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MCAT Preparation Guide

Miriam S. Willey

Barbara M. Jarecky

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MCAT

Preparation Guide



Offers specific strategies and techniques designed to increase scores in each of the four parts of the MCAT



Uses practice tests to help concentrate all your preparation time on acquiring skills that will increase your test scores



Demonstrates how to approach multiple-choice questions (and how to guess effectively as a last resort!)

**Miriam S. Willey
and
Barbara M. Jarecky**

**Extensively
field tested**

**Newest Study Guide
Available**

MICAT

Preparation Guide

Miriam S. Willey

and

Barbara M. Jarecky

THE UNIVERSITY PRESS OF KENTUCKY

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INTRODUCTION

THE MCAT PREPARATION GUIDE

The purpose of this workbook, the *MCAT Preparation Guide (Guide)*, is to provide you with an independent method of review for the *Medical College Admission Test (MCAT)*. It is designed to be used in conjunction with the *MCAT Student Manual (Manual)* and the *MCAT Practice Test* which accompanies the *Manual*.

The *Manual* and *Practice Test* are available from the *Association of American Medical Colleges*.¹ You really should try to get your own copy of the *Manual* before you begin to prepare for the *MCAT*.

Who should use this Guide?

The *Guide* is written so that you, as a well-motivated individual student who is preparing for the *MCAT*, will have a method for guiding your own structured independent review.

It may also be used by a group of students, such as a study group, who come together on a regular basis to help motivate each other to prepare for the next administration of the *MCAT*.

Many medical and undergraduate schools conduct formal review courses during the year and/or over the summer. In addition, the *Guide* can be used with the personal guidance of a friendly teacher or program director.

How to use this Guide

You may start your review with any of the four chapters: *Physical Sciences*, *Biological Sciences*, *Verbal Reasoning*, or *Writing Sample*. Each chapter is self-contained, so you will find much of the method and suggestions repeated in each chapter.

As you become more familiar with the techniques for handling the test questions and the method of review, you may wish to skim the more repetitive areas and go directly to the main purpose of sorting *what you know* from *what you need to review*.

¹ To order your *Manual*, contact: The MCAT Program
Association of American Medical Colleges
2450 N St., N.W.
Washington, D.C. 20037

THE PERFORMANCE-GUIDED REVIEW METHOD

The *Performance-Guided Review* method described in this *Guide* will provide you with a method of review that you will be able to use, not only with the *MCAT Manual* and *Practice Test*, but also with other *MCAT* review materials available in your campus bookstores.

Two basic principles of the *Performance-Guided Review Method* are:

Spend every minute of your review time on information and skills that you do not have

Because your review time is often limited and you may be doing some of your review while you are still taking your undergraduate courses, you will need to make the best possible use of the time available to you.

Any time you review something you already know, or practice a skill you are already good at, you WASTE YOUR TIME because you are NOT ADDING TO your current information or skills.

For example, if you know, understand, and can use Boyle's Law, do not spend your precious time on that topic. If, when you read you can determine what the main topic of the passage is, spend no time practicing that skill. Instead, spend your precious time on a skill at which you are less competent, perhaps on judging the soundness of an argument.

Use test items to sort what you know from what you still need to learn

If you get a test question correct, spend no further time on it. If you get a test item wrong, include it in your review.

In other words, let your *wrong* answers guide your review.

Reviewing for an exam is a very individual process. You and your friends each bring to practice exams very different patterns of information and skills.

As you work through this *Guide* you will find a way to sort what you know from what you still need to review, and a method for determining which reading and writing skills can be improved.

If you are careful about spending your time on the information you need to learn and the skills you need to improve, you will make the best use of your limited review time. Then every minute you spend reviewing will result in adding to your bank of information and your repertoire of skills. Remember, reviewing what you already know and can do well will not help you to increase your *MCAT* scores on the next exam.

MCAT TEST ITEMS

If you are clear about the terminology used in this *Guide* and in the *Manual* it will be easier to follow the written information and directions about the *MCAT* test items.

Multiple-choice test items

You may have noticed that *test item* usually is used instead of *test question*. The terms are interchangeable, but *item* seems to be a little more precise because not all *items* are written in the form of *questions*. Many items are written as statements or incomplete statements.

Multiple-choice items are used in three sections of the *MCAT*: *Physical Sciences*, *Biological Sciences*, and *Verbal Reasoning*. (The *essay* is used in the *Writing Sample* section.)

Test item formats: Two types of One Best Answer

All *MCAT* multiple-choice test items are written as "One Best Answer" items. Your undergraduate courses included this format on their multiple-choice exams.

The "*stem*" of an item is the first part; it appears beside the test item number. The "*alternatives*" are the list of possible answers related to the *stem*.

Example 1: One Best Answer

- | | | |
|----|---|--|
| 1. | An entity composed exclusively of protein is: | <i>This is the "stem" of the item.</i> |
| T | A. bacterial flagellum. | <i>Only 1 "alternative" is the best / correct / true (T) answer and 3 are false (F).</i> |
| F | B. mitochondrion. | |
| F | C. cell membrane. | |
| F | D. wall of a gram positive bacterium. | |
| | | <i>(The correct answer is A.)</i> |
-

The other format that is used on the *MCAT* is One Best Answer with 1 to 3 correct "statements".

Example: One Best Answer - 1 to 3 correct statements

2. The weight of a protein may be estimated by: *This is the "stem" of the item.*
- T* I. ultracentrifugation. *2 of these "statements" are correct / true (T), 1 is false (F).*
T II. gel filtration.
F III. infrared analysis.
- A. I only *Each "alternative" offers a different combination of true statements.*
T B. I and II only
C. II and III only
D. I, II, and III *(The correct answer is B.)*
-

Test item styles: Independent Items and Problem Sets

Independent items stand alone. You consider them one-at-a-time and they do not relate to each other in any way. Your answers are based on the knowledge that you bring to the test and this style is probably the way most of the multiple-choice test questions appeared on your undergraduate course exams.

Problem sets, on the other hand, consist of a passage (written or graphic information) followed by a set of items. Each set of items is related to, if not totally dependent on, the content presented in the passage.

Writing samples

You are given a short statement (*prompt*) and directed to write an essay in which you do three separate tasks:

- Explain or interpret the prompt
- Describe a point-of-view in which the prompt might be contradicted or not applicable
- Discuss how to resolve the conflict between the two opposing viewpoints

Each essay is rated as a whole. Raters will consider how responsive your essay is to the *prompt*, how well the three tasks are covered, how unified (well organized) it is, and, of course, the appropriate use of language.

EXAM-TAKING TECHNIQUES

If you are going to use your performance on practice test items to guide your review, it is important to you to be sure that when you miss an item it is **ONLY** because you do not have the information or skill necessary to answer the item correctly.

Exam-taking techniques presented throughout this *Guide* will help you to avoid missing items because you were not skillful in taking exams.

If you can maintain your motivation to *find your best answer* to each item throughout the test, you will avoid careless mistakes you might make just because you primarily wanted to get the test over with.

You will be especially vulnerable to drifting into this negative motivation when you do self-assessment test items and no one else will know your results, anyway.

Exam-taking techniques are limited to those that you will need for test items on the MCAT.

When you finish this workbook along with the *Manual* and *Practice Test* ((don't forget to get your copies!)), you will be ready to use the *Performance-Guided Review Method* with any other review materials and test items.

Remember, each *new* piece of information you understand and memorize, and each skill you *improve*, will help you to get your best score on the *MCAT*.

I. PHYSICAL SCIENCES SECTION

General Chemistry, Physics and Mathematics

General chemistry, physics and selected mathematics concepts are tested in this section. The 75-80 test items are all the "One Best Answer" multiple-choice format.

About 80% of the test items are presented in 10-11 problem sets:

Information is given in passages (paragraphs, formulae, graphs, diagrams, etc.)

Each passage is followed by a related series of 4 to 8 test items.

About 20% of the items are independent of passages and of each other.

A. USE EXAM-TAKING TECHNIQUES

Watch your motivation during an exam!

For your best performance, your primary motivation has to be *finding your best answer* to each test item ... instead of *getting the whole test over with*.

If your motivation begins to drift (especially when you are tired or when you find several items you are not confident about) ...

STOP ... have a short conversation with yourself to refocus your motivation ... and then continue when your motivation returns to *finding your best answer*.

Your best answer may be based on

What you know for sure (no problem here - just mark your answer form),

What seems to be best (logic, hunches, gut feelings - perhaps based on your subconscious information), or

Back-up plans for choosing answers (when all else fails)

Make these plans before an exam, and

Apply them consistently throughout the exam

These exam-taking techniques are some of the easiest and best ways to add extra points to your score.

INDEPENDENT ITEMS

Finding your best answer for Independent Items

Read the stem first, and underline words that seem important.

This will help you to focus on the item and avoid misreading.

Read each alternative *in order*.

Underline or circle words that seem important.

Decide whether you think it is true or false, or you are not sure.

Write your decision beside each alternative.

Write *T*..... if you decide the alternative is *True*

Write *F*..... if you decide the alternative is *False*

Write *?*..... if you can't decide whether the alternative is *True* or *False*

Mentally set aside that alternative while you consider the next one.

Finally, mark your *Answer Form* before starting the next item.

Example

1. Carbon dioxide is transported in the blood primarily as:

F A. dissolved CO₂.

? B. carbonic acid.

F C. carbaminohemoglobin.

T D. plasma bicarbonate.

No problem here mark D

Do not spend too much time on a test item when you are uncertain of the answer.

If you can rule out 1 or 2 alternatives and you still are not certain of the correct answer:

Choose your *best guess* from the alternatives marked "?".

Examples

?	A.	Choose your <i>best guess</i> mark A or C
F	B.	
?	C.	
F	D.	

F	A.	Choose your <i>best guess</i> mark B, C or D
?	B.	
?	C.	
?	D.	

Back-up Plans

In case you do not have a *best guess*, have a *back-up plan* ready:

Choose the first or last alternative marked "?"

Examples

?	A.	If choose <i>first</i> ? mark A
?	B.	If choose <i>last</i> ? mark B
F	C.	
F	D.	

F	A.	
?	B.	If choose <i>first</i> ? mark B
?	C.	
?	D.	If choose <i>last</i> ? mark D

In case you cannot rule out any alternatives and you have no "best guess", have a back-up plan ready:

Choose your favorite letter ... **A or B or C or D.**

Example

?	A.	<i>If favorite letter is A mark A</i>
?	B.	<i>If favorite letter is B mark B</i>
?	C.	<i>If favorite letter is C mark C</i>
?	D.	<i>If favorite letter is D mark D</i>

Reviewing your answers to *Independent Items*

If you intend to review an item after you have finished all other items ...

Circle the item number in the *Test Booklet* (not on the *Answer Form*).

If you review an item, do not change your answer unless you ...

Thought of additional information

Other items may trigger your memory.

Misread or misinterpreted the item

Made an error regarding calculation

(These rules should help you to avoid changing right answers to wrong answers.)

PROBLEM SETS

(Passage & Set of Related Test Items)

Finding your best answers for items in Problem Sets

Read the *stems of items* before looking at the passage.

Read and underline important words in the stems (not the alternatives) of all items in the problem set.

This will help you to identify information you will need to look for when you read the passage.

It is easier to read and understand new information when you know what you are looking for.

Read the *passage* and underline information that seems important.

Make a note in the margin when you recognize information that seems relevant to one of the items you "previewed".

Make other notes in the margins that you find helpful if it is not too time-consuming.

Re-read the *stem* of an item and consider each alternative *in order*.

Continue in the same way as for *Independent Items*.

All the test items in the *Physical Sciences* section have the same format: "One Best Answer".

Passages appear only in the *Problem Sets*.

Finally, mark your *Answer Form* for all items in one *Problem Set* before starting the next set.

Reviewing answers to items in *Problem Sets*

If you intend to review an item after you have finished all other items ...

Circle the item number in the *Test Booklet* (not on the *Answer Form*).

Write the item number in the margin beside relevant information you recognized in the passage so you can locate it more quickly when you review the item.

If you review an item, do not change your answer unless you notice that you ...

**Misread or misinterpreted the item
Made an error in calculation**

B. TAKE SAMPLE TEST ITEMS

Answer all *Physical Sciences* test items (*Manual* pgs. 45-58²) in a single, timed sitting.

Take items 1-32 in 42 minutes.

Try to simulate the "real" *MCAT* situation.

For example, no notes, no talking, no interruptions, etc.

Score your answers after you have finished all items (*Manual* pg. 125).

C. ANALYZE YOUR PERFORMANCE

WORKSHEETS 1-3

Test Items Categorized by Physical Sciences Objectives

The information that may be tested in the *Physical Sciences* section is described in the *Physical Sciences Objectives* (*Guide* pgs. 22-43).

Topics include general chemistry, physics, and some mathematics concepts.

Objectives in this *Guide* are based on the *MCAT Physical Sciences Topics and Mathematics Concepts* (*Manual* pg. 34-44).

Analyze your performance on the *Sample Test* in terms of these objectives by completing *Worksheets 1, 2 and 3* (*Guide* pgs. 14-16).

Worksheet 1: General Chemistry

Columns are labeled with Roman numerals (*I-IX*) that correspond to the general topics of the objectives.

Rows beside test item numbers (*1-16*) identify specific objectives (by letter/number) within the general topics.

² Any small differences between a page reference given in this *Guide* and the correct page number in your copy of the *Manual* may be due to changes made in the text of the *Manual* between printings.

For each item you missed:

Circle the letter/number combination(s) on the row beside the item number to identify the related objective.

For each column in which you have circled one or more objectives:

Write the total number of items you missed at the bottom of the chart to see which objectives were most difficult for you.

This will help you to set your own priorities for review - for example, beginning with your worst topics first.

One column at a time ...

Read all the *Objectives* circled.

The page number in the *Guide* and the type of item are shown in the last two columns on the right of the chart.

Re-read the *Sample Items* you missed to see how these objectives are tested.

Worksheet 2: Physics

Columns (Objectives X-XX) correspond to the general topics of the objectives.

Rows (Items 17-32) identify specific objectives (by letter/number) within the general topics.

Complete Worksheet 2 in the same way as Worksheet 1.

Worksheet 3: Mathematics

Columns (Objectives 1-8) correspond to general topics in the objectives.

Rows (selected Items 3-31) identify specific objectives (by letter/number) within the general topics.

Not all test items involve a mathematics concept.

Complete Worksheet 3 in the same way as Worksheet 1.

WORKSHEET 1

Physical Sciences - General Chemistry

Test Item No.**	GENERAL CHEMISTRY Objectives*									Page in Guide	Type of Item
	I	II	III	IV	V	VI	VII	VIII	IX		
1						A3				26	Research
2				A2a				BI		24,28	
3	A,B			A1,2a						22,24	
4	A									22	
5				C4b	B					25,26	Research
6					A,B					25,26	
7					B					26	
8					B					26	
9							A6			27	Research
10	A,H									22	
11						B3				27	
12	F			A5,6						22,24	
13	A									22	
14	A,F			A2						22,24	Independent
15		A1,B1								23	
16		B								23	
Total Items	6	2	1	5	5	1	1	1	0		
No. Wrong											

* For Objectives see *Guide* pgs. 22-30.

** For Test Items see *Manual* pgs. 45-51.

WORKSHEET 2

Physical Sciences - Physics

Test Item No.**	PHYSICS Objectives*											Page in Guide	Type of Item
	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX		
17							A					35	Problem-solving
18								A				38	
19								A3				37	
20									E			38	
21					B3							34	Information presentation
22			B									33	
23					B3							34	
24								A				38	Information presentation
25				F								33	
26				F								33	
27	B											31	Problem-solving
28							A2					35	
29			B2									33	
30					A2							34	Independent
31										C		40	
32										C		39	
Total Items	1	0	2	2	3	0	2	1	3	1	1		
No. Wrong													

* For Objectives see *Guide* pgs. 31-40.

** For Test Items see *Manual* pgs. 52-58.

WORKSHEET 3

Physical Sciences - Mathematics

Test Item No.**	MATHEMATICS Objectives*								Page in Guide	
	1	2	3	4	5	6	7	8		
<i>General Chemistry</i>										
3	.....	.2d(2).....	.....	.....	.....	.....	.....	.....	.....	41
4	1.....	.....	.....	4a.....	.....	.....	.....	.....	.....	41,42
10	1b.....	.....	.....	4a.....	.....	.....	.....	.....	.....	41,42
13	1.....	.....	.....	4a.....	.....	.....	.....	.....	.....	41,42
14	.....	.2d.....	.....	.....	.....	.....	.....	.....	.....	41
<i>Physics</i>										
18	.....	.2d.....	.....	.....	.....	.....	.....	.....	.....	41
20	.....	.2d.....	.....	.....	.....	.....	.....	.....	.....	41
21	1c.....	.....	.....	.....	.....	.....	.....	.....	.....	41
22	.....	.2d.....	.....	.....	.....	.....	.....	.....	.....	41
23	1b.....	.....	.....	.....	.....	.....	.....	.....	.....	41
24	1c.....	.....	.....	.....	.....	.....	.....	.....	.....	41
26	.....	.....	.....	4a.....	5c.....	.....	.....	.....	.....	42
27	1d.....	.....	3f.....	.....	.....	.....	7a,b.....	.....	.....	41,42
28	1.....	.....	.....	.....	.....	.....	.....	.....	.....	41
29	.....	.2d.....	.....	.....	.....	.....	.....	.....	.....	41
30	.....	.2d.....	.....	.....	5d.....	.....	.....	.....	.....	41,42
31	1.....	.....	.....	.....	.....	.....	.....	.....	.....	41
Total Items	9	7	1	4	2	0	1	0		
No. Wrong										

* For Objectives see *Guide* pgs. 41-43.

** For Test Items see *Manual* pgs. 45-58. Not all chemistry and physics test items involve a mathematics concept.

D. IMPROVE YOUR PERFORMANCE

STRATEGY

The basic strategy for improving your information base for multiple-choice exams is:

Identify missing information in your information base.

This means that you cannot recall certain information to apply on a timed, multiple-choice test.

Therefore, be sure you take self-assessment items "for real", for example, no discussion, no interruptions, appropriately timed for the number of items, etc.

Research the missing information.

Time management: Spend review time only on missing information.

Organize the information.

It must be clear to you. Use outlines, diagrams, formulae, charts, graphs, tables, flowcharts, etc.

Memorize the organized information.

Memorize information you have organized before organizing more information. On multiple-choice test items that require you to recall information rapidly...

It is better to understand and memorize less information ... than to understand only more information.

How you go about improving your performance depends on why you missed test questions.

Preparing for examinations is an individual matter. Consider both exam-taking techniques and information described in the objectives to identify what you need to do to improve your performance.

EXAM-TAKING TECHNIQUES

Motivation

If your primary motivation drifted from *finding your best answer* ...

Make a conscious effort to maintain your motivation to find your best answer on every test item, including practice and self-assessment test items.

Notice when your motivation begins to drift, and immediately refocus it.

One Best Answer format

If you were not consistent or systematic about finding your best answer ...

Review exam-taking techniques (*Guide* pgs. 7-11) before taking any test questions.

Practice using these techniques as often as possible - on course exams, old exams, review materials.

Make your back-up plans **BEFORE** taking any test questions.

Mark-up your test booklet.

If you changed right answers to wrong answers ...

Develop a track record of your decisions.

If you change your first decision, mark-out the *T*, *F*, or *?*, instead of erasing it.

Examples

F ~~*T*~~ A.
F B.
F C.
T ~~*F*~~ D.

If A is correct ... right changed to wrong

F ~~*T*~~ A.
F B.
F C.
T ~~*F*~~ D.

If D is correct ... wrong changed to right

Count how many times you changed right to wrong and visa versa to see whether or not changing answers works for you.

This should give you confidence to be consistent throughout a test.

If you did not complete all items in the time limit ...

Apply back-up plans as soon as you have checked your "best guess", logic, etc., and have no other clues to your best answer.

Practice "pushing" yourself on old exams.

Passages in Problem Sets

If you read written passages too slowly ...

Review exam-taking techniques and practice using them.

Especially: **Read stems of items before the passage.
Underline important words in the passage
Make notes in margins beside the passage**

If you did not understand a written passage ...

Read *Explanation of Questions (Manual pgs. 58-64)* for items you missed.

Check terminology.

Write definitions for words you could not define.

Memorize terminology that is new to you.

Use 3 x 5 cards (word on front, definition on back) and carry them with you to memorize in free moments during the day.

Discuss passages and items with another student or friendly faculty member.

If you did not understand graphic information ...

Practice "reading" graphics in textbooks and review materials

Read all written information in and around diagrams, tables, etc.

Describe out loud what the graphic information shows.

Example

"This diagram of the shows"

Refer yourself to a reading clinic or skills counselor, if available on your campus.

OBJECTIVES

Objectives related to wrong answers on Sample Items

If you cannot write out the information for an objective ...

Read the *Explanation of Questions (Manual pgs. 58-64)* for the related item.

If you can write out the information for the related objective, be sure to memorize it so that you can recall it later for other test items.

If you cannot write out information for the objective, continue to research the information.

Research the objective in a textbook or review book.

Organize information so that it is clear to you (outline, chart, diagram, etc.) and write it in a notebook.

Check terminology and write definitions for any words you cannot define on 3x5 cards.

Memorize new terminology.

Ask a friend, faculty member, or members of a study group to explain the information.

If you understand information but cannot recall it for a test item ...

Memorize the organized information and definitions.

Each time you start to memorize anything, tell yourself that you are going to remember it a long time!

This should aid your long-term memory.

Check your memory by reproducing information on paper to be sure you have memorized it well enough to use on a multiple-choice test.

Mathematics objectives related to wrong answers on Sample Items

If you did not memorize equations well enough to apply them on the test ...

List equations, their names (if any) and purpose or use.

Memorize equations - use 3 x 5 cards

If you memorized the equations but made an error in calculation ...

Work practice problems in books that have answers and examples until your accuracy improves.

If you could not perform necessary algebraic operations to solve equations ...

Research unfamiliar operations in a high school second level algebra review book.

Memorize algebraic formulae and operations.

Do practice problems similar to the items you missed in books that have answers and examples.

If you did not recognize a mathematical manipulation necessary to solve a problem ...

Read *Explanation of Questions*.

Ask other students or faculty members to explain the problem.

E. PHYSICAL SCIENCES OBJECTIVES³

GENERAL CHEMISTRY

- I. STOICHIOMETRY (mass changes in chemical reactions)**
 - A. Define molecular weight**
 - B. Empirical formula versus molecular formula**
 - 1. Describe the composition of chemical compounds by
 - a. empirical formula
 - b. molecular formula
 - C. Interconvert English to metric units and metric to English units**
 - D. Describe the composition of chemical compounds by percent mass**
 - E. Mole concept, Avogadro's number**
 - 1. Define mole
 - 2. Define Avogadro's number
 - 3. Determine molecular weight
 - F. Define density**
 - G. Oxidation number**
 - 1. List
 - a. common oxidating agents
 - b. common reducing agents
 - 2. Explain the process of redox titration
 - H. Reactions by chemical equations**
 - 1. Describe and give examples of conventions for writing chemical equations
 - 2. Explain and give examples of
 - a. balancing chemical equations
 - b. oxidation-reduction equations

³ The Physical Sciences Objectives are based on the *MCAT Physical Sciences Topics and Mathematics Concepts* in the *MCAT Student Manual*, pages 34-44.

II. ELECTRONIC STRUCTURE AND THE PERIODIC TABLE

- A. Define electronic structure of atoms
- Hydrogen atom
 - Describe the orbital structure
 - Define principal quantum number (n)
 - Describe electron structure of atoms (s, p, d electrons) per orbital
 - Define
 - ground state
 - excited state
 - Explain and be able to use the conventional notation for electronic structure of atoms
- B. Classification of elements and chemical properties of groups and rows
- Valence electrons of the common groups
 - List the groups for classification of elements
 - Elements in each group
 - Compare the chemical characteristics of elements in group
 - List their first and second ionization energies and trends
 - For groups and rows, compare and contrast chemical properties including
 - electron affinity
 - electronegativity

Suggested headings for chart to summarize information in II.B.3:

GROUP	ROW	CHEMICAL PROPERTIES	
		ELECTRON AFFINITY	ELECTRONEGATIVITY

III. BONDING

- A. The ionic bond (electrostatic forces between ions)
- Describe
 - electrostatic structure of elements *
 - ionic bonds of compounds

* The Periodic Table of the elements accompanies each exam.

- B. Describe the covalent bond**
- 1. Define the Lewis electron dot formulas**
 - a. Define and give examples of resonance structures**
 - b. Define formal charge**
 - c. Define Lewis acid and Lewis base**
 - d. Explain valence shell electron pair repulsion and its use in the prediction of shapes of molecules**
 - 2. Describe partial ionic character**
 - a. Describe the role of electronegativity in determining charge distribution**
 - b. Define dipole moment**

IV. PHASES AND PHASE EQUILIBRIA

- A. Describe gas phase**
- 1. State the units for measuring standard**
 - a. temperature**
 - b. pressure**
 - c. molar volume, and be able to calculate it**
 - 2. Ideal gas**
 - a. Memorize the equation for the ideal gas law ($PV = nRT$)**
 - (1) Describe the behavior of an ideal gas using the ideal gas law**
 - b. Memorize and be able to use Boyle's law**
 - c. Memorize and be able to use Charles' law**
 - 3. Discuss the kinetic molecular theory of gases**
 - 4. Explain and give examples of the qualitative aspects of deviation of real gas behavior from the ideal gas law**
 - 5. Explain partial pressure and describe mole fraction and how partial pressure and mole fraction are determined**
 - 6. Dalton's law (relationship of partial pressure to composition)**
 - a. State Dalton's law**
 - b. Apply Dalton's law to determine partial pressures**

- B. Describe liquid phase (inter- and intramolecular forces)
1. Describe the electronic structure of the hydrogen atom and hydrogen bonding
 2. Describe dipole interactions
 3. Discuss van der Waals forces
- C. Describe phase equilibria (solids, liquids and gases)
1. Define phase changes and describe phase diagrams
 2. Define
 - a. freezing point
 - b. melting point
 - c. boiling point
 3. Define molality
 4. Define colligative properties
 - a. State Raoult's law for lowering vapor-pressure of both volatile and nonvolatile substances
 - b. Discuss boiling-point elevation for solutions using the formula $(\Delta T_b = K_b m)$
 - c. Discuss freezing-point depression for solutions using the formula $(\Delta T_f = K_f m)$
 - d. Determine osmotic pressure

V. SOLUTION CHEMISTRY

- A. Describe ions in solution
1. Define an anion
 2. Define a cation
 3. List familiar ions and give their common names, formulae, and charges
Suggested headings for chart to summarize information in V.A.3:

FAMILIAR IONS	CHEMICAL PROPERTIES		
	COMMON	FORMULA	CHARGES

B. Solubility

1. List the units used to describe concentration (e.g., molarity)
2. Define
 - a. solubility product constant
 - b. equilibrium
 - (1) Explain and give an example of equilibrium in reversible reactions
3. Define common-ion effect

VI. ACIDS AND BASES

A. Describe acid / base equilibria

1. Define acids and bases according to Bronsted
2. Describe the formation of ions in an aqueous solution
 - a. Define (K_w) and memorize its approximate value
$$(K_w = [H^+][OH^-] = 10^{-14} \text{ at STP})$$
 - b. Define pH and memorize the pH of pure water
3. Describe conjugate acids (e.g., amino acids) and bases
4. Discuss the properties of strong acids and bases and give common examples of each (e.g., nitric, sulfuric)
5. Discuss the properties of weak acids and bases and give common examples of each (e.g., acetic, benzoic)
 - a. Describe the dissociation of weak acids and bases
 - (1) Contrast and compare the dissociation of weak acids and bases with and without added salt
 - b. Describe the hydrolysis of salts of weak acids or bases
 - c. Calculate the pH of solutions of salts of weak acids or bases
6. Define equilibrium constants
 - a. K_a and K_b
 - b. pK_a and pK_b

7. Define buffers
 - a. Define common buffer systems
 - b. Define and give examples of influence and titration curves
- B. Describe acid / base titrations
 1. List indicators
 2. Define neutralization
 3. Discuss the interpretation of titration curves

VII. THERMODYNAMICS AND THERMOCHEMISTRY

- A. Define thermochemistry
 1. Discuss a thermodynamic system and state its function
 2. Explain conservation of energy
 3. Contrast and compare endothermic reactions with exothermic reactions
 - a. Define enthalpy ΔH and standard heats of reaction
 - b. State Hess' law of heat summation
 4. Define
 - a. heats of formation
 - b. energy of bond dissociation, especially as related to heats of formation
 5. Describe heat changes
 - a. Explain how heat changes are measured (calorimetry)
 - b. Define
 - (1) heat capacity
 - (2) specific heat
 - (a) Memorize: (Specific heat of water = 1 cal/°C)
 6. Define entropy
 - a. Discuss entropy as a measure of "disorder"
 - b. Explain the relative entropy for
 - (1) gas
 - (2) liquid
 - (3) crystal states
 7. Define free energy G
 8. Describe spontaneous reactions

- a. Explain ΔG°
- B. Define thermodynamics
 - 1. State the first law of thermodynamics
 - a. Memorize first law: ($\Delta E = Q - W$)
 - 2. Define thermal energy units
 - a. List the equivalence of
 - (1) mechanical energy units
 - (2) chemical energy units
 - 3. Describe temperature scales
 - a. Explain how to convert from one scale to another
 - 4. Describe heat transfer
 - a. Explain
 - (1) conduction
 - (2) convection
 - (3) radiation
 - 5. Describe coefficient of expansion
 - 6. Define heat
 - a. Explain heats of fusion
 - b. Explain heats of vaporization

VIII. RATE PROCESSES IN CHEMICAL REACTIONS: KINETICS AND EQUILIBRIUM

- A. Describe reaction rate
- B. Describe dependence of reaction rate upon concentration of reactions
 - 1. State the rate law
 - 2. Define rate constant
 - 3. Describe reaction order
- C. Describe a rate-determining step
 - 1. Identify a rate-determining step and be able to identify it
- D. Explain dependence of reaction rate upon temperature; activation energy
 - 1. Describe activated complex
 - a. Describe transition state

2. Discuss the interpretation of energy profiles
 - a. Describe energies of reactants and products
 - b. Describe activation energy
 - c. Calculate ΔH for reactions
- E. Describe control of a reaction
 1. Describe kinetic control of a reaction
 2. Describe thermodynamic control of a reaction
 3. Contrast and compare kinetic control vs. thermodynamic control of a reaction
- F. Define catalysts
 1. Discuss enzyme catalysts (a special case of catalysis)
- G. Describe equilibrium in reversible chemical reactions
 1. State the law of mass action
 2. Define equilibrium constant
 3. Apply LeChatelier's principle
- H. Define equilibrium
 1. Describe the relationship of the equilibrium constant and ΔG°

IX. ELECTROCHEMISTRY

- A. Describe an electrolytic cell
 1. Describe electrolysis
 2. Define
 - a. anode
 - b. cathode
 3. Describe an electrolyte
 4. State Faraday's law
 - a. Describe the amount of current to elements deposited (or gas liberated) at an electrode
 5. Describe electron flow
 - a. Describe oxidation and reduction at electrodes
- B. Describe the galvanic cell
 1. Describe half-cell reactions

2. Define
 - a. reduction potentials
 - b. cell potential
 3. Describe the direction of electron flow
- C. Describe the concentration cell
1. Discuss the direction of electron flow

PHYSICS

X. TRANSITIONAL MOTION

- A. Define units and dimensions**
 - 1. Identify the appropriate units used for translational motion
 - 2. Describe the dimensions of translational motion
- B. Define vectors**
 - 1. Describe the methods for using vectors
- C. Define speed, velocity and acceleration**
 - 1. Speed
 - a. Memorize equations for determining speed
 - b. Identify units used to describe speed
 - 2. Velocity
 - a. Memorize equation for determining velocity
 - b. Identify units used to describe velocity
 - 3. Acceleration
 - a. Memorize equation for determining acceleration
 - b. Identify units used to describe acceleration
- D. Define uniformly accelerated motion**
 - 1. Memorize equations for uniformly accelerated motion
- E. Define freely falling bodies**
 - 1. Memorize equations for determining speed of freely falling bodies
- F. Define projectiles**
 - 1. Memorize equations for determining path of freely falling bodies

XI. FORCE AND MOTION, GRAVITATION

- A. Define mass, center of mass, weight**
 - 1. Mass
 - a. Identify units to measure mass
 - b. Memorize equations using mass

2. Center of mass
 - a. Explain center of mass in terms of equilibrium
3. Define gravitation
- B. State Newton's second law
 1. Memorize equation associated with Newton's second law
- C. State Newton's third law
 1. Memorize equation associated with Newton's third law
- D. State the law of gravitation
 1. Memorize equations associated with the law of gravitation
 2. Identify units used to describe effect of gravitational force
- E. Describe uniform circular motion, centripetal force
 1. Uniform circular motion
 - a. Define uniform circular motion
 - b. Memorize equations for uniform circular motion
 2. Define centripetal force
- F. Describe friction
 1. Define
 - a. friction
 - b. coefficients of friction for
 - (1) static friction
 - (2) kinetic friction
- G. Describe inclined planes
 1. Describe motion on an inclined plane
 2. Describe the component of force
 - a. Memorize equation for component of force
- H. Describe pulley systems
 1. State methods for finding forces on pulley systems
 2. Memorize equations associated with pulley systems

XII. EQUILIBRIUM AND MOMENTUM

- A. Define equilibrium
 1. Define translational equilibrium

2. Define rotational equilibrium, torques, lever arms
 - a. Memorize equations for torque
 - b. Memorize equations associated with lever arms
 3. State Newton's first law, inertia
 - a. Memorize equations for Newton's first law
 - b. Define inertia
 - (1) Memorize equations associated with inertia
- B. Define momentum**
1. Define impulse
 - a. Memorize equation for impulse
 2. Discuss conservation of linear momentum
 3. Define collisions
 - a. Describe elastic collisions
 - b. Describe inelastic collisions

XIII. WORK AND ENERGY

- A. Define work**
1. Memorize equations for work
- B. Define kinetic energy**
1. Memorize equations for kinetic energy
- C. Define potential energy**
1. Memorize equations for potential energy
- D. Describe conservation of energy**
- E. List and describe conservative forces**
- F. Define power**
1. Memorize equations associated with power
 2. Identify units used to describe power

XIV. WAVE CHARACTERISTICS AND PERIODIC MOTION

- A. Describe wave characteristics**

1. Transverse and longitudinal motion
 - a. Describe transverse motion
 - b. Describe longitudinal motion
 2. Define wavelength, frequency, velocity, amplitude, intensity
 - a. Memorize equation for finding wavelength
 - b. Memorize equation for finding frequency
 - c. Memorize equation for finding velocity
 - d. Memorize equation for finding amplitude
 3. Superposition of waves, phase, interference, addition
 - a. Describe the superposition of waves
 - (1) Give an example
 - b. Define phase
 - (1) Give an example
 - c. Define interference
 - (1) Give an example of constructive interference
 - (2) Give an example of destructive interference
 - d. Explain addition of waves
 4. Discuss resonance
 5. Standing waves and nodes
 - a. Describe standing waves
 - b. Define nodes
 - (1) Describe two types of nodes
 6. Define beats
- B. Describe periodic motion**
1. Memorize Hooke's law

$$F = Kx,$$
 where $K = \text{constant}$, and
 $x = \text{displacement from equilibrium}$
 2. Describe simple harmonic motion
 - a. Give examples
 3. Describe pendulum motion

XV. SOUND

- A. Describe the production of sound**

1. Define sound
 2. Describe the characteristics of sound waves
- B. Describe relative speed of sound in solids, liquids and gases
- C. Define intensity and pitch
1. Describe what intensity of sound is proportional to
 2. Discuss the relationship between pitch and frequency
- D. Describe the Doppler effect
1. Memorize the equation for finding the frequency or speed of the wave

$$\frac{f_o}{V \pm v_o} = \frac{f_s}{V \pm v_s}$$

- E. Describe resonance in pipes and strings in terms of nodes and antinodes
- F. Define harmonics
1. Give examples of harmonics

XVI. FLUIDS AND SOLIDS

- A. Define fluids
1. Define density, specific gravity
 - a. Memorize equations for density, for example:

$$D = \frac{\text{Mass}}{\text{Volume}}$$
 2. Buoyancy, Archimedes' principle
 - a. Define buoyancy
 - (1) Memorize the equation for buoyancy:

$$\text{buoyant force} = \text{weight of displaced fluid}$$

$$F = Vsg = mg$$
 - b. State Archimedes' principle
 3. Discuss hydrostatic pressure
 - a. Discuss the characteristics of force and pressure of fluids
 - b. Memorize the equations for finding hydrostatic pressure

$$P = \frac{F}{A} \qquad P = \frac{Mg}{A} \qquad P = \frac{Mgh}{V}$$

4. Describe viscosity
 - a. Discuss the viscosity coefficient (law, high)
5. State the continuity equation
 - a. Discuss fluid flow
 - b. Memorize the continuity equations

$$A_1 v_1 = A_2 v_2 = \text{constant}$$

$$R_1 = R_2 = \text{constant}$$

6. Bernoulli's equation
 - a. State Bernoulli's principle
 - b. Memorize Bernoulli's equation

$$P + pgh + 1/2 \rho v^2 = \text{constant}$$

7. Describe turbulence
 - a. Describe the effect on adhesive and cohesive forces
8. Describe surface tension

B. Define solids

1. Define density
 - a. Contrast and compare the density of solids to the density of liquids and gases
2. Elementary topics in elastic properties
 - a. Discuss elementary topics, for example:

$$ME = \frac{\text{stress}}{\text{strain}}$$

- b. Describe
 - (1) tensile stress
 - (2) compressive stress
 - (3) longitudinal strain
 - (4) shear stress
 - (5) Young's modulus

XVII. ELECTROSTATICS AND ELECTROMAGNETISM

A. Define electrostatics

- 1. Charge, charge conservation, conductors, insulators**
 - a. Discuss elementary charges**
 - (1) Describe methods to charge objects**
 - b. Explain charge conservation**
 - c. Define conductors**
 - d. Define insulators**
- 2. Coulomb's law, electric force**
 - a. State Coulomb's law**
 - (1) Memorize the equation for Coulomb's law**

$$F = K \frac{q_1 q_2}{r^2}$$

- b. Define electric force**
- 3. Describe an electric field**
 - a. Describe field lines**
 - b. Discuss the field due to charge distribution**
- 4. Potential difference, absolute potential, equipotential lines**
 - a. Define potential difference**
 - b. Describe absolute potential**
 - (1) Discuss the characteristics of electric potential**
 - c. Discuss equipotential lines**
- 5. Describe an electric dipole**

B. Define electromagnetism

- 1. Discuss magnetic fields**
- 2. Describe electromagnetic spectrum, X rays**
 - a. Contrast and compare electromagnetic spectrum and magnetic fields**
 - b. Describe X rays and their place in the electromagnetic spectrum**

XVIII. ELECTRIC CIRCUITS

A. Define current

- 1. Memorize equation for current**

$$I = \frac{Q}{t} = \text{amperes} = \frac{\text{coulombs}}{\text{second}}$$

B. Batteries, electromotive force, voltage, terminal potential, internal resistance

- 1. Describe batteries**
- 2. Discuss the electromotive force**
- 3. Define voltage**
- 4. Describe terminal potential**
- 5. Describe internal resistance**

C. Resistance, Ohm's law, series and parallel circuits, resistivity

- 1. Discuss resistance**
- 2. State Ohm's law**
 - a. Memorize Ohm's law**

$$V = IR$$

- 3. Contrast and compare series and parallel circuits**
- 4. Define resistivity**

D. Define capacitor, dielectrics

- 1. Describe a capacitor**
- 2. Contrast and compare a capacitor with and without dielectric**

E. Define electric power

- 1. Discuss the generation and characteristics of electric power (AC current)**

F. Define root-mean-square current

- 1. Define root-mean-square voltage**

XIX. LIGHT AND GEOMETRICAL OPTICS

- A. Define visual spectrum, color
 - 1. Discuss color and its relationship to wave length and frequency
- B. Define polarization
- C. Reflection, mirrors, total internal reflection
 - 1. Define reflection
 - 2. State the two laws of reflection
 - 3. Describe mirrors
 - 4. Contrast and compare planes and spherical mirrors (concave and convex)
 - 5. Explain total internal reflection
- D. Refraction, refractive index, Snell's law
 - 1. Define refraction
 - 2. State the two laws of refraction
 - 3. Explain the refractive index
 - 4. State Snell's law
 - (1) Memorize Snell's law

$$\frac{\sin \theta_1}{\sin \theta_2} = \frac{v_1}{v_2} = \frac{n_2}{n_1} = \frac{1}{2}$$

- E. Define dispersion
- F. Thin lenses, combination of lenses, diopters, lens aberrations
 - 1. Describe the types of thin lenses
 - a. Describe how each type refracts light
 - b. Describe types of images formed
 - 2. Discuss the results of using lenses in combinations
 - 3. Define diopters
 - a. Discuss diopters in terms of lens strength
 - 4. Discuss lens

XX. ATOMIC AND NUCLEAR STRUCTURE

- A. Define atomic number, atomic weight
- B. Define neutrons, protons, isotopes

- C. Radioactive decay, half-life
 - 1. Describe radioactive decay
 - 2. Define half-life in terms of radioactivity
- D. Describe the quantized energy levels for electrons
 - 1. Discuss Planck's Constant and frequency of light absorbed at the various levels
- E. Define fluorescence
 - 1. Describe the fluorescence process

MATHEMATICS OBJECTIVES

1. ARITHMETIC CALCULATIONS

- a. Describe and give examples of finding proportion
- b. Describe and give examples of finding ratio
- c. Describe and give examples of finding percentage
- d. Discuss the process of estimating square root

2. BASIC ALGEBRA

- a. Explain and give examples of exponentials
- b. Describe logarithms
 - (1) Give examples of natural log
 - (2) Give examples of log base ten
- c. Explain and give examples of scientific notation
- d. Solve equations
 - (1) Solve quadratic equations
 - (2) Solve simultaneous equations
- e. Describe the graphic representations of data
 - (1) Define abscissa
 - (2) Define ordinate
 - (3) Define slope or rate of change
- f. Describe reciprocals
- g. Define and give examples of arithmetic scales
- h. Define and give examples of semi-log scales
- i. Define and give examples of log-log scales

3. TRIGONOMETRY

- a. Define sine
- b. Define cosine

- c. Define tangent
- d. Memorize the values of the sines of 0° , 90° , and 180°
- e. Memorize the values of the cosines of 0° , 90° , and 180°
- f. Memorize the relationships between the lengths of sides of right triangles containing 30° , 45° , and 60° angles
- g. Define inverse trigonometric function \sin^{-1}
- h. Define inverse trigonometric function \cos^{-1}
- i. Define inverse trigonometric function \tan^{-1}

4. METRIC UNITS

- a. Explain how to balance equations containing physical units

5. MEASUREMENT

- a. Explain relative magnitude of experimental error
- b. Describe the effect of propagation of error
- c. Discuss the process of making reasonable estimates
- d. Define significant digits of measurement

6. PROBABILITY

- a. Calculate mathematical probability of an event

7. VECTORS

- a. Calculate vector addition
- b. Calculate vector subtraction
- c. Define the right-hand rule

8. STATISTICS

- a. Calculate the arithmetic mean
- b. Calculate the range of a set of numerical data
- c. Define standard deviation
- d. Discuss the general concepts of statistical association
- e. Define correlation

II. BIOLOGICAL SCIENCES SECTION

Biology and Organic Chemistry

Reasoning in biology and organic chemistry are tested in this section. Most of the 77 test items are simple "One Best Answer" multiple-choice format with only one *True* statement. Other items have one to three *True* statements.

About 80% of the test items are presented in 10-11 problem sets:

Information is given in passages (250 word paragraphs, graphs, tables, figures, etc.).

Each passage is followed by a related series of 4 to 8 test items.

About 20% of the items are independent of passages and of each other.

A. USE EXAM-TAKING TECHNIQUES

Watch your motivation during an exam!

For your best performance, your primary motivation has to be *finding your best answer to each test item ...* instead of *... getting the whole test over with.*

If your motivation begins to drift (especially when you are tired or when you find several items you are not confident about) ...

STOP ... have a short conversation with yourself to refocus your motivation ... and then continue when your motivation returns to finding your best answer.

Your best answer may be based on ...

What you know for sure (no problem here - just mark your answer form),

What seems to be best (logic, hunches, gut feelings - perhaps based on your subconscious information), or

Back-up plans for choosing answers (when all else fails)

Make these plans before an exam, and

Apply them consistently throughout the exam.

These exam-taking techniques are some of the easiest and best ways to add extra points to your score.

INDEPENDENT ITEMS
(Only 1 True Statement)

Finding your best answer for Independent Items

Read the stem first, and underline words that seem important.

This will help you to focus on the item and avoid misreading.

Read each alternative *in order*.

Underline or circle words that seem important.

Decide whether you think it is true or false, or you are not sure.

Write your decision beside each alternative.

Write *T* if you decide the alternative is *True*

Write *F* if you decide the alternative is *False*

Write *?* if you can't decide whether the alternative is *True* or *False*

Mentally set aside that alternative while you consider the next one.

Finally, mark your *Answer Form* before starting the next item.

Example: Basic

1. An entity composed exclusively of protein is:

- | | | | |
|----------|----|------------------------------------|-------------------------------------|
| <i>T</i> | A. | bacterial flagellum. | <i>No problem here mark A</i> |
| <i>F</i> | B. | mitochondrion. | |
| <i>F</i> | C. | cell membrane. | |
| <i>F</i> | D. | wall of a gram positive bacterium. | |
-

Do not spend too much time on a test item when you are uncertain of the answer.

If you can rule out 1 or 2 alternatives but you still are not certain of the correct answer ...

Choose your best guess from the alternatives marked " ?".

Examples

?	A.	<i>Choose your best guess mark A or C</i>
F	B.	
?	C.	
F	D.	

F	A.	<i>Choose your best guess mark B or C or D</i>
?	B.	
?	C.	
?	D.	

Back-up Plans

If you do not have a *best guess*, have a *back-up plan* ready:

Choose the first or last alternative marked " ?".

Examples

?	A.	<i>If choose first ? mark A</i>
?	B.	
F	C.	
F	D.	

F	A.	<i>If choose first ? mark B</i>
?	B.	
?	C.	<i>If choose last ? mark D</i>
?	D.	

If you cannot rule out any alternatives (and do not have a "best guess") use your back-up plan

Choose your favorite letter A or B or C or D

Example

?	A.	If favorite letter is A mark A
?	B.	If favorite letter is B mark B
?	C.	If favorite letter is C mark C
?	D.	If favorite letter is D mark D

INDEPENDENT ITEMS

(1-3 True statements)

Finding your best answer

Read the stem first, and underline words that seem important.

Read each statement (I, II, and III) *in order*.

Underline or circle words that seem important.

Decide whether you think it is true or false, or you are not sure.

Write your decision beside each statement.

Mentally set aside that alternative while you consider the next one.

Match your pattern of *True statements* with the possible combinations given in the *alternatives*.

Finally, mark your *Answer Form* before starting the next item.

Example: 1 to 3 correct statements

2. The weight of a protein may be estimated by:

- T I. ultracentrifugation.
- T II. gel filtration.
- F III. infrared analysis.

- A. III only
- T B. I and II only *No problem here mark B*
- C. II and III only
- D. I, II, and III.

Do not spend too much time on a test item when you are uncertain of the answer.

If you have any **False** statements

Cross out (X) each statement-number (I, II, or III) in the alternatives

Rule out these alternatives

Example

- ? I.
- F II. *If II is F and*
- F III. *If III is F*

- T ~~/~~ A. I only *..... and mark A*
- F B. ~~X~~ only *rule out B*
- F C. I and ~~X~~ only *rule out C*
- F D. ~~X~~ and III only *rule out D*

If you cannot identify your best answer only on the basis of **False** statements, and

If you have any **True** statements

Circle **T** statements in any of the alternatives not already ruled out.

Example

T I. and I is T
? II.
F III. If III is F

A. II only
F B. ~~X~~ only rule out B

T C. I and II only and mark C
F D. I and ~~X~~ only rule out D

If you have no *False* statements but you do have a *True* statement ...

Circle each *True* statement-number (I, II, or III) in the alternatives and choose one of these alternatives.

Example

? I.
? II.
T III. If III is T

A. I only
B. II only
C. I and II only
T D. II and III only mark D

Back-up Plans

If you have any *F* and/or *T* statements but still cannot identify your best answer ...

Choose your *first ?* or *last ?* consistently throughout the test.

Example

F I. If I is F

? II.
? III.

F A. ~~X~~ only rule out A
? B. III only If choose first ? mark B
F C. ~~X~~ and II only rule out C
? D. II, and III only If choose last ? mark D

Example

? I.
? II.
T III. *If III is T*

F A. I only
? B. (II) only *If choose first ? mark B*
F C. I and II only
? D. II and (III) only *If choose last ? mark D*

If you have no **False** or **True** statements (and have no other clue)

Choose your favorite letter (A, B, C, or D) consistently throughout the test.

Example

? I.
? II.
? III.

? A. I only *If favorite letter is A mark A*
? B. II only *If favorite letter is B mark B*
? C. I and II only *If favorite letter is C mark C*
? D. I, II, and III only *If favorite letter is D mark D*

Reviewing your answers

If you intend to review an item after you have finished all other items ...

Circle the item number in the *Test Booklet* (not on the *Answer Form*)

If you review an item, do not change your answer unless you ...

Thought of additional information

Other items may trigger your memory

Misread or misinterpreted the item

Made an error regarding calculations

(These rules should help you to avoid changing right answers to wrong answers.)

PROBLEM SETS
(Passage & Set of Related Test Items)

Finding your best answers for items in *Problem Sets*

Read the *stems* of the items before looking at the passage

Read and underline important words in the stems (not the alternatives) of all items in the problem set.

This will help you identify information you will need to look for when you read the passage.

It is easier to read and understand new information when you know what you are looking for.

Read the passage and underline information that seems important.

Make a note in the margin when you recognize information that seems relevant to one of the items you "previewed".

Make other notes in the margins that you find helpful if it is not too time-consuming.

Re-read the stem of an item and consider each alternative *In order*.

Continue in the same way as for *Independent Items*.

All the test items in the *Biological Sciences* section have the same format: "One Best Answer", with only 1 or with 1-3 true statements.

Passages appear only in the *Problem Sets*.

Finally, mark your *Answer Form* for all items in one *Problem Set* before starting the next set.

Reviewing answers to items in *Problem Sets*

If you intend to review an item after you have finished all other items ...

Circle the item number in the *Test Booklet* (not on the *Answer Form*).

If you recognized related information in the passage, write the item number in the margin beside it so you can locate it more quickly when you review the item.

If you review an item, do not change your answer unless you ...

Misread or misinterpreted the passage
Misread or misinterpreted the item

B. TAKE SAMPLE TEST ITEMS

Answer all *Biological Sciences* test items (*Manual* pgs. 102-116⁴) in a single, timed sitting.

Take items 1-35 in 45 minutes.

Try to simulate the "real" *MCAT* situation.

For example, no notes, no talking, no interruptions, etc.

Score your answers (*Manual* pg. 125) after you have finished all items.

C. ANALYZE YOUR PERFORMANCE

The information that may be tested in the *Biological Sciences* section is described in the *Biological Sciences Objectives* (*Guide* pgs. 62-76).

Topics include biology and organic chemistry.

Objectives are based on the *MCAT Biological Sciences Topics* (*Manual* pgs. 91-101)

Analyze your performance on the Sample Test in terms of these objectives by completing *Worksheets 4 and 5* (*Guide* pgs. 55-56).

⁴ Any small differences between a page reference given in this *Guide* and the correct page number in your copy of the *Manual* may be due to changes made in the text of the *Manual* between printings.

WORKSHEETS 4-5

(Test Items Categorized by Biological Sciences Objectives)

Worksheet 4: Biology

Columns are labeled with Roman numerals (*I-XI*) that correspond to the general topics of the objectives.

Rows beside test item numbers (*1-25*) identify specific objectives (by letter/number) within the general topics.

Identify the objective related to each item you missed:

Circle the letter/number combination(s) on the row beside the item numbers of the items you missed.

For each column in which you have circled one or more objectives:

Write the total number of items you missed at the bottom of the chart to see which objectives were most difficult for you.

This will help you to set your own priorities for review - for example, beginning with the worst topics first.

One column at a time

Read all of the *Objectives* circled.

The page number in the *Guide* and the type of item are shown in the last two columns on the right of the chart.

Re-read the *Sample Items* you missed to see how these objectives are tested.

Worksheet 5: Organic Chemistry

Columns (Objectives *XII-XVIII*) correspond to the general topics of the objectives.

Rows (Items *26-35*) identify specific objectives (by letter/number). within the general topics.

Complete Worksheet 5 in the same way as Worksheet 4.

WORKSHEET 4
Biological Sciences - Biology

Test Item No.**	BIOLOGY Objectives*											Page in Guide	Type of Item
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI		
1			C3b									64	Information presentation
2	A							A				62,69	
3								A				69	
4								A2				69	
5									B			70	
6	A											62	Information presentation
7					B			B1b				66,69	
8	A											62	
9								B1b				69	
10	A							B1b				62,69	
11						C3						67	Research
12		B1										63	
13						C3						67	
14		B2						B1				63,69	
15		B2										63	
16		B2										63	
17		A4										63	Research
18	B1	B1										62,63	
19	B1	B										62,63	
20	B1	B										62,63	
21	B1	B										62,63	
22						A5,C3					A1	67,70	Independent
23			C2,3									64	
24			E1									65	
25	B1											62	
Total Items	9	9	3	0	1	3	0	0	7	1	1		
Items Wrong													

* For Objectives see *Guide* pgs. 62-70.

** For Test Items see *Manual* pgs. 102-110.

WORKSHEET 5

Biological Sciences - Organic Chemistry

Test Item No.**	ORGANIC CHEMISTRY Objectives*							Page in Guide	Type of Item
	XII	XIII	XIV	XV	XVI	XVII	XVIII		
26				A3b	B			74,75	Research
27				B2	C1			74,75	
28				B1a				74	
29						A1		75	Problem-solving
30		D2a	A1					73	
31		B2					A,B	72,75,76	
32		A1a						72	
33	B3				A2			71,74	Independent
34	A3d							71	
35			C3					74	
Total Items	2	3	2	3	3	1	1		
Items Wrong									

* For Objectives see *Guide* pgs. 71-76.

** For Test Items see *Manual* pgs. 110-116.

D. IMPROVE YOUR PERFORMANCE

STRATEGY

The basic strategy for improving your information base for multiple-choice exams is:

Identify missing information in your information base

You cannot recall information (which you may have understood) to apply on a timed multiple-choice test.

Take *all* self-assessment items "for real" to see what is missing in a timed-test situation.

Research the missing information

You can't "review" everything, so spend your time on your missing information.

Organize the information

It must be clear to you. Use outlines, diagrams, formulae, charts, graphs, tables, flowcharts, etc.

Memorize the organized information

Memorize information you have organized before organizing more. On a multiple-choice exam ...

It is more effective to understand *and* memorize less information than to understand *only* more information.

How you go about improving your performance depends on why you missed test questions.

Preparing for examinations is an individual matter. Consider both exam-taking techniques and information described in the objectives to identify what you need to do to improve your performance.

EXAM-TAKING TECHNIQUES

Motivation

If your primary motivation drifted from finding your best answer ...

Make a conscious effort to maintain your motivation to find your best answer on every test item every time you do test items.

Notice when your motivation begins to drift, and immediately talk yourself into refocusing it.

One Best Answer format

If you were not consistent or systematic about finding your best answer ...

Review exam-taking techniques (*Guide* pgs. 45-53) before taking any test questions.

Practice using these techniques as often as possible - on course exams, old exams, review materials.

Make your back-up plans before taking test questions

Mark-up your test booklet.

If you changed right answers to wrong answers ...

Develop a track record of your decisions

If you change a decision, mark-out *T*, *F*, and *?*, instead of erasing your first decision.

Example

<i>F</i> <i>T</i>	A.	<i>If A is correct right changed to wrong</i>
<i>F</i>	B.	
<i>F</i>	C.	
<i>T</i> <i>F</i>	D.	

Example

F ~~/~~ A.
F B.
F C.
T ~~/~~ D.

If D is correct **wrong changed to right**

Count how many times you changed right to wrong and visa versa to see whether or not changing answers works for you.

This should give you confidence to be consistent throughout a test.

If you did not complete all items during the time period ...

Apply back-up plans as soon as you have checked your "best guess", logic, etc., and have no other clues to your best answer.

Practice "pushing" yourself on old exams.

If you mismarked your *Answer Form* ...

Be sure to mark answers for *all* items in one set *before* starting the next set.

Passages in Problem Sets

If you read passages too slowly ...

Review exam-taking techniques and practice using them

Especially: **Read stems of items before the passage.**
 Underline important words
 Make notes in margins

Refer yourself to a reading clinic or skills counselor, if available on your campus.

If you did not understand written paragraphs ...

Read *Explanation of Questions (Manual pgs. 117-124)* for items you missed.

Check terminology.

Write definitions for words you could not define.

Memorize terminology that is new to you.

Make 3 x 5 cards: word on front, definition on back.

Each night sort them into "know" and "don't know".

Carry "don't knows" with you to memorize in free moments the next day.

Discuss the problem set with another student or friendly faculty member.

Research the topic in a text or review book.

If you did not understand graphic information ...

Practice "reading" graphics in textbooks and review materials.

Read all written information in and around diagrams, tables, etc.

Describe out loud what the graphic information shows.

Example

"This diagram of the shows"

Refer your self to a reading clinic or skills counselor, if available on your campus.

OBJECTIVES

Objectives related to wrong answers on Sample Items

If you cannot write out the information for an objective ...

Read the *Explanation of Questions (Manual pgs. 117-124)* for the related item.

If you can write out the information for the related objective, be sure to memorize it so that you can recall it later for other test items.

If you cannot write out information for the objective, continue to research the information.

Research the objective in a textbook or review book.

Organize information so that it is clear to you (outline, chart, diagram, etc.) and write it in a notebook.

Check terminology and write definitions for any you cannot define on 3x5 cards.

Memorize new terminology.

Ask a friend, faculty member, or members of a study group to explain the information.

If you understand information but cannot recall it for a test item ...

Memorize the organized information and definitions.

Each time you start to memorize anything, tell yourself that you are going to remember it a long time!

This should aid long-term memory.

Check your memory by reproducing information on paper to be sure you have memorized it well enough to use on a multiple-choice test.

E. BIOLOGICAL SCIENCES OBJECTIVES⁵

BIOLOGY

I. MOLECULAR BIOLOGY

- A. Define enzymes and cellular metabolism**
 - 1. Describe enzyme structure and function
 - 2. Describe methods of control of enzyme activity
 - 3. Describe feedback inhibition
 - 4. Describe anaerobic and aerobic glycolysis
 - 5. Memorize the Krebs (citric acid) cycle
 - 6. Describe the electron transport chain, oxidative phosphorylation
- B. Describe DNA and protein synthesis**
 - 1. DNA structure and function
 - a. Describe the structure and composition of DNA
 - (1) Describe the Watson-Crick model
 - (2) Define double helix
 - (3) Describe base-pair specificity
 - b. Explain the role of DNA as a transmitter of genetic information (the genetic code)
 - c. Explain the method of DNA replication
 - 2. Protein synthesis
 - a. Define transcription
 - (1) Describe the mechanism of transcription
 - (2) Discuss the method of regulation of transcription
 - b. Define translation
 - (1) Define codons and anticodons
 - (2) Describe the roles of mRNA, tRNA, and rRNA in translation
 - (3) Describe the structure and function of ribosomes

⁵ The Biological Sciences Objectives are based on the *MCAT Biological Sciences Topics* in the *MCAT Student Manual*, pages 91-101.

II. MICROBIOLOGY

- A. Describe viral structure and life history**
 - 1. Nucleic acid (DNA and RNA) and protein components**
 - a. Discuss the nucleic acid (DNA and RNA) structure of viruses**
 - b. Discuss the protein components of viruses**
 - 2. Typical bacteriophage structure and function**
 - a. Describe bacteriophage structure**
 - b. Describe bacteriophage function**
 - 3. Contrast and compare relative sizes of bacteria and eukaryotic cells**
 - 4. Generalized phage and animal virus life cycles**
 - a. Describe phage life cycles**
 - b. Describe animal virus life cycles**
- B. Describe prokaryotic cells**
 - 1. Cell structure and physiology**
 - a. List the components of the structure of a prokaryotic cell**
 - b. Describe the function of each of the structural components of a prokaryotic cell**
 - 2. Bacterial life history**
 - a. Discuss the life history of bacteria**
- C. Describe fungi**
 - 1. List the major structural types of fungi**
 - 2. General life history and physiology**
 - a. Discuss the life history of fungi**
 - b. Describe the physiology of fungi**

III. GENERALIZED EUKARYOTIC CELL

- A. Describe the structure and functions of the parts of the nucleus**
 - 1. Nucleolus**
 - a. Memorize characteristics and functions of the parts of the nucleolus**
 - 2. Nuclear envelope and nuclear pores**
 - a. Describe the nuclear envelope**
 - (1) State its function**

- b. Describe nuclear pores
 - (1) State their function
- B. List the membrane-bound organelles: structures and functions
 - 1. Define mitochondria
 - a. Describe the parts of the mitochondria
 - b. Explain the function of each of the parts of the mitochondria
 - 2. Define lysosomes
 - a. Explain the functions of lysosomes
 - b. State the origin of lysosomes
 - 3. Define endoplasmic reticulum
 - a. Describe the types of ER and their functions
 - 4. Define golgi apparatus
 - a. Explain the functions of the golgi apparatus
- C. Describe the plasma membrane: structure and functions
 - 1. Protein and lipid components
 - a. Describe the structures and functions of protein in the membrane
 - b. Describe the structures and functions of lipid in the membrane
 - 2. Fluid mosaic model, membrane traffic
 - a. Describe the fluid mosaic membrane model
 - b. Discuss membrane traffic
 - 3. Movement across membranes
 - a. Define osmosis
 - (1) Describe the process of osmosis
 - b. Contrast and compare passive and active transport
 - c. Define endocytosis and exocytosis
 - 4. Membrane channels, sodium / potassium pump, membrane potential
 - a. Describe membrane channels
 - b. Describe the sodium / potassium pump
 - c. Discuss membrane potential
 - 5. Describe membrane receptors
 - 6. Describe cellular adhesion
- D. List the cytoskeleton structures and functions
 - 1. Microfilaments, microtubules, intermediate filaments
 - a. Describe the structure and functions of microfilaments
 - b. Describe the structure and functions of microtubules

- c. Describe the structure and functions of intermediate filaments
 - 2. Cilia and flagella
 - a. Describe the structure and functions of cilia
 - b. Describe the structure and functions of flagella
 - 3. Centrioles
 - a. Describe the structure and functions of centrioles
- E. Define mitosis
 - 1. Mitotic process, phases of the life cell
 - a. Discuss the steps in the mitotic process
 - b. List the phases of the cell cycle
 - 2. List the mitotic structures
 - a. Describe centrioles, asters, spindles
 - b. Describe chromatids, centromeres, telomeres, kinetochores
 - 3. Describe nuclear membrane breakdown and reorganization
 - 4. Discuss the mechanisms of chromosome movement

IV. SPECIALIZED EUKARYOTIC CELLS AND TISSUES

- A. Describe neural cells and tissues
 - 1. Structures in neural cells
 - a. Describe a cell body
 - b. Describe an axon
 - c. Describe dendrites
 - d. Describe a myelin sheath and Schwann cells
 - e. Describe the nodes of Ranvier
 - 2. Discuss a synapse
 - 3. Discuss resting potential and action potential
- B. Describe contractile cells and tissues
 - 1. Contrast and compare striated, smooth, and cardiac muscle
 - 2. Describe a sarcomere
 - 3. Discuss calcium regulation of contraction
- C. Describe epithelial cells and tissues
 - 1. Describe simple epithelium
 - 2. Describe stratified epithelium

- D. Describe connective cells and tissues**
 - 1. List the major cell and fiber types
 - a. Describe the major types of cells
 - b. Describe major types of fibers
 - 2. Contrast and compare loose vs. dense connective tissue
 - 3. Describe cartilage
 - 4. Describe the extracellular matrix

V. NERVOUS AND ENDOCRINE SYSTEMS

- A. Describe the nervous system structure and function**
 - 1. Describe the organization of the vertebrate nervous system
 - a. Memorize the twelve cranial nerves
 - b. Memorize the function of each of the twelve cranial nerves
 - 2. Describe sensor and effector neurons
 - 3. Describe the sympathetic and parasympathetic nervous systems
- B. Describe sensory reception and processing**
 - 1. Skin, proprioceptive, and somatic sensors
 - a. Describe skin and its role in sensory reception
 - b. List proprioceptive and somatic sensors
 - 2. Olfaction, taste
 - a. Describe the process of olfaction
 - b. Describe the function and the structures involved in the sense of taste
 - 3. Hearing
 - a. Describe the structure of the ear
 - b. Discuss the mechanism of hearing
 - 4. Vision
 - a. Describe the structure of the eye
 - b. Discuss the light receptors of the eye
- C. Describe the endocrine systems: hormones and their sources**
 - 1. Explain the function of the endocrine system
 - 2. Chart the major endocrine glands, their hormones, specificity, and target tissues
 - 3. Describe the cellular mechanisms of hormone action

4. Describe the transport of hormones

VI. CIRCULATORY, LYMPHATIC, AND IMMUNE SYSTEMS

- A. Describe the circulatory system
 1. List the structure and functions of the circulatory system, including the system's role in thermoregulation
 2. Describe the function of the four-chambered heart, and pulmonary and systematic circulation
 3. Describe the arterial and venous systems, and capillary beds
 4. Discuss systolic and diastolic pressure
 5. List the structures and function of the components of blood
 6. Discuss the role of hemoglobin in oxygen transport
- B. Describe the lymphatic system: structure and function
 1. List the structures that comprise the lymphatic system
 2. Describe the functions of the structures in the lymphatic system
- C. Describe the immune system
 1. List the cells involved in the immune system
 - a. Describe the role of T-lymphocytes
 - b. Describe the role of B-lymphocytes
 2. Tissues
 - a. Describe bone marrow and its function
 - b. Describe the spleen and its function
 - c. Describe the thymus and its function
 - d. Describe the lymph nodes and their function
 3. Antigens, antibodies, antigen-antibody reactions
 - a. Define antigen
 - b. Define antibodies
 - c. Describe antigen-antibody reactions

VII. DIGESTIVE AND EXCRETORY SYSTEMS

A. Describe the digestive system

- 1. List the structures and their functions involved in ingestion**
- 2. Describe the stomach**
- 3. List the digestive glands**
 - a. Describe the role of the liver in digestion**
 - b. Describe the role of the pancreas in digestion**
 - c. Explain the process of bile production**
- 4. Describe the small and large intestines**
 - a. Contrast and compare the functions of the small and large intestines**
- 5. Explain muscular control of digestion**

B. Describe the excretory system

- 1. Discuss the role of the excretory system in body homeostasis**
- 2. Describe the structures of the kidney and their functions**
- 3. Describe the structures and functions of the nephron**
- 4. Discuss the process involved in the formation of urine**
- 5. Explain how the body stores and eliminates wastes**

VIII. MUSCLE AND SKELETAL SYSTEMS

A. Describe the muscle system

- 1. Describe the functions of the muscle system**
- 2. List the basic types of muscles and their locations**
- 3. Describe how nerves control muscles**
 - a. Discuss motor and sensory nerve control**
 - b. Contrast and compare the control of voluntary and involuntary muscles**

B. Describe the skeletal system

- 1. Describe the functions of the skeletal system**
- 2. Describe the structure of bones**
 - a. Discuss the calcium / protein matrix**

3. Describe skeletal structures
 - a. Describe the specialization of bone types and list their structures
 - b. Describe joint structures
4. List the structures and functions of cartilage
 - a. Describe ligaments
 - b. Describe tendons

IX. RESPIRATORY AND SKIN SYSTEMS

- A. Describe the respiratory system
 1. Discuss the function of the respiratory system
 - a. Explain gas exchange and the role of the alveoli
 - b. Explain thermoregulation
 - c. Explain the respiratory system's role in protection against disease and particulate matter
 2. Describe the mechanisms of breathing and the structures involved
 - a. Discuss the diaphragm and its role
 - b. Discuss the rib cage and its role
 - c. Explain differential pressure
- B. Describe the skin system
 1. Discuss the functions of the skin system
 - a. Describe homeostasis and osmoregulation by the skin
 - b. Describe thermoregulation by the skin
 - c. Describe physical protection by the skin
 2. Describe the structure of the skin

X. REPRODUCTIVE SYSTEM AND DEVELOPMENT

- A. Describe reproduction
 1. Describe the structures and functions of the male and female gonads and genitalia
 2. Discuss the process of gametogenesis by meiosis
 - a. Describe the role of the ovum and sperm

3. List the steps in the reproductive sequence
 4. Describe the structure and function of placenta
- B. Describe embryogenesis**
1. Describe fertilization
 2. Describe cleavage
 3. Describe blastulation
 4. Describe gastrulation
 5. Describe neurulation
 6. List the major structures arising out of primary germ layers
- C. Describe developmental mechanisms**
1. Discuss cell specialization
 - a. Define determination
 - b. Define differentiation
 2. Discuss induction

XI. GENETICS AND EVOLUTION

- A. Define genetics**
1. Discuss the Mendelian concepts and their application
 2. Discuss the Hardy-Weinberg principle and population genetics
 3. Discuss meiosis and its relationship to genetic variability
 4. Describe sex-linked characteristics
 5. Explain mutations
- B. Define evolution**
1. Discuss the theory of natural selection
 - a. Describe fitness
 - b. Define differential reproduction
 - c. Describe group selection
 2. Discuss species concept and speciation
 3. Discuss the theories of the origin of life
 4. Discuss comparative anatomy
 - a. Describe chordate features
 - b. Describe the vertebrate body plan

ORGANIC CHEMISTRY

XII. BIOLOGICAL MOLECULES

A. Define amino acids and proteins

1. Description

- a. Describe the absolute configuration at the α position
- b. Describe amino acids as dipolar ions
- c. Classification
 - (1) Discuss the method of classification of acids or bases
 - (2) Discuss the method of classification of hydrophobic or hydrophilic

2. Reactions

- a. Describe sulfur linkage for cysteine and cystine
- b. Describe peptide linkage
- c. Describe hydrolysis

3. List general principles for the structure of proteins

- a. Describe the 1° structure of proteins
- b. Describe the 2° structure of proteins
- c. Describe the 3° structure of proteins
 - (1) Describe the roles of proline, cystine
 - (2) Describe hydrophobic bonding
- d. Define isoelectric point

B. Define carbohydrates

1. Description

- a. List the nomenclature and classification and common names of carbohydrates
- b. Describe absolute configuration
- c. Describe the cyclic structure and conformations of hexoses
- d. Define epimers and anomers

2. Describe the oxidation of monosaccharides

3. Describe the hydrolysis of the glycoside linkage

- C. Define lipids
 - 1. Description, structure
 - a. Describe and give the structure of free fatty acids
 - b. Describe and give the structure of triacyl glycerols
 - c. Describe and give the structure of steroids
- D. Define phosphorous compounds
 - 1. Discuss phosphoric acid-chemistry and the structure of anhydrides and esters

XIII. OXYGEN-CONTAINING COMPOUNDS

- A. Define alcohols
 - 1. Important reactions
 - a. Describe dehydrations (i.e., formation of carbocations)
 - b. Discuss substitution reactions for S_N1 or S_N2, depending on alcohol and derived product)
 - 2. General principles
 - a. Describe hydrogen bonding
 - b. Explain the effect of chain branching on physical properties
- B. Define aldehydes and ketones
 - 1. List the important reactions
 - a. Describe nucleophilic addition reactions at C=O bond
 - (1) Describe acetal, ketal, hemiacetal, hemiketal formation
 - (2) Describe imine and enamine formation
 - b. Describe reactions at adjacent positions
 - (1) Describe aldol condensation
 - (2) Describe keto-enol tautomerism
 - 2. List the general principles of aldehyde and ketone formation
 - a. Explain the effect of substituents on reactivity of C=O
 - b. Explain steric hindrance
 - c. Describe the acidity of α-H
 - d. Define carbanions
 - e. Describe α, β, unsaturated carbonyls

- C. Define carboxylic acids
 - 1. List important carboxyl group reactions
 - a. Define decarboxylation
 - b. Define esterification
 - 2. List the general principles of a carboxylic acid formation
 - a. Explain H bonding
 - b. Describe the inductive effect of substituents
 - c. Describe the resonance stability of carboxylate anion
- D. List the common acid derivatives (acid chlorides, anhydrides, amides, esters, keto acids)
 - 1. List the important reactions
 - a. Discuss hydrolysis of fats and glycerides (saponification)
 - b. Discuss hydrolysis of amides
 - 2. List the general principles that govern reactivity
 - a. Describe the relative reactivity of acid derivatives
 - b. Describe steric effects
- E. Define ethers
 - 1. Explain cleavage by acid
 - 2. Explain the weak basicity of ethers
- F. Define phenols
 - 1. List the general principles that govern phenols
 - a. Describe the effects of substituents on acidity
 - b. Discuss hydrogen bonding

XIV. AMINES

- A. Define amines
 - 1. Describe the stereochemistry and physical properties of amines
- B. List the major reactions of amines
 - 1. Describe amide formation
 - 2. Describe alkylation
- C. List the general principles
 - 1. Describe the basicity of amines
 - 2. Describe the stabilization of adjacent carbonium ions (carbocations)

3. Describe the effect of substituents on basicity of aromatic amines
- D. Define quaternary salts
1. List the solubility properties

XV. HYDROCARBONS

- A. Define saturated hydrocarbons (alkanes)
1. Describe alkanes and list their physical properties
 2. List important reactions
 - a. Describe combustion
 - b. Describe substitution reaction with halogens, etc.
 3. List the general principles that govern hydrocarbons
 - a. Discuss the stability of free radicals
 - b. Describe the chain-reaction mechanism
 - c. Define inhibition
 - d. Describe the ring strain in cyclic compounds
- B. Define unsaturated hydrocarbons (alkenes)
1. Description
 - a. Discuss their structure and isomerization
 - b. List the physical properties of alkenes
 2. Describe electrophilic addition (e.g., HBr, H₂O)
- C. Define aromatic hydrocarbons (benzene)
1. Describe benzene
 2. Describe resonance stability and the delocalization of electrons

XVI. MOLECULAR STRUCTURE OF ORGANIC COMPOUNDS

- A. Describe σ and π bonds
1. Describe hybrid orbitals (sp^3 , sp^2 , sp and respective geometries)
 2. List the structural formulas for molecules involving H, C, N, O, F, S, P, Si, Cl
 3. Describe delocalized electrons and resonance in ions and molecules
 - a. Describe resonance in ions

- b. Describe resonance in molecules
 - B. Describe multiple bonding
 - 1. Describe the effect of multiple bonding on bond length
 - a. Describe the effect on bond energies
 - 2. Describe rigidity in molecular structure
 - C. Describe the stereochemistry of covalently bonded molecules
 - 1. Define isomers
 - a. Describe structural isomers
 - b. Describe stereoisomers (e.g., diastereomers, enantiomers, cis/trans isomers)
 - c. Describe conformational isomers
 - 2. Discuss polarization of light, specific rotation
 - 3. Contrast and compare absolute and relative configuration
 - a. List conventions for writing R and S forms
 - 4. Describe racemic mixtures

XVII. SEPARATIONS AND PURIFICATIONS

- A. Define extraction (distribution of solute between two immiscible solvents)
 - 1. Describe the distribution of solute between two immiscible solvents
- B. Define chromatography
 - 1. Describe gas-liquid chromatography
 - 2. Describe thin-layer chromatography
- C. Define distillation
- D. Define recrystallization
 - 1. Define solvent choice from solubility data

XVIII. USE OF SPECTROSCOPY IN STRUCTURAL IDENTIFICATION

- A. Describe the infrared region
 - 1. Describe intramolecular vibrations
 - a. Describe intramolecular rotations
 - 2. Recognize common characteristic group absorptions

- B. Describe NMR spectroscopy**
 - 1. Describe protons in a magnetic field**
 - a. Define equivalent protons**
 - 2. Describe spin-spin splitting**

III. VERBAL REASONING SECTION

Understanding, evaluation, and application of written (text) information and arguments are tested in this section. The 65 test items are all "One Best Answer" multiple-choice format. Most items have only one *True* statement. The other items have one or more *True* statements.

All items are written the same way as *Problem Sets* in the *Physical* and *Biological Sciences* sections.

Information and arguments are written in about 7-9 passages (500-600 words each) from the humanities, social and natural sciences.

Each passage is followed by a related series of 6-10 test items.

Answers are based only on the information given in a passage, not on any other information you may have.

A. USE EXAM-TAKING TECHNIQUES

Watch your motivation during an exam!

For your best performance, your primary motivation must be *finding your best answer to each test item ...* instead of *getting the whole test over with*.

If your **motivation begins to drift** (especially when you are tired or when you find several items you are not confident about) ...

STOP ... have a short conversation with yourself to refocus your motivation ... and then continue when your motivation returns to finding your best answer.

Your best answer may be based on ...

What you know for sure (no problem here - just mark your answer form), or

What seems to be best (logic, or hunches and gut feelings)s.

Back-up plans for choosing answers (when all else fails)

Make these plans before an exam, and

Apply them consistently throughout the exam

These exam-taking techniques are some of the easiest and best ways to ...

Add extra points to your score

Avoid wasting time (when you have no further information)

Reduce anxiety that may interfere with your thinking

PASSAGE & SET OF RELATED TEST ITEMS

Finding your best answers

Passages

Before looking at the passage

Read and underline important words in the stems (not the alternatives) of all items in the set.

This will help you to identify information you will need to look for when you read the passage.

It is easier to read and understand new information when you know what you are looking for.

Read the passage

Underline information that seems important.

Make a note in the margin when you recognize information that seems relevant to one of the items you "previewed".

Make other notes in the margins that you find helpful if it is not too time-consuming.

Test Items (Only 1 True Statement)

Re-read the stem of each item

Consider each alternative *in order* ...

Underline or circle words that seem important.

Decide whether you think it is *True* or *False*, or you are *Not sure*.

Write your decision beside each alternative

Write *T* if you decide the alternative is ***True***

Write *F* if you decide the alternative is ***False***

Write *?* if you can't decide whether the alternative is
True or False

Mentally set aside that alternative while you consider the next one.

Mark your *Answer Form* before starting the next item.

Be sure you have marked answers for all items related to one passage before starting the next passage and related set of items.

There is no penalty for "guessing".

To get your best score, mark answers for all items (blank responses cannot possibly add to your score).

This also will help you to avoid marking right answers in wrong places on your *Answer Form*.

Examples show only *T, F, ?* decisions, with comments.

(See *Chapt. II, Biological Sciences, Guide* pgs. 46 and 49 for examples using complete test items.)

Example

<i>T</i>	A.	<i>No problem here mark A on answer sheet</i>
<i>F</i>	B.	
<i>?</i>	C.	
<i>F</i>	D.	

Do not spend too much time on a test item when you are uncertain of the answer.

If you rule out 1 to 2 alternatives and are not certain about the others ...

Choose your best guess from the alternatives marked "?".

Your choice might be based on information you have at your subconscious level.

Examples

?	A.	<i>Choose your best guess mark A or C</i>
F	B.	
?	C.	
F	D.	

F	A.	<i>Choose your best guess mark B, C or D</i>
?	B.	
?	C.	
?	D.	

Back-up Plans

If you do not have a *best guess*, use your back-up plan ...

Choose the *first* or the *last* alternative marked "?".

Be consistent throughout the test.

Don't waste time when you have no more information to use.

Examples

T	/	A.	<i>If choose first ? mark A</i>
F		C.	
?		B.	
F		D.	

F		A.	<i>If choose last ? mark D</i>
?		B.	
?		C.	
T	/	D.	

If you cannot rule out any alternatives (and do not have a "best guess"), use your *back-up plan* ...

Choose your *favorite letter* for the test *A or B or C or D*

Example

?	A.	<i>If favorite letter is A mark A</i>
?	B.	<i>If favorite letter is B mark B</i>
?	C.	<i>If favorite letter is C mark C</i>
?	D.	<i>If favorite letter is D mark D</i>

Test Items (1-3 True statements)

Re-read the stem and

Consider each *statement* (I, II, and III) *in order*.

Underline or circle words that seem important.

Decide whether you think it is *True* or *False*, or you are *Not sure*.

Write your decision (*T, F* or *?*) beside each statement.

Mentally set aside that statement while you consider the next one.

Match your pattern of *True* statements with the possible combinations given in the alternatives.

Mark your *Answer Form* for all items in the set before starting the next set.

Example: 1-3 True statements

T I.
T II.
F III.

	A.	I only	
	B.	II only	
T	C.	I and II only	<i>No problem here mark C</i>
	D.	I and III only	

Do not spend too much time on a test item when you are uncertain of the answer.

If you have any **False** statements

Cross out (X) each statement-number (I, II, or III) in the alternatives.

Rule out these alternatives

Example

?	I.		
F	II.	<i>If II is F and</i>	
F	III.	<i>If III is F</i>	
<hr/>			
T	A.	I only	..... and mark A
F	B.	X only	rule out B
F	C.	I and X only	rule out C
F	D.	X and X only	rule out D

If you cannot identify your best answer only on the basis of **False** statements, and

If you have any **True** statements

Circle **T** statements in remaining alternatives (not already ruled out).

Example

T	I.		..... and I is T
?	II.		
F	III.	<i>If III is F</i>	
<hr/>			
A.	II only		
F	B.	X only	rule out B
T	C.	Ⓐ and II only	..... and mark C
F	D.	I and X only	rule out D

If you have no *False* statements ...

Circle T statements

Example

? I.
? II.
T III. *If III is T*

- A. I only
B. II only
C. I and II only
T D. II and **(III)** only mark D
-

Back-up Plans

If you have *False* and/or *True* statements but still cannot identify your best answer ...

Choose your *first ?* or *last ?* consistently throughout the test.

Examples

F I. *If I is F*
? II.
? III.

- F A. ~~X~~only *rule out A*
? B. III only *If choose first ? mark B*
F C. ~~X~~and II only *rule out C*
? D. II, and III only *If choose last ? mark D*
-

? I.
? II.
T III. *If III is T*

- F A. I only
? B. **(III)**only *If choose first ? mark B*
F C. I and II only
? D. II and **(III)**only *If choose last ? mark D*
-

If you have no *False* or *True* statements (and have no other clue)

Choose your *favorite letter (A, B, C, or D)* consistently throughout the test.

Example

? I.

? II.

? III.

? A.	I only	<i>If favorite letter is A mark A</i>
? B.	II only	<i>If favorite letter is B mark B</i>
? C.	I and II only	<i>If favorite letter is C mark C</i>
? D.	I, II, and III only	<i>If favorite letter is D mark D</i>

Reviewing answers to items in *Verbal Reasoning*

If you review an item, do not change your answer unless you ...

Misread or misinterpreted the passage or the item.

Recalled additional information.

(These rules should help you to avoid changing right answers to wrong answers.)

B. TAKE SAMPLE TEST ITEMS

Answer all *Verbal Reasoning* test items (*Manual* pgs. 18-26^o) in a single, timed sitting.

Take items 1-28 in 37 minutes.

Try to simulate the "real" *MCAT* situation.

For example, no notes, no talking, no interruptions, etc.

Score your answers (*Manual* pg. 126) *after* you have finished all items.

^o Any small differences between a page reference given in this *Guide* and the correct page number in your copy of the *Manual* may be due to changes made in the text of the *Manual* between printings.

C. ANALYZE YOUR PERFORMANCE

The skills that may be tested in the *Verbal Reasoning* section include comprehension, evaluation, application, and incorporation of new information (*Manual* pg. 16).

Answers should be based only on information provided in the passages.

Information will not require advanced coursework to understand.

Knowing the meanings of words (terminology) will make understanding easier.

Analyze your performance on the Sample Test in terms of these skills by completing *Worksheet 6* (*Guide* pg. 87).

WORKSHEET 6

Test Items by Verbal Reasoning Skills

Worksheet 6 is based on the *MCAT Verbal Reasoning skills*. In order to use this worksheet you must match the number / letter designations on the worksheet with those skills listed and described in the *Manual* (pg. 15-16).

Columns are labeled with Roman numerals (I-IV) that correspond to the general skills, and letters (A-H) identify more specific skills.

Rows beside test item numbers (1-28) show the same letters of the specific skills for ease in reading the chart.

For **each item** you missed

Circle the letter on the row beside the item number to identify the related skill.

For **each column** in which you have circled one or more skills

Write the total number of items you missed at the bottom of the worksheet to see which skills were most difficult for you.

This will help you to set your own priorities for review - for example, you might begin with the worst skills first.

One column at a time

Read the *Skill* associated with the items you missed in a column (identified by the letters you circled).

Re-read all the *Sample Items* you missed in the column to see how the skill is tested.

WORKSHEET 6
Verbal Reasoning

Test Item No.**	VERBAL REASONING - Skills *																							
	I								II				III				IV							
	A	B	C	D	E	F	G	H	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D
1					E																			
2														C										
3	A																							
4																							C	
5																							E	
6																							G	
7																							F	
8		B																						
9					D																			
10																							G	
11																							C	
12																							A	
13																							G	
14																							C	
15																							A	
16																							C	
17																							F	
18																							A	
19																							A	
20																							D	
21																							A	
22	A																							
23																							C	
24																							D	
25	A																							
26																							D	
27																							A	
28																							E	
Total Items	3	1	2	1	1	1	3	0	1	0	3	3	0	0	4	0	1	0	2	1	1	0	0	0
Items Wrong																								

* For Skills, see *Manual* pg. 16.

** For Test Items, see *Manual* pgs. 18-26.

D. IMPROVE YOUR PERFORMANCE

STRATEGY

The basic strategy for improving your skills is:

Identify the types of skills that you find most troublesome as they are tested on the MCAT.

You have difficulty applying these skills on a timed multiple-choice situation.

Research the more difficult skills.

You will not have time to dwell on all skills.

Practice using the skills

Take advantage of every opportunity to apply skills in your coursework as well as in your review activities.

How you go about improving your performance depends on why you missed test questions.

Preparing for examinations is an individual matter. Consider both *exam-taking techniques* and *Verbal Reasoning skills* for meeting your needs to improve your performance.

EXAM-TAKING TECHNIQUES

Motivation

If your primary motivation drifted from *finding your best answer ...*

Make a conscious effort to maintain your motivation to *find your best answer* on every test item every time you do test items.

Notice when your motivation begins to drift, and

Immediately talk yourself into refocusing your motivation.

One Best Answer format

If you were not consistent or systematic about finding your best answer ...

Review all exam-taking techniques (*Guide* pgs. 77-86, 88).

Pay special attention to the most troublesome format:

Items with only one correct statement

Items with 1 to 3 correct statements

Practice using these techniques as often as possible.

If you did not use back-up plans ...

Practice making your back-up plans before taking any test items.

Mark-up your test booklet.

If you changed right answers to wrong answers ...

Develop a track record of your decisions.

If you change a decision, cross-out *T*, *F*, and *?* instead of erasing your first decision.

Examples

F ~~*T*~~ A. *If A is correct right changed to wrong*
 F B.
 F C.
T ~~*F*~~ D.

F ~~*T*~~ A.
 F B.
 F C.
T ~~*F*~~ D. *If D is correct wrong changed to right*

Count how many times you changed right to wrong and visa versa to see whether or not changing answers works for you.

This should give you confidence to be consistent throughout a test.

If you did not complete all items during the time period ...

Practice applying back-up plans as soon as you have checked your "best guess", logic, etc. and have no other clues to your best answer.

Practice "pushing" yourself on old exams.

If you mismarked your *Answer Form* ...

Be sure to mark answers for all items in one set before starting the next set.

Passages

If you read passages too slowly ...

Review exam-taking techniques and practice using them

Especially: **Read stems of items before the passage.**

Underline important words

Make notes in margins, including where to find information you think will be useful in answering questions.

If you did not understand information in the passage ...

Check terminology.

One of the most frequent reasons for lack of understanding is not knowing the definitions of words used in a passage..

Memorize terminology that is new to you. A major benefit of your previous relevant courses is the increase in your usable terminology.

SKILLS

Identify the types of skills that you find most troublesome as they are tested on the *MCAT*.

If you cannot apply skills on a timed multiple-choice situation ...

Take every self-assessment passage / test item set "for real" to see which skills are most difficult for you to use in a timed-test situation.

Research difficult skills

Read the *Explanation of Verbal Reasoning Sample Questions* (*Manual* pgs. 26-31) for each item you missed.

Talk to other students or faculty if you are not clear about the skills.

Refer yourself to a reading skills counselor if one is available in any of the student services on your campus.

Practice using the skills

Take the *MCAT Practice Test* that accompanies the *Manual*.

Practice on course materials

Push yourself to read your textbooks faster and mark-up the text.

Read study questions, course outlines, etc. before going to lectures or reading textbook assignments.

(This will give you practice in recognizing information that you need to look for in verbal materials.)

Find other practice materials in your campus library or bookstore.

IV. WRITING SAMPLE SECTION

The *Writing Sample* section of the *MCAT* consists of two statements or *prompts*. Each of the *prompts* is followed by a description of three tasks associated with writing an essay (*writing sample*) in response to the *prompt* presented. You will have 30 minutes to complete each essay in a *first draft* form.

A. THE THREE WRITING TASKS

For each *prompt* you will be directed to write a unified essay in which you perform the following tasks:

Task 1. Explain or interpret the *prompt*.

That is, state it in another way. For each explanation and/or interpretation you will need to include: Definitions, cause, effect, reason, example, etc.

Task 2. Describe a point-of-view in which the *prompt* might be contradicted or not applicable.

That is, describe a concrete example of a situation or viewpoint opposite to the one presented in the statement. It may be real or hypothetical.

Task 3. Discuss how to resolve the conflict between the two opposing viewpoints.

That is, describe conditions under which each might be valid.

In order to receive your best score, you must address all three tasks.

The test-makers state that the tasks may be presented in any order. However, we suggest that it will be easier to present them in the sequence described.

The *prompts* are selected from areas of general experience of college students, such as art, business, education, ethics, history, politics, etc. You won't need specific information from these areas in order to write your essay.

There are two sample *prompts* included in the *MCAT Student Manual (Manual)*, and each *prompt* is followed by three sample essays.

For each essay there is a score and an explanation of how that score was determined. Scores on these sample essays range from 1 (low) through 6 (high), so you can see examples of each level of response.

The essays must be written with a pen and the sample essays show corrections, additions, and deletions that other students have made where necessary to improve their essays. No points are taken off for corrections that are consistent with a first draft writing.

Before starting to work on the *practice prompts* in this chapter, carefully read the *Manual* (pgs. 67-88⁷).

This will help you to visualize how you might use some of the techniques in this chapter to write and improve your own essays.

SUMMARY of WRITING TASKS

Remember, your goal is to write a unified essay that is responsive to the *prompt*.

To receive your best score, you must address each of the three writing tasks.

If you leave out one task entirely, your essay probably will not be scored above 1, 2, or 3, no matter how well it is written. Therefore, be sure that you include:

An explanation or interpretation of the *prompt* (Task 1)

When you write an outline for your essay, you must explain the meaning of the *prompt* and discuss its meaning in depth, including a reference to a specific situation.

A description of a contradictory point-of-view (Task 2)

You must then present a circumstance in which you describe a situation to illustrate a point-of-view opposite to the one the author presented in the *prompt*.

The opposing point-of-view may be real or hypothetical, and it may or may not be your own personal point-of-view.

A discussion of at least one way to resolve the conflict (Task 3)

Your conclusion of the essay should include suggestions for the resolution of the two opposing points-of-view:

The point-of view expressed in the *prompt* (which you discussed in *Task 1*), and

The opposing point-of-view you created and discussed in *Task 2*).

⁷ Any small differences between a page reference given in this *Guide* and the correct page number in your copy of the *Manual* may be due to changes made in the *Manual* between printings.

GENERAL METHOD

In order to write an essay that is unified and responsive to the *prompt*, we suggest that you use the following general method.

First, analyze the *prompt*.

You will need to be very clear about the specific situation the authors have created in their *prompt*. This will make it easier for you to write an essay that is appropriate and adequately detailed.

Remember, your essay will be judged, to a large extent, by how responsive it is to the *prompt*.

Second, organize your essay.

Your outline should be closely related to your analysis of the *prompt*. This will help you to construct an essay that is both coherent and responsive.

Third, write your essay.

Follow your outline closely to present a clear organization (unified) of your ideas. The benefit of writing a coherent and unified essay is likely to outweigh the addition of a "brilliant" insight that does not fit very well into the essay as a whole.

Finally, critique and improve your essay.

After you have written your essay, you should review and try to improve it. You will not have time to rewrite your essay, so your changes should be limited to those that you can make by marking-up your original draft. Such changes might include spelling, punctuation, verbs, grammar, etc.

TECHNIQUES for PREPARING a WRITING SAMPLE

You will find specific steps described on the following pages that demonstrate one way to prepare a responsive essay. There is space (*work area*) for you to do each step, followed by a *model* to illustrate one way the step could be completed.

Now follow the steps suggested to analyze the *prompt*, and organize, write and improve your own essay. As you work through the steps:

Read the *directions*

Cover the *model*

Do your work in the *work area*

Then compare your work with the *model*

PRACTICE PROMPT 1

B. HOW TO ANALYZE A PROMPT

Read the *practice prompt* and *directions*

Practice prompt and directions

People who hope for success are happier and accomplish more than those who fear failure.

Alan Lakein

Write a unified essay in which you perform the following tasks:

Explain what you think the *prompt* means.

Describe a situation where fear of failure led to success.

Discuss whether you agree or disagree with the statement, or describe conditions under which each could be valid.

Underline significant words and phrases

Work area

People who hope for success are happier and accomplish more than those who fear failure.

Model

People who hope for success are happier and accomplish more than those who fear failure.

Write an outline based on the underlined words

Work area

Model

People

- hope for success
 - happier
 - accomplish more
 - fear failure
 - not as happy
 - accomplish less
-

C. HOW TO ORGANIZE YOUR ESSAY

Organize your essay into at least three paragraphs. Use descriptive words (*labels*) to plan each part of your essay.

Paragraph 1 for Writing Task 1: Explain or interpret the *prompt*

Suggested labels: Characteristics, definition, description, example, explanation, result, etc.

Paragraph 2 for Writing Task 2: Describe a contradictory point-of-view

Suggested labels: Description, example, result, etc.

Paragraph 3 for Writing Task 3: Discuss how to resolve the conflict

Suggested labels: Contrast, comparison (one is correct or better), example, reason, result, etc.

(To help you organize your essay, you might find it helpful to use the *Writing Sample Worksheet* on pg. 118.)

Complete Outline for Task 1:
Explain or interpret the *prompt*

Write labels next to significant words

Use these labels in the example below:

- characteristics*
- description*
- examples*
- explanation*

Work area

People who hope for success are happier and accomplish more
than those who fear failure.

Model

characteristics *example* *explanation & example*
People / who hope for success / are happier / and

example *description & examples*
accomplish more / than those who fear failure /.

Outline the marked-up prompt

(It may be easier just to add labels to your outline of underlined words and phrases.)

Marked-up prompt

characteristics *example* *explanation & example*
People / who hope for success / are happier / and

example *description & examples*
accomplish more / than those who fear failure /.

Work area

Model

People

- characteristics
 - hope for success
 - example
 - happier
 - explanation
 - example
 - accomplish more
 - example
 - fear failure
 - description
 - example
-

Complete outline for Task 2:

Describe a contradictory point-of-view

Think about your outline for the *prompt* situation (*Task 1*).

Describe an opposite situation or point-view

Draft an outline of a situation or point-of-view where fear of failure lead to success.

Work area

Model

Your specific situation(s) where fear of failure lead to success

- description
 - example(s)
-

Complete outline for Task 3:

Resolve the conflict

Think about your outlines for the *prompt* situation (*Task 1*) and the opposite situation (*Task 2*).

Discuss how to resolve the conflict (Conclusion)

Draft an outline of your ideas about how to resolve the conflict between *hope for success* and *fear of failure* both leading to happiness and accomplishment.

Work area

Models

You agree with the prompt

- reasons
- examples
- results

OR

You disagree with the prompt

- reasons
- examples
- results

OR

You both agree and disagree with the prompt to a certain extent, depending on circumstances

- contrast and compare
 - reasons
 - results

Complete Outline for Essay

Compile the three Task outlines

Write in order the outlines you did for *Tasks 1, 2 and 3*.

Work area _____

Model

People

- characteristics
 - hope for success
 - example
 - happier
 - explanation
 - example
 - accomplish more
 - example
- fear failure
 - description
 - example

Your specific situation(s) where fear of failure lead to success

- description
- example(s)

You agree with the prompt

- reasons
- examples
- results

OR

You disagree with the prompt

- reasons
- examples
- results

OR

You both agree and disagree with the prompt to a certain extent, depending on circumstances

- contrast and compare
 - reasons
 - results

D. WRITE AN ESSAY FOLLOWING YOUR OUTLINE

When you write the essay, think in terms of about one page per paragraph or *task*.

Use separate lined paper (because that is what you will have on the MCAT) to write your essay.

You may use the following sentences to get started if you find it helpful:

"People who hope for success have a very positive outlook on life and the tasks at hand. For instance, ... "

Remember, when you make a statement, don't stop there! Be sure to go on ...

Make sure your idea will be perfectly clear to the reader, and

Convince the reader that your statement has merit!

E. HOW TO IMPROVE YOUR ESSAY

There is no time to *rewrite* your essay during the test. Probably all you will have time to do is check your essay for basic mechanics.

Check your essay for *mechanics*

Grammar, spelling and punctuation

Grammar, spelling and punctuation will affect the rating of your essay as a whole, so if you have time to reread your essay, correct any errors that you find.

You may cross out and make corrections on the essay as you might do in a first-draft of any other composition.

Legibility

While grammar, spelling and punctuation count in your score, neatness does not. However, try to write and make changes as legibly as possible. A barely legible essay probably will not receive as high a score as a comparable essay that is easy to read.

PRACTICE PROMPT 2

B. HOW TO ANALYZE THE PROMPT

Read the practice prompt and directions

Practice prompt and directions

Native ability without education is like a tree without fruit.

Areslippus

Write a unified essay in which you perform the following tasks:

Explain what you think the *prompt* means.

Describe a situation where native ability is sufficient.

Discuss what you think determines whether education or native ability is more important

Underline significant words and phrases

Work area

Native ability without education is like a tree without fruit.

Model

Native ability without education is like a tree without fruit

Write the underlined words in an outline

Work area

Model

Native ability

- without education

Tree

- without fruit

C. HOW TO ORGANIZE YOUR ESSAY

Organize your essay into at least three paragraphs. Use descriptive words (*labels*) to plan each part of your essay.

Paragraph 1 for Writing Task 1: Explain or interpret the *prompt*

Suggested labels: Characteristics, definition, description, example, explanation, result, etc.

Paragraph 2 for Writing Task 2: Describe a contradictory point-of-view

Suggested labels: Description, example, result, etc.

Paragraph 3 for Writing Task 3: Discuss how to resolve the conflict

Suggested labels: Comparison (one is correct or better), example, reason, result, etc.

(To help you organize your essay, you might find it helpful to use the *Writing Sample Worksheet* on pg. 118.)

Complete Outline for Task 1:
Explain or Interpret the prompt

Write labels next to significant words

Use these labels in the example below:

- definition*
- description*
- example*
- explanation*
- result*

Work area

Native ability without education is like a tree without fruit.

Model

descrip'n def'n,explan.,result descrip'n descrip'n,example,result
Native ability / without education / is like a tree / without fruit / .

Outline the marked-up prompt

(It may be easier just to add labels to your outline of underlined words and phrases.)

Marked-up prompt

descrip'n def'n,explan.,result descrip'n descrip'n,example,result
Native ability / without education / is like a tree / without fruit / .

Work area

Model

Native ability

- description
- without education
 - definition
 - explanation
 - result

Tree

- description
- without fruit
 - description
 - example
 - result

Complete outline for Task 2:

Describe a contradictory point-of-view

Think about your outline for the *prompt* situation (Task 1).

Describe an opposite situation or point-view

Draft an outline of a situation or point-of-view where native ability is sufficient.

Work area

Model

Your specific situation(s) where native ability alone is sufficient

- description
 - example(s)
 - result
-

Complete outline for Task 3:

Resolve the conflict

Think about your outlines for the *prompt* situation (*Task 1*) and the opposite situation (*Task 2*)

Discuss how to resolve the conflict (Conclusion)

Draft an outline of your ideas about how to resolve the conflict between *native ability* and *education* and explain the importance of both.

Work area

Model

Discuss what determines the importance of

- education
 - description
 - examples
- native ability
 - description
 - examples

Explain the importance of both

- examples
 - results
-

Complete Outline for Essay

Compile the three Task outlines

Write in order the outlines you did for *Tasks 1, 2 and 3*.

Work area

Model

Native ability

- description
- without education
 - definition
 - explanation
 - result

Tree

- description
- without fruit
 - description
 - example
 - result

Your specific situation(s) where native ability alone is sufficient

- description
- example(s)
- result

Discuss what determines the importance of

- education
 - description
 - examples
- native ability
 - description
 - examples

Explain the importance of both

- examples
 - results
-

During the test you should spend only about 10 minutes on your outline. Practice will help you to increase your speed in completing outlines for each *Writing Task*. Spend most of the remaining 20 minutes on writing your essay.

D. WRITE AN ESSAY FOLLOWING YOUR OUTLINE

Do not plan to spend more than about 20 minutes writing your essay.

You will write faster and better if you follow your outline.

Remember, when you make a statement, don't stop there!

Be sure to go on to explain to the reader exactly what you mean and to convince the reader that your statement has merit!

When you write your essay, think in terms of about one page per paragraph or task.

However, quality is considered more important than length alone.

Use lined paper (because that is what you will use on the *MCAT*) to write your essay.

You may want to ask someone else to critique your essay so that you will know how to improve your writing. (See *F. How to Critique Practice Essays, Guide* pg. 116.)

E. HOW TO IMPROVE YOUR ESSAY

There is no time to rewrite your essay during the test. Probably all you will have time to do is check your essay for basic mechanics.

Plan to spend no more than *10 minutes on your outline* and no more than *20 minutes on writing your essay*.

As your skill improves with practice, you will have a little more time at the end to check your essay for mechanics.

Check your essay for mechanics

Grammar, spelling and punctuation

Grammar, spelling and punctuation will affect the rating of your essay as a whole, so if you have time to reread your essay, correct the errors that you find.

You may cross out and make corrections on the essay as you might do in a first-draft of any other composition.

Legibility

While grammar, spelling and punctuation count in your score, neatness does not. However, try to write and make changes as legibly as possible. A barely legible essay probably will not receive as high a score as a comparable essay that is easy to read.

F. HOW TO CRITIQUE PRACTICE ESSAYS TO IMPROVE YOUR SKILLS

To improve your performance, it is helpful to find out just where you are having your most difficulty so that you can focus on those particular skills.

Read your essay three times, focusing on different aspects of the paper each time

Read once to determine if all three tasks were addressed.

Did you: **explain or interpret the *prompt*?**
 describe a contradictory point-of-view?
 discuss how to resolve the conflict?

Read again

Did you: **have a central theme?**
 make the concepts and ideas interrelate?
 include examples that, in fact, illustrate the points?

Read another time

Did you: **use good grammar?**
 spell all words correctly?
 use proper syntax?
 use appropriate punctuation?

Critique your practice essays

Since it is not always possible to have someone else read your practice essays, you can use the *Writing Sample Checklist* (Guide pg. 119) to analyze your own essays.

In addition, as you analyze your own essays, you also will become more skillful and better prepared to improve your own essays when you actually take the *Writing Sample Section* of the *MCAT*.

Of course, these checklists also can be used by anyone else who will be kind enough to take the time to critique your practice essays for you.

Other ways to improve your own essays

Practice writing essays within 30 minute periods.

If you want to improve your performance by practicing these techniques further, you can use the *Extra Practice Prompts* in this *Guide* (pgs. 121-122).

Critique essays.

If you critique not only your own essay, but also someone else's, you will get a feel for other approaches to a given *prompt*.

Read books on essay writing and rules of grammar.

Refer yourself to a writing skills counselor if one is available on your campus.

WRITING SAMPLE WORKSHEET
Organization of Practice Writing Samples

TASKS	LABELS			
(1) Explain author's meaning	Definition	Cause/Effect	Reason	Example
(2) Discuss opposite point-of-view	Description	Example	Cause/effect	Result
(3) Discuss how to resolve two viewpoints	Contrast/compare	Examples: one is correct/better	Restatement: explanation of each viewpoint	

WRITING SAMPLE CHECKLIST
Analysis of Practice Writing Samples

A. Were all three tasks addressed?

Task 1: Interpreted the statement.

- Defined terms
- Explained meaning of statement
- Gave examples
- Discussed: Cause
- Effect
- Result

Task 2: Gave contradiction to statement.

- Described specific situation
- Gave examples
- Cause
- Effect
- Result

Task 3: Resolved conflict between two points-of-view.

- Contrasted/compared each viewpoint
- Gave examples of each
- Wrote conclusion

B. Read for quality of paper as a whole.

1. Central theme, clarity of concepts, ideas, cohesion, logic, etc.

- Paragraphs have a topic sentence.
- Each statement has supporting examples
 - Examples are appropriate
- Transitions introduce each new idea
- Concluding remarks include something on each point discussed

2. Specific points

- Points made are specific
- Points made are general or vague
- Enough supporting detail to convince the reader about the point

3. Read for grammar and mechanics

a. Grammar

- Sentence fragments
- Run-on sentences
- Subject-verb disagreement
- Incorrect verb tense

b. Mechanics

- Punctuation used, especially commas
- Use of pronouns: agreement and reference
- Misspelled words

EXTRA PRACTICE PROMPTS

You can use these *Practice Prompts* to improve your skills.

Review the techniques (*Guide* pgs. 94-117) frequently.

Your goal is to write a unified essay in response to the *prompt*.

Remember - you must perform all three writing tasks to get your best score:

- Task #1: **Explain what you think the *prompt* means.**
- Task #2: **Describe a specific situation which contradicts the *prompt* situation.**
- Task #3: **Discuss what you think about the *prompt* statement (agree, disagree) and resolve the conflict.**

EXTRA PRACTICE PROMPTS

These extra *prompts* are included to give you an opportunity to continue practicing

how to write essays that are responsive to a *prompt*, and

how to critique and improve the essays that you write.

-
1. If we achieve something of value, it is because we stand on the shoulders of giants who have come before us.

Sir Isaac Newton

-
2. Seek simplicity but distrust it.

Alfred North Whitehead

-
3. Naturally occurring events are much more consistent and predictable than events subject to the vagaries of human individuality.

Alfred North Whitehead

4. Advertising has done more to cause the social unrest of the twentieth century than any other single factor.

Clare Barnes, Jr.

5. The aim of education is the knowledge not of fact, but of values.

Dean William R. Inge

6. Intelligence is proved not by ease of learning but by understanding what we learn.

Joseph Whitney

7. Compromise makes a good umbrella but a poor roof; it is a temporary expedient.

James Russell Lowell

8. Care more for the individual patient than for the special features of the disease.

Sir William Osler

9. Any interference with nature is damnable. Not only nature but also people will suffer.

Anahario (wife of Gray Owl)

10. The impersonal hand of government can never replace the helping hand of a neighbor.

Hubert H. Humphrey

11. The preservation of the rights of private property is the very keystone of the arch upon which all civilized government rests.

Joseph H. Choate

V. PRACTICE TEST

The *MCAT Student Manual* is accompanied by a full *Practice Test*. The ideal situation is to take the *Practice Test* just as it would be administered under testing conditions, that is, in a single, timed sitting beginning around 8:30 in the morning.

A. TAKE PRACTICE TEST

Take the *Practice Test* "for real" to find out what you can do in a testing situation

Try to follow the *MCAT* schedule when you take the *Practice Test*..

SEQUENCE OF MCAT SECTIONS	SCHEDULE
Verbal Reasoning (65 items)	1 hour 25 min. (85 min.)
<i>Break</i>	<i>10 min.</i>
Physical Sciences (77 items)	1 hour 40 min. (100 min.)
<i>Lunch</i>	<i>1 hour</i>
Writing Sample (2 prompts)	1 hour (60 min.)
<i>Break</i>	<i>10 min.</i>
Biological Sciences (77 items)	1 hour 40 min. (100 min.)

If it isn't possible or practical for you to set aside a day for this practice test, then do one section at a time under the same timed conditions.

Try to make the situation as similar to the "real" test as you can.

For example, no notes, no talking, no interruptions, etc. Remember to watch your motivation because you will be using your wrong answers to guide your review activities.

B. ANALYZE YOUR PERFORMANCE

Score your test and analyze your wrong answers to find out what you still need to learn

After you have finished the exam, score and analyze your own test performance. The answer key is in the back of the *Test Booklet*, and *Worksheets* for Physical Sciences, Biological Sciences and Verbal Reasoning are at the end of this chapter.

In case you could not take all the *Practice Test* in the same day, score and analyze your performance after each section.

Use *Worksheets 7-12* to sort out what you know from what you still need to learn.

Go back to the objectives in this *Guide* and work on increasing your information base and improving your skills.

Remember, let your performance on practice tests guide your review.

This is one of the main principles of the *Performance-Guided Review Method*: You only "review" what you do not know, or are not skillful at doing, as determined by your own performance on practice exams.

You cannot review everything! Taking practice tests "for real" is one of the fastest ways to determine how (on what) to spend your precious review time to improve your performance on the *MCAT*.

Time management during an exam

A word about time management during the exam is in order here.

When you open your *test booklet*, check to see how many questions you will need to answer in the section of the test, and then be sure you know exactly how much time is allowed for that section.

Divide the time and the number of questions in half so that you will know how many items you should have completed when you check your progress half-way through the test period. If you need to speed up, you have time to do so. If you are ahead, you can take a little more time if you wish to.

If time is a major problem for you, perhaps you will need to divide the time and items in half again so that you can check your progress more frequently, when you are $1/4$, $1/2$, and $3/4$ through the time allotted. Do not break the time into smaller intervals because you will be distracted from the task at hand, that is, finding your best answer to each item.

Remember, you will find your best answer to *multiple-choice test items* by knowing the information or having the skills required to identify the correct answer, and by using the exam-taking techniques described in this *Guide*.

You will create your best *essay* in response to the prompts by addressing all three tasks to the best of your ability, using techniques also described in this *Guide*.

You are now ready to continue taking more practice exams for guiding your work to increase your knowledge and skills.

While the *MCAT* is only one of a number of things that medical school admissions committees consider, it certainly will be to your advantage to present a good series of scores.

WORKSHEET 7

Physical Sciences - General Chemistry

Test Item No.**	GENERAL CHEMISTRY Objectives*									Page in Guide	Type of Item
	I	II	III	IV	V	VI	VII	VIII	IX		
66	D									22	Research
67						A1				26	
68						B1				27	
69			B1c							24	
70			B1							24	
71						B3				27	
72				A5						24	
73								G1		29	
82						A2b				26	Research
83		A3								23	
84						A2b				26	
85						A5				26	
86		B3								23	
87			B1c							24	
89		A1								23	Independent
91		A3								23	
93		B1								23	
100							A2			27	Problem-solving
101	F									22	
102					A					25	
103					B1					26	
104							A3a			27	
105							A4			27	
106							A5b			27	
114					B1					26	Independent
116		B2								23	

Test Item No.**	GENERAL CHEMISTRY Objectives*									Page in Guide	Type of Item
	I	II	III	IV	V	VI	VII	VIII	IX		
119				C2						25	Information presentation
120				C1						25	
121			B1							24	
122				A2a						24	
123		A1								23	
128	F									22	Information presentation
129				A						25	
130	F									22	
131				C3						25	Research
132				C2						25	
133				C2						25	
139									B2	30	Independent
141	E									22	
Total Items	5	7	4	7	4	6	4	1	1		
No. Wrong											

* For Objectives see *Guide* pgs. 22-30.

** For Test Items see *Practice Test* pgs. 27-42. (Chemistry and physics test items are mixed together in the *Physical Sciences* section of the *Practice Test*.)

WORKSHEET 8

Physical Sciences - Physics

Test Item No.**	PHYSICS Objectives*											Page in Guide	Type of Item
	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX		
74				D								33	Problem-solving
75							B	E				37,38	
76		B										32	
77							A					37	
78				B								33	
79	D											31	
80								E				38	
81								B1				38	
88					A2							34	Independent
90							A2					37	
92					A3							34	
94										C		39	Research
95										D		39	
96										D		39	
97					A2							34	
98											D	40	
99										D		39	
107								A				38	Information presentation
108				D								33	
109										C		40	
110										C		40	
111										C		40	
112										C		40	
113			A									31-2	
115			B2									33	Independent
117					B2							34	

Test Item No.**	PHYSICS Objectives*											Page in Guide	Type of Item
	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX		
118							A4					36	Information presentation
124							B1					36	Problem-solving
125							A3					35	
126		C										32	
127							A6					36	
134				D								33	Problem-solving
135				B								33	
136				B								33	
137	D											31	
138		F										32	
140						E						35	Independent
142						C						34	
Total Items	2	3	2	6	4	2	4	3	4	4	5		
No. Wrong													

* For Objectives see *Guide* pgs. 31-40.

** For Test Items see *Practice Test* pgs. 27-42. (General chemistry and physics test items are mixed together in the *Physical Sciences* section of the *Practice Test*.)

WORKSHEET 9

Physical Sciences - Mathematics

Test Item No.**	MATHEMATICS Objectives*								Page in Guide	
	1	2	3	4	5	6	7	8		
<i>General Chemistry</i>										
66	1c.....									41
82	.....	2a,b.....								41
103	1.....									41
114	1.....									41
133	.....	2d.....								41
141	.....	2d.....								41
<i>Physics</i>										
79	1.....									41
80	1.....	2d,e.....								41
88	.....	2a,d.....								41
97	.....	2a,d.....								41
103	1.....									41
105	1.....									41
110	1b.....									41
112	.....	2a.....								41
113	.....	2a,d.....								41
114	1.....									41
115	.....	2d(2).....								41
117	.....	2d.....								41
125	.....	2a.....								41
126	1c.....									41
127	.....	2d.....								41

Test Item No.**	MATHEMATICS Objectives*								Page in Guide	
	1	2	3	4	5	6	7	8		
<i>Physics, cont'd</i>										
133					5c					42
134			3a,b							41
136		2d								41
140		2d								41
141	1									41
Total Items	11	14	1	0	1	0	0	0		
No. Wrong										

* For Objectives see *Guide* pgs. 41-43.

** For test items see *Practice Test* pgs. 27-42. (Not all chemistry and physics test items involve a mathematics concept.)

WORKSHEET 10
Biological Sciences - *Biology*

Test Item No.**	BIOLOGY Objectives*											Page in Guide	Type of Item
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI		
143							B1					68	Research
144			C3									64	
145				A3								65	
146	A4											62	
147			C4									64	
148			C4									64	
156		B1										63	Information presentation
157	A1											62	
158		B2										63	
159		B2										63	
160		B2a										63	
162							B2					68	Independent
164			C3									64	
166				B2								65	
167		A4										63	Information presentation
168		A4										63	
169	B1c											62	
170	B1											62	
171		A4										63	
172			B1									64	Research
173					C2							66	
174					C2							66	
275									B1b			69	
276					C2							66	
177					C2							66	
178					C2							66	

Test Item No.**	BIOLOGY Objectives*											Page in Guide	Type of Item
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI		
185								B1				68	Research
186								B1				68	
187					C2							66	
188				D1								66	
189			C2									64	
190				D1								66	
191		C2										63	Independent
193										B1b		70	
194										A1		70	
196						A6						67	Information presentation
197	A											62	
198										B1a		70	
199						A6						67	
200								A1				69	
208	B2											62	Research
209									A2			69	
210	B2b											62	
211	B2											62	
212										A5		70	
213										A1		70	
214	B2											62	
215										A5		70	
216	B2											62	Independent
217									B6			70	
218						A2						67	
219									A2			69	
Total Items	10	8	6	4	6	3	2	2	2	3	6		
Items Wrong													

* For Objectives see *Guide* pgs. 62-70. ** For Test Items see *Practice Test* pgs. 51-68. (Biology and organic chemistry test items are mixed together in the *Biological Sciences* section of the test.)

WORKSHEET 11

Biological Sciences - Organic Chemistry

Test Item No.**	ORGANIC CHEMISTRY Objectives*							Page in Guide	Type of Item
	XII	XIII	XIV	XV	XVI	XVII	XVIII		
149	B							71	Research
150	B							71	
151	B							71	
152	B							71	
153	B							71	
154	.....	B						72
155	.....				B			75
161	A1a							71	Independent
163	.....	A1						72
165	.....			A2				74
179			A1				74	Information presentation
180	.....					D		75
181	.....	D1						73
182	.....	C2a						73
183	.....		A1					73
184	.....	C2						73
192						A2	75	Independent
195	.....			B1				74

Test Item No.**	ORGANIC CHEMISTRY Objectives*							Page in Guide	Type of Item
	XII	XIII	XIV	XV	XVI	XVII	XVIII		
201		A1b						72	Information presentation
202			A1					73	
203		E2						73	
204			B1					73	
205				A2b				74	
206			A1					73	
207		A1b						72	
Total Items	6	8	4	4	1	1	1		
Items Wrong									

* For Objectives see *Guide* pgs. 71-76.

** For Test Items see *Practice Test* pgs. 51-68. (Biology and organic chemistry test items are mixed together in the *Biological Sciences* section of the *Practice Test*.)

WORKSHEET 12

Verbal Reasoning

Test Item No.**	VERBAL REASONING - Skills *																																		
	I								II						III						IV														
	A	B	C	D	E	F	G	H	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D											
1	....B																																		
2	.....E																																		
3	.....E																																		
4	.....																				..A														
5	.....D																																		
6	.....													...C																					
7	.....																																..B		
8	.....													...D																					
9	.....																				..A														
10	.....																																...C		
11	.....													..A																					
12	.....													...C																					
13	.....																																	
14	A																																		
15	.....D																																		
16	.....G																																		
17	....B																																		
18	.....																																	
19	.....																																	
20	.....																																	..A	
21	.....													...D																					
22	.....																				..A														
23	.....																																	..A	
24	.....																																	..B	
25	.....E																																		
26	.....																																	
27	.....													...D																					
28	.....																				..A														
29	.....													...C																					
30	.....																																	..B	
31	.....D																																		
32	.....																																	
33	.....E																																		
34	.....E																																		

Test Item No.**	VERBAL REASONING - Skills *																							
	I								II						III						IV			
	A	B	C	D	E	F	G	H	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D
35	.....																A						
36	.....																C						
37	.....B																						
38	.....																D						
39	.....																A						
40	.....																F						
41	.....C																						
42	.....																F						
43	.....																D						
44	.....C																						
45	.....																A						
46	.....																G						
47	.....																E						
48	.....																G						
49	.....E																						
50	.....																C						
51	.....																D						
52	.....																F						
53	.....																A						
54	.....																C						
55	.....																B						
56	.....																F						
57	.....																C						
58	.....																B						
59	.....B																						
60	.....																F						
61	.....																D						
62	.....																B						
63	.....																C						
64	.....																A						
65	.....																C						
Total Items	A	B	C	D	E	F	G	H	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D
	1	4	3	4	6	3	3	0	1	0	5	5	0	2	7	1	5	0	1	3	4	5	1	1
Items Wrong																								

* For Skills, see *Manual* pg. 16.

** For Test Items, see *Practice Test* pgs. 10-24.

