Full-Length Practice Test 10

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 urinary system, comprising the kidneys, ureters, bladder, and urethra, maintains homeostasis by filtering blood, regulating fluid and electrolyte balance, controlling blood pressure, and eliminating metabolic waste products while conserving essential substances. This system processes approximately 180 liters of blood daily, producing 1-2 liters of urine that concentrates waste products for excretion. The kidneys also perform endocrine functions, producing hormones that regulate red blood cell production and calcium metabolism. Understanding renal physiology is essential for healthcare professionals because kidney disease affects millions globally, many medications require dose adjustments for impaired kidney function, and systemic conditions often manifest with urinary symptoms.

The nephron, the kidney's functional unit with approximately one million per kidney, performs the complex process of urine formation through three main mechanisms: glomerular filtration, tubular reabsorption, and tubular secretion. Blood enters each nephron through the afferent arteriole into the glomerulus, a specialized capillary network where high pressure forces water and small solutes through the filtration membrane into Bowman's capsule, creating filtrate. This initial filtrate contains water, glucose, amino acids, electrolytes, urea, and other small molecules, but normally excludes blood cells and large proteins. The filtrate then flows through the proximal convoluted tubule, where approximately 65% of filtered sodium and water are reabsorbed along with all filtered glucose and amino acids through active and passive transport mechanisms. The loop of Henle creates and maintains concentration gradients in the kidney medulla through countercurrent multiplication, enabling water conservation when needed.

The distal convoluted tubule and collecting duct fine-tune urine composition through hormone-regulated reabsorption and secretion. Antidiuretic hormone (ADH), released by the posterior pituitary in response to dehydration or increased blood osmolarity, increases water permeability of collecting duct cells, promoting water reabsorption and producing concentrated urine. Without ADH, collecting ducts remain impermeable to water, producing dilute urine. Aldosterone, secreted

by the adrenal cortex, increases sodium reabsorption and potassium secretion in the distal tubule and collecting duct, helping regulate blood pressure and electrolyte balance. Atrial natriuretic peptide (ANP), released when atrial stretch indicates increased blood volume, promotes sodium and water excretion, lowering blood pressure. The kidney also secretes renin, initiating the renin-angiotensin-aldosterone system that raises blood pressure when renal blood flow decreases.

Kidney disease significantly impacts overall health and medication management. Acute kidney injury involves sudden loss of kidney function from causes including severe dehydration, medications, infections, or urinary obstruction, potentially reversible with prompt treatment. Chronic kidney disease (CKD) develops gradually, often from diabetes or hypertension, progressively reducing kidney function over months to years. Early CKD may be asymptomatic, but advancing disease causes fluid retention, electrolyte imbalances, anemia, bone disease, cardiovascular complications, and uremia (waste accumulation in blood). End-stage renal disease requires dialysis or kidney transplantation for survival. Urinary tract infections, caused by bacteria entering the urinary system, can ascend from the urethra to the bladder (cystitis) or kidneys (pyelonephritis), potentially causing serious complications if untreated. For dental professionals, understanding renal function is critical because chronic kidney disease patients have altered medication metabolism requiring dose adjustments for antibiotics and analgesics, increased bleeding risk from platelet dysfunction and potential anticoagulant use, hypertension requiring monitoring, and oral manifestations including xerostomia, altered taste, metallic taste, and potential bone loss affecting dental structures. Additionally, patients on dialysis require appointment scheduling around dialysis sessions and may need antibiotic prophylaxis consideration for some dental procedures.

1. According to the passage, the urinary system's functions include:
   A. Only producing urine
   B. Only filtering blood
   C. Only regulating blood pressure
   D. Filtering blood, regulating fluid balance, controlling blood pressure, and eliminating waste

2. The passage states that the kidneys process approximately how much blood daily?
   A. 180 liters
   B. 100 liters
   C. 50 liters
   D. 200 liters

3. Based on the passage, glomerular filtration occurs when:
   A. Urine is stored
   B. Blood pressure drops
   C. High pressure forces water and solutes through the filtration membrane

D. Hormones are secreted

4. According to the passage, the proximal convoluted tubule reabsorbs:
   A. Only water
   B. Approximately 65% of filtered sodium and water, plus all glucose and amino acids
   C. Only electrolytes
   D. No substances

5. The passage indicates that ADH (antidiuretic hormone):
   A. Decreases water reabsorption
   B. Has no effect on urine
   C. Only affects bones
   D. Increases water reabsorption producing concentrated urine

6. Based on the passage, aldosterone:
   A. Increases sodium reabsorption and potassium secretion
   B. Only affects the brain
   C. Decreases blood pressure only
   D. Has no renal effects

7. According to the passage, atrial natriuretic peptide:
   A. Increases blood pressure
   B. Has no cardiovascular effects
   C. Promotes sodium and water excretion, lowering blood pressure
   D. Only affects muscles

8. The passage states that chronic kidney disease often results from:
   A. Exercise only
   B. Normal aging only
   C. Adequate hydration
   D. Diabetes or hypertension

PASSAGE 2

Cell signaling enables communication between cells through chemical messengers that coordinate physiological processes, regulate development, maintain homeostasis, and respond to environmental changes. This complex system involves signal transmission from sender cells to receiver cells through various pathways including endocrine signaling (hormones traveling through bloodstream), paracrine signaling (signals affecting nearby cells), autocrine signaling (cells responding to signals they produce), and direct cell-to-cell communication through gap

junctions. Understanding cell signaling is crucial for healthcare professionals because signaling defects underlie many diseases including diabetes, cancer, and neurological disorders, many medications target signaling pathways, and comprehending signal transduction helps explain physiological processes and pathological states.

Signal transduction begins when a signaling molecule (ligand) binds to a receptor protein, triggering a cellular response. Receptors exist in two main categories based on location: cell-surface receptors and intracellular receptors. Cell-surface receptors, including G protein-coupled receptors, receptor tyrosine kinases, and ion channel receptors, bind hydrophilic ligands that cannot cross the plasma membrane. G protein-coupled receptors (GPCRs) represent the largest receptor family, responding to hormones, neurotransmitters, and sensory signals. When a ligand binds a GPCR, the receptor activates an associated G protein, which then activates or inhibits enzymes or ion channels, often generating second messengers like cyclic AMP (cAMP) or calcium ions that amplify the signal and trigger multiple cellular responses. Intracellular receptors, located in the cytoplasm or nucleus, bind lipophilic ligands like steroid hormones and thyroid hormones that diffuse through the plasma membrane. These receptor-ligand complexes often act as transcription factors, directly regulating gene expression.

Signal amplification allows a small number of signaling molecules to produce large cellular responses through cascading enzyme activation. One activated receptor can activate multiple G proteins, each activating multiple enzyme molecules, each producing thousands of second messenger molecules, each activating multiple target proteins. This cascade amplifies the original signal millions-fold, enabling sensitive detection and robust responses. Signal transduction pathways also exhibit integration, where multiple signals converge on common targets, allowing cells to integrate information from multiple sources and produce coordinated responses. Crosstalk between signaling pathways creates complex regulatory networks where one pathway can influence another, providing flexibility and fine-tuning of cellular responses.

Dysregulation of cell signaling contributes to numerous diseases. Cancer often involves mutations in signaling proteins that control cell growth and division, causing uncontrolled proliferation. Oncogenes are mutated genes producing overactive signaling proteins that promote excessive cell division, while tumor suppressor genes normally inhibit cell division, and their loss removes growth restraints. Diabetes mellitus involves defective insulin signaling, where Type 1 results from insufficient insulin production and Type 2 involves insulin resistance where cells fail to respond properly to insulin signals. Many medications target cell signaling pathways: beta-blockers inhibit adrenergic receptors, reducing heart rate and blood pressure; antihistamines block histamine receptors, preventing allergic responses; and some cancer therapies target overactive growth factor receptors. For dental professionals, understanding cell signaling explains how local anesthetics work by blocking sodium channel signaling in nerve cells, how anti-inflammatory drugs inhibit prostaglandin signaling pathways, and how growth factors promote wound healing and tissue

regeneration in periodontal therapy. Additionally, recognizing that stress hormones affect immune function through signaling pathways helps explain why stress impacts oral health and healing.

9. According to the passage, cell signaling enables:
   A. Communication between cells through chemical messengers
   B. Only energy production
   C. Only waste removal
   D. No cellular functions

10. The passage states that endocrine signaling involves:
   A. Only nerve transmission
   B. Direct cell contact only
   C. No distance communication
   D. Hormones traveling through the bloodstream

11. Based on the passage, G protein-coupled receptors:
   A. Only exist in bones
   B. Respond to hormones, neurotransmitters, and sensory signals
   C. Have no cellular function
   D. Only detect light

12. According to the passage, intracellular receptors bind:
   A. Only proteins
   B. Only carbohydrates
   C. Lipophilic ligands like steroid hormones
   D. Only water molecules

13. The passage indicates that signal amplification:
   A. Decreases signal strength
   B. Has no effect on signals
   C. Prevents responses
   D. Allows small numbers of signaling molecules to produce large responses

14. Based on the passage, oncogenes:
   A. Produce overactive signaling proteins promoting excessive cell division
   B. Prevent all cell division
   C. Have no role in cancer
   D. Only affect muscles

15. According to the passage, Type 2 diabetes involves:

A. No insulin issues

B. Excessive insulin production only

C. Insulin resistance where cells fail to respond properly

D. Only affects bones

16. The passage states that local anesthetics work by:

A. Increasing nerve signals

B. Blocking sodium channel signaling in nerve cells

C. Producing inflammation

D. Enhancing pain

PASSAGE 3

Genetics determines inherited traits through DNA sequences that encode instructions for building and maintaining organisms. The central dogma of molecular biology describes information flow from DNA to RNA to protein, though modern understanding recognizes additional complexity including epigenetic modifications, regulatory RNAs, and environmental influences on gene expression. Genetic variation arises through mutations, genetic recombination during sexual reproduction, and chromosomal alterations, providing the raw material for evolution and explaining individual differences in appearance, physiology, disease susceptibility, and drug responses. Understanding genetics is essential for healthcare professionals who increasingly encounter genetic testing, genetic counseling situations, and personalized medicine approaches that tailor treatments based on genetic profiles.

DNA structure, discovered by Watson and Crick in 1953, consists of two complementary strands forming a double helix. Each strand is a polymer of nucleotides containing a sugar (deoxyribose), a phosphate group, and one of four nitrogenous bases: adenine (A), thymine (T), guanine (G), or cytosine (C). Base pairing rules specify that adenine pairs with thymine through two hydrogen bonds, while guanine pairs with cytosine through three hydrogen bonds. This complementarity enables DNA replication, where each strand serves as a template for synthesizing a new complementary strand, ensuring genetic information passes accurately to daughter cells. Genes are DNA segments encoding proteins or functional RNAs, with humans possessing approximately 20,000-25,000 genes distributed across 23 chromosome pairs. Gene expression involves transcription (DNA copied to messenger RNA in the nucleus) and translation (mRNA decoded by ribosomes in the cytoplasm to assemble amino acids into proteins).

Inheritance patterns explain how traits pass from parents to offspring through various mechanisms. Mendelian inheritance describes traits controlled by single genes following predictable patterns. Dominant alleles express their phenotype even when heterozygous (one copy present), while recessive alleles require homozygosity (two copies) for expression. Codominance occurs when

both alleles in heterozygotes are fully expressed, as in AB blood type. Incomplete dominance produces intermediate phenotypes in heterozygotes, like pink flowers from red and white parent flowers. Sex-linked inheritance involves genes on sex chromosomes, with X-linked recessive conditions like hemophilia and color blindness affecting males more frequently because males have only one X chromosome. Complex traits like height, intelligence, and disease susceptibility involve multiple genes (polygenic inheritance) and environmental influences, exhibiting continuous variation rather than discrete categories.

Genetic disorders result from mutations altering DNA sequences or chromosomal abnormalities affecting chromosome number or structure. Single-gene disorders follow Mendelian patterns: autosomal dominant conditions like Huntington's disease require only one mutant allele for expression, while autosomal recessive conditions like cystic fibrosis require two mutant alleles. Chromosomal disorders include Down syndrome (trisomy 21, three copies of chromosome 21), Turner syndrome (45,X, missing an X chromosome in females), and Klinefelter syndrome (47,XXY, extra X chromosome in males). Genetic testing identifies disease-causing mutations, carrier status, and disease risk, enabling informed reproductive decisions, early intervention, and personalized treatment. For dental professionals, genetic knowledge explains inherited dental conditions including amelogenesis imperfecta (defective enamel formation), dentinogenesis imperfecta (defective dentin formation), cleft lip and palate, and susceptibility to periodontal disease and dental caries. Understanding pharmacogenetics explains why patients metabolize medications differently based on genetic variations in drug-metabolizing enzymes, affecting appropriate drug selection and dosing. Additionally, recognizing genetic conditions often have oral manifestations helps in early detection and appropriate referral for genetic counseling.

17. According to the passage, the central dogma describes:
    A. Information flow from DNA to RNA to protein
    B. Only protein synthesis
    C. Only DNA replication
    D. Energy production

18. The passage states that DNA base pairing follows rules where adenine pairs with:
    A. Guanine
    B. Thymine
    C. Cytosine
    D. Uracil

19. Based on the passage, humans possess approximately how many genes?
    A. 10,000
    B. 50,000
    C. 20,000-25,000

D. 100,000

20. According to the passage, dominant alleles:
    A. Express their phenotype even when heterozygous
    B. Require homozygosity for expression
    C. Never express
    D. Only affect eye color

21. The passage indicates that codominance occurs when:
    A. One allele is dominant
    B. No alleles express
    C. Alleles don't interact
    D. Both alleles in heterozygotes are fully expressed

22. Based on the passage, X-linked recessive conditions affect males more frequently because:
    A. Males are larger
    B. Males have only one X chromosome
    C. Males have more genes
    D. Males don't inherit X chromosomes

23. According to the passage, Down syndrome involves:
    A. Trisomy 21 (three copies of chromosome 21)
    B. Missing a chromosome
    C. Only one chromosome
    D. No chromosomal abnormality

24. The passage states that pharmacogenetics explains:
    A. Only food preferences
    B. Only physical appearance
    C. Only height
    D. Why patients metabolize medications differently based on genetic variations

PASSAGE 4

The nervous system coordinates rapid responses to internal and external stimuli through electrical and chemical signaling, enabling sensation, movement, cognition, emotion, and homeostatic regulation. This system divides anatomically into the central nervous system (brain and spinal cord) and the peripheral nervous system (nerves extending throughout the body), and functionally into the somatic nervous system (voluntary control of skeletal muscles) and autonomic nervous system (involuntary control of smooth muscle, cardiac muscle, and glands). The autonomic system

further divides into sympathetic (fight-or-flight responses) and parasympathetic (rest-and-digest functions) divisions that generally produce opposite effects on target organs. Understanding neuroscience is essential for healthcare professionals because neurological and psychiatric conditions affect millions, many medications target neural mechanisms, and the nervous system influences all body functions including those relevant to dental practice.

Neurons, the nervous system's functional units, possess specialized structures enabling rapid electrical signaling over long distances. Each neuron has a cell body containing the nucleus and metabolic machinery, dendrites that receive signals from other neurons, and typically one axon conducting electrical impulses away from the cell body toward axon terminals that form synapses with other cells. Myelin, produced by Schwann cells in the peripheral nervous system and oligodendrocytes in the central nervous system, insulates axons and dramatically increases signal transmission speed through saltatory conduction, where action potentials jump between nodes of Ranvier (gaps in myelin). Myelinated axons can conduct impulses over 100 times faster than unmyelinated axons. Multiple sclerosis results from autoimmune destruction of myelin, causing progressive neurological deterioration with symptoms including vision problems, weakness, coordination difficulties, cognitive changes, and fatigue.

Action potentials represent the electrical signals neurons use for rapid long-distance communication. At rest, neurons maintain an electrical potential of approximately -70 millivolts inside relative to outside, created by unequal ion distribution maintained by the sodium-potassium pump. When neurons receive sufficient excitatory stimulation, voltage-gated sodium channels open, allowing sodium influx that depolarizes the membrane. If depolarization reaches threshold (approximately -55 mV), a positive feedback cycle triggers rapid opening of more sodium channels, generating an action potential that propagates along the axon. After the peak, sodium channels close and potassium channels open, allowing potassium efflux that repolarizes the membrane. The sodium-potassium pump restores ion gradients. Action potentials follow the all-or-nothing principle—they either occur fully or not at all, with stimulus strength encoded by firing frequency rather than action potential amplitude.

Synaptic transmission enables communication between neurons through chemical neurotransmitters at most synapses, though some neurons connect through electrical synapses (gap junctions). When an action potential reaches the axon terminal, voltage-gated calcium channels open, allowing calcium influx that triggers neurotransmitter-containing vesicles to fuse with the presynaptic membrane and release neurotransmitters into the synaptic cleft. Neurotransmitters diffuse across the narrow gap and bind to receptors on the postsynaptic neuron, either exciting it (making action potentials more likely) or inhibiting it (making firing less likely). Different neurotransmitters serve various functions: glutamate provides primary excitatory signaling in the brain, GABA serves as the main inhibitory neurotransmitter, dopamine influences motivation and movement, serotonin affects mood and sleep, and acetylcholine functions in muscle activation and

various brain regions. After acting, neurotransmitters are removed through reuptake by the presynaptic neuron, enzymatic degradation, or diffusion away from the synapse. For dental professionals, understanding neuroscience explains local anesthetic mechanisms (blocking sodium channels to prevent action potential generation), recognizes that anxiety and stress activate the sympathetic nervous system affecting heart rate and blood pressure during dental procedures, understands that some medications affecting neurotransmitters cause xerostomia or bruxism, and recognizes neurological conditions like trigeminal neuralgia causing facial pain or Bell's palsy affecting facial muscles. Additionally, understanding neural control of salivation helps explain dry mouth causes and consequences for oral health.

25. According to the passage, the nervous system divides anatomically into:
   A. Only the brain
   B. Only nerves
   C. The central nervous system and peripheral nervous system
   D. Only the spinal cord

26. The passage states that myelin is produced by:
   A. Only muscles
   B. Schwann cells in PNS and oligodendrocytes in CNS
   C. Only the heart
   D. Red blood cells

27. Based on the passage, multiple sclerosis results from:
   A. Excessive myelin production
   B. Normal aging
   C. Increased neurotransmitters
   D. Autoimmune destruction of myelin

28. According to the passage, neurons at rest maintain an electrical potential of approximately:
   A. -70 millivolts
   B. +70 millivolts
   C. 0 millivolts
   D. -140 millivolts

29. The passage indicates that action potentials follow:
   A. The all-or-nothing principle
   B. Partial responses
   C. Variable amplitudes
   D. No consistent pattern

30. Based on the passage, glutamate provides:
   A. Only inhibitory signaling
   B. No neural function
   C. Primary excitatory signaling in the brain
   D. Only hormone production

31. According to the passage, local anesthetics work by:
   A. Increasing sodium channels
   B. Enhancing action potentials
   C. Producing inflammation
   D. Blocking sodium channels to prevent action potential generation

32. The passage states that GABA serves as:
   A. An excitatory neurotransmitter
   B. A hormone only
   C. The main inhibitory neurotransmitter
   D. A nutrient

PASSAGE 5

Microbiology studies microorganisms including bacteria, viruses, fungi, and protozoa, examining their structure, function, growth, and interactions with hosts and environments. While many microorganisms are harmless or beneficial, pathogenic microbes cause infectious diseases representing major global health challenges. Understanding microbial characteristics, transmission routes, host defenses, and antimicrobial treatments is essential for healthcare professionals who must prevent healthcare-associated infections, manage infectious patients, understand antibiotic resistance, and maintain infection control practices. The COVID-19 pandemic dramatically illustrated microorganisms' impacts on health, healthcare systems, and society.

Bacteria represent single-celled prokaryotic organisms lacking membrane-bound organelles, with DNA located in a nucleoid region rather than a nucleus. Bacterial cells have cell walls containing peptidoglycan, with Gram-positive bacteria having thick peptidoglycan layers retaining crystal violet stain, and Gram-negative bacteria having thin peptidoglycan layers with an outer membrane, not retaining crystal violet but taking up safranin counterstain. This Gram stain difference affects antibiotic susceptibility, with some antibiotics targeting peptidoglycan synthesis more effective against Gram-positive bacteria. Bacteria reproduce through binary fission, potentially doubling populations every 20 minutes under optimal conditions, explaining rapid infection progression. Bacterial pathogens cause disease through various mechanisms: some invade tissues, others produce exotoxins (secreted proteins causing specific damage), and Gram-negative bacteria

release endotoxin (lipopolysaccharide from their outer membrane) when they die, triggering strong immune responses potentially causing septic shock.

Viruses differ fundamentally from cells, consisting only of genetic material (DNA or RNA) enclosed in a protein coat (capsid), sometimes with a lipid envelope derived from host cell membranes. Viruses are obligate intracellular parasites requiring living host cells for replication because they lack ribosomes and metabolic machinery. Viral replication involves attachment to specific host cell receptors, entry into the cell, release of viral genetic material, hijacking host cellular machinery to produce viral components, assembly of new virus particles, and release from the host cell often destroying it. Common viral infections include influenza (respiratory illness), herpes simplex virus (causing cold sores and genital herpes), human papillomavirus (associated with cervical and oral cancers), and HIV (causing AIDS by destroying immune cells). Antiviral medications target specific viral replication steps, but viral mutations enable evolution of drug-resistant strains. Vaccines prevent viral infections by exposing the immune system to weakened, killed, or component forms of viruses, generating protective immunity without causing disease.

Antimicrobial resistance represents a critical global health threat, with bacteria evolving resistance mechanisms through mutations or acquiring resistance genes from other bacteria via horizontal gene transfer. Resistance mechanisms include producing enzymes that destroy antibiotics (like beta-lactamases breaking down penicillins), altering drug targets so antibiotics no longer bind effectively, increasing efflux pumps that remove antibiotics from cells, and decreasing membrane permeability preventing antibiotic entry. Methicillin-resistant Staphylococcus aureus (MRSA) and vancomycin-resistant Enterococcus (VRE) represent dangerous multidrug-resistant bacteria causing difficult-to-treat infections. Antibiotic stewardship programs promote appropriate antibiotic use to slow resistance development. For dental professionals, understanding microbiology is critical because the oral cavity houses diverse microbial communities forming biofilms on teeth and soft tissues, Streptococcus mutans metabolizes sugars producing acid causing dental caries, periodontal diseases result from complex bacterial communities triggering inflammatory responses, appropriate antibiotic selection requires understanding likely causative organisms and resistance patterns, and strict infection control prevents disease transmission including surface disinfection, instrument sterilization, hand hygiene, and personal protective equipment use. Additionally, recognizing that immunocompromised patients face increased infection risks guides treatment modifications and prophylactic antibiotic consideration for some patients and procedures.

33. According to the passage, bacteria are:
   A. Single-celled prokaryotic organisms lacking membrane-bound organelles
   B. Multicellular organisms
   C. Only beneficial organisms
   D. Viruses

34. The passage states that Gram-positive bacteria have:
    A. No cell wall
    B. Only membranes
    C. Thin peptidoglycan with outer membrane
    D. Thick peptidoglycan layers retaining crystal violet stain

35. Based on the passage, bacteria can double their population under optimal conditions every:
    A. 24 hours
    B. 20 minutes
    C. 1 week
    D. 1 month

36. According to the passage, viruses consist of:
    A. Only lipids
    B. Complete cells
    C. Genetic material (DNA or RNA) in a protein coat
    D. Only proteins

37. The passage indicates that viruses are obligate intracellular parasites because:
    A. They lack ribosomes and metabolic machinery
    B. They are too large
    C. They have complete metabolism
    D. They don't need cells

38. Based on the passage, vaccines work by:
    A. Destroying all bacteria
    B. Preventing all infections instantly
    C. Eliminating the immune system
    D. Exposing the immune system to weakened or killed pathogens

39. According to the passage, resistance mechanisms include:
    A. Only mutations
    B. Only gene transfer
    C. Producing enzymes that destroy antibiotics
    D. No known mechanisms

40. The passage states that Streptococcus mutans:
    A. Strengthens enamel
    B. Metabolizes sugars producing acid causing dental caries

C. Prevents all disease

D. Only exists in the stomach

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 laboratory received new equipment, it also hired additional staff members.
   A. equipment, it also hired
   B. equipment it also hired
   C. equipment, and it also hired
   D. equipment; because it also hired

2. Neither the supervisor nor the technicians was prepared for the inspection.
   A. nor the technicians was prepared
   B. nor the technicians were prepared
   C. or the technicians was prepared
   D. or the technicians were prepared

3. The administrator asked the employees when could they complete the project.
   A. when could they complete
   B. when they could have completed
   C. when they can complete
   D. when they could complete

4. Between you and I, the new system is significantly more efficient than before.
   A. Between you and me, the new system is
   B. Between you and I, the new system is
   C. Between you and I, the new systems are
   D. Between you and me, the new systems are

5. The hospital provides extensive services including emergency care, surgical procedures, and will offer rehabilitation programs.
   A. emergency care, surgical procedures, and will offer rehabilitation programs
   B. emergency care, surgical procedures, and rehabilitation programs

C. emergency care, surgical procedures, and rehabilitation programs
D. emergently caring, surgical procedures, and will offer rehabilitation programs

6. After completing the assessment the consultant recommended several improvements.
   A. After completing the assessment the consultant recommended
   B. After completing the assessment, the consultant recommended
   C. After completing the assessment; the consultant recommended
   D. After completing the assessment the consultant, recommended

7. The new procedures are more comprehensive than the old methods, they also enhance efficiency.
   A. methods, and they also enhance
   B. methods they also enhance
   C. methods; because they also enhance
   D. methods, they also enhance

8. Everyone in the organization must complete their professional development requirements.
   A. must complete their professional development requirements
   B. must complete its professional development requirements
   C. must complete his or her professional development requirements
   D. must completes his or her professional development requirements

9. The director recommended that the manager submits the proposal immediately.
   A. recommended that the manager submits the proposal
   B. recommended that the manager submit the proposal
   C. recommends that the manager submits the proposal
   D. recommended that the manager submitted the proposal

10. After evaluating the options carefully, a decision was made by the committee.
    A. After evaluating the options carefully, the committee made a decision
    B. After evaluating the options carefully, a decision was made by the committee
    C. A decision was made by the committee, after evaluating the options carefully
    D. After evaluating the options carefully, the committee's decision was made

11. Each of the participants have submitted their registration forms on time.
    A. have submitted their registration forms
    B. have submitted his or her registration form
    C. has submitted their registration forms
    D. has submitted his or her registration form

12. The facility operates continuously, however it undergoes maintenance monthly.

A. continuously, however it undergoes
B. continuously; however, it undergoes
C. continuously however, it undergoes
D. continuously, however, it undergoes

13. Less employees attended the workshop than originally registered.
    A. Less employees attended
    B. Lesser employees attended
    C. Fewer employees attended
    D. Less employee attended

14. The researcher collected the data, analyzed the results, and was writing the report.
    A. collected the data, analyzed the results, and was writing
    B. collected the data, analyzed the results, and wrote
    C. collects the data, analyzed the results, and wrote
    D. collected the data, analyzes the results, and wrote

15. Dr. Thompson told Dr. Martinez that she needed to review the findings immediately.
    A. Dr. Thompson told Dr. Martinez that she needed
    B. Dr. Thompson told Dr. Martinez she needed
    C. Dr. Thompson told Dr. Martinez that Martinez needed
    D. Dr. Thompson told Dr. Martinez that Dr. Thompson needed

16. The regulation change effects all divisions and will take effect next quarter.
    A. affects all divisions and will take effect
    B. effects all divisions and will take affect
    C. affects all divisions and will take affect
    D. effects all divisions and will take effect

17. Maintaining high standards is crucial, all personnel must follow guidelines.
    A. crucial, all personnel must
    B. crucial all personnel must
    C. crucial; because all personnel must
    D. crucial. All personnel must

18. The specialist which completed the training last month demonstrates exceptional expertise.
    A. who completed the training
    B. which had completed the training
    C. whom completed the training
    D. which completed the training

19. Having analyzed the situation thoroughly, the conclusion was presented by the team.
   A. Having analyzed the situation thoroughly, the conclusion was presented by the team
   B. Having analyzed the situation thoroughly, the team's conclusion was presented
   C. Having analyzed the situation thoroughly, the team presented the conclusion
   D. The conclusion was presented by the team, having analyzed the situation thoroughly

20. The employee should of reported the issue earlier to prevent complications.
   A. should have reported
   B. should had reported
   C. should has reported
   D. should of reported

21. The initiative includes planning, implementation, or providing ongoing support.
   A. planning, implementation, or providing ongoing support
   B. plan, implementation, or providing ongoing support
   C. planning, implementing, or providing ongoing support
   D. planning, implementation, or ongoing support

22. Effective leadership improves performance, it enhances team collaboration.
   A. performance, it enhances
   B. performance it enhances
   C. performance; it enhances
   D. performance; and it enhances

23. Among the six proposed solutions, the integrated approach is the more effective strategy.
   A. the more effective strategy
   B. the most effective strategy
   C. the more effectively strategy
   D. the most effectively strategy

24. The research center is located at 456 university avenue near the medical complex in Portland Oregon.
   A. University Avenue near the medical complex in Portland, Oregon
   B. university avenue near the medical complex in Portland Oregon
   C. University avenue near the medical complex in Portland, Oregon
   D. university Avenue near the Medical Complex in Portland, Oregon

25. After the presentation was completed the participants received detailed handouts.
   A. After the presentation was completed the participants received

B. After the presentation, was completed the participants received
C. After the presentation was completed; the participants received
D. After the presentation was completed, the participants received

26. The coordinator asked the staff when can they finalize the schedule.
    A. when can they finalize
    B. when they can finalize
    C. when they could finalize
    D. when can they have finalized

27. The manager and her team both agrees that innovation is essential.
    A. both agrees that
    B. both agree that
    C. both agrees, that
    D. both agree, that

28. Effective communication, strong leadership, and professional development is critical for success.
    A. is critical
    B. is critically
    C. are critically
    D. are critical

29. Strategic planning improves outcomes, it also increases organizational effectiveness.
    A. outcomes, it also increases
    B. outcomes it also increases
    C. outcomes, and it also increases
    D. outcomes; because it also increases

30. The institute offers specialized programs such as leadership training, management development, and executive coaching.
    A. programs, such as leadership training, management development, and executive coaching
    B. programs such as, leadership training, management development, and executive coaching
    C. programs, such as leadership training, management development, and executive coaching
    D. programs such as leadership training management development and executive coaching

31. Executives, managers, and supervisors all plays important roles in organizational success.
    A. all plays important roles
    B. all play important roles
    C. all play important role

D. all plays important role

32. The manager asked the team members to lay the documents on the table before the meeting.
A. to lay the documents on the table
B. to lie the documents on the table
C. to lay the documents in the table
D. to lie the documents in the table

33. Modern organizations have evolved significantly allowing leaders to implement innovative strategies.
    A. significantly, allowing leaders to implement
    B. significantly; allowing leaders to implement
    C. significantly. Allowing leaders to implement
    D. significantly allowing leaders to implement

34. Continuous improvement prevents stagnation, it promotes sustained growth.
    A. stagnation, it promotes
    B. stagnation it promotes
    C. stagnation. It promotes
    D. stagnation; and it promotes

35. The certification program requires candidates to complete coursework before examination.
    A. requires candidates to complete coursework, before examination
    B. requires candidates to complete coursework before examination
    C. require candidates to complete coursework before examination
    D. requires candidates to complete coursework before, examination

36. The organization provides comprehensive resources such as training materials and technical support but not consulting services.
    A. resources, such as training materials and technical support but
    B. resources such as, training materials and technical support, but
    C. resources, such as training materials and technical support, but
    D. resources such as training materials and technical support, but

37. The new facility is more accessible to clients than the former location.
    A. more accessible to clients than the former location
    B. more accessible to clients than the former location was
    C. more accessibly to clients than the former location
    D. most accessible to clients than the former location

38. Achieving excellence requires setting clear goals, maintaining focus, and to pursue continuous improvement.
   A. setting clear goals, maintaining focus, and to pursue continuous improvement
   B. setting clear goals, maintaining focus, and pursuing continuous improvement
   C. to set clear goals, maintaining focus, and pursuing continuous improvement
   D. to set clear goals, to maintain focus, and to pursue continuous improvement

39. The client mentioned that the results has been impressive throughout the entire project.
   A. had been impressive
   B. has been impressive
   C. will have been impressive
   D. has impressed

40. Effective management reduces costs, it also improves overall productivity.
   A. costs, it also improves
   B. costs it also improves
   C. costs, it also improves
   D. costs, and 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: 10x - 18 = 32
   A. 5
   B. 14
   C. 32
   D. 50

2. A clinic treated 200 patients in May and 250 patients in June. What is the percent increase?
   A. 20%
   B. 30%
   C. 50%
   D. 25%

3. If 12y - 11 = 9y + 16, what is the value of y?
  A. 3
  B. 5
  C. 9
  D. 11

4. A nurse earns $50 per hour and works 8 hours per day for 5 days per week. How much does she earn per week?
  A. $400
  B. $2,000
  C. $250
  D. $2,500

5. What is 32% of 550?
  A. 32
  B. 55
  C. 165
  D. 176

6. If a = 9 and b = -7, what is the value of $6a^2 - 5b$?
  A. 521
  B. 486
  C. 450
  D. 420

7. A medication dosage is 1.2 mg per kilogram of body weight. How many milligrams should be given to a patient weighing 75 kilograms?
  A. 75 mg
  B. 80 mg
  C. 90 mg
  D. 100 mg

8. Solve: 7(x + 10) = 5x + 86
  A. 4
  B. 8
  C. 10
  D. 12

9. A box has 16 green balls, 14 yellow balls, and 10 orange balls. If one ball is selected at random, what is the probability it is green?

A. 2/5

B. 7/20

C. 1/4

D. 1/2

10. Convert 7.5 kilometers to meters.

A. 75 meters

B. 750 meters

C. 7,500 meters

D. 7,500 meters

11. If x = 11, what is the value of 6x² - 8x?

A. 638

B. 638

C. 550

D. 700

12. Equipment costs decreased from $5,400 to $4,050. What is the percent decrease?

A. 20%

B. 30%

C. 25%

D. 1,350%

13. Simplify: 9(6x - 7) - 11(x + 6)

A. 54x - 129

B. 65x - 129

C. 43x - 129

D. 43x - 129

14. The ratio of doctors to patients is 1:60. If there are 240 patients, how many doctors are there?

A. 4

B. 5

C. 6

D. 60

15. Solve for x: x/12 + 9 = 16

A. 63

B. 84

C. 28

D. 55

16. A patient's temperature increased from 98.2°F to 103.0°F. What is the amount of increase?

  A. 3.8°F

  B. 4.2°F

  C. 5.4°F

  D. 4.8°F

17. If $11x - 8y = 59$ and $x = 13$, what is the value of y?

  A. 10

  B. 11

  C. 13

  D. 14

18. A pharmacy offers a 40% discount on prescriptions. If the original price is $800, what is the discounted price?

  A. $760

  B. $520

  C. $560

  D. $480

19. Solve for x: $14x - 14 = 11x + 25$

  A. 3

  B. 11

  C. 13

  D. 39

20. What is the mean of the data set: 26, 32, 38, 44, 50?

  A. 38

  B. 32

  C. 44

  D. 40

21. A solution contains 950 mL of liquid. If 48% is active ingredient, how many milliliters of active ingredient does it contain?

  A. 48 mL

  B. 456 mL

  C. 380 mL

  D. 475 mL

22. If $x^2 = 324$, what are the possible values of x?

A. 324 only

B. 162 only

C. -18 only

D. 18 and -18

23. A therapist sees 24 patients per day for 6 days per week for 3 weeks. How many patients in total?

　A. 144

　B. 72

　C. 432

　D. 540

24. Simplify: $(10x^9)(7x^6)$

　A. $17x^{15}$

　B. $70x^{15}$

　C. $17x^{54}$

　D. $70x^{54}$

25. What is 14/25 expressed as a percent?

　A. 56%

　B. 14%

　C. 25%

　D. 0.56%

26. A patient takes medication every 8 hours. How many doses in 6 days?

　A. 16

　B. 12

　C. 18

　D. 24

27. If the perimeter of a rectangle is 120 cm and the width is 26 cm, what is the length?

　A. 47 cm

　B. 30 cm

　C. 60 cm

　D. 34 cm

28. Solve: $13x - 24 = 12x - 16$

　A. 8

　B. -8

　C. -40

D. 40

29. Equipment costs $1,240 before tax. With 9% sales tax, what is the total cost?
   A. $1,249
   B. $1,350
   C. $1,360
   D. $1,351.60

30. What is the median of: 20, 26, 32, 38, 44?
   A. 26
   B. 32
   C. 38
   D. 30

31. If 10x - 18 = 32, what is the value of 5x?
   A. 25
   B. 5
   C. 20
   D. 30

32. A container holds 4.2 liters. How many milliliters is this?
   A. 42 mL
   B. 420 mL
   C. 4,200 mL
   D. 42,000 mL

33. Evaluate: $(-9)^2 - 7(-6)$
   A. 39
   B. -39
   C. 123
   D. 123

34. A hospital has 80 employees. If 40% are nurses, how many nurses work there?
   A. 28
   B. 32
   C. 40
   D. 48

35. Solve for x: x/16 = 9
   A. 25

B. 7
C. 144
D. 16

36. What is 0.625 expressed as a fraction in simplest form?
    A. 625/1000
    B. 5/8
    C. 25/40
    D. 15/24

37. If x + y = 38 and x - y = 18, what is the value of x?
    A. 20
    B. 10
    C. 18
    D. 28

38. A patient's temperature is 43°C. Using F = (9/5)C + 32, what is the temperature in Fahrenheit?
    A. 109.4°F
    B. 110.6°F
    C. 111.4°F
    D. 107.6°F

39. What is the range of: 26, 32, 38, 44, 50?
    A. 26
    B. 38
    C. 24
    D. 32

40. A facility treated 180 patients in July and 270 patients in August. What is the ratio of July to August patients in simplest form?
    A. 180:270
    B. 2:3
    C. 9:13
    D. 36:54

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 64°, Angle 2 measures 126°, Angle 3 measures 88°, and Angle 4 measures 147°. 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 = 45°, Angle B = 136°, Angle C = 102°. Which angle is acute and smallest?
   A. Angle A
   B. Angle B
   C. Angle C
   D. All obtuse

3. Five angles measure 36°, 103°, 67°, 155°, and 94°. Which is the third smallest angle?
   A. 36°
   B. 67°
   C. 67°
   D. 103°

4. Four angles are displayed: 51°, 116°, 79°, and 143°. Which is the smallest angle?
   A. 51°
   B. 79°
   C. 116°
   D. 143°

5. Three angles measure 88°, 134°, and 54°. What is the correct order from largest to smallest?
   A. 88°, 54°, 134°
   B. 54°, 88°, 134°

C. 134°, 54°, 88°

D. 134°, 88°, 54°

6. Five angles are shown: 43°, 111°, 82°, 159°, and 68°. Which angle is acute and closest to 70°?

A. 43°

B. 68°

C. 82°

D. 111°

7. Four angles measure 29°, 107°, 60°, and 174°. Which is the smallest angle?

A. 29°

B. 60°

C. 107°

D. 174°

8. Three angles are presented: 45°, 101°, and 166°. Which is obtuse and less than 110°?

A. 45°

B. 166°

C. 101°

D. None

9. Five angles measure 52°, 115°, 78°, 148°, and 61°. Which is the largest angle?

A. 52°

B. 78°

C. 115°

D. 148°

10. Four angles are shown: 76°, 139°, 41°, and 102°. Which is the second smallest angle?

A. 41°

B. 76°

C. 102°

D. 139°

11. Three acute angles measure 50°, 83°, and 71°. Which is the largest?

A. 50°

B. 71°

C. 83°

D. All equal

12. Five angles measure 126°, 97°, 62°, 177°, and 85°. Which is the largest?

A. 62°
B. 85°
C. 97°
D. 177°

13. Four angles are displayed: 33°, 112°, 84°, and 153°. Which is the smallest angle?
   A. 33°
   B. 84°
   C. 112°
   D. 153°

14. Three angles measure 129°, 56°, and 96°. Which is obtuse and closest to 100°?
   A. 56°
   B. 129°
   C. 96°
   D. None

15. Five angles are shown: 48°, 117°, 74°, 161°, and 92°. Which lists the two largest in order?
   A. 92°, 117°
   B. 161°, 117°
   C. 117°, 92°
   D. 48°, 74°

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 11 cm × 15 cm × 17 cm. Which aperture allows the largest face to pass through?
   A. A circle 15 cm diameter
   B. A rectangle 15 cm × 17 cm
   C. A square 15 cm × 15 cm
   D. A triangle 17 cm base

17. A cylinder with diameter 15 cm and height 21 cm is shown. When entering circular end first, what aperture is needed?
   A. A rectangle 15 cm × 21 cm
   B. A square 21 cm × 21 cm
   C. A circle with at least 15 cm diameter

D. A triangle 15 cm sides

18. A pyramid with square base 15 cm × 15 cm is presented. Which aperture accommodates the base?
   A. A circle 15 cm diameter
   B. A triangle 15 cm sides
   C. A rectangle 13 cm × 15 cm
   D. A square 15 cm × 15 cm or larger

19. A cube measuring 14 cm per side is shown. What is the smallest square aperture needed?
   A. 12 cm × 12 cm
   B. 16 cm × 16 cm
   C. 28 cm × 28 cm
   D. 14 cm × 14 cm

20. A triangular prism has base 13 cm per side and length 19 cm. Which aperture allows triangle-first passage?
   A. An equilateral triangle 13 cm sides
   B. A circle 19 cm diameter
   C. A square 13 cm × 13 cm
   D. A rectangle 13 cm × 19 cm

21. An L-shaped object measures 13 cm wide and 16 cm tall overall. Which aperture accommodates it?
   A. A square 13 cm × 13 cm
   B. A circle 14 cm diameter
   C. A rectangle 13 cm × 16 cm or larger
   D. A triangle 16 cm base

22. A sphere with diameter 18 cm is presented. What aperture is required?
   A. A square 16 cm × 16 cm
   B. A circle with at least 18 cm diameter
   C. A triangle 18 cm sides
   D. A rectangle 17 cm × 19 cm

23. A rectangular block 13 cm × 15 cm × 11 cm is shown. When oriented with 13 cm × 15 cm face forward, what aperture?
   A. A rectangle 13 cm × 15 cm
   B. A circle 15 cm diameter
   C. A square 15 cm × 15 cm

D. A rectangle 11 cm × 13 cm

24. A hexagonal prism with 13 cm wide base and 20 cm length is displayed. Which aperture for hexagon-first entry?
   A. A circle 12 cm diameter
   B. A rectangle 13 cm × 20 cm
   C. A square 13 cm × 13 cm
   D. A hexagon approximately 13 cm across

25. A T-shaped object measures 17 cm wide and 19 cm tall. What minimum aperture?
   A. A square 17 cm × 17 cm
   B. A circle 19 cm diameter
   C. A rectangle 17 cm × 19 cm
   D. A rectangle 15 cm × 17 cm

26. An ellipsoid measures 14 cm × 17 cm × 12 cm. When oriented with 14 cm × 17 cm face forward, which aperture?
   A. An ellipse or rectangle 14 cm × 17 cm
   B. A circle 17 cm diameter
   C. A square 17 cm × 17 cm
   D. A rectangle 12 cm × 14 cm

27. A cross-shaped object has arms extending 15 cm in each direction. What aperture for face-first passage?
   A. A square 13 cm × 13 cm
   B. A square 15 cm × 15 cm or larger
   C. A circle 15 cm diameter
   D. A triangle 15 cm sides

28. A cone with base diameter 17 cm is shown. Which aperture fits the base?
   A. A square 15 cm × 15 cm
   B. A rectangle 14 cm × 17 cm
   C. A triangle 17 cm sides
   D. A circle with at least 17 cm diameter

29. A rectangular block with rounded ends measures 13 cm × 15 cm × 19 cm with 2 cm radius curves. Which aperture for curved end?
   A. A rounded rectangle approximately 13 cm × 15 cm
   B. A circle 15 cm diameter
   C. A square 15 cm × 15 cm

D. A rectangle 12 cm × 14 cm

30. An irregular object with dimensions 14 cm × 16 cm × 12 cm is shown. When oriented with smallest face forward, which aperture?
  A. A circle 14 cm diameter
  B. A rectangle 16 cm × 12 cm
  C. A rectangle 14 cm × 12 cm
  D. A square 14 cm × 14 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 rectangle, front view shows rectangle, end view shows circle. What is the object?
  A. A cube
  B. A cylinder oriented horizontally
  C. A sphere
  D. A rectangular prism

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

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

34. Top view is decagon (10 sides), front view is rectangle, end view is decagon. What is the object?
  A. A decagonal prism
  B. A cube
  C. A decagonal pyramid
  D. Ten prisms

35. Top view shows rectangle, front view shows four circles, end view shows rectangle. What is the object?
  A. A cube
  B. A pyramid
  C. A rectangular prism
  D. Four cylinders arranged in a row

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

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

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

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

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

D. One long prism

41. Top view shows circle, front view shows circle, end view shows rectangle. What is the object?
   A. A sphere
   B. A cube
   C. A pyramid
   D. A cylinder oriented horizontally

42. Top view shows circle with cross, front view shows four rectangles, end view shows circle with cross. What is the object?
   A. Four cylindrical sections with cross divisions
   B. A cone
   C. A cube
   D. A sphere

43. Top view shows octagon, front view shows rectangle, end view shows octagon. What is the object?
   A. A cube
   B. An octagonal pyramid
   C. An octagonal prism
   D. Eight prisms

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

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

CUBE COUNTING (Questions 46-60)
Directions: A three-dimensional structure built from cubes is shown. Answer questions about cubes or painted surfaces.

46. A structure contains 8 layers arranged 6 × 6 × 8. How many total cubes?
    A. 288
    B. 36
    C. 48
    D. 144

47. In a 9 × 9 × 9 cube, how many cubes are on the surface (have at least one face exposed)?
    A. 729
    B. 343
    C. 386
    D. 512

48. A 6 × 8 × 10 structure is built. How many total cubes?
    A. 24
    B. 240
    C. 80
    D. 480

49. In a 12 × 12 × 12 cube where all faces are painted, how many cubes have exactly three painted faces?
    A. 144
    B. 8
    C. 12
    D. 10

50. A structure has 11 layers with 10 cubes per layer arranged 2 × 5. How many total cubes?
    A. 100
    B. 55
    C. 110
    D. 80

51. In a 6 × 9 × 10 structure, how many cubes are on corners?
    A. 8
    B. 12
    C. 24
    D. 6

52. A structure is 12 cubes high, 11 cubes wide, 10 cubes deep. How many total cubes?
    A. 33

B. 1,100

C. 660

D. 1,320

53. In an L-shaped structure with 14 cubes on one arm and 13 on the other (sharing 1 corner), how many total cubes?

  A. 27

  B. 26

  C. 14

  D. 25

54. A $12 \times 12 \times 1$ flat structure has all faces painted. How many cubes have exactly two painted faces?

  A. 44

  B. 40

  C. 144

  D. 48

55. A staircase has 9 cubes on first step, 11 on second, 13 on third. How many total cubes?

  A. 11

  B. 22

  C. 33

  D. 39

56. An $11 \times 12 \times 13$ structure is built. How many cubes are on corners?

  A. 12

  B. 6

  C. 24

  D. 8

57. In a $14 \times 1 \times 1$ structure (14 cubes in row), if all surfaces painted, how many cubes have exactly four painted faces?

  A. 2

  B. 12

  C. 14

  D. 10

58. A pyramid has layers: bottom $11 \times 11 = 121$ cubes, next $9 \times 9 = 81$ cubes, next $7 \times 7 = 49$ cubes, next $5 \times 5 = 25$ cubes, next $3 \times 3 = 9$ cubes, top 1 cube. How many total?

  A. 121

B. 256
C. 286
D. 225

59. In an 11 × 11 × 11 cube with seven corner cubes removed, how many cubes remain?
  A. 1,324
  B. 1,331
  C. 1,320
  D. 1,318

60. A plus-shaped structure uses 12 cubes for vertical arm and 12 for horizontal (sharing 1 center). How many total?
  A. 24
  B. 22
  C. 12
  D. 23

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 ribosomes?
  A. DNA storage
  B. Protein synthesis
  C. Waste digestion
  D. Energy production

2. Which organelle is responsible for modifying, sorting, and packaging proteins?
  A. Ribosome
  B. Mitochondrion
  C. Lysosome
  D. Golgi apparatus

3. During which phase of mitosis do chromosomes first become visible?
  A. Prophase
  B. Metaphase

C. Anaphase

D. Telophase

4. What is the process by which cells take in large particles or liquids?

A. Osmosis

B. Diffusion

C. Endocytosis

D. Facilitated transport

5. What is the function of transfer RNA (tRNA)?

A. Stores genetic information

B. Brings amino acids to ribosomes

C. Forms ribosome structure

D. Carries genetic instructions

6. How many chromosomes are in a human somatic cell?

A. 46

B. 23

C. 92

D. 22

7. In RNA, adenine pairs with which base?

A. Thymine

B. Guanine

C. Cytosine

D. Uracil

8. What is incomplete dominance?

A. Complete dominance of one allele

B. Both alleles fully expressed

C. Blending producing intermediate phenotype

D. No alleles expressed

9. During which phase does DNA condense into chromosomes?

A. Interphase

B. Prophase

C. Anaphase

D. Telophase

10. Which blood component transports nutrients and wastes?

A. Red blood cells

B. White blood cells

C. Platelets

D. Plasma

11. What is the primary function of the stomach?

    A. Chemical and mechanical digestion

    B. Water absorption only

    C. Bile production

    D. Nutrient absorption

12. Which tissue type enables movement?

    A. Epithelial tissue

    B. Muscle tissue

    C. Nervous tissue

    D. Connective tissue

13. In a cross between Aa and Aa, what percentage will be homozygous dominant?

    A. 50%

    B. 75%

    C. 25%

    D. 100%

14. Which process produces two identical diploid daughter cells?

    A. Meiosis

    B. Binary fission

    C. Budding

    D. Mitosis

15. What type of RNA carries genetic information from nucleus to ribosomes?

    A. tRNA

    B. rRNA

    C. DNA

    D. mRNA

16. Which component of blood fights disease?

    A. Red blood cells

    B. White blood cells

    C. Platelets

    D. Plasma proteins

17. What type of muscle is found in the heart?
    A. Skeletal muscle
    B. Smooth muscle
    C. Cardiac muscle
    D. Voluntary muscle

18. What is transcription?
    A. Copying DNA into RNA
    B. Translating RNA into protein
    C. Replicating DNA
    D. Destroying old cells

19. Which organelle produces ATP?
    A. Ribosome
    B. Lysosome
    C. Nucleus
    D. Mitochondrion

20. What do osteoclasts and osteoblasts work together to do?
    A. Only break down bone
    B. Maintain bone through remodeling
    C. Only build bone
    D. Store blood

21. What defines prokaryotic cells?
    A. Lack of membrane-bound nucleus
    B. Presence of mitochondria
    C. Presence of Golgi apparatus
    D. Large size

22. What are the reactants in photosynthesis?
    A. Glucose and oxygen
    B. Carbon dioxide and water
    C. Only ATP
    D. Only carbon dioxide

23. Which system regulates body functions through hormones?
    A. Nervous system
    B. Digestive system

C. Endocrine system

D. Respiratory system

24. If mRNA is AUGC, what was the DNA template strand?

A. TACG

B. ATGC

C. UACG

D. GCUA

25. Which vessels have the thickest walls?

A. Veins

B. Capillaries

C. Venules

D. Arteries

26. What is synthesized by the rough endoplasmic reticulum?

A. Lipids

B. ATP

C. Proteins

D. DNA

27. What term describes the genetic makeup of an organism?

A. Phenotype

B. Genotype

C. Allele

D. Chromosome

28. What occurs during the G1 phase?

A. Cell growth and normal functions

B. DNA replication

C. Cell division

D. Chromosome separation

29. What structures allow gas exchange in the lungs?

A. Bronchi

B. Trachea

C. Pharynx

D. Alveoli

30. What is a key difference between plant and animal cells?

A. Plant cells lack ribosomes

B. Animal cells lack cytoplasm

C. Plant cells have cell walls and chloroplasts

D. Animal cells have larger vacuoles

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 is the mass number?

   A. Number of protons only

   B. Number of neutrons only

   C. Sum of protons and neutrons

   D. Number of electrons only

2. Which subatomic particle has a negative charge?

   A. Proton

   B. Electron

   C. Neutron

   D. Ion

3. What type of bond involves unequal sharing of electrons?

   A. Polar covalent bond

   B. Ionic bond

   C. Metallic bond

   D. Nonpolar covalent bond

4. How many electrons can the third energy level hold?

   A. 2

   B. 8

   C. 32

   D. 18

5. What is produced when a strong acid reacts with a strong base?

   A. Only hydrogen gas

B. Salt and water

C. Only oxygen

D. Only carbon dioxide

6. What is the molar mass of nitrogen gas (N_2)? ($N = 14$ g/mol)

 A. 14 g/mol

 B. 7 g/mol

 C. 28 g/mol

 D. 42 g/mol

7. Which pH value indicates a strongly acidic solution?

 A. 2

 B. 7

 C. 10

 D. 14

8. In the equation $2H_2 + O_2 \rightarrow 2H_2O$, what is the coefficient of H_2?

 A. 1

 B. 3

 C. 4

 D. 2

9. Atoms with the same atomic number but different mass numbers are:

 A. Ions

 B. Molecules

 C. Isotopes

 D. Compounds

10. According to Boyle's Law at constant temperature, if volume doubles, pressure:

 A. Doubles

 B. Decreases to half

 C. Stays constant

 D. Becomes zero

11. What type of bond forms between two nonmetals?

 A. Covalent bond

 B. Ionic bond

 C. Metallic bond

 D. No bond

12. How many moles are in 128 grams of oxygen (O_2)? (Molar mass = 32 g/mol)
   A. 2 moles
   B. 32 moles
   C. 128 moles
   D. 4 moles

13. What is Avogadro's number?
   A. 1.66×10^{24}
   B. 3.14×10^{23}
   C. 6.022×10^{23}
   D. 1.00×10^{23}

14. Which property describes acids?
   A. Turn red litmus blue
   B. Taste sour
   C. Have pH greater than 7
   D. Feel slippery

15. Which state of matter has particles that move freely with large spaces between them?
   A. Solid
   B. Liquid
   C. Plasma
   D. Gas

16. What happens to electrons during ionic bonding?
   A. Electrons are transferred from one atom to another
   B. Electrons are shared equally
   C. Electrons disappear
   D. No electron movement

17. How many hydrogen atoms are in $3Al(OH)_3$?
   A. 3
   B. 6
   C. 9
   D. 27

18. What is the pH of a strongly basic solution?
   A. 0
   B. 7
   C. 1

D. 13

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

20. What type of reaction is $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$?
    A. Synthesis
    B. Decomposition
    C. Combustion
    D. Single replacement

21. How many times more basic is pH 11 compared to pH 8?
    A. 1000 times
    B. 3 times
    C. 100 times
    D. 10 times

22. What is the charge of an electron?
    A. -1
    B. +1
    C. 0
    D. Variable

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

24. What states that matter cannot be created or destroyed in chemical reactions?
    A. Boyle's Law
    B. Charles's Law
    C. Law of Conservation of Mass
    D. Dalton's Law

25. A 5 M solution is diluted from 40 mL to 200 mL. What is the new concentration?
    A. 1 M

B. 2 M
C. 3 M
D. 5 M

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

27. What is the number of particles in one mole?
   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 decreases at constant pressure?
   A. Volume increases
   B. Pressure changes
   C. Volume decreases
   D. Volume stays constant

29. A neutral nitrogen atom (atomic number = 7) has how many electrons?
   A. 14
   B. 6
   C. 8
   D. 7

30. When gas pressure increases at constant temperature, what happens to volume?
   A. Volume decreases
   B. Volume increases
   C. Volume stays constant
   D. Temperature changes

Answer Explanations - Practice Test 10

Reading Comprehension

1. Correct Answer: D (Filtering blood, regulating fluid balance, controlling blood pressure, and eliminating waste)

The passage states that "the urinary system, comprising the kidneys, ureters, bladder, and urethra, maintains homeostasis by filtering blood, regulating fluid and electrolyte balance, controlling blood pressure, and eliminating metabolic waste products." All four functions are explicitly listed together.

2. Correct Answer: A (180 liters)

The passage states that "this system processes approximately 180 liters of blood daily, producing 1-2 liters of urine that concentrates waste products for excretion." The specific volume of 180 liters is mentioned.

3. Correct Answer: C (High pressure forces water and solutes through the filtration membrane)

The passage states that "blood enters each nephron through the afferent arteriole into the glomerulus, a specialized capillary network where high pressure forces water and small solutes through the filtration membrane into Bowman's capsule." High pressure forcing filtration is the mechanism described.

4. Correct Answer: B (Approximately 65% of filtered sodium and water, plus all glucose and amino acids)

The passage states that "the filtrate then flows through the proximal convoluted tubule, where approximately 65% of filtered sodium and water are reabsorbed along with all filtered glucose and amino acids through active and passive transport mechanisms." All these substances are mentioned together.

5. Correct Answer: D (Increases water reabsorption producing concentrated urine)

The passage states that "antidiuretic hormone (ADH), released by the posterior pituitary in response to dehydration or increased blood osmolarity, increases water permeability of collecting duct cells, promoting water reabsorption and producing concentrated urine." Increased water reabsorption and concentrated urine production are the key effects.

6. Correct Answer: A (Increases sodium reabsorption and potassium secretion)

The passage states that "aldosterone, secreted by the adrenal cortex, increases sodium reabsorption and potassium secretion in the distal tubule and collecting duct." Both sodium reabsorption and potassium secretion are mentioned.

7. Correct Answer: C (Promotes sodium and water excretion, lowering blood pressure)

The passage states that "atrial natriuretic peptide (ANP), released when atrial stretch indicates increased blood volume, promotes sodium and water excretion, lowering blood pressure." Sodium and water excretion leading to lower blood pressure is the function described.

8. Correct Answer: D (Diabetes or hypertension)

The passage states that "chronic kidney disease (CKD) develops gradually, often from diabetes or hypertension, progressively reducing kidney function over months to years." Both diabetes and hypertension are specifically named as common causes.

9. Correct Answer: A (Communication between cells through chemical messengers)

The passage states that "cell signaling enables communication between cells through chemical messengers that coordinate physiological processes, regulate development, maintain homeostasis, and respond to environmental changes." Communication through chemical messengers is the primary function.

10. Correct Answer: D (Hormones traveling through the bloodstream)

The passage states that cell signaling includes "endocrine signaling (hormones traveling through bloodstream)." This is the specific definition provided for endocrine signaling.

11. Correct Answer: B (Respond to hormones, neurotransmitters, and sensory signals)

The passage states that "G protein-coupled receptors (GPCRs) represent the largest receptor family, responding to hormones, neurotransmitters, and sensory signals." All three types of signals are mentioned.

12. Correct Answer: C (Lipophilic ligands like steroid hormones)

The passage states that "intracellular receptors, located in the cytoplasm or nucleus, bind lipophilic ligands like steroid hormones and thyroid hormones that diffuse through the plasma membrane." Lipophilic ligands, specifically steroid hormones, are mentioned.

13. Correct Answer: D (Allows small numbers of signaling molecules to produce large responses)

The passage states that "signal amplification allows a small number of signaling molecules to produce large cellular responses through cascading enzyme activation." This is the precise definition of signal amplification.

14. Correct Answer: A (Produce overactive signaling proteins promoting excessive cell division)

The passage states that "oncogenes are mutated genes producing overactive signaling proteins that promote excessive cell division." Both overactivity and excessive cell division are mentioned.

15. Correct Answer: C (Insulin resistance where cells fail to respond properly)

The passage states that "diabetes mellitus involves defective insulin signaling, where Type 1 results from insufficient insulin production and Type 2 involves insulin resistance where cells fail to respond properly to insulin signals." Insulin resistance is the specific characteristic of Type 2.

16. Correct Answer: B (Blocking sodium channel signaling in nerve cells)

The passage states that "understanding cell signaling explains how local anesthetics work by blocking sodium channel signaling in nerve cells." Blocking sodium channels is the mechanism described.

17. Correct Answer: A (Information flow from DNA to RNA to protein)

The passage states that "the central dogma of molecular biology describes information flow from DNA to RNA to protein." This is the exact sequence described.

18. Correct Answer: B (Thymine)

The passage states that "base pairing rules specify that adenine pairs with thymine through two hydrogen bonds, while guanine pairs with cytosine through three hydrogen bonds." Adenine pairs with thymine.

19. Correct Answer: C (20,000-25,000)

The passage states that "genes are DNA segments encoding proteins or functional RNAs, with humans possessing approximately 20,000-25,000 genes distributed across 23 chromosome pairs." This specific range is given.

20. Correct Answer: A (Express their phenotype even when heterozygous)

The passage states that "dominant alleles express their phenotype even when heterozygous (one copy present), while recessive alleles require homozygosity (two copies) for expression." Expression in heterozygous state defines dominant alleles.

21. Correct Answer: D (Both alleles in heterozygotes are fully expressed)

The passage states that "codominance occurs when both alleles in heterozygotes are fully expressed, as in AB blood type." Full expression of both alleles is the definition.

22. Correct Answer: B (Males have only one X chromosome)

The passage states that "sex-linked inheritance involves genes on sex chromosomes, with X-linked recessive conditions like hemophilia and color blindness affecting males more frequently because males have only one X chromosome." Having only one X chromosome is the reason males are affected more.

23. Correct Answer: A (Trisomy 21 (three copies of chromosome 21))

The passage states that "chromosomal disorders include Down syndrome (trisomy 21, three copies of chromosome 21)." Trisomy 21 is explicitly defined.

24. Correct Answer: D (Why patients metabolize medications differently based on genetic variations)

The passage states that "understanding pharmacogenetics explains why patients metabolize medications differently based on genetic variations in drug-metabolizing enzymes." Differences in medication metabolism based on genetics is what pharmacogenetics explains.

25. Correct Answer: C (The central nervous system and peripheral nervous system)

The passage states that "this system divides anatomically into the central nervous system (brain and spinal cord) and the peripheral nervous system (nerves extending throughout the body)." Both CNS and PNS are named as the anatomical divisions.

26. Correct Answer: B (Schwann cells in PNS and oligodendrocytes in CNS)

The passage states that "myelin, produced by Schwann cells in the peripheral nervous system and oligodendrocytes in the central nervous system, insulates axons." Both cell types and their locations are specified.

27. Correct Answer: D (Autoimmune destruction of myelin)

The passage states that "multiple sclerosis results from autoimmune destruction of myelin, causing progressive neurological deterioration." Autoimmune destruction of myelin is the cause.

28. Correct Answer: A (-70 millivolts)

The passage states that "at rest, neurons maintain an electrical potential of approximately -70 millivolts inside relative to outside." This specific value is given.

29. Correct Answer: A (The all-or-nothing principle)

The passage states that "action potentials follow the all-or-nothing principle—they either occur fully or not at all, with stimulus strength encoded by firing frequency rather than action potential amplitude." The all-or-nothing principle is explicitly named.

30. Correct Answer: C (Primary excitatory signaling in the brain)

The passage states that "different neurotransmitters serve various functions: glutamate provides primary excitatory signaling in the brain." Primary excitatory signaling is glutamate's function.

31. Correct Answer: D (Blocking sodium channels to prevent action potential generation)

The passage states that "understanding neuroscience explains local anesthetic mechanisms (blocking sodium channels to prevent action potential generation)." Blocking sodium channels is the mechanism.

32. Correct Answer: C (The main inhibitory neurotransmitter)

The passage states that "different neurotransmitters serve various functions: glutamate provides primary excitatory signaling in the brain, GABA serves as the main inhibitory neurotransmitter." GABA's role as main inhibitory neurotransmitter is specified.

33. Correct Answer: A (Single-celled prokaryotic organisms lacking membrane-bound organelles)

The passage states that "bacteria represent single-celled prokaryotic organisms lacking membrane-bound organelles, with DNA located in a nucleoid region rather than a nucleus." All these characteristics are mentioned together.

34. Correct Answer: D (Thick peptidoglycan layers retaining crystal violet stain)

The passage states that "bacterial cells have cell walls containing peptidoglycan, with Gram-positive bacteria having thick peptidoglycan layers retaining crystal violet stain." Thick peptidoglycan and crystal violet retention characterize Gram-positive bacteria.

35. Correct Answer: B (20 minutes)

The passage states that "bacteria reproduce through binary fission, potentially doubling populations every 20 minutes under optimal conditions." The specific time of 20 minutes is given.

36. Correct Answer: C (Genetic material (DNA or RNA) in a protein coat)

The passage states that "viruses differ fundamentally from cells, consisting only of genetic material (DNA or RNA) enclosed in a protein coat (capsid)." Genetic material in a protein coat is the composition.

37. Correct Answer: A (They lack ribosomes and metabolic machinery)

The passage states that "viruses are obligate intracellular parasites requiring living host cells for replication because they lack ribosomes and metabolic machinery." Lacking ribosomes and metabolic machinery is the reason they need host cells.

38. Correct Answer: D (Exposing the immune system to weakened or killed pathogens)

The passage states that "vaccines prevent viral infections by exposing the immune system to weakened, killed, or component forms of viruses, generating protective immunity without causing disease." Exposure to weakened or killed forms is how vaccines work.

39. Correct Answer: C (Producing enzymes that destroy antibiotics)

The passage states that "resistance mechanisms include producing enzymes that destroy antibiotics (like beta-lactamases breaking down penicillins)." Producing enzymes that destroy antibiotics is one of the resistance mechanisms listed.

40. Correct Answer: B (Metabolizes sugars producing acid causing dental caries)

The passage states that "Streptococcus mutans metabolizes sugars producing acid causing dental caries." Sugar metabolism producing acid that causes cavities is the specific function.

Language Usage

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

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: B (nor the technicians were prepared)

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

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

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 complete."

4. Correct Answer: A (Between you and me, the new system is)

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

5. Correct Answer: C (emergency care, surgical procedures, and rehabilitation programs)

The sentence requires parallel structure. The original uses two nouns and then a verb phrase ("will offer rehabilitation programs"), which is not parallel. Option C maintains parallel structure by using three nouns: "emergency care, surgical procedures, and rehabilitation programs."

6. Correct Answer: B (After completing the assessment, the consultant recommended)

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

7. Correct Answer: A (methods, and they also enhance)

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.

8. Correct Answer: C (must complete his or her professional development requirements)

"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 manager submit the proposal)

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 manager submit" (not "submits").

10. Correct Answer: A (After evaluating the options carefully, the committee made a decision)

The original sentence contains a dangling modifier. "After evaluating the options carefully" must modify a subject that can logically evaluate—the committee, not "a decision." Option A correctly places "the committee" as the subject performing the action.

11. Correct Answer: D (has submitted his or her registration form)

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

12. Correct Answer: B (continuously; however, it undergoes)

"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 B uses the correct punctuation.

13. Correct Answer: C (Fewer employees attended)

"Less" is used with uncountable nouns, while "fewer" is used with countable nouns. "Employees" is countable, so "fewer" is correct. Option C properly uses "fewer employees."

14. Correct Answer: B (collected the data, analyzed the results, and wrote)

The original sentence lacks parallel structure. The first two verbs are in simple past tense ("collected," "analyzed"), but the third uses past progressive ("was writing"). Option B maintains parallel structure by using three simple past tense verbs.

15. Correct Answer: D (Dr. Thompson told Dr. Martinez that Dr. Thompson needed)

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

16. Correct Answer: A (affects all divisions 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 regulation influences divisions, followed by "take effect."

17. Correct Answer: D (crucial. All personnel must)

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

18. Correct Answer: A (who completed the training)

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

19. Correct Answer: C (Having analyzed the situation thoroughly, the team presented the conclusion)

The original sentence contains a dangling modifier. The phrase "Having analyzed the situation thoroughly" must modify "the team" (who did the analyzing), not "the conclusion." Option C correctly places "the team" immediately after the modifying phrase.

20. Correct Answer: A (should have reported)

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

21. Correct Answer: D (planning, implementation, or ongoing support)

The original sentence lacks parallel structure with a gerund phrase at the end. Option D maintains parallel structure by using three noun forms: "planning, implementation, or ongoing support." All three are in parallel grammatical form.

22. Correct Answer: C (performance; it enhances)

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

23. Correct Answer: B (the most effective strategy)

When comparing more than two items (six proposed solutions), use the superlative form ("most effective"), not the comparative form ("more effective"). Option B properly uses the superlative.

24. Correct Answer: A (University Avenue near the medical complex in Portland, Oregon)

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

25. Correct Answer: D (After the presentation was completed, the participants received)

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: C (when they could finalize)

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 C uses correct word order and appropriate tense.

27. Correct Answer: B (both agree that)

The compound subject "the manager and her team" is plural (two entities), so the verb must be "agree" (plural), not "agrees" (singular). Option B correctly uses the plural verb form.

28. Correct Answer: D (are critical)

The compound subject consists of three items ("communication," "leadership," and "development") connected by commas and "and," making it plural. Therefore, the verb must be "are" (plural), not "is" (singular). Option D correctly uses the plural verb.

29. Correct Answer: C (outcomes, and it also increases)

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.

30. Correct Answer: C (programs, such as leadership training, management development, and executive coaching)

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 important roles)

The compound subject "executives, managers, and supervisors" 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 lay the documents on the table)

"Lay" is a transitive verb meaning to place or put something down, and it requires a direct object. In this sentence, "documents" is the object being placed. "Lie" is an intransitive verb meaning to recline or rest, and it does not take an object. Since we are placing documents (an object) on the table, "lay" is correct. Additionally, "on the table" is the correct preposition for placement on a surface. Option A uses both the correct verb and preposition.

33. Correct Answer: D (significantly allowing providers to implement)

The participial phrase "allowing providers to implement innovative strategies" modifies the main clause. When a participial phrase flows naturally from the main clause without requiring separation, no comma is needed. Option D maintains this structure without unnecessary punctuation.

34. Correct Answer: C (stagnation. It promotes)

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

35. Correct Answer: B (requires candidates to complete coursework before examination)

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 B maintains the correct structure.

36. Correct Answer: C (resources, such as training materials and technical support, but)

The phrase "such as training materials and technical support" is a nonrestrictive element providing examples, so it should be set off with commas on both sides. Option C correctly places commas before "such as" and after "support," with "but" properly positioned.

37. Correct Answer: B (more accessible to clients than the former location was)

For complete parallelism in comparisons, including the verb "was" makes the comparison clearer and more grammatically complete. Option B provides the most complete comparative structure.

38. Correct Answer: B (setting clear goals, maintaining focus, and pursuing continuous improvement)

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

39. Correct Answer: A (had been impressive)

The past perfect tense "had been impressive" is correct because the results were impressive in the past and continued throughout another past period (the entire project). This sequence of past events requires past perfect to show the earlier, ongoing state.

40. Correct Answer: D (costs, and it also improves)

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.

Quantitative Reasoning

1. Correct Answer: A (5)

To solve 10x - 18 = 32, first add 18 to both sides: 10x = 50. Then divide both sides by 10: x = 5. Verification: 10(5) - 18 = 50 - 18 = 32 ✓

2. Correct Answer: D (25%)

Percent increase formula: (New - Old)/Old × 100. Calculate: (250 - 200)/200 × 100 = 50/200 × 100 = 0.25 × 100 = 25%. Patient treatments increased by 25%.

3. Correct Answer: C (9)

To solve 12y - 11 = 9y + 16, subtract 9y from both sides: 3y - 11 = 16. Add 11 to both sides: 3y = 27. Divide by 3: y = 9. Verification: 12(9) - 11 = 108 - 11 = 97, and 9(9) + 16 = 81 + 16 = 97 ✓

4. Correct Answer: B ($2,000)

Calculate weekly earnings: $50/hour × 8 hours/day × 5 days/week = $2,000 per week. Break it down: Daily earnings = $50 × 8 = $400; Weekly earnings = $400 × 5 = $2,000.

5. Correct Answer: D (176)

To find 32% of 550, multiply: 0.32 × 550 = 176. Alternatively, 32% is the same as 32/100, so (32/100) × 550 = 17,600/100 = 176.

6. Correct Answer: A (521)

Substitute a = 9 and b = -7 into 6a² - 5b. Calculate: 6(9)² - 5(-7) = 6(81) - (-35) = 486 + 35 = 521.

7. Correct Answer: C (90 mg)

Multiply the dosage rate by body weight: 1.2 mg/kg × 75 kg = 90 mg. The units of kilograms cancel out, leaving milligrams as the answer.

8. Correct Answer: B (8)

Expand the left side: 7(x + 10) = 7x + 70. Set equal to right side: 7x + 70 = 5x + 86. Subtract 5x from both sides: 2x + 70 = 86. Subtract 70: 2x = 16. Divide by 2: x = 8.

9. Correct Answer: A (2/5)

Total balls = 16 + 14 + 10 = 40 balls. Green balls = 16. Probability of selecting green = 16/40 = 2/5 (simplified by dividing numerator and denominator by 8).

10. Correct Answer: D (7,500 meters)

To convert kilometers to meters, multiply by 1,000 (since 1 km = 1,000 m): 7.5 km × 1,000 m/km = 7,500 meters. This is a standard metric conversion.

11. Correct Answer: B (638)

Substitute x = 11 into $6x^2$ - 8x: $6(11)^2$ - 8(11) = 6(121) - 88 = 726 - 88 = 638. Follow the order of operations: exponents first, then multiplication, then subtraction.

12. Correct Answer: C (25%)

Percent decrease = (Old - New)/Old × 100 = (5,400 - 4,050)/5,400 × 100 = 1,350/5,400 × 100 = 0.25 × 100 = 25%. The equipment costs decreased by 25%.

13. Correct Answer: D (43x - 129)

Distribute: 9(6x - 7) - 11(x + 6) = 54x - 63 - 11x - 66. Combine like terms: (54x - 11x) + (-63 - 66) = 43x - 129. Remember to distribute the negative sign in -11(x + 6).

14. Correct Answer: A (4)

If the ratio is 1:60 and there are 240 patients, find the number of doctors: 240 ÷ 60 = 4 doctors. This maintains the 1:60 ratio (4:240 = 1:60).

15. Correct Answer: B (84)

Solve x/12 + 9 = 16. First subtract 9 from both sides: x/12 = 7. Then multiply both sides by 12: x = 84. Verification: 84/12 + 9 = 7 + 9 = 16 ✓

16. Correct Answer: D (4.8°F)

The increase is found by subtracting the original value from the new value: 103.0 - 98.2 = 4.8°F. This represents the amount of temperature increase.

17. Correct Answer: A (10)

Substitute x = 13 into 11x - 8y = 63: 11(13) - 8y = 63, which gives 143 - 8y = 63. Subtract 143 from both sides: -8y = -80. Divide by -8: y = 10.

18. Correct Answer: D ($480)

Calculate the 40% discount amount: 0.40 × $800 = $320. Subtract the discount from the original price: $800 - $320 = $480. The discounted price is $480.

19. Correct Answer: C (13)

Solve 14x - 14 = 11x + 25. Subtract 11x from both sides: 3x - 14 = 25. Add 14 to both sides: 3x = 39. Divide by 3: x = 13.

20. Correct Answer: A (38)

To find the mean, add all values and divide by the count: (26 + 32 + 38 + 44 + 50)/5 = 190/5 = 38. The mean is the arithmetic average of the data set.

21. Correct Answer: B (456 mL)

Calculate 48% of 950 mL: 0.48 × 950 = 456 mL. Alternatively, 48% is the same as 48/100, and 950 × 48/100 = 45,600/100 = 456 mL.

22. Correct Answer: D (18 and -18)

When x^2 = 324, take the square root of both sides. Remember that square roots have both positive and negative solutions: x = +18 or x = -18. Both values satisfy the equation: $(18)^2$ = 324 and $(-18)^2$ = 324.

23. Correct Answer: C (432)

Multiply: 24 patients/day × 6 days/week × 3 weeks = 432 patients total. Calculate step by step: 24 × 6 = 144 patients per week, then 144 × 3 = 432 patients in 3 weeks.

24. Correct Answer: B ($70x^{15}$)

When multiplying powers with the same base, multiply the coefficients and add the exponents: $(10x^9)(7x^6) = (10 \times 7)(x^{9+6}) = 70x^{15}$. Coefficient: 10 × 7 = 70. Exponent: 9 + 6 = 15.

25. Correct Answer: A (56%)

Convert the fraction to a decimal first: 14/25 = 0.56. Then multiply by 100 to get the percentage: 0.56 × 100 = 56%. Alternatively, 14/25 = 56/100 = 56%.

26. Correct Answer: C (18)

Calculate total hours in 6 days: 6 days × 24 hours/day = 144 hours. Divide by the dosing interval: 144 hours ÷ 8 hours/dose = 18 doses. The patient takes medication 3 times per day for 6 days.

27. Correct Answer: D (34 cm)

Perimeter formula for rectangle: $P = 2L + 2W$. Substitute known values: $120 = 2L + 2(26)$, which gives $120 = 2L + 52$. Subtract 52: $68 = 2L$. Divide by 2: $L = 34$ cm.

28. Correct Answer: A (8)

Solve $13x - 24 = 12x - 16$. Subtract 12x from both sides: $x - 24 = -16$. Add 24 to both sides: $x = 8$. Verification: $13(8) - 24 = 104 - 24 = 80$ and $12(8) - 16 = 96 - 16 = 80$ ✓

29. Correct Answer: D ($1,351.60)

Calculate 9% tax on $1,240: $0.09 × \$1,240 = \$111.60$. Add tax to original cost: $\$1,240 + \$111.60 = \$1,351.60$. The total cost including sales tax is $1,351.60.

30. Correct Answer: B (32)

The median is the middle value when data is arranged in order. The data set 20, 26, 32, 38, 44 is already ordered. With 5 values, the middle (3rd) value is 32.

31. Correct Answer: A (25)

First solve for x: $10x - 18 = 32$. Add 18 to both sides: $10x = 50$. Divide by 10: $x = 5$. Then calculate 5x: $5(5) = 25$.

32. Correct Answer: C (4,200 mL)

Convert liters to milliliters by multiplying by 1,000 (since 1 L = 1,000 mL): $4.2 \text{ L} × 1,000 \text{ mL/L} = 4,200$ mL. This is a standard metric conversion.

33. Correct Answer: D (123)

Calculate step by step: $(-9)^2 - 7(-6)$. First, $(-9)^2 = 81$ (squaring a negative gives a positive). Second, $-7(-6) = +42$ (multiplying two negatives gives a positive). Finally, $81 + 42 = 123$.

34. Correct Answer: B (32)

Calculate 40% of 80: $0.40 × 80 = 32$ nurses. Alternatively, 40% is the same as $40/100 = 2/5$, and $80 × 2/5 = 160/5 = 32$ nurses work at the hospital.

35. Correct Answer: C (144)

Solve $x/16 = 9$ by multiplying both sides by 16: $x = 9 \times 16 = 144$. Verification: $144/16 = 9$ ✓

36. Correct Answer: B (5/8)

Convert 0.625 to a fraction: $0.625 = 625/1000$. Simplify by dividing both numerator and denominator by 125: $625/1000 = 5/8$. This fraction is in simplest form since 5 and 8 share no common factors.

37. Correct Answer: D (28)

Use the elimination method. Add the two equations: $(x + y) + (x - y) = 38 + 18$, which gives $2x = 56$. Divide by 2: $x = 28$. The y terms cancel when adding the equations.

38. Correct Answer: A (109.4°F)

Substitute $C = 43$ into $F = (9/5)C + 32$: $F = (9/5)(43) + 32 = 1.8(43) + 32 = 77.4 + 32 = 109.4°F$. This represents a high fever temperature.

39. Correct Answer: C (24)

The range is the difference between the maximum and minimum values: $50 - 26 = 24$. Range measures the spread of the data from lowest to highest value.

40. Correct Answer: B (2:3)

Write the ratio: 180:270. Simplify by dividing both numbers by their GCF (90): $180/90 = 2$ and $270/90 = 3$. 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 = 64°, Angle 2 = 126°, Angle 3 = 88°, Angle 4 = 147°. Ordering from largest to smallest: 147°, 126°, 88°, 64°. The second largest angle is 126° (Angle 2).

2. Correct Answer: A (Angle A)

The three angles measure: Angle A = 45°, Angle B = 136°, Angle C = 102°. Acute angles measure less than 90°. Only Angle A at 45° is acute. It is also the smallest of all three angles.

3. Correct Answer: C (67°)

The five angles measure 36°, 103°, 67°, 155°, and 94°. Ordering from smallest to largest: 36°, 67°, 94°, 103°, 155°. The third smallest angle is 67°.

4. Correct Answer: A (51°)

The four angles measure 51°, 116°, 79°, and 143°. Comparing all measurements, 51° is the smallest angle shown.

5. Correct Answer: D (134°, 88°, 54°)

The three angles measure 88°, 134°, and 54°. Arranging from largest to smallest: 134°, 88°, 54°. This represents the correct descending order.

6. Correct Answer: B (68°)

Acute angles measure less than 90°. From the five angles (43°, 111°, 82°, 159°, 68°), the acute angles are 43°, 82°, and 68°. Comparing distances from 70°: 43° is 27° away, 82° is 12° away, and 68° is 2° away. Angle 68° is closest to 70°.

7. Correct Answer: A (29°)

The four angles measure 29°, 107°, 60°, and 174°. Comparing all measurements, 29° is the smallest angle shown.

8. Correct Answer: C (101°)

Obtuse angles measure between 90° and 180°. From the three angles (45°, 101°, 166°), angle 101° is obtuse and less than 110°. Angle 45° is acute, and 166° is obtuse but greater than 110°.

9. Correct Answer: D (148°)

The five angles measure 52°, 115°, 78°, 148°, and 61°. Comparing all measurements, 148° is the largest angle shown.

10. Correct Answer: B (76°)

The four angles measure 76°, 139°, 41°, and 102°. Ordering from smallest to largest: 41°, 76°, 102°, 139°. The second smallest angle is 76°.

11. Correct Answer: C (83°)

The three acute angles measure 50°, 83°, and 71°. Comparing all three, 83° is the largest angle.

12. Correct Answer: D (177°)

The five angles measure 126°, 97°, 62°, 177°, and 85°. Comparing all measurements, 177° is the largest angle shown.

13. Correct Answer: A (33°)

The four angles measure 33°, 112°, 84°, and 153°. Comparing all measurements, 33° is the smallest angle shown.

14. Correct Answer: C (96°)

Obtuse angles measure between 90° and 180°. From the three angles (129°, 56°, 96°), the obtuse angles are 129° and 96°. Angle 96° is obtuse and closest to 100° (4° away), while 129° is 29° away from 100°.

15. Correct Answer: B (161°, 117°)

The five angles measure 48°, 117°, 74°, 161°, and 92°. Ordering all angles from largest to smallest: 161°, 117°, 92°, 74°, 48°. The two largest angles in order are 161°, 117°.

APERTURES (Questions 16-30)

16. Correct Answer: B (A rectangle 15 cm × 17 cm)

A rectangular prism measuring 11 cm × 15 cm × 17 cm has three possible face orientations. The largest face measures 15 cm × 17 cm. This rectangular aperture would accommodate the largest face when properly oriented.

17. Correct Answer: C (A circle with at least 15 cm diameter)

When a cylinder with diameter 15 cm is oriented with its circular end forward, the cross-section presented is circular with 15 cm diameter. The aperture must be a circle with at least 15 cm diameter to allow passage.

18. Correct Answer: D (A square 15 cm × 15 cm or larger)

A pyramid with a square base measuring 15 cm × 15 cm requires a square aperture of at least 15 cm × 15 cm to accommodate the base when oriented base-first.

19. Correct Answer: D (14 cm × 14 cm)

A cube measuring 14 cm on each side, when oriented face-first, presents a square cross-section of 14 cm × 14 cm. This is the exact size needed for the smallest square aperture through which it can pass.

20. Correct Answer: A (An equilateral triangle 13 cm sides)

A triangular prism with an equilateral triangular base measuring 13 cm on each side, when entering triangle-first, requires an aperture matching that triangular shape with 13 cm sides.

21. Correct Answer: C (A rectangle 13 cm × 16 cm or larger)

An L-shaped object with overall dimensions of 13 cm wide and 16 cm tall requires a rectangular aperture of at least 13 cm × 16 cm to accommodate the entire object's profile when passing through.

22. Correct Answer: B (A circle with at least 18 cm diameter)

A sphere with an 18 cm diameter requires a circular aperture of at least 18 cm diameter to pass through, regardless of orientation, since a sphere presents the same circular profile from any angle.

23. Correct Answer: A (A rectangle 13 cm × 15 cm)

A rectangular block measuring 13 cm × 15 cm × 11 cm, when oriented with the 13 cm × 15 cm face forward, requires a rectangular aperture of at least 13 cm × 15 cm to pass through.

24. Correct Answer: D (A hexagon approximately 13 cm across)

A hexagonal prism with a 13 cm wide hexagonal base, when entering hexagon-first, requires an aperture that matches the hexagonal shape, approximately 13 cm across at its widest point.

25. Correct Answer: C (A rectangle 17 cm × 19 cm)

A T-shaped object with overall dimensions of 17 cm wide and 19 cm tall requires a rectangular aperture of at least 17 cm × 19 cm to accommodate the entire T profile when passing through face-first.

26. Correct Answer: A (An ellipse or rectangle 14 cm × 17 cm)

An ellipsoid measuring 14 cm × 17 cm × 12 cm, when oriented with the 14 cm × 17 cm face forward, requires an elliptical or rectangular aperture of approximately 14 cm × 17 cm.

27. Correct Answer: B (A square 15 cm × 15 cm or larger)

A cross-shaped object with arms extending 15 cm in each direction requires a square aperture of at least 15 cm × 15 cm to accommodate the full width and height of the cross profile when entering face-first.

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

A cone with a base diameter of 17 cm, when oriented base-first, presents a circular cross-section of 17 cm diameter. The aperture must be a circle with at least 17 cm diameter.

29. Correct Answer: A (A rounded rectangle approximately 13 cm × 15 cm)

A rectangular block measuring 13 cm × 15 cm × 19 cm with 2 cm radius curves on the ends requires a rounded rectangular aperture of approximately 13 cm × 15 cm to accommodate the curved end profile.

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

An irregular object with maximum dimensions of 14 cm × 16 cm × 12 cm, when oriented with its smallest face (14 cm × 12 cm) forward, requires a rectangular aperture of at least 14 cm × 12 cm.

ORTHOGRAPHIC PROJECTIONS (Questions 31-45)

31. Correct Answer: B (A cylinder oriented horizontally)

A rectangular top view, rectangular front view, and circular end view indicates a cylinder oriented horizontally (lying on its side). The circular cross-section is visible from the end view, while the rectangular profile is visible from top and front.

32. Correct Answer: D (A cone)

A circular top view, triangular front view, and circular end view indicates a cone. The circular base is visible from top and end views, while the triangular profile is visible from the front.

33. Correct Answer: C (Front view only)

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

34. Correct Answer: A (A decagonal prism)

Decagonal (10-sided) top and end views combined with a rectangular front view indicates a decagonal prism—an object with a uniform ten-sided cross-section throughout its length.

35. Correct Answer: D (Four cylinders arranged in a row)

A rectangular top view, four circles in the front view, and rectangular end view suggests four cylindrical objects positioned side by side horizontally.

36. Correct Answer: B (Five rectangular prisms with dividing features)

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

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

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

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

An octagon with a line in both the top and end views, combined with two pentagons in the front view, suggests two octagonal sections with a dividing feature or diagonal separation between them.

39. Correct Answer: A (An F-shaped prism)

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

40. Correct Answer: B (Nine cubes in a row)

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

41. Correct Answer: D (A cylinder oriented horizontally)

A circular top view, circular front view, and rectangular end view indicates a cylinder oriented horizontally (lying on its side). The circular cross-section is visible from the top and front, while the end view shows the length as a rectangle.

42. Correct Answer: A (Four cylindrical sections with cross divisions)

A circle with a cross in both the top and end views, combined with four rectangles in the front view, suggests four cylindrical sections arranged with cross-shaped divisions.

43. Correct Answer: C (An octagonal prism)

Octagonal top and end views combined with a rectangular front view indicates an octagonal prism—an object with a uniform eight-sided cross-section throughout its length.

44. Correct Answer: D (Seven cylinders arranged in circle pattern)

Seven circles in a circle pattern in the top view, seven rectangles in the front view, and a circle in the end view suggests seven cylindrical objects arranged in a circular pattern.

45. Correct Answer: B (An H-shaped prism)

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

CUBE COUNTING (Questions 46-60)

46. Correct Answer: A (288)

A structure with 8 layers arranged $6 \times 6 \times 8$ contains: 6 cubes wide $\times$ 6 cubes deep $\times$ 8 cubes high = 288 total cubes. Multiply the three dimensions to find the total count.

47. Correct Answer: C (386)

In a $9 \times 9 \times 9$ cube structure containing 729 total cubes, only the interior cubes ($7 \times 7 \times 7 = 343$ cubes) have no faces exposed. Therefore, cubes on the surface with at least one face exposed = 729 - 343 = 386 cubes.

48. Correct Answer: D (480)

A $6 \times 8 \times 10$ structure contains: 6 cubes $\times$ 8 cubes $\times$ 10 cubes = 480 total cubes. Multiply the three dimensions to find the total count.

49. Correct Answer: B (8)

In a $12 \times 12 \times 12$ 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: C (110)

With 11 layers and 10 cubes per layer arranged 2×5: Total cubes = 11 layers $\times$ 10 cubes per layer = 110 cubes. Alternatively, $2 \times 5 \times 11 = 110$ cubes.

51. Correct Answer: A (8)

Any rectangular prism has exactly 8 corners (vertices). In a 6 × 9 × 10 structure, there are 8 corner cubes where three edges meet.

52. Correct Answer: D (1,320)

A structure 12 cubes high × 11 cubes wide × 10 cubes deep contains: 12 × 11 × 10 = 1,320 total cubes. Multiply the three dimensions to find the total count.

53. Correct Answer: B (26)

An L-shaped structure with 14 cubes on one arm and 13 on the other, sharing 1 corner cube: Total = 14 + 13 - 1 = 26 cubes. Subtract the shared corner cube to avoid counting it twice.

54. Correct Answer: A (44)

In a 12 × 12 × 1 flat structure, cubes with exactly two painted faces are the perimeter cubes excluding corners. Perimeter cubes = 12 + 12 + 12 + 12 - 4 corners = 48 - 4 = 44 cubes with two painted faces.

55. Correct Answer: C (33)

A staircase structure with 9 cubes on first step, 11 on second, and 13 on third contains: 9 + 11 + 13 = 33 total cubes. This is the sum of the arithmetic sequence.

56. Correct Answer: D (8)

Any rectangular prism has exactly 8 corners (vertices). In an 11 × 12 × 13 structure, there are 8 corner cubes where three faces meet at each corner position.

57. Correct Answer: B (12)

In a 14 × 1 × 1 structure (14 cubes in a row), the 2 end cubes have 5 faces painted, and the 12 middle cubes have exactly 4 faces painted (top, bottom, front, back—not the two sides touching adjacent cubes).

58. Correct Answer: C (286)

Bottom layer: 11 × 11 = 121 cubes. Next layer: 9 × 9 = 81 cubes. Next layer: 7 × 7 = 49 cubes. Next layer: 5 × 5 = 25 cubes. Next layer: 3 × 3 = 9 cubes. Top layer: 1 cube. Total = 121 + 81 + 49 + 25 + 9 + 1 = 286 cubes in this pyramid structure.

59. Correct Answer: A (1,324)

An 11 × 11 × 11 cube contains 1,331 total cubes. With seven corner cubes removed: 1,331 - 7 = 1,324 cubes remain.

60. Correct Answer: D (23)

A plus-shaped structure with 12 cubes for vertical arm and 12 cubes for horizontal arm, sharing 1 center cube: Total = 12 + 12 - 1 = 23 cubes. The center cube where the arms intersect is counted only once.

Biology

1. Correct Answer: B (Protein synthesis)

The primary function of ribosomes is protein synthesis. Ribosomes are the cellular structures where translation occurs—they read messenger RNA (mRNA) sequences and assemble amino acids in the correct order to create proteins. Ribosomes can be found free-floating in the cytoplasm or attached to the endoplasmic reticulum, and they are essential for producing all cellular proteins.

2. Correct Answer: D (Golgi apparatus)

The Golgi apparatus is responsible for modifying, sorting, and packaging proteins. After proteins are synthesized by ribosomes and processed in the endoplasmic reticulum, they are sent to the Golgi apparatus where they undergo further modifications such as glycosylation (adding carbohydrates). The Golgi then sorts these proteins and packages them into vesicles for transport to their final destinations.

3. Correct Answer: A (Prophase)

During prophase of mitosis, chromosomes first become visible under a microscope. The chromatin condenses and coils tightly, forming distinct, visible chromosomes. The nuclear envelope also begins to break down during prophase, and the mitotic spindle starts to form.

4. Correct Answer: C (Endocytosis)

Endocytosis is the process by which cells take in large particles or liquids by engulfing them with the cell membrane. The membrane surrounds the material and pinches off to form a vesicle inside the cell. This includes phagocytosis (cell eating) for solid particles and pinocytosis (cell drinking) for liquids.

5. Correct Answer: B (Brings amino acids to ribosomes)

The function of transfer RNA (tRNA) is to bring amino acids to ribosomes during translation. Each tRNA molecule has an anticodon that matches a specific codon on mRNA and carries the corresponding amino acid. The tRNA delivers its amino acid to the growing protein chain at the ribosome.

6. Correct Answer: A (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 differs from gametes which contain 23 chromosomes (haploid number).

7. Correct Answer: D (Uracil)

In RNA, adenine pairs with uracil. RNA differs from DNA in that it contains uracil (U) instead of thymine (T). The base pairing rules in RNA are: adenine pairs with uracil, and guanine pairs with cytosine.

8. Correct Answer: C (Blending producing intermediate phenotype)

Incomplete dominance is the inheritance pattern where neither allele is completely dominant, resulting in a blending that produces an intermediate phenotype in heterozygotes. For example, when a red flower and a white flower cross, the offspring may be pink. This differs from codominance where both alleles are fully expressed.

9. Correct Answer: B (Prophase)

During prophase, DNA condenses into visible chromosomes. The chromatin that was loosely distributed in the nucleus during interphase coils and condenses into distinct chromosomes. This condensation makes the chromosomes visible under a microscope and prepares them for segregation during cell division.

10. Correct Answer: D (Plasma)

Plasma is the blood component that transports nutrients and wastes. Plasma is the liquid portion of blood (about 55% of total blood volume) and carries dissolved nutrients, hormones, waste products, proteins, and gases throughout the body. Red blood cells carry oxygen, white blood cells fight infection, and platelets aid in clotting.

11. Correct Answer: A (Chemical and mechanical digestion)

The primary function of the stomach is chemical and mechanical digestion. The stomach mechanically churns food and mixes it with gastric juice containing hydrochloric acid and enzymes

(like pepsin) that chemically break down proteins. This converts food into a semi-liquid mixture called chyme before it moves to the small intestine.

12. Correct Answer: B (Muscle tissue)

Muscle tissue is the tissue type that enables movement. There are three types of muscle tissue: skeletal muscle (voluntary movement of bones), cardiac muscle (heart contractions), and smooth muscle (involuntary movements in organs). All muscle tissue can contract and generate force to produce movement.

13. Correct Answer: C (25%)

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

14. Correct Answer: D (Mitosis)

Mitosis is the cell division process that produces two identical diploid daughter cells. Each daughter cell receives an exact copy of the parent cell's genetic material. Mitosis is used for growth, repair, and asexual reproduction, maintaining the same chromosome number in daughter cells as in the parent cell.

15. Correct Answer: D (mRNA)

Messenger RNA (mRNA) is the type of RNA that carries genetic information from the nucleus to ribosomes. During transcription, DNA is copied into mRNA in the nucleus. The mRNA then travels to the cytoplasm where ribosomes use it as a template for protein synthesis during translation.

16. Correct Answer: B (White blood cells)

White blood cells (leukocytes) are the blood component that fights disease. They are part of the immune system and defend the body against pathogens, foreign substances, and abnormal cells through various mechanisms including phagocytosis, antibody production, and direct cellular attack.

17. Correct Answer: C (Cardiac muscle)

Cardiac muscle is the type of muscle found in the heart. It is striated like skeletal muscle but contracts involuntarily like smooth muscle. Cardiac muscle has unique properties including intercalated discs that allow coordinated contractions and the ability to contract rhythmically without nervous stimulation.

18. Correct Answer: A (Copying DNA into RNA)

Transcription is the process of copying DNA into RNA. During transcription, RNA polymerase reads the DNA template strand and synthesizes a complementary RNA molecule (usually mRNA). This is the first step in gene expression, transferring genetic information from DNA to RNA.

19. Correct Answer: D (Mitochondrion)

The mitochondrion is the organelle that produces ATP through cellular respiration. Mitochondria are often called the "powerhouse of the cell" because they generate most of the cell's adenosine triphosphate (ATP) by breaking down glucose and other nutrients in the presence of oxygen.

20. Correct Answer: B (Maintain bone through remodeling)

Osteoclasts and osteoblasts work together to maintain bone through remodeling. Osteoblasts build new bone tissue by secreting bone matrix, while osteoclasts break down old or damaged bone tissue through resorption. This continuous remodeling maintains bone strength, repairs damage, and regulates calcium levels in the blood.

21. Correct Answer: A (Lack of membrane-bound nucleus)

Prokaryotic cells are defined by their lack of a membrane-bound nucleus. Their DNA is located in a nucleoid region rather than enclosed in a nuclear envelope. Prokaryotic cells also lack other membrane-bound organelles like mitochondria, endoplasmic reticulum, and Golgi apparatus.

22. Correct Answer: B (Carbon dioxide and water)

The reactants in photosynthesis are carbon dioxide and water. During photosynthesis, plants use light energy to convert carbon dioxide (CO_2) and water (H_2O) into glucose ($C_6H_{12}O_6$) and oxygen (O_2). The overall equation is: $6CO_2 + 6H_2O + \text{light energy} \rightarrow C_6H_{12}O_6 + 6O_2$.

23. Correct Answer: C (Endocrine system)

The endocrine system regulates body functions through hormones. It consists of glands (such as the pituitary, thyroid, adrenal glands, and pancreas) that secrete hormones directly into the bloodstream. These hormones regulate metabolism, growth, reproduction, stress responses, and many other physiological processes.

24. Correct Answer: A (TACG)

If mRNA is AUGC, the DNA template strand was TACG. During transcription, DNA is read and complementary mRNA is formed using base pairing rules where DNA adenine pairs with RNA uracil (U), DNA thymine pairs with RNA adenine (A), DNA guanine pairs with RNA cytosine (C),

and DNA cytosine pairs with RNA guanine (G). Working backwards: mRNA A came from DNA T, mRNA U came from DNA A, mRNA G came from DNA C, mRNA C came from DNA G.

25. Correct Answer: D (Arteries)

Arteries are the vessels that have the thickest walls. Arteries carry blood away from the heart under high pressure and have thick, muscular, elastic walls that can withstand and regulate this pressure. The thick walls help maintain blood pressure and control blood flow to tissues.

26. Correct Answer: C (Proteins)

Proteins are synthesized by the rough endoplasmic reticulum (rough ER). 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 "rough" appearance comes from these attached ribosomes.

27. Correct Answer: B (Genotype)

Genotype is the term that describes the genetic makeup of an organism. It refers to the specific alleles (gene variants) an organism possesses, which may or may not be expressed in the observable characteristics. This contrasts with phenotype, which describes the observable traits.

28. Correct Answer: A (Cell growth and normal functions)

During the G1 phase (Gap 1 phase) of interphase, the cell undergoes growth and performs its normal metabolic functions. The cell increases in size, produces RNA and proteins, and synthesizes enzymes needed for DNA replication. G1 occurs before the S phase where DNA replication takes place.

29. Correct Answer: D (Alveoli)

Alveoli are the structures that allow gas exchange in the lungs. These tiny, thin-walled air sacs are surrounded by capillaries where oxygen diffuses from the air into the blood and carbon dioxide diffuses from the blood into the air for exhalation. The large surface area of millions of alveoli makes efficient gas exchange possible.

30. Correct Answer: C (Plant cells have cell walls and chloroplasts)

A key difference between plant and animal cells is that plant cells have cell walls and chloroplasts, while animal cells do not. The cell wall provides structural support and protection, while chloroplasts enable photosynthesis. Plant cells also typically have large central vacuoles, while animal cells have smaller vacuoles if any.

General Chemistry

1. Correct Answer: C (Sum of protons and neutrons)

The mass number is the sum of protons and neutrons in an atom's nucleus. It represents the total number of nucleons (nuclear particles) and determines the atom's mass. For example, carbon-12 has 6 protons and 6 neutrons, giving it a mass number of 12. The mass number differs from the atomic number, which is only the number of protons.

2. Correct Answer: B (Electron)

Electrons are subatomic particles with a negative electrical charge (-1). They orbit the nucleus and are much lighter than protons or neutrons. Protons have positive charge (+1), neutrons have no charge (neutral), and ions are charged atoms or molecules rather than subatomic particles.

3. Correct Answer: A (Polar covalent bond)

A polar covalent bond forms when electrons are shared unequally between atoms. This occurs when atoms with different electronegativities bond, causing the shared electrons to be pulled more toward the more electronegative atom. This creates partial positive and negative charges on the atoms. Water (H_2O) is a classic example with polar covalent bonds.

4. Correct Answer: D (18)

The third energy level (shell) can hold a maximum of 18 electrons, calculated using the formula $2n^2$ where n is the shell number. For the third shell: $2(3)^2 = 2(9) = 18$ electrons maximum. The first shell holds 2, the second holds 8, the third holds 18, and the fourth can hold 32.

5. Correct Answer: B (Salt and water)

When a strong acid reacts with a strong base, a neutralization reaction occurs producing salt and water. 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: C (28 g/mol)

The molar mass of nitrogen gas (N_2) is calculated by adding the atomic masses: 2 nitrogen atoms $\times$ 14 g/mol = 28 g/mol total. Note that nitrogen gas exists as a diatomic molecule (N_2), so we must account for two nitrogen atoms.

7. Correct Answer: A (2)

The pH scale ranges from 0 to 14, with pH 7 being neutral. Strongly acidic solutions have pH values much less than 7, typically between 0 and 3. Among the options, pH 2 indicates a strongly acidic solution. pH 7 is neutral, while pH 10 and 14 are basic.

8. Correct Answer: D (2)

In the balanced equation $2H_2 + O_2 \rightarrow 2H_2O$, the coefficient of H_2 is 2. This coefficient indicates that 2 molecules of hydrogen gas are required to react with 1 molecule of oxygen gas to produce 2 molecules of water.

9. Correct Answer: C (Isotopes)

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

10. Correct Answer: B (Decreases to half)

According to Boyle's Law, at constant temperature, pressure and volume are inversely proportional ($P_1V_1 = P_2V_2$). If volume doubles, pressure must decrease to half to maintain the relationship. This explains why expanding a gas decreases its pressure.

11. Correct Answer: A (Covalent bond)

A covalent bond forms between two nonmetals when they share electrons. Nonmetals have similar electronegativities, so they tend to share electrons rather than transfer them. Examples include H_2, O_2, N_2, and molecular compounds like H_2O and CO_2.

12. Correct Answer: D (4 moles)

To calculate moles, divide mass by molar mass: moles = 128 g ÷ 32 g/mol = 4 moles. This shows that 128 grams of oxygen gas (O_2) contains 4 moles of O_2 molecules.

13. Correct Answer: C (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.

14. Correct Answer: B (Taste sour)

Acids have characteristic properties including tasting sour (like lemon juice or vinegar). They also turn blue litmus paper red and have pH values less than 7. Bases, in contrast, turn red litmus blue, feel slippery, and have pH greater than 7.

15. Correct Answer: D (Gas)

Gas is the state of matter where particles move freely with large spaces between them. Gas particles have high kinetic energy, move randomly in all directions, and are far apart compared to liquids and solids. Gases have no fixed shape or volume and expand to fill their containers.

16. Correct Answer: A (Electrons are transferred from one atom to another)

During ionic bonding, electrons are transferred completely from one atom to another, forming charged ions. 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.

17. Correct Answer: C (9)

The formula $3Al(OH)_3$ represents 3 formula units of aluminum hydroxide. Each $Al(OH)_3$ contains 3 OH groups, and each OH group contains 1 hydrogen atom. Therefore: 3 formula units × 3 OH groups per unit × 1 hydrogen per OH = 9 hydrogen atoms total.

18. Correct Answer: D (13)

A strongly basic solution has a pH significantly greater than 7, typically between 12 and 14. Among the options, pH 13 indicates a strongly basic solution. pH 0 and 1 are strongly acidic, while pH 7 is neutral.

19. Correct Answer: B (Group 1)

The alkali metals are located in Group 1 of the periodic table and include lithium, sodium, potassium, rubidium, cesium, and francium. These highly reactive metals have 1 valence electron and readily form +1 ions by losing that electron. They react vigorously with water.

20. Correct Answer: C (Combustion)

The reaction $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ represents a combustion reaction, where a hydrocarbon (methane) burns in oxygen to produce carbon dioxide and water. Combustion reactions are exothermic and release energy. This is the reaction that occurs when natural gas burns.

21. Correct Answer: A (1000 times)

The pH scale is logarithmic with base 10. Each unit represents a 10-fold difference in hydroxide ion concentration for bases. A difference of 3 pH units represents $10^3 = 1000$-fold difference. A solution with pH 11 has 1000 times more OH^- ions (is 1000 times more basic) than a solution with pH 8.

22. Correct Answer: A (-1)

The charge of an electron is -1 (negative one). Electrons carry a fundamental unit of negative electrical charge. This negative charge balances the positive charge of protons (+1) in neutral atoms, where the number of electrons equals the number of protons.

23. Correct Answer: B (1)

Elements in Group 1 (the alkali metals) have 1 valence electron in their outermost energy level. This includes lithium, sodium, potassium, rubidium, cesium, and francium. Because they have 1 valence electron, they readily lose it to form +1 ions and are highly reactive.

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

The Law of Conservation of Mass states that matter cannot be created or destroyed in chemical reactions—atoms 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 throughout the reaction.

25. Correct Answer: A (1 M)

Using the dilution formula $M_1V_1 = M_2V_2$: (5 M)(40 mL) = M_2(200 mL). Solving: $200 = 200M_2$, so $M_2 = 1$ M. Diluting from 40 mL to 200 mL (5-fold dilution) reduces the concentration from 5 M to 1 M.

26. Correct Answer: D (OH^- ions)

According to the Arrhenius definition, bases are substances that produce hydroxide ions (OH^-) when dissolved in water. For example, NaOH dissociates to produce Na^+ and OH^- ions. Acids, in contrast, produce H^+ ions in water.

27. Correct Answer: B (6.022×10^{23})

The number of particles in one mole is Avogadro's number: 6.022×10^{23}. This applies to any type of particle—atoms, molecules, ions, or formula units. One mole of any substance contains exactly this number of particles.

28. Correct Answer: C (Volume decreases)

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 decreases, gas molecules move slower and require less space, causing volume to decrease proportionally.

29. Correct Answer: D (7)

A neutral atom has equal numbers of protons and electrons, making the overall charge zero. Nitrogen has an atomic number of 7, meaning it has 7 protons. Therefore, a neutral nitrogen atom also has 7 electrons to balance the positive charge of the protons.

30. Correct Answer: A (Volume decreases)

According to Boyle's Law, at constant temperature, pressure and volume are inversely proportional ($P_1V_1 = P_2V_2$). When gas pressure increases, volume must decrease. This occurs because gas molecules are compressed into a smaller space, colliding with container walls more frequently.