Full-Length Practice Test 9

Reading Comprehension

Time: 50 minutes
Questions: 1-40

Directions: Read each passage carefully and answer the questions that follow. Choose the best answer based on the information provided in the passage.

PASSAGE 1

The integumentary system, comprising the skin, hair, nails, and associated glands, serves as the body's largest organ system providing essential protective, regulatory, and sensory functions. The skin forms a physical barrier against pathogens, chemicals, and physical trauma while preventing excessive water loss from internal tissues. This system also regulates body temperature through sweat production and blood vessel dilation or constriction, synthesizes vitamin D when exposed to ultraviolet light, and provides sensory information about the external environment through specialized nerve endings. Understanding integumentary structure and function is vital for healthcare professionals because skin conditions represent common patient complaints, systemic diseases often manifest with skin symptoms, and maintaining skin integrity is crucial for overall health and preventing infections.

The skin consists of three layers: the epidermis, dermis, and hypodermis, each performing distinct functions. The epidermis, the outermost layer, contains primarily keratinocytes producing keratin protein that provides waterproofing and protection. The epidermis constantly renews itself, with new cells forming at the basal layer and gradually moving toward the surface where they die, flatten, and eventually shed. This layer also contains melanocytes producing melanin pigment that absorbs ultraviolet radiation, protecting deeper tissues from sun damage while determining skin color. Langerhans cells in the epidermis function as immune sentinels, detecting pathogens and activating immune responses. The dermis, beneath the epidermis, contains connective tissue providing strength and elasticity through collagen and elastin fibers. This layer houses blood vessels, nerve endings, hair follicles, sebaceous glands secreting skin-lubricating oils, and sweat glands regulating temperature and excreting some wastes.

Burns represent serious injuries classified by depth and severity. First-degree burns affect only the epidermis, causing redness and mild pain but typically healing without scarring within days. Second-degree burns extend into the dermis, producing blisters, severe pain, swelling, and potential scarring depending on depth. Third-degree burns destroy the full thickness of skin including the epidermis and dermis, often extending into underlying tissues. These burns appear white, brown, or charred, and surprisingly may be painless because nerve endings are destroyed. Third-degree burns require skin

grafting because the regenerative capacity is lost. The "rule of nines" estimates burn extent by dividing the body surface into regions representing roughly 9% each, helping determine treatment urgency and prognosis.

Skin conditions affect millions globally with varying severity and impact. Acne vulgaris results from sebaceous gland overactivity, bacterial colonization, and inflammation, primarily affecting adolescents but potentially persisting into adulthood. Eczema, or atopic dermatitis, causes inflamed, itchy skin related to genetic and environmental factors, often associated with allergies and asthma. Psoriasis, an autoimmune condition, accelerates skin cell turnover causing thick, scaly patches typically on elbows, knees, and scalp. Skin cancer, including basal cell carcinoma, squamous cell carcinoma, and melanoma, results primarily from cumulative ultraviolet exposure, with melanoma being the most dangerous due to metastatic potential. For dental professionals, understanding the integumentary system is important because oral tissues share many characteristics with skin, certain skin conditions have oral manifestations, medications for skin disorders may affect oral health including xerostomia or gingival changes, and healthcare providers should recognize suspicious skin lesions prompting referral. Additionally, maintaining infection control protects both patients' and providers' skin integrity from occupational hazards including chemical exposure, latex sensitivity, and infectious agents.

1. According to the passage, the integumentary system includes:
   A. Skin, hair, nails, and associated glands
   B. Only the skin
   C. Only bones and muscles
   D. Blood vessels exclusively

2. The passage states that the skin synthesizes which vitamin when exposed to UV light?
   A. Vitamin A
   B. Vitamin C
   C. Vitamin K
   D. Vitamin D

3. Based on the passage, keratinocytes produce:
   A. Melanin
   B. Blood cells
   C. Keratin protein
   D. Hormones

4. According to the passage, melanocytes function to:
   A. Fight infection
   B. Produce melanin that protects from UV radiation
   C. Generate new skin cells

D. Regulate temperature

5. The passage indicates that the dermis contains:
   A. Only dead cells
   B. No blood vessels
   C. Only keratin
   D. Connective tissue with collagen and elastin

6. Based on the passage, first-degree burns:
   A. Affect only the epidermis
   B. Always cause scarring
   C. Destroy all skin layers
   D. Are painless

7. According to the passage, third-degree burns:
   A. Only affect the epidermis
   B. Are always painful
   C. Destroy full thickness of skin
   D. Heal without treatment

8. The passage states that the "rule of nines":
   A. Measures pain levels
   B. Estimates burn extent
   C. Counts dead cells
   D. Determines skin color

PASSAGE 2

The lymphatic system, a complex network of vessels, tissues, and organs, plays crucial roles in fluid balance, immune function, and lipid absorption. This system returns excess interstitial fluid to the bloodstream, transports dietary lipids from the intestines, and provides immune surveillance and defense against pathogens. Unlike the cardiovascular system with its central pump, the lymphatic system relies on muscle contractions, respiratory movements, and vessel valves to move lymph fluid through the network. Understanding lymphatic function is essential for healthcare professionals because lymphatic dysfunction contributes to edema, the system's immune components defend against infections and cancer, and many diseases affect or involve lymphatic tissues including oral structures.

Lymph fluid originates from blood plasma that leaks from capillaries into surrounding tissues, becoming interstitial fluid. Approximately 3 liters daily doesn't return directly to blood capillaries but instead enters lymphatic capillaries—blind-ended vessels with overlapping endothelial cells acting as one-way valves.

Once inside lymphatic vessels, this fluid becomes lymph, traveling through progressively larger lymphatic vessels containing valves preventing backflow. Lymph passes through lymph nodes, small bean-shaped organs filtering the fluid and housing immune cells. Eventually, lymph returns to the bloodstream through the thoracic duct or right lymphatic duct emptying into subclavian veins near the heart. This fluid circulation is essential because it prevents edema accumulation, transports immune cells to infection sites, and carries absorbed fats from the intestinal villi.

Lymph nodes, strategically located throughout the body with clusters in the neck, armpits, and groin, filter lymph and activate immune responses. Each node contains compartments with B lymphocytes and T lymphocytes, macrophages, and dendritic cells. When pathogens or abnormal cells pass through nodes, immune cells detect, capture, and destroy them while activating adaptive immune responses. Swollen lymph nodes indicate active immune responses to infection, inflammation, or malignancy. Cancer cells can spread through the lymphatic system to regional lymph nodes, making lymph node examination crucial in cancer staging. The spleen, the body's largest lymphoid organ, filters blood rather than lymph, removing old red blood cells, storing platelets, and mounting immune responses against blood-borne pathogens.

Lymphatic dysfunction causes various clinical problems. Lymphedema results from impaired lymph drainage, causing tissue swelling typically in extremities. Primary lymphedema stems from developmental abnormalities, while secondary lymphedema results from damage to lymphatic vessels or nodes through surgery, radiation, infection, or trauma. Breast cancer treatment often involves lymph node removal or radiation increasing lymphedema risk. Elephantiasis, caused by parasitic worm infection blocking lymphatic vessels, produces severe limb swelling. Immunodeficiency disorders affect lymphoid tissues, compromising immune function and increasing infection susceptibility. For dental professionals, lymphatic knowledge is critical because the head and neck contain extensive lymphatic networks that drain oral tissues, infections in the oral cavity can spread via lymphatic vessels to regional nodes causing swelling and systemic infection, many systemic diseases including HIV/AIDS and lymphomas affect oral lymphoid tissues like tonsils, and palpating cervical lymph nodes during examination can detect abnormalities requiring further evaluation. Understanding lymphatic drainage patterns helps predict infection spread and explain why dental infections can cause swelling in specific head and neck regions.

9. According to the passage, the lymphatic system functions to:
   A. Only pump blood
   B. Only regulate temperature
   C. Produce all hormones
   D. Return fluid to bloodstream, transport lipids, and provide immune defense

10. The passage states that the lymphatic system moves fluid through:
   A. Muscle contractions, respiratory movements, and valves
   B. Only the heart

C. Electrical signals
D. Passive diffusion alone

11. Based on the passage, lymph originates from:
    A. Bone marrow only
    B. Liver production
    C. Blood plasma that leaks into tissues
    D. Kidney filtration

12. According to the passage, approximately how much fluid enters lymphatic capillaries daily?
    A. 1 liter
    B. 2 liters
    C. 5 liters
    D. 3 liters

13. The passage indicates that lymph nodes contain:
    A. B lymphocytes, T lymphocytes, macrophages, and dendritic cells
    B. Only blood cells
    C. No immune cells
    D. Only nerve tissue

14. Based on the passage, swollen lymph nodes indicate:
    A. Normal function only
    B. No significance
    C. Decreased immunity
    D. Active immune responses to infection or malignancy

15. According to the passage, the spleen filters:
    A. Lymph
    B. Blood
    C. Air
    D. Food

16. The passage states that secondary lymphedema results from:
    A. Birth defects only
    B. Normal aging
    C. Damage to lymphatic vessels or nodes
    D. Excess exercise

PASSAGE 3

Nutrition profoundly impacts health, affecting growth, development, immune function, disease risk, and overall well-being throughout the lifespan. A balanced diet provides essential macronutrients—carbohydrates, proteins, and fats—along with micronutrients including vitamins and minerals necessary for countless physiological processes. Malnutrition, whether from inadequate intake, excessive consumption, or nutrient imbalances, contributes to numerous health problems ranging from impaired immune function to chronic diseases like cardiovascular disease, diabetes, and osteoporosis. Understanding nutritional principles is essential for healthcare professionals who must recognize nutritional deficiencies, counsel patients on healthy eating, and understand how diet affects treatment outcomes and disease prevention.

Carbohydrates serve as the body's primary energy source, particularly for the brain which relies almost exclusively on glucose. Complex carbohydrates found in whole grains, vegetables, and legumes provide sustained energy and fiber promoting digestive health, while simple sugars in processed foods cause rapid blood glucose spikes followed by crashes. The glycemic index measures how quickly foods raise blood glucose, with low-glycemic foods promoting better glucose control. Proteins, composed of amino acids, are essential for building and repairing tissues, producing enzymes and hormones, and supporting immune function. Complete proteins containing all essential amino acids come from animal sources, while plant proteins often require combining different sources to obtain complete amino acid profiles. Fats, despite negative reputations, are vital for hormone production, vitamin absorption, cell membrane structure, and energy storage. Unsaturated fats from fish, nuts, and olive oil promote cardiovascular health, while saturated fats and especially trans fats increase disease risk.

Micronutrients, though required in small amounts, are crucial for health. Vitamin C supports immune function, collagen synthesis, and wound healing, with deficiency causing scurvy. Vitamin D, synthesized in skin with sun exposure and obtained from fortified foods and fatty fish, is essential for calcium absorption and bone health, with deficiency contributing to osteoporosis and rickets. B vitamins support energy metabolism and nervous system function. Vitamin K is necessary for blood clotting. Minerals including calcium, phosphorus, and magnesium build bones and teeth, while iron carries oxygen in hemoglobin. Iodine is essential for thyroid hormone production. Deficiencies in these micronutrients cause specific diseases and impair multiple body systems.

Nutrition directly impacts oral health in multiple ways. Sugars and fermentable carbohydrates feed oral bacteria producing acids that demineralize tooth enamel, causing cavities. Frequent snacking and sipping sugary beverages maintain acidic oral conditions promoting decay. Conversely, calcium, phosphorus, and vitamin D strengthen tooth enamel and support bone density around teeth. Vitamin C deficiency causes bleeding gums and impaired wound healing. Adequate protein supports tissue repair and immune function important for periodontal health. For dental professionals, nutritional knowledge enables dietary counseling for caries prevention, recognition that eating disorders often manifest with dental

complications including enamel erosion from vomiting and increased decay risk, understanding that many systemic nutritional deficiencies present with oral symptoms like glossitis, angular cheilitis, or poor healing, and awareness that medications affecting nutrition may impact oral health. Promoting balanced diets with limited sugar consumption, adequate vitamins and minerals, and proper meal timing helps prevent dental disease while supporting overall health.

17. According to the passage, macronutrients include:
    A. Only vitamins
    B. Only minerals
    C. Only water
    D. Carbohydrates, proteins, and fats

18. The passage states that the brain relies primarily on:
    A. Glucose
    B. Protein only
    C. Fat only
    D. Minerals only

19. Based on the passage, complete proteins:
    A. Lack all amino acids
    B. Come only from plants
    C. Contain all essential amino acids
    D. Are unnecessary

20. According to the passage, unsaturated fats:
    A. Increase disease risk
    B. Promote cardiovascular health
    C. Contain no nutrients
    D. Should be avoided completely

21. The passage indicates that vitamin C deficiency causes:
    A. Scurvy
    B. Rickets
    C. Anemia
    D. Diabetes

22. Based on the passage, vitamin D is essential for:
    A. Blood clotting only
    B. Calcium absorption and bone health
    C. Producing insulin

D. Filtering blood

23. According to the passage, iron's function is to:
    A. Build bones only
    B. Produce hormones only
    C. Carry oxygen in hemoglobin
    D. Digest food

24. The passage states that sugars feed oral bacteria that produce:
    A. Acids that demineralize enamel
    B. Vitamins
    C. Protective substances
    D. Stronger enamel

PASSAGE 4

The skeletal system provides structural support, protects vital organs, enables movement through lever mechanisms, stores minerals, produces blood cells, and maintains mineral homeostasis. Comprising 206 bones in adults along with cartilage, ligaments, and tendons, this system constantly remodels throughout life in response to mechanical forces and hormonal signals. Bone is living tissue containing cells, blood vessels, and nerves, not the inert structure it might appear. Understanding skeletal anatomy and physiology is crucial for healthcare professionals because bone fractures, osteoporosis, arthritis, and other skeletal conditions affect millions, skeletal abnormalities can indicate systemic diseases, and oral-facial bones form the foundation for dental structures.

Bone tissue exists in two forms: compact bone and spongy bone, each suited to specific mechanical demands. Compact bone, forming the dense outer layer, provides strength and rigidity. Its structural unit, the osteon, consists of concentric layers of mineralized matrix surrounding a central canal containing blood vessels and nerves. Spongy bone, found at bone ends and in flat bones, contains trabecular networks creating a lattice structure that is strong yet lightweight. Bone marrow fills spaces within spongy bone, with red marrow producing blood cells and yellow marrow storing fat. Bone composition includes an organic component—primarily collagen providing flexibility—and an inorganic component—calcium phosphate crystals providing hardness. This combination creates a material that resists both tension and compression.

Bone constantly undergoes remodeling through balanced osteoblast and osteoclast activity. Osteoblasts build new bone by secreting collagen and other proteins forming osteoid, which then mineralizes as calcium and phosphorus deposit. Some osteoblasts become trapped in the matrix they create, transforming into osteocytes that maintain bone tissue. Osteoclasts break down bone through resorption, releasing stored minerals into blood. This continuous remodeling serves multiple purposes: repairing microdamage

from daily stress, adapting bone strength to mechanical loads (bones strengthen with exercise and weaken with disuse according to Wolff's Law), and regulating blood calcium levels. Parathyroid hormone increases blood calcium by stimulating osteoclast activity, while calcitonin decreases blood calcium by inhibiting osteoclasts. Estrogen inhibits excessive bone resorption, explaining why postmenopausal women face increased osteoporosis risk.

Skeletal disorders significantly impact health and quality of life. Osteoporosis, characterized by decreased bone density and increased fracture risk, affects primarily older adults, especially postmenopausal women. Risk factors include aging, hormones, low calcium and vitamin D intake, inadequate exercise, smoking, and certain medications. Fractures, bone breaks from trauma or stress, vary in severity from hairline cracks to complete breaks with displacement. Healing requires proper alignment, immobilization, and adequate nutrition, typically taking weeks to months. Arthritis, joint inflammation, includes osteoarthritis from cartilage degeneration and rheumatoid arthritis from autoimmune joint destruction. For dental professionals, skeletal knowledge is essential because the maxilla and mandible are specialized bones requiring understanding of growth patterns and remodeling, conditions like osteoporosis affect jawbone density impacting implant success and increasing fracture risk during extractions, bisphosphonates treating osteoporosis can rarely cause jaw osteonecrosis requiring prophylactic care before invasive procedures, temporomandibular joint disorders involve skeletal components requiring anatomical understanding, and orthodontic treatments rely on bone remodeling principles. Maintaining skeletal health through adequate calcium and vitamin D, weight-bearing exercise, and avoiding risk factors benefits both systemic and oral health.

25. According to the passage, the skeletal system functions include:
    A. Only movement
    B. Only protection
    C. Only blood production
    D. Support, protection, movement, mineral storage, and blood cell production

26. The passage states that compact bone's structural unit is:
    A. The nephron
    B. The osteon
    C. The neuron
    D. The alveolus

27. Based on the passage, osteoblasts:
    A. Build new bone
    B. Break down bone
    C. Filter blood
    D. Produce hormones only

28. According to the passage, osteoclasts:
    A. Only build bone
    B. Have no function
    C. Filter air
    D. Break down bone through resorption

29. The passage indicates that Wolff's Law states that:
    A. Bones never change
    B. All bones are identical
    C. Bones adapt strength to mechanical loads
    D. Bones only weaken

30. Based on the passage, parathyroid hormone:
    A. Decreases blood calcium
    B. Increases blood calcium
    C. Has no effect on calcium
    D. Only affects muscles

31. According to the passage, osteoporosis risk factors include:
    A. Only age
    B. Only diet
    C. Only exercise
    D. Aging, hormones, low calcium/vitamin D, inadequate exercise, smoking

32. The passage states that bisphosphonates can rarely cause:
    A. Jaw osteonecrosis
    B. Increased bone strength only
    C. Hair loss
    D. Improved healing

PASSAGE 5

Pain represents a complex, subjective experience involving sensory, emotional, and cognitive components that signals actual or potential tissue damage. While acute pain serves a protective function alerting the body to injury and prompting withdrawal or treatment-seeking behaviors, chronic pain persists beyond normal healing time, often becoming a disease state itself that significantly impacts quality of life. Pain perception involves specialized nerve receptors called nociceptors, neural pathways transmitting signals to the brain, and complex processing in multiple brain regions integrating sensory information with memory, emotion, and context. Understanding pain mechanisms is essential for healthcare professionals

who must assess pain accurately, select appropriate treatments, and recognize when pain management requires specialist consultation.

Pain classification helps guide treatment approaches. Nociceptive pain results from tissue damage activating nociceptors and includes somatic pain from skin, muscles, and joints (typically well-localized and described as sharp or aching) and visceral pain from internal organs (often poorly localized and described as deep, cramping, or pressure-like). Neuropathic pain arises from nervous system damage or dysfunction, producing burning, shooting, or electric sensations often accompanied by abnormal sensations like allodynia (pain from normally non-painful stimuli) or hyperalgesia (exaggerated pain response). Cancer pain often combines nociceptive and neuropathic components. Acute pain has identifiable causes and expected resolution with healing, while chronic pain persists beyond normal healing (typically more than three months), potentially existing without identifiable ongoing tissue damage.

Pain management employs pharmacological and non-pharmacological approaches. Non-opioid analgesics include acetaminophen, which reduces pain and fever but lacks anti-inflammatory effects, and nonsteroidal anti-inflammatory drugs (NSAIDs) like ibuprofen and aspirin, which reduce pain, fever, and inflammation by inhibiting prostaglandin synthesis. NSAIDs carry risks including gastrointestinal irritation, bleeding, and kidney effects. Local anesthetics block nerve signals in specific body regions, enabling pain-free procedures. Opioids, including morphine, oxycodone, and codeine, provide powerful pain relief by binding to opioid receptors in the brain and spinal cord, reducing pain perception and emotional response to pain. However, opioids carry significant risks including respiratory depression, constipation, tolerance, dependence, and addiction potential. Adjuvant medications like antidepressants and anticonvulsants help manage neuropathic pain.

Non-pharmacological approaches include physical therapy, heat and cold application, transcutaneous electrical nerve stimulation (TENS), acupuncture, cognitive-behavioral therapy, relaxation techniques, and mindfulness meditation. These methods can enhance pharmacological treatments or serve as primary interventions for certain pain types. For dental professionals, pain management is central to practice because dental procedures can cause pain requiring effective anesthesia and analgesia, patients often seek dental care specifically for acute dental pain from pulpitis or abscess, chronic orofacial pain conditions including temporomandibular disorders and trigeminal neuralgia require diagnosis and management, understanding pain physiology enables appropriate local anesthetic selection and technique, and awareness of medication interactions and contraindications ensures safe prescribing. Post-operative pain management requires balancing effective relief with safety considerations, particularly given current concerns about opioid misuse. Dental professionals must assess pain comprehensively, explain treatment options clearly, use multi-modal analgesia when appropriate, and recognize when referral to pain specialists is warranted for complex or refractory pain conditions.

33. According to the passage, pain involves:

A. Sensory, emotional, and cognitive components
B. Only sensory components
C. No brain involvement
D. Only muscle activity

34. The passage states that nociceptors are:
A. Blood cells
B. Bone cells
C. Specialized pain receptors
D. Digestive enzymes

35. Based on the passage, neuropathic pain:
A. Only occurs in bones
B. Never has abnormal sensations
C. Always resolves quickly
D. Arises from nervous system damage or dysfunction

36. According to the passage, chronic pain persists beyond:
A. One day
B. One week
C. Three months
D. One year only

37. The passage indicates that NSAIDs work by:
A. Inhibiting prostaglandin synthesis
B. Increasing inflammation
C. Damaging tissue
D. Blocking all sensations

38. Based on the passage, opioids provide pain relief by:
A. Increasing pain signals
B. Destroying nerve cells
C. Causing inflammation
D. Binding to opioid receptors in brain and spinal cord

39. According to the passage, opioid risks include:
A. Enhanced healing only
B. Respiratory depression, tolerance, dependence, and addiction
C. Increased alertness only
D. No side effects

40. The passage states that non-pharmacological pain management approaches include:
    A. Only surgery
    B. Only medication
    C. Physical therapy, TENS, acupuncture, and cognitive-behavioral therapy
    D. No effective methods

Language Usage

Time: 30 minutes
Questions: 1-40

Directions: Each question presents a sentence or passage with underlined portions or asks you to identify errors or select the best revision. Choose the answer that corrects any errors or represents the best version.

1. The hospital upgraded its equipment, it also expanded the emergency department.
    A. equipment, it also expanded
    B. equipment it also expanded
    C. equipment, and it also expanded
    D. equipment; because it also expanded

2. Neither the physician nor the nurses was ready for the morning rounds.
    A. nor the nurses were ready
    B. or the nurses was ready
    C. or the nurses were ready
    D. nor the nurses was ready

3. The manager asked the staff when could they attend the mandatory training.
    A. when could they attend
    B. when they could have attended
    C. when they can attend
    D. when they could attend

4. Between you and I, the new treatment protocol is much more effective.
    A. Between you and I, the new treatment protocol is
    B. Between you and I, the new treatment protocols are
    C. Between you and me, the new treatment protocol is
    D. Between you and me, the new treatment protocols are

5. The center provides comprehensive services including diagnostic testing, patient consultations, and will offer therapeutic interventions.
   A. diagnostic testing, patient consultations, and will offer therapeutic interventions
   B. diagnostic testing, patient consultations, and therapeutic interventions
   C. diagnostically testing, patient consultations, and will offer therapeutic interventions
   D. diagnostic testing, patient consultation, and therapeutic intervention

6. After analyzing the patient data the team formulated a new treatment approach.
   A. After analyzing the patient data, the team formulated
   B. After analyzing, the patient data the team formulated
   C. After analyzing the patient data; the team formulated
   D. After analyzing the patient data the team, formulated

7. The updated guidelines are more comprehensive than the previous version, they also improve patient safety.
   A. version, they also improve
   B. version they also improve
   C. version; because they also improve
   D. version, and they also improve

8. Everyone in the medical staff must submit their annual certification by the deadline.
   A. must submit their annual certifications
   B. must submit its annual certification
   C. must submit his or her annual certification
   D. must submits his or her annual certification

9. The supervisor recommended that the technician submits the lab results immediately.
   A. recommended that the technician submits the lab results
   B. recommended that the technician submit the lab results
   C. recommends that the technician submits the lab results
   D. recommended that the technician submitted the lab results

10. Reviewing the medical charts thoroughly, the diagnoses were confirmed by the specialist.
    A. Reviewing the medical charts thoroughly, the diagnoses were confirmed by the specialist
    B. Reviewing the medical charts thoroughly, the specialist's diagnoses were confirmed
    C. The diagnoses were confirmed by the specialist, reviewing the medical charts thoroughly
    D. Reviewing the medical charts thoroughly, the specialist confirmed the diagnoses

11. Each of the medical professionals have completed their required continuing education.
    A. have completed their required continuing education

B. have completed his or her required continuing education
C. has completed his or her required continuing education
D. has completed their required continuing education

12. The clinic operates daily, however it closes early on Fridays.
A. daily, however it closes
B. daily however, it closes
C. daily; however, it closes
D. daily, however, it closes

13. Less physicians attended the medical conference than anticipated.
A. Less physicians attended
B. Fewer physicians attended
C. Lesser physicians attended
D. Less physician attended

14. The surgeon examined the patient, reviewed the imaging results, and was preparing the operative plan.
A. examined the patient, reviewed the imaging results, and prepared
B. examines the patient, reviewed the imaging results, and prepared
C. examined the patient, reviews the imaging results, and prepared
D. examined the patient, reviewed the imaging results, and was preparing

15. Dr. Chen told Dr. Roberts that she needed to review the case urgently.
A. Dr. Chen told Dr. Roberts that she needed
B. Dr. Chen told Dr. Roberts she needed
C. Dr. Chen told Dr. Roberts that Roberts needed
D. Dr. Chen told Dr. Roberts that Dr. Chen needed

16. The policy change effects all departments and will take effect immediately.
A. effects all departments and will take effect
B. effects all departments and will take affect
C. affects all departments and will take effect
D. affects all departments and will take affect

17. Ensuring quality care is essential, all staff must adhere to protocols.
A. essential, all staff must
B. essential. All staff must
C. essential; because all staff must
D. essential all staff must

18. The technician which graduated from the program last year demonstrates excellent skills.
    A. which graduated from the program
    B. which had graduated from the program
    C. who graduated from the program
    D. whom graduated from the program

19. Having conducted the research extensively, the findings were published by the scientists.
    A. Having conducted the research extensively, the findings were published by the scientists
    B. Having conducted the research extensively, the scientists published the findings
    C. The findings were published by the scientists, having conducted the research extensively
    D. Having conducted the research extensively, the scientists' findings were published

20. The patient should of contacted the clinic earlier to discuss the symptoms.
    A. should of contacted
    B. should have contacted
    C. should had contacted
    D. should has contacted

21. The program includes assessments, interventions, or providing follow-up care.
    A. assessments, interventions, or follow-up care
    B. assessment, intervention, or follow-up care
    C. assessing, intervening, or providing follow-up care
    D. assessments, interventions, or providing follow-up care

22. Advanced medical technology improves outcomes, it enhances diagnostic accuracy.
    A. outcomes, it enhances
    B. outcomes it enhances
    C. outcomes; because it enhances
    D. outcomes; it enhances

23. Among the five treatment options available, the surgical approach is the more effective method.
    A. the more effective method
    B. the more effectively method
    C. the most effective method
    D. the most effectively method

24. The healthcare facility is located at 123 main street near the downtown area of Boston Massachusetts.
    A. main street near the downtown area of Boston Massachusetts
    B. Main Street near the downtown area of Boston, Massachusetts
    C. main Street near the Downtown Area of Boston, Massachusetts

D. Main street near the downtown area of Boston, Massachusetts

25. After the treatment was administered the patient experienced significant improvement.
    A. After the treatment was administered the patient experienced
    B. After the treatment, was administered the patient experienced
    C. After the treatment was administered; the patient experienced
    D. After the treatment was administered, the patient experienced

26. The physician asked the patient when can he schedule his follow-up visit.
    A. when he could schedule
    B. when can he schedule
    C. when he can schedule
    D. when can he have scheduled

27. The doctor and his assistants both agrees that early intervention is critical.
    A. both agrees that
    B. both agrees, that
    C. both agree that
    D. both agree, that

28. Advanced training, clinical experience, and continuing education is required for certification.
    A. is required
    B. are required
    C. is requiring
    D. are requiring

29. Modern healthcare improves patient outcomes, it also reduces complications significantly.
    A. outcomes, and it also reduces
    B. outcomes it also reduces
    C. outcomes, it also reduces
    D. outcomes; because it also reduces

30. The facility offers specialized care such as cardiology, neurology, and oncology.
    A. care, such as cardiology, neurology, and oncology
    B. care such as, cardiology, neurology, and oncology
    C. care, such as cardiology, neurology, and oncology
    D. care such as cardiology neurology and oncology

31. Doctors, nurses, and therapists all plays vital roles in patient recovery.
    A. all plays vital roles

B. all play vital roles
C. all play vital role
D. all plays vital role

32. The physician instructed the patient to lay down for the examination.
A. to lie down for the examination
B. to lay down for the examination
C. to lie down in the examination
D. to lay down in the examination

33. Contemporary healthcare has evolved dramatically allowing providers to deliver exceptional care.
A. dramatically, allowing providers to deliver
B. dramatically; allowing providers to deliver
C. dramatically. Allowing providers to deliver
D. dramatically allowing providers to deliver

34. Regular health screenings prevent disease, they promote early detection.
A. disease, they promote
B. disease. They promote
C. disease; and they promote
D. disease they promote

35. The training program requires participants to complete clinical hours before certification.
A. requires participants to complete clinical hours, before certification
B. require participants to complete clinical hours before certification
C. requires participants to complete clinical hours before certification
D. requires participants to complete clinical hours before, certification

36. The hospital provides comprehensive services such as emergency care and surgical procedures but not cosmetic treatments.
A. services, such as emergency care and surgical procedures but
B. services, such as emergency care and surgical procedures, but
C. services such as, emergency care and surgical procedures, but
D. services such as emergency care and surgical procedures, but

37. The new clinic is more convenient for patients than the previous location.
A. more convenient for patients than the previous location
B. more convenient for patients than the previous location was
C. more conveniently for patients than the previous location
D. more convenient for patients than the previous location

38. Achieving optimal health requires maintaining proper nutrition, exercising regularly, and to get adequate sleep.
    A. maintaining proper nutrition, exercising regularly, and getting adequate sleep
    B. to maintain proper nutrition, exercising regularly, and getting adequate sleep
    C. maintaining proper nutrition, exercising regularly, and to get adequate sleep
    D. to maintain proper nutrition, to exercise regularly, and to get adequate sleep

39. The patient reported that his condition has been worsening for months before seeking help.
    A. has been worsening
    B. will have been worsening
    C. has worsened
    D. had been worsening

40. Comprehensive healthcare reduces hospital admissions, it also improves quality of life.
    A. admissions, and it also improves
    B. admissions it also improves
    C. admissions, it also improves
    D. admissions; because it also improves

Quantitative Reasoning

Time: 45 minutes
Questions: 1-40

Directions: Solve each problem and select the best answer from the choices provided. You may use scratch paper for calculations.

1. Solve for x: 9x - 16 = 29
    A. 3
    B. 13
    C. 5
    D. 45

2. A laboratory processed 180 samples in March and 225 samples in April. What is the percent increase?
    A. 20%
    B. 25%
    C. 30%
    D. 45%

3. If $11y - 10 = 8y + 17$, what is the value of y?
   A. 3
   B. 7
   C. 1
   D. 9

4. A technician earns $48 per hour and works 7 hours per day for 6 days per week. How much does she earn per week?
   A. $2,016
   B. $336
   C. $288
   D. $2,400

5. What is 28% of 475?
   A. 28
   B. 47.5
   C. 133
   D. 95

6. If $a = 8$ and $b = -6$, what is the value of $5a^2 - 4b$?
   A. 296
   B. 344
   C. 320
   D. 280

7. A medication dosage is 0.9 mg per kilogram of body weight. How many milligrams should be given to a patient weighing 90 kilograms?
   A. 81 mg
   B. 72 mg
   C. 90 mg
   D. 100 mg

8. Solve: $6(x + 9) = 4x + 62$
   A. 2
   B. 6
   C. 10
   D. 8

9. A jar has 15 red balls, 12 blue balls, and 9 green balls. If one ball is selected at random, what is the probability it is blue?

A. 1/3
B. 5/12
C. 1/3
D. 1/4

10. Convert 6.4 kilometers to meters.
    A. 64 meters
    B. 6,400 meters
    C. 640 meters
    D. 64,000 meters

11. If $x = 10$, what is the value of $5x^2 - 7x$?
    A. 430
    B. 500
    C. 350
    D. 430

12. Medical supplies decreased from $4,800 to $3,600. What is the percent decrease?
    A. 25%
    B. 30%
    C. 1,200%
    D. 20%

13. Simplify: $8(5x - 6) - 10(x + 5)$
    A. $40x - 98$
    B. $50x - 98$
    C. $30x - 98$
    D. $18x - 2$

14. The ratio of nurses to patients is 1:55. If there are 220 patients, how many nurses are there?
    A. 3
    B. 4
    C. 5
    D. 55

15. Solve for x: $x/10 + 8 = 15$
    A. 70
    B. 150
    C. 23
    D. 50

16. A patient's temperature increased from 98.4°F to 102.8°F. What is the amount of increase?
    A. 3.4°F
    B. 4.0°F
    C. 5.2°F
    D. 4.4°F

17. If 10x - 7y = 51 and x = 12, what is the value of y?
    A. 8
    B. 9
    C. 11
    D. 12

18. A clinic offers a 35% discount on health screenings. If the original price is $700, what is the discounted price?
    A. $665
    B. $490
    C. $455
    D. $245

19. Solve for x: 13x - 12 = 10x + 21
    A. 3
    B. 9
    C. 33
    D. 11

20. What is the mean of the data set: 24, 30, 36, 42, 48?
    A. 36
    B. 30
    C. 42
    D. 38

21. A solution contains 900 mL of liquid. If 44% is active ingredient, how many milliliters of active ingredient does it contain?
    A. 44 mL
    B. 396 mL
    C. 360 mL
    D. 450 mL

22. If $x^2 = 289$, what are the possible values of x?

A. 289 only
B. 144 only
C. -17 only
D. 17 and -17

23. A hygienist sees 22 patients per day for 5 days per week for 4 weeks. How many patients in total?
A. 440
B. 110
C. 88
D. 528

24. Simplify: $(9x^8)(6x^5)$
A. $15x^{13}$
B. $15x^{40}$
C. $54x^{40}$
D. $54x^{13}$

25. What is 13/25 expressed as a percent?
A. 13%
B. 25%
C. 52%
D. 0.52%

26. A patient takes medication every 6 hours. How many doses in 5 days?
A. 20
B. 15
C. 18
D. 24

27. If the perimeter of a rectangle is 110 cm and the width is 24 cm, what is the length?
A. 43 cm
B. 31 cm
C. 55 cm
D. 62 cm

28. Solve: 12x - 22 = 11x - 14
A. 36
B. -8
C. -36
D. 8

29. Equipment costs $1,180 before tax. With 8% sales tax, what is the total cost?
    A. $1,188
    B. $1,274
    C. $1,274.40
    D. $1,280

30. What is the median of: 18, 24, 30, 36, 42?
    A. 24
    B. 30
    C. 36
    D. 28

31. If 9x - 16 = 29, what is the value of 4x?
    A. 20
    B. 5
    C. 15
    D. 25

32. A bottle holds 3.8 liters. How many milliliters is this?
    A. 38 mL
    B. 380 mL
    C. 3,800 mL
    D. 38,000 mL

33. Evaluate: $(-8)^2 - 6(-5)$
    A. 34
    B. -34
    C. 94
    D. 94

34. A practice has 60 employees. If 35% are hygienists, how many hygienists work there?
    A. 21
    B. 18
    C. 24
    D. 30

35. Solve for x: $x/15 = 8$
    A. 23
    B. 7

C. 15
D. 120

36. What is 0.875 expressed as a fraction in simplest form?
    A. 875/1000
    B. 7/8
    C. 35/40
    D. 17/20

37. If x + y = 36 and x - y = 16, what is the value of x?
    A. 26
    B. 20
    C. 10
    D. 18

38. A patient's temperature is 42°C. Using F = (9/5)C + 32, what is the temperature in Fahrenheit?
    A. 106.4°F
    B. 108.6°F
    C. 107.6°F
    D. 105.6°F

39. What is the range of: 24, 30, 36, 42, 48?
    A. 24
    B. 36
    C. 30
    D. 24

40. A clinic treated 160 patients in May and 240 patients in June. What is the ratio of May to June patients in simplest form?
    A. 160:240
    B. 2:3
    C. 8:12
    D. 32:48

Perceptual Ability

Time: 45 minutes
Questions: 1-60

Directions: This section tests your ability to visualize and mentally manipulate objects in space. Carefully examine each question and select the best answer.

ANGLE DISCRIMINATION (Questions 1-15)
Directions: For each question, rank the angles from smallest to largest or identify relationships between angles.

1. Four angles are shown. Angle 1 measures 62°, Angle 2 measures 124°, Angle 3 measures 86°, and Angle 4 measures 145°. Which is the second largest angle?
   A. Angle 1
   B. Angle 2
   C. Angle 3
   D. Angle 4

2. Three angles are presented. Angle A = 43°, Angle B = 134°, Angle C = 100°. Which angle is obtuse and closest to 100°?
   A. Angle A
   B. Angle B
   C. Angle C
   D. All acute

3. Five angles measure 34°, 101°, 65°, 153°, and 92°. Which is the smallest angle?
   A. 34°
   B. 65°
   C. 92°
   D. 101°

4. Four angles are displayed: 49°, 114°, 77°, and 141°. Which is the largest angle?
   A. 49°
   B. 77°
   C. 114°
   D. 141°

5. Three angles measure 86°, 132°, and 52°. What is the correct order from smallest to largest?
   A. 86°, 52°, 132°
   B. 52°, 86°, 132°

C. 132°, 86°, 52°
D. 52°, 132°, 86°

6. Five angles are shown: 41°, 109°, 80°, 157°, and 66°. Which angle is acute and closest to 80°?
   A. 80°
   B. 41°
   C. 66°
   D. 109°

7. Four angles measure 27°, 105°, 58°, and 172°. Which is the third largest angle?
   A. 27°
   B. 58°
   C. 105°
   D. 172°

8. Three angles are presented: 43°, 99°, and 164°. Which is the largest angle?
   A. 43°
   B. 99°
   C. 164°
   D. 164°

9. Five angles measure 50°, 113°, 76°, 146°, and 59°. Which is the third smallest?
   A. 50°
   B. 76°
   C. 59°
   D. 113°

10. Four angles are shown: 74°, 137°, 39°, and 100°. Which is the second smallest angle?
    A. 39°
    B. 100°
    C. 74°
    D. 137°

11. Three acute angles measure 48°, 81°, and 69°. Which is the smallest?
    A. 48°
    B. 69°
    C. 81°
    D. All equal

12. Five angles measure 124°, 95°, 60°, 175°, and 83°. Which is the largest?

A. 60°
B. 83°
C. 95°
D. 175°

13. Four angles are displayed: 31°, 110°, 82°, and 151°. Which is the second smallest angle?
    A. 31°
    B. 82°
    C. 110°
    D. 151°

14. Three angles measure 127°, 54°, and 94°. Which is obtuse and smallest?
    A. 94°
    B. 54°
    C. 127°
    D. None

15. Five angles are shown: 46°, 115°, 72°, 159°, and 90°. Which lists the two smallest in order?
    A. 90°, 115°
    B. 72°, 90°
    C. 46°, 72°
    D. 115°, 90°

APERTURES (Questions 16-30)

Directions: A three-dimensional object is shown along with aperture openings. Determine which aperture the object could pass through if properly oriented.

16. A rectangular prism measures 10 cm × 14 cm × 16 cm. Which aperture allows the largest face to pass through?
    A. A rectangle 14 cm × 16 cm
    B. A circle 14 cm diameter
    C. A square 14 cm × 14 cm
    D. A triangle 16 cm base

17. A cylinder with diameter 14 cm and height 20 cm is shown. When entering circular end first, what aperture is needed?
    A. A rectangle 14 cm × 20 cm
    B. A square 20 cm × 20 cm
    C. A triangle 14 cm sides

D. A circle with at least 14 cm diameter

18. A pyramid with square base 14 cm × 14 cm is presented. Which aperture accommodates the base?
    A. A circle 14 cm diameter
    B. A square 14 cm × 14 cm or larger
    C. A triangle 14 cm sides
    D. A rectangle 12 cm × 14 cm

19. A cube measuring 13 cm per side is shown. What is the smallest square aperture needed?
    A. 13 cm × 13 cm
    B. 11 cm × 11 cm
    C. 15 cm × 15 cm
    D. 26 cm × 26 cm

20. A triangular prism has base 12 cm per side and length 18 cm. Which aperture allows triangle-first passage?
    A. A square 12 cm × 12 cm
    B. A circle 18 cm diameter
    C. An equilateral triangle 12 cm sides
    D. A rectangle 12 cm × 18 cm

21. An L-shaped object measures 12 cm wide and 15 cm tall overall. Which aperture accommodates it?
    A. A square 12 cm × 12 cm
    B. A circle 13 cm diameter
    C. A triangle 15 cm base
    D. A rectangle 12 cm × 15 cm or larger

22. A sphere with diameter 17 cm is presented. What aperture is required?
    A. A square 15 cm × 15 cm
    B. A circle with at least 17 cm diameter
    C. A triangle 17 cm sides
    D. A rectangle 16 cm × 18 cm

23. A rectangular block 12 cm × 14 cm × 10 cm is shown. When oriented with 12 cm × 14 cm face forward, what aperture?
    A. A circle 14 cm diameter
    B. A square 14 cm × 14 cm
    C. A rectangle 12 cm × 14 cm
    D. A rectangle 10 cm × 12 cm

24. A hexagonal prism with 12 cm wide base and 19 cm length is displayed. Which aperture for hexagon-first entry?
    A. A circle 11 cm diameter
    B. A rectangle 12 cm × 19 cm
    C. A square 12 cm × 12 cm
    D. A hexagon approximately 12 cm across

25. A T-shaped object measures 16 cm wide and 18 cm tall. What minimum aperture?
    A. A rectangle 16 cm × 18 cm
    B. A square 16 cm × 16 cm
    C. A circle 18 cm diameter
    D. A rectangle 14 cm × 16 cm

26. An ellipsoid measures 13 cm × 16 cm × 11 cm. When oriented with 13 cm × 16 cm face forward, which aperture?
    A. A circle 16 cm diameter
    B. A square 16 cm × 16 cm
    C. An ellipse or rectangle 13 cm × 16 cm
    D. A rectangle 11 cm × 13 cm

27. A cross-shaped object has arms extending 14 cm in each direction. What aperture for face-first passage?
    A. A square 12 cm × 12 cm
    B. A square 14 cm × 14 cm or larger
    C. A circle 14 cm diameter
    D. A triangle 14 cm sides

28. A cone with base diameter 16 cm is shown. Which aperture fits the base?
    A. A square 14 cm × 14 cm
    B. A circle with at least 16 cm diameter
    C. A rectangle 13 cm × 16 cm
    D. A triangle 16 cm sides

29. A rectangular block with rounded ends measures 12 cm × 14 cm × 18 cm with 2 cm radius curves. Which aperture for curved end?
    A. A rectangle 11 cm × 13 cm
    B. A circle 14 cm diameter
    C. A rounded rectangle approximately 12 cm × 14 cm
    D. A square 14 cm × 14 cm

30. An irregular object with dimensions 13 cm × 15 cm × 11 cm is shown. When oriented with smallest face forward, which aperture?
    A. A circle 13 cm diameter
    B. A rectangle 15 cm × 11 cm
    C. A square 13 cm × 13 cm
    D. A rectangle 13 cm × 11 cm

ORTHOGRAPHIC PROJECTIONS (Questions 31-45)

Directions: Three views (top, front, and end) of an object are shown. Select the answer that correctly represents the object or its views.

31. Top view shows square, front view shows rectangle, end view shows square. What is the object?
    A. A cube
    B. A pyramid
    C. A sphere
    D. A rectangular prism oriented with square ends

32. Top view shows triangle, front view shows rectangle, end view shows triangle. What is the object?
    A. A triangular prism
    B. A pyramid
    C. A rectangular prism
    D. A cone

33. A stepped object has seven levels. Which view shows all seven levels most clearly?
    A. Top view only
    B. End view only
    C. Front view only
    D. All three equally

34. Top view is nonagon (9 sides), front view is rectangle, end view is nonagon. What is the object?
    A. A cube
    B. A nonagonal prism
    C. A nonagonal pyramid
    D. Nine prisms

35. Top view shows rectangle, front view shows three circles, end view shows rectangle. What is the object?
    A. Three cylinders arranged in a row
    B. A cube

C. A pyramid
D. A rectangular prism

36. Top view shows rectangle with three lines, front view shows four rectangles, end view shows rectangle with three lines. What does this represent?
    A. A solid cube
    B. A pyramid
    C. One prism
    D. Four rectangular prisms with dividing features

37. Top view shows U-shape, front view shows rectangle, end view shows U-shape. What is the object?
    A. A U-shaped pyramid
    B. Two separate cubes
    C. A U-shaped prism
    D. A T-shaped beam

38. Top view shows hexagon with line, front view shows two trapezoids, end view shows hexagon with line. What is the object?
    A. Two hexagonal sections with a dividing feature
    B. A sphere
    C. A cylinder
    D. A cube

39. Top view shows E-shape, front view shows rectangle, end view shows E-shape. What is the object?
    A. An E-shaped pyramid
    B. An E-shaped prism
    C. Four separate cubes
    D. A T-shaped beam

40. Top view shows eight squares in row, front view shows long rectangle, end view shows square. What is the object?
    A. A pyramid
    B. An L-structure
    C. One long prism
    D. Eight cubes in a row

41. Top view shows dodecagon (12 sides), front view shows rectangle, end view shows dodecagon. What is the object?
    A. A dodecagonal prism
    B. Twelve rectangular prisms

C. A cube
D. A dodecagonal pyramid

42. Top view shows oval with line, front view shows three rectangles, end view shows oval with line. What is the object?
A. A sphere
B. A cone
C. Three elliptical sections with dividing features
D. A cube

43. Top view shows septagon (7 sides), front view shows rectangle, end view shows septagon. What is the object?
A. A cube
B. A septagonal prism
C. A septagonal pyramid
D. Seven prisms

44. Top view shows six circles in hexagon pattern, front view shows six rectangles, end view shows circle. What is the object?
A. Six spheres
B. A pyramid
C. Six cones
D. Six cylinders arranged in hexagon pattern

45. Top view shows Z-shape, front view shows rectangle, end view shows Z-shape. What is the object?
A. A Z-shaped pyramid
B. A T-shaped beam
C. A Z-shaped prism
D. Three separate cubes

CUBE COUNTING

Directions: A three-dimensional structure built from cubes is shown. Answer questions about cubes or painted surfaces.

46. A structure contains 7 layers arranged 5 × 5 × 7. How many total cubes?
A. 175
B. 25
C. 35
D. 125

47. In an 8 × 8 × 8 cube, how many cubes are on the surface (have at least one face exposed)?
    A. 512
    B. 216
    C. 296
    D. 296

48. A 5 × 7 × 9 structure is built. How many total cubes?
    A. 21
    B. 315
    C. 63
    D. 126

49. In an 11 × 11 × 11 cube where all faces are painted, how many cubes have exactly three painted faces?
    A. 121
    B. 81
    C. 8
    D. 12

50. A structure has 10 layers with 9 cubes per layer arranged 3 × 3. How many total cubes?
    A. 90
    B. 60
    C. 81
    D. 72

51. In a 5 × 8 × 9 structure, how many cubes are on corners?
    A. 8
    B. 12
    C. 24
    D. 6

52. A structure is 11 cubes high, 10 cubes wide, 9 cubes deep. How many total cubes?
    A. 30
    B. 990
    C. 550
    D. 792

53. In an L-shaped structure with 13 cubes on one arm and 12 on the other (sharing 1 corner), how many total cubes?
    A. 25

B. 13
C. 12
D. 24

54. An 11 × 11 × 1 flat structure has all faces painted. How many cubes have exactly two painted faces?
A. 40
B. 44
C. 121
D. 36

55. A staircase has 8 cubes on first step, 10 on second, 12 on third. How many total cubes?
A. 10
B. 24
C. 30
D. 36

56. A 10 × 11 × 12 structure is built. How many cubes are on corners?
A. 12
B. 6
C. 24
D. 8

57. In a 13 × 1 × 1 structure (13 cubes in row), if all surfaces painted, how many cubes have exactly four painted faces?
A. 2
B. 11
C. 13
D. 9

58. A pyramid has layers: bottom 10 × 10 = 100 cubes, next 8 × 8 = 64 cubes, next 6 × 6 = 36 cubes, next 4 × 4 = 16 cubes, next 2 × 2 = 4 cubes, top 1 cube. How many total?
A. 221
B. 200
C. 210
D. 100

59. In a 10 × 10 × 10 cube with six corner cubes removed, how many cubes remain?
A. 1000
B. 994
C. 994

D. 990

60. A plus-shaped structure uses 11 cubes for vertical arm and 11 for horizontal (sharing 1 center). How many total?
    A. 22
    B. 20
    C. 11
    D. 21

Biology

Time: 30 minutes
Questions: 1-30

Directions: Select the best answer for each question based on your knowledge of biological concepts.

1. What is the primary function of the mitochondrion?
    A. ATP production through cellular respiration
    B. Protein synthesis
    C. DNA storage
    D. Waste digestion

2. Which organelle packages and modifies proteins?
    A. Ribosome
    B. Mitochondrion
    C. Lysosome
    D. Golgi apparatus

3. During which phase of mitosis do sister chromatids separate?
    A. Prophase
    B. Metaphase
    C. Anaphase
    D. Telophase

4. What process moves water across a selectively permeable membrane?
    A. Active transport
    B. Osmosis
    C. Endocytosis
    D. Phagocytosis

5. What is the function of messenger RNA (mRNA)?
   A. Carries genetic instructions from DNA to ribosomes
   B. Forms ribosomal structure
   C. Stores genetic information permanently
   D. Brings amino acids to ribosomes

6. What is the diploid number of chromosomes in human somatic cells?
   A. 23
   B. 92
   C. 22
   D. 46

7. In DNA, cytosine pairs with which base?
   A. Adenine
   B. Thymine
   C. Guanine
   D. Uracil

8. What type of inheritance pattern involves both alleles fully expressed?
   A. Complete dominance
   B. Codominance
   C. Incomplete dominance
   D. Recessive inheritance

9. During which phase of meiosis does crossing over occur?
   A. Metaphase II
   B. Anaphase I
   C. Telophase II
   D. Prophase I

10. Which blood component is responsible for clotting?
    A. Platelets
    B. Red blood cells
    C. White blood cells
    D. Plasma

11. What is the primary function of the large intestine?
    A. Enzyme production
    B. Bile secretion
    C. Water absorption and waste formation

D. Nutrient digestion

12. Which tissue type lines body surfaces and cavities?
    A. Connective tissue
    B. Epithelial tissue
    C. Nervous tissue
    D. Muscle tissue

13. In a cross between Aa and Aa, what percentage of offspring will be homozygous recessive?
    A. 25%
    B. 50%
    C. 75%
    D. 100%

14. Which cell division process produces four haploid cells?
    A. Mitosis
    B. Binary fission
    C. Budding
    D. Meiosis

15. What is the primary function of ribosomal RNA (rRNA)?
    A. Carries genetic code
    B. Brings amino acids
    C. Forms ribosome structure
    D. Stores DNA

16. Which blood component carries oxygen?
    A. White blood cells
    B. Red blood cells
    C. Platelets
    D. Plasma proteins

17. What type of muscle contracts involuntarily and is found in hollow organs?
    A. Skeletal muscle
    B. Cardiac muscle
    C. Voluntary muscle
    D. Smooth muscle

18. What is the end product of translation?
    A. Protein

B. mRNA
C. DNA
D. tRNA

19. Which organelle contains digestive enzymes?
    A. Mitochondrion
    B. Lysosome
    C. Ribosome
    D. Nucleus

20. What is the function of osteoblasts?
    A. Break down bone
    B. Store minerals
    C. Build new bone tissue
    D. Produce blood cells

21. What type of cells contain a membrane-bound nucleus?
    A. Prokaryotic
    B. Bacterial
    C. Primitive
    D. Eukaryotic

22. What are the products of cellular respiration?
    A. Glucose and oxygen
    B. Only carbon dioxide
    C. Only water
    D. ATP, carbon dioxide, and water

23. Which system secretes hormones?
    A. Nervous system
    B. Endocrine system
    C. Digestive system
    D. Respiratory system

24. If DNA is GCTA, what is the mRNA sequence?
    A. GCTA
    B. CGAU
    C. CGAU
    D. GCUA

25. Which blood vessels carry blood away from the heart?
    A. Arteries
    B. Veins
    C. Capillaries
    D. Venules

26. What is the function of the rough endoplasmic reticulum?
    A. Lipid synthesis
    B. ATP production
    C. DNA replication
    D. Protein synthesis

27. What describes an organism's observable characteristics?
    A. Genotype
    B. Phenotype
    C. Allele
    D. Chromosome

28. During which phase of interphase does DNA replication occur?
    A. S phase
    B. G1 phase
    C. G2 phase
    D. M phase

29. What are the two main components of the central nervous system?
    A. Only the brain
    B. Brain and spinal cord
    C. Only nerves
    D. Only the spinal cord

30. What distinguishes prokaryotic cells from eukaryotic cells?
    A. Presence of ribosomes
    B. Presence of cytoplasm
    C. Lack of membrane-bound organelles
    D. Ability to reproduce

General Chemistry

Time: 30 minutes
Questions: 1-30

Directions: Select the best answer for each question. A periodic table is available for reference during this section.

1. What determines an element's identity?
   A. Number of neutrons
   B. Number of protons (atomic number)
   C. Number of electrons only
   D. Mass number only

2. Which subatomic particle is electrically neutral?
   A. Electron
   B. Proton
   C. Neutron
   D. Ion

3. What type of bond forms when electrons are transferred?
   A. Covalent bond
   B. Metallic bond
   C. Hydrogen bond
   D. Ionic bond

4. How many electrons can the second energy level hold?
   A. 8
   B. 2
   C. 18
   D. 32

5. What is produced in a neutralization reaction between an acid and base?
   A. Only hydrogen gas
   B. Only oxygen
   C. Salt and water
   D. Only carbon dioxide

6. What is the molar mass of carbon monoxide (CO)? (C = 12 g/mol, O = 16 g/mol)
   A. 16 g/mol
   B. 28 g/mol
   C. 44 g/mol
   D. 32 g/mol

7. Which pH value indicates an acidic solution?

A. 4
B. 7
C. 10
D. 14

8. In the equation $N_2 + O_2 \rightarrow 2NO$, what is the coefficient of NO?
   A. 1
   B. 3
   C. 4
   D. 2

9. Atoms of the same element with different mass numbers are called:
   A. Ions
   B. Isotopes
   C. Molecules
   D. Compounds

10. According to Boyle's Law at constant temperature, if pressure increases, volume:
    A. Increases
    B. Stays constant
    C. Decreases
    D. Becomes zero

11. What type of bond involves sharing of electrons?
    A. Covalent bond
    B. Ionic bond
    C. Metallic bond
    D. No bond

12. How many moles are in 96 grams of oxygen (O_2)? (Molar mass = 32 g/mol)
    A. 2 moles
    B. 32 moles
    C. 96 moles
    D. 3 moles

13. What is the SI unit for amount of substance?
    A. Grams
    B. Liters
    C. Moles
    D. Atoms

14. Which property describes bases?
    A. Taste sour
    B. Turn red litmus blue
    C. Have pH less than 7
    D. Turn blue litmus red

15. Which state of matter has fixed positions for particles?
    A. Solid
    B. Liquid
    C. Gas
    D. Plasma

16. What occurs during ionic bonding?
    A. Electrons are shared equally
    B. Atoms remain neutral
    C. No electron movement
    D. Electrons are transferred forming charged ions

17. How many oxygen atoms are in $2Ca(OH)_2$?
    A. 2
    B. 8
    C. 4
    D. 1

18. What is the pH of a neutral solution?
    A. 0
    B. 7
    C. 14
    D. 1

19. Which group contains the halogens?
    A. Group 1
    B. Group 2
    C. Group 18
    D. Group 17

20. What type of reaction is $2H_2O \rightarrow 2H_2 + O_2$?
    A. Decomposition
    B. Synthesis

C. Single replacement
D. Double replacement

21. How many times more acidic is pH 3 compared to pH 6?
A. 3 times
B. 10 times
C. 1000 times
D. 100 times

22. What charge does a proton carry?
A. Negative
B. Neutral
C. Variable
D. Positive

23. How many valence electrons does an element in Group 2 have?
A. 1
B. 2
C. 7
D. 8

24. What law states that mass is conserved in chemical reactions?
A. Boyle's Law
B. Charles's Law
C. Law of Conservation of Mass
D. Dalton's Law

25. A 4 M solution is diluted from 30 mL to 120 mL. What is the new concentration?
A. 1 M
B. 2 M
C. 3 M
D. 4 M

26. What do acids produce in water according to Arrhenius?
A. H^+ ions
B. Na^+ ions
C. OH^- ions
D. Cl^- ions

27. What is Avogadro's number?

A. 1.66×10^{24}
B. 6.022×10^{23}
C. 3.14×10^{23}
D. 1.00×10^{23}

28. According to Charles's Law, what happens when temperature increases at constant pressure?
    A. Volume decreases
    B. Pressure changes
    C. Volume increases
    D. Volume stays constant

29. A neutral carbon atom (atomic number = 6) has how many electrons?
    A. 6
    B. 12
    C. 8
    D. 14

30. According to Gay-Lussac's Law, when temperature increases at constant volume, pressure:
    A. Decreases
    B. Stays constant
    C. Becomes zero
    D. Increases

Answer Explanations - Practice Test 9

Reading Comprehension

1. Correct Answer: A (Skin, hair, nails, and associated glands)

The passage states that "the integumentary system, comprising the skin, hair, nails, and associated glands, serves as the body's largest organ system." All four components are explicitly listed in the opening sentence.

2. Correct Answer: D (Vitamin D)

The passage states that the skin "synthesizes vitamin D when exposed to ultraviolet light." This is one of the skin's important regulatory functions mentioned.

3. Correct Answer: C (Keratin protein)

The passage states that "the epidermis, the outermost layer, contains primarily keratinocytes producing keratin protein that provides waterproofing and protection." Keratinocytes specifically produce keratin.

4. Correct Answer: B (Produce melanin that protects from UV radiation)

The passage states that the epidermis "also contains melanocytes producing melanin pigment that absorbs ultraviolet radiation, protecting deeper tissues from sun damage while determining skin color." Both melanin production and UV protection are mentioned.

5. Correct Answer: D (Connective tissue with collagen and elastin)

The passage states that "the dermis, beneath the epidermis, contains connective tissue providing strength and elasticity through collagen and elastin fibers." Both the tissue type and specific fiber proteins are named.

6. Correct Answer: A (Affect only the epidermis)

The passage states that "first-degree burns affect only the epidermis, causing redness and mild pain but typically healing without scarring within days." The epidermis is the only layer affected.

7. Correct Answer: C (Destroy full thickness of skin)

The passage states that "third-degree burns destroy the full thickness of skin including the epidermis and dermis, often extending into underlying tissues." Full thickness destruction is the defining characteristic.

8. Correct Answer: B (Estimates burn extent)

The passage states that "the 'rule of nines' estimates burn extent by dividing the body surface into regions representing roughly 9% each, helping determine treatment urgency and prognosis." It specifically estimates extent or surface area affected.

9. Correct Answer: D (Return fluid to bloodstream, transport lipids, and provide immune defense)

The passage states that the lymphatic system "plays crucial roles in fluid balance, immune function, and lipid absorption. This system returns excess interstitial fluid to the bloodstream, transports dietary lipids from the intestines, and provides immune surveillance and defense against pathogens." All three functions are listed.

10. Correct Answer: A (Muscle contractions, respiratory movements, and valves)

The passage states that "unlike the cardiovascular system with its central pump, the lymphatic system relies on muscle contractions, respiratory movements, and vessel valves to move lymph fluid through the network." All three mechanisms are specified.

11. Correct Answer: C (Blood plasma that leaks into tissues)

The passage states that "lymph fluid originates from blood plasma that leaks from capillaries into surrounding tissues, becoming interstitial fluid." This is the specific origin described.

12. Correct Answer: D (3 liters)

The passage states that "approximately 3 liters daily doesn't return directly to blood capillaries but instead enters lymphatic capillaries." This specific volume is mentioned.

13. Correct Answer: A (B lymphocytes, T lymphocytes, macrophages, and dendritic cells)

The passage states that "each node contains compartments with B lymphocytes and T lymphocytes, macrophages, and dendritic cells." All four cell types are listed.

14. Correct Answer: D (Active immune responses to infection or malignancy)

The passage states that "swollen lymph nodes indicate active immune responses to infection, inflammation, or malignancy." Active immune responses are the key indicator.

15. Correct Answer: B (Blood)

The passage states that "the spleen, the body's largest lymphoid organ, filters blood rather than lymph, removing old red blood cells, storing platelets, and mounting immune responses against blood-borne pathogens." Blood filtering is its distinguishing function.

16. Correct Answer: C (Damage to lymphatic vessels or nodes)

The passage states that "secondary lymphedema results from damage to lymphatic vessels or nodes through surgery, radiation, infection, or trauma." Damage is the cause of secondary lymphedema.

17. Correct Answer: D (Carbohydrates, proteins, and fats)

The passage states that "a balanced diet provides essential macronutrients—carbohydrates, proteins, and fats—along with micronutrients including vitamins and minerals." The three macronutrients are explicitly named.

18. Correct Answer: A (Glucose)

The passage states that "carbohydrates serve as the body's primary energy source, particularly for the brain which relies almost exclusively on glucose." Glucose is specifically named as what the brain requires.

19. Correct Answer: C (Contain all essential amino acids)

The passage states that "complete proteins containing all essential amino acids come from animal sources, while plant proteins often require combining different sources to obtain complete amino acid profiles." Having all essential amino acids defines complete proteins.

20. Correct Answer: B (Promote cardiovascular health)

The passage states that "unsaturated fats from fish, nuts, and olive oil promote cardiovascular health, while saturated fats and especially trans fats increase disease risk." Cardiovascular health promotion is the key benefit.

21. Correct Answer: A (Scurvy)

The passage states that "vitamin C supports immune function, collagen synthesis, and wound healing, with deficiency causing scurvy." Scurvy is the specific deficiency disease named.

22. Correct Answer: B (Calcium absorption and bone health)

The passage states that "vitamin D, synthesized in skin with sun exposure and obtained from fortified foods and fatty fish, is essential for calcium absorption and bone health." Both calcium absorption and bone health are mentioned.

23. Correct Answer: C (Carry oxygen in hemoglobin)

The passage states that "minerals including calcium, phosphorus, and magnesium build bones and teeth, while iron carries oxygen in hemoglobin." Carrying oxygen in hemoglobin is iron's specific function.

24. Correct Answer: A (Acids that demineralize enamel)

The passage states that "sugars and fermentable carbohydrates feed oral bacteria producing acids that demineralize tooth enamel, causing cavities." Acid production that demineralizes enamel is the mechanism described.

25. Correct Answer: D (Support, protection, movement, mineral storage, and blood cell production)

The passage states that "the skeletal system provides structural support, protects vital organs, enables movement through lever mechanisms, stores minerals, produces blood cells, and maintains mineral homeostasis." All five functions are listed.

26. Correct Answer: B (The osteon)

The passage states that "compact bone, forming the dense outer layer, provides strength and rigidity. Its structural unit, the osteon, consists of concentric layers of mineralized matrix surrounding a central canal." The osteon is explicitly named as the structural unit.

27. Correct Answer: A (Build new bone)

The passage states that "osteoblasts build new bone by secreting collagen and other proteins forming osteoid, which then mineralizes as calcium and phosphorus deposit." Building new bone is the primary function.

28. Correct Answer: D (Break down bone through resorption)

The passage states that "osteoclasts break down bone through resorption, releasing stored minerals into blood." Breaking down bone through resorption is the specific action.

29. Correct Answer: C (Bones adapt strength to mechanical loads)

The passage states that "this continuous remodeling serves multiple purposes: repairing microdamage from daily stress, adapting bone strength to mechanical loads (bones strengthen with exercise and weaken with disuse according to Wolff's Law)." Wolff's Law specifically describes adaptation to mechanical loads.

30. Correct Answer: B (Increases blood calcium)

The passage states that "parathyroid hormone increases blood calcium by stimulating osteoclast activity, while calcitonin decreases blood calcium by inhibiting osteoclasts." Increasing blood calcium is parathyroid hormone's function.

31. Correct Answer: D (Aging, hormones, low calcium/vitamin D, inadequate exercise, smoking)

The passage states that "risk factors include aging, hormones, low calcium and vitamin D intake, inadequate exercise, smoking, and certain medications." Multiple risk factors are listed together.

32. Correct Answer: A (Jaw osteonecrosis)

The passage states that "bisphosphonates treating osteoporosis can rarely cause jaw osteonecrosis requiring prophylactic care before invasive procedures." Jaw osteonecrosis is the specific rare complication mentioned.

33. Correct Answer: A (Sensory, emotional, and cognitive components)

The passage states that "pain represents a complex, subjective experience involving sensory, emotional, and cognitive components that signals actual or potential tissue damage." All three components are explicitly named.

34. Correct Answer: C (Specialized pain receptors)

The passage states that "pain perception involves specialized nerve receptors called nociceptors, neural pathways transmitting signals to the brain, and complex processing in multiple brain regions." Nociceptors are defined as specialized receptors.

35. Correct Answer: D (Arises from nervous system damage or dysfunction)

The passage states that "neuropathic pain arises from nervous system damage or dysfunction, producing burning, shooting, or electric sensations often accompanied by abnormal sensations." Nervous system damage or dysfunction is the origin.

36. Correct Answer: C (Three months)

The passage states that "acute pain has identifiable causes and expected resolution with healing, while chronic pain persists beyond normal healing (typically more than three months)." Three months is the specific timeframe mentioned.

37. Correct Answer: A (Inhibiting prostaglandin synthesis)

The passage states that "nonsteroidal anti-inflammatory drugs (NSAIDs) like ibuprofen and aspirin, which reduce pain, fever, and inflammation by inhibiting prostaglandin synthesis." Prostaglandin inhibition is the mechanism described.

38. Correct Answer: D (Binding to opioid receptors in brain and spinal cord)

The passage states that "opioids, including morphine, oxycodone, and codeine, provide powerful pain relief by binding to opioid receptors in the brain and spinal cord, reducing pain perception and emotional response to pain." Binding to receptors is the mechanism.

39. Correct Answer: B (Respiratory depression, tolerance, dependence, and addiction)

The passage states that "however, opioids carry significant risks including respiratory depression, constipation, tolerance, dependence, and addiction potential." Multiple risks are listed, with respiratory depression, tolerance, dependence, and addiction being key concerns.

40. Correct Answer: C (Physical therapy, TENS, acupuncture, and cognitive-behavioral therapy)

The passage states that "non-pharmacological approaches include physical therapy, heat and cold application, transcutaneous electrical nerve stimulation (TENS), acupuncture, cognitive-behavioral therapy, relaxation techniques, and mindfulness meditation." Multiple non-pharmacological approaches are listed.

Language Usage

1. Correct Answer: C (equipment, and it also expanded)

The original sentence is a comma splice (two independent clauses joined only by a comma). Option C corrects this by adding the coordinating conjunction "and" after the comma, which properly connects the two independent clauses.

2. Correct Answer: A (nor the nurses were ready)

With "neither...nor" constructions, the verb must agree with the subject closest to it. Since "nurses" (plural) is nearest to the verb, the verb must be "were" (plural), not "was" (singular). Option A correctly uses the plural verb form with "nor."

3. Correct Answer: D (when they could attend)

In indirect questions embedded within statements, normal word order (subject-verb) is used, not inverted question order (verb-subject). The original uses inverted order "when could they." Option D correctly uses "when they could attend."

4. Correct Answer: C (Between you and me, the new treatment protocol is)

After the preposition "between," pronouns must be in the objective case. "Between" requires "me" (objective case), not "I" (subjective case). Additionally, "protocol" (singular) requires the singular verb "is." Option C correctly uses both the objective case and singular verb.

5. Correct Answer: B (diagnostic testing, patient consultations, and therapeutic interventions)

The sentence requires parallel structure. The original uses two nouns and then a verb phrase ("will offer therapeutic interventions"), which is not parallel. Option B maintains parallel structure by using three nouns: "diagnostic testing, patient consultations, and therapeutic interventions."

6. Correct Answer: A (After analyzing the patient data, the team formulated)

Introductory dependent clauses should be followed by a comma to separate them from the main clause. The phrase "After analyzing the patient data" is an introductory adverbial clause that requires a comma before the independent clause.

7. Correct Answer: D (version, and they also improve)

The original sentence is a comma splice (two independent clauses joined only by a comma). Option D corrects this by adding the coordinating conjunction "and" after the comma, which properly connects the two independent clauses.

8. Correct Answer: C (must submit his or her annual certification)

"Everyone" is a singular indefinite pronoun and requires a singular pronoun reference. Standard formal grammar requires "his or her" to agree with the singular subject "everyone." Option C uses the correct singular forms.

9. Correct Answer: B (recommended that the technician submit the lab results)

After verbs like "recommended," "suggested," or "required," the subjunctive mood is used, requiring the base form of the verb without "s." The correct construction is "recommended that the technician submit" (not "submits").

10. Correct Answer: D (Reviewing the medical charts thoroughly, the specialist confirmed the diagnoses)

The original sentence contains a dangling modifier. "Reviewing the medical charts thoroughly" must modify a subject that can logically review—the specialist, not the diagnoses. Option D correctly places "the specialist" as the subject being modified.

11. Correct Answer: C (has completed his or her required continuing education)

The subject "each" is singular and requires a singular verb and pronoun. Option C correctly uses "has" (singular verb) and "his or her" (singular pronoun) to agree with "each."

12. Correct Answer: C (daily; however, it closes)

"However" is a conjunctive adverb connecting two independent clauses. When used this way, it requires a semicolon before it and a comma after it. Option C uses the correct punctuation.

13. Correct Answer: B (Fewer physicians attended)

"Less" is used with uncountable nouns, while "fewer" is used with countable nouns. "Physicians" is countable, so "fewer" is correct. Option B properly uses "fewer physicians."

14. Correct Answer: A (examined the patient, reviewed the imaging results, and prepared)

The original sentence lacks parallel structure. The first two verbs are in simple past tense ("examined," "reviewed"), but the third uses past progressive ("was preparing"). Option A maintains parallel structure by using three simple past tense verbs.

15. Correct Answer: D (Dr. Chen told Dr. Roberts that Dr. Chen needed)

The original sentence has an ambiguous pronoun. "She" could refer to either Dr. Chen or Dr. Roberts. Option D eliminates ambiguity by using the proper name "Dr. Chen" instead of the unclear pronoun.

16. Correct Answer: C (affects all departments and will take effect)

"Affect" is a verb meaning to influence. "Effect" as a noun means result; "take effect" is an idiom meaning to become operative. The sentence needs the verb "affect" to indicate that the policy change influences departments, followed by "take effect."

17. Correct Answer: B (essential. All staff must)

The original sentence is a comma splice (two independent clauses incorrectly joined by only a comma). Option B corrects this by using a period to create two separate sentences, providing the clearest separation.

18. Correct Answer: C (who graduated from the program)

"Which" is used for things; "who" is used for people. Since "the technician" is a person, the correct relative pronoun is "who," not "which." Option C makes this correction.

19. Correct Answer: B (Having conducted the research extensively, the scientists published the findings)

The original sentence contains a dangling modifier. The phrase "Having conducted the research extensively" must modify "the scientists" (who did the conducting), not "the findings." Option B correctly places "the scientists" immediately after the modifying phrase.

20. Correct Answer: B (should have contacted)

"Should of" is incorrect; the correct phrase is "should have." "Of" is a preposition and cannot function as a helping verb. Option B correctly uses "should have."

21. Correct Answer: A (assessments, interventions, or follow-up care)

The original sentence lacks parallel structure with a gerund phrase at the end. Option A maintains parallel structure by using three noun forms: "assessments, interventions, or follow-up care." All three are in parallel grammatical form.

22. Correct Answer: D (outcomes; it enhances)

The original sentence is a comma splice (two independent clauses joined only by a comma). Option D correctly uses a semicolon to connect two closely related independent clauses without a coordinating conjunction.

23. Correct Answer: C (the most effective method)

When comparing more than two items (five treatment options), use the superlative form ("most effective"), not the comparative form ("more effective"). Option C properly uses the superlative.

24. Correct Answer: B (Main Street near the downtown area of Boston, Massachusetts)

Street names should be capitalized ("Main Street," not "main street"). When a city and state are used together, a comma must separate them. Option B correctly capitalizes the street name and adds the necessary comma between city and state.

25. Correct Answer: D (After the treatment was administered, the patient experienced)

Introductory dependent clauses should be followed by a comma to separate them from the main clause. Option D correctly includes the necessary comma after the introductory clause.

26. Correct Answer: A (when he could schedule)

In indirect questions within reported speech, normal word order (subject-verb) is used, and the tense typically shifts back. "Asked" (past tense) in the main clause suggests shifting "can" to "could." Option A uses correct word order and appropriate tense.

27. Correct Answer: C (both agree that)

The compound subject "the doctor and his assistants" is plural (two entities), so the verb must be "agree" (plural), not "agrees" (singular). Option C correctly uses the plural verb form.

28. Correct Answer: B (are required)

The compound subject consists of three items ("training," "experience," and "education") connected by commas and "and," making it plural. Therefore, the verb must be "are" (plural), not "is" (singular). Option B correctly uses the plural verb.

29. Correct Answer: A (outcomes, and it also reduces)

The original sentence is a comma splice (two independent clauses joined only by a comma). Option A corrects this by adding the coordinating conjunction "and" after the comma, which properly connects the two independent clauses.

30. Correct Answer: C (care, such as cardiology, neurology, and oncology)

When "such as" introduces examples that are nonrestrictive (supplementary information), a comma is placed before "such as." Since the examples come at the end of the sentence, no closing comma is needed after the list. Option C correctly uses the comma before "such as."

31. Correct Answer: B (all play vital roles)

The compound subject "doctors, nurses, and therapists" is plural, so the verb must be "play" (plural), not "plays" (singular). Additionally, "roles" (plural) is correct since multiple people play multiple roles. Option B uses correct subject-verb agreement.

32. Correct Answer: A (to lie down for the examination)

"Lie" means to recline or rest in a horizontal position (intransitive verb). "Lay" means to place or put something down (transitive verb requiring an object). Since the patient is reclining, "lie" is correct. Option A correctly uses "lie down for the examination."

33. Correct Answer: D (dramatically allowing providers to deliver)

The participial phrase "allowing providers to deliver exceptional care" modifies the main clause. In this construction, no comma is needed before the participial phrase when it flows naturally from the main clause. Option D maintains this structure without unnecessary punctuation.

34. Correct Answer: B (disease. They promote)

The original sentence is a comma splice (two independent clauses joined only by a comma). Option B corrects this by using a period to create two separate sentences, providing clear separation between the complete thoughts.

35. Correct Answer: C (requires participants to complete clinical hours before certification)

The sentence is correct as written. "Program" (singular subject) takes "requires" (singular verb). The clause structure is correct, and no comma is needed before "before" because the dependent clause is restrictive (essential to meaning). Option C maintains the correct structure.

36. Correct Answer: B (services, such as emergency care and surgical procedures, but)

The phrase "such as emergency care and surgical procedures" is a nonrestrictive element providing examples, so it should be set off with commas on both sides. Option B correctly places commas before "such as" and after "procedures," with "but" properly positioned.

37. Correct Answer: D (more convenient for patients than the previous location)

The sentence correctly uses the comparative form "more convenient" when comparing two locations. The comparison is clear and grammatically complete as stated. Option D maintains the proper comparative structure without unnecessary additions.

38. Correct Answer: A (maintaining proper nutrition, exercising regularly, and getting adequate sleep)

The original sentence lacks parallel structure with an infinitive phrase at the end. Option A maintains parallel structure by using three gerunds: "maintaining, exercising, and getting." All three verb forms are consistent.

39. Correct Answer: D (had been worsening)

The past perfect tense "had been worsening" is correct because the condition began worsening in the past and continued up to another past point (seeking help). This sequence of past events requires past perfect to show the earlier, ongoing action.

40. Correct Answer: A (admissions, and it also improves)

The original sentence is a comma splice (two independent clauses joined only by a comma). Option A corrects this by adding the coordinating conjunction "and" after the comma, which properly connects the two independent clauses.

Quantitative Reasoning

1. Correct Answer: C (5)

To solve 9x - 16 = 29, first add 16 to both sides: 9x = 45. Then divide both sides by 9: x = 5. Verification: 9(5) - 16 = 45 - 16 = 29 ✓

2. Correct Answer: B (25%)

Percent increase formula: (New - Old)/Old × 100. Calculate: (225 - 180)/180 × 100 = 45/180 × 100 = 0.25 × 100 = 25%. Sample processing increased by 25%.

3. Correct Answer: D (9)

To solve 11y - 10 = 8y + 17, subtract 8y from both sides: 3y - 10 = 17. Add 10 to both sides: 3y = 27. Divide by 3: y = 9. Verification: 11(9) - 10 = 99 - 10 = 89, and 8(9) + 17 = 72 + 17 = 89 ✓

4. Correct Answer: A ($2,016)

Calculate weekly earnings: $48/hour × 7 hours/day × 6 days/week = $2,016 per week. Break it down: Daily earnings = $48 × 7 = $336; Weekly earnings = $336 × 6 = $2,016.

5. Correct Answer: C (133)

To find 28% of 475, multiply: 0.28 × 475 = 133. Alternatively, 28% is the same as 28/100, so (28/100) × 475 = 13,300/100 = 133.

6. Correct Answer: B (344)

Substitute a = 8 and b = -6 into $5a^2 - 4b$. Calculate: $5(8)^2 - 4(-6) = 5(64) - (-24) = 320 + 24 = 344$.

7. Correct Answer: A (81 mg)

Multiply the dosage rate by body weight: 0.9 mg/kg × 90 kg = 81 mg. The units of kilograms cancel out, leaving milligrams as the answer.

8. Correct Answer: D (8)

Expand the left side: $6(x + 9) = 6x + 54$. Set equal to right side: $6x + 54 = 4x + 70$. Subtract 4x from both sides: $2x + 54 = 70$. Subtract 54: $2x = 16$. Divide by 2: $x = 8$.

9. Correct Answer: C (1/3)

Total balls = 15 + 12 + 9 = 36 balls. Blue balls = 12. Probability of selecting blue = 12/36 = 1/3 (simplified by dividing numerator and denominator by 12).

10. Correct Answer: B (6,400 meters)

To convert kilometers to meters, multiply by 1,000 (since 1 km = 1,000 m): 6.4 km × 1,000 m/km = 6,400 meters. This is a standard metric conversion.

11. Correct Answer: D (430)

Substitute $x = 10$ into $5x^2 - 7x$: $5(10)^2 - 7(10) = 5(100) - 70 = 500 - 70 = 430$. Follow the order of operations: exponents first, then multiplication, then subtraction.

12. Correct Answer: A (25%)

Percent decrease = (Old - New)/Old × 100 = (4,800 - 3,600)/4,800 × 100 = 1,200/4,800 × 100 = 0.25 × 100 = 25%. The supplies decreased by 25%.

13. Correct Answer: C (30x - 98)

Distribute: $8(5x - 6) - 10(x + 5) = 40x - 48 - 10x - 50$. Combine like terms: $(40x - 10x) + (-48 - 50) = 30x - 98$. Remember to distribute the negative sign in $-10(x + 5)$.

14. Correct Answer: B (4)

If the ratio is 1:55 and there are 220 patients, find the number of nurses: 220 ÷ 55 = 4 nurses. This maintains the 1:55 ratio (4:220 = 1:55).

15. Correct Answer: A (70)

Solve $x/10 + 8 = 15$. First subtract 8 from both sides: $x/10 = 7$. Then multiply both sides by 10: $x = 70$. Verification: $70/10 + 8 = 7 + 8 = 15$ ✓

16. Correct Answer: D (4.4°F)

The increase is found by subtracting the original value from the new value: 102.8 - 98.4 = 4.4°F. This represents the amount of temperature increase.

17. Correct Answer: B (9)

Substitute x = 12 into 10x - 7y = 57: 10(12) - 7y = 57, which gives 120 - 7y = 57. Subtract 120 from both sides: -7y = -63. Divide by -7: y = 9.

18. Correct Answer: C ($455)

Calculate the 35% discount amount: 0.35 × $700 = $245. Subtract the discount from the original price: $700 - $245 = $455. The discounted price is $455.

19. Correct Answer: D (11)

Solve 13x - 12 = 10x + 21. Subtract 10x from both sides: 3x - 12 = 21. Add 12 to both sides: 3x = 33. Divide by 3: x = 11.

20. Correct Answer: A (36)

To find the mean, add all values and divide by the count: (24 + 30 + 36 + 42 + 48)/5 = 180/5 = 36. The mean is the arithmetic average of the data set.

21. Correct Answer: B (396 mL)

Calculate 44% of 900 mL: 0.44 × 900 = 396 mL. Alternatively, 44% is the same as 44/100, and 900 × 44/100 = 39,600/100 = 396 mL.

22. Correct Answer: D (17 and -17)

When $x^2 = 289$, take the square root of both sides. Remember that square roots have both positive and negative solutions: x = +17 or x = -17. Both values satisfy the equation: $(17)^2 = 289$ and $(-17)^2 = 289$.

23. Correct Answer: A (440)

Multiply: 22 patients/day × 5 days/week × 4 weeks = 440 patients total. Calculate step by step: 22 × 5 = 110 patients per week, then 110 × 4 = 440 patients in 4 weeks.

24. Correct Answer: D ($54x^{13}$)

When multiplying powers with the same base, multiply the coefficients and add the exponents: $(9x^8)(6x^5) = (9 \times 6)(x^{8+5}) = 54x^{13}$. Coefficient: 9 × 6 = 54. Exponent: 8 + 5 = 13.

25. Correct Answer: C (52%)

Convert the fraction to a decimal first: 13/25 = 0.52. Then multiply by 100 to get the percentage: 0.52 × 100 = 52%. Alternatively, 13/25 = 52/100 = 52%.

26. Correct Answer: A (20)

Calculate total hours in 5 days: 5 days × 24 hours/day = 120 hours. Divide by the dosing interval: 120 hours ÷ 6 hours/dose = 20 doses. The patient takes medication 4 times per day for 5 days.

27. Correct Answer: B (31 cm)

Perimeter formula for rectangle: P = 2L + 2W. Substitute known values: 110 = 2L + 2(24), which gives 110 = 2L + 48. Subtract 48: 62 = 2L. Divide by 2: L = 31 cm.

28. Correct Answer: D (8)

Solve 12x - 22 = 11x - 14. Subtract 11x from both sides: x - 22 = -14. Add 22 to both sides: x = 8. Verification: 12(8) - 22 = 96 - 22 = 74 and 11(8) - 14 = 88 - 14 = 74 ✓

29. Correct Answer: C ($1,274.40)

Calculate 8% tax on $1,180: 0.08 × $1,180 = $94.40. Add tax to original cost: $1,180 + $94.40 = $1,274.40. The total cost including sales tax is $1,274.40.

30. Correct Answer: B (30)

The median is the middle value when data is arranged in order. The data set 18, 24, 30, 36, 42 is already ordered. With 5 values, the middle (3rd) value is 30.

31. Correct Answer: A (20)

First solve for x: 9x - 16 = 29. Add 16 to both sides: 9x = 45. Divide by 9: x = 5. Then calculate 4x: 4(5) = 20.

32. Correct Answer: C (3,800 mL)

Convert liters to milliliters by multiplying by 1,000 (since 1 L = 1,000 mL): 3.8 L × 1,000 mL/L = 3,800 mL. This is a standard metric conversion.

33. Correct Answer: D (94)

Calculate step by step: $(-8)^2 - 6(-5)$. First, $(-8)^2 = 64$ (squaring a negative gives a positive). Second, -6(-5) = +30 (multiplying two negatives gives a positive). Finally, 64 + 30 = 94.

34. Correct Answer: A (21)

Calculate 35% of 60: 0.35 × 60 = 21 hygienists. Alternatively, 35% is the same as 35/100, and 60 × 35/100 = 2,100/100 = 21 hygienists work at the practice.

35. Correct Answer: D (120)

Solve x/15 = 8 by multiplying both sides by 15: x = 8 × 15 = 120. Verification: 120/15 = 8 ✓

36. Correct Answer: B (7/8)

Convert 0.875 to a fraction: 0.875 = 875/1000. Simplify by dividing both numerator and denominator by 125: 875/1000 = 7/8. This fraction is in simplest form since 7 and 8 share no common factors.

37. Correct Answer: A (26)

Use the elimination method. Add the two equations: (x + y) + (x - y) = 36 + 16, which gives 2x = 52. Divide by 2: x = 26. The y terms cancel when adding the equations.

38. Correct Answer: C (107.6°F)

Substitute C = 42 into F = (9/5)C + 32: F = (9/5)(42) + 32 = 1.8(42) + 32 = 75.6 + 32 = 107.6°F. This represents a high fever temperature.

39. Correct Answer: D (24)

The range is the difference between the maximum and minimum values: 48 - 24 = 24. Range measures the spread of the data from lowest to highest value.

40. Correct Answer: B (2:3)

Write the ratio: 160:240. Simplify by dividing both numbers by their GCF (80): 160/80 = 2 and 240/80 = 3. The simplest form of the ratio is 2:3.

Perceptual Ability

ANGLE DISCRIMINATION (Questions 1-15)

1. Correct Answer: B (Angle 2)

The angles measure: Angle 1 = 62°, Angle 2 = 124°, Angle 3 = 86°, Angle 4 = 145°. Ordering from largest to smallest: 145°, 124°, 86°, 62°. The second largest angle is Angle 2 at 124°.

2. Correct Answer: C (Angle C)

The three angles measure: Angle A = 43°, Angle B = 134°, Angle C = 100°. Obtuse angles measure between 90° and 180°. Among the obtuse angles, Angle C at 100° is closest to 100° (exactly 100°). Angle B is obtuse but further from 100°.

3. Correct Answer: A (34°)

The five angles measure 34°, 101°, 65°, 153°, and 92°. Comparing all measurements, 34° is the smallest angle shown.

4. Correct Answer: D (141°)

The four angles measure 49°, 114°, 77°, and 141°. Comparing all measurements, 141° is the largest angle shown.

5. Correct Answer: B (52°, 86°, 132°)

The three angles measure 86°, 132°, and 52°. Arranging from smallest to largest: 52°, 86°, 132°. This represents the correct ascending order.

6. Correct Answer: A (80°)

Acute angles measure less than 90°. From the five angles (41°, 109°, 80°, 157°, 66°), the acute angles are 41°, 80°, and 66°. Angle 80° is acute and is exactly at 80°, making it the closest to 80° (distance of 0°).

7. Correct Answer: C (105°)

The four angles measure 27°, 105°, 58°, and 172°. Ordering from largest to smallest: 172°, 105°, 58°, 27°. The third largest angle is 105°.

8. Correct Answer: D (164°)

The three angles measure 43°, 99°, and 164°. Comparing all three, 164° is the largest angle shown.

9. Correct Answer: B (76°)

The five angles measure 50°, 113°, 76°, 146°, and 59°. Ordering from smallest to largest: 50°, 59°, 76°, 113°, 146°. The third smallest angle is 76°.

10. Correct Answer: C (74°)

The four angles measure 74°, 137°, 39°, and 100°. Ordering from smallest to largest: 39°, 74°, 100°, 137°. The second smallest angle is 74°.

11. Correct Answer: A (48°)

The three acute angles measure 48°, 81°, and 69°. Comparing all three, 48° is the smallest angle.

12. Correct Answer: D (175°)

The five angles measure 124°, 95°, 60°, 175°, and 83°. Comparing all measurements, 175° is the largest angle shown.

13. Correct Answer: B (82°)

The four angles measure 31°, 110°, 82°, and 151°. Ordering from smallest to largest: 31°, 82°, 110°, 151°. The second smallest angle is 82°.

14. Correct Answer: A (94°)

Obtuse angles measure between 90° and 180°. From the three angles (127°, 54°, 94°), the obtuse angles are 127° and 94°. Among the obtuse angles, 94° is the smallest.

15. Correct Answer: C (46°, 72°)

The five angles measure 46°, 115°, 72°, 159°, and 90°. Ordering all angles from smallest to largest: 46°, 72°, 90°, 115°, 159°. The two smallest angles in order are 46°, 72°.

APERTURES (Questions 16-30)

16. Correct Answer: A (A rectangle 14 cm × 16 cm)

A rectangular prism measuring 10 cm × 14 cm × 16 cm has three possible face orientations. The largest face measures 14 cm × 16 cm. This rectangular aperture would accommodate the largest face when properly oriented.

17. Correct Answer: D (A circle with at least 14 cm diameter)

When a cylinder with diameter 14 cm is oriented with its circular end forward, the cross-section presented is circular with 14 cm diameter. The aperture must be a circle with at least 14 cm diameter to allow passage.

18. Correct Answer: B (A square 14 cm × 14 cm or larger)

A pyramid with a square base measuring 14 cm × 14 cm requires a square aperture of at least 14 cm × 14 cm to accommodate the base when oriented base-first.

19. Correct Answer: A (13 cm × 13 cm)

A cube measuring 13 cm on each side, when oriented face-first, presents a square cross-section of 13 cm × 13 cm. This is the exact size needed for the smallest square aperture through which it can pass.

20. Correct Answer: C (An equilateral triangle 12 cm sides)

A triangular prism with an equilateral triangular base measuring 12 cm on each side, when entering triangle-first, requires an aperture matching that triangular shape with 12 cm sides.

21. Correct Answer: D (A rectangle 12 cm × 15 cm or larger)

An L-shaped object with overall dimensions of 12 cm wide and 15 cm tall requires a rectangular aperture of at least 12 cm × 15 cm to accommodate the entire object's profile when passing through.

22. Correct Answer: B (A circle with at least 17 cm diameter)

A sphere with a 17 cm diameter requires a circular aperture of at least 17 cm diameter to pass through, regardless of orientation, since a sphere presents the same circular profile from any angle.

23. Correct Answer: C (A rectangle 12 cm × 14 cm)

A rectangular block measuring 12 cm × 14 cm × 10 cm, when oriented with the 12 cm × 14 cm face forward, requires a rectangular aperture of at least 12 cm × 14 cm to pass through.

24. Correct Answer: D (A hexagon approximately 12 cm across)

A hexagonal prism with a 12 cm wide hexagonal base, when entering hexagon-first, requires an aperture that matches the hexagonal shape, approximately 12 cm across at its widest point.

25. Correct Answer: A (A rectangle 16 cm × 18 cm)

A T-shaped object with overall dimensions of 16 cm wide and 18 cm tall requires a rectangular aperture of at least 16 cm × 18 cm to accommodate the entire T profile when passing through face-first.

26. Correct Answer: C (An ellipse or rectangle 13 cm × 16 cm)

An ellipsoid measuring 13 cm × 16 cm × 11 cm, when oriented with the 13 cm × 16 cm face forward, requires an elliptical or rectangular aperture of approximately 13 cm × 16 cm.

27. Correct Answer: B (A square 14 cm × 14 cm or larger)

A cross-shaped object with arms extending 14 cm in each direction requires a square aperture of at least 14 cm × 14 cm to accommodate the full width and height of the cross profile when entering face-first.

28. Correct Answer: B (A circle with at least 16 cm diameter)

A cone with a base diameter of 16 cm, when oriented base-first, presents a circular cross-section of 16 cm diameter. The aperture must be a circle with at least 16 cm diameter.

29. Correct Answer: C (A rounded rectangle approximately 12 cm × 14 cm)

A rectangular block measuring 12 cm × 14 cm × 18 cm with 2 cm radius curves on the ends requires a rounded rectangular aperture of approximately 12 cm × 14 cm to accommodate the curved end profile.

30. Correct Answer: D (A rectangle 13 cm × 11 cm)

An irregular object with maximum dimensions of 13 cm × 15 cm × 11 cm, when oriented with its smallest face (13 cm × 11 cm) forward, requires a rectangular aperture of at least 13 cm × 11 cm.

ORTHOGRAPHIC PROJECTIONS (Questions 31-45)

31. Correct Answer: D (A rectangular prism oriented with square ends)

A square top view, rectangular front view, and square end view indicates a rectangular prism (box) oriented with square ends. The square cross-section is visible from the top and end, while the length is shown in the rectangular front view.

32. Correct Answer: A (A triangular prism)

Triangular top and end views combined with a rectangular front view indicates a triangular prism—an object with a uniform triangular cross-section throughout its length.

33. Correct Answer: C (Front view only)

In a stepped object with seven distinct levels, the front view (elevation) shows all seven levels as steps or tiers most clearly, displaying the height differences between the seven levels in a side profile.

34. Correct Answer: B (A nonagonal prism)

Nonagonal (9-sided) top and end views combined with a rectangular front view indicates a nonagonal prism—an object with a uniform nine-sided cross-section throughout its length.

35. Correct Answer: A (Three cylinders arranged in a row)

A rectangular top view, three circles in the front view, and rectangular end view suggests three cylindrical objects arranged in a row horizontally.

36. Correct Answer: D (Four rectangular prisms with dividing features)

A rectangle with three lines in both the top and end views, combined with four rectangles in the front view, suggests four rectangular prisms with dividing features or separations between them.

37. Correct Answer: C (A U-shaped prism)

U-shaped top and end views combined with a rectangular front view indicates a three-dimensional object with a uniform U-shaped cross-section throughout its length—a U-shaped prism.

38. Correct Answer: A (Two hexagonal sections with a dividing feature)

A hexagon with a line in both the top and end views, combined with two trapezoids in the front view, suggests two hexagonal sections with a dividing feature or separation between them.

39. Correct Answer: B (An E-shaped prism)

E-shaped top and end views combined with a rectangular front view indicates a three-dimensional object with a uniform E-shaped cross-section throughout its length—an E-shaped prism.

40. Correct Answer: D (Eight cubes in a row)

Eight squares in a row in the top view, a long rectangle in the front view, and a square in the end view suggests eight cube-like units arranged in a linear row.

41. Correct Answer: A (A dodecagonal prism)

Dodecagonal (12-sided) top and end views combined with a rectangular front view indicates a dodecagonal prism—an object with a uniform twelve-sided cross-section throughout its length.

42. Correct Answer: C (Three elliptical sections with dividing features)

An oval with a line in both the top and end views, combined with three rectangles in the front view, suggests three elliptical sections with dividing features or separations.

43. Correct Answer: B (A septagonal prism)

Septagonal (7-sided) top and end views combined with a rectangular front view indicates a septagonal prism—an object with a uniform seven-sided cross-section throughout its length.

44. Correct Answer: D (Six cylinders arranged in hexagon pattern)

Six circles in hexagon pattern in the top view, six rectangles in the front view, and a circle in the end view suggests six cylindrical objects arranged in a hexagonal pattern.

45. Correct Answer: C (A Z-shaped prism)

Z-shaped top and end views combined with a rectangular front view indicates a three-dimensional object with a uniform Z-shaped cross-section throughout its length—a Z-shaped prism.

CUBE COUNTING (Questions 46-60)

46. Correct Answer: A (175)

A structure with 7 layers arranged 5 × 5 × 7 contains: 5 cubes wide × 5 cubes deep × 7 cubes high = 175 total cubes. Multiply the three dimensions to find the total count.

47. Correct Answer: D (296)

In an 8 × 8 × 8 cube structure containing 512 total cubes, only the interior cubes (6 × 6 × 6 = 216 cubes) have no faces exposed. Therefore, cubes on the surface with at least one face exposed = 512 - 216 = 296 cubes.

48. Correct Answer: B (315)

A 5 × 7 × 9 structure contains: 5 cubes × 7 cubes × 9 cubes = 315 total cubes. Multiply the three dimensions to find the total count.

49. Correct Answer: C (8)

In an 11 × 11 × 11 cube, cubes with exactly three painted faces are corner cubes. Any rectangular prism has exactly 8 corners (vertices), so there are 8 corner cubes with three painted faces.

50. Correct Answer: A (90)

With 10 layers and 9 cubes per layer arranged 3 × 3: Total cubes = 10 layers × 9 cubes per layer = 90 cubes. Alternatively, 3 × 3 × 10 = 90 cubes.

51. Correct Answer: A (8)

Any rectangular prism has exactly 8 corners (vertices). In a 5 × 8 × 9 structure, there are 8 corner cubes where three edges meet.

52. Correct Answer: B (990)

A structure 11 cubes high × 10 cubes wide × 9 cubes deep contains: 11 × 10 × 9 = 990 total cubes. Multiply the three dimensions to find the total count.

53. Correct Answer: D (24)

An L-shaped structure with 13 cubes on one arm and 12 on the other, sharing 1 corner cube: Total = 13 + 12 - 1 = 24 cubes. Subtract the shared corner cube to avoid counting it twice.

54. Correct Answer: A (40)

In an 11 × 11 × 1 flat structure, cubes with exactly two painted faces are the perimeter cubes excluding corners. Perimeter cubes = 11 + 11 + 11 + 11 - 4 corners = 44 - 4 = 40 cubes with two painted faces.

55. Correct Answer: C (30)

A staircase structure with 8 cubes on first step, 10 on second, and 12 on third contains: 8 + 10 + 12 = 30 total cubes. This is the sum of the arithmetic sequence.

56. Correct Answer: D (8)

Any rectangular prism has exactly 8 corners (vertices). In a 10 × 11 × 12 structure, there are 8 corner cubes where three faces meet at each corner position.

57. Correct Answer: B (11)

In a 13 × 1 × 1 structure (13 cubes in a row), the 2 end cubes have 5 faces painted, and the 11 middle cubes have exactly 4 faces painted (top, bottom, front, back—not the two sides touching adjacent cubes).

58. Correct Answer: A (221)

Bottom layer: 10 × 10 = 100 cubes. Next layer: 8 × 8 = 64 cubes. Next layer: 6 × 6 = 36 cubes. Next layer: 4 × 4 = 16 cubes. Next layer: 2 × 2 = 4 cubes. Top layer: 1 cube. Total = 100 + 64 + 36 + 16 + 4 + 1 = 221 cubes in this pyramid structure.

59. Correct Answer: C (994)

A 10 × 10 × 10 cube contains 1,000 total cubes. With six corner cubes removed: 1,000 - 6 = 994 cubes remain.

60. Correct Answer: D (21)

A plus-shaped structure with 11 cubes for vertical arm and 11 cubes for horizontal arm, sharing 1 center cube: Total = 11 + 11 - 1 = 21 cubes. The center cube where the arms intersect is counted only once.

Biology

1. Correct Answer: A (ATP production through cellular respiration)

The primary function of the mitochondrion is ATP production through cellular respiration. Mitochondria are often called the "powerhouse of the cell" because they generate most of the cell's supply of adenosine triphosphate (ATP), which is used as a source of chemical energy. This occurs through the process of cellular respiration, where glucose and oxygen are converted to ATP, carbon dioxide, and water.

2. Correct Answer: D (Golgi apparatus)

The Golgi apparatus is the organelle that packages and modifies proteins. After proteins are synthesized by ribosomes, they are sent to the Golgi apparatus where they undergo modifications such as adding carbohydrate groups (glycosylation) or other chemical modifications. The Golgi then sorts and packages these proteins into vesicles for transport to their final destinations.

3. Correct Answer: C (Anaphase)

During anaphase of mitosis, sister chromatids separate and move to opposite poles of the cell. The spindle fibers shorten, pulling the sister chromatids apart toward opposite ends of the cell. This ensures each daughter cell will receive an identical set of chromosomes.

4. Correct Answer: B (Osmosis)

Osmosis is the process by which water moves across a selectively permeable membrane. It is the passive diffusion of water molecules from an area of high water concentration (low solute concentration) to an area of low water concentration (high solute concentration) through a semipermeable membrane, moving down the concentration gradient without requiring energy.

5. Correct Answer: A (Carries genetic instructions from DNA to ribosomes)

The function of messenger RNA (mRNA) is to carry genetic instructions from DNA in the nucleus to ribosomes in the cytoplasm. During transcription, DNA is copied into mRNA, which then serves as the template for protein synthesis during translation at the ribosomes, specifying the sequence of amino acids in the protein.

6. Correct Answer: D (46)

Human somatic cells (body cells) contain 46 chromosomes, which is the diploid number ($2n = 46$). These consist of 23 pairs of chromosomes—22 pairs of autosomes and 1 pair of sex chromosomes. This is different from gametes (sex cells) which contain 23 chromosomes, the haploid number.

7. Correct Answer: C (Guanine)

In DNA structure, the base pairing rules are specific: cytosine (C) pairs with guanine (G), and adenine (A) pairs with thymine (T). These complementary base pairs are held together by hydrogen bonds—three bonds between C and G, and two bonds between A and T.

8. Correct Answer: B (Codominance)

Codominance is the inheritance pattern where both alleles are fully expressed in heterozygotes. Neither allele is dominant over the other, so both phenotypes appear simultaneously without blending. An example is the AB blood type, where both A and B alleles are expressed, resulting in both A and B antigens on red blood cells.

9. Correct Answer: D (Prophase I)

Crossing over (genetic recombination) occurs during prophase I of meiosis. During this phase, homologous chromosomes pair up in a process called synapsis and exchange genetic material at points called chiasmata. This creates genetic variation in gametes by producing new combinations of alleles on chromosomes.

10. Correct Answer: A (Platelets)

Platelets (thrombocytes) are the blood component responsible for clotting. When a blood vessel is damaged, platelets adhere to the injury site, aggregate together, and release chemicals that trigger the coagulation cascade, forming a clot to stop bleeding and begin the healing process.

11. Correct Answer: C (Water absorption and waste formation)

The primary function of the large intestine is water absorption and waste formation. It absorbs water and electrolytes from the remaining indigestible food matter, consolidating it into feces. The large intestine also houses beneficial bacteria and stores waste until elimination.

12. Correct Answer: B (Epithelial tissue)

Epithelial tissue is the tissue type that lines body surfaces and cavities. It covers the outside of the body (skin), lines internal organs and body cavities, and forms glands. Epithelial tissue provides protection, secretion, absorption, and filtration functions.

13. Correct Answer: A (25%)

In a cross between two heterozygous parents (Aa × Aa), the Punnett square produces: AA (25%), Aa (50%), and aa (25%). The homozygous recessive genotype (aa) appears in 25% or 1/4 of offspring.

14. Correct Answer: D (Meiosis)

Meiosis is the cell division process that produces four haploid cells (gametes). It involves two successive divisions (meiosis I and II) and reduces the chromosome number from diploid (2n) to haploid (n), producing four genetically different haploid cells used in sexual reproduction.

15. Correct Answer: C (Forms ribosome structure)

The primary function of ribosomal RNA (rRNA) is to form the structure of ribosomes. Along with ribosomal proteins, rRNA makes up the ribosome's structural framework and also has catalytic functions in forming peptide bonds during protein synthesis. It is both a structural and functional component essential for translation.

16. Correct Answer: B (Red blood cells)

Red blood cells (erythrocytes) are the blood component that carries oxygen throughout the body. They contain hemoglobin, an iron-containing protein that binds to oxygen in the lungs and releases it to tissues. Red blood cells also help transport some carbon dioxide back to the lungs.

17. Correct Answer: D (Smooth muscle)

Smooth muscle is the type of muscle tissue that contracts involuntarily and is found in the walls of hollow organs. It lines the digestive tract, blood vessels, bladder, uterus, and other internal organs. Smooth muscle contracts slowly and rhythmically without conscious control to move substances through organs or regulate vessel diameter.

18. Correct Answer: A (Protein)

The end product of translation is a protein. During translation, ribosomes read the mRNA sequence and assemble amino acids in the specified order to create a polypeptide chain (protein). The ribosome catalyzes peptide bond formation between amino acids, producing the final protein product.

19. Correct Answer: B (Lysosome)

Lysosomes are membrane-bound organelles that contain digestive enzymes. These enzymes break down worn-out cell parts, damaged organelles, macromolecules, and foreign materials that enter the cell. Lysosomes function as the cell's recycling center and waste disposal system through enzymatic digestion.

20. Correct Answer: C (Build new bone tissue)

Osteoblasts are bone cells responsible for building new bone tissue. They synthesize and secrete the organic components of bone matrix (primarily collagen) and regulate mineralization, depositing calcium and phosphorus to create new bone. This contrasts with osteoclasts, which break down bone tissue.

21. Correct Answer: D (Eukaryotic)

Eukaryotic cells are the type of cells that contain a membrane-bound nucleus. Eukaryotic cells have their DNA enclosed within a nuclear envelope, along with other membrane-bound organelles like mitochondria, endoplasmic reticulum, and Golgi apparatus. This distinguishes them from prokaryotic cells which lack these membrane-bound structures.

22. Correct Answer: D (ATP, carbon dioxide, and water)

The products of cellular respiration are ATP (adenosine triphosphate), carbon dioxide, and water. During cellular respiration, glucose is broken down in the presence of oxygen to produce energy (ATP), with carbon dioxide and water as waste products. The equation is: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + ATP$.

23. Correct Answer: B (Endocrine system)

The endocrine system is the system that secretes hormones. It consists of glands (such as the pituitary, thyroid, adrenal glands, and pancreas) that secrete hormones directly into the bloodstream to regulate processes like metabolism, growth, reproduction, and stress responses.

24. Correct Answer: C (CGAU)

If DNA sequence is GCTA, the complementary mRNA sequence is CGAU. During transcription, DNA is read and complementary mRNA is formed using base pairing rules: DNA guanine pairs with RNA cytosine (C), DNA cytosine pairs with RNA guanine (G), DNA thymine pairs with RNA adenine (A), and DNA adenine pairs with RNA uracil (U).

25. Correct Answer: A (Arteries)

Arteries are blood vessels that carry blood away from the heart to the body's tissues. Most arteries carry oxygenated blood (except pulmonary arteries which carry deoxygenated blood to the lungs). Arteries have thick, muscular walls that can withstand and regulate high blood pressure.

26. Correct Answer: D (Protein synthesis)

The function of the rough endoplasmic reticulum (rough ER) is protein synthesis. The rough ER has ribosomes attached to its surface, which synthesize proteins that are either secreted from the cell, incorporated into the cell membrane, or sent to other organelles. The ribosomes give the rough ER its "rough" appearance.

27. Correct Answer: B (Phenotype)

Phenotype describes an organism's observable characteristics—the physical expression of genes. It results from the interaction of the genotype (genetic makeup) with the environment and includes physical appearance, biochemical properties, physiological traits, and behavior—any characteristic that can be observed or measured.

28. Correct Answer: A (S phase)

DNA replication occurs during the S phase (synthesis phase) of interphase in the cell cycle. During this phase, the cell duplicates its entire genome so that each daughter cell will receive a complete copy of the genetic material during cell division. The S phase occurs between the G1 and G2 phases of interphase.

29. Correct Answer: B (Brain and spinal cord)

The two main components of the central nervous system (CNS) are the brain and spinal cord. The CNS serves as the control center for the nervous system, processing and integrating information from the peripheral nervous system and coordinating body responses.

30. Correct Answer: C (Lack of membrane-bound organelles)

Prokaryotic cells are distinguished from eukaryotic cells by their lack of membrane-bound organelles. Their DNA is located in a nucleoid region rather than enclosed in a nuclear envelope, and they lack organelles like mitochondria, endoplasmic reticulum, Golgi apparatus, and lysosomes that are present in eukaryotic cells.

General Chemistry

1. Correct Answer: B (Number of protons (atomic number))

The atomic number, which equals the number of protons in the nucleus, determines an element's identity. Every atom with the same atomic number is the same element, regardless of the number of neutrons or electrons. For example, all atoms with 6 protons are carbon atoms, and all atoms with 8 protons are oxygen atoms.

2. Correct Answer: C (Neutron)

Neutrons are subatomic particles that are electrically neutral—they have no charge. They are located in the nucleus along with protons and contribute to the atom's mass. Protons have positive charge (+1), while electrons have negative charge (-1).

3. Correct Answer: D (Ionic bond)

An ionic bond forms when electrons are transferred from one atom to another. Typically, a metal atom loses electrons to become a positively charged cation, and a nonmetal atom gains those electrons to become a negatively charged anion. The electrostatic attraction between oppositely charged ions creates the ionic bond.

4. Correct Answer: A (8)

The second energy level (shell) can hold a maximum of 8 electrons, calculated using the formula $2n^2$ where n is the shell number. For the second shell: $2(2)^2 = 2(4) = 8$ electrons maximum. The first shell holds 2, the third holds 18, etc.

5. Correct Answer: C (Salt and water)

In a neutralization reaction between an acid and base, salt and water are produced. For example: $HCl + NaOH \rightarrow NaCl + H_2O$. The H^+ from the acid combines with the OH^- from the base to form water, while the remaining ions form a salt.

6. Correct Answer: B (28 g/mol)

The molar mass of carbon monoxide (CO) is calculated by adding the atomic masses: 1 carbon atom (12 g/mol) + 1 oxygen atom (16 g/mol) = 28 g/mol total.

7. Correct Answer: A (4)

The pH scale ranges from 0 to 14, with pH 7 being neutral. Acidic solutions have pH values less than 7. Among the options, pH 4 indicates an acidic solution. pH 7 is neutral, while pH 10 and 14 are basic.

8. Correct Answer: D (2)

In the balanced equation $N_2 + O_2 \rightarrow 2NO$, the coefficient of NO is 2. This coefficient indicates that 2 molecules of nitrogen monoxide are produced when 1 molecule of nitrogen gas reacts with 1 molecule of oxygen gas.

9. Correct Answer: B (Isotopes)

Atoms of the same element that have the same number of protons (same atomic number) but different numbers of neutrons are called isotopes. They have different mass numbers but identical chemical properties. For example, carbon-12 and carbon-14 are isotopes with 6 protons but 6 and 8 neutrons respectively.

10. Correct Answer: C (Decreases)

According to Boyle's Law, at constant temperature, pressure and volume are inversely proportional ($P_1V_1 = P_2V_2$). When pressure increases, volume decreases proportionally. This explains why compressing a gas increases its pressure while decreasing its volume.

11. Correct Answer: A (Covalent bond)

A covalent bond involves the sharing of electrons between atoms. This type of bonding typically occurs between nonmetal atoms, where each atom contributes electrons to form shared pairs that hold the atoms together, allowing both to achieve more stable electron configurations.

12. Correct Answer: D (3 moles)

To calculate moles, divide mass by molar mass: moles = 96 g ÷ 32 g/mol = 3 moles. This shows that 96 grams of oxygen gas (O_2) contains 3 moles of O_2 molecules.

13. Correct Answer: C (Moles)

The mole is the SI unit for measuring amount of substance in chemistry. One mole contains Avogadro's number (6.022×10^{23}) of particles, whether atoms, molecules, or formula units. This unit connects the microscopic scale to the macroscopic scale in chemistry.

14. Correct Answer: B (Turn red litmus blue)

Bases have characteristic properties including turning red litmus paper blue. They also feel slippery, taste bitter, and have pH values greater than 7. Acids, in contrast, taste sour, turn blue litmus paper red, and have pH less than 7.

15. Correct Answer: A (Solid)

Solids have fixed positions for their particles because the particles are held in place by strong intermolecular forces and can only vibrate in place. Liquids have particles that can move past each other, and gases have particles that move freely with large spaces between them.

16. Correct Answer: D (Electrons are transferred forming charged ions)

During ionic bonding, electrons are transferred completely from one atom to another, forming charged ions. One atom (typically a metal) loses electrons to become a positively charged cation, and another atom (typically a nonmetal) gains those electrons to become a negatively charged anion. The electrostatic attraction between oppositely charged ions creates the ionic bond.

17. Correct Answer: C (4)

The formula $2Ca(OH)_2$ represents 2 formula units of calcium hydroxide. Each $Ca(OH)_2$ contains 2 OH groups, and each OH group contains 1 oxygen atom. Therefore: 2 formula units × 2 OH groups per unit × 1 oxygen per OH = 4 oxygen atoms total.

18. Correct Answer: B (7)

A neutral solution at 25°C has a pH of exactly 7. At this pH, the concentration of hydrogen ions (H^+) equals the concentration of hydroxide ions (OH^-), resulting in neither acidic nor basic properties.

19. Correct Answer: D (Group 17)

The halogens are located in Group 17 of the periodic table and include fluorine, chlorine, bromine, iodine, and astatine. These highly reactive nonmetals have 7 valence electrons and readily form -1 ions by gaining one electron.

20. Correct Answer: A (Decomposition)

The reaction $2H_2O \rightarrow 2H_2 + O_2$ represents a decomposition reaction, where a single compound breaks down into two or more simpler substances. This is the opposite of a synthesis reaction ($A + B \rightarrow AB$). Water decomposes into hydrogen and oxygen.

21. Correct Answer: C (1000 times)

The pH scale is logarithmic with base 10. Each unit represents a 10-fold difference in hydrogen ion concentration. A difference of 3 pH units represents $10^3 = 1000$-fold difference. A solution with pH 3 has 1000 times more H^+ ions than a solution with pH 6.

22. Correct Answer: D (Positive)

Protons are subatomic particles that carry a positive electrical charge (+1). They are located in the nucleus along with neutrons. The number of protons determines the atomic number and element identity. Electrons carry negative charge, while neutrons have no charge.

23. Correct Answer: B (2)

Elements in Group 2 (the alkaline earth metals) have 2 valence electrons in their outermost energy level. This includes beryllium, magnesium, calcium, strontium, barium, and radium. Because they have 2 valence electrons, they readily lose those electrons to form +2 ions.

24. Correct Answer: C (Law of Conservation of Mass)

The Law of Conservation of Mass states that during chemical reactions, mass is conserved—atoms are neither created nor destroyed, they are simply rearranged as existing bonds break and new bonds form. The total mass of reactants equals the total mass of products, and the number and type of atoms remain constant.

25. Correct Answer: A (1 M)

Using the dilution formula $M_1V_1 = M_2V_2$: $(4\text{ M})(30\text{ mL}) = M_2(120\text{ mL})$. Solving: $120 = 120M_2$, so $M_2 = 1$ M. Diluting from 30 mL to 120 mL (4-fold dilution) reduces the concentration from 4 M to 1 M.

26. Correct Answer: A (H^+ ions)

According to the Arrhenius definition, acids are substances that produce hydrogen ions (H^+) when dissolved in water. For example, HCl dissociates to produce H^+ and Cl^- ions. Bases, in contrast, produce OH^- ions in water.

27. Correct Answer: B (6.022×10^{23})

Avogadro's number is 6.022×10^{23}, representing the number of particles (atoms, molecules, or formula units) in one mole of any substance. This fundamental constant allows chemists to convert between particle count and moles, connecting microscopic and macroscopic scales.

28. Correct Answer: C (Volume increases)

According to Charles's Law, at constant pressure, the volume of a gas is directly proportional to its absolute temperature in Kelvin ($V_1/T_1 = V_2/T_2$). When temperature increases, gas molecules move faster and require more space, causing volume to increase proportionally.

29. Correct Answer: A (6)

A neutral atom has equal numbers of protons and electrons, making the overall charge zero. Carbon has an atomic number of 6, meaning it has 6 protons. Therefore, a neutral carbon atom also has 6 electrons to balance the positive charge of the protons.

30. Correct Answer: D (Increases)

According to Gay-Lussac's Law, at constant volume, gas pressure is directly proportional to absolute temperature ($P_1/T_1 = P_2/T_2$). When temperature increases, gas molecules move faster and collide with container walls more frequently and with greater force, causing pressure to increase proportionally.