

# POSTAL Study Package

# 2021

## Production and Industrial Engineering

### Objective Practice Sets

#### Quality and Reliability

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# Quality Management

- Q.1** Which one of the following is not a dimension of quality?  
(a) Performance (b) Perceived Quality  
(c) Serviceability (d) Process Capability
- Q.2** How is aesthetics of a product defined as?  
(a) How good the product performs its job.  
(b) How good it looks.  
(c) How fast the job of the product is completed.  
(d) Whether the product is made exactly as the designer intended.
- Q.3** Who was the man who first introduced the concept of control charts in the arena of quality control?  
(a) Frank Gilberth (b) Henry Grant  
(c) W.A. Shewart (d) G. Taguchi
- Q.4** By whom was six-sigma methodology first developed?  
(a) Motorola (b) Bell Laboratories  
(c) Ford Motors (d) Toyota
- Q.5** What does ASQC stand for?  
(a) All-India Standards for Quality Control  
(b) Attribute Specified Quality Control  
(c) American Society for Quality Control  
(d) All-India Society for Quality
- Q.6** Which one of these is not the part of Deming's 7 diseases of management?  
(a) Lack of constancy of purpose  
(b) Emphasis on short-term profits  
(c) Emphasis on long-term profits  
(d) Mobility of top management
- Q.7** DMAIC stands for :  
(a) Do-Measure-Act-Implement-Check  
(b) Define-Measure-Act-Implement-Control  
(c) Define-Measure-Analyse-Improve-Control  
(d) Do-Measure-Analyse-Improve-Control
- Q.8** The cause and effect diagram is a part of \_\_\_\_\_ step of DMAIC process.  
(a) Define (b) Analyze  
(c) Control (d) Measure
- Q.9** DFSS refers to :  
(a) Development of six-sigma  
(b) Design for six-sigma  
(c) Define for six-sigma  
(d) Development for six-sigma
- Q.10** In FMEA, RPN stands for  
(a) Reliability Priority Number  
(b) Risk Priority Number  
(c) Recalled Precautions Number  
(d) Reliability Precautions Number
- Q.11** Which of these is not a tool to describe variation in product units?  
(a) The Box Plot  
(b) The Histogram  
(c) Steam-and-Leaf plant  
(d) Acceptance Sampling
- Q.12** In Steam-and-Leaf Plot, the measure of variability is \_\_\_\_\_.  
(a) IQR (interquartile Range)  
(b) Mean  
(c) Median  
(d) Third Quartile
- Q.13** For a set of data having 100 observations, how many bins must be created for satisfactory results of histogram?  
(a) 25 (b) 10  
(c) 28 (d) 4
- Q.14** The most important measure of central tendency in a sample is \_\_\_\_\_.  
(a) Sample Average  
(b) Sample Variance  
(c) Frequency of Highest Observation  
(d) Frequency of Lowest Observation

- Q.15** The variability in the sample data is measured by  
(a) Sample Data (b) Sample Mean  
(c) Sample Variance (d) Range of Data
- Q.16** Which of the following expression is always true?  
(a)  $\bar{x} = s^2$ ; where  $\bar{x}$  = Mean of sample data,  
s = Sample standard deviation  
(b) Sample Standard Deviation  
=  $\sqrt{\text{Sample Variance}}$   
(c) Sample Standard Deviation > Sample Variance  
(d) None of these
- Q.17** The standard deviation of the data(s) is expressed by  
(a)  $s = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}}$   
(b)  $s = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{(n-1)}}$   
(c)  $s = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}$   
(d)  $s = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}$   
where  $\bar{x}$  is the mean of the data and  $n$  is sample size.
- Q.18** A process is said to be in the statistical control if it operates with \_\_\_\_\_ of variation.  
(a) Chance causes  
(b) Assignable causes  
(c) Both chance and assignable causes  
(d) Neither chance nor assignable causes
- Q.19** Which one of the following is not a part of SPC's 7 tools?  
(a) Pareto Chart  
(b) Histogram  
(c) Design of Experiments  
(d) Check Sheet
- Q.20** Chance causes of variation are also called \_\_\_\_\_ and assignable causes are also called \_\_\_\_\_.  
(a) Common Causes, Special Causes  
(b) Special Causes, Common Causes  
(c) Variability Causes, Non-Variability Causes  
(d) Non-Variability Causes, Variability Causes
- Q.21** In the name of the OC curve, OC stands for  
(a) Operation Characteristics  
(b) Operating Characteristics  
(c) Operator Charactersitic  
(d) Operated Characteristic
- Q.22** OC curve can be used to determine the probability of \_\_\_\_\_.  
(a) Type I Error  
(b) Type II Error  
(c) Both Type I and Type II Error  
(d) Neither Type I nor Type II Error
- Q.23** The correct expression for UCL (Upper Control Limit) for construction of a control chart is given by \_\_\_\_\_.  
(a)  $UCL = \bar{x} + \frac{Z_\alpha}{2}(\sigma_x)$   
(b)  $UCL = \bar{x} - \frac{Z_\alpha}{2}(\sigma)$   
(c)  $UCL = \bar{x} - \frac{Z_\alpha}{2}(\sigma_x)$   
(d)  $UCL = \bar{x} + \frac{Z_\alpha}{2}(\sigma)$
- Q.24** Which of the following can be used to estimate the capability of the process?  
(a) Control Charts  
(b) Process Mean  
(c) Acceptance Sampling  
(d) Designed Experiments
- Q.25** The control charts for central tendency and variability are called \_\_\_\_\_ control charts.  
(a) Variables (b) Attributes  
(c) Acceptance (d) Rejections
- Q.26** The control charts formed for judgement of conformities and non-conformities are called \_\_\_\_\_ control charts.  
(a) Variables (b) Attributes  
(c) Acceptance (d) Rejections

Answers	Quality Management						
1. (d)	2. (b)	3. (c)	4. (a)	5. (c)	6. (c)	7. (c)	8. (d)
9. (b)	10. (b)	11. (d)	12. (a)	13. (b)	14. (a)	15. (c)	16. (b)
17. (b)	18. (a)	19. (c)	20. (a)	21. (b)	22. (c)	23. (a)	24. (a)
25. (a)	26. (b)	27. (a)	28. (c)	29. (c)	30. (a)	31. (b)	32. (a)
33. (a)	34. (a)	35. (a)	36. (d)	37. (b)	38. (a)	39. (c)	40. (d)
41. (c)	42. (a)	43. (c)	44. (d)	45. (b)	46. (a)	47. (c)	48. (d)
49. (d)	50. (a)	51. (b)	52. (d)	53. (a)	54. (a)	55. (d)	56. (a)
57. (a)	58. (a)	59. (a)	60. (c)	61. (a)	62. (c)	63. (b)	64. (0.491)
65. (0.918)	66. (a)	67. (a)	68. (b)	69. (a)	70. (c)	71. (a)	72. (c)
73. (a)	74. (c)	75. (341.54)	76. (315.45)	77. (21.95)	78. (14.5795)	79. (13.741)	80. (0)
81. (22.075)	82. (1.924)	83. (a)	84. (0.0095)	85. (0.3149)	86. (0)	87. (d)	88. (a)
89. (a)	90. (b)	91. (0.0803)	92. (0.5438)	93. (0.8187)	94. (0.18)	95. (b)	96. (a)
97. (6.65)	98. (0)	99. (0.5346)	100. (b)	101. (2.666)	102. (a)		

Explanations	Quality Management
<p><b>1. (d)</b></p> <p>Eight dimensions of quality are as follows :</p> <ol style="list-style-type: none"> <li>1. Performance</li> <li>2. Reliability</li> <li>3. Durability</li> <li>4. Serviceability</li> <li>5. Aesthetics</li> <li>6. Features</li> <li>7. Perceived Quality</li> <li>8. Conformance to Standards</li> </ol>	<p>This organization promotes the use of quality improvement techniques, used in all kinds of production industries.</p>
<p><b>2. (b)</b></p> <p>The visual appeal of the product is regarded as the aesthetics of the product. The looking of a product is the aesthetic dimension of quality.</p>	<p><b>6. (c)</b></p> <p>Deming's seven deadly diseases of management are :</p> <ol style="list-style-type: none"> <li>(i) Lack of constancy of purpose</li> <li>(ii) Emphasis on short-term profits</li> <li>(iii) Evaluation of performance, merit rating and annual reviews of performance</li> <li>(iv) Mobility of top management</li> <li>(v) Running a company on visible figures alone</li> <li>(vi) Excessive medical costs</li> <li>(vii) Excessive legal damage awards</li> </ol>
<p><b>3. (c)</b></p> <p>In 1924, W.A. Shewart introduced the control chart concept in a Bell Laboratories technical memorandum.</p>	<p><b>7. (c)</b></p> <p>DMAIC is a problem solving process. It is a collection of 5 steps :</p> <p>D : Define</p> <p>M : Measure</p> <p>A : Analyse</p> <p>I : Improve</p> <p>C : Control</p>
<p><b>4. (a)</b></p> <p>Motorola developed six-sigma technique and started implementing the initiative after the year of 1987.</p>	
<p><b>5. (c)</b></p> <p>ASQC stands for American Society for Quality Control formed in 1946.</p>	

**8. (d)**

The cause and effect diagram is a part of a measure step of DMAIC process. This diagram is also known as fish bone diagram or Ishikawa diagram.

**9. (b)**

For a six-sigma organization, when it is determined that a new product is required, the improved step in DMAIC becomes design step. This is sometimes called Design for Six-Sigma.

**10. (b)**

The scores of 3 criteria of the FMEA give information about variability, failure and error score. They are multiplied together to find the RPN (Risk Priority Number).

$$\text{RPN} = \text{Severity (S)} \times \text{Occurrence (O)} \\ \times \text{Detection (D)}$$

**11. (d)**

The Box-Plot, the Histogram, and the Steam-and-Leaf plot, all are used to illustrate variation among the product units. But, acceptance sampling cannot be used to describe variation as, it is not a variation describing tool.

**12. (a)**

IQR is the interquartile range, which is equal to the value of difference between third and first quartile. It is used as a measure of variability, in the case of steam-and-leaf plot.

**13. (b)**

The bin number, in the case of creating histogram, must be between 5 and 20, to give satisfactory results. If we choose number of bins approximately equal to square root of the number of observations, it results well.

$$\sqrt{n} = \sqrt{100} = 10$$

**14. (a)**

For a sample data of 'n' observations, sample average is the most important measure of central tendency. It is an arithmetic mean of all the observations of the sample data.

**15. (c)**

The sample variance is the measure of the variability of the sample data, because it shows deviation of the observations from the mean of the data.

**16. (b)**

Sample variance is always the square of the sample standard deviation. This clarifies that Sample Standard Deviation

$$= \sqrt{\text{Sample Variance}}$$

**17. (b)**

The data sample standard deviation is expressed as :

$$s = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{(n-1)}}$$

**18. (a)**

Chance causes of variation produce the natural variability of the stable process. As this natural variability cannot be avoided, so a process is said to be in statistical control if it operates only with chance cause of variation.

**19. (c)**

**SPC's (Statistical Process Control) 7 Tools :**

- (i) Histogram or Steam-and-Leaf Plot
- (ii) Check Sheet
- (iii) Pareto Chart
- (iv) Cause-and-Effect Diagram
- (v) Defect Concentration Diagram
- (vi) Scatter Diagram
- (vii) Control Chart

**20. (a)**

Chance causes of variation and assignable causes of variation are also called the common causes and special causes of variation respectively.

**23. (a)**

$$\text{UCL (Upper Control Limit)} = \bar{x} + \frac{Z_{\alpha}}{2} (\sigma_x)$$

**41. (c)**

$$\text{Process Capability Ratio } (C_p) = \frac{USL - LSL}{6\sigma}$$

**42. (a)**

A six-sigma process has defect level below 3.4 ppm (parts per million opportunities)

**43. (c)**

S-chart is a control chart used to monitor the variability of a process quality characteristic. It is variable chart as it is used for monitor variability of variables.

**44. (d)**

The run chart of individual observations in each sample is called the tolerance diagram for any process. The tolerance diagram is also called Tier Chart of the process.

**45. (b)**

When using the standard values of process mean and standard deviation, 'A' in the equation of UCL for  $\bar{X}$ -chart is given by

$$A = \frac{3}{\sqrt{n}}$$

$$\text{So, } UCL = \mu + \frac{3}{\sqrt{n}}\sigma$$

**46. (a)**

Quality control would lead to interchangeability.

**47. (c)**

p-Charts are based on the binomial distribution.

**48. (d)**

AOQ (Average Outgoing Quality) represents the average fractional or percentage defectives in the outgoing products after inspection, included all accepted and rejected lots.

$$AOQ = \frac{P_a p(N - n)}{N}$$

where,  $N$  = Lot size  
 $n$  = Sample size  
 $p$  = % or fraction defectives in incoming lots  
 $P_a$  = Probability of acceptance

If  $N \gg n$

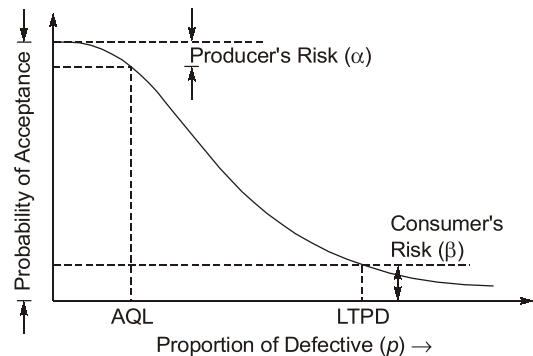
$$AOQ \approx P_a p$$

**49. (d)**

Product inspection and testing cost are a part of appraisal cost related to quality.

**50. (a)**

**AQL (Acceptable Quality Level)** : It represents the maximum percentage or proportion of defectives in a lot that consumers are willing to accept in a lot. But sometimes this type of lot rejected which is called producer's risk ( $\alpha$ ).


**51. (b)**

$$p = \frac{1}{C_p} \times 100$$

**52. (d)**

$$C_{pu} = \frac{USL - \mu}{3\sigma}$$

**53. (a)**

Process Capability Ratio is used as the measure of the ability of the process to manufacture the products, which meet the specifications set for it.

**54. (a)**

The acceptance sampling procedure is necessarily a lot sentencing procedure. It cannot be used to estimate the lot quality or lot conformity to the standard specifications.

**55. (d)**

Standard deviation of the sample average

$$\sigma_x = \frac{\sigma}{\sqrt{n}} = \frac{0.15}{\sqrt{5}}$$

$\Rightarrow$

$$\sigma_x = 0.0671 \text{ micron}$$