Michigan

TEST FOR TEACHER CERTIFICATION

STUDY GUIDE

94 Integrated Science (Secondary)

MI-SG-FLD094-02

TABLE OF CONTENTS

PART 1: General Information About the MTTC Program and Test Preparation

OVERVIEW OF THE TESTING PROGRAM **1-1**

Contact Information
Test Development Process
Characteristics of the Tests
Test Administration
Score Reporting

HOW TO PREPARE FOR THE TESTS **1-4**

Plan Your Course of Study

THE DAY OF THE TEST: HELPFUL HINTS **1-5**

Preparing for the Test Administration
Test-Taking Tips
Test Directions

PART 2: Test Objectives and Sample Test Questions

INTRODUCTION **2-1**

TEST OBJECTIVES **2-3**

SAMPLE MULTIPLE-CHOICE TEST QUESTIONS **2-9**

ANSWER KEY FOR THE SAMPLE MULTIPLE-CHOICE TEST QUESTIONS **2-19**

Readers should be advised that this study guide, including many of the excerpts used herein, is protected by federal copyright law.

National Evaluation Systems, P.O. Box 226, Amherst, MA 01004

PART 1: General Information About the MTTC Program and Test Preparation

The first section of the study guide is available in a separate PDF file. Click the link below to view or print this section.

General Information About the MTTC Program and Test Preparation

PART 2: Test Objectives and Sample Test Questions

INTRODUCTION

This section includes a list of the test objectives, immediately followed by sample test questions and an answer key for the field covered by this study guide.

Test Objectives

As noted, the test objectives are broad, conceptual statements that reflect the knowledge, skills, and understanding an entry-level teacher needs in order to teach effectively in a Michigan classroom. Each field's list of test objectives represents the **only** source of information about what a specific test will cover and, therefore, should be studied carefully.

The test objectives are organized into groups known as "subareas." These subareas define the major content areas of the test. You will find a list of subareas at the beginning of the test objective list. The percentages shown in the list of subareas indicate the approximate weighting of the subareas on the test.

Sample Multiple-Choice Test Questions

The sample multiple-choice test questions included in this section are designed to give the test-taker an introduction to the nature of the test questions included on the MTTC test for each field. The sample test questions represent the various types of test questions you may expect to see on an actual test; however, they are **not** designed to provide diagnostic information to help you identify specific areas of individual strengths and weaknesses or predict your performance on the test as a whole. Use the answer key that follows the sample test questions to check your answers.

To help you identify which test objective is being assessed, the objective statement to which the question corresponds is listed in the answer key. When you are finished with the sample test questions, you may wish to go back and review the entire list of test objectives and descriptive statements once again.

TEST OBJECTIVES

Subarea	Approximate Percentage of Questions on Test
Constructing and Reflecting on Scientific Knowledge	25%
Life Sciences	25%
Earth/Space Sciences	25%
Physical Sciences	25%

Candidates for the secondary integrated science endorsement must have an understanding of the common themes and connections among the various scientific disciplines. Although these test objectives contain separate subareas for the life, earth/space, and physical sciences, the teacher candidate should be prepared to analyze some scientific problems and phenomena from the perspective of two or more of these disciplines and to understand the integrated nature of all scientific inquiry.

CONSTRUCTING AND REFLECTING ON SCIENTIFIC KNOWLEDGE

Understand and apply the principles and procedures for conducting scientific research.

Includes formulating research questions and designing experiments; developing valid experimental designs for collecting and analyzing data and testing hypotheses; recognizing the role of control groups in experiments; understanding procedures for collecting and interpreting data to minimize bias; identifying procedures used in setting up and conducting scientific investigations in natural and laboratory settings; recognizing independent and dependent variables and analyzing the role of each in experimental design; identifying how best to present data with graphs, tables, equations, and maps; using and evaluating simple descriptive statistics; interpreting data presented in different formats; evaluating the validity of conclusions; and assessing the reliability of sources of information.

Apply knowledge of methods and equipment used in scientific investigations.

Includes identifying and implementing procedures for the safe use, storage, and disposal of equipment and materials related to scientific investigations; understanding the practices and requirements related to the humane treatment of animals; applying procedures for selecting and using simple standard and metric measurement devices (e.g., rulers, balances, scales, thermometers); and solving problems involving measurement.

Understand the nature and history of scientific thought and inquiry.

Includes demonstrating knowledge of the reliance of scientific investigations on empirical data, verifiable evidence, and logical reasoning; recognizing the effect of researcher bias on scientific investigations and the interpretation of data; identifying major scientific ideas developed by individuals from different periods and cultures; and recognizing the dynamic nature of scientific knowledge, including ways in which scientific knowledge and theory are acquired and modified.

Understand the relationship of science and technology to contemporary, historical, and societal issues.

Includes recognizing the relationships and differences between science and technology; identifying how society influences the practice of science; analyzing the issues related to scientific and technological changes; assessing the effects of science and technology on society; recognizing ethical issues (e.g., cloning, genetically modified foods, energy use) related to science and technology; analyzing the effects of pollution and conservation on the environment; and evaluating the credibility of scientific claims made in various forums (e.g., the popular media, professional journals, advertising).

Understand interrelationships among the life, physical, and earth/space sciences and their connections to mathematics and technology.

Includes recognizing major unifying themes and concepts that are common to the various scientific disciplines and that connect science, mathematics, and technology (e.g., classification, cause and effect, conservation of energy, entropy); describing the integration and interdependence of the sciences; and recognizing how common themes of science, mathematics, and technology (e.g., feedback, systems, scale) apply in real-world contexts.

LIFE SCIENCES

Understand cell structure and function.

Includes describing the principles of cell theory; applying knowledge of basic cell structures to explain their functions; describing the processes of mitosis and meiosis; recognizing the steps involved in protein synthesis; comparing animal cells and plant cells; recognizing the roles of biomolecules in cell structure; and analyzing the relationship between a cell's structure and its function.

Understand the organization, characteristics, and functions of living things.

Includes recognizing the characteristics that differentiate living and nonliving things; applying knowledge of systems for classifying organisms; analyzing the development of multicellular organisms by cell growth and division; describing the life cycles and reproductive strategies of common organisms; comparing sexual and asexual reproduction; analyzing the processes and products of photosynthesis and cellular respiration; identifying homeostatic and metabolic processes; recognizing levels of biological organization (e.g., cells, tissues, organs, systems) and analyzing interactions between the levels; and analyzing the functions of specialized structures (e.g., bark, fur) and systems (e.g., vascular, skeletal) found in plants and animals.

Understand characteristics of human biology.

Includes demonstrating knowledge of anatomical structures and physiological functions; recognizing common causes (e.g., immunologic, microbiologic, genetic) and characteristics of diseases and methods of prevention; demonstrating knowledge of human reproduction and growth; analyzing the effects of environmental factors, nutrition, and fitness on health; and identifying factors that affect human population growth and diversity.

Understand concepts of heredity and modern genetics.

Includes recognizing how characteristics are passed from one generation to the next (e.g., Mendelian genetics, molecular basis of inheritance); predicting the inheritance of traits; analyzing the influence of environmental factors (e.g., nutrition, pollution, climate change) and how they affect natural selection and mutation; and recognizing characteristics and applications of modern genetics (e.g., genetic engineering, DNA fingerprinting).

Understand evolutionary change of life on Earth.

Includes recognizing theories and processes associated with the origin, evolution, and extinction of life; evaluating scientific evidence for these theories and processes (e.g., fossil record, genetics, speciation); applying knowledge of methods used to investigate evolution; and analyzing the roles of variation, natural selection, and adaptation in producing species diversity.

Understand characteristics of ecological systems.

Includes analyzing biotic and abiotic factors that affect populations, communities, ecosystems, and biomes; identifying strategies used by organisms to obtain basic requirements for life (e.g., nutrients, shelter, oxygen, water); analyzing factors that affect population dynamics; analyzing interrelationships among and effects of organisms, including humans, on ecosystems; relating biogeochemical cycles to the functioning of ecosystems; analyzing energy transfers in food webs and food chains; applying knowledge of the process of ecological succession; analyzing responses of ecosystems to changes in the environment (e.g., agriculture, land use, waste disposal); and analyzing issues related to the availability, management, and use of renewable and nonrenewable resources.

EARTH/SPACE SCIENCES

Understand characteristics of the lithosphere and the history and processes of the changing earth.

Includes comparing theories and evaluating evidence of Earth's origin; identifying methods of determining the age of the earth; recognizing processes of structural change in the earth's crust (e.g., mountain building, seafloor spreading); demonstrating knowledge of the theory of plate tectonics and evidence that supports this theory; recognizing and describing the structure and composition of the earth and its layers; demonstrating knowledge of the rock cycle and its relationship to the geologic timeline; analyzing the processes of rock, mineral, and soil formation; evaluating the effects of catastrophic phenomena (e.g., volcanism, meteor impacts, earthquakes) on the earth and biosphere; identifying important topographical features of the earth and their characteristics; and reading topographic and geologic maps.

Understand characteristics of the hydrosphere.

Includes demonstrating knowledge of the physical, chemical, and biological characteristics of oceans, lakes, streams, and ground water; describing how ocean currents and temperature affect climate and the biosphere; using knowledge of the water cycle to explain watersheds and the movement and renewal of ground water; describing the role of phase changes in the hydrologic cycle; and recognizing how energy from the sun drives the hydrologic cycle.

Understand the earth's atmosphere, weather, and climate.

Includes recognizing and describing the structure and characteristics of the atmosphere; describing the processes and causes of atmospheric convection, cloud formation, and precipitation; applying knowledge of the characteristics of low- and high-pressure systems to explain the movement of air in the atmosphere and weather phenomena; evaluating the climatological evidence and mechanisms implicated in global warming and depletion of ozone in the upper atmosphere; identifying equipment and techniques used to monitor the weather; interpreting meteorological and climatological information; and applying knowledge of meteorologic techniques to predict the weather and climatic change.

Understand features of the universe and the methods of astronomy.

Includes identifying the structure and components of the solar system; describing the planets and their characteristics; understanding interactions and movements of the earth, moon, and sun and applying this knowledge to explain seasonal changes, moon phases, eclipses, and tides; identifying other components of the universe (e.g., stars, galaxies) and their characteristics; and comparing theories and evaluating evidence of the origin and evolution of the universe, stars, and the solar system.

PHYSICAL SCIENCES

Understand the chemical properties of matter.

Includes using models of atomic structure to explain chemical behavior; relating atomic structure to the structure and organization of the periodic table; differentiating among elements, compounds, and mixtures; interpreting chemical symbols, formulas, and expressions; and identifying the molecular structures of various types of organic compounds (e.g., polymers, heterocyclic compounds, aromatic and aliphatic hydrocarbons).

Understand the nature of chemical changes in matter.

Includes analyzing common chemical changes (e.g., acid-base reactions, redox reactions, aliphatic and alicyclic reactions) in terms of properties of reactants and products; recognizing types of chemical bonds, their characteristics, and their effects on the properties of matter; balancing equations; demonstrating understanding of the mole concept; analyzing factors that affect rates of reaction and chemical equilibrium; and identifying organic functional groups (e.g., alcohols, ethers, amines).

Understand the physical properties of matter, the ideal gas laws, and the nature of physical changes in terms of molecular behavior.

Includes demonstrating knowledge of the physical characteristics of matter (e.g., density, mass, atomic structure); understanding the difference between weight and mass; applying knowledge of the characteristics of the states of matter; describing what happens at the molecular level during changes of state; identifying the changes in energy that occur during changes of state; demonstrating knowledge of the physical properties of common materials (e.g., metals, nonmetals, water); relating the structure of a crystalline solid to its physical properties (e.g., melting point, conductivity, solubility); comparing the physical properties of mixtures and solutions; and demonstrating knowledge of the behavior of ideal gases, including the relationships among pressure, temperature, and volume.

Understand and apply the concepts of mechanics.

Includes analyzing motions in terms of concepts of displacement, velocity, and acceleration; recognizing how force and motion are related; applying the laws of motion to various situations; understanding the concepts of inertial mass and momentum; and describing the types and uses of simple machines and explaining their principles of operation.

Understand and apply the concepts of electricity and magnetism.

Includes relating the phenomenon of electrostatic charge to the atomic structure of matter; describing the electrostatic forces between charges; describing electric current and conduction in terms of flow of charge; analyzing electric circuits in terms of concepts of potential difference, current, and resistance; recognizing that magnetic fields are produced by both magnets and electric currents; understanding that electric current can be produced from magnetic field changes; and describing technological applications of electromagnetism.

Understand and apply the basic concepts of energy and thermodynamics.

Includes describing the concept of work and understanding its relationship to energy; identifying different forms of energy (e.g., kinetic, potential, thermal); understanding that energy may transform from one form to another, but that total energy is conserved; discriminating between heat and temperature; describing modes of heat transfer (i.e., convection, conduction, radiation); and demonstrating understanding of the first and second laws of thermodynamics and relating them to the conversion of mechanical to thermal energy and vice versa, including the basic idea of entropy.

Understand the characteristics of waves and vibrations and the properties of light and sound.

Includes identifying characteristics of waves and oscillations (e.g., amplitude, frequency, period) and relating these to perceived properties of sound and light (e.g., loudness, pitch, intensity, color); describing types of wave (e.g., transverse, longitudinal); applying the concept of light rays to the formation of shadows in various situations; demonstrating knowledge of the law of reflection and its application to the formation of images in mirrors; describing refraction of an interface and by lenses; and recognizing characteristics and properties of the electromagnetic spectrum, including visible light.

PERIODIC TABLE OF THE ELEMENTS

1 **IA**																	18 **VIIIA**
1 **H** 1.01	2 **IIA**											13 **IIIA**	14 **IVA**	15 **VA**	16 **VIA**	17 **VIIA**	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 23.0	12 **Mg** 24.3	3 **IIIB**	4 **IVB**	5 **VB**	6 **VIB**	7 **VIIB**	8	9 **VIIIB**	10	11 **IB**	12 **IIB**	13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 39.9
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.8	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** (98.9)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57–71	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89–103	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (266)	107 **Bh** (264)	108 **Hs** (277)	109 **Mt** (268)	110 **Ds** (271)	111	112	113	114	115	116	117	118

Lanthanide Series	57 **La** 138.9	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
Actinide Series	89 **Ac** (227)	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)

Some of the elements 111 and above have been reported but not fully authenticated and named.

SAMPLE MULTIPLE-CHOICE TEST QUESTIONS

1. A student spills concentrated hydrochloric acid on his hand during a laboratory experiment. Which of the following actions is most appropriate for the teacher to take first?

   A. Flush the skin with water for 15 minutes.

   B. Send the student to the school nurse.

   C. Dry the hand with a clean cloth.

   D. Explain to the class the hazard posed by the spilled substance.

2. A biologist is consulting a physics book to better understand the relationship between volume and pressure in gases. The biologist is most likely to need this information for research involving:

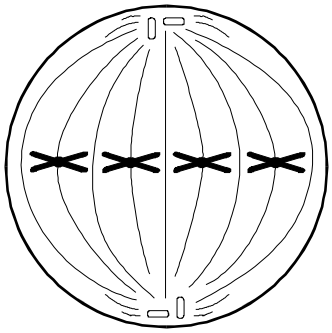
   A. the mechanism by which the heart moves oxygenated blood through the circulatory system.

   B. the ability of fish to remain neutrally buoyant at various depths.

   C. the mechanism by which sap moves upward against gravity in a tree.

   D. the ability of hibernating animals to reduce their oxygen consumption.

3. Use the diagram below to answer the question that follows.



The cell in the diagram is undergoing mitosis. Which of the following processes will occur next?

A. Two of the chromatid pairs will migrate to one pole, and the other two chromatid pairs will migrate to the other pole.

B. All four chromatid pairs will migrate to one of the two poles.

C. The individual chromatids of each pair will separate in preparation for migration to opposite poles.

D. Each chromatid pair will make a copy of itself, then the original pairs will migrate to one pole and the copies will migrate to the other pole.

4. Which of the following best explains why some individuals react to the presence of foreign antigens with symptoms of hay fever?

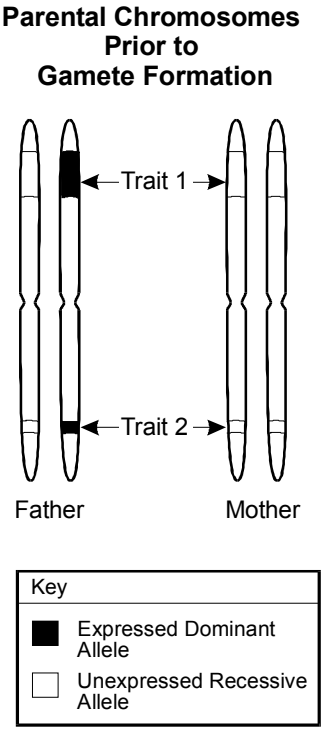
A. They produce fewer antibodies that can neutralize specific antigens, causing irritation of exposed membranes.

B. They produce specific antibodies, which react with foreign antigens, leading to the release of histamine and an inflammatory response.

C. They have fewer white blood cells, allowing foreign antigens to build up to higher levels in the blood and inflame exposed tissue.

D. Their antibodies fail to distinguish between the body's own proteins and the foreign antigens, inducing an exaggerated immune response.

5. Use the diagram below to answer the question that follows.



The genes for two independent genetic traits are located on a single chromosome as shown. The father is heterozygous for both of the traits, while the mother is homozygous recessive for each trait. Which of the following events during gamete formation would best explain an offspring who expresses only one of the dominant alleles?

A. crossing over

B. genetic equilibrium

C. incomplete dominance

D. sex-linked inheritance

6. The evolutionary progression from amphibians to reptiles to birds is paralleled by an increase in which of the following characteristics?

A. the ability to maintain body temperature by using the organism's metabolic heat

B. the density and durability of bones and bone material

C. the egg's ability to protect the embryo from desiccation and physical damage

D. the number of offspring produced by each individual

Use the information below to answer the three questions that follow.

Some marine animals, called osmoregulators, are able to tolerate decreases in the salinity of their environment by regulating the osmotic concentrations of their body fluids. Animals that do this are able to maintain fairly constant ionic concentrations in tissues over a wide range of environmental ionic concentrations. Other animals, called osmoconformers, allow their bodily ionic concentrations to conform to that of the changing medium.

7. The ability of osmoregulators described in the passage is most likely to be important to animals inhabiting:

   A. coral reef environments.

   B. lakes and ponds.

   C. deep sea basins.

   D. estuaries.

8. The behavior of osmoregulators described in the passage is most likely to involve the expenditure of energy because:

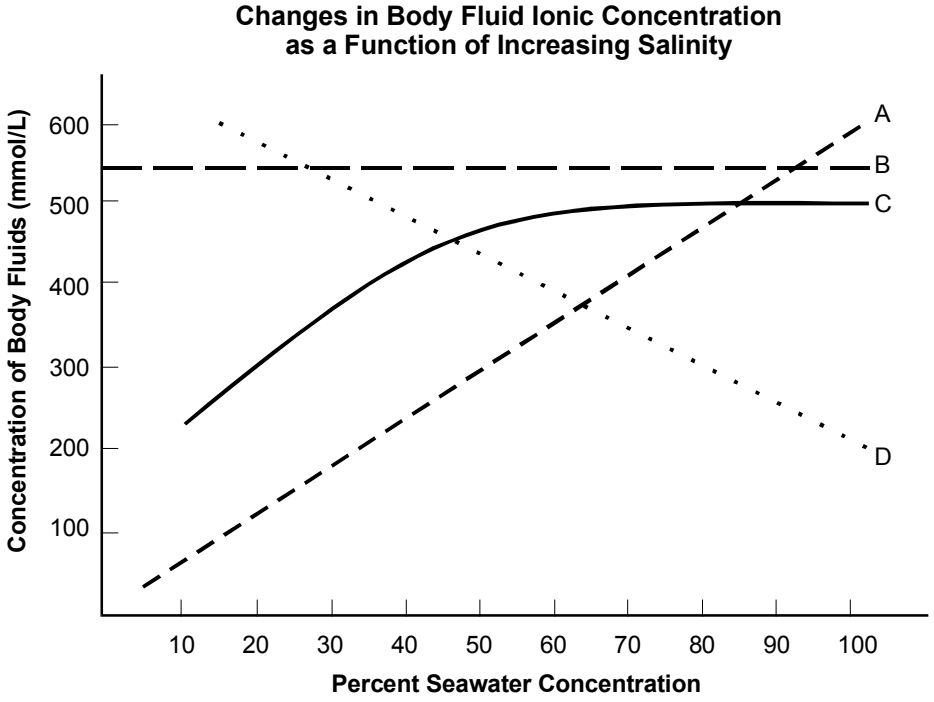
   A. ions will have to be moved against their concentration gradient.

   B. hydrostatic pressure will be required to prevent the influx of water.

   C. an inflow of ions will result in an increase in metabolic activity.

   D. water regulation will require an increase in neuromuscular activity.

9. Use the diagram below to answer the question that follows.



Which organism in the diagram is most likely an osmoconformer?

A. A

B. B

C. C

D. D

Use the passage below to answer the four questions that follow.

Methane is a gas that is plentiful in nature and is the main ingredient in natural gas. It is composed of a single carbon atom attached to four hydrogen atoms by single covalent bonds. Methane is produced from the breakdown of organic matter in a variety of natural settings including swamps, soils, and sediments. Methane, in the form of natural gas, is also found in association with oil deposits where, until the 1960s, it was considered a nuisance that was disposed of as cheaply as possible so as not to hinder the pumping of oil. Methane hydrate is a crystalline compound composed of methane molecules trapped inside a cage-like lattice of water molecules. The compound is found in great quantities in ocean sediments and in the soils of permafrost regions, making it an attractive potential energy resource. At times in the geologic past, methane hydrates and the deposits that contain them have become unstable, releasing large quantities of methane into the oceans and atmosphere.

10. One of the reasons that methane is a relatively stable compound is that:

    A. atomic hydrogen's high electronegativity creates a strong attraction to the central carbon atom.

    B. transfer of electrons between the hydrogen and carbon atoms creates a tetrahedron.

    C. hydrogen atoms that surround the central carbon atom share electrons to form ionic bonds.

    D. shared electrons fill the valence orbitals in the hydrogen and carbon atoms.

11. New technology is making the use of methane hydrate resources found in ocean sediments a possible future source of energy. A major reason for developing methane hydrates as an energy resource is that:

    A. the solid nature of methane hydrates allows them to be burned like coal or liquified for pipeline transport.

    B. combustion of methane from methane hydrates does not produce nitrogen and sulfur oxides.

    C. the inert nature of methane hydrates makes them less explosive than natural gas.

    D. retrieval of methane hydrates would cause less environmental damage than oil or natural gas extraction.

12. Which of the following best describes how methane is produced by cattle?

    A. The multi-chambered stomach of a cow supports the growth of bacterial populations that digest cellulose and produce methane.

    B. Elemental carbon and hydrogen are broken down from grain consumed by the cow, recombining to produce methane.

    C. Incomplete breakdown of complex carbohydrates consumed by cattle promotes the growth of yeast, which produce methane during respiration.

    D. Oxygen entering the cow's digestive system during feeding and regurgitation promotes the growth of methane-producing microorganisms.

13. The concentration of methane in the atmosphere has doubled since the beginning of the industrial revolution and is continuing to increase. The primary reason this is a concern for society is because methane:

    A. is a very limited resource that cannot be produced on human time scales.

    B. combines with chloroflourocarbons in the upper atmosphere, causing increased ozone loss.

    C. is a major heat-trapping gas in the atmosphere implicated as a cause of global warming.

    D. creates haze at high levels in the atmosphere, altering atmospheric circulation patterns.

14. As ecological succession progresses in a field following the abandonment of a farm in Michigan, which of the following would be most likely to occur?

    A. The species of birds in the area will change as the vegetation shifts from grasses to shrubs to trees.

    B. The total numbers of living things in the ecosystem will increase, while the biodiversity of species will decrease.

    C. The rate at which new plant species adapt to the area will increase after a climax forest ecosystem is established.

    D. The hardwood trees that first colonize the field will increase shade, allowing for the growth of pine tree saplings.

15. A geologist is dating a sample of igneous rock using radiometric dating techniques. After the ratio of the parent isotope to daughter isotope in the sample has been measured, which of the following additional information must be known to determine the age of the sample?

    A. the mass of the sample

    B. half-life of the daughter isotope

    C. the mass of the parent isotope

    D. the half-life of the parent isotope

16. In astronomy, the concept of "dark matter" has been used to explain which of the following phenomena?

    A. the microwave background radiation

    B. the rate of expansion of the universe

    C. the birth of the solar system

    D. the formation of black holes

17. Use the chemical equation below to answer the question that follows.

    $A_2(g) + B_2(g) \rightleftharpoons AB(g)$

    Two gases are combined in a closed container and react according to the equation above. Which of the following statements defines what will occur after the reaction reaches equilibrium?

    A. The concentration of reactants will be twice the concentration of the products.

    B. The concentration of products and reactants will be equal.

    C. The concentration of products will be twice the concentration of the reactants.

    D. The concentration of the reactants and products will remain constant.

18. Cubes of ice are placed in a beaker over a heat source. Which of the following best explains why the temperature of the ice water will remain constant at 0°C until all of the ice has melted?

    A. Melting and evaporation are occurring at the same time and there is no net gain in kinetic energy.

    B. As the ice melts, the kinetic energy gained by the molecules is used to increase the volume of the water.

    C. The energy is used to rearrange the molecules rather than increasing the molecules' kinetic energy.

    D. Kinetic energy gained by the system is used to re-form crystals on the surface of the ice cubes.

19. A 10 N force produces an acceleration of 2.5 m/s^2 in a toy rocket. A second toy rocket having a mass twice that of the first rocket is launched by a 15 N force. What is the approximate acceleration of the second rocket?

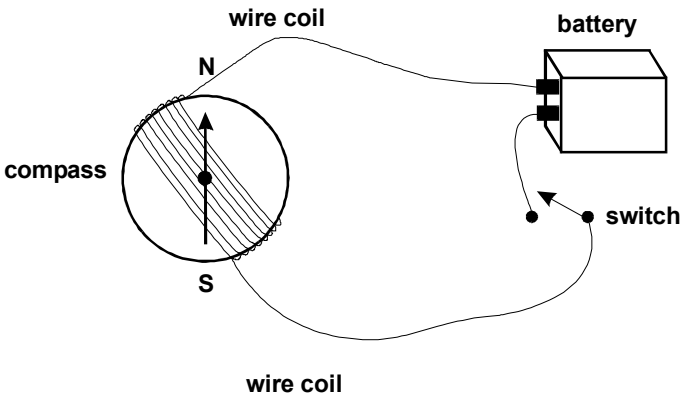
    A. 0.63 m/s^2

    B. 1.3 m/s^2

    C. 1.9 m/s^2

    D. 2.8 m/s^2

20. Use the diagram below to answer the question that follows.



A student coils a wire around a compass to make the circuit shown above. The student observes that the needle of the compass is deflected from its north-south position whenever the switch in the circuit is kept closed. When the switch is kept open, the needle is not deflected from the north-south position. Which of the following best describes why this occurs?

A. The metal wire is composed of an alloy of iron or nickel.

B. The electric field in the wire attracts the electrons in the compass needle.

C. The current in the circuit causes the magnetic needle to reverse polarity.

D. The moving electrons in the wire produce a magnetic field.

ANSWER KEY FOR THE SAMPLE MULTIPLE-CHOICE TEST QUESTIONS

Item Number	Correct Response	Objective
1.	**A**	Apply knowledge of methods and equipment used in scientific investigations.
2.	**B**	Understand interrelationships among the life, physical, and earth/space sciences and their connections to mathematics and technology.
3.	**C**	Understand cell structure and function.
4.	**B**	Understand characteristics of human biology.
5.	**A**	Understand concepts of heredity and modern genetics.
6.	**C**	Understand evolutionary change of life on Earth.
7.	**D**	Understand characteristics of the hydrosphere.
8.	**A**	Understand and apply the basic concepts of energy and thermodynamics.
9.	**A**	Understand and apply the principles and procedures for conducting scientific research.
10.	**D**	Understand the nature of chemical changes in matter.
11.	**B**	Understand the relationship of science and technology to contemporary, historical, and societal issues.
12.	**A**	Understand the organization, characteristics, and functions of living things.
13.	**C**	Understand the earth's atmosphere, weather, and climate.
14.	**A**	Understand characteristics of ecological systems.
15.	**D**	Understand characteristics of the lithosphere and the history and processes of the changing earth.
16.	**B**	Understand features of the universe and the methods of astronomy.
17.	**D**	Understand the chemical properties of matter.
18.	**C**	Understand the physical properties of matter, the ideal gas laws, and the nature of physical changes in terms of molecular behavior.
19.	**C**	Understand and apply the concepts of mechanics.
20.	**D**	Understand and apply the concepts of electricity and magnetism.