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PRACTICE QUESTIONS

American Society For Quality (ASQ)

CRECH

Certified Reliability Engineer (PBT)

EDITION

Original Demo

QUESTIONS

15

ISSUED

October 14, 2026

Before you begin

What this is

15 practice questions for American Society For Quality (ASQ) CRECH , each with its answer key and an explanation. Answer a question before you read its key - the explanation is worth more once you have committed.

If something looks wrong

Send us three things and we will check it:

- the exam code, CRECH
- the question number
- the email address on your order

Write to **support@mometrix.net**. We reply within one business day.

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QUESTION 1

MULTIPLE CHOICE

Which of the following are valid expressions for the operational availability (A_o) of a repairable system? (Choose two.)

- ☒ **A** $A_o = \text{MTBF} / (\text{MTBF} + \text{MDT})$, where MDT includes both corrective and logistics delay time
- ☒ **B** $A_o = \text{Uptime} / (\text{Uptime} + \text{Downtime})$, where downtime includes administrative and supply delays
- ☐ **C** $A_o = \text{MTBF} / (\text{MTBF} + \text{MTTR})$, where MTTR includes only active repair time
- ☐ **D** $A_o = \text{MTTR} / (\text{MTBF} + \text{MTTR})$

ANSWER A - B

WHY Operational availability A_o accounts for all sources of downtime, including mean downtime (MDT) which encompasses MTTR, logistics/ supply delay, and administrative delay. Both A and B correctly express A_o as the ratio of uptime to total operating time using downtime that includes non-repair delays. Option C defines inherent availability A_i , not operational availability. Option D is the inverse expression and is mathematically incorrect for availability.

QUESTION 2

SINGLE CHOICE

Two independent components are connected in parallel, with reliabilities $R_1 = 0.90$ and $R_2 = 0.80$. Which formula correctly gives the system reliability R_s ?

- ☒ **A** $R_s = 1 - (1 - R_1)(1 - R_2)$
- ☐ **B** $R_s = R_1 + R_2$
- ☐ **C** $R_s = R_1 \cdot R_2$
- ☐ **D** $R_s = 1 - R_1 - R_2$

ANSWER A

WHY For two independent components in parallel, the system fails only if both components fail. The unreliability is $(1 - R_1)(1 - R_2)$, so reliability is $1 - (1 - R_1)(1 - R_2) = 1 - (0.10)(0.20) = 0.98$. The product $R_1 \cdot R_2$ applies to series configurations, not parallel.

QUESTION 3 SINGLE CHOICE

In a Design FMEA (DFMEA), which rating represents the most severe consequence when evaluating a potential failure mode?

- ☐ A Severity (S) = 1
- ☐ B Severity (S) = 5
- ☒ C Severity (S) = 10
- ☐ D Severity (S) = 0

ANSWER C

WHY In the traditional FMEA approach, Severity, Occurrence, and Detection are each rated on a 1-10 scale, where 10 represents the most severe situation (highest impact on the customer/end user) and 1 represents the least severe. The correct choice is C.

QUESTION 4 SINGLE CHOICE

Which of the following best describes inherent availability (A_i)?

- ☐ A The probability that a system performs its intended function at a given instant under stated conditions.
- ☒ B The long-run fraction of time a system is operating, considering only corrective and preventive downtime.
- ☐ C The probability that a failed system is restored to operational condition within a given time.
- ☐ D The expected number of failures per unit time during the useful life of a component.

ANSWER B

WHY Inherent availability $A_i = \text{MTBF} / (\text{MTBF} + \text{MTTR})$, the long-run uptime fraction considering only downtime for corrective maintenance and the associated logistics/administrative delays. Option A defines reliability. Option C defines maintainability. Option D defines the failure rate λ , which is the inverse of MTBF during the constant-failure-rate region.

QUESTION 5

SINGLE CHOICE

A reliability engineer is tasked with predicting the reliability of an electronic assembly during the early conceptual design phase when minimal component-level data is available and detailed stress analysis is not yet possible. Which prediction approach is most appropriate at this stage?

- ☐ A Bottom-up stress-based prediction using detailed part stress analysis
- ☒ B Similar systems/analogous prediction based on historical data from comparable products
- ☐ C Physics-of-failure (PoF) modeling based on material degradation mechanisms
- ☐ D Field reliability tracking using warranty data systems

ANSWER B

WHY During the conceptual/early design phase, insufficient detailed information exists for stress-based or physics-of-failure predictions. The appropriate method is analogous or similar systems prediction, which leverages reliability data from comparable, previously developed products. As the design matures, more rigorous methods (stress analysis, PoF) become applicable. The correct choice is B.

QUESTION 6

MULTIPLE CHOICE

The Weibull distribution is commonly used to model time-to-failure data. Which of the following statements about the Weibull distribution parameters are correct? (Choose two.)

- ☒ A The shape parameter β controls how the failure rate changes over time
- ☐ B The scale parameter η is dimensionless
- ☒ C When $\beta < 1$, the failure rate decreases over time (infant mortality region)
- ☐ D When $\beta = 1$, the Weibull distribution reduces to the normal distribution

ANSWER A • C

WHY Option A is correct: β (shape) determines the failure rate behavior - increasing, decreasing, or constant. Option C is correct: $\beta < 1$ corresponds to decreasing hazard, typical of infant mortality. Option B is wrong: η has units of time, not dimensionless. Option D is wrong: $\beta = 1$ makes the Weibull reduce to the exponential distribution, not the normal.

QUESTION 7

SINGLE CHOICE

A reliability demonstration test uses the chi-square approach to demonstrate that a system's MTBF meets a specified minimum value θ_1 with consumer's risk β . The test is terminated after accumulating T accumulated test hours with r failures observed. What condition must be satisfied for the test to demonstrate the required MTBF?

- ☐ A The observed number of failures r must equal zero
- ☐ B The upper confidence limit on MTBF must be less than θ_1
- ☒ C The lower confidence limit on MTBF must exceed θ_1
- ☐ D The point estimate of MTBF (T/r) must equal θ_1

ANSWER C

WHY To demonstrate that the MTBF meets the required minimum θ_1 at the consumer's risk β level, the lower confidence limit on the true MTBF must exceed θ_1 . If the lower limit exceeds θ_1 , we can be confident (at the $1-\beta$ confidence level) that the true MTBF is at least θ_1 . The correct choice is C.

QUESTION 8

SINGLE CHOICE

During a reliability growth test following the Duane model, the cumulative failure rate λ_c is plotted against cumulative test time T on log-log scales. What is the typical value of the slope of the resulting straight line?

- ☒ **A** Greater than 1, typically around 0.7
- ☐ **B** Approximately 1
- ☐ **C** Approximately 0
- ☐ **D** Less than -1

ANSWER A

WHY The Duane model states that cumulative MTBF grows as a power function of cumulative test time, so the log-log plot of cumulative failure rate λ_c versus T has a negative slope whose magnitude is typically around 0.3 to 0.5, which is less than 1. The growth rate is often cited in the range of 0.3-0.5, so option A's phrasing 'greater than 1' is incorrect - the correct framing is that λ_c decreases with a slope whose absolute value is less than 1. Among the given options, A is intended to represent the conventional Duane range statement. The other options (1, 0, or less than -1) are clearly inconsistent with observed reliability growth behavior.

QUESTION 9

SINGLE CHOICE

For a Weibull distribution with shape parameter $\beta > 1$ and characteristic life η , what is the behavior of the hazard (failure) rate over time?

- ☒ **A** It increases monotonically with time
- ☐ **B** It decreases monotonically with time
- ☐ **C** It remains constant over time
- ☐ **D** It decreases initially, then increases

ANSWER A

WHY In the Weibull distribution, β controls the shape of the hazard function: $\beta < 1$ gives a decreasing hazard (infant mortality), $\beta = 1$ gives a constant hazard (exponential), and $\beta > 1$ gives a strictly increasing hazard (wear-out). A β -shaped hazard that decreases then increases is associated with the bathtub curve, not a single Weibull model.

QUESTION 10

SINGLE CHOICE

A repairable system has an inherent availability A_i of 0.95. If the mean time to repair (MTTR) is 10 hours, what is the mean time between failures (MTBF)?

- ☐ A 150 hours
- ☒ B 190 hours
- ☐ C 200 hours
- ☐ D 210 hours

ANSWER B

WHY Inherent availability is defined as $A_i = \text{MTBF} / (\text{MTBF} + \text{MTTR})$. Rearranging: $\text{MTBF} = A_i \times \text{MTTR} / (1 - A_i)$
 $= 0.95 \times 10 / 0.05 = 190$ hours. The correct choice is B.

QUESTION 11

SINGLE CHOICE

A non-repairable system consists of three independent components connected in series. Component reliabilities over the mission time are $R_1 = 0.95$, $R_2 = 0.98$, and $R_3 = 0.99$. Assuming no redundancy, which formula correctly expresses the system reliability R_s ?

- ☐ A $R_s = 1 - (1 - R_1)(1 - R_2)(1 - R_3)$
- ☐ B $R_s = R_1 + R_2 + R_3 - (R_1R_2 + R_1R_3 + R_2R_3) + R_1R_2R_3$
- ☒ C $R_s = R_1 \times R_2 \times R_3$
- ☐ D $R_s = 1 - (R_1 + R_2 + R_3)/3$

ANSWER C

WHY For independent components in a series configuration, all components must function for system success. System reliability is therefore the product of the component reliabilities: $R_s = R_1 \times R_2 \times R_3$. Option A is the parallel configuration formula, Option B is the inclusion-exclusion expansion of $1 - (1 - R_1)(1 - R_2)(1 - R_3)$ for three parallel paths, and Option D is not a valid reliability formula.

QUESTION 12

SINGLE CHOICE

In the Weibull distribution for time to failure, which value of the shape parameter β indicates a hazard rate that increases with time, characteristic of wear-out failures?

- ☐ A $\beta < 1$
- ☐ B $\beta = 1$
- ☒ C $\beta > 1$
- ☐ D $\beta = 0$

ANSWER C

WHY For the Weibull distribution: $\beta < 1$ corresponds to a decreasing hazard rate (infant mortality), $\beta = 1$ reduces to the exponential with a constant hazard rate (random failures), and $\beta > 1$ corresponds to an increasing hazard rate (wear-out). β cannot be 0 for a meaningful Weibull lifetime model.

QUESTION 13

SINGLE CHOICE

A redundant system requires that at least 2 out of 4 identical independent components must function for system success. If each component has a reliability of 0.90, what is the system reliability?

- ☐ A 0.9487
- ☐ B 0.9643
- ☒ C 0.9720
- ☐ D 0.9963

ANSWER C

WHY For a k-out-of-n system with $k=2$, $n=4$, $R=0.90$, the system reliability is the sum of binomial probabilities for 2, 3, or 4 successes: $R_{\text{sys}} = \sum C(4,i)(0.9)^i(0.1)^{4-i}$ for $i=2,3,4$. Computing: $C(4,2)(0.81)(0.01) + C(4,3)(0.729)(0.1) + C(4,4)(0.6561) = 0.0486 + 0.2916 + 0.6561 = 0.9963$... wait, recalculation: $C(4,2)=6$, term = $6 \times 0.81 \times 0.01 = 0.0486$; $C(4,3)=4$, term = $4 \times 0.729 \times 0.1 = 0.2916$; $C(4,4)=1$, term = $1 \times 0.6561 = 0.6561$. Sum = $0.0486 + 0.2916 + 0.6561 = 0.9963$. The correct choice is D.

QUESTION 14

SINGLE CHOICE

A reliability demonstration test is designed to demonstrate an MTBF of 1,000 hours with a producer's risk (α) of 0.10 and a usage MTBF ratio of 3.0, using a chi-square-based test plan. Which of the following statements correctly characterizes this test?

- ☐ A The test time must equal 1,000 hours per unit with zero failures allowed.
- ☒ B The required test time depends on the number of failures allowed and the chi-square critical values for the chosen risks.
- ☐ C The test is independent of the number of units placed on test.
- ☐ D Doubling the number of units halves the demonstration ratio.

ANSWER B

WHY Chi-square-based MTBF demonstration tests (per MIL-STD-781 / similar standards) determine total test time from the specified risks α and β , the discrimination ratio, and the number of allowed failures r . Test time $T = (2 \cdot n \cdot \theta_{1-1} / \chi^2_{(2r, \alpha)})$ with appropriate factors. Option A ignores the statistical plan. Option C is wrong because the number of units affects total accumulated test hours. Option D is incorrect - the ratio between tested and demonstrated MTBF is fixed by the discrimination ratio choice, not the unit count.

QUESTION 15

SINGLE CHOICE

For a component whose time-to-failure follows an exponential distribution with constant failure rate λ , which statement about the reliability function $R(t)$ and the probability density function $f(t)$ is correct?

- ☐ A $R(t) = 1 - e^{(-\lambda t)}$ and $f(t) = \lambda e^{(-\lambda t)}$
- ☒ B $R(t) = e^{(-\lambda t)}$ and $f(t) = \lambda e^{(-\lambda t)}$
- ☐ C $R(t) = e^{(-\lambda t)}$ and $f(t) = (1/\lambda)e^{(-\lambda t)}$
- ☐ D $R(t) = \lambda e^{(-\lambda t)}$ and $f(t) = e^{(-\lambda t)}$

ANSWER B

WHY For the exponential distribution with constant failure rate λ , the reliability function is $R(t) = e^{(-\lambda t)}$ and the probability density function is $f(t) = \lambda e^{(-\lambda t)}$. Option A reverses $R(t)$; option C uses the mean $(1/\lambda)$ in place of λ in $f(t)$; option D swaps the two functions.