

ANSWER KEY WITH EXPLANATIONS FOR CHAPTER 22

Skill Drill Answers

SD 22.1: Hypothalamic-Pituitary Hormone Matching

1. **A** — TRH stimulates TSH release
2. **B** — CRH stimulates ACTH release
3. **C** — GnRH stimulates LH and FSH release
4. **D** — GHRH stimulates GH release
5. **E** — Dopamine inhibits prolactin release

SD 22.2: True/False with Correction

1. **F** — Prolactin is under tonic INHIBITORY control by dopamine.
2. **F** — PTU is preferred in the first trimester; methimazole associated with embryopathy.
3. **F** — Levothyroxine should be taken on an EMPTY stomach, 30-60 minutes before food.
4. **T** — Dopamine agonists (cabergoline, bromocriptine) are first-line even for macroadenomas.
5. **T** — TSH is the primary monitoring parameter for levothyroxine in primary hypothyroidism.
6. **T** — Radioactive iodine destroys thyroid tissue, causing permanent hypothyroidism in most patients.

SD 22.3: Fill in the Blank

1. **thyroid peroxidase (TPO)**
2. **ADH (vasopressin)**
3. **deiodinases**
4. **agranulocytosis**

5. **6-8**
 6. **D2 (dopamine)**
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SD 22.4: Pituitary Hormone Function Matching

1. **A** — TSH stimulates thyroid hormone production
 2. **B** — ACTH stimulates cortisol production
 3. **C** — Prolactin stimulates milk production
 4. **D** — GH promotes growth via IGF-1
 5. **E** — LH/FSH stimulates gonadal function
 6. **F** — ADH promotes water retention
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SD 22.5: Thyroid Drug Mechanism Matching

1. **C** — Levothyroxine replaces thyroid hormone
 2. **A** — Methimazole inhibits thyroid peroxidase
 3. **B** — Radioactive iodine destroys thyroid tissue
 4. **D** — Propranolol blocks beta-adrenergic symptoms
 5. **E** — Potassium iodide inhibits thyroid hormone release at high doses
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SD 22.6: Rapid Recall

1. **Methimazole**
 2. **Desmopressin (DDAVP)**
 3. **Cabergoline**
 4. **TSH**
 5. **Agranulocytosis**
 6. **Pegvisomant**
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SD 22.7: Complete the Sentence

1. **inhibitory**

2. **first**
 3. **long**
 4. **concentrated**
 5. **hepatotoxicity**
 6. **V2**
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SD 22.8: Drug-Condition Matching

1. **A** — Somatropin for GH deficiency
 2. **B** — Octreotide for acromegaly
 3. **C** — Cabergoline for prolactinoma
 4. **D** — Desmopressin for central diabetes insipidus
 5. **E** — Tolvaptan for SIADH
 6. **F** — Oxytocin for labor induction
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SD 22.9: Thyroid Condition-Treatment Matching

1. **A** — Levothyroxine for hypothyroidism
 2. **B** — Methimazole for Graves' disease (non-pregnant)
 3. **C** — PTU for first trimester pregnancy
 4. **E** — Propranolol for symptomatic tachycardia
 5. **D** — Radioactive iodine for definitive treatment
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SD 22.10: Adverse Effect Identification

1. **C** — PTU causes severe hepatotoxicity (black box)
 2. **A** — Excess levothyroxine causes hyperthyroid symptoms
 3. **B** — Methimazole (and PTU) cause agranulocytosis
 4. **D** — Dopamine agonists cause impulse control disorders
 5. **E** — Somatropin causes arthralgias and fluid retention
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SD 22.11: Drug Interaction Identification

1. **T** — Calcium reduces levothyroxine absorption
 2. **T** — Antipsychotics block D2 receptors, causing hyperprolactinemia
 3. **F** — PPIs DECREASE levothyroxine absorption
 4. **T** — High-dose propranolol inhibits T4→T3 conversion
 5. **T** — Methimazole crosses placenta and can cause fetal hypothyroidism
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SD 22.12: Clinical Scenario Drug Selection

1. **B** — PTU is preferred in first trimester pregnancy
2. **C** — Pegvisomant blocks GH receptor when octreotide fails
3. **C** — Desmopressin replaces ADH in central diabetes insipidus

Case Study Answers

Case 22.1: Hypothyroidism Management

Question 1. TSH is elevated because the pituitary is trying to stimulate a failing thyroid gland. In primary hypothyroidism, the thyroid itself is the problem (not the pituitary or hypothalamus). Low T4 removes negative feedback on the pituitary, causing TSH to rise dramatically. The markedly elevated TSH (45 mIU/L) with low free T4 confirms primary hypothyroidism.

Question 2. Levothyroxine (T4) is preferred because T4 serves as a prohormone converted to active T3 by peripheral deiodinases. This mimics normal physiology and produces stable T3 levels throughout the day. T3 has a shorter half-life and would cause peaks and troughs if given directly. Levothyroxine's long half-life (~7 days) allows once-daily dosing with stable serum concentrations.

Question 3. Instructions for levothyroxine: (1) Take on an empty stomach, 30-60 minutes before breakfast, with water only; (2) Avoid taking with calcium supplements, iron supplements, or antacids—separate by at least 4 hours; (3) Take at the same time daily for consistent levels; (4) Do not discontinue without medical advice even if feeling better; (5) Report symptoms of overreplacement (palpitations, heat intolerance, weight loss).

Question 4. TSH should be rechecked in 6-8 weeks after initiating or changing the dose. This timeframe allows levothyroxine to reach steady state given its 7-day half-life. The therapeutic goal is a TSH within normal range (typically 0.5-4.5 mIU/L). If TSH remains elevated, increase the dose; if suppressed, decrease the dose. Once stable, TSH can be monitored annually.

Case 22.2: Graves' Disease Treatment

Question 1. This is Graves' disease, an autoimmune condition where antibodies (TSH receptor antibodies/thyroid-stimulating immunoglobulins) activate TSH receptors, causing autonomous thyroid hormone production. This explains the suppressed TSH (negative feedback from excess hormone), elevated T4, and diffuse goiter with bruit (increased vascularity from stimulation). The positive TSH receptor antibodies confirm the diagnosis.

Question 2. Counseling for methimazole: (1) Watch for signs of agranulocytosis—fever, sore throat, or mouth sores require immediate medical evaluation and CBC; this is rare (0.1-0.5%) but serious; (2) Common side effects include rash and GI upset; (3) Take consistently as prescribed—it takes weeks to see full effect; (4) Regular monitoring of thyroid function is required; (5) If she becomes pregnant, notify provider immediately (may need to switch to PTU in first trimester).

Question 3. Propranolol provides rapid symptomatic relief while methimazole takes effect (several weeks). It blocks beta-adrenergic symptoms of hyperthyroidism including tachycardia, tremor, palpitations, and anxiety. At high doses, propranolol also inhibits peripheral T4→T3 conversion, providing additional benefit. However, it does not address the underlying hormone excess and should not be used as sole therapy.

Question 4. Radioactive iodine provides definitive treatment by destroying thyroid tissue. She should expect: (1) Resolution of hyperthyroidism over weeks to months; (2) Likely development of permanent hypothyroidism requiring lifelong levothyroxine replacement (this is expected, not a complication); (3) Initial radiation precautions (avoid close contact with pregnant women and children for several days); (4) If she has significant eye disease, it may worsen—concurrent glucocorticoids can mitigate this; (5) Radioactive iodine is contraindicated if she is or may become pregnant.

Diagram/Table Exercise Answers

DT 22.1: Hypothalamic-Pituitary-Thyroid Axis

1. TRH from the hypothalamus stimulates pituitary release of **TSH**.
2. TSH stimulates the thyroid to produce **T4** and **T3**.
3. Elevated T4/T3 provides **negative** feedback to suppress TSH.
4. In primary hypothyroidism, TSH is **elevated** because feedback inhibition is lost.

DT 22.2: Antithyroid Drug Mechanisms

1. Thionamides (methimazole, PTU) inhibit **thyroid peroxidase (TPO)**, blocking hormone synthesis.
2. Radioactive iodine enters thyroid cells via the **sodium-iodide symporter (NIS)**.
3. PTU has an additional effect of blocking peripheral **T4 to T3** conversion.
4. Beta-blockers like propranolol address **adrenergic (sympathetic)** symptoms but not hormone levels.

DT 22.3: Thyroid Drug Comparison Table

Drug	Mechanism	Indication	Key Consideration
Levothyroxine	T4 replacement	Hypothyroidism	Empty stomach; many absorption interactions
Methimazole	TPO inhibition	Hyperthyroidism	Once-daily, preferred agent
PTU	TPO inhibition + blocks T4→T3	First trimester pregnancy, thyroid storm	Black box for hepatotoxicity
Radioactive iodine	Thyroid destruction	Definitive hyperthyroid treatment	Causes permanent hypothyroidism; contraindicated in pregnancy
Propranolol	Beta-blockade	Symptomatic relief	Does not address hormone levels

DT 22.4: Posterior Pituitary Hormone Comparison Table

Feature	ADH/Vasopressin	Oxytocin
Primary receptor	V2 (kidney), V1 (vascular)	Oxytocin receptor (uterus)
Main physiological effect	Water retention/urine concentration	Uterine contraction, milk let-down
Synthetic analogue	Desmopressin (DDAVP)	Pitocin
Deficiency state	Central diabetes insipidus	N/A
Excess state	SIADH (hyponatremia)	N/A
Antagonist drugs	Vaptans (tolvaptan, conivaptan)	Atosiban (tocolytic)

Multiple-Choice Question Answers

Question 1. Answer: B

Prolactin is unique among anterior pituitary hormones in being under tonic inhibitory control by dopamine. Any interruption of dopamine delivery (pituitary stalk lesion, dopamine receptor blockade) causes hyperprolactinemia.

Question 2. Answer: C

TSH is the primary monitoring parameter for levothyroxine therapy in primary hypothyroidism. Elevated TSH indicates underreplacement; suppressed TSH indicates overreplacement. Free T4 is used as an adjunct or when TSH is unreliable (pituitary disease).

Question 3. Answer: B

Thionamides inhibit thyroid peroxidase (TPO), the enzyme responsible for iodine organification and thyroid hormone synthesis. This blocks T4 and T3 production at the thyroid gland.

Question 4. Answer: B

Desmopressin is a synthetic ADH analogue used for central diabetes insipidus (ADH deficiency), where it replaces the missing hormone and reduces urine output. Tolvaptan (a vasopressin antagonist) is used for SIADH.

Question 5. Answer: B

Cabergoline is the preferred dopamine agonist for prolactinoma due to superior efficacy, better tolerability, and convenient twice-weekly dosing compared to bromocriptine.

Question 6. Answer: B

Fever and sore throat in a patient on thionamides suggests possible agranulocytosis, a rare but potentially fatal adverse effect. The drug must be stopped immediately and a CBC obtained. If agranulocytosis is confirmed, the drug cannot be restarted.

Question 7. Answer: D

Vitamin D does not significantly affect levothyroxine absorption. Calcium, iron, antacids, PPIs, cholestyramine, and coffee all reduce absorption and should be separated from levothyroxine administration.

Question 8. Answer: B

PTU is preferred in the first trimester of pregnancy because methimazole is associated with rare embryopathy (aplasia cutis, choanal atresia). After the first trimester, switching to methimazole may be considered due to PTU's hepatotoxicity risk.

Question 9. Answer: B

Tolvaptan is a vasopressin (V2) receptor antagonist that promotes free water excretion. It is used for euvolemic or hypervolemic hyponatremia caused by SIADH, not for volume depletion-related hyponatremia.

Question 10. Answer: B

Somatostatin analogues (octreotide, lanreotide) bind somatostatin receptors on pituitary somatotrophs, inhibiting GH secretion. Pegvisomant blocks GH receptors peripherally—a different mechanism for refractory cases.

Question 11. Answer: B

The Wolff-Chaikoff effect is transient inhibition of thyroid hormone synthesis by high-dose iodide. The thyroid "shuts down" briefly when exposed to excess iodine. This effect is exploited preoperatively and in thyroid storm.

Question 12. Answer: C

Radioactive iodine can worsen Graves' ophthalmopathy, likely due to thyroid antigen release and immune activation. Concurrent glucocorticoid treatment (prednisone) mitigates this risk in patients with significant eye disease.

Question 13. Answer: B

Radioactive iodine destroys thyroid tissue, and most patients develop permanent hypothyroidism requiring lifelong levothyroxine replacement. This is an expected outcome, not a complication. It is contraindicated in pregnancy and not preferred in children.

Question 14. Answer: B

Pegvisomant is a GH receptor antagonist that blocks GH action peripherally. It normalizes IGF-1 in patients who fail to respond adequately to somatostatin analogues like octreotide.

Question 15. Answer: B

PTU carries an FDA black box warning for severe hepatotoxicity, including liver failure requiring transplantation. This is why methimazole is preferred except in first trimester pregnancy and thyroid storm.

Question 16. Answer: B

Congenital hypothyroidism, if untreated, causes irreversible intellectual disability (formerly called cretinism). Thyroid hormone is essential for normal brain development. Newborn screening allows early detection and prompt treatment with levothyroxine.