NBRC
The National Board for Respiratory Care

# Item Writing Guide

# Table of Contents

# Foreword

The NBRC Item Writer's Guide is designed to encourage production of content that will quickly transition to approval by an examination committee. The Guide is intended to apply to any of the following examinations that make use of multiple-choice items:

- **The Therapist Multiple-Choice (TMC) Examination**
- **The Pulmonary Function Technologist (PFT) Examination**
- **The Adult Critical Care Specialty (ACCS) Examination**
- **The Sleep Disorders Specialty (SDS) Examination**
- **The Neonatal/Pediatric Respiratory Care Specialty (NPS) Examination**

Before reviewing specific information about how to write high-quality items, it is important to understand the design underpinning NBRC examinations. Content of each examination is based on results of a national job analysis study, which identified critical tasks performed by therapists, technologists, or specialists. When item content becomes linked to one of these critical tasks, the result is a stimulus that prompts a candidate to respond based on competence. Such competence draws on multiple cognitive resources including learned knowledge. However, competence extends to the application of knowledge and solving problems, the exact details of which a candidate may not have encountered before. Assuming that examination content will be limited to points that are taught in school could lead to surprises about examination content.

The watchword for examination content is that it should be **realistic** in depicting work situations. Writers are encouraged to enhance the realism by including visual content like graphics, screenshots, and even photographs with items. Care must be taken to make it impossible to identify a patient in such circumstances. Such content must be original. In other words, a search of the Internet cannot find the content.

A detailed content outline for an examination is a supplement to this guide. Each outline organizes critical tasks from the job analysis study and shows how each test form will be assembled. Depending on the examination, a specific item must satisfy multiple content criteria (for example, content, cognitive level, patient type), which are summarized within the outline. Hence, a writer who seeks to produce a high-quality item should seek to creatively incorporate all of the content that will tap into the criteria that have been identified for the item.

# Definitions

**Multiple-Choice Item**

An item consists of text and formatting associated with the stem and options that present candidates with a finite number of responses. Selecting the keyed response will add one point to a candidate's score.

**Stem**

The stem of an item is the text (the statement or question) that precedes the options of a multiple-choice item.

**Options**

The options are the responses that a candidate can select.

- Distractors
  - responses that will not be given credit
- Key
  - the response that will be given credit because it is the best within the set

# Item Types

## One Best Response Type

A successful response requires a candidate to find the best choice among the options. Whatever a candidate should consider is described toward the end of the stem. Examples of prompts can include the words like first, most, and highest priority to help a candidate.

**Example:**

The vessel from which a blood sample came must have branched from which of the following to label results of laboratory testing as arterial?

A. coronary sinus
B. pulmonary artery
C. aorta √
D. peripheral capillary bed

Item stems can be presented as direct questions or sentences to be completed by the options.

**Example:**

**Direct Question:**

Which of the following best describes the primary purpose of gas cylinder coding and coloring?

A. Prevent administration of unwanted gas. √
B. Identify the appropriate yoke connection.
C. Indicate whether gases should be humidified during administration.
D. Alert users to structural integrity testing outcomes.

**Sentence Completion:**

The primary purpose of gas cylinder coding and coloring is

A. preventing unwanted gas administration. √
B. identifying the appropriate yoke connection.
C. indicating the need for gas humidification during administration.
D. alerting users to structural integrity testing outcomes.

## Complex Multiple-Choice (CMC)

CMC items consist of a stem followed by four true or false statements called elements preceded by Arabic numerals. Below these elements are the four options containing combinations of the elements. CMC items cover contingencies in which a therapist, technologist, or specialist is expected to move on multiple fronts or require multiple pieces of information. However, CMCs are generally considered less effective than one best response items and should not be used a crutch by a writer who finds it challenging to create distractors.

Each option must contain the same quantity of elements and each element should be presented an equal number of times. This guidance is given because writers tend to present true elements more frequently than false elements.

**Example:**

Before a patient is intubated, a respiratory therapist must verify the function of the

1. endotracheal tube cuff.
2. portable radiography machine.
3. capnometer.
4. suction system.

A. 1 and 3 only
B. 2 and 3 only
C. 1 and 4 only √
D. 2 and 4 only

## Embedded Table

There is an alternative type of item that a writer can produce when the key will include multiple elements. Such items involve a table embedded within the stem. Note that with both the CMC type and the embedded table type of item, the writer declares how many elements are correct with the construction of the options. This is mandated by the requirement that incorrect elements are offered as often as the correct elements. The mandate exists because of the way candidates who guess will approach such an item. Option construction should give no clue as to the correct elements.

**Example:**

Before a patient is intubated, a respiratory therapist must verify the function of the

| | endotracheal tube cuff. | portable radiography machine. | capnometer. | suction system. |
|---|---|---|---|---|
| 1. | yes | no | yes | no |
| 2. | no | yes | yes | no |
| 3. | yes | no | no | yes |
| 4. | no | yes | no | yes |

A. 1
B. 2
C. 3 √
D. 4

**Tip**

The embedded table can be a sophisticated tool because a writer can present more than just "yes" and "no" information. For example, each row could present a set of (1) ventilator settings, (2) drugs and dosages, or (3) physiologic information from a patient.

**Example:**

A 75-kg (165-lb) patient had a cardiac arrest and is admitted to the intensive care unit. The patient is apneic, is receiving 100% O2 by a bag-valve-mask resuscitator, and has a PaO2 of 96 torr. Which of the following are the most appropriate ventilator settings:

| | Mode | $F_IO_2$ | Mandatory rate | $V_T$ | PEEP |
|---|---|---|---|---|---|
| 1. | SIMV | 1.0 | 8 | 350 mL | 3 cm $H_2O$ |
| 2. | SIMV | 0.5 | 10 | 700 mL | 5 cm $H_2O$ |
| 3. | A/C | 1.0 | 12 | 550 mL | 5 cm $H_2O$ |
| 4. | A/C | 0.5 | 6 | 800 mL | 3 cm $H_2O$ |

# Cognitive Levels

A three-level classification system identifies the complexity of cognition required to respond to an item. The three levels are recall, application, and analysis and are a distillation of Bloom's Taxonomy (1965). As you study the examples below, it should become clear that it is possible to test the same task at multiple cognitive levels.

## Recall

Recall items assess whether a candidate can recognize or remember information including specific facts, principles, and procedures. Item keys tend to be correct regardless of the scenario, so a writer should avoid including a lot of text.

**Example:**

A distinctive finding associated with epiglottitis when shown on a lateral neck radiograph is

A. tracheal deviation.
B. vascular hypertrophy.
C. airway narrowing. √
D. tonsilar edema.

## Application

Application items primarily assess a candidate's ability to

- conclude what a set information means.
- classify a cluster of information.
- predict an outcome based on recognition of a relationship.
- calculate a result.
- translate from one system to another.

A moderate amount of detail is expected to be included within an item written to the application level of complexity.

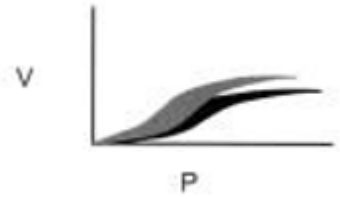
**Example:**

A mother brings a 15-month-old infant to the ED and reports a history of fever and malaise. The child is drooling and sitting upright on the bed. A lateral neck radiograph reveals airway narrowing. The respiratory therapist should expect to treat the child for

A. epiglottitis. √
B. croup.
C. pneumonia.
D. asthma.

**Example:**

A patient is receiving VC ventilation and the following graph is observed:




Black = PEEP 4 cm $H_2O$
Grey = PEEP 8 cm $H_2O$

A respiratory therapist should conclude the PEEP value of 8 cm $H_2O$ is associated with

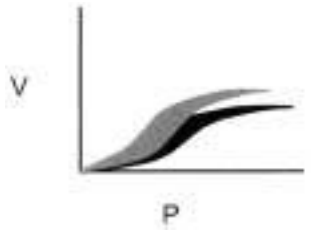
A. increased compliance. √
B. decreased compliance.
C. increased resistance.
D. decreased resistance.

## Analysis

Analysis items assess whether a candidate can (1) synthesize a set of information, (2) conclude what the information means, AND (3) act to solve the problem. Items at this level will ordinarily require candidates to make judgments. Because analysis items include a step in which a candidate reaches a conclusion, writers often make the mistake of omitting the final action step.

**Example:**

An unconscious patient presents to the emergency department and a companion reports a history of depression and repeated suicide attempts by drug overdose. The patient is receiving VC ventilation with 100% $O_2$. A respiratory therapist notes copious pink, frothy secretions have entered the expiratory limb of the circuit. PEEP is changed from 5 to 10 cm $H_2O$ as shown below:




Black = PEEP 5 cm $H_2O$
$SpO_2$ 99%
Grey = PEEP 10 cm $H_2O$
SpO2 99%

Which of the following should the respiratory therapist recommend about the PEEP?

A. Decrease to 5 cm $H_2O$.
B. Remove it from the system.
C. Maintain at 10 cm $H_2O$.
D. Find the optimal level. √

# Recommendations

## The Item as a Whole

1. **Follow the normal rules of grammar and punctuation.**
   - This is critical when linking options to the stem because a grammatical disconnect will reduce the likelihood of selection by candidates.
   - Treat a sentence as a sentence.
2. **Expose items to expert review by asking a trusted colleague to do the following:**
   - Evaluate whether the item belongs on a future examination.
   - Identify extraneous information in the stem.
   - Verify the key.
   - Consider whether the complexity of the item and the complexity classification match.
   - Evaluate distractor plausibility and suggest better distractors when indicated.
3. **Avoid irrelevant sources of difficulty.**
   - Use whole numbers in computational problems so competence with the procedure, rather than complex computational skill, is assessed.
   - Ensure stems only present information relevant to producing a correct response or will lead to an incorrect distractor; assessing candidates' abilities to sift through extraneous information is typically not the goal.
4. **Use an efficient format.**
   - Words repeated among options waste candidates' time.
   - Distraction should come from the options that are incorrect, not by adding facts to a stem that do not connect to the options.
   - Distractor writing presents opportunities to be creative.
5. **Eliminate clues to the key.**
   - Using the same word(s) in the stem and the key
   - Using technical words in the key, but not in the distractors
   - Presenting the key in greater detail and length than the distractors
   - Qualifying the key with weak modifiers (e.g., sometimes, may, usually) while distractors are qualified with absolute words (e.g., always, never)
6. **Avoid violating principles of logic.**
   - Presenting an option that is a subset of another option
   - Creating an unbalanced set of options when repeating elements across options
   - Presenting two options that make the same point although stated differently

## The Stem

1. **Use positive wording in the stem.**

   Stems that direct a candidate to find the **exception** among the options or the option that is **not** correct will be rejected.

2. **Use clear and simple language.**

   Simple words and simple sentence structure is best when describing complex situations.

3. **Present a single, clearly formulated problem.**

   The undertaking set forth in the stem of the item should be so clear that it is understood without reading the options. If an item cannot be fully understood until reading the options, then specifics should be added to the stem.

4. **Avoid items relating to definitions of terms.**

   Instead, use terms (e.g., cyanosis, diaphoresis) to describe a problem so candidates must remember the definition to put the larger picture together.

5. **Put as much of the wording as possible into the stem of the item.**

   Avoid repeating the same words in each of the options.

6. **Include all qualifications needed to choose the right answer.**

   Conditions that are associated with the situation must be stated in the stem. Because options are only possibilities, a writer cannot present new conditions in the options.

## The Options

1. **Make certain the key is correct and clearly the best response.**

   There should be only ONE correct answer and it should be unquestionably the best option among those that are presented.

2. **Formulate the content of distractors to distract candidates who are less able.**

   The finer the distinctions that must be made to select the correct answer from the distractors, the more difficult the item, which is desirable.

3. **Make the distractors attractive to the uninformed.**

   Use the common misconceptions or common candidate errors as distractors. Make the distractors similar to the correct answer in length and detail.

4. **Never use "All of the Above" or "None of the Above" as options.**

   Items with such options will not be accepted.

## Items Concerning Equipment

Because multiple brands of equipment that do the same thing are available and it is likely that a hospital only deploys some of them, the NBRC has developed a policy for items concerning equipment. General descriptions of equipment are preferred. If brand-name equipment must be referred to in an item, be sure the equipment

- is commercially available nationwide,
- has been on the market for at least two years, and
- has been evaluated or described in publicly available professional literature.

# Instructions for Developing Option Explanations

Explanations are required. Once you are satisfied with item content, develop explanations for each option so the examination committee can better understand your thought process and justification for the key. Option explanations consist of two parts.

**Part 1** – Using complete sentences, explain why the key is the best response and then explain why each distractor is not the best.

**Part 2** – Using the following notation, classify each option based on the potential impact on a patient:

**h = harmful** – potentially harmful to the patient
**u = unsatisfactory** – incorrect or unacceptable response
**a = acceptable** – but not the best response
**c = correct** – the best response (key)

# Example 1

1. A patient with severe emphysema should be instructed to do which of the following to encourage effective ventilation?
   A. Inhale slowly.
   B. Exhale slowly. √
   C. Breathe as rapidly as possible.
   D. Breathe as deeply as possible.

Explanations:
(u) A. The primary limitation of airflow occurs during expiration.
(c) B. Slow exhalation reduces the effect of airway collapse and air trapping.
(h) C. A faster respiratory rate increases the work of breathing and patient fatigue.
(u) D. Breathing deeply is an impractical suggestion for patients with severe emphysema.

**Tip**

Take note of how phrases and words are shared between options. Doing so can be a tool when it is a struggle to create options with completely independent content. However, a writer is encouraged to first try to produce options containing independent content.

For items involving calculations, the candidate is referred to the explanation for the key that describes the formula. It can help to describe where the error was made (for example, forgetting to convert from mL to L will produce this result). Incorrect options contained in items that involve mathematical calculations are typically classified as (u) unsatisfactory.

# Example 2

2. The static compliance of a patient who is receiving VC ventilation is being monitored. The tidal volume is 500 mL, the plateau pressure is 25 cm $H_2O$, and the PEEP is 5 cm $H_2O$. What is the static compliance?
   A. 17 mL/ cm $H_2O$
   B. 20 mL/cm $H_2O$
   C. 25 mL/cm $H_2O$ √
   D. 30 mL/cm $H_2O$

Explanations:
(u) A. See C for correct calculation. Adding PEEP to the plateau pressure will produce this result.
(u) B. See C for correct calculation. Forgetting to subtract the PEEP from the plateau pressure will produce this result.
(u) C. The volume change divided by the pressure change yields this value.
(c) D. See C for correct calculation.

**Tip**
Take note that writers are encouraged to anticipate common mistakes that candidates might make when the competency that is being assessed relies on a calculation.

# Quality Improvement

Writers are encouraged to set draft items aside, return to them later with a fresh perspective, and reconsider the content. Like any kind of writing, the quality of item content typically improves with revisions. The following questions may help guide such reviews:

1. Does the item content link strongly to the competency described in the detailed content outline?
   a. Content classifications should be linked to the **keyed** response.
   b. Content domain subheadings and headings add context to a task statement, so ensure this context is represented in the item.
2. Is the complexity of thought required to select the key consistent with the cognitive level classification?
3. Is the stem clearly and concisely presented?
4. Would a trusted colleague agree that the key is the best response among the options?
5. Will candidates find each distractor plausible?
6. If a calculation will be done, can it be done quickly?

# More Examples

| | Comment |
|---|---|
| Which of the following will best facilitate monitoring of carbon dioxide dissolved in blood during mechanical ventilation?<br>A. pulse oximetry<br>B. co-oximetry<br>C. capnography √<br>D. plethysmography | Each option is similar in length and will be judged equally plausible to candidates who guess because the construction of the options has not emphasized any option. |
| A 58-year-old patient who appears to be breathing normally is being evaluated. The following vital signs and arterial blood gas results are obtained while the patient breathes from a nasal cannula at 1 L/min:<br>HR 88<br>RR 12<br>BP 128/88 mmHg<br><br>pH 7.37<br>$PCO_2$ 44 torr<br>$PO_2$ 40 torr<br>$HCO_3$ 22 mEq/L<br>BE 1 mEq/L<br>$SaO_2$ (calc) 74%<br><br>A respiratory therapist should<br>A. administer oxygen therapy at 100%.<br>B. start noninvasive positive pressure ventilation.<br>C. repeat arterial blood sampling and analysis. √<br>D. notify the physician with a stat page. | This item is supposed to measure the analysis cognitive level, so a longer stem is required and options present possible actions a respiratory therapist might take.<br>It is not your job to teach with these items. Let candidates figure out on their own that the blood sample was probably venous. Therefore, the statement just before the option is relatively short. |
| Which of the following describes a normal range for central venous pressure?<br>A. 0 to 6 mm Hg √<br>B. 7 to 12 mm Hg<br>C. 13 to 20 mm Hg<br>D. 21 to 28 mm Hg | It is very important when offering data ranges in options to avoid overlap. Otherwise, more than one option could be correct. Note as well that the size of each range should be similar. |