PA-CAT™

Physician Assistant College Admissions Test

PA Admissions Exam Blueprint
and
Sample Questions

PA Admissions Exam Blueprint

All PA Admissions Examinations are constructed from a pre-established content outline that is reviewed annually and updated as needed for currency. The primary subject areas of the PA Admissions Exam are shown below in Table 2, with the percentage assigned to each for a typical exam[1].

Subject	Percentage	Number of Items
Anatomy	16%	39
Physiology	16%	39
Chemistry	16%	38
General Biology	11%	26
Microbiology	11%	26
Genetics	11%	26
Biochemistry	5%	12
Behavioral Sciences	9%	22
Statistics	5%	12
Total	**100%**	**240**

Table 1 PA-CAT Content Categories

Tables 2-10 show the detailed content objectives for each of the subjects assessed on the PA Admissions Exam. These detailed lists represent examples of the material that may be covered on the PA-CAT[2]. While not all the listed content objectives are included in every PA Admissions Exam, overall content coverage is equivalent among the various examination forms that will be taken by different examinees.

[1] Percentages are subject to change at any time.

[2] It is not possible to include all topics on a single exam, and it may be possible that some questions on the exam cover objectives that are not listed in the examples.

Anatomy Content Objectives	
The Back	The Pelvis and Perineum
Curvatures of the Vertebral Column	The Bony Pelvis
The Vertebrae	The Pelvic Viscera
Spinal Cord and Spinal Nerves	The Male Perineum and Reproductive Organs
The Abdomen	The Female Perineum and Reproductive Organs
The Anterior Abdominal Wall	The Thorax
The Spleen	Mediastinum
The Esophagus	Skeletal and Muscular Components
The Stomach	The Lungs, Trachea, and Bronchi
The Large and Small Intestine	The Pericardium
The Pancreas	The Heart and Great Vessels
The Liver and Biliary Ducts	The Upper Limb
The Hepatic Circulation	The Pectoral Girdle
The Kidney and Ureters	The Axilla
The Head	The Brachial Plexus
The Skull	The Arm and Forearm
The Face	The Wrist and Hand
The Ear	
The Cranial Nerves	
The Lower Limb	
The Hip and Thigh Areas	
The Gluteal Region	
The Leg	
The Hip, Knee, and Ankle Joints	
The Foot	

Table 2 PA-CAT Anatomy Blueprint

Physiology Content Objectives	
The Cell	Renal Physiology
Functions of the Cellular Organelles	Fluid Balance Regulation
Translation and Transcription	Glomerular Filtration and Renal Blood Flow
Blood and Clotting	Renal Tubular Reabsorption and Secretion
Hemostasis and Blood Coagulation	Renal Ion Regulation
Circulation	Renal Acid/Base Regulation
Basics of Flow, Pressure, and Resistance	Respiratory Physiology
Microcirculation	Basics of Pulmonary Ventilation
Mechanisms of Blood Flow Control	Basics of Gas Exchange
Cardiac Output and Venous Return	Pulmonary Circulation and Edema
The Lymphatic System	Oxygen and Carbon Dioxide Transport in Blood
Coronary Blood Flow	Regulation of Respiration
Endocrinology	Reproduction
Hypothalamus Hormones	Mitosis and Meiosis
Pituitary Hormones	Spermatogenesis
Thyroid Hormones	Oogenesis
Parathyroid Hormones	Pregnancy and Lactation
Endocrine Hormones	Basics of Fetal Physiology
Adrenocortical Hormones	The Heart
Gastrointestinal Physiology	Heart Structure Valves, and Valve Sounds
Paristalsis, Segmentation, and Defecation	Cardiac Cycle
Chemical Digestion, Absorption, and Regulation	Electrical Activity of the Heart
Membrane Physiology	Coronary Blood Flow
Diffusion and Osmosis	Heart Defects
Membrane Transport (Active and Passive)	The Special Senses
Basics of Membrane Potential	Vision, Hearing, Taste, and Smell
The Actions Potential	
The Muscular Contraction	
Metabolism	
Carbohydrate, Protein, and Lipid Metabolism	
Nervous System	
Nerve Physiology, Conduction, and Transmission	
Basics of Somatic Sensations	
Basics of Motor and Cerebral Circuits	
Basics of the Autonomic Nervous System	

Table 3 PA-CAT Physiology Blueprint

Chemistry Content Objectives
Acids and Bases
Bronsted Lowry Acids and Bases
Measuring Acidity and Basicity
Strengths of Acids and Bases
Atoms, Ions, and Molecules
Atomic Theory
Ions and Molecules
Chemical Bonding and Molecular Geometry
VSEPR Theory
Chemical Reactions
Balancing
Solubility Rules
Types of Reactions
Electrochemistry
Oxidation and Reduction
Gases
Gas Laws; Dalton's Laws of Partial Pressures
Dalton's Laws of Partial Pressures
Ideal vs. Real Gases
Liquids, Solids, and Gases
Colligative Properties of Solutes
Factors Affecting Solubility
Stoichiometry
Conversion and Conservation of Matter and Energy
Reactant and Product Calculations
Thermochemistry and Energy
Energy and Chemical Changes/Reactions
Organic Chemistry
Alkanes
Cycloalkanes
Bond Properties
Resonance
Hybridization/LCAO
Stereochemistry
Spectroscopy

Table 4 PA-CAT Chemistry Blueprint

General Biology Content Objectives	
Bioenergetics	Gene Expression
Enzymes	Regulatory Proteins
Metabolism	Eukaryotic Regulation
Energy and ATP	Posttranscriptional Regulation
Hydrogen and Electron Carriers	Protein Degradation
Thermodynamics and Free Energy	Genetics
Biotechnology	Mendelian Genetics
Mapping, Characterizing, and Sequencing Genomes	Patterns of Inheritance
Cell Structure and Function	Incomplete Dominance
Composition and Function of Cell Structures	Sex Linkage
Cell Membranes and Membranous Organelles	Mutations and Genetic Change
Cell Theory	Clinical Genetics
Cellular Reproduction	Cytogenetics
Eukaryotic Cell Reproduction	Molecular Genetics
Stages of Meiosis	Mitochondrial Genetics
Cellular Respiration	RNA
Fermentation and Anaerobic Respiration	Structure and Replication
Aerobic Respiration	Types of RNA
Oxidation of Glucose	tRNA and Ribosomes
Oxidation of Pyruvate	Pre-mRNA Splicing
Catabolism of Proteins and Fats	Eukaryotic Transcription
Cellular Transport	Signal Transduction
Diffusion and Osmosis	Intracellular Communication
Facilitated and Active Transport	Receptor Types
Pinocytosis and Phagocytosis	Intracellular Receptors
Chemical Building Blocks	G Protein-Coupled Receptor Signaling
Proteins	Receptor Kinase Signaling
Carbohydrates	Microbiology
Carbon	Viral Replication and Invasion
Nucleic Acids	Bacterial Viruses
Lipids	Human Immunodeficiency Virus
Chemical Composition of Cells	Viral Diseases
Water and Its Properties	Prions
Organization of Matter	Parasitic
Acids, Bases, and Salts	Fungal
Biological Molecules	Biochemical Testing
DNA	Polymerase Chain Reaction
Structure, Replication, Repair	

Table 5 PA-CAT General Biology Blueprint

Microbiology Content Objectives
Bacteria
Intracellular Bacteria
Gram-Positive Cocci
Gram-Positive Rods
Acid-Fast Bacteria
Gram-Negative Cocci and Coccobacilli
Fermentative Gram-Negative Rods
Nonfermenting Gram-Negative Rods
Anaerobic Bacteria
Spiral-Shaped Bacteria
Intracellular Bacteria
Role in Disease
Viruses
Human Immunodeficiency Virus
Human Herpesvirus
Respiratory Viruses
Hepatitis Viruses
Gastrointestinal Viruses
Role in Disease
Fungi
Classification
Opportunistic Fungi
Cutaneous and Subcutaneous Fungi
Systemic Dimorphic Fungi
Parasites
Classification
Protozoa
Trematodes
Nematodes
Cestodes
Arthropods
Interaction between Microbe and Host
Principles of Disease and Epidemiology
Microbial Mechanisms of Pathogenicity
Innate and Adaptive Immunity
Pathology, Infection, and Disease
Microorganisms and Human Disease
Environmental Microbiology

Table 6 PA-CAT Microbiology Blueprint

Genetics Content Objectives
Molecular Structure and Replication of Genetic Material
Molecular Structure of DNA and RNA
Chromosome Organization and Molecular Structure
DNA Replication
Patterns of Inheritance
Chromosome Transmission During Cell Division and Sexual Reproduction
Mendelian and Non-Mendelian Inheritance
Genetic Linkage and Mapping in Eukaryotes
Genetic Transfer and Mapping in Bacteria and Bacteriophages
Variation in Chromosome Structure and Number
Molecular Properties of Genes
Gene Transcription and RNA Modification
Translation of mRNA
Gene Regulation in Bacteria
Gene Regulation in Eukaryotes
Non-Coding RNAs
Genetics of Viruses
Gene Mutation and DNA Repair
Recombination, Immunogenetics, and Transposition
Genetic Technologies
Molecular Technologies
Biotechnology
Genomics
Genetic Analysis of Individuals and Populations
Medical Genetics and Cancer
Developmental Genetics
Population Genetics
Complex and Quantitative Traits

Table 7 PA-CAT Genetics Blueprint

Biochemistry Content Objectives
Intermediary Metabolism
Gluconeogenesis
Glycolysis
Respiratory Cycles and Oxidative Phosphorylation
Biologic Oxidation
Mitochondria and ATP
Citric Acid Cycle
Bioenergetics
Proteins
Structure and Function of Proteins
Structure and Classification of Amino Acids
Peptide Bonds, Polypeptides
Specialized Metabolism of Tissues
Cell and Membrane Structure and Function
Hormones and Their Mechanisms of Action
Cell Membrane
Enzymes
Properties and Classification of Enzymes
Mechanism of Actions of Enzymes
Enzyme Kinetics
Nucleic Acids
Genes and Diseases
Regulation of Gene Expression
Genetic Code, Ribosomal Translation
RNA Synthesis
DNA Organization and Replication
Eukaryotic and Prokaryotic Genetic Organization and Regulation
Individual Hormones
Classification of Hormones
Protein, Peptide, and Amino Acid-Derived Hormones
Cytokines
Lipids
Regulation of Lipid Metabolism
Lipoproteins and Disease
Cholesterol Metabolism
Carbohydrates

Table 8 PA-CAT Biochemistry Blueprint

Behavioral Sciences Content Objectives
Biological Bases of Behavior
Neuroanatomy
Human Genetics
Neural Transmission
History and Approaches
Lifespan Development
Memory
Motivation and Emotion
Emotion
Hunger and Eating
Personality
Sensation and Perception
Sensation vs. Perception
Waves and Wavelengths
Learning
Classical and Operant Conditioning
Thinking and Intelligence
Cognition
Language
Social Psychology
Dispositional Approach to Explaining Human Behavior
Self-Presentation
Stress, Lifestyle, and Health
States of Consciousness
Sleep and Dreaming
Psychoactive Drug Effects
Psychological Research
Importance of Research
Analyzing Research Findings
Approaches to Research
Statistics
Sociology
Culture
Deviance and Conformity
Social Change
Social Inequalities
Social Institutions
Sociological Perspective
Socialization
Psychological Disorders
Therapy and Treatment

Table 9 PA-CAT Behavioral Sciences Blueprint

Statistics Content Objectives
Anticipating Patterns
Probability
Combining Independent Random Variables
The Normal Distribution
Sampling Distributions
Exploring Data
Graphical Displays of Distributions
Summarizing Distributions of Univariate Data
Comparing Distributions of Univariate Data
Exploring Bivariate Data
Exploring Categorical Data
Sampling Experimentation
Methods of Data Collection
Planning and Conducting Surveys
Planning and Conducting Experiments
Generalizability of Results and Types of Conclusions
Statistical Inference
Estimation
Test of Significance

Table 10 PA-CAT Statistics Blueprint

Sample Test Items

Anatomy

Question 1 of 2

What is the likely diagnosis for a child who reports increased back pain, an uneven gait, and favoritism to the left side?

Answer Choices:

A. Kyphosis
B. Lordosis
C. Scoliosis
D. Spina bifida

Explanation:

Scoliosis is the lateral bending of the vertebral column, often in the thoracic area.

Kyphosis is a curvature of the spine that produces a "humpback."

Lordosis is having a "hollow back," or being "bent backward." Some describe it as a sway back. It may be caused by poor posture.

Spina bifida is a defect of the vertebral column where L5 or S1 fails to develop normally, leaving a hole or dimple.

References:

1. Tortora, GJ, Derrickson BH. *Principles of Anatomy & Physiology*. 15th ed. Hoboken, NJ: Wiley: 2017:255-9.

Question 2 of 2

A 42-year-old man with a history of anxiety and peptic ulcer disease develops severe back pain. An analysis reveals the presence of amylase, lipase, and peptidase in his stomach. This patient's condition is caused by erosion of a peptic ulcer in what structure?

Answer Choices:

A. Left gastric artery
B. Pancreas
C. Peritoneal cavity
D. Pleural cavity
E. Splenic artery

Explanation:

This patient's sudden onset severe back pain suggests perforation of a peptic ulcer. The location of his pain along with the presence of pancreatic enzymes in the stomach suggest that the ulcer eroded into the **pancreas**. Since the pancreas is located directly posterior to the stomach, the ulcer would be located on the posterior wall of the stomach.

If the ulcer had eroded into the **peritoneal cavity**, the leakage of stomach contents into the peritoneal cavity would result in a generalized peritonitis, causing generalized severe abdominal pain and rebound tenderness, not focal back pain. If the ulcer had somehow eroded into the **pleural cavity**, we would expect to see pleuritic chest pain. If the ulcer had eroded into a blood vessel, we might see blood in the stomach or peritoneum instead of pancreatic enzymes, resulting in a much more serious clinical presentation. Two common blood vessels that a peptic ulcer can erode into are the **splenic artery**, which carries blood to the spleen, or the **left gastric artery**, which supplies blood to the lesser curvature of the stomach.

References:

1. Moore KL, Dalley AF, Agur AMR. *Clinically Oriented Anatomy.* 7th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2014:255-7.

Physiology

Question 1 of 2

A patient sustains a myocardial infarction (heart attack) that damages the ventricular septum of the heart. What effect on the heart is most likely to be seen immediately after the heart attack?

Answer Choices:

A. Blood flowing from the left side of the heart to the right
B. Changes in the electrical conduction of the heart
C. Damage to the valves of the heart
D. Reduction in blood pressure

Explanation:

The septum contains fibers that coordinate the beating of the ventricles. These are sensitive and are damaged almost instantly in myocardial infarction. This damage can be seen via changes in the **conduction** of electricity through the heart.

Damage to valves, left to right **blood flow**, and dramatic **hypotension** are common late complications of myocardial infarction, generally occurring days to weeks following the initial event. This is in contrast to electrical changes, which present near instantly.

References:

1. OpenStax, Anatomy & Physiology. OpenStax CNX. Jul 31, 2018. https://cnx.org/contents/FPtK1zmh@11.1:Y5T_wVSC@5/Heart-Anatomy. Accessed September 5, 2018.

Question 2 of 2

If a patient ingests a poison that inhibits protein synthesis, what cellular organelle(s) is/are being targeted?

Answer Choices:

A. Lysosomes
B. Golgi apparatus
C. Plasma membrane
D. Mitochondria
E. Ribosomes

Explanation:

Ribosomes are responsible for the production of cellular proteins through the process of translation.

Lysosomes contain digestive enzymes and are involved in the breakdown of molecules and cellular maintenance.

The **Golgi apparatus** is responsible for sorting, packaging, and sending proteins throughout the cell.

The **plasma membrane** is a semi permeable boundary surrounding the cell.

Mitochondria are the energy-producing organelles within the cell. Mitochondria produce energy in the form of ATP via aerobic respiration in humans.

References:

1. Tortora GJ, Derrickson B, & Tortora GJ. *Principles of anatomy & physiology*. Hoboken, NJ: Wiley; 2014.

General Biology

Question 1 of 2

Case:

Trace evidence retrieved in a crime scene revealed 2 distinct monosaccharides upon infrared spectroscopic analysis. The victim was a scientist who was working with an enzyme that cleaves disaccharides. The spectroscopic analysis from the crime lab exactly matched the last entry on the victim's electronic notebook. During their investigation, the forensics team analyzed carbohydrate samples from 4 suspects who had entered the crime scene in the past 24 hours. Each of the suspects had a unique carbohydrate sample that they needed to analyze.

Stem:

Based on this evidence, which of the following carbohydrates did the most likely suspect possess?

Answer Choices:

A. Fructose
B. Maltose
C. Starch
D. Sucrose

Explanation:

The victim was working with an enzyme that cleaves disaccharides into its constituent monosaccharides. The spectroscopic analysis revealed the presence of 2 different monosaccharides. The most likely suspect must have been the person who possessed a disaccharide made of 2 different monomers.

The suspect who possessed **sucrose** (glucose + fructose), is most likely to have seen the victim the last.

Maltose is a disaccharide made of 2 glucose monomers and could not have been the relevant disaccharide.

Fructose (a monosaccharide) and **starch** (a polysaccharide) cannot be cleaved by the enzyme in question.

References:

1. Simon EJ, Dickey JL, Hogan KA, Reece JB. Essential Chemistry for Biology. In: *Campbell Essential Biology with Physiology*. 5th ed. Harlow, UK: Pearson; 2016:22-35.

Question 2 of 2

Case:

A graduate student received organellar fractions from 4 different sources. The student was asked to extract DNA from each and was surprised to find 1 sample devoid of any genetic material.

Stem:

Given that the student was careful and there were no mistakes in the extraction procedure, what source would be devoid of genetic material?

Answer Choices:

A. Beetle leaf extract
B. Onion peel
C. Red blood cells
D. Semen sample

Explanation:

Red blood cells (RBCs) extracted from blood would be devoid of any genetic material. Typically, a blood sample would contain all cellular components (lymphocytes, RBCs, and platelets) from which DNA can be extracted, but RBCs specifically do not contain nuclei or any organelles (to make room for packaging hemoglobin).

Beetle leaf extract and **onion peel**, both plant sources, and **semen sample** (human source) would all contain DNA, as they contain nuclei and organelles (mitochondria and chloroplasts), which house various amounts of DNA.

References:

1. The Princeton Review: Molecular Biology. In: *Cracking the AP Biology Exam*. New York, NY: Penguin Random House; 2018:161-81.
2. The Princeton Review: Cells. In: *Cracking the AP Biology Exam*. New York, NY: Penguin Random House; 2018:111-8.

General and Organic Chemistry

Question 1 of 2

What process occurs during the increase in water solubility of a compound containing functional groups with carboxylic acids as they undergo ionization?

Answer Choices:

A. Elongation of hydrocarbons
B. Formation of salts
C. Grouping of aromatic rings
D. Standardization of charge

Explanation:

One way in which carboxylic acids increase the water solubility of a compound is through reaction with a strong base to **form salts** (carboxylate anion salts). Salt formation can increase the water solubility of a compound due to the attraction of the area of the partial positive charge within the compound to the partial negative of water (area surrounding oxygen).

Elongation of hydrocarbons, **grouping of aromatic rings**, and **standardization of charge** (reduction of polarity) serve to reduce water solubility.

References:

1. Jonsson AL, Roberts MAJ, Kiappes JL, Scott KA. Essential chemistry for biochemists. *Essays Biochem*. 2017;61(4):401-27. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5869253/.

Question 2 of 2

The acetylation of 0.205 mol of p-aminophenol by acetic anhydride produced acetaminophen and acetic acid. A side reaction resulting from moisture in the reaction vessel hydrolyzed an unknown amount of acetic anhydride before the reaction was complete. After purification, only 29.47 g of acetaminophen was isolated. If 13.35 g of acetic acid was recovered from the products, how much acetic anhydride was consumed in the acetylation reaction and how much underwent hydrolysis?

Answer Choices:

A. Acetylation – 11.71 g and Hydrolysis – 1.39 g
B. Acetylation – 19.91 g and Hydrolysis – 1.39 g
C. Acetylation – 19.91 g and Hydrolysis – 1.64 g
D. Acetylation – 20.93 g and Hydrolysis – unknown
E. Acetylation – 19.91 g and Hydrolysis – unknown

Explanation:

The correct answer is **Acetylation – 19.91 g and Hydrolysis – 1.39 g**.

Since acetaminophen is the product of the acetylation reaction, the amount of acetaminophen produced from the reaction is used to determine how much of the acetic anhydride was consumed by the acetylation reaction. Using the molecular mass, we can determine that 0.195 mol of acetaminophen was produced through acetylation. This would require 19.91 g of acetic anhydride.

Calculate the amount of acetic acid produced as a side product of the acetylation reaction: 0.195 mol*60.05 g = 11.71 g. Now, subtract the mass of acetic acid produced as a result of acetylation from the mass recovered after reaction to get the mass of acetic acid produced through hydrolysis: 13.35 g – 11.71 g = 1.64 g acetic acid. The hydrolysis reaction proceeds as follows:

$(CH_3CO)_2O + H2O \rightarrow 2CH_3COH$

Therefore, 1.64 g of acetic acid is produced by 1.39 g of acetic anhydride.

References:

1. Zumdahl SS, Zumdahl SA. *Chemistry: An Atoms First Approach*. 2nd ed. Bellmont, CA: Cengage Learning; 2015:236.

Biochemistry

Question 1 of 2

What generally results from a point mutation, deletion, or insertion in the promoter region of a proto-oncogene?

Answer Choices:

A. **Increased transcription of protein product**
B. Stimulation of cell mitosis
C. Transduction of continuous cell growth signals
D. Uncontrolled stimulation of kinase signaling pathway

Explanation:

A point mutation, deletion, or insertion in the promoter region of a proto-oncogene is an activation mechanism that generally causes **increased transcription**.

Stimulation of cell mitosis is an example of a general process involving proteins encoded by proto-oncogenes.

Transduction of continuous cell growth signals relates to a mutation within an oncogene rather than a mutation to the promoter region; specifically, this refers to the mutated *ras* oncogene, which causes a protein to remain in an active state and transduces continuous cell growth signals.

Uncontrolled stimulation of kinase signaling pathway similarly relates to a mutation within an oncogene rather than a mutation to the promoter region; specifically, this refers to the mutated *braf* oncogene, which encodes for a protein with a modified kinase domain.

References:

1. Lowdon R, Wang T. Epigenomic annotation of noncoding mutations identifies mutated pathways in primary liver cancer. *PLoS One.* 2017;12(3):e0174032. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5363827/.

Question 2 of 2

Which hormone produced by the hypothalamus and secreted by the pituitary gland would you expect to be effective in improving social interactions in children with autism?

Answer Choices:

A. Human growth hormone
B. Oxytocin
C. Thyroid-stimulating hormone
D. Vasopressin

Explanation:

Oxytocin is involved in bonding and trust; low levels of this hormone are correlated with autism in children. **Human growth hormone** is involved with physical development of children. **Thyroid-stimulating hormone** activates production of thyroid hormones. **Vasopressin** helps regulate water and electrolyte homeostasis.

References:

1. Higashida H, Munesue T, Kosaka H, Yamasue H, Yokoyama S, Kikuchi M. Social Interaction Improved by Oxytocin in the Subclass of Autism with Comorbid Intellectual Disabilities. *Diseases*. 2019;7(1):24. doi:10.3390/diseases7010024.

Microbiology

Question 1 of 2

An 8-month-old boy who has never been vaccinated presents with a 3-day history of fever and watery non-bloody diarrhea. On physical examination, he appears dehydrated. What is the genome of the most likely infecting organism?

Answer Choices:

A. Double-stranded DNA
B. Non-segmented single-stranded positive-sense RNA
C. Segmented double-stranded RNA
D. Single-stranded DNA

Explanation:

Rotaviruses cause most of the watery diarrheal illness in infants and children worldwide. They are non-enveloped RNA viruses containing 11 segments of **double-stranded RNA genome** within a double-shelled capsid.

Rotaviruses, like the influenza viruses that have a segmented genome, can undergo genetic reassortment. Other viruses that cause gastroenteritis are Adenovirus, a **double-stranded DNA** virus, and Norovirus, a **non-segmented single-stranded positive-sense RNA**. **Single-stranded DNA** viruses do not cause gastroenteritis.

References:

1. Murray PR, Rosenthal KS, Pfaller MA. *Medical Microbiology*. 8th ed. Elsevier; 2016. pg. 505-508.
2. Johnson AG, Hawley L, Johnson AG, Ziegler RJ. *Microbiology and Immunology*: Wolters Kluwer/Lippincott Williams & Wilkins; 2010. pg.207

Question 2 of 2
Key Words:

Case:

A 13-year-old boy presents in the ED with fever, tender joints, and rapid heartbeat. His mother says he has been sick with a sore throat, which she thought was a cold; now she is concerned it may actually be the flu. Rapid strep test and flu test in the ED are both negative. The physician assistant finds a rash with pink rings and a clear center, orders an Antistreptolysin O antibody test and EKG, and gives the patient penicillin and a round of steroids. The lab test shows a high level of antibodies against *Streptococcus*.

Stem:

What organism is the most likely pathogen?

Answer Choices:

A. *Escherichia coli*
B. *Staphylococcus aureus*
C. *Streptococcus pyogenes*
D. *Streptococcus viridans*

Explanation:

Streptococcus pyogenes typically causes "strep throat" and would cause a positive rapid strep test. A rapid strep test looks for Group A strep, which causes beta-hemolysis or full hemolysis on blood agar after culture. Untreated strep throat can lead to rheumatic fever in children and adolescents, caused by the immune system's response from an earlier strep throat or scarlet fever infection; it is thought to be caused by a generalized inflammatory response.

Escherichia coli is a Gram-negative rod that does not typically cause pharyngitis. *E. coli* can grow on blood agar as a smooth round gray-white colony. Some strains are beta-hemolytic, or they show no hemolysis at all.

Staphylococcus aureus is a Gram-positive coccus seen in clusters that does not typically cause pharyngitis. On a culture, this organism grows as a medium-sized round creamy yellow colony and shows beta-hemolysis.

Streptococcus viridans is an alpha-hemolytic (green incomplete hemolysis) Gram-positive coccus seen in chains. *Streptococcus viridans* is part of the normal flora of a human mouth. On blood agar, it grows in small grayish alpha-hemolytic colonies.

References:

1. Group A Strep. *CDC*. https://www.cdc.gov/groupastrep/diseases-public/rheumatic-fever.html. Reviewed November 1, 2018. Accessed August 4, 2019.
2. Parker N, Schneegurt M, Tu A-HT, Forster BM, Lister P. *Microbiology*. Houston, TX: OpenStaxsity; 2017:177.

Behavioral Sciences

Question 1 of 2

Case:

A young boy being observed at his daycare. The observer noted that he was quite relaxed and not very interested in his surroundings.

Stem:

According to the EAS Temperament Model, how would the child have scored?

Answer Choices:

A. **Low on emotionality**
B. Low on sociability
C. Low on activity
D. Low on affection

Explanation:

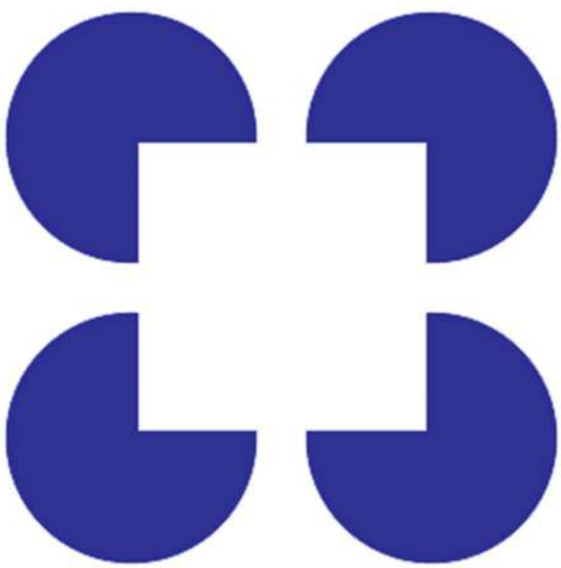
The **EAS Temperament Model** uses 3 dimensions of temperament: emotionality, activity, and sociability. Affection is not one of the 3 dimensions. The boy's relaxed and non-interested demeanor is part of the **emotionality** dimension, which measures the intensity of emotional reactions. **Activity** measures a person's energy level and **sociability** measures a person's ability to affiliate and interact with others.

References:

1. Chapter 3: Section 3: Temperament and Personality. AllPsych. Available at: https://allpsych.com/personalitysynopsis/temperament/. Accessed July 14, 2017.

Question 2 of 2

Which Gestalt principle describes the following example? **Refer to the image.**



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Answer Choices:

A. Similarity
B. Camouflage
C. Continuity
D. Closure

Explanation:

Closure is when we tend to see complete figures even when part of the information is missing. In this case, the square image in white is not really there, but rather, formed by the missing pieces of the surrounding circles.

Similarity is when things that share visual characteristics—such as shape, size, color, texture, or value—are seen as belonging together.

Continuity is when the edge of one shape continues into space and meets with other shapes or the edges of the picture plane; the viewer will follow the established pattern.

Camouflage is when the figure blends into the background, making the image visually disruptive.

References:

1. Gestalt Principles. Gestalt Principles. Available at: http://facweb.cs.depaul.edu/sgrais/gestalt_principles.htm. Accessed June 23, 2017.

Genetics

Question 1 of 2

Which statement applies to the elongation stage of transcription?

Answer Choices:

A. RNA polymerase binds to a sequence of DNA known as a promoter.
B. RNA polymerase builds an RNA molecule, making a chain.

C. RNA polymerase separates the DNA strands, creating a single-strand template.
D. Sequences send signals that release the transcript from the RNA polymerase.

Explanation:

During the elongation stage of transcription, the RNA polymerase decodes the template strand, **building an RNA molecule, creating a chain**. In the initiation stage of transcription RNA polymerase is bound to a sequence of DNA referred to as the **promoter**. Once bound, the polymerase separates the DNA strands, creating the **template** strand. In the termination stage, sequences called terminators signal completion of the RNA transcript. This causes the transcript to be **released** from the RNA.

References:

1. Griffiths A, Wessler S, Carol S, Doebley J. *An Introduction to Genetic Analysis*. 11th ed. New York, NY: WH Freeman & Company; 2015:356-9.

Question 2 of 2

A couple expecting a child have different blood types; the mother is AO and the father is BO. Which blood type in the infant would be an example of codominance?

Answer Choices:

A. AB
B. AO
C. BO
D. O

Explanation:

The blood type **AB is an example of codominance**. The A and B allele are both fully dominant, and the phenotype has both traits expressed equally. AO and BO blood types are examples of simple dominance, where either the A or B allele is the dominant trait and the O allele is a recessive trait. With type O blood, the offspring has received 2 copies of the recessive trait, one from each parent.

References:

1. Lashley F, Casper C, Schneidereith T. *Lashley's Essentials of Clinical Genetics.* 2nd ed. New York, NY: Springer; 2016:43-4.
2. Klug W, Cummings M, Spencer C, Palladino M. *Concepts of Genetics.* 11th ed. Edinburgh Gate, Harlow, Essex CM20 21E, England: Pearson; 2015:107-8.

Statistics

Question 1 of 2

What is the standard deviation calculated for the following 10 fasting blood sugar levels of patients with diabetes?

84, 87, 93, 99, 103, 116, 126, 129, 130, 133

Answer Choices:

A. 0
B. 2.86
C. 18.02
D. 18.99

Explanation:

A standard deviation is the square root of a variance, so the variance must be calculated first.

Variance is the squared difference from the mean (average).

First, calculate the mean of the values.

84 + 87 + 93 + 99 + 103 + 116 + 126 + 129 + 130 + 133 = 1100

1100 ÷ 10 = 110

For each value, subtract the mean and square the result (the squared difference).

For example,

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84 – 110 = -26

$-26^2 = 676$

After completing all the calculations, take the average of the squared difference to find the variance.

3246/10 = 324.6 Therefore, the variance is 324.6.

The standard deviation (the square root of the variance) is $\sqrt{324.6}$=18.02324.6=18.02
2.86 would result from squaring the negative numbers and getting negative numbers instead of positive numbers. **0** would result from forgetting to square the differences. **18.99** would result from dividing the squared difference sum by 9 instead of by 10.

References:

1. OpenStax, Introductory Statistics. OpenStax CNX. Jun 17, 2019. https://cnx.org/contents/MBiUQmmY@23.31:gp5Hz9v3@17/2-7-Measures-of-the-Spread-of-the-Data.

Question 2 of 2

Researchers often wish to reduce their sample size to save money in conducting studies.

What factor might make a study's sample size smaller?

Answer Choices:

A. Measure central tendency and dispersion.
B. Reduce statistical power and use chi-squared models for analysis.
C. Reduce the nonresponse rate and stratify the population.
D. Use inferential statistics rather than descriptive statistics.

Explanation:

A study that has a nonresponse bias of 50% will need a large sample size in comparison to one with a nonresponse rate of 1%. Putting resources into follow-up can **reduce the nonresponse**

rate and reduce sample size. **Stratifying** the population reduces variation within groups, allowing a smaller sample size to adequately represent a population.

Measuring central tendency and dispersion would not affect the sample size. This is synonymous with analyzing mean and standard deviation, so these calculations would not affect the experimental setup. Similar to the case of central tendency and dispersion, our method of analysis would not affect our experimental design.

Reducing statistical power would allow us to reduce our sample size, but using **chi-squared models** for analysis would not.

Using **inferential statistics** rather than **descriptive statistics** is another mode of analysis, and would not achieve the desired reduction in sample size.

References:

1. Amatya A, Bhaumik DK. Sample size determination for multilevel hierarchical designs using generalized linear mixed models. *Biom.* 2018;74:673-84. doi:https://doi.org/10.1111/biom.12764.