Lecture #05 Diencephalon

Question 1: Which describes the ventromedial and lateral nuclei of the hypothalamus?

a) Receive their principal input from the postcommissural fibers of the fornix

b) Contain neurons that respond to an increase in blood temperature

c) Control the wake-sleep cycle

d) Are responsible for the regulation of eating behavior

e) Control water balance

HINT:

Famous early hypothalamic lesion studies involved ventromedial nucleus lesions

EXPLANATION:

The lateral hypothalamus motivates appetitive behavior. Lateral hypothalamic lesions stop eating behaviors and the animal wastes away. The ventromedial hypothalamus controls satiety. In some animals, ventromedial hypothalamic lesions cause extreme obesity.

ANSWER: ['Are responsible for the regulation of eating behavior']

Lecture #05 Diencephalon

Question 2: Extending from the ventral surface of the hypothalamus is the tuber cinereum and what?

a) Tuberomammillary nucleus

b) Massa intermedia

c) Neurohypophysis

d) Anterior pituitary

e) Reticular nucleus

HINT:

The tuber cinereum is adjacent to the mammillary bodies

EXPLANATION:

The tuber cinereum lies at the base of the neurohypophysis or infundibulum, the pituitary stalk. The tuber cinereum is generally removed with the brain along with some infundibulum when the brain is removed, but its pituitary gland remains enclosed in the sella turcica in the skull.

ANSWER: ['Neurohypophysis']

Lecture #05 Diencephalon

Question 3: The thalamic syndrome of Dejerine-Roussy (lesion destroying the Ventral Posterior Nucleus of thalamus) results initially in loss of sensation from which?

a) Ipsilateral half of the head only

b) Ipsilateral half of the head and body

c) Ipsilateral half of the body only

d) Contralateral half of the body only

e) Contralateral half of the head and body

HINT:

Both divisions of the ventral posterior nucleus are affected

EXPLANATION:

The ventral posterolateral nucleus carries contralateral body sensations, the ventral posteromedial carries contralateral face (head) sensations.

ANSWER: ['Contralateral half of the head and body']

Lecture #05 Diencephalon

Question 4: The suprachiasmatic nucleus influences which diencephalic structure?

a) Habenula

b) Pineal gland

c) Lateral geniculate nucleus (LGN)

d) Dejerine-Roussy

e) Substantia nigra pars compacta

HINT:

The suprachiasmatic nucleus is the master clock of the circadian system

EXPLANATION:

Circadian rhythms of sleep and wakefulness are governed by suprachiasmatic nucleus activity that follows a 24 hour cycle. Suprachiasmatic nucleus activity is cycled by its genetic expressions and influenced by light input from specialized ganglion cells of the retina. Suprachiasmatic nucleus output is relayed via the hypothalamus, intermediolateral cell column, and superior cervical ganglion to the pineal gland, which secretes melatonin to promote sleep. Damage to the suprachiasmatic nucleus disrupts sleep, resulting in very irregular sleep patterns.

ANSWER: ['Pineal gland']

Lecture #05 Diencephalon

Question 5: Which of the following describes a feature of the organization of the hypothalamus?

a) It contains the pineal gland

b) It is divided from front to back into four regions of nuclei: preoptic, anterior, middle, and posterior

c) It is divided into lateral, medial, and anterior nuclei by the internal medullary lamina

d) It contains the subthalamic nucleus

e) The lateral group of nuclei is divided into dorsal and ventral tiers

HINT:

The hypothalamus is divided topographically, either anterior to posterior or medial to lateral

EXPLANATION:

The hypothalamus is divided topographically, either anterior to posterior (rostral to caudal) or medial to lateral. The medial to lateral sequence is periventricular, medial, and lateral zones. The anterior to posterior sequence is preoptic, anterior, middle or tuberal (referring to the tuber cinereum), and posterior or mammillary zones. The dorsal and ventral tiers and the internal medullary lamina are features of the thalamus.

ANSWER: ['It is divided from front to back into four regions of nuclei: preoptic, anterior, middle, and posterior']

Lecture #05 Diencephalon

Question 6: Which hypothalamic structure provides a major input to the anterior thalamic nucleus?

a) Anterior

b) Mammillary body

c) Interthalamic adhesion

d) Massa intermedia

e) Tuberomammillary

HINT:

This is part of the Papez circuit

EXPLANATION:

The Papez circuit is the basic limbic loop. It can be traced from cingulate cortex. Posterior cingulate cortex axons project via several steps in parahippocampal temporal cortex to the hippocampus. The hippocampus projects via the fornix to the mammillary bodies. The mammillary bodies project via the mammillothalamic tract to the anterior thalamus. The anterior thalamus projects via the thalamic radiations to the cingulate cortex, completing the Papez circuit limbic loop.

ANSWER: ['Mammillary body']

Lecture #05 Diencephalon

Question 7: What is the function of the intralaminar thalamic nuclei?

a) Association relay

b) Motor relay

c) Corticolimbic relay

d) Corticothalamic relay

e) Increasing arousal

HINT:

The intralaminar nuclei have a different function from the medial or lateral geniculate nucleus

EXPLANATION:

The intralaminar thalamic nuclei in the internal medullary lamina are neuromodulatory. They increase excitability of the thalamus and areas beyond via projections to several other parts of the brain.

ANSWER: ['Increasing arousal']

Lecture #05 Diencephalon

Question 8: Which of the thalamic nuclear groups is related to prefrontal association cortex?

a) Medial

b) Preoptic

c) Anterior

d) Lateral

e) Supraoptic

HINT:

Eliminate the specific sensory nuclear groups

EXPLANATION:

The three thalamic nuclear groups are the anterior, medial, and lateral. The anterior nucleus divisions dominate the anterior group. The anterior nucleus gets limbic system input and projects to prefrontal association cortex and anterior cingulate cortex.

ANSWER: ['Medial']

Lecture #05 Diencephalon

Question 9: Where is the reticular nucleus of the thalamus?

a) Within the internal medullary lamina of the thalamus

b) In the central core region of the specific thalamic relay nuclei

c) In the brainstem tegmentum from medulla to midbrain

d) Overlying the external medullary lamina on the lateral surface of the thalamus

e) Spread diffusely throughout the thalamus

HINT:

Do not confuse the thalamic reticular nucleus with the brainstem reticular neuromodulatory areas

EXPLANATION:

The reticular thalamic nucleus is a thin nucleus that overlies the surface of the lateral thalamus, separated from it by the external medullary lamina. Reticular thalamic nucleus neurons project into the thalamus to regulate burst versus tonic firing of thalamic specific relay neurons.

ANSWER: ['Overlying the external medullary lamina on the lateral surface of the thalamus']

Lecture #05 Diencephalon

Question 10: The ventral posterolateral, ventral posteromedial, medial geniculate, and lateral geniculate nuclei of the thalamus are characterized by which?

a) Specific inputs and projecting to sensory areas of cortex

b) Specific inputs and projecting to limbic areas of cortex

c) Integrating different cortical areas

d) Switching thalamocortical neurons between tonic and burst modes

e) Specific inputs and projecting to motor areas of cortex

HINT:

Begin by distinguishing specific thalamic sensory relay nuclei from thalamic nuclei that mediate arousal or burst and tonic modes of firing

EXPLANATION:

The specific sensory relay nuclei of the thalamus carry somatic sense, hearing, and vision to primary cortical sensory areas. They are the ventral posterolateral for contralateral body sensations, the ventral posteromedial for contralateral face sensations, the medial geniculate for bilateral hearing, and the lateral geniculate for the contralateral hemifield of vision.

ANSWER: ['Specific inputs and projecting to sensory areas of cortex']

Lecture #05 Diencephalon

Question 11: Which hypothalamic region facilitates body heat conservation?

a) Posterior

b) Tuberomammillary

c) Supraoptic

d) Lateral

e) Ventromedial

HINT:

This is best answered in terms of the rostrocaudal hypothalamic zones

EXPLANATION:

Several hypothalamic nuclei, areas, or regions can be linked to specific regulatory functions. The ventromedial (or ventral medial tuberal) and lateral hypothalamus regulate satiety and hunger, respectively. The posterior hypothalamus regulates body heat conservation. The medial preoptic nucleus contains neurons that are heat sensitive and command heat loss mechanisms including sweating. Other medial preoptic neurons detect water loss and drive behaviors to restore water.

ANSWER: ['Posterior']

Lecture #05 Diencephalon

Question 12: The sensory relay nuclei of the thalamus that project to primary sensory areas of the cortex are which?

a) Ventral posterolateral, ventral posteromedial, medial geniculate, and lateral geniculate

b) Anterior and lateral dorsal

c) Ventral anterior and ventral lateral

d) Reticular, intralaminar, and midline

e) Dorsomedial, lateral posterior, and pulvinar

HINT:

Begin by distinguishing specific thalamic sensory relay nuclei from thalamic nuclei that mediate arousal or burst and tonic modes of firing

EXPLANATION:

The specific sensory relay nuclei of the thalamus carry somatic sense, hearing, and vision to primary cortical sensory areas. They are the ventral posterolateral for contralateral body sensations, the ventral posteromedial for contralateral face sensations, the medial geniculate for bilateral hearing, and the lateral geniculate for the contralateral hemifield of vision.

ANSWER: ['Ventral posterolateral, ventral posteromedial, medial geniculate, and lateral geniculate']

Lecture #05 Diencephalon

Question 13: Which of the following describes the organization of the hypothalamus?

a) The lateral group of nuclei is divided into dorsal and ventral tiers

b) It contains the subthalamic nucleus

c) It consists of the habenular nuclei and pineal gland

d) It is divided from medial to lateral into periventricular, medial, and lateral zones

e) It is divided into lateral, medial, and anterior nuclei by the internal medullary lamina

HINT:

The hypothalamus is divided topographically, either anterior to posterior or medial to lateral

EXPLANATION:

The hypothalamus is divided topographically, either anterior to posterior (rostral to caudal) or medial to lateral. The medial to lateral sequence is periventricular, medial, and lateral zones. The anterior to posterior sequence is preoptic, anterior, middle or tuberal (referring to the tuber cinereum), and posterior zones. The dorsal and ventral tiers and the internal medullary lamina are features of the thalamus.

ANSWER: ['It is divided from medial to lateral into periventricular, medial, and lateral zones']

Lecture #05 Diencephalon

Question 14: The fornix passes through the hypothalamus to synapse where?

a) Medial dorsal nucleus (dorsomedial nucleus) of the thalamus

b) Anterior nucleus of the thalamus

c) Amygdala

d) Mammillary body

e) Cingulate gyrus

HINT:

This is part of the Papez circuit

EXPLANATION:

The Papez circuit is the basic limbic loop. It can be traced from cingulate cortex. Posterior cingulate cortex axons project via several steps in parahippocampal temporal cortex to the hippocampus. The hippocampus projects via the fornix to the mammillary bodies. The mammillary bodies project via the mammillothalamic tract to the anterior thalamus. The anterior thalamus projects via the thalamic radiations to the cingulate cortex, completing the Papez circuit limbic loop.

ANSWER: ['Mammillary body']

Lecture #05 Diencephalon

Question 15: Which structures comprise the epithalamus?

a) Ventral posteromedial nucleus, ventral posterolateral nucleus

b) Habenula, pineal gland

c) Suprachiasmatic nucleus, medial geniculate nucleus, lateral geniculate nucleus

d) Suprachiasmatic nucleus, pineal gland

e) Septal nuclei, stria medullaris thalami

HINT:

The epithalamus includes a little-discussed limbic structure and a part of circadian circuitry

EXPLANATION:

The epithalamus includes a little-discussed limbic structure the habenula, and an important part of circadian circuitry, the melatonin-producing pineal gland. The habenula has complex inputs via the stria medullaris, including from the ventral basal ganglia and various limbic structures. The habenula has complex outputs to the brainstem tegmentum, thought to be involved in pain and other aspects of motivation. The pineal gland has input relayed from the circadian master clock in the suprachiasmatic nucleus of the hypothalamus. The output of the pineal gland is secretion of melatonin to promote sleep.

ANSWER: ['Habenula, pineal gland']

Lecture #05 Diencephalon

Question 16: According to the review article by Janig et al. 2006, what is the proposed order of the four medial to lateral functional zones of the hypothalamus?

a) Medial, intermediate, tuberomammillary, lateral

b) Appetitive, thermoregulatory, osmotic regulatory, reproductive

c) Neuroendocrine, circadian, visceral motor, behavioral control

d) Periventricular, intermediate, tuberomammillary, lateral

e) Periventricular, medial, tuberomammillary, lateral

HINT:

The highest functions are most lateral

EXPLANATION:

The four Janig hypothalamic functional zones from medial to lateral are endocrine, circadian, visceral motor, and behavioral control. One may regard these as progressing from most simple and fundamental to most complex and advanced neuronal functions.

ANSWER: ['Neuroendocrine, circadian, visceral motor, behavioral control']

Lecture #05 Diencephalon

Question 17: Which is a major nucleus of the subthalamus?

a) Suprachiasmatic nucleus

b) Tuber cinereum

c) Subthalamic nucleus

d) Pineal gland

e) Adenohypophysis

HINT:

There is one widely recognized nucleus of the subthalamus

EXPLANATION:

There is one widely recognized nucleus of the subthalamus, the subthalamic nucleus, which has a major role in the basal ganglia indirect pathway that inhibits movement.

ANSWER: ['Subthalamic nucleus']

Lecture #05 Diencephalon

Question 18: Where is the massa intermedia?

a) Adjacent to the intralaminar nuclei

b) Between the left and right thalamus

c) Under the cerebral aqueduct

d) Adjacent to the reticular nucleus

e) Between the diencephalon and mesencephalon

HINT:

It is also called the interthalamic adhesion

EXPLANATION:

The massa intermedia or interthalamic adhesion joins the left and right thalamus at the midline, though it does not contain any major interconnections, and it is absent in some people. It is surrounded by the third ventricle.

ANSWER: ['Between the left and right thalamus']

Lecture #05 Diencephalon

Question 19: A lesion restricted to the ventral posterolateral (VPL) thalamic nucleus results initially in loss of sensation from which?

a) Contralateral half of the head and body

b) Contralateral half of the body

c) Contralateral half of the head

d) Ipsilateral half of the head and body

e) Ipsilateral half of the body

HINT:

Spinal and bulbar signals project to separate subdivisions of the ventral posterior nucleus

EXPLANATION:

The specific sensory relay nuclei of the thalamus carry somatic sense, hearing, and vision to primary cortical sensory areas. They are the ventral posterolateral for contralateral body sensations, the ventral posteromedial for contralateral face sensations, the medial geniculate for bilateral hearing, and the lateral geniculate for the contralateral hemifield of vision

ANSWER: ['Contralateral half of the body']

Lecture #05 Diencephalon

Question 20: Destruction of which hypothalamic nucleus most directly disrupts sleep cycles?

a) Supraoptic

b) Reticular

c) Suprachiasmatic

d) Tuberomammillary

e) Subthalamic

HINT:

The master biological clock controls sleep cycles

EXPLANATION:

Circadian rhythms of sleep and wakefulness are governed by suprachiasmatic nucleus activity that follows a 24 hour cycle. Suprachiasmatic nucleus activity is cycled by its genetic expressions and influenced by light input from specialized ganglion cells of the retina. Suprachiasmatic nucleus output is relayed via the hypothalamus, intermediolateral cell column, and superior cervical ganglion to the pineal gland, which secretes melatonin to promote sleep. Damage to the suprachiasmatic nucleus disrupts sleep, resulting in very irregular sleep patterns.

ANSWER: ['Suprachiasmatic']

Lecture #05 Diencephalon

Question 21: Which of the thalamic nuclear groups is related to cingulate cortex?

a) Anterior

b) Medial

c) Preoptic

d) Lateral

e) Supraoptic

HINT:

This is part of the Papez circuit

EXPLANATION:

The Papez circuit is the basic limbic loop. It can be traced from cingulate cortex. Posterior cingulate cortex axons project via several steps in parahippocampal temporal cortex to the hippocampus. The hippocampus projects via the fornix to the mammillary bodies. The mammillary bodies project via the mammillothalamic tract to the anterior thalamus. The anterior thalamus projects via the thalamic radiations to the cingulate cortex, completing the Papez circuit limbic loop.

ANSWER: ['Anterior']

Lecture #05 Diencephalon

Question 22: Thalamic syndrome includes emotional instability, dysesthesia, and what else?

a) Intractable pain

b) Ipsilateral sensory loss in the body and usually the head

c) Bilateral loss of pain and temperature sensitivity

d) Anterograde amnesia

e) Retrograde amnesia

HINT:

Thalamic syndrome results from damage to the ventral posterior thalamic nucleus

EXPLANATION:

Thalamic syndrome initially exhibits loss of contralateral body and head sensation due to interruption of somatic sensory signals that were relayed by the ventral posterolateral and ventral posteromedial nuclei. This is eventually followed by emotional instability, dysesthesia, and intractable pain. There is no obvious explanation for these later symptoms.

ANSWER: ['Intractable pain']