Certified Quality Engineer—Simulated Exam

THIS SECTION WILL NOT BE PERMITTED IN THE CLASSROOM WHILE SITTING FOR THE CERTIFICATION EXAMINATION.

Eighty questions distributed by topic approximately proportional to that indicated in the CQE Body of Knowledge.

(The CQE Exam allows five hours for 160 questions.)

1. The Juran trilogy for quality management consists of:

   A. planning, execution, reward.

   B. process, product, shipment.

   C. planning, control, improvement.

   D. production, perspective, payment.

2. A method of dealing with an inspector found to be falsifying the results of inspection of borderline product is to:

   A. criticize the inspector on the basis that the pattern of reading does not follow the laws of chance.

   B. review the procedure for evaluating and reporting borderline product.

   C. review the inspector's results against the expected results calculated from a normal curve.

   D. criticize the inspector for not knowing how to read the inspection equipment.

3. The probability that defect type A occurs is .83, the probability that defect type B occurs is .83, and the probability that both occur is .83. Find the probability that at least one of the defects occurs.

   A. .83

   B. .92

   C. .33

   D. 1.05

   E. .029

4. In the "storming" stage of team development:

   A. the team "storms" the threshold of the problem.

   B. team members think primarily as individuals.

   C. team members think primarily as team members.

   D. the team breaks up.

5. Deming estimated that ____% of quality problems are due to the system rather than the workers.

   A. 15

   B. 50

   C. 75

   D. 85

6. The management team is establishing priorities to attack a serious quality problem. You are requested to establish a data collection system to direct this attack. You use which of the general management rules to support your recommendations as to the quantity of data required?

      I. You compare the incremental cost of additional data with the value of the information

      II. Your decision will correspond to the rules applicable for management decisions in other factors of production

      III. Your decision is based upon the pure relationship between value and cost

   A. I only

   B. I and II only

   C. I and III only

   D. I, II, and III

7. If prevention costs are increased to pay for engineering work in quality control, and this results in a reduction in the number of product defects, this yields a reduction in:

   A. appraisal costs.

   B. operating costs.

   C. quality costs.

   D. failure costs.

8. The primary reason for evaluating and maintaining surveillance over a supplier's quality program is to:

   A. perform product inspection at the source.

   B. eliminate incoming inspection costs.

   C. motivate suppliers to improve quality.

   D. make sure the supplier's quality program is functioning effectively.

9. When planning a total quality system, one key objective is to provide a means of guaranteeing "the maintenance of product integrity." Which of the following quality systems provisions is designed to *most* directly provide such a guarantee?

   A. Drawing and print control

   B. Calibration and maintenance of test equipment

   C. Identification and segregation of nonconforming material

   D. Specification change control

10. The most desirable method of evaluating a supplier is:

    A. a history evaluation.

    B. a survey evaluation.

    C. a questionnaire.

    D. a discussion with the quality manager on the phone.

11. The advantage of a written procedure is:

    A. it provides flexibility in dealing with problems.

    B. unusual conditions are handled better.

    C. it is a perpetual coordination device.

    D. coordination with other departments is not required.

12. A quality control program is considered to be:

    A. a collection of quality control procedures and guidelines.

    B. a step-by-step listing of all quality control check points.

    C. a summary of company quality control policies.

    D. a system of activities to provide quality of products and service.

13. In recent months, several quality problems have resulted from apparent changes in design specifications by engineering, including material substitutions. This has only come to light through quality engineering's failure analysis system. You recommend establishing which of the following quality system provisions as the best corrective action?

    A. A formal procedure for initial design review

    B. A formal procedure for specification change control (sometimes called an ECO or SCO system)

    C. A formal system for drawing and print control

    D. A formal material review board (MRB) system

14. One of the most important reasons for a checklist in an "in-process" audit is to:

    A. assure that the auditor is qualified.

    B. obtain relatively uniform audits.

    C. minimize the time required to complete the audit.

    D. notify the audited function prior to the audit.

15. ASQ certification is:

    A. licensure.

    B. peer recognition.

    C. registration.

    D. governmentally regulated.

16. Which line below is not found in the ASQ Code of Ethics?

    A. Will do whatever I can to promote the reliability and safety of all products that come within my jurisdiction

    B. Will not disclose information concerning the business affairs or technical processes of any present or former employer or client without his or her consent

    C. Will strive to improve each process I encounter

    D. Will take care that credit for the work of others is given to those to whom it is due

17. The primary purpose of audit working papers is to provide:

    A. evidence of analysis of internal control.

    B. support for the audit report.

    C. a basis for evaluating audit personnel.

    D. a guide for subsequent audits of the same areas.

18. A quality engineer, when asked about details of a technical process used by his employer, is bound by the ASQ Code of Ethics to:
    A. obtain the consent of the employer first.
    B. divulge no information.
    C. inform his employer of the request.
    D. provide information verbally but provide no documents.
19. It is usually true that increasing the resources devoted to prevention efforts will:
    A. increase total cost of quality.
    B. decrease failure costs.
    C. increase quality department visibility.
    D. cause cost accounting miscalculations.
20. The acronym "AQL," as used in sampling inspection, means:
    A. that level of lot quality for which there is a small risk of rejecting the lot.
    B. the average quality limit.
    C. the maximum percent defective that can be considered satisfactory as a process average.
    D. the quality level.
21. Which of the following elements is least necessary to a good corrective action feedback report?
    A. What caused the failure
    B. Who caused the failure
    C. What correction has been made
    D. When the correction is effective
22. A classification of characteristics makes it possible to:
    A. separate the "vital few" from the "trivial many" kinds of defects.
    B. direct the greatest inspection effort to the most important quality characteristics.
    C. establish inspection tolerances.
    D. allow the inspector to choose what to inspect and what not to inspect.

23. Where inspector efficiency is defined as the ratio of correct decisions to the total decisions regarding individual items, most inspection operations performed by human inspectors are approximately:

    A. 40–55% efficient.

    B. 55–70% efficient.

    C. 70–95% efficient.

    D. 95–100% efficient.

24. In a visual inspection situation, one of the best ways to minimize deterioration of the quality level is to:

    A. retrain the inspector frequently.

    B. have a program of frequent eye exams.

    C. add variety to the task.

    D. have a standard to compare against as an element of the operation.

25. The quality engineer should be concerned with the human factors of a new piece of in-house manufacturing equipment as well as its operational effects because it:

    I. may speed the line to the point where a visual operator inspection is impossible.

    II. may require the operator's undivided attention at the controls so the product cannot be fully seen.

    III. may remove an operator formerly devoting some portion of time to inspection.

    A. I only

    B. II only

    C. I and III only

    D. I, II, and III

26. The technique of seeking out and studying the best products and processes in other divisions or companies with the intent of continuous improvement is called:

    A. quality function deployment.

    B. benchmarking.

    C. using Baldridge criteria.

    D. quality auditing.

27. In ANSI/ASQ Z1.4-2003, the AQL is always determined at what probability of acceptance (Pa) on the OC curve?

    A. 0.05

    B. 0.10

    C. 0.90

    D. 0.95

    E. None of the above

28. In comparison with attributes sampling plans, variables sampling plans:

    A. have the advantage of greater simplicity.

    B. usually require a larger sample size for comparable assurance as to the correctness of decisions in judging a single quality characteristic.

    C. have the advantage of being applicable to either single or multiple quality characteristics.

    D. provide greater assurance, for the same sample size, as to the correctness of decisions in judging a single quality characteristic.

29. An operation requires shipments from your vendor of small lots of fixed size. The attribute sampling plan used for receiving inspection should have its OC curve developed using:

    A. the binomial distribution.

    B. the Gaussian (normal) distribution.

    C. the Poisson distribution.

    D. the hypergeometric distribution.

30. Using ANSI/ASQ Z1.4-2003, determine the sample size(s) for a lot of 300, AQL = 1.0%, level II normal inspection, double sampling.

    A. 50, 50

    B. 20, 20

    C. 32, 32

    D. 80, 100

31. Precontrol starts a process specifically centered between:

    A. process limits.

    B. safety lines.

    C. normal distribution limits.

    D. three-sigma limits.

    E. specification limits.

32. Lots of 75 parts each are inspected to an AQL of 0.25% using normal inspection, level II single sampling. Assuming general inspection level II, what is the sample size for ANSI/ASQ Z1.4-2003?

    A. 13

    B. 32

    C. 50

    D. 75

33. The cost of equipment used for inspection is allocated to which category?

    A. Prevention

    B. Internal failure

    C. External failure

    D. None of the above

34. One element of a quality system is product verification. This activity includes:

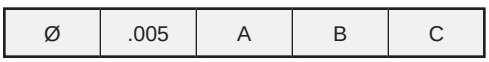
    A. use of test and inspection points in processes to verify conformance.

    B. verification of incoming materials.

    C. final product verification.

    D. all of the above.

    E. A and C only.

35. 

    In the control frame, datum C is the:

    A. primary datum.

    B. tertiary datum.

    C. basic datum.

    D. largest datum.

36. Requirements for document control include all of the following *except:*

    A. a process for generation, approval, and distribution of documents.

    B. a process to ensure ready availability of documents where they are needed.

    C. a process for distribution of revisions and the removal of obsolete documents.

    D. a process for making the documents available to the general public.

37. What is the reliability of a system at 850 hours, if the average usage of the system was 400 hours for 1650 items and the total number of failures was 145? Assume an exponential distribution.

    A. 0%

    B. 36%

    C. 18%

    D. 83%

38. Which material listed below can be usefully tested by the magnetic particle method?

    A. Carbon steel

    B. Aluminum

    C. Magnesium

    D. Lead

    E. None of the above

39. If the mean time between failure is found to be 129 hours for a component, what is the reliability of the component at $t = 129$ hours?

    A. .720

    B. .306

    C. .368

    D. .785

40. The MTBF for a system is 2500 hours. What is the probability of failure for that system after 2000 hours of operation?

    A. .37

    B. .45

    C. .55

    D. .82

41. A population of repairable components (having an exponential distribution of life) has an MTBF of 100 hours. What fraction of the components would fail if the population is operated 100 hours? (Failed components are not replaced.)

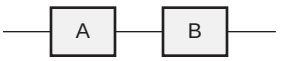
    A. 50%

    B. 37%

    C. 63%

    D. 83%

42. Component A has an exponential failure rate of 3×10^{-4} failures per hour. The life of component B is normally distributed with a mean of 600 and standard deviation of 200 hours. Assuming independence, calculate the reliability of the system after 200 hours.



A. 0.88

B. 0.92

C. 0.95

D. 0.98

43. The difference between an internal and an external audit is:

A. an internal audit is conducted indoors while an external audit is conducted outside.

B. for an internal audit, the auditors are employees of the auditee organization, whereas for an external audit they are not.

C. an external audit is always conducted by a third party.

D. an internal audit is done by the auditee in preparation for an external audit.

44. The ASQ definition of quality is:

A. the efficient production of products that the customer expects.

B. conformance to expectations.

C. conformance to specifications.

D. the composite of marketing, engineering, and manufacturing, through which the product or service will meet the expectations of the customer.

E. the totality of features and characteristics of a product that affect its ability to satisfy a given need.

45. The ASQ Code of Ethics has four sections. They are:

A. Policies, Goals, Objectives, Tools.

B. Introduction, Definitions, Tools, Summary.

C. Fundamental Principles, Relations with the Public, Relations with Employers and Clients, Relations with Peers.

D. Leadership, Implementation, Planning, Improvement.

46. One difference between a "finding" and an "observation" in an audit report is:

    A. an observation is supported by one or more findings.

    B. a finding is supported by one or more observations.

    C. findings detail weaknesses found in the documentation and observations refer to weaknesses in the implementation of the documentation.

    D. findings are discovered accidentally while observations are intentionally sought.

47. A team studies a coil steel banding process and makes five changes resulting in productivity improvements of 2%, 2.8%, 2.4%, 2%, and 3% respectively. These improvements are best described by which approach to problem solving?

    A. 5S

    B. Poka-yoke

    C. Kaizen

    D. PDCA

    E. Reengineering

48. The operators of a manufacturing cell work out a more orderly arrangement for tool storage and establish a schedule to maintain cleanliness on a daily basis. These improvements are best described by which approach to problem solving?

    A. 5S

    B. Poka-yoke

    C. Kaizen

    D. PDCA

    E. Reengineering

49. A quality engineer employed by a hospital is asked to improve the process of medication storage in locked cabinets near patient doors. One defect that occurs rarely is that the medication caddy is left out when the cabinet is relocked. The engineer installs a gravity-activated arm that will not permit the door to close when the caddy isn't inside. This improvement is best described by which approach to problem solving?

    A. 5S

    B. Poka-yoke

    C. Kaizen

    D. PDCA

    E. Reengineering

50. A team is investigating ways to reduce power outages. They determine that an outage can occur in only three ways: grid failure, local transformer failure, or local overload. They then investigate each of these three events for possible causes. They draw a diagram that "fans out," using the power outage as the handle of the fan. These improvements are best described by which approach to problem solving?

    A. Affinity diagram

    B. Interrelationship digraph

    C. Tree diagram

    D. Process decision program chart

    E. Matrix diagram

    F. Prioritization matrix

    G. Activity network diagram

51. A team's goal is to improve information flow in a payroll function. They make 33 Post-It notes, each listing an issue for further investigation. After some discussion, they group them into four categories: mandated record keeping, privacy concerns, insurance concerns, and transfer concerns. This grouping process is best described by which approach to problem solving?

    A. Affinity diagram

    B. Interrelationship digraph

    C. Tree diagram

    D. Process decision program chart

    E. Matrix diagram

    F. Prioritization matrix

    G. Activity network diagram

52. The team in the above problem draws arrows from Post-It notes that are causes to notes that are the effects of these causes. This step is best described by which approach to problem solving?

    A. Affinity diagram

    B. Interrelationship digraph

    C. Tree diagram

    D. Process decision program chart

    E. Matrix diagram

    F. Prioritization matrix

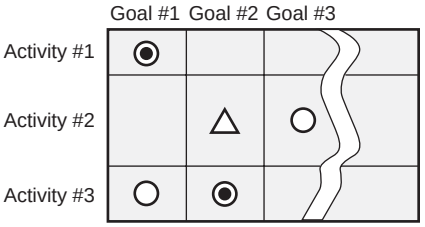
    G. Activity network diagram

53. A team working with a plant relocation is tasked with designing a process for moving 180 pieces of equipment. Incoming orders may need to be filled during the move at either the old site or the new one. Transportation equipment availability is uncertain. Construction schedules at the new site are very weather-dependent. The team designs a chart that attempts to cover these and other contingencies with appropriate measures for each. The tool best fitted for this task is:

    A. Affinity diagram
    B. Interrelationship digraph
    C. Tree diagram
    D. Process decision program chart
    E. Matrix diagram
    F. Prioritization matrix
    G. Activity network diagram

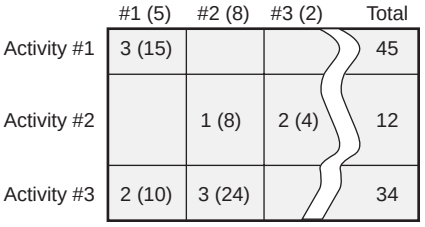
54. A management team lists nine goals across the top of a rectangle and 15 activity initiatives along the left-hand side of the rectangle. If one of the activities strongly supports one of the goals, a circle is placed in the box where that activity's row intersects the goal's column. If the activity's support is very strong, a "bull's-eye" is placed in the box; and if the support is weak, a triangle is used. This best describes which problem-solving tool?

    A. Affinity diagram
    B. Interrelationship digraph
    C. Tree diagram
    D. Process decision program chart
    E. Matrix diagram
    F. Prioritization matrix
    G. Activity network diagram



55. The management team in the above problem assigns each goal a numerical value designating its importance. The "bull's-eyes," circles, and triangles are replaced by the values 3, 2, and 1 respectively. Entries are made in each box by multiplying the 3, 2, or 1 by the goal value. The importance of each activity is calculated by adding the entries in its row. This best describes which problem-solving tool?

    A. Affinity diagram
    B. Interrelationship digraph
    C. Tree diagram
    D. Process decision program chart
    E. Matrix diagram
    F. Prioritization matrix
    G. Activity network diagram



56. Calculate the standard deviation of the population from which the following set of sample observations was drawn: 26, 31, 31, 27, 24, 29, 29

    A. 6.81

    B. 28.14

    C. 2.61

    D. 2.42

57. The expression $P(x) = (\mu^x e^{-\mu})/x!$ is the general term for the:

    A. Poisson distribution.

    B. Pascal distribution.

    C. hypergeometric distribution.

    D. binomial distribution.

58. A number derived from sample data which describes the data in some useful way is called a:

    A. constant.

    B. statistic.

    C. parameter.

    D. critical value.

59. Estimate the variance of the population which produced the following sample data: 26, 31, 31, 27, 24, 29, 29

    A. 6.81

    B. 5.84

    C. 2.61

    D. 2.42

60. Which problem-solving technique is derived from PERT (program evaluation and review technique) and CPM (critical path method) for project management?

    A. Affinity diagram

    B. Interrelationship digraph

    C. Tree diagram

    D. Process decision program chart

    E. Matrix diagram

    F. Prioritization matrix

    G. Activity network diagram

61. An example of a measurement scale with an interval rather than a ratio scale is:

    A. 1 = blue, 2 = green, 3 = red.

    B. temperature in degrees centigrade.

    C. area in square millimeters.

    D. priority ranking, such as first, second, third.

62. Given six books, how many sets can be arranged in lots of three—but always in a different order?

    A. 18

    B. 54

    C. 108

    D. 120

63. The probability of observing at least one defective in a random sample of size 10, drawn from a population that has been producing, on the average, 10 percent defective units, is:

    A. $(0.10)^{10}$

    B. $(0.90)^{10}$

    C. $1 - (0.10)^{10}$

    D. $1 - (0.9)^{10}$

64. An accident occurs when both fault event A and fault event B occur. The equation for joint probability of two fault events under any circumstances is given by:

    $P(A\&B) = P(A|B) \times P(B)$ where $P(A|B)$ means the probability of fault A given that fault B has occurred. If the occurrence of fault B does not affect the probability of the occurrence of fault A, the probability of an accident, when P(A) = .1 and P(B) = .05, is given by:

    A. .00025

    B. .10000

    C. .05000

    D. .00500

65. Find system reliability if each component has reliability .92.

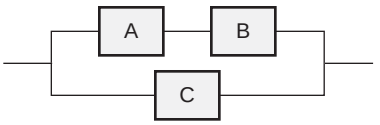
    A. .78

    B. .31

    C. .92

    D. .97

    E. .99



66. What is the upper control limit for a p chart (proportion defective) when the average daily production is 2500 units with an established fraction defective of 0.05?

    A. 0.054

    B. 0.058

    C. 0.063

    D. 0.066

67. An $\bar{x}$ and R chart was prepared for an operation using 20 samples with five pieces in each sample. X was found to be 33.6 and R was 6.20. During production, a sample of five was taken and the pieces measured 36, 43, 37, 25, and 38. At the time this sample was taken:

    A. both the average and range were within control limits.

    B. neither the average nor range were within control limits.

    C. only the average was outside control limits.

    D. only the range was outside control limits.

68. In a normal distribution, what is the area under the curve between +0.7 and +1.3 standard deviation units?

    A. 0.2903

    B. 0.7580

    C. 0.2580

    D. 0.1452

69. Given process average = 1.64, average range = .05, n = 5, assuming statistical control and a normal population, what proportion of the population will meet specifications of 1.65 ± .05?

    A. 80%

    B. 86%

    C. 97%

    D. 93%

70. The control chart that is most sensitive to variations in measurements is:

    A. p chart.

    B. np chart.

    C. c chart.

    D. $\bar{x}$ and R chart.

71. If a process is out of control, the theoretical probability that a single point on the $\bar{x}$ chart will fall between plus one sigma and the upper control limit is:

    A. 0.2240

    B. 0.1587

    C. Unknown

    D. 0.3413

72. What sample size is required to construct a confidence interval for the mean of a population with standard deviation .035? Assume a confidence level of 98% and a confidence interval width of .02.

    A. 8

    B. 33

    C. 21

    D. 67

73. In order to be effective, the quality audit function ideally should be:

    A. an independent organizational segment in the quality control function.

    B. an independent organizational segment in the production control function.

    C. an independent organizational segment in the manufacturing operations function.

    D. all of the above.

74. A purchaser wants to determine whether or not there is any difference between the means of the convolute paperboard cans supplied by two different vendors, A and B. A random sample of 100 cans is selected from the output of each vendor. The sample from A yielded a mean of 13.59 with a standard deviation of 5.94. The sample from B yielded a mean of 14.43 with a standard deviation of 5.61. Which of the following would be a suitable null hypothesis to test?

    A. $\mu A = \mu B$

    B. $\mu A > \mu B$

    C. $\mu A < \mu B$

    D. $\mu A \neq \mu B$

75. If a sample size of 16 has an average of 2.53 and a standard deviation of .04, estimate the 95% confidence interval for the population mean, μ (assume a normal distribution).

    A. (2.525, 2.535)

    B. (2.52, 2.54)

    C. (2.44, 2.62)

    D. (2.51, 2.55)

76. The test used for testing significance in an analysis of variance table is:

    A. the z-test.

    B. the t-test.

    C. the F-test.

    D. the Chi-square test.

77. A 4^3 experiment means that we are considering:

    A. three levels of four factors.

    B. four dependent variables and three independent variables.

    C. four go/no-go variables and three continuous variables.

    D. four levels of three factors.

78. Use this contingency table to compute P(A|X) (the conditional probability of event A given that event X has occurred):

	A	B	
X	3	8	
Y	5	6	

    A. .273

    B. .304

    C. .426

    D. .602

79. In performing an analysis of variance for a single-factor experiment, a fundamental assumption is made that the treatment:

    A. means are equal.

    B. means are unequal.

    C. variances are equal.

    D. variances are unequal.

80. Dodge-Romig tables are designed to minimize which parameter?

    A. AOQL

    B. AQL

    C. ATI

    D. AOQ

ANSWERS TO SIMULATED EXAM

(* denotes problems from the sample CQE Exam published in *Quality Progress* July 1984)

1. C
2. B*
3. A; P(A or B) = P(A) + P(B) – P(A&B) = .83 + .83 – .83
4. B
5. D
6. A
7. D
8. D*
9. C*
10. B
11. C*
12. D*
13. B
14. B
15. B
16. C
17. B
18. A
19. B
20. C*
21. B
22. B
23. C*
24. D
25. D
26. B
27. E*
28. D*

*From the sample CQE Exam published in *Quality Progress* July 1984.

29. D*
30. C
31. E*
32. C; The downward arrow points to the sampling plan for code letter H.
33. E; Such equipment is not considered a quality cost.
34. D
35. B*
36. D
37. D*; $\lambda = 145 \div [1650 \times 400] \approx .00022$; $R(850) \approx e^{-.00022 \times 850} \approx .83$
38. A*
39. C; $R(129) = e^{-129 \times 1/129} = e^{-1} \approx .368$
    [Note that it is always true that $R(\text{MTBF}) \approx .368$]
40. C; $\lambda = 1/2500 = .0004$ $R(2000) = e^{-.0004 \times 2000} \approx .45$ Prob(success) = .45 Prob(failure) = .55
41. C
42. B; For A: $R(200) = e^{-.0003 \times 200} \approx .94$

    For B, for a normal distribution with $\mu = 600$ and $\sigma = 200$, 200 has a Z-value of –2. The area to the right of –2 in a normal table is .9772. For the series system, $Rs = .94 \times .9772$.
43. B
44. E
45. C
46. B
47. C
48. A
49. B
50. C
51. A
52. B
53. D
54. E
55. F

*From the sample CQE Exam published in *Quality Progress* July 1984.

56. C

57. A

58. B

59. A; Variance is the square of the standard deviation.

60. G

61. B

62. D; The number of orderings or permutations of 6 objects taken 3 at a time is sometimes symbolized ${}_6P_3$. The formula is ${}_nP_x = n!/(n-x)!$
In this case $6!/(6-3)!$

63. D*; x = number of defectives observed

$P(x \geq 1) = P(x > 0) = 1 - P(x = 0)$ The binomial formula is:

$$P(x) = \frac{n!}{(n-x)!\,x!} p^x (1-p)^{n-x}$$

$$P(x=0) = \frac{10!}{10! \times 0!} .1^0 .9^9 = .9^9$$

$$P(x>0) = 1 - 9^9 \approx .61$$

64. D; P(A|B) = P(A) so P(A&B) = P(A) × P(B) = .1 × .05

65. E; In the series branch, R = .92 × .92 = .8464.

That leaves a parallel system with branches .8464 and .92.
1 – .8464 = .1536, 1 – .92 = .08,
Therefore: Rs = 1 – .1536 × .08

66. C; $\bar{p}$ = .05n = 2500

$$\bar{p} \pm 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}} = 0.5 \pm 3\sqrt{.05 \times .95 / 2500} = .05 \pm 3(.0043)6$$

67. D;

UCL = 33.6 + .58 × 6.2 = 37.2
LCL = 33.6 – .58 × 6.2 = 30
UCLr = 2.11 × 6.2 = 13.1

For the sample given, average is 35.8, range = 18.

68. D; From a normal table, the area to right of +0.7 = .2420
area to right of 1.3 = .0968
subtracting: .1452

*From the sample CQE Exam published in *Quality Progress* July 1984.

69. C;

$\mu = 1.64$
USL = 1.70
LSL = 1.60
$\sigma \approx R/d_2 = .05/2.33 \approx .021$

$Zu = (USL - \mu)/\sigma = (1.70 - 1.64)/.021 = 2.86$
$Z_l = (1.60 - 1.54)/.021 = -1.90$

Area to right of 2.86 = .0021. Area to left of 1.90 = .0287.
Total area outside spec ≈.03.

70. D

71. C; Since the process is unstable, the probability is unknown.

72. D;

The z-value associated with 1% is 2.33.
The formula $n = [(z\sigma)/E]^2$ is rounded up.
E = margin of error = half the interval width.
$N = [(2.33 \times .035)/.01]^2 \approx 66.5$

73. A

74. A

75. D;

$$\bar{x} \pm \frac{ts}{\sqrt{n}}; t(.025 \times 15df) = 2.131$$

$$2.53 \pm \frac{2.131 \times .04}{4} \approx 2.53 \pm .02$$

76. C

77. D

78. A; Complete the table by totaling rows and columns:

	A	B	
X	3	8	**11**
Y	5	6	**11**
	8	**14**	**22**

P(A|X) means we focus on row X which has 11 items, of which 3 are type A.
P(A|X) = 3/11

79. C

80. C*

*From the sample CQE Exam published in *Quality Progress* July 1984.