

# NMTCB ITEM WRITERS' GUIDELINES

This guide is to assist item writers in developing test questions (items) of the highest quality that will provide a reliable measure of an examinee's preparedness to practice as a NMTCB certified technologist. The role of the item writer in test development is very important and critical to the success of the examination. These Guidelines will assist item writers in writing technically-sound multiple-choice test items.

## Item-writing Principles

The development of multiple-choice test items follows well-defined steps. First, item writers are assigned a task at a specific taxonomy level (*Comprehension, Application, or Analysis*) from the task list. Each assigned task represents an activity identified by the NMTCB as required in the certification examination. The task and taxonomy level should lead the item writer to select an appropriate topic for the question to be developed.

## Taxonomy Levels

### Comprehension

- most basic level of understanding and remembering;
- recall, recognition, or understanding of facts, specifics, or patterns;
- may involve recognizing information presented in graphic form;
- knowledge of relationships or implications of basic information to other information are not involved;
- Items written at the Comprehension level usually require examinees to restate, recognize, remember, Express, identify, recall or translate important ideas.

### Application

- comprehension as well as the ability to apply knowledge in a specific situation;
- identifying the operations necessary for a problem or context, and performing them;
- recognizing and applying technical principles, ideas, theories, and formulas in a specific context;
- interpreting graphs or images.
- Items written at the Application level usually require examinees to interpret, employ, illustrate, practice, sketch, predict, use or apply information.

### Analysis

- includes comprehension and application as well as analyzing a concept, principle or idea;
- separating a concept, principle, or idea into its component parts or identifying relationships among the parts;
- combining concepts, principles or ideas into a new pattern or structure;
- evaluation of an image or procedure to determine accuracy and/or errors
- reducing complex expressions into simpler or more basic expressions;
- comparing, contrasting, identifying similarities and differences among concepts, principles or ideas.
- Items written at the Analysis level usually require the examinee to compare, contrast, diagram, examine, analyze, construct and relate important concepts.

## Multiple-Choice Questions

NMTCB's examinations consists exclusively of at least 4-option multiple choice items. Each item includes a keyed (correct) response and 3 distractors (incorrect responses).

**Every test item begins with an idea.** Ideas selected for test items should be important in the practice of nuclear medicine technology and should be relevant to the purpose of the test; they should not be trivial bits of knowledge written to stump knowledgeable examinees. Because the purpose of the NMTCB exam is to identify examinees who are prepared to practice, rather than to compare the performances of examinees with each other, the item topics selected for the assigned task should be fundamental, significant, and relevant to the practice of nuclear medicine technology.

Once the question topic is determined, the next step is the construction of the stem. The stem should present examinees with all the information they will need in order to respond to the item. Examinees should not have to sift through the various alternative answers in order to determine the intent of the item, nor through unnecessary information in the stem that is unrelated to the intent of the item; this simply increases the time required to answer the item.

Once the stem has been written, the next step is to design a single keyed (correct) response. The final step, once the stem and keyed response have been developed, is to develop the four incorrect alternative responses (incorrect choices). These alternatives are designed to differentiate between those examinees who are prepared to practice from those who are not. The incorrect responses should not be written to trick examinees, but to discriminate between those examinees who truly know the answer and those who do not. Statements which are true in their own right, but are only peripherally related to the question asked, or choices that would appear attractive to an examinee who does not know the correct answer, make excellent alternative responses.

### **GENERAL GUIDELINES** FOR AUTHORIZING MULTIPLE CHOICE ITEMS

- Make sure the item can be answered without looking at the distractor (answer) options.
- Include as much of the item as possible in the stem. The stem should be long and the distractor options short.
- Avoid superfluous or unnecessary information.
- Avoid overly **complex** items.
- Write options that are *grammatically consistent* and *logically compatible* with the stem;  
list the distractor options in logical or alphabetical order.
- Write distractors that are plausible and the same relative length as the answer.
- Try to avoid using absolutes such as *always*, *never* and *all* in the options; also avoid using vague terms such as *usually* and *frequently*.
- Focus on important concept; Don't waste time testing on trivial facts.
- Avoid "fill in the blank items" – use complete sentences.
- Define eponyms, acronyms, or abbreviations when used.
- Radionuclides can be used in this short form:  $^{99m}\text{Tc}$ ,  $^{111}\text{In}$ ,  $^{67}\text{Ga}$  – we prefer using the superscript
- Avoid using symbols – write out microcurie and millicurie
- Avoid use of trade drug names (or have them in parentheses) – example: **regadenoson (Lexiscan)**



**DON'T TRICK THEM!** Examinees should get an item...  
**Right** - because they know the correct answer  
**Wrong** - because they don't know the correct answer.

## Multiple-choice Item Forms

Regardless of the specific form of a multiple-choice, each item has three main parts:

1. The "**STEM**" - a question or an incomplete statement presented to the examinee first;
2. The incorrect alternative responses to the question - the **incorrect** responses to the stem;
3. The keyed response - the **correct** response to the question.

Diagrammatically, a multiple-choice item can be represented as follows:

1. (STEM): Presentation of question or problem
  - A. incorrect response] --- > (incorrect
  - B. incorrect response] --- > alternative
  - C. incorrect response] --- > responses)
  - \* D. keyed response] (key)

The item stem should convey the question or problem in its entirety. The test of whether this criterion is met is to ask if a knowledgeable examinee could answer the question without looking at the choices. The keyed response must be the most acceptable of the four responses.

Remember: the purpose of incorrect alternatives is not to "trick" examinees but to differentiate the examinees who are prepared to practice from those who are not. The alternatives, "none of the above" or "all of the above" are to be avoided.

**Multiple-choice items can take several different forms.**

The type of multiple choice forms selected for use on the NMTCB Examination are:

**Correct-answer form.** One response is unequivocally correct. Factual information lends itself well to the correct-answer form (keyed responses are designated with an asterisk).

Example:

A patient's pulse should be measured at which anatomical location?

- A. neck
- B. ankle
- \* C. wrist
- D. underarm
- E. temple

**Best-answer form.** The examinee is required to select the best answer from among those presented; the answer, however, may not be the best of all possible answers.

Example:

Which of the following radiopharmaceuticals should be used to evaluate renal function?

- \*A. Tc-99m DTPA
- B. Tc-99m DMSA
- C. Tc-99m MAA
- D. I-131 RISA
- E. I-125 fibrinogen

In this example, the best of all possible answers (based solely on the information available in the stem) generally is conceded to be I-131 orthoiodohippurate, which is not among the alternative responses provided. Note: the qualifier "of the following" is important because it excludes this option from consideration; Tc-99m DTPA thus becomes the best answer. Strictly speaking, if the stem states, "The radiopharmaceutical of choice to evaluate renal function is...", the best answer would not be among the alternatives provided. In a simple item such as this, adding the qualifier may not be critical; nevertheless, neglecting such features can increase the ambiguity of any item, which, in turn, impairs test reliability.

**Negative-approach form.** The examinee is asked to identify the exception among the alternative responses. The examinee must select the INCORRECT or LEAST defensible response from among several correct or more satisfactory ones.

Example:

Which of the following is NOT a computer language?

- A. COBOL
- B. BASIC
- C. FORTRAN
- \* D. FOTAL
- E. PASCAL

The negative aspect should be highlighted or capitalized; e.g., NOT, CANNOT, LEAST, NEVER, and FALSE. The question must be worded very carefully to avoid confusion.

Example:

All the following are likely to be helpful to a person in shock EXCEPT:

- A. giving oxygen
- \* B. applying external heat
- C. placing the person in a dorsal recumbent position
- D. giving reassurance
- E. keeping the person quiet

Because this item form asks the examinee to identify the exception, the item writer must be extremely cautious when developing this type of item to ensure that the item is clear and unambiguous. Avoid using double-negatives (having one negative in the stem and another in the response).

## Sample Items

The following examples may assist you in writing items by demonstrating the strengths of several items.

### Example Item

Intrinsic bar phantom images taken over three days are compared. A significant degradation in spatial resolution is noted and is most likely due to:

- A. incorrect detector orientation.
- B. a change of 4° in room temperature.
- \* C. drift in the high-voltage power supply.
- D. damage to the collimator surface.
- E. improperly mixed emission phantom.

### Comment

The task for this item is to perform spatial resolution checks on a scintillation camera. This is a **good example** of an item written in accordance with the task. This is to be written at a taxonomy level of "application". This item also demonstrates application knowledge of the candidate in detecting an instrument malfunction and identifying the cause of the malfunction is required.

### Example Item

A patient has received therapeutic 32-P colloidal chromic phosphate. The most likely source of radiation hazard to hospital personnel is:

- A. the spread of contamination caused by the patient's respiration.
- B. radiation exposure from handling the patient's urine.
- C. radiation exposure from handling the patient's stool.
- D. radiation exposure from the radionuclide inside the patient.
- \* E. leakage from a puncture wound made during or after administration.

### Comment

This item is **well-written** because:

it has a single focus in the stem;

the stem is a complete question unto itself and could be answered without viewing any of the responses; and

all the incorrect responses have some relevance to the correct response and stem.

### Example Item

A technologist prepared Tc-99m macroaggregated albumin (MAA) by adding only one-tenth of the minimum recommended volume of Tc-99m pertechnetate. What is the most likely result?

- A. hot spots will appear in lung images.
- B. labeled particles will aggregate more rapidly.
- C. the prepared radiopharmaceutical will be a nonhomogeneous suspension.
- \* D. a patient dose will have more than the recommended number of particles to be administered.
- E. the radiopharmaceutical preparation will have particles that exceed the recommended size.

### Comment

This item is a **good** example of an item written at the application taxonomy level. It requires the examinee to have a knowledge of a common radiopharmaceutical preparation and to predict what will occur when the proper preparation procedure is not utilized.

Although discussing radiopharmaceutical preparation, the item is not specific to any individual manufacturer's kit.

### Example Item

A technologist who schedules a 42-year-old woman for a 3-phase bone scan of the foot must first determine if the patient:

- \*A. has the possibility of being pregnant, or is nursing.
- B. is allergic to iodine.
- C. is afraid of radiation.
- D. has a history of seizures.
- E. has had a recent foot X-ray.

### Comment

An **improvement** in the responses could be made:

-by removal of unnecessary words from the first response; and

-the correct response would then not be obviously longer than any other responses.

### Improvement

- \*A. is pregnant.
- B. is allergic to iodine.
- C. is afraid of radiation.
- D. has a history of seizures.
- E. has had a recent radiograph of the foot.

# Item Writers' Checklist

An item for the NMTCB Exam is well-written and appropriate if the:

1. item relates and is classified to a specific content area.
2. item asks a single question.
3. item is clear, complete and well-focused, and concerns a topic that experts in the field would agree is significant.
4. item is direct, concise, and unambiguous.
5. item has a stem includes all necessary, but no extraneous, information.
6. item has at least four responses.
7. stem and responses do not contain confusing double-negatives or logical inconsistencies.
8. responses provide logically appropriate completions of the stem.
9. responses are homogeneous in focus, phrasing and length.
10. responses do not overlap with one another.
11. responses do not clue examinees who are less well prepared as to which response is correct.
12. keyed response is clearly the best of the choices offered as responses to the stem.
13. incorrect responses are plausible but clearly not the best.
14. item does not contain jargon, slang, and nonstandard abbreviations.
15. item does not use information which is instrument-specific or kit-specific.
16. a confirmed and identifiable reference is given, along with the author's name.

*Thank you for supporting the NMTCB exam development process!*

Nuclear Medicine Technology Certification Board  
3558 Habersham @ Northlake, Bldg. I  
Tucker, GA 30084

**p** 404 315 1739 | **f** 404 315 6502 | [www.NMTCB.org](http://www.NMTCB.org)

**“The PREMIER Certification Board for Nuclear Medicine Technologists”**