THE

RELIABILITY ENGINEER

SOLUTIONS TEXT

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WITH A LITTLE HELP FROM MY FRIENDS.

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We would appreciate any comments regarding improvement and errata. It is our concern to be accurate.

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SECTION II

RELIABILITY FUNDAMENTALS -- TEST QUESTIONS

2.1. Which of the following is required to establish a reliability specification?

a. The usage environment
b. The system quality
c. The reliability policy
d. A reliability model

Solution: One of the key components of a reliability specification is the usage environment. When other factors are included in the specification a reliability model can be projected. System quality (answer **b**) and reliability policy (answer **c**) are out of sync with the wording of the question.

Answer a is correct.

Reference: *CRE Primer*, Section II - 6.

2.2. The focal point for reliability tests and initial design ideas would be:

a. Supplier improvement
b. Supplier audits
c. Initial manufacturing results
d. Field data results

Solution: The focus point for reliability tests and initial design ideas would be supplier improvement.

Answers **b**, **c**, and **d** are also feedback components that would contribute to supplier improvement.

Answer a is correct.

Reference: *CRE Primer*, Section II - 21.

2.3. Specifically, up-time ratio is a measure of:

a. Maintenance action rate
b. Hazard rate
c. Maintainability
d. Availability

Solution: This is basically a definition question. "Uptime" is the time when a unit is available for use. Availability is the probability that a system will operate satisfactorily and effectively at any point in time, when used and operated under specified conditions. Maintenance Action Rate is the reciprocal of Mean Time Between Maintenance Actions (MTBMA). Hazard Rate is the limit of the failure rate as the interval length between two times approaches zero (also known as the "instantaneous failure rate"). Maintainability is defined as a systems effectiveness concept that measures the ease and rapidity with which a system can be restored to operational status after failing.

$$A_0 = \frac{MTBMA}{MTBMA + MDT} \text{ or } \frac{UPTIME}{UPTIME + DOWNTIME}$$

Answer d is correct.

References: *CRE Primer*, Section II - 36 and 65. Omdahl, T. P., *Reliability, Availability, and Maintainability (RAM) Dictionary*. This question has been modified from old published CRE exams.

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2.4. Which of the following terms applies when discussing reliability specifications of non-repairable devices?

a. MTBF
b. MTBM
c. MTTF
d. Average maintenance time

Solution: Mean time to failure (MTTF) is applied when the device is not expected to be repaired. MTBF assume the device is repairable and, therefore could fail again. MTBM is mean time between maintenance and implies repairable devices.

Answer c is correct.

Reference: *CRE Primer, Section* II - 41.

2.5. Systems engineering includes mission requirements analysis, functional analysis, synthesis, logistics engineering, and which of the following?

a. HALT
b. Reliability derating
c. Reliability allocation
d. Failure modes and effects analysis

Solution: Allocation is one key for knowing how many units to plan for. The other three entries are useful tools for improving reliability.

Answer c is correct.

Reference: *CRE Primer*, Section II - 82/83.

2.6. The reliability engineer's ultimate goal in most organizations may be best expressed as:

a. The reduction of warranty returns and improvement of test yields
b. The minimization of product failure rate during the constant failure rate period
c. The analysis and optimization of full life cycle phases
d. The identification and elimination of all failure modes

Solution: A “big picture” perspective is highlighted by this question. The key phrase is “best expressed.”

The “analysis and optimization of full life cycle cost impact” best captures and conveys the ultimate objective of the complexities associated with the activities and tasks carried out by the reliability engineer. Answer **d** is always difficult to achieve. Elements of answers **a**, **b**, and **d** could be looked upon as subsets of answer **c**.

Answer c is correct.

Reference: *CRE Primer*, Section II - 54/56.

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2.7. One would say that product safety is largely:

a. A result of product quality, reliability, and management direction
b. A composite outcome of tight vendor and supplier control
c. An outcome of good product design and low component costs
d. The result of design reviews, FMEAs, and FRACAS analysis

Solution: This question is stated at a general level. Answers **b**, **c**, and **d** tend to be directed mainly at reliability and quality concerns. Answer **a** considers the larger impact of reliability, quality, and management action.

Answer a is correct

Reference: *CRE Primer*, Section II - 3/6.

2.8. Using the DMAIC approach to lean six sigma improvement, at what step would the root causes of defects be identified?

a. Measure
b. Control
c. Improve
d. Analyze

Solution: This is a straight forward question that requires some understanding of the DMAIC approach. The root causes of defects are identified during the analyze phase.

Answer d is correct.

Reference: *CRE Primer*, Section II - 71.

2.9. A lowered rejection rate following corrective action:

a. Gives a positive indication that performance has improved
b. May be unrelated to the corrective action
c. Indicates that the corrective action was directly related to the problem
d. Has no significance

Solution: Using a lowered rejection rate as a positive indication of corrective action or assuming the corrective action was directly related to the problem is often not true. Thus, answers **a** and **c** are not good choices. It also cannot be stated that the lowered rejection rate was not significant (**d** is incorrect).

The lowered rejection rate may be unrelated to the corrective action.

Answer b is correct.

Reference: *CRE Primer*, Section II - 47/52.

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2.10. Which of the following supplier reliability components would come last?

a. Document the basic supplier requirement
b. Analyze potential supplier capabilities
c. Finalize procurement criteria with the selected supplier
d. Provide supplier component feedback

Solution: As the CRE Primer documents the answer choices as presented are:

a) first step
b) third step
c) fifth step
d) ninth step

Even if the above sequences are not properly aligned for all potential customers, clearly customer feedback would follow answers **a**, **b**, and **c**.

Answer d is correct.

Reference: *CRE Primer*, Section II - 19/20.

2.11. The condition wherein an item is able to function but is not required to function is called?

a. Dormant state
b. Downing event
c. Derating
d. Degradation

Solution: The question content describes an item that is in a dormant state. The other answer choices have different meanings.

Answer a is correct.

Reference: *CRE Primer*, Section II - 25/26.

2.12. Supplier selection should be primarily based upon:

a. The time to deliver a product; faster is better
b. Life cycle cost estimates
c. The price paid, lower is better
d. Design flexibility of the supplier

Life cycle costs take into account both the initial price paid and the cost to support a component over time. Fast delivery is not a good reason to select a supplier nor is design flexibility. The price per unit is a part of life cycle cost, but is an incomplete measure by itself.

Answer b is correct

Reference: *CRE Primer*, Section II - 20.

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