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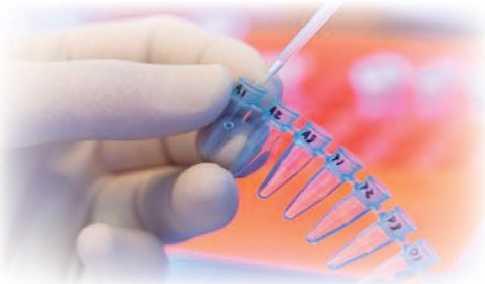

MCQs in BIOCHEMISTRY for Medical Students

(With Explanatory Answers)



MCQs

Arti S Pandey

JAYPEE

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Chapter 3

Central Nervous System

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1. Which of the following is not a neurotransmitter in the CNS?
   a. Glutamate
   b. γ amino butyrate
   c. Acetylcholine
   d. Histidine
2. The main excitatory neurotransmitter in brain is _____ and the main inhibitory neurotransmitter is _____.
   a. Norepinephrine, glutamate
   b. Glutamate, γ amino butyrate
   c. Acetylcholine, norepinephrine
   d. Serotonin, melatonin
3. Which of the following is the correct set of amino acid neurotransmitters in the brain?
   a. Glycine, histidine, glutamine, aspartate
   b. Glycine, glutamine, histamine, glutamate
   c. Glycine, γ amino butyric acid, glutamate, aspartate
   d. Histidine, γ amino butyric acid, glutamate, arginine
4. Glutamate is _____ to γ amino butyric acid (GABA) and GABA donates its _____ group to _____ to form glutamate.
   a. Decarboxylated, carboxyl, glutamine
   b. Deaminated, amino, glycine
   c. Dehydoxylated, amino, aspartate
   d. Decarboxylated, amino, α ketoglutarate
5. Glutamate from the synaptic cleft is transported into the _____ and converted to _____, which diffuses into the _____ and forms _____.

a. Presynaptic neuron, GABA, synaptic vesicle, glutamate
b. Glial cell, α ketoglutarate, presynaptic neuron, glutamate
c. Presynaptic neuron, glutamine, glial cell, glutamate
d. Glial cell, glutamine, presynaptic neuron, glutamate

6. Glutamate excitotoxicity refers to:
   a. Excessive depolarization of postsynaptic neurons
   b. Neuronal cell death due to excess of intracellular glutamate
   c. Neuronal cell death due to lack of glutamate
   d. Excessive accumulation of glutamate in the synaptic vesicles
7. In case of a stroke, neuronal necrosis occurs due to:
   a. Impaired uptake of glutamate into glial cells
   b. Influx of Ca^{2+} and Na^{+} into the postsynaptic neuron
   c. Generation of reactive oxygen species in the postsynaptic neuron
   d. All of the above
8. During an epileptic episode, it will be desirable to _____ glutamate and _____ GABA.
   a. Enhance, inhibit
   b. Release, synthesize
   c. Synthesize, metabolize
   d. Inhibit, enhance
9. Which of the following is true about glycine in the CNS?
   a. It has both excitatory and inhibitory roles
   b. Its inhibitory role involves blocking glutamate receptors
   c. It results in hyperpolarization of the postsynaptic neuron
   d. a and c
10. Tetanus is caused due to:
    a. An inhibition of glutamate release
    b. Enhancement of glycine release
    c. Blocking of glycine and GABA release
    d. Reduced uptake of GABA and glycine from the synapse
11. Which of the following associations of neurotransmitters and their localization in the brain is correct?
    a. Serotonin—substantia nigra
    b. Acetylcholine—nucleus basalis
    c. Dopamine—locus coeruleus
    d. Epinephrine—raphe nuclei
12. Which of the following neurotransmitters are monoamines?
    a. Serotonin
    b. Acetylcholine
    c. Nitric oxide
    d. Glutamate

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13. Catecholamines are derived from _____ whereas serotonin is derived from _____.
    a. Phenylalanine, tyrosine
    b. Tyrosine, serine
    c. Tyrosine, tryptophan
    d. Hydroxyproline, tryptophan
14. The synthesis of catecholamines depends upon the coenzyme:
    a. Tetrahydrofolate
    b. Tetrahydrobiopterin
    c. Pyridoxal phosphate
    d. Phenylalanine hydroxylase
15. A deficiency of tetrahydrobiopterin (BH4) will lead to:
    a. An accumulation of tyrosine and serotonin
    b. A deficiency of tyrosine
    c. A deficiency of pheynylalanine
    d. A deficiency of serotonin
16. Norepinephrine forms epinephrine by:
    a. Hydroxylation
    b. Decarboxylation
    c. Deamination
    d. Methylation
17. Norepinephrine does **not**:
    a. Increase heart rate
    b. Cause vasoconstriction
    c. Stimulate storage of glucose
    d. Cause wakefulness
18. In the adrenal medulla, norepinephrine gets converted to:
    a. Dopamine
    b. Epinephrine
    c. Vanillylmandelic acid
    d. Aldosterone
19. Dopaminergic neurons in the brain lack:
    a. Monoamine oxidase
    b. Tyrosine hydroxylase
    c. Catechol-O-methyl transferase
    d. Dopamine hydroxylase
20. Dopamine is degraded to _____ and ____ which are excreted in urine.
    a. Vanillylmandelic acid, metanephrine
    b. Phenylalanine, tyrosine
    c. Homovanillic acid, dihydroxyphenylacetic acid
    d. Phenylacetic acid, urea
21. Dopamine is NOT associated with:
    a. Nausea and vomiting
    b. Inhibition of prolactin secretion
    c. Motor control
    d. Alzheimer's disease

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22. A deficiency of dopamine leads to:
    a. Parkinson's disease
    b. Alzheimer's disease
    c. Myasthenia gravis
    d. Huntington's disease
23. Serotonin is the same as:
    a. Dihydroxyphenylalanine
    b. 5 hydroxytryptamine
    c. Catecholamine
    d. Tryptophan
24. A lack of serotonin in brain is most commonly associated with:
    a. Induction of sleep
    b. Euphoria
    c. Major depressive disorder
    d. Hallucinations
25. Acetylcholine in the CNS is associated with:
    a. Euphoria
    b. Learning and memory
    c. Myasthenia gravis
    d. Depression
26. Alzheimer's disease shows a loss of_____ in the frontal cortex and the hippocampus.
    a. Cholinergic neurons
    b. Noradrenergic neurons
    c. Dopaminergic neurons
    d. GABA synthesizing neurons
27. Which of the following nucleotides is a neurotransmitter in the CNS?
    a. Adenosine
    b. Guanosine
    c. Cytosine
    d. Thymidine
28. _____ and _____ cause and oppose sedation respectively.
    a. Acetylcholine, norepinephrine
    b. Dopamine, serotonin
    c. Melatonin, histamine
    d. Glutamate, GABA
29. Which of the following neurotransmitter is present in the CNS as well as the ANS?
    a. GABA
    b. Glutamate
    c. Serotonin
    d. Nitric oxide
30. The brain consumes ____ of the body's glucose.
    a. 10%
    b. 60%
    c. 40%
    d. 80%

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31. Which of the following is not utilized in the adult brain as a fuel?
    a. Amino acids
    b. Ketone bodies
    c. Fatty acids
    d. Glucose
32. Glucose uptake into the brain occurs through _____ and is insulin_____.
    a. GLUT4, dependent
    b. GLUT2, independent
    c. GLUT1, independent
    d. GLUT2, dependent
33. Brain needs a continuous supply of ATP which it utilizes mainly to:
    a. Synthesize storage molecules
    b. Fuel active ionic transport
    c. Synthesize neurotransmitters
    d. Transport glucose actively into CNS neurons
34. Which of the following cannot cross the blood brain barrier through passive diffusion?
    a. Water
    b. Lipid-soluble molecules
    c. O_2
    d. Glucose
35. Knowledge of brain metabolism is utilized for _____ to assess its function.
    a. Ultrasonography (USG)
    b. Positron emission tomography (PET)
    c. X-ray
    d. A computerized tomography scan (CT-scan)
36. Which of the following can result in cerebral edema?
    a. Hyperglycemia
    b. Hypoxia
    c. Hyperalbuminemia
    d. Hyperbilirubinemia
37. A breakdown of the blood brain barrier will lead to cerebral edema because:
    a. Na^+ K^+ ATPase activity is disrupted
    b. Cerebrospinal fluid (CSF) leaks into interstitial space
    c. Neuronal Na^+ increases
    d. Protein enters the neurons
38. Glucose levels in the CSF are usually ____ of glucose levels in the plasma.
    a. 20–40%
    b. 50%
    c. 60–80%
    d. 100%

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39. In prolonged diabetes mellitus, the CSF glucose levels are ____ plasma glucose levels.
    a. The same as
    b. Lower than
    c. Higher than
    d. Not determined by
40. CSF lactate concentration:
    a. Changes independent of plasma lactate
    b. In proportion to plasma lactate
    c. Depends on plasma glucose levels
    d. Increases with O_2 consumption by brain
41. Which of the following conditions will not cause hypoglycorrhachia (decreased CSF glucose levels)?
    a. Brain tumor
    b. Starvation
    c. Tuberculous meningitis
    d. Fungal meningitis
42. Total protein in the CSF is about _____ of that in plasma.
    a. 5%
    b. 10%
    c. 1%
    d. 0.5%
43. Plasma proteins in the capillaries cross the BBB through _____.
    a. Passive diffusion
    b. Leakage through cellular junctions
    c. Carrier-mediated transport
    d. Binding to lipids
44. A CSF serum albumin index of <9 indicates:
    a. Albumin synthesis by the brain cells
    b. A leaky blood brain barrier
    c. A leaky CSF blood barrier
    d. An intact blood brain barrier
45. The presence of "oligoclonal band" on CSF electrophoresis is most indicative of:
    a. Immune disorders
    b. Multiple sclerosis
    c. A disrupted blood brain barrier
    d. Brain hemorrhage

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ANSWERS

CENTRAL NERVOUS SYSTEM

1. d. Histidine is not a neurotransmitter, in CNS or ANS.
2. b. Glutamate and GABA, respectively
3. c. Glutamate, GABA, glycine and aspartate are the amino acid neurotransmitters. Histamine is derived from histidine, and is an "amine' neurotransmitter, not an amino acid.
4. d. GABA can be formed from glutamate by decarboxylation by the enzyme glutamic acid decarboxylase (GAD). Glutamate, in turn can be synthesized from the TCA cycle intermediate, α ketoglutarate (α KG) by transfer of an amino group from GABA to α KG.
5. d. This is the metabolic pathway of glutamate after its release from the pre-synaptic neuron. It is also directly transported back into the pre-synaptic neuron and repacked into vesicles.
6. b. Since glutamate is an excitatory neurotransmitter, its excess is referred to as excitotoxicity, which results in the death of neurons.
7. d. Due to lack of ATP in the neurons, the uptake of glutamate into glial cells is diminished so that glutamate stays in the synaptic cleft for a long time, stimulating its receptors which cause an influx of Ca^{2+} and Na^{+} and generation of reactive oxygen species, which kills the neuron.
8. d. During epilepsy, excitatory neurotransmitters should be inhibited and inhibitory transmitter activity should be enhanced to decrease neuronal transmission.
9. d. Glycine enhances glutamate activity by facilitating the activation of its receptor. For inhibition, it acts through a different set of receptors which cause inhibition of transmission of action potential by causing hyperpolarization.
10. c. Tetanus toxin is a protein that binds to transporters on synaptic vesicles in inhibitory neurons and blocks the release of glycine and GABA.

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11. b. Nucleus basalis is one of the nuclei in the basal forebrain that secretes acetylcholine, and is associated with Alzheimer's disease. Dopamine is associated with substantia nigra, epinephrine with locus coeruleus and serotonin with raphe nuclei.
12. a. Serotonin is a monoamine because it has an amino group attached to an aromatic ring through a –CH2-CH2-linkage.
13. c. Serotonin is also called 5-hydroxytryptamine, reflecting its derivation from tryptophan.
14. b. BH4 is required for the activity of phenylalanine hydroxylase and tyrosine hydroxylase. "d." is incorrect because it is an enzyme, not a coenzyme.
15. d. BH4 deficiency results in an accumulation of phenylalanine derivatives (phenylketonuria) and a deficiency of the catecholamines as well as serotonin, as BH4 is also required as a coenzyme for tryptophan hydroxylase during the biosynthesis of serotonin.
16. d. The enzyme phenylethanolamine N methyl transferase (PNMT) catalyzes the conversion of norepinephrine to epinephrine.
17. c. Norepinephrine causes a rise in blood pressure by increasing the heart rate and vascular resistance to increase the distribution of glucose that has been released by it in the tissues. In the brain, its main action is alertness.
18. b. Epinephrine is the main hormone secreted by the adrenal medulla.
19. d. Dopaminergic neurons can synthesize dopamine from Phe or Tyr, and can also break it down through the action of MAO and COMT, but cannot convert dopamine to norepinephrine, which is catalyzed by dopamine hydroxylase.
20. c.
21. d. Alzheimer's disease is associated with acetylcholine and norepinephrine in the CNS.
22. a. Dopamine deficiency is also associated with schizophrenia besides Parkinsonism.

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23. b. Serotonin or 5 hydroxytryptamine is derived from tryptophan. It is a monoamine, but not a catecholamine, as it lacks the catechol group.
24. c. Serotonin agonists are most commonly used to treat depression. A lack of serotonin abolishes sleep, while an excess can result in euphoria, as well as hallucinations.
25. b. Acetylcholine affects alertness, learning and memory both through the effects on nicotinic as well as muscarinic receptors in the brain.
26. a. Alzheimer's disease shows a characteristic loss of cholinergic neurons.
27. a. Adenosine as well as ATP are neurotransmitters in the CNS, as well as in the ANS.
28. c. Melatonin is derived from serotonin and induces sleep. Histamine causes wakefulness.
29. d. Nitric oxide is synthesized by and acts on all types of neurons both in the CNS and ANS.
30. b.
31. c. Brain is capable of utilizing glucose, amino acids and ketone bodies for fuel. Fatty acids can undergo β oxidation to give acetyl Co A and eventually ATP, but only in the neonate and not in the adult brain.
32. c. This is the reason that insulin resistance affects peripheral tissues that have insulin dependent GLU Transporters, and not the brain.
33. b. A disruption of ATP supply to the brain rapidly causes brain dysfunction as action potentials can no longer be generated.
34. d. Glucose transport across the blood brain barrier (BBB) requires GLUT1 transporters. Lipid-soluble molecules, gases like O_2 and CO_2 and water can freely diffuse across the BBB.
35. b. A PET scan utilizes the uptake of radiolabeled glucose into the brain cells to assess brain activity. X-rays, CT scans or ultrasonography provide an imaging of the brain that doesn't outline the active areas of brain.

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36. b. Hypoxia causes a decline in ATP, which will result in low activity of Na^+ K^+ ATPase, so that Na^+ is retained inside the neurons, along with water. Glucose, albumin and bilirubin (conjugated) cannot cross the BBB, even at high concentrations, as they need specific transporters.
37. d. A leakage of protein into the brain will osmotically also bring in water. The BBB disruption does not directly affect neuronal levels of Na^+ or the Na^+ K^+ ATPase activity. CSF leakage into interstitial space is not due to BBB disruption.
38. c.
39. b. Glucose levels in the CSF will rise as more plasma glucose is transported into brain, and more is transported into the CSF by membrane carriers. The latter however, get saturated resulting in low glucose entering CSF compared to what is taken up from plasma.
40. a. Brain astrocytes convert glucose into lactate which enters the CSF. This concentration depends on brain activity or the absence of O_2, but not on plasma glucose levels.
41. b. During starvation, metabolic shifts ensure a constant supply of glucose to the brain. Bacterial or viral meningitis, or tumor in the brain, can consume most of the glucose delivered to the brain and result in much lower values in CSF compared to plasma.
42. d.
43. c. All plasma proteins have carriers in the capillary-BBB junction and a small percentage can cross over into the brain through carrier-mediated endocytosis.
44. d. Albumin is not synthesized in the brain and its presence in the CSF is entirely from what was transported into the brain from the plasma and later into the CSF. A leaky CSF blood barrier or disruption of the blood brain barrier would have raised the CSF serum albumin index, which is the ratio of CSF albumin (mg/L) to serum albumin (mg/dL) to >9.
45. b. The oligoclonal banding is due to the production of several IgG clones that indicate an inflammatory condition or multiple sclerosis due to production of IgG from within the brain.

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Q. No.	A	B	C	D
1.	◯	◯	◯	◯
2.	◯	◯	◯	◯
3.	◯	◯	◯	◯
4.	◯	◯	◯	◯
5.	◯	◯	◯	◯
6.	◯	◯	◯	◯
7.	◯	◯	◯	◯
8.	◯	◯	◯	◯
9.	◯	◯	◯	◯
10.	◯	◯	◯	◯
11.	◯	◯	◯	◯
12.	◯	◯	◯	◯
13.	◯	◯	◯	◯
14.	◯	◯	◯	◯
15.	◯	◯	◯	◯

Q. No.	A	B	C	D
16.	◯	◯	◯	◯
17.	◯	◯	◯	◯
18.	◯	◯	◯	◯
19.	◯	◯	◯	◯
20.	◯	◯	◯	◯
21.	◯	◯	◯	◯
22.	◯	◯	◯	◯
23.	◯	◯	◯	◯
24.	◯	◯	◯	◯
25.	◯	◯	◯	◯
26.	◯	◯	◯	◯
27.	◯	◯	◯	◯
28.	◯	◯	◯	◯
29.	◯	◯	◯	◯
30.	◯	◯	◯	◯

Q. No.	A	B	C	D
31.	◯	◯	◯	◯
32.	◯	◯	◯	◯
33.	◯	◯	◯	◯
34.	◯	◯	◯	◯
35.	◯	◯	◯	◯
36.	◯	◯	◯	◯
37.	◯	◯	◯	◯
38.	◯	◯	◯	◯
39.	◯	◯	◯	◯
40.	◯	◯	◯	◯
41.	◯	◯	◯	◯
42.	◯	◯	◯	◯
43.	◯	◯	◯	◯
44.	◯	◯	◯	◯
45.	◯	◯	◯	◯

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