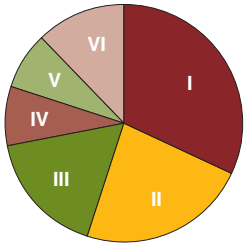
Physics: Content Knowledge (0265)

Test at a Glance

Test Name	**Physics: Content Knowledge**
Test Code	**0265**
Time	**2 hours**
Number of Questions	**100**
Format	**Multiple-choice questions; calculator use prohibited**



Content Categories		Approximate Number of Questions	Approximate Percentage of Examination
I.	Mechanics	32	32%
II.	Electricity and Magnetism	23	23%
III.	Optics and Waves	17	17%
IV.	Heat and Thermodynamics	8	8%
V.	Modern Physics, Atomic, and Nuclear Structure	8	8%
VI.	History and Nature of Science; Science Technology, and Social Perspectives (STS)	12	12%

About This Test

The Physics: Content Knowledge test is designed to measure the knowledge and competencies necessary for a beginning teacher of secondary school Physics. Examinees have typically completed or nearly completed a bachelor's degree program with appropriate coursework in Physics and education. This test may contain some questions that will not count towards your score.

The development of the test questions and the construction of the test reflect the National Science Education Standards (NSES) and the National Science Teacher Association (NSTA) standards and recognize that there are conceptual and procedural schemes that unify the various scientific disciplines. These fundamental concepts and processes (systems; models; constancy and change; equilibrium; form and function) are useful in understanding the natural world. Insofar as possible, then, the test questions will have the primary objective of evaluating the content areas by using questions that focus on conceptual understanding, critical thinking, and problem solving in science. The test content is developed and reviewed in collaboration with practicing high school Physics teachers, teacher-educators, and higher education content specialists to keep the test updated and representative of current standards.

The 100 multiple choice questions include concepts, terms, phenomena, methods, applications, data analysis, and problem solving in Physics, and include an understanding of the impact of science and technology on the environment and human affairs. The topics are typically those covered in introductory college-level Physics courses, although some questions of a more advanced nature are included, because secondary-school teachers must understand the subject matter from a more advanced viewpoint than that presented to their students.

Examinees will not need to use calculators in taking this test. The test book contains a periodic table of the elements and a table of information that presents various physical constants and a few conversion factors among SI units. Whenever necessary, additional values of physical constants are printed with the text of a question.

Topics Covered

Representative descriptions of topics covered in each category are provided below.

I. Mechanics

1. Vector and scalar quantities in describing motion and forces.
   - Scalars (e.g., mass, speed, time, energy)
   - Vectors (e.g., displacement, velocity, acceleration, force, momentum)
   - Vector components
   - Addition of vectors
   - Resultant vector

Kinematics

1. Motion in terms of displacement, velocity, and acceleration.
   - Linear motion
   - Simple harmonic motion (e.g., pendulums, spring oscillation)
   - Circular motion
   - Projectile motion
   - Rotational kinematics (e.g., angular displacement, angular velocity, angular acceleration)
2. Frames of reference and their applications.
   - Frames of reference (e.g., coordinate systems, inertial reference frames)
   - Relative velocity

Dynamics and Fluid Mechanics

1. Newton's three laws of motion.
   - Newton's first law of motion (e.g., mass, inertia, inertial reference frame)
   - Newton's second law of motion (net force, mass, acceleration)
   - Newton's third law of motion (action-reaction forces)
   - Applications (e.g., inclined planes, pendulums, Atwood machine)
2. Static equilibrium.
   - Sum of forces
   - Sum of torques
3. Friction, including forces and coefficients.
   - Normal force
   - Frictional force
   - Coefficients of static and kinetic friction
4. Circular motion.
   - Centripetal acceleration
   - Centripetal force
5. Simple harmonic motion.
   - Restoring force (e.g., Hooke's law)
   - Properties of simple harmonic motion (e.g., period, frequency, amplitude)
   - Pendulums
   - Spring oscillation
6. Work, mechanical energy, and power, and how they are related to one another.
   - Mechanical energy (e.g., kinetic energy, potential energy, conservation of energy)
   - Work
   - Work and energy
   - Power
   - Simple machines and mechanical advantage
7. Linear momentum and impulse and how they are related to one another.
   - Linear momentum
   - Impulse
   - Impulse and momentum

8. Rotational motion.
   - Center of mass
   - Angular momentum
   - Conservation of angular momentum
   - Torque
   - Rotational inertia (moment of inertia)
9. Differences between elastic and inelastic collisions.
   - Elastic collisions
   - Inelastic collisions
   - Conservation of momentum
   - Conservation of kinetic energy
   - Collisions in one dimension
   - Collisions in two dimensions
10. Laws of conservation of energy and conservation of linear momentum.
    - Conservation of energy
    - Conservation of linear momentum
    - Energy transformations
11. Newton's law of universal gravitation.
    - Newton's law of universal gravitation
    - Satellites and orbital motion
    - Gravitational acceleration
12. Difference between weight and mass.
    - Weight and mass
    - Difference between weight and mass
    - Relationship between density and mass
13. Kepler's three laws of orbital motion.
    - Kepler's first law (law of ellipses)
    - Kepler's second law (law of equal areas)
    - Kepler's third law (relationship between orbital period and mean orbital radius)
14. Fluid mechanics.
    - Archimedes' principle
    - Bernoulli's principle
    - Pascal's principle
    - Properties of fluids (e.g., density, pressure, viscosity)

II. Electricity and Magnetism

1. Electrostatics.
   - Electric charge
   - Induced charge
   - Coulomb's law
   - Electrostatic forces
   - Electric field
   - Electric flux
   - Electric potential
   - Electric potential energy
   - Potential difference
   - Gauss's law
2. Electrical properties of conductors, insulators, and semiconductors.
   - Conductors
   - Insulators
   - Semiconductors
   - Material examples (e.g., metals, ceramics, superconductors)
3. Electrical current, resistance, potential difference, energy, power, and the relationships between them.
   - Electric current
   - Potential difference
   - Resistance
   - Resistivity
   - Ohm's law
   - Energy
   - Power
   - Energy and power (e.g., kilowatt-hours vs. kilowatts)
4. Capacitance and inductance.
   - Capacitance and capacitors
   - Inductance and inductors
5. Differences between alternating and direct current.
   - Direct current
   - Alternating current

6. How to analyze simple series, parallel, and combination circuits.
   - Series circuits
   - Parallel circuits
   - Combination circuits
   - Ohm's law
   - Equivalent resistance
   - Equivalent capacitance
   - Kirchhoff's laws
   - Measurement devices within circuits (e.g., ammeters, voltmeters)
7. How sources generate electric potential.
   - Batteries
   - Photocells
   - Generators
   - Electromotive force (EMF)
8. Magnetic fields, magnetic forces, and properties of magnetic materials.
   - Magnetic field
   - Magnetic flux
   - Magnetic force
   - Magnets (e.g., bar magnets and poles, permanent magnets, electromagnets)
   - Transformers, motors, and generators
   - Direction of fields and forces (e.g., right-hand rule)
   - Magnetic field generated by a steady current (e.g., Biot-Savart law)
   - Ampere's law
   - Lorentz force law (force on point charge)
   - Force between current-carrying wires
9. How a changing electric field produces a magnetic field and how a changing magnetic field produces an electric field.
   - Ampere's law
   - Lenz's law (direction of induced current)
   - Faraday's law of induction
   - Motional EMF

III. Optics and Waves

1. Types of waves and their characteristics.
   - Transverse and longitudinal
   - Wave motion and propagation (mechanical vs. electromagnetic)
   - Amplitude, wavelength, frequency, period, speed, energy
   - Superposition and phase
   - Intensity and inverse square law
   - Standing waves
2. Wave phenomena such as reflection, refraction, interference, and diffraction.
   - Reflection, refraction, Snell's law, dispersion, total internal reflection
   - Diffraction, interference, superposition, Young's double-slit interference experiment
   - Polarization
   - Scattering, absorption, transmission
   - Resonance and natural frequencies, harmonics
3. Fundamentals of the Doppler effect.
   - Doppler effect
   - Apparent frequency
   - Moving source
   - Moving observer
   - Redshift, blueshift
4. Characteristics of sound.
   - Compression waves
   - Speed of sound (e.g., sonic boom, sound barrier)
   - Pitch (frequency), loudness (intensity)
   - Beats
   - Air columns (open and closed pipes)
5. Electromagnetic waves and the electromagnetic spectrum.
   - Electromagnetic waves (e.g., electric and magnetic fields, speed of light, energy)
   - Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, x-rays, gamma rays)

6. Geometric optics.
   - Ray tracing
   - Focal point, image distance, image size and magnification, real vs. virtual image, image orientation
   - Lenses (converging, diverging)
   - Mirrors (plane, convex, concave, spherical, parabolic)
   - Lens and mirror equations
   - Simple instruments (e.g., magnifying glass, telescope, microscope)
   - Prisms

IV. Heat and Thermodynamics

1. Temperature, temperature scales, heat, and heat capacity.
   - Temperature (measure of average kinetic energy)
   - Temperature scales
   - Heat and thermal energy
   - Difference between temperature and thermal energy
   - Heat capacity and specific heat
   - Calorimetry
   - Thermal expansion
2. Mechanisms of heat transfer.
   - Conduction
   - Convection
   - Radiation
3. Different forms of energy and transformations between them.
   - Forms of energy (e.g., kinetic, potential, mechanical, electrical, electromagnetic, chemical, nuclear)
   - Energy transformations
4. Energy involved in phase transitions between the various states of matter.
   - Phase transitions
   - Phase diagrams
   - Heating/cooling diagrams
   - Heats of vaporization, fusion, and sublimation
5. Kinetic molecular theory and the ideal gas laws.
   - Kinetic molecular theory (e.g., assumptions of the theory, temperature, pressure, average molecular speeds)
   - Ideal gases and the ideal gas law
6. Laws of thermodynamics.
   - First law (e.g., internal energy, conservation of energy, work, heat)
   - Second law (entropy)
   - Third law (absolute zero)
   - Zeroth law (thermal equilibrium)
   - P-V diagrams
   - Thermodynamic processes (e.g., isothermal, adiabatic, reversible/irreversible)
   - Heat engines and efficiency (e.g., ideal vs. actual efficiency, temperature differences)

V. Modern Physics, Atomic and Nuclear Structure

1. Organization, structure and states of matter.
   - Atoms, molecules, ions
   - Solids, liquids, gases, plasmas
   - Chemical/physical properties and changes
2. Nature of atomic and subatomic structure including various models of the atom.
   - Atomic and subatomic structure (e.g., electrons, protons, neutrons, and isotopes)
   - Models of the atom (e.g., Bohr model, quantum model)
   - Experimental basis of models (e.g., Rutherford experiment, Millikan oil-drop experiment, Thomson experiment)
3. Relationship of atomic spectra to electron energy levels.
   - Electron energy transitions in atoms
   - Absorption and emission spectra

4. Characteristics, processes, and effects of radioactivity.
   - Radioactivity and radioactive decay processes
   - Alpha particles, beta particles, and gamma radiation
   - Half-life
   - Radioisotopes
   - Fission and fusion
5. Topics in modern physics.
   - Wave-particle duality
   - Photoelectric effect
   - Special relativity
   - Heisenberg uncertainty principle
   - de Broglie's hypothesis
   - Nuclear forces (strong and weak) and binding energy

VI. History and Nature of Science; Science, Technology, and Social Perspectives (STS)

A. History and Nature of Scientific Inquiry

1. Processes involved in scientific inquiry.
   - Identifying problems
   - Forming and testing hypotheses
   - Development of theories, models, and laws
   - Process skills, including observing, comparing, inferring, categorizing, generalizing, and concluding
2. Experimental design.
   - Experimental procedures used to test hypotheses
   - Reproducible procedures
   - Significance of controls
   - Dependent and independent variables
   - Determining what data need to be collected
3. Nature of scientific knowledge.
   - Is subject to change
   - Is consistent with evidence
   - Is based on reproducible evidence
   - Includes unifying concepts and processes (e.g., systems, models, constancy and change, equilibrium, form and function)
4. How major principles in physics developed historically and the contributions of major historical figures.
   - How current principles and models developed over time
   - Major developments (e.g., atomic model, Newtonian mechanics, Rutherford experiment)
   - Major historical figures in the development of physics

B. Scientific Procedures and Techniques

1. How to collect, process, analyze, and report data including sources of error.
   - Organization and presentation of data
   - Units of measurement including SI, SI derived, and others (e.g., meter, newton, mile)
   - Unit conversion and dimensional analysis
   - Scientific notation and significant figures
   - Measurement equipment, including applications
   - Basic error analysis, including precision and accuracy
   - Identifying sources of error
   - Interpreting and drawing valid conclusions from data presented in tables, graphs, and charts (e.g., trends in data, relationships between variables, predictions based on data)
2. Appropriate use of materials, equipment, and technology in the high school physics laboratory and classroom.
   - Appropriate use and storage
   - Appropriate prelab setup and classroom demonstrations
   - Safety procedures and precautions

C. Science, Technology, and Society

1. Impact of physics and technology on society and the environment.
   - Space exploration, communications, etc.
   - Climate change, ozone layer depletion, noise pollution, etc.
   - Production, storage, and disposal issues associated with consumer products
2. Major issues associated with energy use and production.
   - Renewable and nonrenewable energy resources
   - Conservation and recycling
   - Power generation based on various sources, such as fossil and nuclear fuel, hydropower, wind power, solar power, and geothermal power
   - Storage and distribution of renewable energy (e.g., alternative fuels, fuel cells, rechargeable batteries)
3. Applications of physics in daily life.
   - Communications (e.g., wireless devices, fiber optics, satellites)
   - Research tools (e.g., space telescopes, lasers, super colliders)
   - Medicine (e.g., medical imaging, lasers)
   - Transportation (e.g., superconductors, magnetic levitation)
   - Other applications

Sample Test Questions

The sample questions that follow illustrate the kinds of questions in the test. They are not, however, representative of the entire scope of the test in either content or difficulty. Answers with explanations follow the questions.

Directions: Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one that is best in each case.

1. Three resistors of 4 ohms each CANNOT be connected to give an equivalent resistance that is close to

   (A) 0.75 ohms

   (B) 2.66 ohms

   (C) 6 ohms

   (D) 12 ohms

2. A beam of light travels obliquely from one medium into another medium of higher index of refraction. All of the following are true statements about the beam of light EXCEPT:

   (A) Its speed increases.

   (B) Its wavelength decreases.

   (C) Its frequency remains the same.

   (D) It bends toward the normal.

3. Two satellites move in circular orbits around the Earth. The radius of the orbit of the outer satellite is three times the radius of the orbit of the inner satellite, as measured from the Earth's center. If the orbital speed of the inner satellite is v, then the orbital speed of the outer satellite is

   (A) $v/3$

   (B) $v/\sqrt{3}$

   (C) $\sqrt{3} \cdot v$

   (D) $3v$

4. Which of the following is an example of the Doppler effect?

   (A) Sudden increase in pitch when a moving sound source is moving away from a listener

   (B) Sudden increase in pitch when a moving listener is moving away from a sound source

   (C) Sudden drop in pitch as a moving sound source passes a listener

   (D) Continuous drop in pitch as a moving sound source approaches a listener

5. Supplies appropriate for the measurement in a school laboratory of the density of a small rock sample include all of the following EXCEPT

   (A) water

   (B) a graduated cylinder

   (C) a platform balance

   (D) a thermometer

6. Which of the following properties of a substance depends on the amount of the sample?

   (A) Temperature

   (B) Half-life

   (C) Density

   (D) Inertia

7. $n \longrightarrow p + e^{-} + \overline{\nu}$
   A nucleus can emit a negative beta particle according to the reaction above, where n = neutron, p = proton, e^{-} = electron, and $\overline{\nu}$ = antineutrino. Which of the following best states the information in this reaction?

   (A) A neutron is composed of an electron and a proton.

   (B) The mass of a neutron is equal to the mass of a proton plus the mass of an electron.

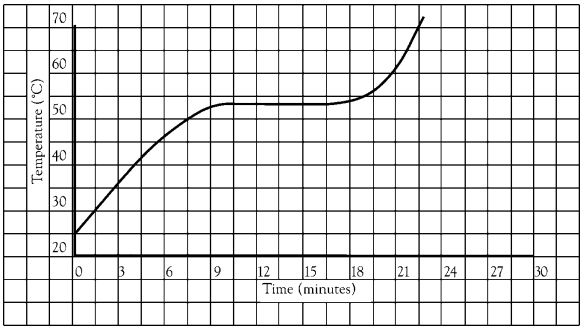
   (C) Since a neutrino has no rest mass or charge, a neutron may decay into a proton and an electron.

   (D) The mass of a neutron is greater than the mass of a proton plus the mass of an electron.

8. Faraday's law of electromagnetic induction describes how an electric field can be produced at a point in space by

   (A) an electric charge
   (B) a constant magnetic field
   (C) a changing magnetic field
   (D) a steady current

9.



A sample of a pure solid substance is heated at a constant rate and its temperature recorded as a function of time. A graph of the data is shown above. At about what temperature is the heat added being used to melt the substance?

(A) 25°C
(B) 41°C
(C) 53°C
(D) 60°C

10. If electrons have a velocity of 4.0×10^{6} meters per second at right angles to a magnetic field of 0.20 newton per ampere-meter, what is the magnitude of the force on a single electron?

    (A) 1.3×10^{-13} N
    (B) 1.6×10^{-14} N
    (C) 6.4×10^{-19} N
    (D) 3.2×10^{-26} N

Questions 11–12 refer to the following statements.

A mass is suspended from a vertical spring and displaced downward a distance *Y* from its equilibrium position. After being released, it oscillates with period *T*.

11. At a time 5T/4, the velocity of the mass is

    (A) a maximum and directed upward
    (B) a maximum and directed downward
    (C) constant
    (D) zero

12. At a time 5T/4, the acceleration of the mass is

    (A) a maximum and directed upward
    (B) a maximum and directed downward
    (C) constant
    (D) zero

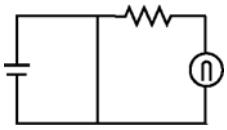
13. In a test of an automobile air bag, a mannequin with a mass of 70 kilograms hits a stationary air bag. The velocity of the mannequin at the instant of impact is 25 meters per second. After 0.25 seconds the mannequin has come to a complete stop and the air bag has deflated. The average force on the mannequin during this interval is most nearly

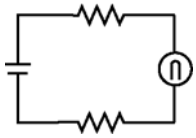
    (A) 70 N
    (B) 700 N
    (C) 7,000 N
    (D) 70,000 N

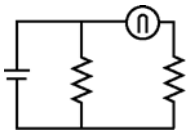
14. In which of the following is the battery short-circuited?

= – battery ⏦ – resistance ⓝ – bulb

(A) 

(B) 

(C) 

(D) 

15. Polarized sunglasses are used to cut glare from sunlight reflected at a glancing angle off cars, water, and other surfaces. Such sunglasses are a practical application of which of the following physical principles?

(A) Brewster's law
(B) Lenz's law
(C) Coulomb's law
(D) Snell's law

16. A thin ring of mass 50 g and radius 5.0 cm is spinning at a frequency of 6.0 rev/s. Mass is added uniformly to the ring until it has a final mass of 75 g. What is the final spinning frequency of the ring?

(A) 0 rev/s
(B) 4 rev/s
(C) 6 rev/s
(D) 8 rev/s

17. A washer consists of a 3.00 cm diameter circle of sheet metal with a 1.00 cm diameter circular hole in the middle. If the metal washer is heated until the diameter of the washer is 3.03 cm, then the diameter of the hole will be

(A) 0.97 cm
(B) 0.99 cm
(C) 1.00 cm
(D) 1.01 cm

18. In a particle accelerator, it becomes increasingly difficult to increase a particle's speed because of

(A) relativistic mass increase
(B) time dilation
(C) length contraction
(D) inelastic collisions

19. The true length of a block of wood is 1.010 cm. Three measurements of this block produced the following values: 1.4 cm, 1.2 cm, and 0.9 cm. Which of the following statements is true concerning these measurements?

(A) They are precise and accurate.
(B) They are precise but not accurate.
(C) They are accurate but not precise.
(D) They are neither precise nor accurate.

20. Which of the following items will be attracted to the north pole of a permanent magnet by a magnetic force?

(A) The north pole of another permanent magnet
(B) A piece of iron that is not a permanent magnet
(C) A positively charged glass rod
(D) A negatively charged rubber rod

Answers

1. There are four possible series and parallel combinations involving three resistors of equal value. The following table lists these combinations along with their corresponding equivalent resistances.

COMBINATION	*REQ*
3 in series	12 Ω
3 in parallel	1.33 Ω
2 series, 1 parallel	2.66 Ω
1 series, 2 parallel	6.0 Ω

Thus, A is the correct answer.

2. According to Snell's law, $n_1 \sin\Theta_1 = n_2 \sin\Theta_2$, and when $n_2 > n_1$ then $\Theta_2 < \Theta_1$; that is, the beam bends toward the normal, so choice D is true. The frequency of the light will remain unchanged. Thus, choice C is true. The speeds v_1 and v_2 of the light in the two media are c/n_1 and c/n_2, respectively. Thus $v_2 < v_1$ for $n_2 > n_1$, and since the frequency remains the same, the wavelength decreases. That is, $\lambda_2 < \lambda_1$, so choice B is true. Finally, $v_2 < v_1$ indicates that choice A is false. Because A is false, it is the correct answer.

3. For circular orbital motion in a gravitational field, $\frac{v^2}{R} = \frac{GM}{R^2}$ which gives $v^2 = \frac{GM}{R}$.
Thus, letting v_i, R_i denote the velocity and radius of the orbit of the inner satellite and v_o, R_o the velocity and the radius of the orbit of the outer satellite, one has

$$\left[\frac{v_o}{v_i}\right]^2 = \frac{R_i}{R_o}, \text{ or } v_o = v\sqrt{\frac{R_i}{R_o}} = \frac{v}{\sqrt{3}} \text{ since } v_i = v.$$

This gives B as the correct answer.

4. Choices A, B, and D are NOT true of the Doppler effect. Choice C is true. The frequency drops as a sound source passes and then moves away from a listener.

5. The density of a rock is subject to very small variations with temperature, so the thermometer is not important. The other pieces of equipment are needed for the determination since density is mass per unit volume. The correct answer is D.

6. Inertia is a property of a substance, proportional to its mass, and therefore depends on the amount of the sample. The correct answer is D.

7. The antineutrino carries energy and has a very small but nonzero rest mass. Thus, the mass of a neutron must be greater than the mass of a proton plus the mass of an electron. The correct answer is D.

8. Choice C is the correct answer. For circuits, Faraday's law of electromagnetic induction states that the induced electromotive force in a circuit is equal to the rate of change of the magnetic flux through it. In general, Faraday's law relates an electric field in vacuum to the rate of change of a magnetic field. In differential form, the relation is clearly seen:

$$\nabla \times \mathbf{E} = -\frac{\partial B}{\partial t}$$

9. When a substance is heated, its temperature increases unless it is undergoing a phase change. During melting, the temperature remains constant since the energy absorbed is being used to do work against the attractive forces in becoming liquid particles. In the diagram, melting begins around 9 minutes and a temperature around 53°C. The correct answer is C.

10. According to the Lorentz force law,
$F = qvB = (1.6 \times 10^{-19}\text{C})\ (4.0 \times 10^{6}\ \text{m/s})\ (0.20\ \text{N/Am}) = 1.3 \times 10^{-13}\ \text{N}$

Thus, A is the correct answer.

11. At 5T/4, the mass is situated midway between its highest and lowest positions; it is moving upward and has its maximum speed. Thus, A is the correct answer.

12. At 5T/4, the mass is situated midway between its highest and lowest positions. At this position, the sum of the two forces acting on the mass is zero; thus its acceleration is zero and D is the correct answer.

13. The average force $\bar{F}$ is equal in magnitude to the change in the momentum of the mannequin divided by the elapsed time, or

$$\bar{F} = \frac{m\Delta V}{\Delta t} = \frac{(70\text{ kg})(25\text{ m/s})}{0.25\text{s}} = 7{,}000\text{ N}.$$

Thus, C is the correct answer.

14. The correct answer is B. In this diagram the path of the circuit is such that current will be diverted from passing through the resistor and the bulb. When the part of a circuit with the most resistance is bypassed, and all of the current flows through the part with zero (negligible) resistance, a short circuit is said to exist.

15. The correct answer is A. According to Brewster's law, reflected light will always be polarized in a horizontal direction, parallel to the reflecting surface. Polarized sunglasses are constructed to block this reflected light and to transmit light polarized only in the vertical direction.

16. The correct answer is B. The additional mass is added uniformly to the ring, which means that no external torques act on the system and angular momentum is conserved. Now, the angular momentum is equal to the product of the ring's mass, the ring's angular velocity, and the square of the ring's radius. Because the radius is also constant, conservation of angular momentum gives (50 g) x (6.0 rev/s) = (75 g) x (final angular frequency), or final angular frequency = 4 rev/s.

17. The correct answer is D. At a given radius, the linear expansion is the same in all radial directions and is equal to the product of the radius, the thermal expansion coefficient, and the temperature change. Thus, the expansion of the inner diameter will be equal to one-third the expansion of the outer diameter, or 0.01 cm, for a total internal diameter of 1.01 cm.

18. The correct answer is A. In a particle accelerator, the particles are accelerated to relativistic speeds. According to the theory of special relativity, a particle's relativistic mass (inertia) increases as the particle's speed increases. Thus, greater and greater forces are needed to accelerate the particle as its speed increases.

19. The correct answer is D. The measurements differ from the true length by 0.39 cm, 0.19 cm, and -0.11 cm. Thus, the measurements are quite different in value from the true value, which means that they are not accurate. The measurements are also quite different in value from one another (not repeatable), which means that they are not precise.

20. The correct answer is B. Iron is easily magnetized. When iron is brought close to a permanent magnet, the iron will become magnetized in such a way as to be attracted to the permanent magnet.

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