

CSQE

CERTIFIED SOFTWARE QUALITY ENGINEER



Quality excellence to enhance your career
and boost your organization's bottom line

asq.org/cert



The Global Voice of Quality®

Certification from ASQ is considered a mark of quality excellence in many industries. It helps you advance your career, and boosts your organization's bottom line through your mastery of quality skills. Becoming certified as a Software Quality Engineer confirms your commitment to quality and the positive impact it will have on your organization.



Examination

Each certification candidate is required to pass a written examination that consists of multiple-choice questions that measure comprehension of the body of knowledge.

Certified Software Quality Engineer

The Certified Software Quality Engineer (CSQE) understands software quality development and implementation, software inspection, testing, and verification and validation; and implements software development and maintenance processes and methods.



CSQE

Computer Delivered – The CSQE examination is a one-part, 175-question, four-and-a-half-hour exam and is offered in English only. One hundred and sixty questions are scored and 15 are unscored.

Paper and Pencil – The CSQE examination is a one-part, 160-question, four-hour exam and is offered in English only.

For comprehensive exam information on Software Quality Engineer certification, visit asq.org/cert.



Education and/or Experience

Work experience must be in a full-time, paid role. Paid intern, co-op, or any other course work cannot be applied toward the work experience requirement.

You must have eight years of on-the-job experience in one or more of the areas of the Certified Software Quality Engineer Body of Knowledge.

A minimum of three years of this experience must be in a decision-making position. (“Decision-making” is defined as the authority to define, execute, or control projects/processes and to be responsible for the outcome. This may or may not include management or supervisory positions.)

If you’ve ever been certified by ASQ as a Quality Engineer, Quality Auditor, Reliability Engineer, Supplier Quality Professional, or Quality Manager, experience used to qualify for certification in these fields applies to certification as a Software Quality Engineer.

If you have completed a degree* from a college, university, or technical school with accreditation accepted by ASQ, part of the eight-year experience requirement will be waived, as follows (only one of these waivers may be claimed):

- Diploma from a technical or trade school—one year will be waived.
- Associate’s degree—two years waived.
- Bachelor’s degree—four years waived.
- Master’s or doctorate—five years waived.

*Degrees or diplomas from educational institutions outside the United States must be equivalent to degrees from U.S. educational institutions.



Minimum Expectations

- Must possess a fundamental understanding of quality philosophies, principles, methods, tools, standards, organizational and team dynamics, interpersonal relationships, professional ethics, and legal and regulatory requirements.
- Must evaluate the impact of software quality management principles on business objectives and demonstrate comprehensive knowledge of developing and implementing software quality programs, which include tracking, analyzing, reporting, problem resolution, process improvement, training, and supplier management. Must have a basic understanding of how and when to perform software audits including audit planning, approaches, types, analyses, reporting results, and follow-up.
- Must understand systems architecture and be able to implement software development and maintenance processes, quantify the fundamental problems and risks associated with various software development methodologies, and assess, support, and implement process and technology changes.
- Must be able to apply project management principles and techniques as they relate to software project planning, implementation, and tracking. Must be able to identify, evaluate, and manage risk.
- Must have an understanding of measurement theory. Must be able to select, define, and apply product and process metrics and analytical techniques, and communicate results.
- Must be able to apply verification and validation processes, including early software defect detection and removal, inspection, and testing methods (e.g., types, levels, strategies, tools, and documentation). Must be able to analyze test strategies, develop test plans and execution documents, and review customer deliverables.
- Must have a basic understanding of configuration management processes, including planning, configuration identification, configuration control, change management, status accounting, auditing, and reporting. Must be able to assess the effectiveness of product release and archival processes.

BODY OF KNOWLEDGE

Certified Software Quality Engineer (CSQE)

Topics in this body of knowledge 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 intended 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 highest cognitive level at which the topic will be tested. A more comprehensive description of cognitive levels is provided at the end of this document.

I. General Knowledge (16 questions)

A. Benefits of Software Quality Engineering

Within the Organization

Describe the benefits that software quality engineering can have at the organizational level. (Understand)

B. Ethical and Legal Compliance

1. ASQ code of ethics for professional conduct

Determine appropriate behavior in situations requiring ethical decisions, including identifying conflicts of interest, recognizing and resolving ethical issues, etc. (Evaluate)

2. Regulatory and legal issues

Describe the importance of compliance to federal, national, and statutory regulations on software development. Determine the impact that issues such as copyright, intellectual property rights, product liability, and data privacy. (Understand)

C. Standards and Models

Define and describe the ISO 9000 and IEEE software standards, and the SEI Capability Maturity Model Integration (CMMI) for development, services, and acquisition assessment models. (Understand)

D. Leadership Skills

1. Organizational leadership

Use leadership tools and techniques (e.g., organizational change management, knowledge transfer, motivation, mentoring and coaching, recognition). (Apply)

2. Facilitation skills

Use facilitation and conflict resolution skills as well as negotiation techniques to manage and resolve issues. Use meeting management tools to maximize meeting effectiveness. (Apply)

3. Communication skills

Use various communication methods in oral, written, and presentation formats. Use various techniques for working in multicultural environments, and

identify and describe the impact that culture and communications can have on quality. (Apply)

E. Team Skills

1. Team management

Use various team management skills, including assigning roles and responsibilities, identifying the classic stages of team development (forming, storming, norming, performing, adjourning),

monitoring and responding to group dynamics, working with diverse groups and in distributed work environments, and using techniques for working with virtual teams. (Apply)

2. Team tools

Use decision-making and creativity tools, such as brainstorming, nominal group technique (NGT), multi-voting. (Apply)



II. Software Quality Management (22 questions)

A. Quality Management System

1. Quality goals and objectives

Design software quality goals and objectives that are consistent with business objectives. Incorporate software quality goals and objectives into high-level program and project plans. Develop and use documents and processes necessary to support software quality management systems. (Create)

2. Customers and other stakeholders

Describe and analyze the effect of various stakeholder group requirements on software projects and products. (Analyze)

3. Outsourcing

Determine the impact that outsourced services can have on organizational goals and objectives, and identify criteria for evaluating suppliers/vendors and subcontractors. (Analyze)

4. Business continuity, data protection, and data management

Design plans for business continuity, disaster recovery, business documentation and change management, information security, and protection of sensitive and personal data. (Analyze)

B. Methodologies

1. Cost of quality (COQ) and return on investment (ROI)

Analyze COQ categories (prevention, appraisal, internal failure, external failure) and return on investment (ROI) metrics in relation to products and processes. (Analyze)

2. Process improvement

Define and describe elements of benchmarking, lean processes, the Six Sigma methodology, and use define, measure, act, improve, control (DMAIC) model and the plan-do-check-act (PDCA) model for process improvement. (Apply)

3. Corrective action procedures

Evaluate corrective action procedures related to software defects, process nonconformances, and other quality system deficiencies. (Evaluate)

4. Defect prevention

Design and use defect prevention processes such as technical reviews, software tools and technology, special training. (Evaluate)

C. Audits

1. Audit types

Define and distinguish between various audit types, including process, compliance, supplier, system. (Understand)

2. Audit roles and responsibilities

Identify roles and responsibilities for audit participants including client, lead auditor, audit team members, and auditee. (Understand)

3. Audit process

Define and describe the steps in conducting an audit, developing and delivering an audit report, and determining appropriate follow-up activities. (Apply)

III. System and Software Engineering Processes (32 questions)

A. Life Cycles and Process Models

1. Waterfall software development life cycle

Apply the waterfall life cycle and related process models, and identify their benefits and when they are used. (Apply)

2. Incremental/iterative software development life cycles

Apply the incremental and iterative life cycles and related process models, and identify their benefits and when they are used. (Apply)

3. Agile software development life cycle

Apply the agile life cycle and related process models, and identify their benefits and when they are used. (Apply)

B. Systems Architecture

Identify and describe various architectures, including embedded systems, client-server, n-tier, web, wireless, messaging, collaboration platforms, and analyze their impact on quality. (Analyze)

C. Requirements Engineering

1. Product requirements

Define and describe various types of product requirements, including system, feature, function, interface, integration, performance, globalization, localization. (Understand)

2. Data/information requirements

Define and describe various types of data and information requirements, including data management and data integrity. (Understand)

3. Quality requirements

Define and describe various types of quality requirements, including reliability, usability. (Understand)



4. Compliance requirements

Define and describe various types of regulatory and safety requirements. (Understand)

5. Security requirements

Define and describe various types of security requirements including data security, information security, cybersecurity, data privacy. (Understand)

6. Requirements elicitation methods

Describe and use various requirements elicitation methods, including customer needs analysis, use cases, human factors studies, usability prototypes, joint application development (JAD), storyboards, etc. (Apply)

7. Requirements evaluation

Assess the completeness, consistency, correctness, and testability of requirements, and determine their priority. (Evaluate)

D. Requirements Management

1. Requirements change management

Assess the impact that changes to requirements will have on software development processes for all types of life-cycle models. (Evaluate)

2. Bidirectional traceability

Use various tools and techniques to ensure bidirectional traceability from requirements elicitation and analysis through design and testing. (Apply)

E. Software Analysis, Design, and Development

1. Design methods

Identify the steps used in software design and their functions, and define and distinguish between software design methods. (Understand)

2. Quality attributes and design

Analyze the impact that quality-related elements (safety, security, reliability, usability, reusability, maintainability) can have on software design. (Analyze)

3. Software reuse

Define and distinguish between software reuse, reengineering, and reverse engineering, and describe the impact these practices can have on software quality. (Understand)

4. Software development tools

Analyze and select the appropriate development tools for modeling, code analysis, requirements management, and documentation. (Analyze)

F. Maintenance Management

1. Maintenance types

Describe the characteristics of corrective, adaptive, perfective, and preventive maintenance types. (Understand)

2. Maintenance strategy

Describe various factors affecting the strategy for software maintenance, including service-level agreements (SLAs), short- and long-term costs, maintenance releases, product discontinuance, and their impact on software quality. (Understand)

3. Customer feedback management

Describe the importance of customer feedback management including quality of product support, and post-delivery issues analysis and resolution. (Understand)

IV. Project Management (22 questions)

A. Planning, Scheduling, and Deployment

1. Project planning

Use forecasts, resources, schedules, task and cost estimates, etc., to develop project plans. (Apply)

2. Work breakdown structure (WBS)

Use work breakdown structure (WBS) in scheduling and monitoring projects. (Apply)

3. Project deployment

Use various tools, including milestones, objectives achieved, and task duration to set goals and deploy the project. (Apply)

B. Tracking and Controlling

1. Phase transition control

Use various tools and techniques such as entry/exit criteria, quality gates, Gantt charts, integrated master schedules, etc., to control phase transitions. (Apply)

2. Tracking methods

Calculate project-related costs, including earned value, deliverables, productivity, etc., and track the results against project baselines. (Apply)

3. Project reviews

Use various types of project reviews such as phase-end, management, and retrospectives or post-project reviews to assess project performance and status, to review issues and risks, and to discover and capture lessons learned from the project. (Apply)

4. Program reviews

Define and describe various methods for reviewing and assessing programs in terms of their performance, technical accomplishments, resource utilization, etc. (Understand)

C. Risk Management

1. Risk management methods

Use risk management techniques (e.g., assess, prevent, mitigate, transfer) to evaluate project risks. (Evaluate)

2. Software security risks

Evaluate risks specific to software security, including deliberate attacks (hacking, sabotage, etc.), inherent defects that allow unauthorized access to data, and other security breaches. Plan appropriate responses to minimize their impact. (Evaluate)

3. Safety and hazard analysis

Evaluate safety risks and hazards related to software development and implementation and determine appropriate steps to minimize their impact. (Evaluate)

V. Software Metrics and Analysis (19 questions)

A. Process and Product Measurement

1. Terminology

Define and describe metric and measurement terms such as reliability, internal and external validity, explicit and derived measures, and variation. (Understand)

2. Software product metrics

Choose appropriate metrics to assess various software attributes (e.g., size, complexity, the amount of test coverage needed, requirements volatility, and overall system performance). (Apply)

3. Software process metrics

Measure the effectiveness and efficiency of software processes (e.g., functional verification tests (FVT), cost, yield, customer impact, defect detection, defect containment, total defect containment effectiveness (TDCE), defect removal efficiency (DRE), process capability). (Apply)

4. Data integrity

Describe the importance of data integrity from planning through collection and analysis and apply various techniques to ensure data quality, accuracy, completeness, and timeliness. (Apply)

B. Analysis and Reporting Techniques

1. Metric reporting tools

Using various metric representation tools, including dashboards, spotlight charts, etc., to report results. (Apply)

2. Classic quality tools

Describe the appropriate use of classic quality tools (e.g., flowcharts, Pareto charts, cause and effect diagrams, control charts, and histograms). (Apply)



3. Problem-solving tools

Describe the appropriate use of problem solving tools (e.g., affinity and tree diagrams, matrix and activity network diagrams, root cause analysis and data flow diagrams [DFDs]). (Apply)

VI. Software Verification and Validation (29 questions)

A. Theory

1. V&V methods

Use software verification and validation methods (e.g., static analysis, structural analysis, mathematical proof, simulation, and automation) and determine which tasks should be iterated as a result of modifications. (Apply)

2. Software product evaluation

Use various evaluation methods on documentation, source code, etc., to determine whether user needs and project objectives have been satisfied. (Analyze)

B. Test Planning and Design

1. Test strategies

Select and analyze test strategies (e.g., test-driven design, good-enough, risk-based, time-box, top-down, bottom-up, black-box, white-box, simulation, automation, etc.) for various situations. (Analyze)

2. Test plans

Develop and evaluate test plans and procedures, including system, acceptance, validation, etc., to determine whether project objectives are being met and risks are appropriately mitigated. (Create)

3. Test designs

Select and evaluate various test designs, including fault insertion, fault-error handling, equivalence class partitioning, boundary value. (Evaluate)

4. Software tests

Identify and use various tests, including unit, functional, performance, integration,

regression, usability, acceptance, certification, environmental load, stress, worst-case, perfective, exploratory, system. (Apply)

5. Tests of external products

Determine appropriate levels of testing for integrating supplier, third-party, and subcontractor components and products. (Apply)

6. Test coverage specifications

Evaluate the adequacy of test specifications such as functions, states, data and time domains, interfaces, security, and configurations that include internationalization and platform variances. (Evaluate)

7. Code coverage techniques

Use and identify various tools and techniques to facilitate code coverage analysis techniques such as branch coverage, condition, domain, and boundary. (Apply)

8. Test environments

Select and use simulations, test libraries, drivers, stubs, harnesses, etc., and identify parameters to establish a controlled test environment. (Analyze)

9. Test tools

Identify and use test utilities, diagnostics, automation, and test management tools. (Apply)

10. Test data management

Ensure the integrity and security of test data through the use of configuration controls. (Apply)

C. Reviews and Inspections

Use desk checks, peer reviews, walk-throughs, inspections, etc., to identify defects. (Apply)

D. Test Execution Documents

Review and evaluate test execution documents such as test results, defect reporting and tracking records, test completion metrics, trouble reports, input/output specifications. (Evaluate)

VII. Software Configuration Management (20 questions)

A. Configuration Infrastructure

1. Configuration management team

Describe the roles and responsibilities of a configuration management group. (Understand) (NOTE: The roles and responsibilities of the configuration control board [CCB] are covered in area VII.C.2.)

2. Configuration management tools

Describe configuration management tools as they are used for managing libraries, build systems, and defect tracking systems. (Understand)

3. Library processes

Describe dynamic, static, and controlled library processes and related procedures, such as check-in/check-out, merge changes. (Understand)

B. Configuration Identification

1. Configuration items

Describe software configuration items (baselines, documentation, software code, equipment), identification methods (naming conventions, versioning schemes). (Understand)

2. Software builds and baselines

Describe the relationship between software builds and baselines, and describe methods for controlling builds and baselines (automation, new versions). (Understand)

C. Configuration Control and Status Accounting

1. Item change and version control

Describe processes for documentation control, item change tracking, version control that are used to manage various configurations, and describe processes used to manage configuration item dependencies in software builds and versioning. (Understand)

2. Configuration control board (CCB)

Describe the roles, responsibilities and processes of the CCB. (Understand) (NOTE: The roles and responsibilities of the configuration management team are covered in area VII.A.1.)

3. Concurrent development

Describe the use of configuration management control principles in concurrent development processes. (Understand)

4. Status accounting

Discuss various processes for establishing, maintaining, and reporting the status of configuration items, such as baselines, builds, and tools. (Understand)

D. Configuration Audits

Define and distinguish between functional and physical configuration audits and how they are used in relation to product specification. (Understand)

E. Product Release and Distribution

1. Product release

Assess the effectiveness of product release processes (planning, scheduling, defining hardware and software dependencies). (Evaluate)

2. Customer deliverables

Assess the completeness of customer deliverables including packaged and hosted or downloadable products, license keys and user documentation, and marketing and training materials. (Evaluate)

3. Archival processes

Assess the effectiveness of source and release archival processes (backup planning and scheduling, data retrieval, archival of build environments, retention of historical records, offsite storage). (Evaluate)

LEVELS OF COGNITION

Based on Bloom's Taxonomy—Revised (2001)

In addition to **content** specifics, the subtext for each topic in this BoK 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—Revised, 2001) and are presented below in rank order, from least complex to most complex.

REMEMBER | Recall or recognize terms, definitions, facts, ideas, materials, patterns, sequences, methods, principles, etc.

UNDERSTAND | Read and understand descriptions, communications, reports, tables, diagrams, directions, regulations, etc.

APPLY | Know when and how to use ideas, procedures, methods, formulas, principles, theories, etc.

ANALYZE | Break down information into its constituent parts and recognize their relationship to one another and how they are organized; identify sublevel factors or salient data from a complex scenario.

EVALUATE | Make judgments about the value of proposed ideas, solutions, etc., by comparing the proposal to specific criteria or standards.

CREATE | Put parts or elements together in such a way as to reveal a pattern or structure not clearly there before; identify which data or information from a complex set is appropriate to examine further or from which supported conclusions can be drawn.

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600 N. Plankinton Ave.
Milwaukee, WI 53203-2914

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