TACS ACADEMIC CHALLENGE

STUDY GUIDE

2015-2016
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Mathematics

I. Algebra

A. Simplify and factor polynomial and rational expressions
B. Simplify expressions including those involving exponents, radicals, and complex numbers
C. Solve polynomial, absolute value, rational, radical, exponential and logarithmic equations
D. Solve linear and absolute value inequalities
E. Functions, domain, range and inverses
F. Graphs of linear and quadratic functions
G. Solve real-world application problems, including those involving ratios, percents and proportions

II. Geometry

A. Triangle congruence and similarity
B. Be able to apply the Pythagorean Theorem, properties of 30-60-90 and 45-45-90 triangles
C. Solve problems involving the lengths, angles, perimeters, and areas of convex polygons.
D. Distances and midpoints
E. Solve problems involving the surface area and volume of spheres, cones, cylinders, and prisms
F. Solve problems involving lines, rays, and segments
G. Find measures of arcs, angles, chords, and secant segments of a circle
III. Pre-Calculus and Trigonometry

A. Composition of functions
B. Conic sections and their graphs
C. Arithmetic and geometric sequences and series
D. Degree and radian angle measure
E. Understand the six major trigonometric functions and their values on the unit circle
F. Recognize and apply the reciprocal, quotient, Pythagorean, double-angle, and half-angle trigonometric identities
G. Law of Sines and Law of Cosines
H. Solve problems involving angular and linear velocity

NOTES:

Be able to apply formulas, theorems, axioms, concepts, and techniques found in high school mathematics.

Calculators and scratch paper may **not** be used.

Recognition, recall, mental math, and number sense are the keys to accuracy on the math questions.
Sample Questions: Mathematics

1. Math (Level 1)
Solve \( e^x + 5 = 60 \) for \( x \)

   (a) \( \ln 12 \)  
   (b) \( \ln 55^* \)  
   (c) 12  
   (d) \( \ln 300 \)

2. Math (Level 2)
If triangle A has sides of 2, 4, and 5 and is similar to triangle B, whose shortest side is 6, what is the ratio of the area of triangle B to the area of triangle A?

   (a) \( \frac{1}{3} \)  
   (b) 3  
   (c) 4  
   (d) \( 9^* \)

3. Math (Level 3)
Which expression is a simplification of \( \frac{x^2 + 6x - 27}{x-3} \)?

   (a) \( x+9^* \)  
   (b) \( x-9 \)  
   (c) \( x+6 \)  
   (d) \( x-6 \)
Science

I. Physics
   A. Motion and Forces
      1. Velocity and Acceleration
      2. Newton’s Laws of Motion
      3. Momentum / Inertia
      4. Graphing Motion / Frames of reference
   B. Work, Energy, and Simple Machines
      1. Work
      2. Potential/kinetic energy
      3. Law of conservation of energy and momentum
   C. Electrostatics
      1. Forces, fields and energy
      2. Current Electricity and Magnetic Fields
      3. Electromagnetism
      4. Conductors / insulators
      5. Calculating Gravitational and Electrical Force
      6. Parallel and series circuits
   D. Properties of Waves
      1. Characteristics of waves
   E. Thermodynamics
      1. Methods of heat transfer
      2. Endo and Exothermic reactions

II. Biology
   A. Genetics
      1. Laws and terminology
      2. Genetic code
      3. DNA transcription/translation/replication
   B. Human Biology
      1. Nutrition
      2. Blood and immune system
      3. Body Systems
   C. The Cell – Parts and Functions
      1. Prokaryotic and Eukaryotic cells
      2. Mitosis/Meiosis
      3. Respiration and photosynthesis
III. Chemistry

A. Matter
1. Chemical and physical properties/changes
2. Calculating Density
3. Solids, liquids and gases
4. Pure substances / mixtures

B. Atomic Structure
1. Early atomic models and periodic table development
2. Subatomic particles
3. Periodic trends
4. Electron configurations

C. Chemical Compounds
1. Chemical Bonding
2. Chemical formulas
3. IUPAC Naming Rules

D. Solutions
1. Acids and bases
2. Solubility

E. Chemical Reactions
1. Balanced Equations
2. Reaction Types
3. Thermochemistry

F. Mole Compounds
1. Stoichiometry
2. Gases
Sample Questions: Science

Science (Level 1)

On the following table, a student has recorded observations and data on a copper cylinder.

<table>
<thead>
<tr>
<th>Mass</th>
<th>2262 grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>4 cm</td>
</tr>
<tr>
<td>Length</td>
<td>20 cm</td>
</tr>
<tr>
<td>Density</td>
<td>9 g/cm³</td>
</tr>
<tr>
<td>Color</td>
<td>reddish-orange</td>
</tr>
<tr>
<td>Other</td>
<td>Metallic</td>
</tr>
</tbody>
</table>

The cylinder is sliced into 2 even pieces.

What is the density of piece A?

- a. 4.5 g/cm³
- b. 5 g/cm³

Science (Level 2)

I throw 4 objects into a lake, which object will float the best?

- a. A rock with a density of .87 g/ml
- b. A toy with a density of 2.3 g/ml
- c. A cell phone with a density of 1.2 g/ml

Science (Level 3)

Which of the following is NOT classified as matter?

- a. Rock
- b. Light
- c. air
- d. Steam
I. Fundamental Language Skills
   A. Grammar Usage
      1. Subject-verb agreement; pronoun-antecedent agreement
      2. Misplaced/dangling modifiers
      3. Correcting double negatives
      4. Phrases: gerunds, infinitives, participles, prepositions, appositives
   B. Punctuation
      1. Commas
      2. Semi-colons
      3. Quotation marks
      4. Rules for commas, periods, etc. within quotations
   C. Capitalization
      1. Proper nouns
      2. When to capitalize mother, father, grandmother, etc.
   D. Vocabulary/spelling
      1. Prefixes, root words
      2. Spelling rules, plurals, etc.

II. Literature
   No more than three questions from any one reading selection will be asked during the contest.
   
   A. Literary terms and devices/figurative language, including
      1. Alliteration
      2. Allusion
      3. Analogy
      4. Flashback, flash-forward, foreshadowing
      5. Hyperbole
      6. Idiom
      7. Personification
      8. Point of View—first person, third person, omniscient
      9. Simile, metaphor
     10. Symbolism, repetition, etc.
B. World Literature
   1. *Night* by Elie Wiesel
   2. “Rikki-Tikki-Tavi” by Rudyard Kipling
   3. “The Necklace” by Guy de Maupassant
   4. *The Odyssey/The Iliad* by Homer

C. American Literature
   1. “Annabel Lee” by Edgar Allan Poe
   2. “Birches” by Robert Frost
   3. “Chicago” by Carl Sandburg
   4. “Let America Be America Again” by Langston Hughes
   5. “Letter from Birmingham City Jail” by Martin Luther King, Jr.
   6. *Of Mice and Men* by John Steinbeck
   7. *The Great Gatsby* by F. Scott Fitzgerald
   8. “The Lottery” by Shirley Jackson
   10. “The New Colossus” by Emma Lazarus
   11. *The Old Man and the Sea* by Ernest Hemingway
   12. *The Scarlet Letter* by Nathaniel Hawthorne
   13. “The Soul Selects Her Own Society” by Emily Dickinson
   14. “The Turtle” by John Steinbeck (excerpt for *The Grapes of Wrath*)
   15. “To Build a Fire” by Jack London
   16. “Young Goodman Brown” by Nathaniel Hawthorne
D. British Literature

1. Beowulf
2. “Jabberwocky” by Lewis Carroll
3. Jane Eyre by Charlotte Bronte
4. “Jerusalem” by William Blake
5. Just So Stories by Rudyard Kipling
6. “Sailing to Byzantium” by William Butler Yeats
7. Silas Marner by George Eliot
8. “The Charge of the Light Brigade” by Alfred, Lord Tennyson
10. “The Man He Killed” by Thomas Hardy
14. The Strange Case of Dr. Jekyll and Mr. Hyde by Robert Louis Stevenson
15. “The Wife’s Lament” from The Exeter Book
16. “To a Mouse” by Robert Burns

E. Shakespeare

1. A Midsummer Night’s Dream
2. Julius Caesar
3. Macbeth
Sample Questions: English

1. **English Level 1**
   Elie Wiesel, the author of the novel, *Night*, was a Jewish resident of which European country?
   A. Hungary*
   B. France
   C. Poland

2. **English Level 2**
   In the passage from the book, *Night*, by Elie Wiesel, the following passage is an example of what literary device?
   “Never shall I forget that smoke. Never shall I forget those flames that consumed my faith forever. Never shall I forget those things, even were I condemned to live as long as God Himself. Never.”
   A. Alliteration
   B. Allusion
   C. Repetition*

3. **English Level 3**
   In the novel, *Night*, by Elie Wiesel, the setting takes place during what war?
   A. World War I
   B. World War II*
   C. the Vietnam War
I. United States History

Eras, wars, important events, dates, & people

C. Gilded Age
   A. Progressive Era
   B. World War I
   C. Roaring Twenties
   D. Great Depression
   E. World War II
   F. Civil Rights Movement
   G. 1970s to 1990s
   H. 2000 to Present

II. World Geography

Capitals, governments, cultures and major landforms with an emphasis on:

A. North & South America
B. Europe
C. Asia
III. World History
   Important events, dates & people
   A. Ancient Civilizations
   B. Classical Civilizations (Greece, Rome, Persia, India, China)
   C. Middle Ages
   D. European renaissance & Reformation
   E. Civilizations of the Americas (Incan, Mayan, Aztec)
   F. European Industrialization & Imperialism
   G. Political Revolutions
   H. World Wars I & II
   I. Cold War, including collapse of communism
   J. Independence movements (Israel, India, Africa, South Asia)
   K. Radical Islam and Terrorism

IV. U.S. and Texas Government
   A. Current officeholders
   B. The Constitution
   C. Landmark Court Cases

V. Economics
   A. Definitions of basic terms
   B. The Federal Reserve System
   C. Theories of taxation
Sample Questions: Social Studies

1. US HISTORY (LEVEL 3)

This man, considered the Father of the Modern Navy, advocated that in order for the US to become a world power, it needed to have a powerful navy.

   a. Sanford Dole
   b. Theodore Roosevelt
   c. Alfred Thayer Mahan*
   d. Henry Cabot Lodge

2. US GOVERNMENT (LEVEL 1)

The Constitutional Amendment that guarantees your right to bear arms is the:

   a. 1st Amendment
   b. 2nd Amendment*
   c. 4th Amendment
   d. 5th Amendment

3. WORLD GEOGRAPHY (LEVEL 2)

What is the world’s longest river?

   a. Nile*
   b. Mississippi
   c. Congo
   d. Euphrates

Notes on revision of the study guide

1. The study guide is now more closely linked to the TEKS.
2. Economic questions will be kept to a minimum since so few students will have had that course by the time the test is given.
3. Expect the questions to be spread over the categories with an emphasis on US History, since students will have had two years of that course (8th grade and 11th grade).