American Society for Quality (ASQ)
Certified Quality Inspector
Body of Knowledge (BOK)

This NEW Quality Inspector Body of Knowledge is effective March 3, 2012.

The 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 Exam Development Committee and the candidate 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 line of subtext refers to the maximum cognitive level at which the topic will be tested. A complete description of cognitive levels is provided at the end of this document.

I. Technical Mathematics (20 Questions)

A. Basic Shop Math

Solve basic shop math problems using addition, subtraction, multiplication, division of fractions and decimals, squares and square roots. Use methods such as truncating and rounding to obtain significant digits for positive and negative numbers. (Apply)

B. Basic Algebra

Solve or simplify first-degree and single-variable equations. (Apply)

C. Basic Geometry

Calculate general parameters such as area, circumference, perimeter, and volume for basic geometric shapes. Calculate complementary and supplementary angles. (Apply)

D. Basic Trigonometry

Compute angles and lengths using trigonometric functions such as sine, cosine, tangent, and the Pythagorean Theorem. (Apply)

E. Measurement Systems

Convert units within and between English and metric measurement systems (SI) such as inch to micro-inch, liter to quart, meter to millimeter, etc. (Apply)

F. Numeric Conversions

Use various numbering methods such as scientific notation, decimals, and fractions, and convert values between these systems. (Apply)

II. Metrology (30 Questions)

A. Common Gauges and Measurement Instruments

1. Variable gauges

Identify and use variable gauges, including micrometers, calipers, dial indicator, CMM, linear scales, etc. (Apply)

2. Attribute gauges

Identify and use attribute gauges, including thread plug, progressive ring, flush pin, radius gauge, etc. (Apply)

3. **Transfer gauges**
   Identify and use transfer gauges, including small-hole gauges, spring calipers, etc. (Apply)
4. **Measurement scales**
   Describe and distinguish between dial, digital, and vernier scales. (Remember)

B. Special Gauges and Applications

Identify and describe the following basic tools and components. (Remember)

1. **Electronic gauging tools: oscilloscopes, multimeters, pyrometers, etc.**
2. **Automatic gauging components: machine vision, ultrasonic, X-ray, laser, etc.**
3. **Pneumatic gauging components: air columns, probes, rings, etc.**

C. Gauge Selection, Handling, and Use

1. **Gauge selection**
   Select gauges according to the feature or characteristic to be measured, the applicable tolerance and the accuracy, and the resolution and capability of the test instrument. Determine whether the type of measurement should be direct, differential, or transfer. (Apply)
2. **Gauge handling, preservation, and storage**
   Identify and apply various methods of cleaning, handling, and storing gauges. (Apply)
3. **Gauge correlation**
   Identify and apply methods for establishing the correlation between measurement instruments such as gauge-to-gauge or manual-to-automated process. (Apply)

D. Surface Plate Tools and Techniques

1. **Surface plate equipment**
   Select and use height gauges, V-blocks, indicators, etc., to measure various types of features. (Apply)
2. **Angle measurement instruments**
   Identify and use protractors, sine bars, angle blocks, etc. (Apply)

E. Specialized Inspection Equipment

1. **Measuring mass**
   Describe and apply weights, balances and scales. (Apply)
2. **Measuring finish**
   Describe and apply profilometers, fingernail comparators, etc. (Apply)
3. **Measuring shape and profile**
   Describe and apply mechanical comparators, roundness testers, precision spindles, profile tracers, etc. (Apply)
4. **Optical equipment**
   Describe and apply optical comparators, optical flats, microscopes, etc. (Apply)
5. **Digital vision systems**
   Define and describe the use of digital cameras, in-line optical sensors, and other digital systems for product inspection. (Remember)
6. **Coordinate measuring machine (CMM)**
   Describe the advantages and disadvantages of the CMM and the basic operation of the x, y, and z axes. Describe its limitations with regard to locating functional datums, target points and areas, and hole positions. (Understand)

F. Calibration

1. **Calibration systems**
   Describe the principles and purpose of a calibration system, including the importance of establishing calibration intervals. Identify and use basic tracking and identification methods such as logs, stickers, identification codes, etc., to control calibration equipment. (Apply)
2. **Calibration standards**
   Describe the hierarchy of standards, from working standards through international standards. (Remember)
3. **Equipment traceability**
   Describe the requirements for documenting traceability to standards. (Remember)
4. **Gage calibration environment**
   Describe the effects that environmental conditions, such as temperature, humidity, vibration and cleanliness of the gauge, etc., can have on calibration. (Apply)
5. **Out-of-calibration effects**
   Describe the effects that out-of-calibration instruments can have on product acceptance and the actions to take in response to this situation. (Apply)

G. Measurement System Analysis (MSA)

Define and describe the following elements of MSA. (Remember)

1. **Bias**
2. **Stability**
3. **Accuracy**
4. **Linearity**
5. **Repeatability and reproducibility (R&R) studies**

III. Inspection and Test (30 Questions)

A. Blueprints, Drawings, Geometric Dimensioning & Tolerancing (GD&T)

1. **Blueprints and engineering drawings**
   Define and interpret various sections of technical drawings: title block, tolerances, change or revision blocks, including notes, scale, and size details, etc. (Apply)
2. **Terminology and symbols**
   Define and interpret drawing views and details for product specifications or other controlling documents. Define and use various terms and symbols from the ASME Y14.5M Standard. (Analyze)
3. **Position and bonus tolerances**
   Calculate position and bonus tolerances from various drawings. (Analyze)
4. **Part alignment and datum structure**
   Determine part alignment and setup using the datum structure. (Analyze)

B. Sampling

Define and interpret the following terms related to sampling. (Apply)

1. **Acceptance quality limit (AQL)**
2. **Random sampling**
3. **Lot and sample size**
4. **Acceptance number**
5. **Sampling plans**

C. Inspection Planning and Processes

1. **Inspection types**
   Define and distinguish between inspection types such as incoming material, first-article (first-piece), in-process, final, etc. (Apply)
2. **Inspection errors**
   Identify potential inspection errors such as bias, fatigue, flinching, distraction, etc. (Apply)
3. **Product traceability**
   Identify methods to trace products and materials such as age control, shelf life, and first-in first-out (FIFO). (Apply)
4. **Identification of nonconforming material**
   Describe various methods of identifying nonconforming material such as tagging, labeling, and segregating. (Apply)
5. **Level of severity**
   Define and describe levels of severity (critical, major, minor, etc.) and apply them to product features and defects. (Apply)
6. **Disposition of nonconforming material**
   Describe disposition methods including rework, reprocess, scrap, customer waiver, etc., as determined by a material review board (MRB) or other authority. (Apply)

D. Testing Methods

Define and use the following methods in various situations. (Apply)

1. **Nondestructive testing: X-ray, eddy current, ultrasonic, dye penetrant, magnetic particle, etc.**
2. **Destructive testing: tensile, force testing, drop test, etc.**
3. **Functionality testing: tension, torque, leak testing and compression, etc.**
4. **Hardness testing: Brinell, Rockwell, durometer, and micro-hardness scales**

E. Software for test equipment

Identify and describe basic tools (e.g., safeguarding, functional checks, comparison of test results, identification of attributes and parameters) used to ensure that the software for test equipment adequately and correctly performs its intended functions. (Remember)

IV. Quality Assurance (20 Questions)

A. Basic Statistics and Applications

1. **Measures of central tendency**
   Calculate mean, median, and mode. (Apply)
2. **Measures of dispersion**
   Calculate range, standard deviation, and variance. (Apply)
3. **Measures of proportion**
   Calculate percentage and ratio measures for various data sets. (Apply)
4. **Graphical displays**
   Define, interpret, and use scatter diagrams, tally sheets, bar charts, etc., to display data effectively in various situations. (Apply)
5. **Normal distribution**

Describe various characteristics of a normal distribution: symmetry, bell curve, central tendency, etc. (Understand)

B. Statistical Process Control (SPC)

1. Common and special cause variation
Explain the difference between these causes of variation. Determine whether a process is in statistical control by analyzing data patterns (runs, trends, hugging, etc.), and identify what actions should be taken in response. (Evaluate)

2. Control limits and specification limits
Define, describe, and distinguish between these limits as used in SPC. (Apply)

3. Variables charts
Identify characteristics and uses of $\overline{X} - R$ and $\overline{X} - s$ charts. (Apply)

4. Attributes charts
Identify characteristics and uses of p, np, c, and u charts. (Apply)

5. Process capability analysis
Define and distinguish between C_p, C_{pk}, P_p, and P_{pk} studies and identify their application to various types of data. (Understand)

C. Quality Improvement

1. Terms and concepts
Define basic quality improvement concepts such as defect detection and prevention, the cost of poor quality, total quality management (TQM), the importance of customer satisfaction, etc. (Understand)

2. Products and processes
Define and distinguish between products and processes. Describe the interrelationships of product design, materials used, manufacturing processes, and final output, and how individual steps in a process can affect the final product or the system as a whole. (Understand)

D. Quality Audits

1. Types of audits
Define and describe various types of audits, including internal, external, system, product, process, etc. (Understand)

2. Audit process
Define and describe various stages of the audit process (planning, performance, and closure), including audit scope and purpose, resources needed, audit schedule, opening meeting, interviewing, data gathering, document and record review, analysis of results, closing meeting, audit documentation and recordkeeping, verification of corrective actions, etc. (Understand)

3. Audit tools
Define and describe the purpose of checklists, log sheets, sampling plans, record and document reviews and forward-and backward-tracing. (Understand)

4. Communication tools and techniques
Define and describe the use of graphs, charts, diagrams, and other aids for written and oral presentations including interview techniques and listening skills. (Understand)

5. Corrective action requests (CARs)
Describe how CARs from audits can support quality improvement. (Understand)

E. Quality Tools and Techniques

Define and use the following quality tools and techniques. (Apply)

1. **Pareto charts**
2. **Cause and effect diagrams**
3. **Flowcharts**
4. **Control charts**
5. **Check sheets**
6. **Scatter diagrams**
7. **Histograms**

F. Problem-solving Tools and Continuous Improvement Techniques

Describe and use the following tools and techniques in various situations. (Apply)

1. **Plan-do-check-act (PDCA) or plan-do-study-act (PDSA) cycles**
2. **Lean tools for eliminating waste: 5S, error-proofing, value-stream mapping; and lean concepts: kaizen, flow, pull,**
3. **Six sigma phases: define, measure, analyze, improve, control (DMAIC)**
4. **Failure mode and effects analysis (FMEA)**

G. Resources

1. **Environmental and safety support**
   Define and use various resources related to personal and environmental safety: material safety data sheet (MSDS), personal protective equipment (PPE), etc. (Apply)
2. **Reference documents**
   Identify and use national and international standards (e.g., ISO, ANSI, ASTM, QS) and customer requirements as authorities that support processes and procedures used to assure quality products. (Apply)
3. **Technical reports**
   Review, analyze, and interpret technical reports that are used to diagnose problems and communicate solutions. (Analyze)
4. **Employees as resources (Remember)**
   Describe how employees can be empowered and the value they add to project teams or quality improvement teams. Describe typical team roles and responsibilities: facilitator, ground rules, project or team charter, etc. Describe the four stages of team development: forming, storming, norming, performing. (Remember)

Note: Approximately 20% of the questions in each test will require calculation.

SIX LEVELS OF COGNITION BASED ON BLOOM'S TAXONOMY (REVISED)

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 the Revised "Levels of Cognition" (from Bloom's Taxonomy, 2001) and are presented below in rank order, from least complex to most complex.

REMEMBER

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

UNDERSTAND

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

APPLY

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

ANALYZE

Be 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.

EVALUATE

Be 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.

CREATE

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