

Science Student Guide

GPS/QCC TRANSITIONAL VERSION 2006



**A Guide for Students Preparing for the
Georgia High School Graduation Tests**

Science

Includes:

Hints on Preparing for the GHS GT
Sample Science Test Items and Explanations
Practice Questions
Study Plan

**NOTE: This section is intended as a student aid.
Please photocopy as necessary for student use.**

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Introduction

Georgia High School Assessments

In order to earn a high school diploma in Georgia, all students must pass tests in English language arts, mathematics, science, social studies, and writing. The content tests are referred to as the Georgia High School Graduation Tests (GHSGT). The writing test is referred to as the Georgia High School Writing Test (GHSWT).

Students take all five tests for the first time in the 11th grade. For a detailed explanation of the Georgia High School Graduation Tests (GHSGT), refer to the Department of Education's website: http://public.doe.k12.ga.us/ci_testing.aspx?PageReq=CI_TESTING_GHSGT.

Science Student Guide – GPS/QCC Transitional Version

This document is designed to help you prepare for the GPS/QCC version of the graduation test in Science, which will be administered to first time test-takers in 2006. The *Science Student Guide – GPS/QCC* test can also be viewed at the link provided above.

If you have taken the Science test at least once already, you will take a QCC version of the test. A [student guide for the science – QCC test](#) can also be found at the website provided above. Look for the GPS and QCC designations in the document title. You may also use this document for extra review.

Science Content Descriptions

The content in the Science - GPS/QCC test is grouped into five sections called *domains* that are described on page 2. The sample test items that appear on pages 9-11 of this student guide are representative of these domains and closely resemble items found on an actual test. The items are also aligned to the Georgia Performance Standards (GPS) as well as to QCC standards. The percentages listed for each domain indicate how much emphasis is given to each domain on the test. A Science document entitled [Science Test Content Descriptions: Based on the Georgia Performance Standards and the Quality Core Curriculum](#) appears on the Testing Division's website at the address given above. For students taking the QCC version, a Science document entitled [Science Test Content Descriptions: Based on the Georgia QCC](#) is provided at the same website listed above.

Content Covered on the Test

The science test is comprised of five sections or domains. The domains are:

Domain 1: *Cells and Heredity (25% of the test)*

Students of life science must understand the importance of cells to all living things. Cells are made up of many organelles, each with a specific function in cell processes such as reproduction and homeostasis. DNA stores and transmits cellular information making it possible for traits to change or be passed on to other generations. Students demonstrate understanding by identifying, analyzing, and explaining various cell structures and relating these structures to their functions. Students also relate cell structure to the complexity of organisms and systems and their ability to survive. Assessment of this domain focuses on students' abilities to understand specialized cell parts, to analyze elements in living cells, and to compare diffusion and osmosis. Assessments focus on concepts-not specific laws, on essential elements and processes, on genetic terms and expression at a chemical level, and practical applications of genetics.

Domain 2: *Ecology (17% of the test)*

Students of life science must also understand the concept of interdependence among organisms, especially with regard to the flow of matter and energy within their ecosystems. Assessment in this domain focuses on students identifying, analyzing, and evaluating relationships among organisms, populations, communities, ecosystems, and biomes. Students relate biome types to the climate, geography, and vegetation of given areas, but do not locate biome types on maps. Students analyze the causes and effects of pollution, possible solutions, and preventative measures. Students analyze and evaluate change over time.

Domain 3: *Structure and Properties of Matter (26% of the test)*

Students of physical science must understand the structure of atoms and their particles. Our current understanding of the atom includes knowledge about the locations of subatomic particles, the effects of changes in the number or arrangement of subatomic particles in elements, and the characteristics of different elements and substances. Assessment in this domain focuses on the conceptual examination of the atom including the nucleus, protons, neutrons, and electrons. Students examine atoms with different numbers of neutrons and protons and use the first 20 elements of the periodic table to examine atomic mass, mass number, and atomic number. Students also analyze properties of solutions.

Domain 4: *Energy Transformations (16% of the test)*

Students of physical science must understand the various forms in which energy exists and how it may be transformed from one form to another. Assessment in this domain focuses on students' knowledge of the phases of matter. Students also compare and contrast the atomic and molecular motion of solids, liquids, gases, and plasmas. Students identify and analyze energy transformations and thermal energy changes in terms of conduction, convection and radiation, as well as radioactive decay. Questions assess conceptual understanding of energy transformation.

Domain 5: Forces, Waves, and Electricity (16% of the test)

Students of physical science must understand the relationship of force, mass, and motion through Newton's Laws of Motion. Assessment in this domain focuses on student's ability to apply the concepts of inertia and gravitational force, velocity and acceleration, mechanical advantage, waves, magnetism, and electricity. Students demonstrate understanding of these concepts in several ways including calculating velocity, acceleration, amount of work, and mechanical advantage using formula sheets. Students analyze factors affecting the transfer of energy by heat, light, sound, or mechanical waves including reflection, refraction, interference, and diffraction. Students apply knowledge of magnetism and electricity as they relate to the movement of electrical charges in electromagnets and simple motors.

Physical Science items make up approximately 58% of the test and Biology items make up approximately 42% of the test.

Frequently Asked Questions

Who must take the Science test?

All students who have entered ninth grade since July 1, 1991, must pass the Science test as a requirement for earning a high school diploma.

When will I take the test?

If you are an 11th grade student, you must take the test in the spring of the eleventh grade. Students who are unsure when they should test should contact their school counselor. Students who have taken the test and may retest at any administration.

What kind of questions are on the test?

The test has only multiple-choice questions with four answer options.

How many questions are on the test?

The test consists of between 70 and 80 questions.

Is the test timed?

You should be able to complete the test in 90 minutes. However, you have up to 3 hours and 10 minutes if needed.

What score is required to pass the test?

Students must earn a scale score of 500 in order to pass. You can go to the Georgia Department of Education's website (http://public.doe.k12.ga.us/ci_testing) for more information on scoring.

How many opportunities do I have to take the test?

You have 5 opportunities to take and pass the test between the spring administration of your 11th grade year and the end of the 12th grade.

What happens if I don't pass this test?

If you do not pass the Science test, but have met all other graduation requirements, you may be eligible for a Certificate of Performance or a Special Education Diploma. If you leave school with a Certificate of Performance or a Special Education Diploma, you may retake the test as often as necessary in order to qualify for a high school diploma.

Also, the waiver and variance rule was revised in December 2005. Students who meet certain criteria may be eligible to apply to the State Board of Education for a waiver or variance. Refer to the [Georgia Department of Education's website](#) for more information.

Can I use instructional materials to help me take the Science test?

The Science test will include a periodic table and a Science Facts and Formulas sheet to be used as a reference. (A sample of the periodic table and the Science Facts and Formulas sheet is attached to this document). You cannot use dictionaries, textbooks or other materials while taking the test. Furthermore, you are not permitted to use any electronic devices such as cell phones, PDAs, or other devices that allow you to store and/or transmit text. Please do not take these devices into the room. Students who attempt to use these devices during testing will be in danger of having their tests invalidated.

What materials may I use to help me study for this test?

In addition to this document, you may use any high school reading, literature, writing, or grammar textbooks. You may also refer to the [Science Test Content Descriptions](#) mentioned earlier to help you prepare for this test. Finally, you may use questions in the [Georgia Online Assessment System](#) for further practice.

Hints to Help You Succeed on the GHSGT For Science – GPS/QCC

Read everything carefully.

Many of the *GHSGT* questions involve diagrams, pictures, tables, charts and graphs. You should read all parts of each test item very carefully, including directions, questions, and all four answer choices.

There are no trick questions.

The questions are NOT designed to be tricky. If you read the entire question, including all accompanying material, and think carefully about what the question is asking, the meaning will be clear. Also, remember that each question has only one answer that content experts agree is the correct answer. However, you may be looking for the BEST answer among the choices. If so, the word BEST will be emphasized.

Sometimes questions ask you for the choice that is NOT correct among the options. Always notice words like NOT, EXCEPT, or BUT in the question. These words tell you are looking for a choice that does not answer or complete the item stem correctly. For example, you might be asked, “Which of these statements is NOT an example of an energy change?” You should look for the statement that is wrong; three of the choices will be energy changes.

Consider every choice.

From the four answer choices, you must choose the one that BEST answers the question. Some of the alternative choices (distractors) will be attractive because they include an irrelevant detail, a common misconception, or apply the right information in the wrong way.

Guess intelligently.

There is no penalty for guessing on this test. If you are not certain of the correct answer, then reread the material. Then if you are still uncertain, make your best guess. Guessing is easier if you can eliminate one or more distractors as clearly incorrect. Be warned, however, that many of the distractors are very attractive because they are based on the common mistakes students make.

Spend test time wisely.

Many tests are arranged so that the easier items are first and the harder items are last. The *GHSGTs* are not arranged this way. Therefore, it is possible to find several difficult questions followed by a set of easier questions later. If you come to a few hard questions, do not get discouraged. It would be better to move on, answer as many questions as possible, and then go back to answer the remaining questions.

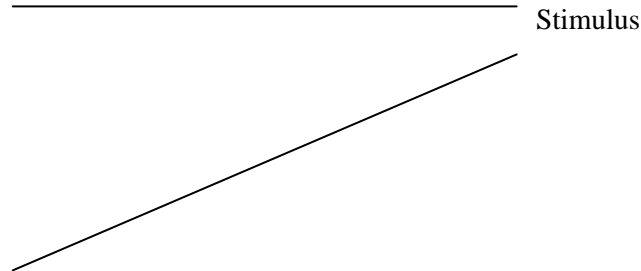
Check your answers.

There are several areas where carelessness can cause you to answer incorrectly: in reading the question initially, in choosing the answer, and in transferring the correct answer to your answer document. You should ask yourself three questions: Did I read the question carefully? Am I on the correct question number in the correct section of the answer booklet? And is this the answer I intended to mark?

Parts of a Test Question

Use this part of the periodic table to answer question 1.

5
B
Boron
10.811
2, 3



1. The number 5 refers to the element's _____ Stem

- | | | | |
|-------------------------------|------------------|--|----------------|
| A. atomic mass. | <=Distractor | | Answer Choices |
| B. atomic number. | <=Correct Answer | | |
| C. number of neutrons. | <=Distractor | | |
| D. number of electron shells. | <=Distractor | | |

Stimulus: text that you must use to answer the question

Stem: the question or statement

Distractors: other answer choices that you might select

Explanation

Correct answer: B. This item asks students to use the Periodic Table to get information about the element, Boron. The number 5 represent Boron’s atomic number.

Cognitive Levels

Cognitive levels are based on learning expectations, not item difficulty.

Low: requires recognition only and typically deals with terminology, identification, or other low-level activities

Medium: requires some degree of interpretation of a problem or situation in which a scientific principle is applied

High: requires a significant degree of interpretation, problem solving, and analysis (e.g., devising a solution to a problem by applying a scientific principle)

All three cognitive levels are represented on the test.

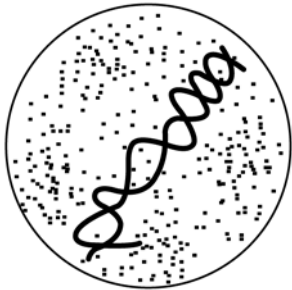
Sample Test Items and Explanations

The items listed below are sample items. These items should be considered as **examples** of items and types of items that may be found on the Science test.

Cognitive Level: Medium

Domain 1: Cells and Heredity

1. Using a microscope, a student observes a single, membrane-bound structure that is shown below:



What is the function of this membrane-bound structure?

- A. to provide cell movement for reproduction
- B. to store genetic information for reproduction*
- C. to dispose of waste to maintain homeostasis
- D. to construct proteins to maintain homeostasis

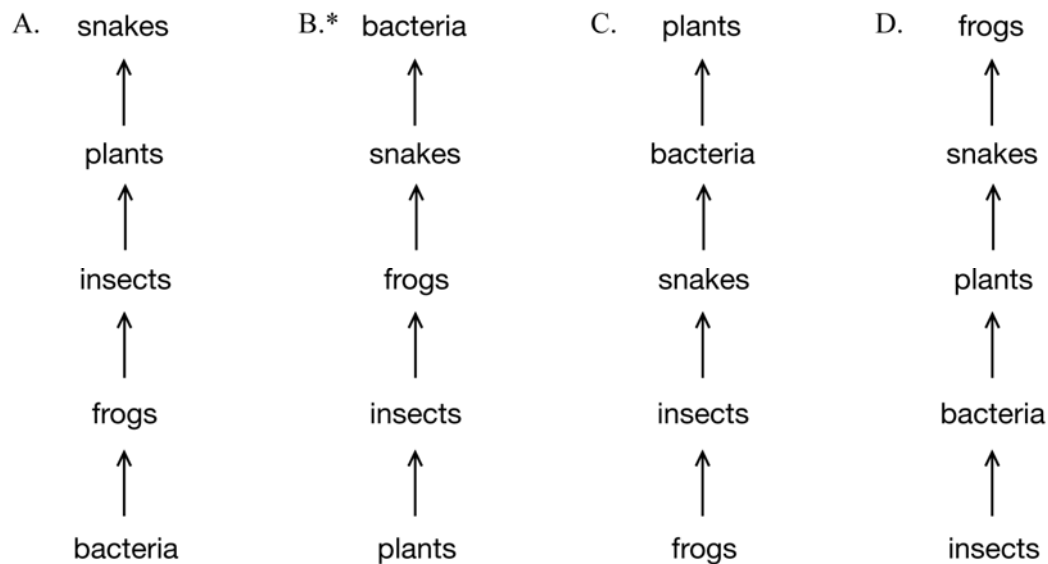
Explanation

Correct answer: B. This item is about the role of cell organelles in reproduction or homeostasis. This item is at the medium cognitive level because it requires that students recognize which organelle is described and understand the function of that organelle. Option A is incorrect because structures that provide movement can be seen outside the cell. Options C and D are incorrect because the primary function of organelles described are not related to cell reproduction or homeostasis.

Cognitive Level: Medium

Domain 2: Ecology

2. A student is analyzing a food chain. The community contains bacteria, frogs, insects, plants, and snakes. Which food chain correctly shows the flow of energy?



Explanation

Correct answer: B. This item asks students to organize a food chain according to energy flow. It is a medium cognitive level because it requires the student to understand relationships between organisms and how these relationships relate to the flow of energy. Option A is incorrect because plants are not at the beginning of a food chain. Option C is incorrect because frogs do not provide energy to insects. Option D is incorrect because snakes do not provide energy to frogs.

Cognitive Level: Medium-High

Domain 3: Structure and Properties of Matter

Use this table to answer question 3.

Description of Samples

Sample	Number of Protons	Number of Neutrons
1	15	15
2	15	16
3	16	16
4	17	17

3. A scientist performs experiments on four unknown samples and records data in the table. What can a student conclude from the data?
- A. Each sample has a different mass number.*
 - B. Each sample is an atom of a different element.
 - C. Each sample is an isotope of the same element.
 - D. Each sample has the same number of electrons as protons.

Explanation

Correct answer: A. This item is a medium - high cognitive level because it asks students to analyze the data presented. Option B is incorrect because two of the samples have the same number of protons, so they are atoms of the same element. Option C is incorrect because the only samples that could be isotopes of the same element are samples 1 and 2 (they have the same number of protons). It is possible that each sample has the same number of electrons as it does protons, but that information is not given on the table. Therefore, option D is incorrect. The only statement that can be concluded from the data given is that each sample has a different mass number (number of protons + number of neutrons).

Cognitive Level: Medium

Domain 4: Energy Transformations

4. Neutral atoms in a sample of matter move independently of one another. The substance takes the shape of its container. When the substance is moved from one container to a larger container, the volume of the sample increases. Which substance is described?
- A. gas*
 - B. solid
 - C. liquid
 - D. plasma

Explanation

Correct answer: A. This question describes a gas in terms of its characteristics. It is a medium cognitive level because it asks students to interpret a situation. The substance (neutral particles, atoms that move independently of each other and take the shape of their container without maintaining a constant volume) suggest that the substance described is a gas. No other states of matter (described in options B, C, and D) fit the characteristics described.

Cognitive Level: Low

Domain 5: Forces, Waves, and Electricity

5. Which object has the **greatest** inertia?
- A. a marble
 - B. a bicycle
 - C. a toy car
 - D. a school bus*

Explanation

Correct answer: D. This question describes the relationship between mass and inertia. It is a low cognitive level because it asks students to recognize the meaning of the term inertia. Inertia is the ability of matter to resist change in motion and is measured by mass. An object with the greatest mass, in this case a school bus, would also have the greatest inertia. Options A, B, and C describe objects with less mass than the school bus.

Practice Questions

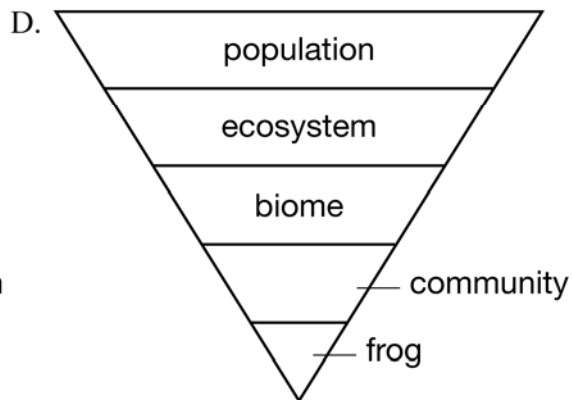
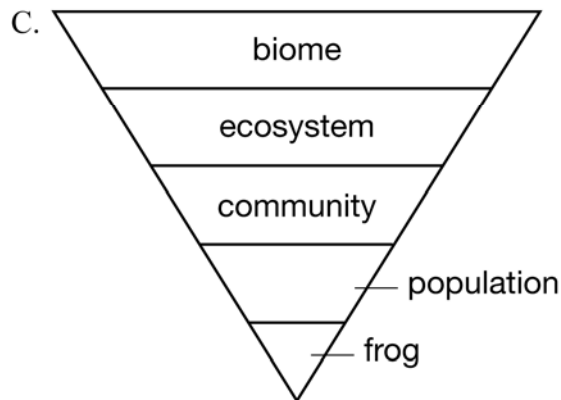
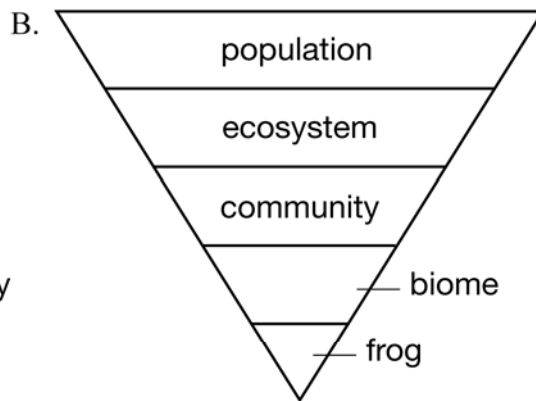
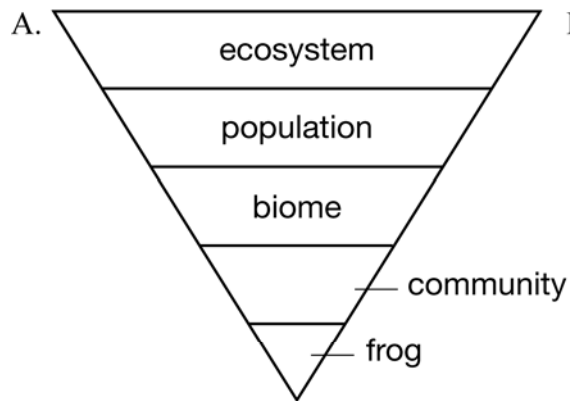
Directions: These questions are similar to the ones you will answer on the *GHSGT* for *Science*. Read each question carefully. Then, read each answer choice. When you are finished, check your answers on page 15. A **Study Plan** is provided to help you identify areas in which you may need additional practice.

1. Which macromolecule is used for **long-term** energy storage in animal cells?
 - A. lipid
 - B. protein
 - C. nucleic acid
 - D. carbohydrate

2. Which statement correctly describes the relationship between DNA and RNA in transferring genetic information?
 - A. DNA is carried by RNA to the nucleus.
 - B. DNA is carried by RNA to the cytoplasm.
 - C. RNA is carried by DNA to the nucleus.
 - D. RNA is carried by DNA to the cytoplasm.

3. A student draws a food chain that includes an owl, a mouse, grass, and a grasshopper. Through which organism does the energy flow last?
 - A. owl
 - B. mouse
 - C. grass
 - D. grasshopper

4. A student is preparing a presentation on the relationships between a frog and its biome, community, ecosystem, and population. Which diagram is correctly arranged to model ecological levels of organization?



Use the periodic table to answer question 5.

5. A student reads that a phosphorus atom has 4 more particles in its nucleus than an aluminum atom. Its atomic number is 2 greater than that of aluminum. Which of the following should she conclude are the 4 extra nuclear particles?

- A. 4 neutrons
- B. 2 neutrons and 2 protons
- C. 2 protons and 2 electrons
- D. 2 protons, 1 neutron, and 1 electron

6. A sample of an unknown substance is added to a beaker of water; it dissolves completely. When water is cooled, the substance reappears and settles to the bottom. When the water is evaporated, the substance retains all of its original properties. What is water in this example?
- A. a solute in a physical change
 - B. a solvent in a physical change
 - C. a reactant in a chemical reaction
 - D. a product in a chemical reaction
7. Turbines from a hydroelectric dam convert what type of energy into electrical energy?
- A. solar
 - B. chemical
 - C. nuclear
 - D. mechanical
8. A student safely heats crystals of an unknown solid in a closed container until they melt. Which molecular characteristic of the unknown solid has increased during this process?
- A. mass
 - B. motion
 - C. number of molecules
 - D. weight
9. A student used a compound pulley to reduce the force required to lift a box. The force was reduced to 8 Newtons, but the distance over which the force was applied was 12 meters. How much work did the student do on the box?
- A. 4 joules
 - B. 20 joules
 - C. 96 joules
 - D. 128 joules
10. Which items would **best** be used to demonstrate refraction of light?
- A. a mirror and a black cloth
 - B. clear glass and clear plastic
 - C. a flashlight and a white wall
 - D. shiny foil and shiny floor

Answers and Explanations to Sample Questions

Question Number	Domain	Domain Number	GPS	Answer	Result
1	Cells and Heredity	1	B1c	A	
2	Cells and Heredity	1	B2a	B	
3	Ecology	2	B4b1	A	
4	Ecology	2	B4a	C	
5	Structure and Properties of Matter	3	PS1a1	B	
6	Structure and Properties of Matter	3	PS6a1	B	
7	Energy Transformations	4	PS7a	D	
8	Energy Transformations	4	PS5a	B	
9	Forces, Waves, and Electricity	5	PS8e	C	
10	Forces, Waves, and Electricity	5	PS9d	B	

Explanations

1. The correct answer is A. Lipid macromolecules are associated with long term energy storage in animal cells.
2. The correct answer is B. RNA transfers the genetic information from DNA into the cytoplasm
3. The correct answer is A. Of the animals listed, the owl is the highest on the food chain.
4. The correct answer is C. The frog is at the organism level of organization.
5. The correct answer is B. Phosphorus has two more protons than aluminum. The other two particles must be neutrons.
6. The correct answer is B. Water dissolves the unknown substance. Water is the solvent. When a substance is dissolved in water, it is a physical change.
7. The correct answer is D. Mechanical energy is the energy associated with motion. As water moves over a hydroelectric dam, it turns a turbine. The turbine turns an electromagnet which transforms the mechanical energy into electrical energy.
8. The correct answer is B. The motion of molecules will increase as a substance changes from a solid to a liquid.
9. The correct answer is C. Work is force applied over a distance. $8 \text{ Newtons} \times 12 \text{ meters} = 96 \text{ joules (Newton-meters)}$
10. The correct answer is B. Refraction is the bending of light when it passes from one transparent medium to another.

Study Plan

After checking your answers to the *Sample Questions*, review the GPS from each domain and identify those areas that you need further study. For further explanation and detailed definitions of the standards, please consult the following resources:

1. Georgia Performance Standards (Science).
<http://www.georgiastandards.org/science.aspx>
2. Science Test Content Descriptions GPS/QCC Versions
http://www.doe.k12.ga.us/documents/curriculum/testing/tcd_gps_qcc_Science.doc

Domain Number	Domain	GPS	Study Plan for this GPS
1	Cells and Heredity	B1a	
		B1c	
		B2a	
		B2b	
		B2c	
		B2f	
2	Ecology	B3a	
		B4a	
2	Ecology	B4b1	
3	Structure and Properties of Matter	PS1a1	
		PS1a2	
		PS1a3	
		PS1a4	
		PS6a1	
4	Energy Transformations	PS3c	
		PS5a	
		PS7a	
		PS7b	
5	Forces, Waves and Electricity	PS8a	
		PS8b1	
		PS8c	
		PS8d	
		PS8e	
		PS9a	
		PS9b	
		PS9d	
		PS9e	
		PS10c1	
PS10c2			

PERIODIC TABLE

PERIODS	GROUP 1 (Ia)		GROUP 2 (IIa)		GROUP 13 (IIIa)		GROUP 14 (IVa)		GROUP 15 (VA)		GROUP 16 (VIA)		GROUP 17 (VIIa)		GROUP 18 (VIIIa)																																																																																																																																																																																																																																																																																																																																																																																																																																													
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1	H Hydrogen 1.00797																	He Helium 4.0026																																																																																																																																																																																																																																																																																																																																																																																																																																										
2	Li Lithium 6.941	Be Beryllium 9.0122											B Boron 10.811	C Carbon 12.011	N Nitrogen 14.0067	O Oxygen 15.9994	F Fluorine 18.998	Ne Neon 20.183																																																																																																																																																																																																																																																																																																																																																																																																																																										
3	Na Sodium 22.9898	Mg Magnesium 24.312											Al Aluminum 26.9815	Si Silicon 28.086	P Phosphorus 30.9738	S Sulfur 32.064	Cl Chlorine 35.453	Ar Argon 39.948																																																																																																																																																																																																																																																																																																																																																																																																																																										
4	K Potassium 39.102	Ca Calcium 40.08											Ga Gallium 69.72	Ge Germanium 72.59	As Arsenic 74.9216	Se Selenium 78.96	Br Bromine 79.904	Kr Krypton 83.80																																																																																																																																																																																																																																																																																																																																																																																																																																										
5	Rb Rubidium 85.47	Sr Strontium 88.905											In Indium 114.82	Sn Tin 118.69	Sb Antimony 121.75	Te Tellurium 127.60	I Iodine 126.9045	Xe Xenon 131.30																																																																																																																																																																																																																																																																																																																																																																																																																																										
6	Cs Cesium 132.905	Ba Barium 137.34											Tl Thallium 204.37	Pb Lead 207.19	Bi Bismuth 208.9806	Po Polonium (209)	At Astatine (210)	Rn Radon (222)																																																																																																																																																																																																																																																																																																																																																																																																																																										
7	Fr Francium (223)	Ra Radium (226)											Au Gold 196.967	Hg Mercury 200.59	Pt Platinum 195.09	Ir Iridium 192.2	Os Osmium 190.2	Rh Rhodium 102.905	Pd Palladium 106.4	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868	Cd Cadmium 112.40	Ni Nickel 58.71	Co Cobalt 58.9332	Fe Iron 55.847	Mn Manganese 54.9380	Cr Chromium 51.996	Mn Manganese 54.9380	Fe Iron 55.847	Co Cobalt 58.9332	Ni Nickel 58.71	Cu Copper 63.546	Zn Zinc 65.37	Ag Silver 107.868

SCIENCE FACTS AND FORMULAS

Some of the questions in this test require you to solve problems. This page contains all the basic facts and formulas you will need to solve those problems. You may refer to this page as often as you wish while you take the test. Some questions may require information from the PERIODIC TABLE. This table can be found at the end of the test booklet.

Basic Facts

Acceleration due to gravity = 9.8 meters/second/second (9.8 m/s^2)

Weight = Mass (m) \times Acceleration due to gravity (g) ($W = mg$)

Density = Mass/Volume

Volume of a Rectangular Solid = Length \times Width \times Height

1 newton = 1 kilogram·meter/second/second

1 joule = 1 newton·meter

1 watt = 1 newton·meter/second = 1 joule/second

Motion

Velocity (V) = $V_0 + at$, where V_0 = Initial Velocity, a = Acceleration, and t = Time

Acceleration = Change in Velocity/Time Elapsed $\left(a = \frac{V - V_0}{t} \right)$

Force, Mechanical Advantage, Power, Work

Force = Mass \times Acceleration ($F = ma$)

Mechanical Advantage

Actual Mechanical Advantage: $\left(AMA = \frac{F_R}{F_E} \right)$,

where F_R is Force due to resistance and F_E is Force due to effort.

Ideal Mechanical Advantage: $\left(IMA = \frac{\text{Effort Length}}{\text{Resistance Length}} \right)$

Power = Work/Time $\left(P = \frac{w}{t} \right)$

Work = Force \times Distance ($W = Fd$)

Electricity

Voltage = Current \times Resistance ($V = IR$)