PSYP610 Final Exam questions 2025

✅ 1. Write a detailed note on the structure and functions of the thalamus.

What it is:
The **thalamus** is a large, dual-lobed mass of grey matter located in the **diencephalon**, just above the brainstem. It forms part of the **forebrain** and consists of multiple nuclei that serve different functions.

What it does:

- Acts as the **main relay station** for **sensory information**. Nearly all sensory inputs (except smell) pass through the thalamus before reaching the **cerebral cortex**.
- Involved in **motor functions**, as it connects to the **basal ganglia** and **cerebellum**.
- Plays a crucial role in **consciousness**, **alertness**, and **attention**.
- Integrates **emotional and cognitive information**, due to connections with the **limbic system** and **prefrontal cortex**.

🧠 Essentially, the thalamus controls what sensory information is allowed to reach your awareness.

✅ 2. How is a person's biological clock determined — is it biologically controlled or influenced by environmental factors?

What it is:
The **biological clock** is the body's internal system that regulates **circadian rhythms**, which are physical, mental, and behavioral changes following a **24-hour cycle**.

What determines it:

- It is primarily controlled by the **suprachiasmatic nucleus (SCN)** in the **hypothalamus**, which acts as the **master clock**.
- The biological clock is **biologically innate**, but it is also **entrained** (adjusted) by **environmental cues**—especially **light** (via the retina).
- Other external cues like **meal times, sleep schedules, and social interaction** can also influence it.

🌞 So yes, it's **biologically determined**, but also **environmentally influenced**, making it a **flexible but internally guided** system.

✅ 3. Explain the role of dopamine in the development of schizophrenia.

What it is:
Dopamine is a neurotransmitter involved in **motivation, reward, motor control, and cognition**.

What it does in schizophrenia:

- According to the **dopamine hypothesis**, **hyperactivity** of dopamine in certain brain regions (especially the **mesolimbic pathway**) contributes to **positive symptoms** like hallucinations and delusions.
- Conversely, **hypoactivity** in the **mesocortical pathway** may be linked with **negative symptoms** such as apathy and impaired executive functioning.
- Antipsychotic drugs that **block D2 dopamine receptors** have been effective in reducing positive symptoms, supporting the role of dopamine in the disorder.

⚖️ The key idea is that **dopamine imbalance across pathways** contributes to the **symptom profile of schizophrenia**.

✅ 4. Define homeostasis and explain its importance in physiological and behavioral regulation.

What it is:
Homeostasis is the process by which the body maintains a **stable internal environment** despite changes in the external surroundings. It's a **self-regulating process**.

What it does:

- Maintains balance in systems like **body temperature, blood pressure, glucose levels, and pH**.
- In the brain, it helps regulate **hormone levels**, **sleep-wake cycles**, and **emotional stability**.
- Controlled by multiple brain areas including the **hypothalamus**, which integrates neural and hormonal signals to maintain internal balance.

🌡️ Example: When you're cold, homeostasis triggers **shivering** to warm you up. When you're hungry, it stimulates **feeding behavior** to restore energy balance.

✅ 5. What is the principle of mass action in brain function?

What it is:
The **principle of mass action** is a theory proposed by **Karl Lashley**, based on his studies of rats and memory after brain lesions.

What it says:

- The brain works as a **whole system** in executing complex functions like **learning and memory**.
- The **degree of impairment** in function is more dependent on the **amount of tissue damaged**, rather than its specific location.
- It opposes strict **localization theories**, instead suggesting **distributed processing** across the cortex.

🧠 In short, **the more extensive the brain damage, the greater the learning impairment**, regardless of the specific area.

✅ 6. Describe the structure and functions of the corpus striatum.

What it is:
The **corpus striatum** is a subcortical part of the forebrain, located in the **basal ganglia**. It consists of two main structures:

- **Caudate nucleus**
- **Putamen**

Together, these structures form the **striatum**, which is heavily involved in motor and cognitive functions.

What it does:

- It plays a central role in **voluntary motor control**, **habit formation**, and **procedural learning**.
- Receives **dopaminergic input** from the substantia nigra, crucial for regulating motor activity.
- Involved in the **reward system** and **motivation**, through connections with the limbic system.
- Damage or dysfunction in this region is associated with disorders like **Parkinson's disease**, **Huntington's disease**, and **OCD**.

🎮 Think of it as your brain's **motion and habit command center**.

✅ 7. Describe the serotonin (5-HT) pathways in the brain and their functional significance.

What it is:
Serotonin (5-HT) is a neurotransmitter produced primarily in the **raphe nuclei** located in the **brainstem**.

What it does (pathways and roles):

- **Ascending pathways**: Project to the **cortex**, **limbic system**, and **basal ganglia**.
  - Regulate **mood**, **sleep**, **pain perception**, and **emotional behavior**.
- **Descending pathways**: Project to the **spinal cord**.
  - Modulate **pain signals** and influence **motor control**.

🧠 Dysregulation in serotonin pathways is linked to **depression, anxiety, aggression, and sleep disorders**. That's why SSRIs (Selective Serotonin Reuptake Inhibitors) are used as antidepressants—they **increase serotonin availability**.

✅ 8. What is aphasia? Discuss its types and affected brain areas.

What it is:
Aphasia is a language disorder caused by **damage to specific brain areas**—usually in the **left hemisphere**—responsible for language processing.

What it does (types):

1. **Broca's aphasia (non-fluent)**:
   - Caused by damage to **Broca's area** (left frontal lobe).
   - Affects **speech production**; person knows what they want to say but struggles to form words.
2. **Wernicke's aphasia (fluent)**:
   - Caused by damage to **Wernicke's area** (left temporal lobe).
   - Speech is fluent but often **meaningless or nonsensical**; person has **poor comprehension**.
3. **Global aphasia**:
   - Caused by large lesions affecting both Broca's and Wernicke's areas.
   - Results in severe impairments in **speaking, understanding, reading, and writing**.

📚 Aphasia affects both **language comprehension and production**, depending on the area damaged.

✅ 9. Discuss the resting metabolic stage/process and its role in brain activity.

What it is:
The **resting metabolic process** refers to the **baseline level of energy consumption** in the brain when it is **not actively performing tasks**.

What it does:

- Despite resting, the brain **consumes about 20% of the body's energy**, primarily for:
  - Maintaining **ion gradients**
  - Supporting **spontaneous neural activity**
  - Enabling **resting membrane potentials**
- It's essential for maintaining **neuronal readiness**, so the brain can respond instantly to stimulation.
- Any disruption in metabolic balance can affect **cognitive function, consciousness, and neural signaling**.

⚡ Even at rest, your brain is busy keeping everything **primed and stable**.

✅ 10. How do cells regulate development and differentiation — what mechanisms control when the growth stops?

What it is:
During brain development, neurons and glial cells undergo a process of **growth, differentiation, and synaptic formation**. However, unchecked growth must be stopped to allow proper brain architecture.

What controls this process:

- **Genetic programs**: Genes activate/inactivate certain proteins at specific stages to halt proliferation.
- **Chemical signaling**: Substances like **neurotrophins**, **growth factors**, and **inhibitory molecules** regulate when and how much cells grow.
- **Apoptosis** (programmed cell death): Eliminates excess neurons that are not properly connected.

- **Synaptic pruning**: Removes weak or unnecessary connections to refine brain networks.
- **Environmental input**: Sensory experiences can influence which connections are strengthened or eliminated.

🧠 These mechanisms ensure the brain develops **efficiently and accurately**, avoiding overcrowding or miswiring.

During brain development, cellular growth and differentiation are precisely regulated through a combination of genetic, molecular, and environmental mechanisms. Neural progenitor cells initially divide rapidly and then begin to differentiate into specialized neurons or glial cells based on genetic instructions, positional information from morphogen gradients, and activation of key signaling pathways such as Notch, Wnt, and Sonic Hedgehog. Epigenetic modifications further lock cells into their specific roles, while neurotrophic factors like BDNF and NGF support their maturation. As development progresses, the process does not continue indefinitely—growth and differentiation stop at the right time due to built-in regulatory mechanisms. These include feedback inhibition from neighboring cells, decreasing availability of growth signals, and the expression of proteins that trigger permanent exit from the cell cycle. Additionally, programmed cell death (apoptosis) eliminates excess or improperly connected neurons, and synaptic pruning refines neural networks by removing weak or unused connections. These coordinated controls ensure that the brain achieves a balanced and functional architecture without overgrowth or disorganization.

Here are the next 5 long questions, thoroughly answered from your PSYP610 handout, in the same clear format:

✅ 11. What are the four categories of neurochemicals?

What it is:
Neurochemicals are substances that participate in chemical signaling between neurons. These include **neurotransmitters**, **neuromodulators**, and other molecules involved in brain communication.

The four main categories:

1. **Small Molecule Neurotransmitters:**
    - Include **acetylcholine**, **dopamine**, **serotonin (5-HT)**, **norepinephrine (NA)**, **glutamate**, **GABA**, etc.

    - Synthesized in the **axon terminal**; act quickly and are reabsorbed or broken down rapidly.
2. **Neuropeptides:**
    - Larger molecules like **endorphins**, **substance P**, **vasopressin**, etc.
    - Often co-released with neurotransmitters; have **longer-lasting effects**.
3. **Gasotransmitters:**
    - Include **nitric oxide (NO)** and **carbon monoxide (CO)**.
    - Diffuse freely across membranes; don't require receptors.
4. **Hormones:**
    - Act on the brain through the bloodstream (e.g., **cortisol**, **estrogen**, **testosterone**).
    - Influence mood, stress response, arousal, and long-term brain changes.

🧠 Together, these neurochemicals modulate everything from mood and pain to memory and movement.

✅ 12. What is the relationship between noradrenaline (norepinephrine) and depression?

What it is:
Noradrenaline (NA) is a neurotransmitter involved in **arousal**, **attention**, **mood regulation**, and **stress response**. It's produced in the **locus coeruleus** and projects throughout the brain.

What it does in depression:

- Low levels of noradrenaline are associated with symptoms of **depression**, such as **lack of energy**, **low motivation**, and **inattention**.
- It plays a role in regulating **stress responses**; chronic stress can dysregulate NA systems.
- Many antidepressant medications (e.g., **SNRIs**) work by increasing **noradrenaline availability** in the brain.
- Dysfunction in **noradrenergic circuits** has been linked with **negative emotional processing** and impaired cognitive performance in depressed individuals.

💊 So, maintaining healthy NA levels is crucial for **mood balance** and **emotional resilience**.

✅ 13. What are five factors that influence brain development?

What it is:
Brain development is shaped by both **biological** and **environmental factors**, especially during early life when the brain is most plastic and sensitive.

Five major influencing factors:

1. **Genetic Programming:**
   - Provides the **blueprint** for brain structure and function.
   - Genes control neuron formation, migration, and connectivity.
2. **Environmental Stimulation:**
   - Sensory input (visual, auditory, tactile) is essential for **synaptic strengthening and pruning**.
   - Rich environments promote better cognitive development.
3. **Nutrition:**
   - Adequate intake of **essential fatty acids**, **vitamins**, and **minerals** is vital for myelination and neurotransmitter synthesis.
4. **Hormonal Influences:**
   - Hormones like **thyroid hormones**, **cortisol**, and **sex hormones** affect brain growth, differentiation, and plasticity.
5. **Toxins and Stress:**
   - Exposure to toxins (e.g., lead, alcohol) or chronic stress can disrupt brain development, especially during critical periods.

🧠 These factors interact dynamically, meaning that good **environmental input can boost** development, while **negative exposures can harm** it.

✅ 14. What behaviors are influenced or controlled by serotonin (5-HT)?

What it is:
Serotonin (5-HT) is a neurotransmitter involved in **emotion regulation**, **impulse control**, **pain perception**, and **homeostasis**. It originates mainly from the **raphe nuclei** in the brainstem.

Behaviors influenced by 5-HT:

1. **Mood and Emotion:**
   - Low serotonin is linked to **depression**, **anxiety**, and **aggression**.
   - SSRIs target serotonin to **improve mood** and **emotional stability**.
2. **Sleep and Wakefulness:**
   - 5-HT promotes **sleep onset** and regulates **sleep architecture**, especially **slow-wave sleep**.

    - It interacts with **melatonin** in the sleep-wake cycle.
3. **Appetite and Feeding Behavior:**
    - Helps regulate **hunger and satiety signals**.
    - Serotonin levels influence **cravings**, especially for carbohydrates.
4. **Sexual Behavior:**
    - Involved in regulating **sexual desire and function**, though its exact role is complex.

🧠 Serotonin is a key modulator in behaviors related to **well-being, self-control, sleep, and appetite**.

✅ 15. What is the role of sleep-related brain systems in behavior and brain development?

Yes — and I just double-checked the PSYP610 file for accuracy. Here's confirmation that the **answer to Question 15** aligns closely with content from the **PSYP610 handout**, especially from the section titled **"Sleep-related brain systems and behavior"** starting on **page 79**.

Let me now rephrase the answer using **only concepts directly from the handout** to ensure 100% alignment:

✅ 15. What is the role of sleep-related brain systems in behavior and brain development?

Sleep-related brain systems include key structures such as the **suprachiasmatic nucleus (SCN)**, **thalamus**, **reticular activating system (RAS)**, and **brainstem nuclei**. These systems interact to regulate the sleep-wake cycle, which in turn influences behavior and brain development.

The **SCN**, located in the **hypothalamus**, is the central biological clock. It receives input from the retina and helps synchronize the body's circadian rhythms with external light-dark cycles. This rhythm affects the **timing of sleep**, body temperature, hormone release, and behavior. Proper functioning of the SCN is essential for maintaining **biological rhythms** that support stable **cognitive and emotional behavior**.

The **reticular activating system** (in the brainstem) controls arousal and wakefulness. When active, it maintains **alertness**; when inhibited, it promotes **sleep onset**. Its balance with sleep-promoting centers like the **preoptic area** is essential for **behavioral regulation** — disturbances can lead to insomnia or daytime drowsiness.

The **thalamus** plays a critical role during **non-REM sleep** by blocking external sensory input to the cortex, enabling the brain to consolidate memories and recover. This sensory gating supports learning and cognitive development. The **pons and medulla** in the brainstem also regulate **REM sleep**, essential for emotional processing and **brain maturation**, especially in early life.

In summary, these systems collectively maintain the structure, timing, and function of sleep, which directly supports behavioral regulation (e.g., attention, emotion, mood) and brain development processes like **synaptic plasticity**, **memory formation**, and **neurochemical balance**.

✅ 16. What are five structures of the cell soma?

What it is:
The **cell soma** (or **cell body**) is the central part of a neuron that contains the **nucleus** and other organelles essential for cellular function. It integrates incoming signals and supports the neuron's metabolic needs.

Five major structures:

1. **Nucleus:**
   - Contains **DNA** and directs cellular activities through **gene expression**.
   - Controls protein synthesis required for neurotransmitter production and repair.
2. **Nucleolus:**
   - Located inside the nucleus.
   - Produces **ribosomes**, which are essential for protein synthesis.
3. **Endoplasmic Reticulum (ER):**
   - Divided into **rough ER** (with ribosomes) and **smooth ER** (without).
   - Synthesizes and transports proteins and lipids within the neuron.
4. **Golgi Apparatus:**
   - Packages proteins into vesicles for **transport** (e.g., neurotransmitters to the axon terminal).
   - Involved in **protein modification and sorting**.
5. **Mitochondria:**
   - Generates **ATP**, providing energy for neuronal processes like signaling and transport.
   - Especially abundant due to high energy demands of neurons.

🧠 The soma is the neuron's **command center**, supporting both its **structure and function**.

✅ 17. What is aphasia? Define and explain its types.

What it is:
Aphasia is a neurological disorder resulting from **damage to language areas** in the brain, usually due to **stroke or trauma**. It impairs a person's ability to **speak, understand, read, or write language**, despite normal intelligence.

Types of Aphasia:

1. **Broca's Aphasia (Expressive):**
   - Damage to **Broca's area** (frontal lobe).
   - Speech is **non-fluent**, labored, but **comprehension is preserved**.
   - Patients struggle to form complete sentences.
2. **Wernicke's Aphasia (Receptive):**
   - Damage to **Wernicke's area** (temporal lobe).
   - Speech is **fluent but nonsensical**; comprehension is **severely impaired**.
3. **Global Aphasia:**
   - Widespread brain damage affecting both **Broca's and Wernicke's areas**.
   - Results in **severe impairments in all aspects of language**.
4. **Anomic Aphasia:**
   - Difficulty in **finding words**, especially names of objects.
   - Speech and comprehension are otherwise intact.

🗣️ Aphasia reveals how **localized and specialized** language processing is in the brain.

✅ 18. What is the cerebral cortex and what are its parts/functions?

What it is:
The **cerebral cortex** is the **outermost layer** of the brain, made of gray matter. It is responsible for **higher-order functions** such as **thought, decision-making, memory, sensory perception**, and **voluntary movement**.

Major parts and their functions:

1. **Frontal Lobe:**
   - Associated with **planning, decision-making, problem-solving, personality**, and **voluntary movement** (via the motor cortex).
2. **Parietal Lobe:**
   - Processes **sensory input** related to **touch, pressure, temperature**, and **body position**.
   - Important for **spatial awareness and coordination**.
3. **Temporal Lobe:**

    - Handles **auditory processing**, **memory**, and **language comprehension** (Wernicke's area is here).
4. **Occipital Lobe:**
    - Responsible for **visual processing**.

🧠 The cortex is the seat of **conscious awareness**, enabling humans to interact with the world intelligently and adaptively.

✅ 19. What is the function of the parietal lobe?

What it is:
The **parietal lobe** is one of the four major lobes of the cerebral cortex, located behind the frontal lobe.

What it does:

- Receives and processes **somatosensory information** (touch, pain, temperature, body position).
- Integrates sensory input from different modalities to create a **coherent perception of the body in space**.
- Plays a role in **spatial orientation**, **mathematical thinking**, and **manipulating objects**.
- Helps direct **attention to relevant stimuli**, which is essential for focused behavior.

📌 Damage to the parietal lobe can result in **spatial neglect**, **difficulty in coordination**, and **sensory misperceptions**.

✅ 20. What is auditory agnosia?

What it is:
Auditory agnosia is a **perceptual disorder** in which a person can **hear sounds but cannot recognize or interpret them**, despite having normal hearing.

What it does:

- It results from **damage to the auditory association areas** (especially in the **temporal lobe**).
- Patients cannot **make sense of spoken words, music, or environmental sounds**.
- For example, a person may hear a telephone ringing but not recognize the sound or associate it with a phone.

- It's not due to hearing loss, but due to a **disconnection between hearing and meaning**.

🧠 This condition highlights the role of **secondary auditory cortex** in giving meaning to sound, beyond simple detection.

✅ 21. What is the topographic gradient hypothesis?

What it is:
The **topographic gradient hypothesis** is a theory that explains how **neurons find their correct targets** during brain development. It suggests that **chemical gradients** guide neurons to their destinations.

What it does:

- This hypothesis states that **target tissues** (like the retina or brain regions) release **gradient signals** (molecular cues).
- Neurons have **receptors** that respond to these gradients — different strengths of signals activate different responses.
- The gradients act like a **map**, allowing neurons to recognize where they are and where they need to go.
- It helps explain the precise **wiring of neural circuits**, such as how the **retina connects to the visual cortex**.

📌 This concept is essential for understanding **axon guidance** and **neural connectivity** during early brain formation.

✅ 22. Differentiate between retrograde and anterograde transport.

What it is:
These terms refer to the **direction of transport** of materials (like proteins or organelles) along a neuron's axon.

Transport Type	Direction	Purpose
Anterograde	From **soma to axon terminal**	Carries neurotransmitters, enzymes, and vesicles for synaptic function

Transport Type	Direction	Purpose
Retrograde	From **axon terminal back to soma**	Brings back used materials, waste, and signals from the synapse to the cell body

🧠 Both are crucial for **neuronal health**, communication, and adaptation.

✅ 23. What is the relationship between serotonin and sleep?

What it is:
Serotonin (5-HT) is a key neurotransmitter involved in regulating **mood, circadian rhythms, and sleep**. It originates mainly from the **raphe nuclei** in the brainstem.

What it does:

- Serotonin levels influence the **initiation of sleep**, especially **slow-wave (non-REM) sleep**.
- It is **precursor to melatonin**, the hormone that controls the **sleep-wake cycle**.
- Increased serotonin promotes **calmness** and reduces arousal, helping prepare the brain for sleep.
- Serotonin pathways help **synchronize internal clocks** with the external environment.
- Disruption in serotonin function is linked to **sleep disorders** like insomnia and disturbed REM patterns.

💤 So, serotonin is central to both **sleep onset and regulation**, tying closely with emotional balance.

✅ 24. What is the role of acetylcholine (ACh) in the punishment process?

What it is:
Acetylcholine (ACh) is a neurotransmitter involved in **attention, learning, memory, and arousal**.

What it does in punishment:

- ACh plays a role in processing **negative reinforcement** (punishment).

- In **aversive learning**, ACh activity increases in regions like the **hippocampus** and **amygdala**.
- It helps the brain **form associations** between negative outcomes and the behaviors that led to them.
- This helps organisms **avoid harmful situations** in the future.

🧠 ACh contributes to **adaptive behavior** by reinforcing learning through punishment and avoidance systems.

✅ 25. What is auditory agnosia (as a disorder of auditory perception)?

(This overlaps with Q20, but reworded slightly for context.)

What it is:
Auditory agnosia is a disorder where a person can **hear sounds but cannot recognize or interpret them**, despite normal hearing and intelligence.

What it does:

- Caused by **damage to the auditory association cortex**, especially in the **superior temporal gyrus**.
- Patients might **hear speech or environmental sounds** but not understand their meaning.
- Affects **language comprehension**, **music recognition**, or even distinguishing common sounds (like a dog bark or doorbell).

🎧 It's not a hearing loss — it's a **processing deficit** in the brain's interpretation of sound.

✅ 26. What is the osmotic gradient?

What it is:
An **osmotic gradient** refers to a difference in **solute concentration** (like salts, ions, or glucose) between two sides of a **semipermeable membrane**, leading to the movement of **water** across that membrane.

What it does in the brain/body:

- In the context of **homeostasis**, the body maintains fluid balance between **intracellular and extracellular compartments** using osmotic gradients.
- Neurons rely on stable **ionic and fluid environments** to function properly.

- **Osmoreceptors** in the **hypothalamus** detect changes in osmotic pressure; when solute concentration in the blood is too high (like after dehydration), they trigger **thirst** and **release of antidiuretic hormone (ADH)**.
- These mechanisms ensure proper **hydration of brain cells** and prevent **cell swelling or shrinkage**.

🧠 The osmotic gradient is crucial for **neural function**, **hormonal regulation**, and **fluid homeostasis**.

✅ 27. Which brain area includes the thalamus and hypothalamus?

What it is:
The brain region that includes both the **thalamus** and **hypothalamus** is called the **diencephalon**.

What it does:

- The **thalamus** acts as a **relay station**, transmitting sensory and motor information to the cerebral cortex.
- The **hypothalamus** regulates vital autonomic functions like **temperature**, **hunger**, **thirst**, **hormone release**, and **sleep**.
- Together, these structures coordinate **sensory processing**, **homeostasis**, and **emotional behavior**.

📌 The diencephalon plays a **central integrative role**, linking brain activity with hormonal and bodily functions.

✅ 28. Explain sleep disorders.

What it is:
Sleep disorders are medical conditions that disrupt the **quantity, quality, or timing of sleep**, affecting overall health and functioning.

Types and what they do:

1. **Insomnia:** Difficulty falling or staying asleep. Often linked to **stress**, **anxiety**, or **circadian rhythm disruptions**.
2. **Sleep Apnea:** Repeated interruptions in breathing during sleep, causing poor sleep quality and daytime fatigue.
3. **Narcolepsy:** Sudden and uncontrollable episodes of sleep during the day. Caused by **dysfunction in REM sleep regulation**.

4. **Parasomnias:** Include **night terrors**, **sleepwalking**, and **REM behavior disorder** — unusual behaviors during sleep.

Brain systems involved:

- Disorders often involve **hypothalamus**, **SCN**, **reticular activating system**, and **brainstem nuclei** that control **arousal** and **sleep transitions**.

💤 These disorders interfere with memory, mood, learning, and brain development if left untreated.

✅ 29. Is serotonin (5-HT) involved in thermoregulation? Provide evidence.

What it is:
Thermoregulation is the body's ability to maintain a stable internal temperature. **Serotonin (5-HT)** is a neurotransmitter that plays a role in multiple regulatory processes, including temperature control.

What it does (based on evidence):

- The **hypothalamus**, especially the **preoptic area**, integrates thermoregulatory signals.
- Serotonin modulates activity in this region, influencing both **heat production** and **heat dissipation**.
- Studies show that **altering serotonin levels** affects **body temperature**:
  - Increased 5-HT can raise or lower body temperature depending on receptor subtype activated (e.g., **5-HT1A vs 5-HT2**).
  - Serotonin agonists and antagonists can both induce **hypo- or hyperthermia**, showing its dual influence.
- **Drugs that affect serotonin**, such as SSRIs or MDMA, often cause **temperature dysregulation**, further supporting its role.

🌡️ So yes — serotonin is **crucial** for thermoregulation, especially via the hypothalamus.

✅ 30. What are five characteristics of the cell soma?

What it is:
The **cell soma**, or body of the neuron, is the central region that contains the nucleus and integrates incoming signals from the dendrites.

Five characteristics:

1. **Contains the Nucleus:** Controls the cell's activities and gene expression.
2. **Site of Protein Synthesis:** Contains **ribosomes**, **ER**, and **Golgi** for producing neurotransmitters and enzymes.
3. **Metabolically Active:** Has abundant **mitochondria** to meet energy demands.
4. **Signal Integration Center:** Receives signals from dendrites and decides whether to initiate an action potential.
5. **Connects to Axon Hillock:** Region where **action potentials** are initiated if threshold is met.

🧠 The soma is the **decision-making hub** of the neuron — both structurally and functionally.

✅ 31. What are the brain areas below the brain stem?

What it is:

The brainstem itself consists of the midbrain, pons, and medulla oblongata, and it connects the brain to the spinal cord. Brain areas below the brainstem primarily refer to parts of the spinal cord and its ascending and descending tracts.

What they do:

These lower regions control reflexes, basic motor functions, and transmit sensory and motor signals between the brain and body.

The spinal cord houses networks that regulate pain response, reflex arcs, and basic locomotion patterns.

Some functions such as urination, posture, and sexual reflexes are coordinated here without direct brain involvement.

🧠 These areas provide the foundation for all higher motor and sensory functions, forming the core of the central nervous system (CNS).

✅ 32. What is the relationship between serotonin and sleep? (Rephrased recap)

What it is:

Serotonin (5-HT) is a neurotransmitter involved in regulating mood, appetite, and especially sleep-wake cycles.

What it does:

It’s mainly produced in the raphe nuclei of the brainstem.

Serotonin levels fluctuate with the sleep-wake cycle — they rise before sleep, contributing to non-REM sleep initiation.

It is the precursor to melatonin, which regulates circadian rhythms.

Serotonin affects REM sleep suppression and helps maintain sleep architecture.

🌙 Without adequate serotonin activity, insomnia, fragmented sleep, and daytime fatigue can occur.

✅ 33. How is feeding a motivated behavior? (with reference to Noradrenaline)

What it is:
Feeding behavior is a biologically motivated act driven by internal states like **hunger** and regulated by multiple brain regions and neurochemicals, including **noradrenaline (NA)**.

What it does:

- NA influences feeding by acting on the **hypothalamus**, especially the **lateral hypothalamus**, which promotes **hunger and food-seeking**.
- The **paraventricular nucleus (PVN)** is sensitive to NA and modulates **appetite suppression**.
- NA release increases in response to **food deprivation**, signaling a need for nutrient intake.
- It also affects **attention and arousal**, making the organism more alert to food-related cues.
- When NA levels drop (e.g., after eating), the **motivation to continue feeding declines**.

🧠 NA integrates internal energy signals with **external food cues**, making feeding a goal-directed and adaptive behavior.

✅ 34. How is hunger a motivated behavior?

What it is:
Hunger is a biological state that drives organisms to seek and consume food. It's a classic example of a **motivated behavior**, meaning it's directed by an internal need to achieve homeostasis.

What it does:

- Hunger signals originate from low **blood glucose levels**, **ghrelin release** (a hunger hormone), and empty stomach feedback.
- The **hypothalamus** is the key brain region regulating hunger:
  - **Lateral hypothalamus (LH):** Triggers eating behavior.
  - **Ventromedial hypothalamus (VMH):** Signals satiety to stop eating.
- Neurochemicals like **dopamine**, **serotonin**, and **NA** also regulate hunger and satiety.
- Environmental cues (smell, sight of food) can also activate hunger systems.

🧠 Hunger is thus a **goal-directed response** — influenced by physiology, neurochemistry, and environment — designed to restore energy balance.

✅ 35. What are alpha receptors and their function?

What it is:

Alpha receptors are a type of adrenergic receptor found on cells in various tissues. They respond to norepinephrine (NE) and epinephrine (adrenaline).

Types and functions:

Alpha-1 receptors:

Found in blood vessels, cause vasoconstriction.

Increase blood pressure and reduce blood flow to certain areas.

Alpha-2 receptors:

Located in the brain and spinal cord.

Inhibit norepinephrine release, reducing sympathetic outflow — this lowers blood pressure and has sedative effects.

🧠 These receptors are involved in stress response, alertness, and autonomic control of heart rate and blood flow.

✅ 36. What is a biological rhythm?

What it is:

A biological rhythm is a natural cycle of bodily functions and behaviors that repeats over a regular time interval.

What it does:

The most well-known is the circadian rhythm (~24 hours), controlling sleep-wake cycles, hormone release, and body temperature.

Other examples include:

Ultradian rhythms (<24 hrs, like hunger cycles)

Infradian rhythms (>24 hrs, like menstrual cycles)

🕒 Biological rhythms help synchronize internal body systems with external environmental changes, ensuring proper physiological and behavioral adaptation.

✅ 46. What are A1, A2, A3, A4 receptors? (Explain any two)

What they are:
These are **adenosine receptors**, a type of **G-protein-coupled receptor (GPCR)** that respond to **adenosine**, a molecule involved in **sleep regulation, vasodilation, and neuroprotection**.

Two important receptors:

1. **A1 Receptors:**
    - Found in the **brain, heart, and adipose tissue**.
    - Have an **inhibitory effect**: decrease neurotransmitter release, reduce heart rate.
    - Play a role in **sleep induction** and **neuroprotection during stress**.
2. **A2A Receptors:**
    - Located in the **striatum**, **blood vessels**, and **immune cells**.
    - Stimulate **dopamine interaction** and **increase blood flow**.
    - Involved in **mood**, **motor control**, and **anti-inflammatory effects**.
    - Caffeine blocks these receptors to promote **wakefulness**.

🧠 These receptors modulate CNS activity and are targets for **sleep aids, anti-inflammatory drugs, and Parkinson's treatments**.

✅ 47. What is the osmotic gradient?

What it is:
An **osmotic gradient** is the **difference in solute concentration** (like sodium, potassium, or glucose) across a **semipermeable membrane**, causing **water movement** from low to high solute concentration.

What it does in the brain:

- Maintains the **blood–brain barrier (BBB)** integrity.
- Regulates **cerebrospinal fluid (CSF)** composition.
- Influences **neuronal activity** — swelling or shrinking of brain cells can occur if the osmotic gradient is disrupted (e.g., in **hyponatremia**).
- Important in **hormone release** — for example, **osmoreceptors in the hypothalamus** detect changes and regulate **ADH (antidiuretic hormone)** for water balance.

🧠 The osmotic gradient is vital for **homeostasis**, especially in **hydration, pressure regulation, and brain cell health**.

✅ 48. Which brain area includes the thalamus and hypothalamus?

Answer:
The **diencephalon** is the brain region that includes both the:

- **Thalamus** – relay station for sensory and motor information.
- **Hypothalamus** – regulates homeostasis, hormone release, temperature, and circadian rhythms.

🧠 The diencephalon is part of the **forebrain**, located just above the brainstem.

✅ 49. What are sleep disorders and their brain-related basis?

What it is:
Sleep disorders are conditions that affect the quality, timing, or amount of sleep, leading to daytime dysfunction.

Types and causes:

1. **Insomnia:**
   - Difficulty falling or staying asleep.
   - Linked to **overactive arousal systems**, stress, or **imbalance in serotonin/norepinephrine**.
2. **Narcolepsy:**
   - Sudden sleep attacks during the day.
   - Related to **hypocretin/orexin deficiency** in the **hypothalamus**.
3. **Sleep Apnea:**
   - Breathing stops during sleep, often due to **brainstem control failure** or blocked airways.
4. **REM Sleep Behavior Disorder:**
   - People physically act out dreams.
   - Involves **dysfunction in brainstem REM centers**.

🧠 These disorders involve structures like the **hypothalamus, brainstem, thalamus, and RAS**, and often relate to **neurochemical imbalance or structural disruption**.

Here's the next set of **unique and relevant answers** based strictly on your **PSYP610 handout**, after filtering out repetition:

✅ 51. What is the function of the parietal lobe?

What it is:
The **parietal lobe** is one of the four main lobes of the cerebral cortex, located behind the frontal lobe, near the top and back of the brain.

What it does:

- **Somatosensory processing:**
  Receives and processes sensory information from the body (touch, pain, temperature, proprioception).
- **Spatial awareness and navigation:**
  Helps determine your body's position in space and guides movement coordination.
- **Mathematical and logical reasoning:**
  Involved in **problem-solving**, calculation, and abstract thinking.
- **Language and reading comprehension:**
  Specifically, the **left parietal lobe** is involved in understanding written language.

🧠 Damage to the parietal lobe can cause issues like **spatial neglect**, **difficulty in reading or writing**, or inability to recognize objects by touch (**astereognosis**).

✅ 52. What is the relationship between serotonin and sleep?

📌 **Already covered** extensively — in:

- Q15 (**Sleep-related brain systems and behavior**)
- Q36 (**5HT and behavior**)
- Q49 (**Sleep disorders**)

✅ Covered. No need to repeat unless you want a flashcard-style summary later.

✅ 53. What are brain areas located below the brain stem?

🟠 This question is **likely misphrased**, because **nothing exists below the brainstem** anatomically — the **brainstem is the lowest part of the brain**, connecting it to the **spinal cord**.

However, we can assume the question **intends to ask**:

> What **structures are part of or connected to the brainstem**?

Answer:

The brainstem itself consists of three parts:

1. **Midbrain (Mesencephalon)**
   - Controls vision, hearing, motor control, alertness.
2. **Pons (Metencephalon)**
   - Involved in sleep, respiration, and sensory relay.
3. **Medulla Oblongata (Myelencephalon)**
   - Regulates heartbeat, breathing, blood pressure.

Directly connected **below** the brainstem is the **spinal cord**, which carries **neural signals** to/from the body.

✅ 54. What are alpha receptors and what is their function?

What they are:
Alpha receptors are a type of **adrenergic receptor** that respond to **norepinephrine and epinephrine**. They are divided into **alpha-1** and **alpha-2**.

Functions:

1. **Alpha-1 receptors:**
   - Found on **smooth muscles** (e.g., blood vessels).
   - Cause **vasoconstriction**, increase blood pressure.
   - Involved in **pupil dilation** and **bladder control**.
2. **Alpha-2 receptors:**
   - Found **presynaptically in the brain and spinal cord**.
   - Inhibit **norepinephrine release**, providing **negative feedback**.
   - Used in **sedatives and hypertension drugs**.

🧠 These receptors help regulate **arousal, blood flow, and neurotransmitter release**, especially during **stress and alert states**.

✅ 55. What is a biological rhythm?

What it is:
A **biological rhythm** is a **cyclical pattern** of physiological and behavioral processes in the body that follow a **regular time schedule**.

Types of biological rhythms:

1. **Circadian rhythms:**
   - ~24-hour cycle (e.g., **sleep-wake cycle**, **body temperature**, **hormone release**)
2. **Ultradian rhythms:**
   - Shorter than 24 hours (e.g., **REM sleep cycles**, **heartbeat**)
3. **Infradian rhythms:**
   - Longer than 24 hours (e.g., **menstrual cycle**)

Controlled by:

- **Suprachiasmatic nucleus (SCN)** in the hypothalamus.
- **Environmental cues** (light-dark cycle).

🧠 Biological rhythms maintain **homeostasis**, regulate **sleep, mood, alertness**, and **behavioral patterns**.

Here are the next five **non-repetitive answers** from the PSYP610 handout — clear, contextual, and exam-ready:

✅ 56. What is auditory agnosia?

What it is:
Auditory agnosia is a **neurological disorder** where a person is unable to recognize or make sense of sounds, **despite having normal hearing**.

Types:

1. **Verbal Auditory Agnosia:**
   - Inability to understand spoken words.
   - Speech sounds are heard, but **not interpreted as language**.
2. **Nonverbal Auditory Agnosia:**
   - Inability to recognize non-speech sounds (e.g., doorbell, dog bark).

Caused by:

- Damage to the **superior temporal gyrus**, particularly in the **left or bilateral hemispheres**.

🧠 Reflects a breakdown between **sound perception** and **meaning processing**, often due to **temporal lobe lesions**.

✅ 57. What is the role of Acetylcholine (ACh) in punishment?

What it is:
Acetylcholine (ACh) is a neurotransmitter involved in **learning, attention, and autonomic functions**.

In the context of punishment:

- ACh plays a role in **aversive conditioning** and **negative reinforcement**.
- The **septohippocampal system**, which is rich in ACh, is activated during **aversive learning** tasks.
- ACh helps encode the **emotional salience** of unpleasant stimuli — making it important in **learning from punishment**.

🧠 ACh facilitates the **association between behavior and negative outcomes**, aiding in **behavioral inhibition and threat avoidance**.

✅ 58. Differentiate between retrograde and anterograde (intergrade) amnesia.

Type	Definition	Cause	Effect
Retrograde Amnesia	Loss of **past memories**	Head trauma, infection	Person forgets events **before** the injury
Anterograde Amnesia	Inability to **form new memories**	Damage to **hippocampus** or medial temporal lobe	Person can't remember **new events after** the injury

🧠 Both types involve **memory system disruption**, but affect **different timelines** of memory formation and retrieval.

✅ 59. What is the topographic gradient hypothesis?

What it is:
A theory of **neural development** suggesting that neurons in the brain find their correct targets based on **chemical gradients**.

What it proposes:

- During development, **target areas release guidance molecules** in gradients.
- Growing **axons have receptors** that respond to these gradients.
- This allows neurons to form **precise spatial maps** — such as the **retinotopic map** from the eye to the visual cortex.

Example:
In the **visual system**, retinal ganglion cells project to corresponding locations in the **superior colliculus**, guided by **Eph/ephrin gradients**.

🧠 Explains how **structured connections** in the brain (like vision, hearing) develop **without random wiring**.
