PHARMACOGNOSY MCQ EXAMINATION

Chapter 9: Alkaloids & Nitrogenous Secondary Metabolites

Student Name: .....

Date: .....

Time Allowed: 45 Minutes

Total Marks: 20

---

1. Which nitrogenous secondary metabolite class liberates hydrogen cyanide (HCN) upon hydrolysis and emits a characteristic odor of bitter almonds?

A) Alliines

B) Cyanogenic glycosides

C) Glucosinolates

D) Purine alkaloids

2. What distinguishes glucosinolates (thiocyanate glucosides) from cyanogenic glycosides?

A) They contain nitrogen only and no sulfur

B) They possess a variable sugar moiety and phosphorus

C) They contain sulfur in their skeleton and have a constant glucose moiety

D) They are derived exclusively from aromatic amino acids

3. According to the modern definition, alkaloids are best described as:

A) Linear non-cyclic proteins present in all plant species

B) Cyclic organic compounds containing nitrogen in a negative oxidation state with limited distribution

C) Highly acidic non-nitrogenous compounds found exclusively in animals

D) Macro-nutritional storage carbohydrates with high basicity

4. Which of the following amino acids is an ALIPHATIC precursor for alkaloid biosynthesis?

A) Phenylalanine

B) Tyrosine

C) Tryptophan

D) Ornithine

5. Atropine is classified as a "True (typical) alkaloid" because:

A) Its nitrogen originates from transamination and is outside the ring

B) It gives a false-positive result with Mayer's reagent

C) Its nitrogen is derived from an amino acid and incorporated into a heterocycle

D) It is a purine derivative devoid of basic properties

6. Ephedrine and colchicine are categorized as Proto-alkaloids because:

A) Their nitrogen is located in a side chain rather than inside a heterocycle

B) They are derived strictly from carbohydrate pathways

C) They do not contain any nitrogen atoms

D) They are formed via purine nucleic acid synthesis

7. Purine alkaloids (e.g., caffeine) are classified as Pseudo-alkaloids because:

A) They contain nitrogen inside a ring, but the nitrogen source is transamination (not amino acids)

B) They lack a heterocyclic ring system entirely

C) They are non-nitrogenous coumarin derivatives

D) They are insoluble in hot water as free bases

8. What visual observation confirms a positive alkaloid test when using Dragendorff's reagent?

A) Cream-colored precipitate

B) Intense orange-colored precipitate

C) Deep blue solution

D) Effervescence of gas

9. Which purine derivative fails to form a precipitate with heavy metal iodide reagents like Mayer's reagent?

A) Atropine
B) Morphine
C) Caffeine
D) Quinine

10. In the purine ring structure, nitrogen atom number 7 (N-7) originates from which metabolic donor?

A) Glutamine
B) Aspartic acid
C) Glycine
D) Tyrosine

11. Chemically, all pharmacologically active purine alkaloids are derivatives of xanthine, which represents purine oxygenated at carbons:

A) C-1 and C-3
B) C-2 and C-6
C) C-4 and C-5
D) C-7 and C-8

12. Caffeine has which systematic chemical structure and name?

A) 1,3-dimethylxanthine
B) 3,7-dimethylxanthine
C) 1,3,7-trimethylxanthine
D) 1,7-dimethylxanthine

13. Which purine derivative lacks a methyl group at N-7 and is widely used clinically as a bronchodilator?

A) Caffeine
B) Theophylline (1,3-dimethylxanthine)
C) Theobromine (3,7-dimethylxanthine)
D) Nicotine

14. What is the cellular mechanism of action for purine alkaloids?

A) Direct inhibition of voltage-gated sodium channels
B) Inhibition of phosphodiesterase (PDE), reducing cAMP degradation
C) Activation of acetylcholinesterase enzymes
D) Direct block of intracellular calcium release

15. Which natural source has the HIGHEST caffeine content among the following plant products?

A) Coffea arabica seeds (1-2%)
B) Camellia sinensis green tea (20mg/cup)
C) Ilex paraguariensis leaves (0.8-1.7%)
D) Paullinia cupana (Guarana) seeds (3-5%)

16. Green tea contains higher concentrations of active antioxidant catechins than black tea because:

A) Black tea undergoes extensive fermentation that triggers enzymatic changes
B) Green tea is harvested from a completely different plant family
C) Green tea is extracted using toxic organic solvents
D) Black tea is boiled with calcium oxide during processing

17. In the tobacco plant (Nicotiana tabacum), where is nicotine BIOSYNTHESIZED versus where is it STORED?

A) Biosynthesized in leaves, stored in roots
B) Biosynthesized in roots, stored in leaves
C) Biosynthesized in flowers, stored in stems
D) Biosynthesized in seeds, stored in bark

18. A rapid colorimetric identification test for Opium relies on meconic acid reacting with ferric chloride ($FeCl_3$) to yield what color?

A) Bright yellow
B) Intense red
C) Deep green
D) Pale white

19. In alkaloid extraction procedures, what is the primary purpose of adding calcium oxide (lime) or aqueous ammonia?

A) To convert water-soluble alkaloidal salts into lipophilic free bases

B) To permanently destroy all secondary metabolites

C) To decrease the pH and form inorganic sulfate salts

D) To oxidize caffeine into xanthine derivatives

20. What ecological advantage do bitter-tasting alkaloids primarily provide to host plants?

A) Attracting pollinating insects during winter

B) Serving as defense mechanisms against herbivores and environmental adaptation

C) Increasing soil moisture retention

D) Inhibiting photosynthetic gas exchange

Answer Key & Detailed Explanations

Q#	Answer	Pharmacognostical Explanation / Reference
1	B	Cyanogenic glycosides release HCN upon enzymatic/acid hydrolysis, producing a characteristic bitter almond odor.
2	C	Glucosinolates contain sulfur in addition to nitrogen and always feature glucose as their sugar moiety.
3	B	Alkaloids are redefined as cyclic organic compounds with nitrogen in a negative state of oxidation, basic, and limited in distribution.
4	D	Ornithine (and Lysine) are the two aliphatic amino acid precursors; Phenylalanine, Tyrosine, and Tryptophan are aromatic.
5	C	True alkaloids have nitrogen incorporated directly inside a heterocyclic ring and are derived from amino acids.
6	A	Proto-alkaloids originate from amino acids, but their nitrogen atom is situated in an aliphatic side chain.
7	A	Pseudo-alkaloids contain heterocyclic nitrogen, but the nitrogen originates from transamination rather than amino acid precursors.
8	B	Dragendorff's reagent (potassium bismuth iodide) forms an orange-colored precipitate with basic alkaloids.
9	C	Caffeine (a xanthine derivative) is a pseudo-alkaloid that does not precipitate with heavy metal iodide reagents like Mayer's reagent.
10	C	In purine biosynthesis, N-7 comes from glycine, N-1 and N-3 from glutamine, and N-9 from aspartic acid.
11	B	Xanthine is the 2,6-dioxo (oxygenated) form of purine upon which caffeine, theophylline, and theobromine are based.
12	C	Caffeine contains three methyl groups located at position 1, 3, and 7 (1,3,7-trimethylxanthine).
13	B	Theophylline is 1,3-dimethylxanthine (lacks the N-7 methyl group) and acts as a potent smooth muscle relaxant and bronchodilator.
14	B	Purine alkaloids inhibit phosphodiesterase (PDE), preventing cAMP degradation and increasing intracellular calcium.
15	D	Guarana seeds (Paullinia cupana) contain the highest caffeine content at 3–5%.
16	A	Black tea leaves undergo complete fermentation, whereas green tea leaves are unfermented/steamed, preserving active catechins.
17	B	Nicotine is biosynthesized in the roots of Nicotiana tabacum and subsequently transported and deposited in the leaves.
18	B	Meconic acid present in opium reacts with $FeCl_3$ to yield an intense red color, serving as a specific diagnostic test for opium.
19	A	Bases like lime or ammonia neutralize alkaloidal salts, converting them back into organic-soluble free bases.
20	B	The primary biological role of alkaloids is ecological defense against herbivores (due to bitter taste) and aiding environmental adaptation.