B	32%
A and C	15%

A – Incorrect. Agonists do not cause ligand-gated receptors to open wider.

B – Incorrect. Agonists do not cause ligand-gated receptors to open for longer durations of time.

C – Correct. Agonists cause ligand-gated ion channels to open more frequently.

D – Incorrect.

E – Incorrect.

References

Stahl SM. *Stahl's essential psychopharmacology*, fourth edition. New York, NY: Cambridge University Press; 2013. (Chapter 3)

QUESTION FIVE

Presynaptic reuptake transporters are a major method of inactivation for which of the following?

A. Serotonin

B. Serotonin and GABA

C. Serotonin, GABA, and histamine

D. Serotonin, GABA, histamine, and neuropeptides

Answer to Question Five

The correct answer is B.

Choice	Peer answers
Serotonin	35%
Serotonin and GABA	49%
Serotonin, GABA, and histamine	8%
Serotonin, GABA, histamine, and neuropeptides	8%

A – Partially correct.

B – Correct. Both monoamines such as serotonin and amino acid neurotransmitters such as GABA are inactivated primarily via presynaptic transporters.

C – Incorrect. Histamine does not have a known presynaptic reuptake transporter and is instead inactivated via enzymatic degradation.

D – Incorrect. Histamine and neuropeptides do not have known presynaptic reuptake transporters. Histamine is inactivated enzymatically and neuropeptides are inactivated by diffusion, sequestration, and enzymatic destruction.

References

Stahl SM. *Stahl's essential psychopharmacology*, fourth edition. New York, NY: Cambridge University Press; 2013. (Chapter 2)