Sample Exam Questions

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

Choose the best answer.

1. The ASQ Code of Ethics includes the following four sections:
   A. Fundamental Principles, Relations with the Public, Relations with Employers and Clients, Relations with Peers.
   B. Fundamental Principles, Legal Obligations, Relations with Employers and Clients, Relations with Peers.
   C. Fundamental Principles, Relations with the Public, Relations with Employers and Clients, Rights and Responsibilities.
   D. Appropriate Use of Knowledge, Relations with the Public, Relations with Employers and Clients, Relations with Peers.
   E. none of the above.
2. The process of studying "best practices" of other organizations is called:
   A. good manufacturing practice (GMP).
   B. quality initiative analysis.
   C. policy study and deployment (PS&D).
   D. benchmarking.
   E. none of the above.

3. The people responsible for leading quality initiatives need to:
   A. involve all those impacted in the decision-making process.
   B. consider the unanticipated consequences of any proposed changes.
   C. establish a mechanism to verify that the proposed change has the desired affect.
   D. communicate the results to others.
   E. all of the above.
4. When strong disagreements arise between team members:
   A. they should be encouraged to ignore their differences for the sake of team harmony.
   B. the team should explore data collection schemes that would help determine the correct position.
   C. the team should vote as soon as possible.
   D. the team should seek outside mediation to solve the problem.
   E. the team should report that it is unable to reach a conclusion.
5. The most useful measure of the effectiveness of training is:
   A. the score on a final examination.
   B. the opinion survey at the end of the class.
   C. a pre-test and post-test comparison.
   D. the impact on processes and products.
6. The expenditure for new equipment to be used for measuring functionality of products belongs in which quality cost category?
   A. Appraisal
   B. Prevention
   C. Internal Failure
   D. External Failure
   E. None of the above

7. Expenses incurred for a quality engineer's visit to determine whether a supplier is meeting the specifications on an existing purchase order belongs under which quality cost category?

   A. Appraisal

   B. Prevention

   C. Internal Failure

   D. External Failure

   E. None of the above

8. The quality leader most often associated with robust design is:

   A. Juran

   B. Deming

   C. Taguchi

   D. Ishikawa

9. The quality improvement cycle referred to as either PDCA or PDSA is credited to which two people?

   A. Deming and Shewhart

   B. Juran and Ishikawa

   C. Crosby and Shewhart

   D. Deming and Taguchi

   E. Juran Juran

10. Robustness of processes and products refers to:

    A. the resistance to change caused by environmental variables.

    B. the ability to produce the first part within specifications.

    C. the tendency to use less than half the total tolerance.

    D. the likelihood that the product or service will exceed customer expectations.

11. Customer complaints for products with low unit price are usually:

    A. easily satisfied.

    B. not serious.

    C. underreported.

    D. due to subterfuge.

    E. due to shortages.

12. When gathering data about product performance, one should keep in mind that customer complaints:

    A. provide reliable performance data.

    B. should be the only source for product performance data.

    C. are a poor measure of product performance.

    D. are useless as an indicator of customer satisfaction.

13. Deming recommends single suppliers for purchased parts. Advantages of this approach include:

    I. size of contract will be larger and therefore may command more attention from supplier.

    II. minimal disruption due to strikes.

    III. simplified communication.

    IV. increased competition among suppliers for each order.

    A. I and II

    B. I and IV

    C. III and IV

    D. I and III

    E. II and IV

14. Teams sometimes progress through the development stages referred to as "forming–storming–norming–performing." In the "norming" stage, the team members:

    A. each act as normal individuals rather than as a group.

    B. have opinions that tend to be normally distributed.

    C. are reluctant to express views that are different from the group consensus.

    D. begin to shift their focus from personal to team goals.

15. A team facilitator's main function is to:

    A. keep the team on task.

    B. make sure restroom facilities are available.

    C. provide new ideas for the team to consider.

    D. select team members.

16. Joseph Juran delineated three managerial processes that are interrelated as the Juran Trilogy. These may be summarized as:

    I. quality improvement.

    II. quality policy.

    III. quality training.

    IV. quality mission and vision statement.

    V. quality planning.

    VI. quality control.

    A. IV, V, III

    B. V, VI, I

    C. IV, II, VI

    D. II, IV, V

    E. II, V, I

17. Ishikawa diagrams are:

    A. based on the Japanese character for quality.

    B. cause-and-effect diagrams.

    C. similar to Pareto charts.

    D. an alternative to CPM for project management.

    E. an alternative to flowcharts.

18. Which of the following quality cost indices is likely to have the greatest appeal to top management as an indicator of relative costs?

    A. Quality cost per unit of product

    B. Quality cost per hour of direct production labor

    C. Quality cost per unit of processing cost

    D. Quality cost per unit of sales

    E. Quality cost per dollar of direct production labor

19. In spite of the quality engineer's best efforts, situations may develop in which his or her decision is overruled. The most appropriate action would be to:

    A. resign the position based upon convictions.

    B. report findings to an outside source, such as a regulatory agency or the press.

    C. document findings, report to superiors, and move on to the next assignment.

    D. discuss findings with co-workers in order to gain support, thereby forcing action.

20. Review of purchase orders for quality requirements falls into which one of the following quality cost segments?

    A. Prevention

    B. Appraisal

    C. Internal failures

    D. External failures

21. Failure costs include costs due to:

    A. quality control engineering.

    B. inspection setup for tests.

    C. certification of special-process suppliers.

    D. supplier analysis of nonconforming hardware.

22. For a typical month, 900D Manufacturing Company identified and reported the following quality costs:

Inspection wages	$ 12,000
Quality planning	4,000
Source inspection	2,000
In-plant scrap and rework	88,000
Final product test	110,000
Retest and troubleshooting	39,000
Field warranty cost	205,000

    What is the total *failure* cost for this month?

    A. $244,000

    B. $151,000

    C. $261,000

    D. $205,000

    E. $332,000

23. A quality system must include two main items—the preparation of documented quality system procedures and instructions, and:

    A. the effective implementation of the documented quality system procedures and instructions.

    B. management responsibility.

    C. purchasing department involvement.

    D. assessment of subcontractors.

24. Product verification is an important element of a quality system. Product verification:

    A. is the procedure used to verify shipping routes and rates.

    B. is primarily a design function and is not used once the design has been finalized.

    C. consists of procedures that inform top management that numerical quotas are being met.

    D. uses tests and inspection in the manufacturing process to verify conformance.

    E. is a tool used mostly by third-party auditors.

25. Unless otherwise designated, changes to quality documents should be reviewed and approved by:

    A. top management.

    B. the same organization/function that produced the original document.

    C. a team with representation from the quality function.

    D. the chief quality officer.

    E. all persons impacted by the changes.

26. The "layers" of a quality manual are:

    A. policies, procedures, instructions, and records.

    B. executive, middle management, team leader, and team members.

    C. financial, product integrity, supplier relations, and process control.

    D. vision, goals, objectives, and projects.

27. ISO 9000 is an example of:

    A. a domestic standard.

    B. an industry association standard.

    C. an international standard.

    D. an isometric standard.

    E. none of the above.

28. You contract with a company to audit one of their offshore suppliers. This type of audit is called a:

    A. client audit.

    B. third-party audit.

    C. follow-up audit.

    D. registration audit.

    E. certification audit.

29. The step of the audit that is most often poorly completed is:
    A. audit team training.
    B. corrective action and verification.
    C. notification and preparation.
    D. execution.
    E. exit meeting.
30. In most audit situations, it is best for the auditor to:
    A. notify the auditee in advance, unless prohibited by regulations.
    B. conduct a surprise audit.
    C. provide the auditee with the audit checklist at, but not before, the opening meeting.
    D. none of the above.
31. In an audit team meeting following the exit meeting, a team member suggests an additional finding. It is appropriate to:
    A. add the finding to the final report.
    B. omit the finding since it was not mentioned in the exit session.
32. The main purpose of a quality audit is to:
    A. evaluate management commitment.
    B. determine whether products conform to specifications.
    C. assure that the organization is financially sound.
    D. obtain information regarding the quality system.
    E. determine whether quality personnel are certified by a third party.
33. ANSI/ISO/ASQ Q9001-2000 replaces:
    A. ANSI/ISO/ASQC Q9001-1994.
    B. ANSI/ISO/ASQC Q9002-1994.
    C. ANSI/ISO/ASQC Q9003-1994.
    D. all of the above.
    E. none of the above.

34. In most systems of classification of quality characteristics:
    A. there are five categories.
    B. the highest categories make reference to safety and health.
    C. the lowest category refers to functional failure.
    D. fit and finish are not considered in any of the categories.
    E. none of the above.
35. Strategic plans:
    A. should be determined after tactical plans are established.
    B. tend to be more devious than operational plans.
    C. are longer term than tactical plans.
    D. are less controversial than tactical plans.
    E. are used to implement goals established by the tactical plans.
36. A material traceability system provides information on:
    A. the flow of material through manufacturing processes.
    B. the raw material used for a particular manufactured item.
    C. the purchase order to invoice payment process.
    D. location of items material to pending legal action.
    E. none of the above.
37. The principle purpose of a material review board (MRB) is to:
    A. determine the vendor of purchased material.
    B. make decisions regarding nonconforming material.
    C. review traceability records for outgoing materials.
    D. establish policies and procedures for inspecting incoming material.
38. Product traceability is usually used to:
    A. identify sources of the material used for the product.
    B. maintain a paper trail of financial transactions regarding the product.
    C. track the design changes affecting the product.
    D. maintain payroll records, clock times, and so on regarding the product.

39. A lot of size 2000 is to be inspected using ANSI/ASQ Z1.4-2003, with an AQL of .65%. Use a single, normal level II plan. The sample size is:

    A. 20

    B. 40

    C. 60

    D. 80

    E. None of the above

40. An attribute sampling plan lists the accept and reject values as Ac = 3, Re = 6. Using the plan correctly, the inspector finds five defectives. The appropriate action is to:

    A. reject the lot since the number of defectives exceeds the Ac value.

    B. accept the lot since the number of defectives is less than the Re value.

    C. draw another sample.

    D. use a different sampling plan.

    E. none of the above.

41. A lot is inspected using ANSI/ASQ Z1.4-2003 with an AQL of .65%. The lot passes the inspection. Does that guarantee that the lot has .65% or fewer defectives?

    A. Yes, because the sampling plans are statistically valid

    B. Yes, assuming the sample was randomly selected

    C. No, because Z1.4 isn't appropriate for use with defectives

    D. No, because Type I error could have occurred

    E. No, because Type II error could have occurred

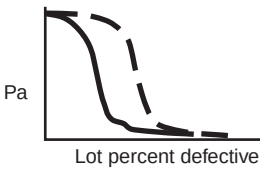
42. The diagram shows operating characteristic (OC) curves for two sampling plans. The dashed curve is:

    A. better.

    B. worse.

    C. better for the consumer.

    D. better for the producer.



43. If the lot is much worse than the AQL, then the sampling plan most likely to detect this at the lowest cost is:

    A. single.

    B. double.

44. If the same characteristic is measured 10 times, the precision of the measurement system refers to the:
    A. amount of variation among the 10 readings.
    B. proximity of the average of the 10 readings to the true value of the characteristic.
    C. smallest unit measurable.
    D. general quality of the equipment used.
45. If the same characteristic is measured 10 times, the accuracy of the measurement system refers to the:
    A. amount of variation among the 10 readings.
    B. proximity of the average of the 10 readings to the true value of the characteristic.
    C. smallest unit measurable.
    D. general quality of the equipment used.
46. The official length of a meter:
    A. is defined by a brass bar maintained at a constant temperature in Paris.
    B. varies from country to country due to the lack of an international standard.
    C. is defined using krypton-86.
    D. is the distance from the king's nose to the tip of his middle finger.
    E. None of the above
47. Accuracy refers to the:
    A. degree of agreement of measurements with an accepted reference value.
    B. number of digits on an LCD readout.
    C. ability to obtain the same value with more than one measuring device.
    D. ability to get the same answer more than once using the same measurement system.
48. FMEA is most beneficial when used:
    A. to analyze warranty data.
    B. to analyze data from the manufacturing process.
    C. during the design phase.
    D. in documentation analysis.

49. A technique for translating customer demands into product characteristics is:

    A. QFD.

    B. SPC.

    C. FMEA.

    D. AQP.

    E. DOE.

50. A subsurface discontinuity in some purchased steel bar stock is a suspected cause for the high failure rate in your parts fabrication area. All of the following nondestructive test (NDT) methods could be used to screen the bar stock except:

    A. magnetic particle testing.

    B. radiographic testing.

    C. liquid penetrant testing.

    D. eddy current testing.

    E. ultrasonic testing.

51. A lot has .15% defective parts. The attribute sampling plan is based on an AQL of .10%. In this situation, the probability of rejection is .936. Find β.

    A. 0.936

    B. 93.6%

    C. 0.468

    D. 0.064

    E. None of the above

52. A lot of size 2000 is to be inspected using ANSI/ASQ Z1.4-2003, with an AQL of .15%. Use a single, normal level II plan. The sample size is:

    A. 20

    B. 40

    C. 60

    D. 80

    E. None of the above

53. In a reliability test, 135 nonrepairable items are tested for two hours. Eleven failures are observed at the end of the test. The best expression for MTTF is:

    A. 11/270

    B. 270/11

    C. 1/135

    D. 11

    E. 1/11

54. If the time to failure distribution is exponential, the formula for the reliability function is $R(t) = e^{-\lambda t}$. If MTBF = 285, find $R(100)$.

    A. $R \approx .704$

    B. $R \approx .058$

    C. $R \approx -28{,}500$

    D. $R \approx 77{,}471$

55. Refer to the diagram of the bathtub curve. Failures in the area labeled A are usually caused by:

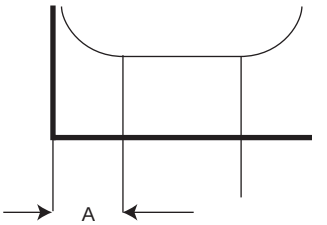
    A. product design failure.

    B. fatigue.

    C. warranty cost.

    D. manufacturing and/or quality control errors.

    E. random failure.



56. The bathtub curve can be divided into three regions. Which region is most impacted by changes in manufacturing process control?

    A. Early life region

    B. Constant failure rate region

    C. Wear out region

    D. Within $\pm 2\sigma$ of the mean

    E. None of the above

57. Appropriate labels for the horizontal and vertical axes of a graph of the bathtub curve are, respectively:

    A. MTBF and time.

    B. time and failure rate.

    C. failure rate and MTTF.

    D. time and number of failures.

    E. failure rate and time.

58. On the flat part (floor) of the bathtub curve:

    A. the failure rate is zero.

    B. the failure rate is increasing.

    C. the MTBF is constant.

    D. none of the above.

59. A system has five components in a series, each with a reliability of .999. The system reliability is closest to:

    A. .995

    B. 4.995

    C. 1.01

    D. .1998

    E. 1.000

60. A dual brake system on an automobile allows it to stop safely even if the line to one of the wheels leaks. This is an example of a:

    A. parallel system.

    B. series system.

    C. delayed failure system.

    D. constant failure rate.

    E. early failure phase.

61. Knowing the point where the floor of the bathtub curve begins to turn upward helps determine:

    A. burn-in time.

    B. failure rate.

    C. replacement schedule.

    D. MTTR.

    E. none of the above.

62. A system has $\lambda = .0032$ failures per hour and mean time to repair (MTTR) = 11 hours. The steady state availability of the system is approximately:

    A. .97

    B. .0003

    C. .035

    D. .9997

    E. none of the above

63. Derating as a design tool is the:
    A. reduction of the rated reliability of a product or component based on new data.
    B. assignment of a product to operate at stress levels below its normal rating.
    C. shortening of the warranty period in order to lower consumer expectations.
    D. removal of posted ratings from electronic components.
64. FMECA includes tools for:
    A. determining root causes of failure.
    B. assessing the probability that a product will function for a stated period of time.
    C. approximating the capability of a process to hold a certain dimension within tolerance.
    D. examining a proposed design for possible ways it can fail.
65. In calculating the RPN in an FMEA, the following three values are multiplied together:
    A. severity, opportunity, difficulty.
    B. severity, occurrence, design.
    C. severity, occurrence, detection.
    D. sensitivity, opportunity, difficulty.
66. Each failure mode and effects analysis (FMEA) report should contain:
    A. a department to be assigned.
    B. recommended corrective actions.
    C. deadline dates.
    D. return on investment.
    E. associated project management procedures.
67. A quality team is given a process problem. The team responds by carefully selecting a solution from among several that are proposed. The team next installs the solution and collects the resulting data. Based on this data, the team modifies the solution slightly, then installs it as a permanent part of the process. The best description of the procedure the team has employed is:
    A. Kaizen
    B. CI
    C. PDSA
    D. C.A.R.
    E. FMEA

68. The Deming (or Shewhart) Cycle is a guide for:
    A. the steps followed in continuous quality improvement.
    B. milestones in project or process management.
    C. the procedure used for setting up control charts.
    D. the design of quality products.
    E. quality team facilitation.
69. Kaizen activity usually:
    A. only involves personnel from accounting functions.
    B. results in a single change which has a large impact on improvement.
    C. focuses on warranty and customer satisfaction analysis.
    D. tends to produce many small incremental improvements.
70. An improvement technique known as the Shewhart Cycle has the initials PDCA or PDSA. Which element of the cycle is being executed when a team tries out a proposed procedure for improving data integrity?
    A. P
    B. D
    C. C (or S)
    D. A
71. An improvement technique known as the Shewhart Cycle has the initials PDCA or PDSA. Which element of the cycle is being executed when a team decides to make a change in standard operating procedure?
    A. P
    B. D
    C. C (or S)
    D. A
72. An affinity diagram provides a technique to:
    A. determine the extent to which two components will operate synergistically.
    B. evaluate the way different failure modes cascade into one another in a domino effect.
    C. determine the area under the normal curve as the number of standard deviations increases without bound.
    D. organize facts and opinions into natural groupings.

73. A team wants to reduce the failure rate of a complex system. A useful tool for analyzing the problem would be a:

    A. histogram.

    B. scatter diagram.

    C. Gantt chart.

    D. tree diagram.

74. A scatter diagram is most often used to provide a visual clue to:

    A. the existence of correlation.

    B. changes over time.

    C. percent defects.

    D. capability.

    E. the dispersion of the defects around the product surface.

75. Statistical software calculates that the correlation between mold temperature and shrinkage is .92. This means that:

    A. the best way to control shrinkage is to control mold temperature.

    B. changes in mold temperature influence the quality of the product.

    C. the software is calculating incorrectly.

    D. mold temperature changes cause shrinkage changes.

    E. none of the above.

76. A team needs to decide at which points in a process to measure quality characteristics. The quality tool they would use is a:

    A. control chart.

    B. check sheet.

    C. scatter diagram.

    D. flowchart.

    E. Pareto chart.

77. A team wants to illustrate which defect types are occurring most frequently. The quality tool they would use is a:

    A. control chart.

    B. check sheet.

    C. scatter diagram.

    D. flowchart.

    E. Pareto chart.

78. A team wants to determine whether it might be useful to calculate the correlation coefficient between two variables. The quality tool they would use is a:

    A. control chart.

    B. check sheet.

    C. scatter diagram.

    D. flowchart.

    E. capability analysis.

79. A team wants to determine the "shape" of the data to help determine whether it is bimodal as suspected. The quality tool they would use is a:

    A. control chart.

    B. histogram.

    C. scatter diagram.

    D. flowchart.

    E. Pareto chart.

80. The first step in determining whether there is a linear association or correlation between two variables is to:

    A. calculate the correlation coefficient.

    B. construct a Pareto analysis.

    C. construct a scatter diagram.

    D. calculate the standard deviation.

    E. construct a control chart.

81. When installing corrective action for a quality problem, it is important that:

    A. documents be updated.

    B. all involved personnel be informed.

    C. the process be monitored for recurrence of the problem.

    D. all of the above.

    E. none of the above.

82. When completing a corrective action cycle, the most frequently underemphasized step is:

    A. recurrence control.

    B. effectiveness assessment.

    C. problem identification.

    D. correction.

83. The steps in a corrective action cycle, in alphabetical order, are: 1. Correction; 2. Effectiveness assessment; 3. Problem identification; 4. Recurrence control. List these in the order a team should execute them.

    A. 3, 1, 2, 4

    B. 3, 4, 1, 2

    C. 3, 4, 2, 1

    D. 3, 2, 4, 1

84. In most lists of problem solving steps, the first step is to:

    A. install a quick fix.

    B. analyze the data.

    C. identify the problem.

    D. propose several alternative solutions.

85. Many organizations "successfully" solve problems only to have the same problems reoccur at a later date. This is due to failure of:

    A. recurrence control.

    B. problem identification.

    C. cause-and-effect analysis.

    D. flowchart application.

    E. matrix diagram implementation.

86. Robust design refers to the ability of a product to:

    A. fulfill its function for extended periods of time without failure.

    B. fulfill its function despite changes in operating environment.

    C. continue operating even though it has suffered damage.

    D. operate well for various functions in addition to the one for which it was designed.

    E. none of the above.

87. "Poka-yoke," or error-proofing, and "robust design" have the following in common:

    A. Both require statistical analysis of data

    B. Both are preventive in nature

    C. Both deal exclusively with products rather than processes

    D. Neither are used in nonmanufacturing processes

88. Most barriers to quality improvement can be attributed to:
    A. poor attitudes of hourly employees.
    B. unreasonable requirements by suppliers.
    C. inadequate statistical knowledge by quality professionals.
    D. insufficient commitment by management.
    E. lack of computer power.
89. According to the central limit theorem:
    A. the median and the mean have the same value in a symmetric distribution.
    B. the mode of a normal distribution is also the mean.
    C. the mean of an exponential distribution is smaller than the median.
    D. the mean, median, and mode of a normal distribution all have the same value.
    E. none of the above.
90. The term "expected value" is closest to the term:
    A. median.
    B. probabilistic model.
    C. mean.
    D. Markov value.
    E. regressive value.
91. A random sample is selected from a population of measurements. The mean of the sample is not equal to the mean of the population. This is due to:
    A. type I error.
    B. type II error.
    C. sampling error.
    D. abnormal population.
    E. inexact measurements.
92. A population of size 1,000,000 has mean 42 and standard deviation 6. Sixty random samples of size 15 are selected. According to the central limit theorem, the distribution of the 60 sample means has a mean of approximately:
    A. 42
    B. 42/6
    C. 42/15
    D. $42 / \sqrt{15}$
    E. none of the above

93. A population of size 1,000,000 has mean 42 and standard deviation 6. Sixty random samples of size 15 are selected. According to the central limit theorem, the distribution of the 60 sample means has a standard deviation of approximately:

    A. 6

    B. 6/42

    C. 6/15

    D. $6 / \sqrt{15}$

    E. none of the above

94. A _____ from a sample is used to estimate a population _____. The two words that best fill these blanks are:

    A. item, value.

    B. value, statistic.

    C. statistic, parameter.

    D. parameter, value.

    E. parameter, statistic.

95. Deming called the technique of studying a sample to gain understanding of the distribution of a population an "enumerative study." His main objection to these studies was that:

    A. they are too difficult to perform correctly.

    B. they require extensive use of computers.

    C. they assume a stable distribution.

    D. random samples are expensive to obtain.

    E. these studies have a high probability of type II error.

96. If the probability that an event will occur is .83, then the probability that the event will not occur is:

    A. .17

    B. .07

    C. .6889

    D. ≈ 1.20

    E. 83%

97. If the probability that event A occurs is .51, the probability that event B occurs is .64, and the probability that both A and B occur is .23, then:

    A. events A and B are complementary.

    B. events A and B are mutually exclusive.

    C. events A and B are supplementary.

    D. events A and B are not mutually exclusive.

    E. events A and B are statistically independent.

98. If the probability that event A occurs is .51, the probability that event B occurs is .64, and events A and B are statistically independent, then:

    A. A and B are mutually exclusive.

    B. the probability that both A and B occur is .3264.

    C. A and B can't both occur.

    D. the probability that A occurs is 1 – (probability that B occurs).

    E. A and B have different standard deviations.

99. The stem-and-leaf plot has the following advantage over the histogram:

    A. It provides additional information

    B. It provides a time reference

    C. It provides a better indication of the shape of the data

    D. It is more appropriate for discrete data

    E. None of the above

100. A dimension has tolerance 15.100 to 15.110. To simplify the data collection sheets, the 15 is omitted so values such as .102 are recorded. This is an example of:

    A. data coding.

    B. data manipulation.

    C. stem-and-leaf separation.

    D. data shifting.

    E. rational subgroups.

101. Maintaining a good calibration schedule will help with:

    A. data accuracy.

    B. data precision.

    C. data integrity.

    D. data security.

    E. data coding.

102. A population is bimodal. One hundred samples of size 30 are randomly collected and the 100 sample means are calculated. The distribution of these sample means is:

    A. bimodal.

    B. approximately exponential.

    C. approximately Poisson.

    D. approximately normal.

    E. approximately uniform.

103. A population is bimodal with a variance of 5.77. One hundred samples of size 30 are randomly collected and the 100 sample means are calculated. The standard deviation of these sample means is approximately:

    A. 5.77

    B. 2.40

    C. 1.05

    D. 0.44

    E. 0.19

104. An automatic gauging system is to be installed in a process. The gage will insert data values into a database from which machine adjustments will be made automatically. A critical factor in specifying the equipment is:

    A. the communication link between the gage and the computer.

    B. the compatibility of software in the the gage and in the computer.

    C. adequate manual overrides.

    D. all of the above.

105. The median is a better choice than the mean for a measure of central tendency if the data:

    A. is bimodal.

    B. often has outliers.

    C. is normally distributed.

    D. is exponentially distributed.

106. Calculate the estimated variance of the population from which the following values have been randomly selected: 2.8 2.7 2.6 2.9 2.8 2.8 2.8

    A. .095

    B. .009

    C. .088

    D. .008

107. An advantage of using standard deviation rather than range for measuring dispersion of a large sample is that:

    A. standard deviation has a simpler formula.

    B. calculators have a standard deviation key but not a range key.

    C. standard deviation uses information from each measurement.

    D. range calculations are not normally distributed.

108. Data are collected in *xy* pairs and a scatter diagram shows that the points are grouped very close to a straight line that tips down on its right-hand end. A reasonable value for the coefficient of correlation is:

    A. .8

    B. 0

    C. –.9

    D. 1

    E. 1.3

    F. –1.8

109. The mean, median, and mode of a distribution have the same value. What can be said about the distribution?

    A. It is exponential

    B. It is normal

    C. It is uniform

    D. None of the above

110. Approximately what percent of the data values are smaller than the mean?

    A. 25%

    B. 50%

    C. 75%

    D. Between 0% and 99+% inclusive

111. A normal probability plot is used to:

    A. determine whether the distribution is normal.

    B. plot z-values.

    C. determine process capability.

    D. find percent out of specification.

112. The mean of a Poisson distribution is 2.94. Its standard deviation is:

    A. Not enough information is given

    B. 1.71

    C. 8.64

    D. 74.7

    E. 1.31

113. The χ^2 distribution is:

    A. symmetric.

    B. left skewed.

    C. right skewed.

    D. normal.

    E. uniform.

114. The distribution upon which p charts are based is called:

    A. normal.

    B. Poisson.

    C. bimodal.

    D. binomial.

    E. exponential.

115. Ten parts are randomly selected from a normally distributed population. The lengths of the parts are measured and the mean of the 10 values is 10.622. The sample standard deviation of the 10 values is .005. There is a .95 probability that the mean of the population from which the sample is drawn is between:

    A. 10.600 and 10.644

    B. 10.615 and 10.629

    C. 10.618 and 10.626

    D. 10.621 and 10.623

116. An example of a measurement 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. length in inches.

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

117. Samples of 100 units of blood are tested for the presence or absence of the hepatitis C antibody. The resulting data (number of units per sample testing positive) will form which type of distribution?

    A. Normal

    B. Poisson

    C. Hypergeometric

    D. Binomial

    E. Exponential

118. A capability study is done on the diameter of stainless steel rods turned on an automatic lathe. The most appropriate probability distribution to use is:

    A. normal.

    B. Poisson.

    C. hypergeometric.

    D. binomial.

    E. exponential.

119. A control chart will plot the number of errors per invoice for an accounts receivable function. The most appropriate probability distribution is:

    A. normal.

    B. Poisson.

    C. hypergeometric.

    D. binomial.

    E. exponential.

120. A sample of size 35 is selected from a population of 10,000. The resulting analysis shows that *"The 95% confidence interval for the mean is (34.5, 45.6)."* This indicates that:

    A. 95% of the sample values are between 34.5 and 45.6.

    B. 95% of the population is between 34.5 and 45.6.

    C. there is a 95% probability that the population mean is between 34.5 and 45.6.

    D. there is a 95% probability that the sample mean is between 34.5 and 45.6.

    E. 95% of the sample means are between 34.5 and 45.6.

121. A lot of 10,000 pieces of plastic tubing has been received. The purchase order states that the average inside diameter is to be .188 inch. Twelve pieces are randomly selected. Their inside diameters are:

    .182 .188 .186 .186 .187 .183 .182 .183 .185 .184 .183 .186

    A hypothesis test is performed with null hypothesis Ho: $\mu = .188$ and alternative hypothesis Ha: $\mu < .188$. The critical (or table) value would be (Use $\alpha = .01$):

    A. 2.681

    B. 2.718

    C. 3.055

    D. 3.106

    E. 2.33

122. Paired data collected from a process are: (2.3, 9.7), (2.4, 10.6), (3.5, 12.8), (4.1, 14.2). Use this data to calculate the coefficient of linear correlation. Its value is approximately:

    A. .58

    B. .77

    C. –.42

    D. 1.29

    E. None of the above

123. Paired data collected from a process are: (2.3, 9.7), (2.4, 10.6), (3.5, 12.8), (4.1, 14.2). Calculate the slope of the best fitting "least squares" linear regression equation. Its value is approximately:

    A. .58

    B. .77

    C. –.42

    D. 1.29

    E. None of the above

124. Assume that a regression equation has slope $b_1 = 2.5$ and intercept $b_0 = –77.3$. Estimate the y-value that would result if x is 12:

    A. –47.3

    B. –925.1

    C. –79.8

    D. –62.8

    E. None of the above

125. Two variables have a linear coefficient of –.97. One concludes from this information that:

    A. the two variables are not related.

    B. changes in one of the variables could not be causing changes in the other.

    C. there is strong evidence that changes in one of the variables causes changes in the other.

    D. the two variables are strongly correlated.

126. After conducting a hypothesis test, it is concluded that the null hypothesis cannot be rejected at the .05 significance level. This means that:

    A. we can be 95% certain that the null hypothesis is true.

    B. there is a 95% probability that the alternative hypothesis is false.

    C. there is a 95% probability that the alternative hypothesis is true.

    D. there is a 5% probability that the null hypothesis is true.

    E. none of the above.

127. A pharmaceutical manufacturer is designing an experiment to test four different capsule ingredients designed to reduce dissolution time. Each ingredient will be tested at 10 milligrams and 40 milligrams. A full or complete factorial design is used with five replications per run. The number of levels, factors, and runs is, respectively:

    A. 2, 4, 16

    B. 4, 5, 8

    C. 10, 4, 40

    D. 2, 20, 16

128. (Refer to the previous problem.) The variance of the five replications for each run is calculated. Most of these variances are approximately equal but two are significantly lower than the others. The experimenters would be especially interested in those two runs if they want to optimize:

    A. dissolution time.

    B. interactions.

    C. main effects.

    D. robustness.

    E. degrees of freedom.

129. (Refer to the previous problem.) To estimate the within-treatment variance, the experimenters would calculate the variances of:

    A. all 80 readings.

    B. the five replications for each run.

    C. the runs for which a factor is at its lowest level.

130. An experiment has seven factors at two levels each. The experiment has eight runs. This experimental design is called:

    A. full-factorial design.

    B. half-fractional-factorial design.

    C. interaction.

    D. none of the above.

131. The principle disadvantage of fractional factorial experiments is that:

    A. experimental error is high.

    B. robustness is compromised.

    C. effects are confounded.

    D. measurements are less precise.

    E. analysis is more difficult.

132. In a resolution III fractional factorial experimental design, main effects are confounded with:

    A. one-factor interactions.

    B. two-factor and higher interactions.

    C. three-factor and higher interactions.

    D. no other effects.

133. A process needs a constant pH of between 5 and 9 to operate efficiently. A control chart is used to monitor the acidity of a well-stirred vat of liquid. An $\bar{x}$ and R chart is used with $n = 4$. The four readings in each sample are collected from the four compass points approximately 4″ from the outside of the round vat. The $\bar{x}$ and R chart is not a good choice for this situation because it will probably show:

    A. very few points outside control limits even when the process is not stable.

    B. a large number of points outside the control limits even when the process is stable.

    C. the process is not normally distributed.

    D. the average run length (ARL) is excessive.

134. A stable, normally distributed process with specification 3.50 ± .03 has $\mu = 3.51$ and $\sigma = .016$. What percent of the production violates specification?

    A. 16.43%

    B. 12.62%

    C. 18.58%

    D. 11.18%

135. (Refer to the previous problem.) Find C_p and C_{pk}:

    A. 1.21 and .85

    B. .85 and 1.21

    C. .35 and .63

    D. .63 and .42

    E. None of the above

136. The following data were collected on the diameters of turned shafts: 2.506 2.508 2.505 2.505. These values are:

    I. attribute data.

    II. discrete data.

    III. variables data.

    IV. continuous data.

    A. I and II

    B. I only

    C. II only

    D. I and IV

    E. III and IV

ANSWERS TO SAMPLE EXAM QUESTIONS

1. A
2. D
3. E
4. B
5. D
6. E
7. A; A visit to determine whether a contract should be awarded belongs in the Prevention category.
8. C
9. A
10. A
11. C
12. C
13. D
14. D
15. A
16. B
17. B
18. D
19. C
20. A
21. D
22. E
23. A
24. D
25. B
26. A
27. C
28. B
29. B
30. A

31. B
32. D
33. D
34. B
35. C
36. B
37. B
38. A
39. E; The correct answer is 125.
40. C
41. E
42. D
43. B
44. A
45. B
46. E; The krypton-based standard was replaced in 1975 with one based on the distance traveled by a light wave in a stated period of time.
47. A
48. C
49. A
50. C
51. D; β is the probability of failing to reject a bad lot. Since the probability of rejection is .936, the probability of not rejecting is 1 – .936.
52. D; Note that the arrow in the table points to the plan with code letter J.
53. B; λ = failure rate = (# failures) ÷ (total test time). Then calculate MTTF = $1/\lambda$.
54. A; $\lambda = 1/\text{MTBF} = 1/285 \approx .003509$ $\quad R(100) \approx e^{(-.0035)(100)} = .704$
55. D
56. A
57. B
58. C; Since the failure rate is constant, MTBF will be also.
59. A; $Rs = .9995$
60. A

61. C; It is often appropriate to recommend replacement as the wear-out phase begins and λ rises.
62. A; Solution note: A = MTBF/(MTBF + MTTR)
63. B
64. D
65. C
66. B
67. C
68. A
69. D
70. B
71. D
72. D
73. D
74. A
75. E
76. D; Although all these could be used, the team would almost invariably use a flowchart also.
77. B
78. C; Before calculating *r*, it is best to view the data on a scatter diagram to see if there appears to be an association between the variables.
79. B
80. C
81. D
82. A
83. A
84. C
85. A; Cause-and-effect analysis could be faulty, but even if the CE were perfect, a failure can occur if recurrence control is poor.
86. B
87. B
88. D
89. E

90. C

91. C

92. A

93. D; The formula for approximating the standard deviation of the distribution of sample means is $\sigma / \sqrt{n}$.

94. C

95. C

96. A; P(not A) = 1 – P(A)

97. D; If A and B are mutually exclusive, P(A&B) = 0. Since P(A&B) = .23, they are not mutually exclusive, indicating that D is the correct response. Could E be correct also? If the events are statistically independent, then P(A&B) = P(A)P(B). Since this equation is not valid, the events are not statistically independent.

98. B; Since the events are statistically independent, P(A&B) = P(A)P(B).

99. A

100. A

101. A

102. D; This is an application of the central limit theorem.

103. D; The population standard deviation is $\sqrt{.577} \approx 2.40$. The formula for standard deviation of the distribution of sample means is $\sigma / \sqrt{n} \approx 2.40 / \sqrt{30}$.

104. D

105. B; The median tends to be minimally influenced by an outlier. Consider the set 3, 4, 6, 8, 8, 12, which has a median of 7. If the 6 is misread as 60, the set would be 3, 4, 8, 8, 12, 60. The median would still be 8 although the mean has gone from 6.8 in the original set to 15.8 in the new set.

106. B; Find the estimated standard deviation of the population and square it to obtain the variance.

107. C

108. C

109. D; Any symmetric distribution with mode at the axis of symmetry will have mean = median = mode.

110. D; If all values in a set are equal, the mean would be that value and 0% would be less than the mean.

111. A

112. B; The mean and variance of a Poisson distribution are equal.

113. C

114. D

115. C; The confidence interval formulas are: $\bar{x} \pm ts / \sqrt{n}$

Substituting: $10.622 \pm t_{.025}(.005) / \sqrt{10} \approx 10.622 \pm .004$

116. B

117. D

118. A

119. B

120. C

121. A; $\bar{x} \approx .185 \quad s \approx .002$ The confidence interval formula is $\bar{x} \pm ts / \sqrt{n}$.

Substituting: $.185 \pm t_{.05}(.002) / \sqrt{12} = .185 \pm 1.796(.002) / \sqrt{12} \approx .185 \pm .001$

122. E;

	x	y	xy	x^2	y^2
	2.3	9.7	22.31	5.29	94.09
	2.4	10.6	25.44	5.76	112.36
	3.5	12.8	44.8	12.25	163.84
	4.1	14.2	58.2	16.81	201.64
Σ	12.3	47.3	150.75	40.11	571.93
mean	3.075	11.825			

$$r = \frac{S_{xy}}{\sqrt{S_{xx} S_{yy}}}$$

where $S_{xx} = \Sigma x^2 - (\Sigma x)^2/n = 40.11 - 12.3^2/4 = 2.2875$

$S_{xy} = \Sigma xy - (\Sigma x)(\Sigma y)/n = 150.75 - 12.3 \times 47.3/4 = 5.3025$

$S_{yy} = \Sigma y^2 - (\Sigma y)^2/n = 571.93 - 47.3^2/4 = 12.6075$

Substituting, $r = (5.3025) / \sqrt{(2.2875)(12.6075)} \approx .99$

123. E; $b_1 = S_{xy}/S_{xx} = 5.3025/2.2575 \approx 2.3$

(Incidentally, $b_o = \bar{y} - b_1 \bar{x} = 11.825 - 2.3 \times 3.075 \approx 4.75$)

124. A; $y = 2.5x - 77.3 = 2.5 \times 12 - 77.3$

125. D; Correlation, even though high, does not imply causation.

126. E; It means that the probability that the null hypothesis is false is less than 95%.

127. A; The formula for number of runs for a full-factorial experiment: $(\#\text{levels})^{(\#\text{factors})}$

128. D; The most robust design occurs when the environmental factors (those not being controlled) have the least impact on the quality characteristic being studied.

129. B; Within-treatment variation is the variation that occurs when the treatment (levels and factors) are not changed.

130. D; A full factorial would have $2^7 = 128$ runs. A half factorial would have 64 runs. This is a one-sixteenth fractional factorial.

131. C

132. B

133. B

134. D;

$Z_L = .04/.016 = 2.5$ from a normal table, .62% violates the lower specification
$Z_U = .02/.016 = 1.25$ from a normal table, 10.56% violates the upper specification

135. D;

$C_p = (USL - LSL) \div (6\sigma) = (3.53 - 3.47) \div (.096) \approx .63$
$C_{pk} = \text{Min}(Z_L, Z_U) \div 3 = \text{Min}(2.5, 1.25) \div 3 = 1.25 \div 3 \approx .42$

136. E