

Certified Six Sigma Black Belt



Certified



Knowledge  
Get  
**GET**  
Noticed  
Get Certified

C e r t i f i c a t i o n



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## ASQ Certification Programs

Since 1968, when the first ASQ certification exam was given, more than 85,000 individuals have become certified through ASQ, including many who have attained more than one designation. In addition, an increasing number of companies, some 125 at last count, have formally recognized ASQ's certification as verification of an individual's knowledge of quality theory and techniques. A recent search on www.monster.com, an Internet job listings site, resulted in more than 575 job postings calling for an ASQ certification. These statistics demonstrate the increasing value of ASQ certification as perceived in the marketplace.

It's important to understand that ASQ certification is not a license or registration. It is peer recognition that an individual has demonstrated a proficiency in and comprehension of a particular quality area at a specific point in time. ASQ certification is awarded to those who meet three criteria: Candidates must 1) have a specified level of education and/or experience, 2) provide proof of professionalism, and 3) pass a standardized examination in the certification area.

In today's world, where competition is a fact of life and the need for a work force proficient in the principles and practices of quality is a central concern of many companies,

certification is a mark of excellence. It demonstrates that the certified individual has the knowledge to ensure the quality of products and services. Certification is an investment in your career and in the future of your employer.

But for many, the process of becoming certified remains something of a mystery. Frequently questions come up about how the exams are put together, how they are scored, and how best to prepare for taking the test. In this brochure we will attempt to address many of these issues.

ASQ welcomes your interest in becoming certified and hopes that this brochure will aid you in preparing for this important career achievement. Although ASQ membership is not a prerequisite for certification, most of the people who hold one of these designations do belong to the Society. In fact certification ranks as one of the **top benefits** of membership. If you have any questions about becoming a member of ASQ, or if you would like information on any of our other certification programs, call Customer Service at ASQ headquarters, 800-248-1946 (United States, Canada, and Mexico) or 414-272-8575. You can also visit our Web site at [www.asq.org](http://www.asq.org).



# The Exam and the Questions

The ASQ certification exams are not created in an ivory tower or by a computer program that randomly generates questions. Their development relies heavily on the efforts of ASQ members. During the course of any given year, approximately 300 volunteers are involved in some phase of exam development, ranging from developing a body of knowledge (BOK), to writing questions, to ensuring the validity of an exam through a variety of review processes. Volunteers travel to ASQ headquarters in Milwaukee for up to three days at a time. During that period, they are expected to put in long, fast-paced days that may keep them occupied for up to 10 hours at a stretch. These are intense sessions with lots of questioning and interaction. In return the volunteers get to sharpen their skills, network with peers, and come away with the knowledge that they have contributed to the development of the quality field.

The ASQ Certification Board has oversight responsibility for the exams, and the board's top priority is to ensure the integrity of the exam development process. Toward that end, the board has mandated that anyone involved in the development of an exam must refrain from helping others prepare for the test, either formally or informally, for a period of two years.

## The Many Phases of Exam Development

To ensure that ASQ certification retains its status as a hallmark of excellence, the Certification Board uses continuous improvement processes and formally reexamines each certification program on a five-year cycle to ensure continued relevance.

- **Job Analysis and Survey** (*the foundation for the examinations*)

Whether a program is new or has been available for many years, the starting point for the exam development process is with a job analysis. This tool is developed as a survey and is used to identify the skills and knowledge areas currently being used in the field to be tested.

- **Advisory Committee** (*identifies job responsibilities and knowledge of field*)

In order to create an appropriate survey instrument, an advisory committee is appointed by the sponsoring ASQ division. This committee, like all of the subsequent exam development committees, is composed of ASQ members who work in the area to be tested and are already certified. (In the case of brand-new certification exams, ASQ volunteers who are subject matter experts in the field to be tested serve on the committee.) The volunteers for the advisory committee meet for two days, and their primary goals are to identify typical job responsibilities (what people do on the job) and the knowledge required (what people need to know in order to perform their job). The result of this meeting is a questionnaire that asks respondents to rate each item in the survey in terms of criticality ("How important is this task or knowledge?") and frequency ("How often is this task performed or knowledge used?").

- **Member Input** (*who decides what will be in the Body of Knowledge?*)

Once the survey instrument has been approved by the advisory committee, it is sent to a sample of certified or otherwise qualified ASQ members who either work in the area to be tested (as identified by job title) or supervise employees who perform the tasks identified in the survey. Except for the deliberate job-title selection, the 2,000 plus certified ASQ members who receive the survey are randomly selected across geographic locations and industry types to ensure that no one industry or region skews the results of the survey. The data from the survey are then analyzed and a set of recommended tasks and knowledge areas are presented to the sponsoring division, which approves the results. This same report is then submitted to the Certification Board for final approval.

So while the sponsoring division and Certification Board approve the results of the job analysis, it is really the ASQ members who answer the survey who truly determine what should be in the BOK and, ultimately, what material should be covered in the exam itself.

- **The Body of Knowledge (BOK) Committee** (*how does the content get organized in the BOK?*)

After the approval process, a BOK committee is formed. This committee includes some members of the advisory committee and other qualified individuals who have subject matter expertise and represent a wide demographic and industry spectrum. The BOK committee meets for two days, and its primary task is to translate the job analysis results into meaningful categories that can be tested. As part of this process, the committee determines how many questions will be asked in each area of the BOK, based on the importance of the topic (as indicated in the job analysis) and the depth of testable material for each subtopic.

- **Question-Writing Committee** (*how do they write questions?*)

The next step is the actual writing of the exam questions. This task is handled by a group of 25 certified volunteers who attend a two-day question-writing workshop. The volunteers are given extensive training in a variety of exam development issues, including how to avoid writing trick questions and how to develop thought-provoking questions and answers. The processes used in this and other exam-development workshops are driven by internationally recognized standards for the development of assessments.<sup>1</sup> In keeping with those standards, and as a means of ensuring the validity of the exam, each question must be linked to a reference book from the bibliography for that certification. (The bibliography for each exam is listed in the "Reference Materials" section of this brochure.) This "linkage requirement" means that the question-writers must document support for the correct answer, down to the specific page number, in their reference for each question. Once a question-writer or a team has finished writing a complete item, the other members of the team review it for completeness, accuracy, and appropriateness. Only after approval by one or more reviewers at the question-writing session can it be data-entered into the exam bank as a "raw" item.

- **Question Review** (*verification and review*)

The next stage in the exam development process is to convene another panel of 12 subject matter experts who meet for two days to review those raw questions, verify the references and the BOK classification, and, most important, agree that there is one, and only one, correct answer.



## The Many Phases of Exam Development *(continued)*

This additional, intensive process of review, revision, and rework is designed to ensure that all language ambiguities have been eliminated and that the questions have been phrased and presented as clearly as possible. The questions are also reviewed to ensure that they aren't biased in favor of any particular industry. A question can be selected for use in a test only if it has survived these two initial phases of development.

### ■ **Testing the Test** *(the last check before the exam)*

The next phase in the process is the exam review meeting at which another 12 volunteers are asked to participate, first by actually taking the exam and submitting their comments and answers before coming to the meeting. At the meeting, the

group reviews each question for clarity and correctness. By the time an exam makes it through this process, each question on the test has been reviewed and approved by dozens of qualified professionals.

### ■ **Exam Statistics** *(post-exam question verification)*

Despite the best efforts of all of these individuals, there are questions on the test that do not perform well. These problem items are identified through a statistical analysis that is conducted after each administration of a test. Also, comments from examinees and proctors let us know if they think a question is bad: i.e., is confusing, tricky, or has more than one correct answer. These questions are checked again.

<sup>1</sup>*The Standards for Education and Psychology Testing*

## The Grading Process *(how ASQ examinations are graded)*

Just as great care is taken in developing an exam, ASQ goes to great lengths to ensure that the grading process provides an accurate assessment of a candidate's proficiency. ASQ uses procedures that meet the *Standards for Educational and Psychological Testing*, which were developed jointly by the American Educational Research Association (AERA), the American Psychological Association (APA), and the National Council on Measurement in Education (NCME)

### ■ **Cut-Score Process** *(the process to determine the passing score)*

Since the whole point of taking an ASQ certification exam is to pass it, many questions arise about how the passing grade for any given exam is determined and what adjustments are made to ensure that one version of an exam is no harder, or easier, than any other.

The passing grade, or cut point, is established through a cut-score study. The methodology used on ASQ exams is called a Modified Angoff and is based on the work of the late William Angoff, a renowned measurement research statistician in Princeton, NJ.

The cut point for an ASQ exam is established each time a body of knowledge (BOK) is created or revised. For this process, a panel of 12 to 15 subject matter experts, also called judges, is convened. The panel's first task is to set the performance standard for the exam. Through consensus they determine a set of characteristics that they expect of a minimally qualified or "borderline" candidate in relation to the BOK. The distinction regarding borderline candidates is key to understanding the cut-score process, as it ultimately draws a very fine line between candidates who are qualified to be certified and those who are not. The expectations for performance, therefore, need to be clearly stated and agreed to by all of the participants in the study.

Once that list of characteristics is developed, the subject matter experts use it as a guide to help them rate each question on the test in terms of what proportion of 100 such borderline candidates will get the answer right. For example, the judges may agree that borderline candidates will know a particular topic in the BOK very well when asked a definition question, and therefore they may estimate that 85% to 90% will get it right. But the same candidates will be much more challenged in that topic when required to apply a specific formula to get the correct answer (resulting in estimates of 35% to 45% correct).

The results of this two-day cut-score study are then presented to the Certification Board. Along with the written expectation of performance that the panel developed, the summary of the judges' combined estimate of the difficulty

of the exam is presented as the recommended cut point for the exam. Once that raw cut-score point is established by board approval, it is converted to a scaled score (550), which becomes the minimum score necessary to earn certification in that BOK.

### ■ **Scaled Scores** *(how results are reported)*

Although the raw cut-score is established for a specific number of questions correct for the first exam under a BOK, the scaled score is what is reported to the candidates. This scale score allows adjustments for exam difficulty on subsequent forms of the test, while maintaining a scaled score of 550. This is the minimum standard of performance for all ASQ certification exams.

The goal of ensuring that two versions of the same exam have the equivalent degree of difficulty is achieved through a process known as common item equating. Here ASQ selects a set of questions from the previous exam and embeds them in the next exam. This set of questions, called equators, is a kind of mini-exam in that the questions are representative of the previous exam's difficulty level (some easy, some hard, some in the middle) and cover areas of the BOK proportionately. ASQ then develops the rest of the test with different questions, some new and some previously used. This way ASQ can administer almost entirely new tests each time and still maintain the established standard of performance.

For example, on Test 1, the mean score of the candidates is 111; on Test 2, their mean score is 108. All of which could mean either that Test 1 was a lot easier than Test 2, or that the candidates who took Test 1 were significantly better prepared than the candidates who took Test 2. Before making any adjustments to the cut point based on differences in exam difficulty, more information is needed about the two candidate groups. To gather that information, comparisons are made between the performances of the two groups on the common items (equators) in the two tests. If the two groups perform equally well on the equators, then it is safe to conclude that Test 2 is in fact harder than Test 1. Only then is the cut point adjusted to offset the effects of that more difficult exam. Through this method, both tests will fairly assess the candidates' abilities while maintaining a consistent scaled score of 550 to pass.

Candidates shouldn't worry about whether they will get a hard test or an easy test. If they get a hard test, they won't have to get as many questions right to meet the standard. If they get an easy test, they will have to get more of the easy questions right in order to meet the standard.



# Top 10 Myths of Certification

*Myth:* If an answer is obvious it must be a trick question.

**FACT:** Just because an answer is obvious to you doesn't mean it is obvious to everyone. Don't let the fact that this is a test question get in the way of your knowledge. Answer it and move on. Don't read more into the question in an effort to make it harder.

*Myth:* Guessing wrong can hurt your score more than leaving an answer blank.

**FACT:** There is no penalty for guessing, and you have a 25% chance of getting it right. Although some tests use "formula scoring" methods, ASQ certifications do not. You get one point for each question you answer correctly and zero points for those you get wrong or leave blank.

*Myth:* The passing score for all ASQ exams is 70%.

**FACT:** The passing score for each ASQ exam is established as a minimum performance standard during the cut-score process, which is detailed on p. 3.

*Myth:* Taking a section refresher course or buying ASQ exam prep material is a sure way to pass.

**FACT:** Section refresher courses and the self-directed products are excellent ways to prepare for the examinations, but using them does not guarantee that you will pass. Refresher courses are meant to renew your knowledge, not to instruct you in areas that aren't familiar to you. Questions from the self-directed products will assist you in becoming familiar with how to answer certain questions, but they are not the same questions that you will see on the exams. Individual study is also a critical element for success.

*Myth:* If you do poorly on one area of the body of knowledge, you automatically fail the test.

**FACT:** Your total score on the examination determines whether you pass or fail, not your score on any one portion of the test. Even in the certified quality manager's exam it is possible to pass if you do poorly on the constructed response portion, as long as your overall score is at or above the passing grade.

*Myth:* ASQ limits the number of people who pass.

**FACT:** Anyone who meets or exceeds the passing score (cut point) passes the examination. ASQ does not set a passing rate.

*Myth:* The grading of the constructed response portion of the certified quality manager exam is very subjective.

**FACT:** The constructed response portion of the exam is designed to test the candidate's ability to respond to real-world situations. The responses are scored by certified quality managers who have been trained in the evaluation techniques used for the scoring process. In addition, all the scorers judge the papers against a standard of performance that is specific to each essay question. That standard is neither arbitrary nor subjective, but is developed on the basis of sound quality practices, as described and prescribed in major textbooks in the field of quality. The essay questions are pretested on a group of certified quality managers, so the development of the question includes a reality check to make sure that the committee's expectation of performance matches actual responses.

*Myth:* It takes a long time to receive exam results.

**FACT:** ASQ works very hard to provide exam results as quickly as possible and is very aware that the examinees are anxious to learn whether they have passed or failed. As a direct result of bringing the exam development in house, ASQ has recently reduced the exam turnaround time from eight weeks to two weeks, and to three and one-half weeks for the quality manager results.

There are many steps that have to be completed, verified, and checked prior to sending out the results: The answer sheets are sent back to ASQ headquarters and scanned; statistics must be run and reviewed by the test development staff and appropriate volunteers. The results are then scored, verified, and uploaded to a computer before any result letters can be generated. ASQ is continuously working to reduce this cycle time.

*Myth:* Test questions are deliberately tricky.

**FACT:** ASQ goes through an extensive process to ensure that examination questions are as accurate, clear, and concise as possible. (Please see p. 2 of this brochure.)

*Myth:* I can't learn from my mistakes if I don't get my scored test back.

**FACT:** Because of its policy to reuse examination questions, ASQ cannot release copies of the examinations. Releasing tests would give the retake applicants an unfair advantage over candidates taking the examinations for the first time. The integrity of the examination process is of paramount importance to ASQ. Besides, it would not support the underlying premise of the certification program for candidates to just study the questions they got wrong, as it would not ensure that they would understand the material any better. It is more appropriate for the retake candidates to use the diagnostic information to identify the areas where they are weak and improve their knowledge in those areas.

# Study Guide

We should say at the outset that preparing to take an exam is a personal matter and highly dependent on an individual's personal learning methods. For some, a careful reading of the texts in the reference bibliography will be most helpful, while others may find value in purchasing study guides, taking a local ASQ section refresher course, or forming a study group with other quality professionals. All certification candidates are responsible for their own study and preparation for the examination. No specific set of courses or curriculum of study is required as part of the certification process. Likewise, ASQ makes no representation that completion of any specific course or program of study will significantly enhance a person's chance of passing a certification examination.

## T E S T - T A K I N G T I P S

# Test-Taking Tips

Test takers are also advised to keep in mind these general pointers about standardized exams:

- Read all of the questions on the first page of the test so you realize that you do know the material. In other words, *relax*.
- Read each question thoroughly. Don't assume you know what's being asked.
- Eliminate implausible answers and move quickly past the obviously wrong choices.
- Keep in mind that an answer may be a correct statement in itself but may not answer the question. Two answers may say exactly the opposite things or may be very similar. Read them again to decide what makes one correct and the other wrong.
- ASQ does not subtract points for incorrect answers. Answer every question. There is no penalty for guessing, and you have a 25% chance of getting it right.
- Go through and answer the questions you know. Then go through and read the ones you're unsure of. Mark those you are still uncomfortable with. You will narrow the field down to just a few questions you will need to spend more time on. These are the questions you might want to use your reference books for.
- Be aware of the time available for the exam and the remaining time as you work through the exam.
- Do not double-bubble your response for a question. If you do, it will be scored as a "blank." For example, you think that both A and C are correct answers. Bubble in only one answer and use the comment sheet supplied with your test to point out why you think both A and C are correct. Your comments will be reviewed before results are reported.

# Application Process

## Submitting an Application

Complete and submit the application included in this brochure along with supporting documentation for all qualifying work history (resume, job description, Six Sigma Black Belt Affidavit, etc.) and the correct fee to ASQ headquarters. You may also apply online at [www.asq.org](http://www.asq.org).

Applications must be postmarked or faxed on or before the deadline date. Applications postmarked after the deadline date will be scheduled for the next subsequent exam. If you are applying for certification through your ASQ section or company, you are still responsible for submitting the application by the deadline. You will not be allowed to take an examination unless you have paid all fees. ASQ certification is not restricted to ASQ members. Nonmembers may apply by submitting the nonmember fee. To become a member of ASQ, please complete the membership application included in this brochure. You can mail your membership and certification applications together and pay the member rate for certification. Or, you may call and join over the phone using your credit card—800-248-1946 or 414-272-8575. Applicants should indicate their preferred site on the application form. A list of possible sites begins on p. 18. Each examination is conducted on prescribed dates, as listed on the application.

In submitting an application for certification, applicants agree to uphold the security of the examination itself while complying with the ASQ Code of Ethics (see p. 7). This includes complying with the proctor's instructions and not discussing the content of the examination with anyone except the proctor. Problems with the content or administration of the examination should be reported only to the proctor, who is required to

submit a written report. The Code of Ethics, which is binding for all ASQ members and certificate holders, defines the responsibilities and obligations of a quality professional. It is strictly forbidden for either examinees or proctors to make any copies of any questions or answers that appear on an actual examination. If such unauthorized copying is detected, the examinee will be disqualified from the examination and will not be certified by ASQ.

## Exam Sites—Domestic and International

Examination sites are hosted by local ASQ sections and by international organizations (please refer to the section list on p. 18 and the list of international organizations on p. 19). You will be asked to designate a preferred examination site on your application form. If at all possible, ASQ will assign you to your preferred location. If this is not possible, ASQ will assign you to the site nearest your preferred location. You will be notified approximately two weeks before the examination date of your assigned testing location. If for some reason you do not receive a seating letter one week before the exam, please call our Customer Service Center to inquire. International notification will be by e-mail, fax, or mail through local exam proctors in your country.

If you live in a country other than the United States, Canada, or Mexico, please check the list of established international organizations on p. 19. If your country is not listed, please contact ASQ headquarters for details. You may be required to provide your own proctor. Proctors may be from professional societies, government agencies, educational institutions, or employers of the applicants.





## Refund / Reschedule / Retake Policies

- **Refund:** If you are not approved to sit for a particular certification examination, you may obtain a partial refund of the fee if you write or phone the Certification Department at ASQ headquarters. The \$50.00 application fee is not refundable. Once the exam has been held, or you have taken the examination, no refunds will be granted.
- **Absence:** Notification of reschedule or cancellation must be postmarked, faxed, telephoned, or e-mailed six business days prior to the exam or you will forfeit all fees and need to reapply.
- **Reschedule:** You are allowed to reschedule once within a one-year period. If you do not take the exam during that one-year period, you will forfeit all fees and must reapply.
- **Retake:** There is no limit to the number of times you may retake an examination; however, you will be charged a fee each time. You must retake the examination within two years of your last attempt. If you do not retake within this period, you will have to submit a new application with full fees.

## What Can and Cannot be Brought into the Exam Site

### What You Can Bring into the Exam Site:

- PICTURE IDENTIFICATION IS REQUIRED FOR ADMITTANCE. Your seating letter is only exam site and proctor contact information.
- You will need at least two soft-lead (no. 2) pencils with erasers.
- The multiple-choice portion of the exam is an open-book examination and personally generated materials/notes from training or refresher courses are allowed with the following conditions:
  - Each examinee must make his/her reference materials available to the proctor for review.
  - Calculator Policy: With the introduction of palmtop computers and the increasing sophistication of scientific calculators, ASQ has become increasingly aware of the need to limit the types of calculators that are permitted for use during examinations. Any silent, hand-held, battery-operated calculator **without** an alphabetic keyboard will be permitted. All programmable memory must be cleared before you enter the exam room. If you bring an alphabetic keyboard calculator into the exam room, it will be confiscated by the proctor, and returned after the exam. It is the obligation of ASQ to ensure that everyone is treated equitably. The examination is written so that a simple calculator will be sufficient to perform all calculations.
  - The proctor for the exam site will make the final determination of appropriateness of any electronic device.

### What You Cannot Bring into the Exam Site:

- No laptops, palmtop computers, cell phones, headphones, or pagers are allowed.
- You may not share reference materials or calculators.
- Absolutely no collections of questions and answers or weekly refresher course quizzes are permitted. Reference sources that contain such copy are not allowed unless the questions are removed or obscured. Examples of such sources include, but are not limited to, refresher and preparatory primers.

## Exam Results

Examination results for pilot exams and exams with updated BOKs are mailed within six weeks. Otherwise, examination results are mailed about two weeks (three and a half weeks for quality manager results) after the examination date (delays may occur with international mail). We recognize that prompt notification of examination results is important and we will make every effort to provide results as soon as possible. Results will not be given over the telephone. Information about certification is never divulged to third parties except at the written request of the person who took the examination. Your examination results are kept in strict confidence.

## Exam Result Notification

If you pass the examination you will receive a letter of congratulations from the Certification Board, a wallet card and certificate showing your certificate number. Your name will be published in *The Quality Advocate* and your local ASQ section will be notified. If you are certified as a Quality Manager, CQE, CQA, CSQE, Six Sigma Black Belt, or CRE, you must participate in the Maintenance of Certification program to keep your certification current. The recertification journal provided with your certificate gives complete details.

ASQ certification is not a license. It is peer recognition of proficiency within the prescribed body of knowledge. In order to avoid misunderstanding, the Certification Board requires that certified persons always refer to ASQ in citing their certification, e.g., "ASQ Certified Six Sigma Black Belt."

ASQ may withdraw formal recognition and any current ASQ certification for falsification of credentials and/or unethical behavior. Such action may be taken by the Certification Board or, in the case of an ethics action, by the ASQ board of directors or its designee. In such cases, due process will be afforded to the individual against whom the action is directed. A copy of the ASQ Code of Ethics is supplied to all certified persons. By applying for certification, you pledge to uphold this code.

If you don't pass the examination you will receive an analysis of the exam to assist you in further studies.



# ASQ Code of Ethics

*To uphold and advance the honor and dignity of the profession, and in keeping with high standards of ethical conduct, I acknowledge that I:*

## **Fundamental Principles**

- I. Will be honest and impartial; will serve with devotion my employer, my clients, and the public.
- II. Will strive to increase the competence and prestige of the profession.
- III. Will use my knowledge and skill for the advancement of human welfare and in promoting the safety and reliability of products for public use.
- IV. Will earnestly endeavor to aid the work of the Society.

## **Relations With the Public**

- 1.1 Will do whatever I can to promote the reliability and safety of all products that come within my jurisdiction.
- 1.2 Will endeavor to extend public knowledge of the work of the Society and its members that relates to the public welfare.
- 1.3 Will be dignified and modest in explaining my work and merit.
- 1.4 Will preface any public statements that I may issue by clearly indicating on whose behalf they are made.

## **Relations With Employers and Clients**

- 2.1 Will act in professional matters as a faithful agent or trustee for each employer or client.
- 2.2 Will inform each client or employer of any business connections, interests, or affiliations that might influence my judgment or impair the equitable character of my services.
- 2.3 Will indicate to my employer or client the adverse consequences to be expected if my professional judgment is overruled.
- 2.4 Will not disclose information concerning the business affairs or technical processes of any present or former employer or client without his or her consent.
- 2.5 Will not accept compensation from more than one party for the same service without the consent of all parties. If employed, I will engage in supplementary employment of consulting practice only with the consent of my employer.

## **Relations With Peers**

- 3.1 Will take care that credit for the work of others is given to those to whom it is due.
- 3.2 Will endeavor to aid the professional development and advancement of those in my employ or under my supervision.
- 3.3 Will not compete unfairly with others; will extend my friendship and confidence to all associates and those with whom I have business relations.





# Certified Six Sigma Black Belt Information

## Certified Six Sigma Black Belt Certification Requirements:

### *The application as a Six Sigma Black Belt...*

...requires two completed Six Sigma projects documented by signed affidavits or one project, with a signed affidavit and three years of work experience, as it pertains to the BOK. No education waiver is given.

### **Proof of Professionalism**

Proof of professionalism may be demonstrated in one of three ways:

1. Membership in ASQ, an international affiliate society of ASQ, or another society that is a member of the American Association of Engineering Societies or the Accreditation Board for Engineering and Technology

2. Registration as a Professional Engineer
3. The signatures of two persons—ASQ members, members of an international affiliate society, or members of another recognized professional society—verifying that you are a qualified practitioner of the quality sciences

### **Examination**

Each certification candidate is required to pass a written examination that consists of multiple-choice questions measuring comprehension of the BOK examination. The Six Sigma Black Belt certification examination is a four-hour, 150 multiple-choice question examination. It is offered in the English language only.

## Minimum Expectations for a Certified Six Sigma Black Belt (CSSBB)

Will be able to explain Six Sigma philosophies and principles, including supporting systems and tools, (quality, process/continuous improvement, etc.) and will be able to apply them in various business processes throughout the organization.

Will be able to demonstrate and be a driver for various leadership roles and responsibilities, organizational dynamics, customer expectations and satisfaction.

Will have a fundamental understanding of the components and techniques used in project management, including planning, deploying, monitoring, etc. Will be able to demonstrate team leadership, understand team dynamics, assign team member roles and responsibilities, and be a driver of change agent methodologies and various communication tools such as negotiation, motivation, conflict resolution, etc.

Will have a thorough understanding of and will be able to use all aspects of the Define, Measure, Analyze, Improve, and Control (DMAIC) model in accordance with Six Sigma principles (and as detailed in the subtext of the body of knowledge).

Will have basic knowledge of lean enterprise concepts, will be able to identify non-value-added elements and activities, and will be able to use specific tools.

Will be able to use and analyze quality function deployment (QFD) techniques, failure mode and effects analysis (FMEA), and basic robust design processes, including noise strategies, tolerance design, and process capability tools. Will have a basic understanding of design for X (DFX) and special design tools.

# Body of Knowledge



The topics in this BOK include additional detail in the form of subtext explanations and the cognitive level at which the questions will be written. This information will provide useful guidance for both the Examination Development Committee and the candidates preparing to take the exam. The subtext is not intended to limit the subject matter or be all-inclusive of what might be covered in an exam. It is meant to clarify the type of content to be included in the exam. The descriptor in parentheses at the end of each entry refers to the maximum cognitive level at which the topic will be tested. A more complete description of each cognitive level is provided at the end of this document.

## I. Enterprisewide Deployment (9 questions)

### A. Enterprise View

1. *Value of six sigma*  
Understand the organizational value of six sigma and its philosophy, goals, and definition. (Comprehension)
2. *Business systems and processes*  
Understand and distinguish interrelationships between business systems and processes. (Comprehension)
3. *Process inputs, outputs, and feedback*  
Describe how process inputs, outputs, and feedback of the system impact the enterprise system as a whole. (Comprehension)

### B. Leadership

1. *Enterprise leadership*  
Understand leadership roles in the deployment of six sigma (e.g., resources, organizational structure). (Comprehension)
2. *Six sigma roles and responsibilities*  
Understand the roles/responsibilities of black belt, master black belt, green belt, champion, executive, and process owners. (Comprehension)

### C. Organizational Goals and Objectives

Understand key drivers for business; understand key metrics/scorecards

1. *Linking projects to organizational goals*  
Describe the project selection process including knowing when to use six sigma improvement methodology (DMAIC) as opposed to other problem-solving tools, and confirm link back to organizational goals. (Comprehension)
2. *Risk analysis*  
Describe the purpose and benefit of strategic risk analysis (e.g., strengths, weaknesses, opportunities, threats (SWOT), scenario planning), including the risk of optimizing elements in a project or process resulting in suboptimizing the whole. (Comprehension)
3. *Closed-loop assessment/knowledge management*  
Document the objectives achieved and manage the lessons learned to identify additional opportunities. (Comprehension)

### D. History of Organizational

#### Improvement/Foundations of Six Sigma

Understand origin of continuous improvement tools used in six sigma (e.g., Deming, Juran, Shewhart, Ishikawa, Taguchi). (Comprehension)

## II. Business Process Management (9 questions)

### A. Process vs. Functional View

1. *Process elements*  
Understand process components and boundaries. (Analysis)

### 2. Owners and stakeholders

Identify process owners, internal and external customers, and other stakeholders. (Analysis)

### 3. Project management and benefits

Understand the difference between managing projects and maximizing their benefits to the business. (Analysis)

### 4. Project measures

Establish key performance metrics and appropriate project documentation. (Analysis)

## B. Voice of the Customer

### 1. Identify customer

Segment customers as applicable to a particular project; list specific customers impacted by project within each segment; show how a project impacts internal and external customers; recognize the financial impact of customer loyalty. (Analysis)

### 2. Collect customer data

Use various methods to collect customer feedback (surveys, focus groups, interviews, observation, etc.) and understand the strengths and weaknesses of each approach; recognize the key elements that make surveys, interviews, and other feedback tools effective; review questions for integrity (bias, vagueness, etc.). (Application)

### 3. Analyze customer data

Use graphical, statistical, and qualitative tools to understand customer feedback. (Analysis)

### 4. Determine critical customer requirements

Translate customer feedback into strategic project focus areas using quality function deployment (QFD) or similar tools, and establish key project metrics that relate to the voice of the customer and yield process insights. (Analysis)  
[NOTE: The analysis of QFD matrices is covered in section X. A.]

## C. Business Results

### 1. Process performance metrics

Calculate DPU, RTY, and DPMO sigma levels; understand how metrics propagate upward and allocate downward; compare and contrast capability, complexity, and control; manage the use of sigma performance measures (e.g., PPM, DPMO, DPU, RTY, COPQ) to drive enterprise decisions. (Analysis)

### 2. Benchmarking

Understand the importance of benchmarking. (Knowledge)

### 3. Financial benefits

Understand and present financial measures and other benefits (soft and hard) of a project; understand and use basic financial models (e.g., NPV, ROI); describe, apply, evaluate, and interpret cost of quality concepts, including quality cost categories, data collection, reporting, etc. (Application)



## ASQ Six Sigma Black Belt BOK (continued)

### III. Project Management (15 questions)

#### A. Project Charter and Plan

1. *Charter/plan elements*  
Compare, select, and explain elements of a project's charter and plan. (Analysis)
2. *Planning tools*  
Plan the project using tools such as Gantt chart, PERT chart, planning trees, etc. (Application)
3. *Project documentation*  
Create data-driven and fact-driven project documentation using spreadsheets, storyboards, phased reviews, management reviews, presentations to the executive team, etc. (Synthesis)
4. *Charter negotiation*  
Create and negotiate the charter, including objectives, scope, boundaries, resources, project transition, and project closure. (Analysis)

#### B. Team Leadership

1. *Initiating teams*  
Know the elements of launching a team and why they are important: clear purpose, goals, commitment, ground rules, roles and responsibilities of team members, schedules, support from management, and team empowerment. (Application)
2. *Selecting team members*  
Select team members who have appropriate skills sets (e.g., self-facilitation, technical/subject-matter expertise), and create teams with appropriate numbers of members and representation. (Application)
3. *Team stages*  
Facilitate the stages of team evolution, including forming, storming, norming, performing, adjourning, and recognition. (Application)

#### C. Team Dynamics and Performance

1. *Team-building techniques*  
Recognize and apply the basic steps in team building: goals, roles and responsibilities, introductions, and both stated and hidden agendas. (Synthesis)
2. *Team facilitation techniques*  
Apply coaching, mentoring, and facilitation techniques to guide a team and overcome problems such as overbearing, dominant, or reluctant participants; the unquestioned acceptance of opinions as facts; group-think; feuding; floundering; the rush to accomplishment; attribution; discounts and plops; digressions and tangents; etc. (Application)
3. *Team performance evaluation*  
Measure team progress in relation to goals, objectives, and metrics that support team success. (Analysis)
4. *Team tools*  
Define, select, and apply team tools such as nominal group technique, force-field analysis, multivoting, and conversion/diversion. (Application)

#### D. Change Agent

1. *Managing change*  
Understand and apply techniques for facilitating or managing organizational change through change agent methodologies. (Application)

2. *Organizational roadblocks*  
Understand the inherent structures of an organization (e.g., its cultures and constructs) that present basic barriers to improvement; select and apply techniques to overcome them. (Application)
3. *Negotiation and conflict resolution techniques*  
Define, select, and apply tools such as consensus techniques, brainstorming, effort/impact, multivoting, interest-based bargaining to help conflicting parties (e.g., departments, groups, leaders, staff) recognize common goals and how to work together to achieve them. (Application)
4. *Motivation techniques*  
Define, select, and apply techniques that support and sustain team member participation and commitment. (Application)
5. *Communication*  
Use effective and appropriate communication techniques for different situations to overcome organizational barriers to success. (Application)

#### E. Management and planning tools

- Define, select, and use: 1) affinity diagrams; 2) interrelationship digraphs; 3) tree diagrams; 4) prioritization matrices; 5) matrix diagrams; 6) process decision program charts (PDPC); and 7) activity network diagrams. (Application)

### IV. Six Sigma Improvement Methodology and Tools – Define (9 questions)

#### A. Project Scope

Determine project definition/scope using Pareto charts, top-level process (macro) maps, etc. (Synthesis)

#### B. Metrics

Establish primary and consequential metrics (quality, cycle time, cost). (Analysis)

#### C. Problem Statement

Develop problem statement, including baseline and improvement goals. (Synthesis)

### V. Six Sigma Improvement Methodology and Tools – Measure (30 questions)

#### A. Process Analysis and Documentation

1. *Tools*  
Develop and review process maps, written procedures, work instructions, flowcharts, etc. (Analysis)
2. *Process inputs and outputs*  
Identify process input variables and process output variables, and document their relationships through cause-and-effect diagrams, relational matrices, etc. (Evaluation)

#### B. Probability and Statistics

1. *Drawing valid statistical conclusions*  
Distinguish between enumerative (descriptive) and analytical (inferential) studies, and distinguish between a population parameter and a sample statistic. (Evaluation)
2. *Central limit theorem and sampling distribution of the mean*  
Define the central limit theorem and understand its significance in the application of inferential statistics for confidence intervals, control charts, etc. (Application)



3. *Basic probability concepts*  
Describe and apply concepts such as independence, mutually exclusive, multiplication rules, complementary probability, joint occurrence of events, etc. (Application)

**C. Collecting and Summarizing Data**

1. *Types of data*  
Identify, define, classify, and compare continuous (variables) and discrete (attributes) data, and recognize opportunities to convert attributes data to variables measures. (Evaluation)
2. *Measurement scales*  
Define and apply nominal, ordinal, interval, and ratio measurement scales. (Application)
3. *Methods for collecting data*  
Define and apply methods for collecting data such as check sheets, coding data, automatic gauging, etc. (Evaluation)
4. *Techniques for assuring data accuracy and integrity*  
Define and apply techniques for assuring data accuracy and integrity such as random sampling, stratified sampling, sample homogeneity, etc. (Evaluation)
5. *Descriptive statistics*  
Define, compute, and interpret measures of dispersion and central tendency, and construct and interpret frequency distributions and cumulative frequency distributions. (Evaluation)  
[NOTE: Measures of the geometric and harmonic mean will not be tested.]
6. *Graphical methods*  
Depict relationships by constructing, applying, and interpreting diagrams and charts such as stem-and-leaf plots, box-and-whisker plots, run charts, scatter diagrams, etc., and depict distributions by constructing, applying, and interpreting diagrams such as histograms, normal probability plots, Weibull plots, etc. (Evaluation)

**D. Properties and Applications of Probability Distributions**

1. *Distributions commonly used by black belts*  
Describe and apply binomial, Poisson, normal, chi-square, Student's t, and F distributions. (Evaluation)
2. *Other distributions*  
Recognize when to use hypergeometric, bivariate, exponential, lognormal, and Weibull distributions. (Application)

**E. Measurement Systems**

1. *Measurement methods*  
Describe and review measurement methods such as attribute screens, gauge blocks, calipers, micrometers, optical comparators, tensile strength, titration, etc. (Comprehension)
2. *Measurement system analysis*  
Calculate, analyze, and interpret measurement system capability using repeatability and reproducibility, measurement correlation, bias, linearity, percent agreement, precision/tolerance (P/T), precision/total variation (P/TV), and use both ANOVA and control chart methods for nondestructive, destructive, and attribute systems. (Evaluation)

3. *Metrology*  
Understand traceability to calibration standards, measurement error, calibration systems, control and integrity of standards and measurement devices (Comprehension)

**F. Analyzing Process Capability**

1. *Designing and conducting process capability studies*  
Identify, describe, and apply the elements of designing and conducting process capability studies, including identifying characteristics, identifying specifications/tolerances, developing sampling plans, and verifying stability and normality (Evaluation)
2. *Calculating process performance vs. specification*  
Distinguish between natural process limits and specification limits, and calculate process performance metrics such as percent defective (Evaluation)
3. *Process capability indices*  
Define, select, and calculate  $C_p$ ,  $C_{pk}$ , and assess process capability (Evaluation)
4. *Process performance indices*  
Define, select, and calculate  $P_p$ ,  $P_{pk}$ ,  $C_{pm}$ , and assess process performance (Evaluation)
5. *Short-term vs. long-term capability*  
Understand the assumptions and conventions appropriate when only short-term data are collected and when only attributes data are available; understand the changes in relationships that occur when long-term data are used; interpret relationships between long-term and short-term capability as it relates to technology and/or control problems. (Evaluation)
6. *Non-normal data transformations (process capability for non-normal data)*  
Understand the cause of non-normal data and determine when it is appropriate to transform. (Application)
7. *Process capability for attributes data*  
Compute sigma level and understand its relationship to  $P_{pk}$  (Application)

**VI. Six Sigma Improvement Methodology and Tools—Analyze (23 questions)**

**A. Exploratory Data Analysis**

1. *Multi-vari studies*  
Use multi-vari studies to interpret the difference between positional, cyclical, and temporal variation; design sampling plans to investigate the largest sources of variation; create and interpret multi-vari charts. (Application)
2. *Measuring and modeling relationships between variables*
  - a. *Simple and multiple least-squares linear regression*  
Calculate the regression equation; apply and interpret hypothesis tests for regression statistics; use the regression model for estimation and prediction, and analyze the uncertainty in the estimate. (Models that have nonlinear parameters will not be tested.) (Evaluation)





## ASQ Six Sigma Black Belt BOK (continued)

- b. *Simple linear correlation*  
Calculate and interpret the correlation coefficient and its confidence interval; apply and interpret a hypothesis test for the correlation coefficient; understand the difference between correlation and causation. (Serial correlation will not be tested.) (Evaluation)
- c. *Diagnostics*  
Analyze residuals of the model. (Analysis)

### B. Hypothesis Testing

1. *Fundamental concepts of hypothesis testing*
  - a. *Statistical vs. practical significance*  
Define, compare, and contrast statistical and practical significance. (Evaluation)
  - b. *Significance level, power, type I and type II errors*  
Apply and interpret the significance level, power, type I and type II errors of statistical tests. (Evaluation)
  - c. *Sample size*  
Understand how to calculate sample size for any given hypothesis test. (Application)
2. *Point and interval estimation*  
Define and interpret the efficiency and bias of estimators; compute, interpret, and draw conclusions from statistics such as standard error, tolerance intervals, and confidence intervals; understand the distinction between confidence intervals and prediction intervals. (Analysis)
3. *Tests for means, variances, and proportions*  
Apply hypothesis tests for means, variances, and proportions, and interpret the results. (Evaluation)
4. *Paired-comparison tests*  
Define, determine applicability, and apply paired-comparison parametric hypothesis tests, and interpret the results. (Evaluation)
5. *Goodness-of-fit tests*  
Define, determine applicability, and apply chi-square tests and interpret the results. (Evaluation)
6. *Analysis of variance (ANOVA)*  
Define, determine applicability, and apply ANOVAs and interpret the results. (Evaluation)
7. *Contingency tables*  
Define, determine applicability, and construct a contingency table and use it to determine statistical significance. (Evaluation)
8. *Nonparametric tests*  
Define, determine applicability, and construct various nonparametric tests including Mood's Median, Levene's test, Kruskal-Wallis, Mann-Whitney, etc. (Analysis)

### VII. Six Sigma Improvement Methodology and Tools—Improve (22 questions)

#### A. Design of Experiments (DOE)

1. *Terminology*  
Define independent and dependent variables, factors and levels, response, treatment, error, and replication (Comprehension)
2. *Planning and organizing experiments*  
Describe and apply the basic elements of experiment planning and organizing, including determining the experiment objective; selecting factors, responses, and measurement methods; choosing the appropriate design, etc. (Evaluation)

3. *Design principles*  
Define and apply the principles of power and sample size, balance, replication, order, efficiency, randomization and blocking, interaction, and confounding. (Application)
4. *Design and analysis of one-factor experiments*  
Construct these experiments such as completely randomized, randomized block, and Latin square designs, and apply computational and graphical methods to analyze and evaluate the significance of results. (Evaluation)
5. *Design and analysis of full-factorial experiments*  
Construct these experiments and apply computational and graphical methods to analyze and evaluate the significance of results. (Evaluation)
6. *Design and analysis of two-level fractional factorial experiments*  
Construct experiments (including Taguchi designs) and apply computational and graphical methods to analyze and evaluate the significance of results; understand limitations of fractional factorials due to confounding. (Evaluation)
7. *Taguchi robustness concepts*  
Apply Taguchi robustness concepts and techniques such as signal-to-noise ratio, controllable and noise factors, and robustness to external sources of variability. (Analysis)
8. *Mixture experiments*  
Construct these experiments and apply computational and graphical methods to analyze and evaluate the significance of results. (Analysis)

#### B. Response Surface Methodology

1. *Steepest ascent/descent experiments*  
Construct these experiments and apply computational and graphical methods to analyze the significance of results. (Analysis)
2. *Higher-order experiments*  
Construct experiments such as CCD, Box-Behnken, etc., and apply computational and graphical methods to analyze the significance of results. (Analysis)

#### C. Evolutionary Operations (EVOP)

- Understand the application and strategy of EVOP. (Comprehension)

### VIII. Six Sigma Improvement Methodology and Tools—Control (15 questions)

#### A. Statistical Process Control (SPC)

1. *Objectives and benefits*  
Understand objectives and benefits of SPC (e.g., controlling process performance, distinguishing special from common causes). (Comprehension)
2. *Selection of variable*  
Select critical characteristics for monitoring by control chart. (Application)
3. *Rational subgrouping*  
Define and apply the principle of rational subgrouping. (Application)
4. *Selection and application of control charts*  
Identify, select, construct, and apply the following types of control charts:  $\bar{x}$  and  $R$ ,  $\bar{x}$  and  $s$ , individual and moving range ( $ImR$  /  $XmR$ ), median,  $p$ ,  $np$ ,  $c$ , and  $u$ . (Application)



5. *Analysis of control charts*  
Interpret control charts and distinguish between common and special causes using rules for determining statistical control. (Analysis)

6. *PRE-control*  
Define and explain PRE-control and perform PRE-control calculations and analysis. (Analysis)

**B. Advanced Statistical Process Control**  
Understand appropriate uses of short-run SPC, EWMA, CuSum, and moving average (Comprehension)

**C. Lean Tools for Control**  
Apply appropriate lean tools (e.g., 5S, visual factory, kaizen, kanban, poka-yoke, total productive maintenance, standard work) as they relate to the control phase of DMAIC (Application)  
[NOTE: The use of lean tools in other areas of DMAIC is covered in section IX. C.]

**D. Measurement System Reanalysis**  
Understand the need to improve measurement system capability as process capability improves; evaluate the use of control measurement systems (e.g., attributes, variables, destructive); and ensure that measurement capability is sufficient for its intended use. (Evaluation)

**IX. Lean Enterprise (9 questions)**

**A. Lean Concepts**

1. *Theory of constraints*  
Describe the theory of constraints (Comprehension)
2. *Lean thinking*  
Describe concepts such as value, value chain, flow, pull, perfection, etc. (Comprehension)
3. *Continuous flow manufacturing (CFM)*  
Describe the concept CFM. (Comprehension)
4. *Nonvalue-added activities*  
Identify these activities in terms inventory, space, test inspection, rework, transportation, storage, etc. (Application)
5. *Cycle-time reduction*  
Describe how cycle-time reduction can be used to identify defects and nonvalue-added activities using kaizen-type methods to reduce waste of space, inventory, labor, and distance. (Comprehension)

**B. Lean Tools**  
Define, select, and apply tools such as visual factory, kanban, poka-yoke, standard work, SMED, etc., in areas outside of DMAIC-Control. (Application)  
[NOTE: The use of lean tools in DMAIC-Control is covered in section VIII. C.]

**C. Total Productive Maintenance (TPM)**  
Understand the concept of TPM. (Comprehension)

**X. Design for Six Sigma (DFSS) (9 questions)**

**A. Quality Function Deployment (QFD)**  
Analyze a completed QFD matrix. (Analysis)

**B. Robust Design and Process**

1. *Functional requirements*  
Understand functional requirements of a design. (Comprehension)
2. *Noise strategies*  
Develop a robust design using noise strategies. (Application)

3. *Tolerance design*  
Understand the concepts of tolerance design and statistical tolerancing. (Analysis)

4. *Tolerance and process capability*  
Calculate tolerances using process capability data. (Analysis)

**C. Failure Mode and Effects Analysis (FMEA)**  
Understand the terminology, purpose, and use of scale criteria (RPN) and be able to apply it to a process, product, or service; understand the distinction between and interpret data associated with DFMEA and PFMEA (Analysis)

**D. Design for X (DFX)**  
Understand design constraints such as design for cost, design for manufacturability and producibility, design for test, design for maintainability, etc. (Comprehension)

**E. Special Design Tools**  
Understand the concept of special design tools such as the theory of inventive problem-solving (TRIZ), axiomatic design (conceptual structure robustness), etc. (Knowledge)

**Six Levels of Cognition Based on Bloom's Taxonomy (1956)**

In addition to *content* specifics, the subtext detail also indicates the intended *complexity level* of the test questions for that topic. These levels are based on "Levels of Cognition" (from Bloom's Taxonomy, 1956) and are presented below in rank order, from least complex to most complex.

**Knowledge Level**

(Also commonly referred to as recognition, recall, or rote knowledge.) Being able to remember or recognize terminology, definitions, facts, ideas, materials, patterns, sequences, methodologies, principles, etc.

**Comprehension Level**

Being able to read and understand descriptions, communications, reports, tables, diagrams, directions, regulations, etc.

**Application Level**

Being able to apply ideas, procedures, methods, formulas, principles, theories, etc., in job-related situations

**Analysis**

Being able to break down information into its constituent parts and recognize the parts' relationship to one another and how they are organized; identify sublevel factors or salient data from a complex scenario

**Synthesis**

Being able to put parts or elements together in such a way as to show a pattern or structure not clearly there before; identify which data or information from a complex set are appropriate to examine further or from which supported conclusions can be drawn

**Evaluation**

Being able to make judgments regarding the value of proposed ideas, solutions, methodologies, etc., by using appropriate criteria or standards to estimate accuracy, effectiveness, economic benefits, etc.



# Study Guide

1. For a normal distribution, two standard deviations on each side of the mean would include what percentage of the total population?
  - a. 47%
  - b. 68%
  - c. 95%
  - d. 99%
2. Which of the following is most important in evaluating and understanding design intent?
  - a. Identifying the functional requirement
  - b. Brainstorming failure modes
  - c. Conducting computer simulations
  - d. Developing FMEA
3. For consumer products, an increase in the percentage of returned goods most likely equates to an increase in
  - a. product not meeting specifications
  - b. end-user dissatisfaction
  - c. internal reject rates
  - d. nonconforming material costs
4. In measurement system analysis, which of the following pairs of data measures is used to determine total variance?
  - a. Process variance and reproducibility
  - b. Noise system and repeatability
  - c. Measurement variance and process variance
  - d. System variance and bias
5. All of the following are effective when a team leader is giving feedback to the team EXCEPT
  - a. describing the behavior in context
  - b. describing the reasons for giving feedback
  - c. giving feedback when it is convenient
  - d. providing actionable guidance
6. Process data being used in the initial set-up of a process are assumed to have a normal distribution. If the nominal (target) is set at the center of the distribution, and the specification limits are set at  $\pm 3\sigma$  from the center, the  $C_{pk}$  is equal to
  - a. 0.25
  - b. 1.00
  - c. 1.33
  - d. 1.67
7. A Green Belt is going to monitor the number of defects on different size samples. Which of the following control charts would be most appropriate?
  - a. u
  - b. np
  - c. c
  - d. p
8. Compared to a two-level factorial experiment, which of the following is an advantage of an experiment in three levels?
  - a. Interaction effects can be estimated.
  - b. Curvature can be characterized.
  - c. The design can be augmented.
  - d. Efficiency is maximized in the experimental effort.
9. Which of the following is the best technique for improving the precision of a designed experiment when the experimental material is **not** homogeneous?
  - a. Blocking
  - b. Confounding
  - c. Randomization
  - d. Fractionalizing
10. Which of the following most influences consumer perception of quality?
  - a. Industry standards
  - b. Company financial performance
  - c. Audit results
  - d. Service and repair policies
11. Correction, over-production, inventory, and motion are all examples of
  - a. waste
  - b. 5S target areas
  - c. noise
  - d. value-added activities
12. The primary factor in the successful implementation of six sigma is to have
  - a. the necessary resources
  - b. the support/leadership of top management
  - c. explicit customer requirements
  - d. a comprehensive training program
13. All of the following experimental designs could be used to investigate interactions EXCEPT
  - a. half-fraction
  - b. half-fraction with replication
  - c. full-factorial with replication
  - d. saturated screening with replication
14. The most important aspect of functional requirements is that they
  - a. describe a single, measurable performance
  - b. describe how a product or service should operate
  - c. be traceable to the voice of the customer
  - d. provide upper and lower performance limits
15. Which of the following types of variation is LEAST likely to occur in sequential repetitions of a process over a short period of time?
  - a. Cyclical
  - b. Positional
  - c. Temporal
  - d. Seasonal
16. The primary reason that most companies implement six sigma is to
  - a. reduce defects
  - b. improve processes
  - c. improve profit
  - d. increase customer satisfaction

## Study Guide (continued)

17. According to Deming, which of the following is NOT a key element of quality leadership?
- Establishment of an organizational goal to meet or exceed customer needs
  - The use of displays and awards to promote employee motivation
  - Continual education and training that elevate the level of technical and professional expertise
  - Elimination of barriers and distrust to create an organizational culture that fosters teamwork
18. What is the standard deviation of a process that operates to an exponential distribution with a mean of 25 units?
- 0.4
  - 5.0
  - 12.5
  - 25.0
19. The term used to describe the risk of a Type I error in a test of hypotheses is
- power
  - confidence level
  - level of significance
  - beta risk
20. Which of the following techniques can be used in regression analysis to reduce higher-order terms in the model?
- Large samples
  - Dummy variables
  - Transformations
  - Blocking
21. Which of the following tools has the highest resolution?
- A feeler gage
  - A gage block
  - A caliper
  - A micrometer
22. Which of the following best describes internal failure costs?
- The economic costs associated with a catastrophic failure of an internal subsystem
  - The unavoidable quality system costs associated with the production of any product or service
  - The opposite of external failure costs
  - The costs resulting from a nonconformance detected before a product or service is provided
23. In order for a problem to be solved correctly, which of the following must occur first?
- The problem must be defined.
  - Relevant data must be gathered.
  - The measurement system must be validated.
  - The process must be mapped.
24. One characteristic of attributes data is that they are always
- continuous
  - discrete
  - expensive to collect
  - read from a scale of measurement

### Answers

- |      |       |       |       |
|------|-------|-------|-------|
| 1. c | 7. a  | 13. d | 19. c |
| 2. a | 8. b  | 14. c | 20. c |
| 3. b | 9. a  | 15. d | 21. d |
| 4. c | 10. d | 16. c | 22. d |
| 5. c | 11. a | 17. b | 23. a |
| 6. b | 12. b | 18. d | 24. b |







# Reference Materials

These books cover significant parts of the BOK. The ASQ Certification Board does not endorse any one particular reference source.

## I. Enterprise-wide Deployment

Breyfogle, Forrest, *Implementing Six Sigma: Smarter Solutions Using Statistical Methods*, New York: John Wiley & Sons, 1999. **P782**

Harry, Mikel, and Rich Schroeder, *Six Sigma: The Breakthrough Management Strategy Revolutionizing the World's Top Corporations*, New York: Doubleday, 2000. **P785**

Harry, Mikel, *The Vision of Six Sigma* (8 volume set), 5th ed., Sigma Publishing Co., 1997. ISBN 0964355574

Naumann, Earl, and Steven Hoisington, *Customer Centered Six Sigma: Linking Customers, Process Improvement, and Financial Results*, Milwaukee: ASQ Quality Press, 2001. **H1080**

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While numerous organizations utilize ASQ certification in their personnel practices, we have received formal written endorsement from these firms:

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