

Q1) List the types of acceptance sampling mentioning which side is of interest. (3marks)

1-outgoing inspection (manufacture side)

2-incoming inspection (costumer side)

3-rectifying (rework, scrap, recycle)

Q2) Three leaders for quality impacted the field. List their names and their major focus areas. (3marks)

1- Demings → statistical method of improvement quality continuous improvement.

2- Juran → managerial rule in quality implementation.

3- Armand →organizational structure.

Q3) Why is it desired to reduce the variability. (6marks)

1-Design and production of inherently safe products.

2-Economics:- **a**- increased productivity **b**-increased efficiency **c**-reduced cost **d**-greater profit

3-increased competence

4-environmental (reduced waste)

5-legal (avoid litigations and law suits).

Q4)

Performance durability aesthetics
 perceived quality security
 performance standard features

4. (8 marks) the following situations illustrate certain quality dimension or characteristic. In the provided answer box, provide which quality dimension/characteristic is illustrated in the particular situation.

a) The seal for a centrifugal pump lasts for two months.	durability
b) A manufacturer of lithium ion batteries for a certain cell phone developed another type of battery with the same performance but lasting more time.	2
c) A certain reactor is designed to achieve 80% conversion. However, the log data indicate that the reactor is operating at 81% conversion.	Performance Conformity
d) A polymerization process where it is easy to determine the molecular weight distribution from viscosity measurement.	2
e) A pharmaceutical product based on fermentation and the activity of the fermentation process is to be measured.	2
f) The Jordan Phosphate Mines Co. (JPMC) decided to purify its phosphoric acid from cadmium in compliance with the European standards.	Conformity to standard
g) Jameed-up Company made a customer survey and found that the majority of Jordanians prefer to buy liquid jameed in packages with yellowish color and labels containing a picture of mansaf (national dish in Jordan).	aesthetics = color
h) It is desired to measure the concentration of uranium in phosphoric acid.	2

(24)

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Q5)

5. (10 marks) the following (hypothetical data) were obtained when measurements of the mercury (Hg) concentration (measured as ppm) in the effluents of an adsorption column. The values of 20 samples of size 5 are given in the table below. Use $d_2 = 2.326$.

Hg conc. (ppm)	
1	0.97
2	0.93
3	1.02
4	0.93
5	0.94
6	1.04
7	1.03
8	1.04
9	1.01
10	0.99
11	1.05
12	0.92
13	1.00
14	0.99
15	1.08
16	1.04
17	0.97
18	1.00
19	1.07
20	0.96

Handwritten calculations and notes:

- $\bar{x} = 0.999$
- $s = 0.047$
- $\sigma = \frac{s}{d_2} = 0.055$
- $n = 5$
- Control limits: $\bar{x} \pm 3\sigma = 1.021$ and 0.977
- Warning limits: $\bar{x} \pm 2\sigma = 1.04$ and 0.958
- Reaction limits: $\bar{x} \pm \sigma = 1.055$ and 0.943

Handwritten notes on the table:

- 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20
- 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Questions:

- If the data are to be used to initiate mean (\bar{X}) chart for controlling the process, determine the action and warning lines for the chart.
- Are there any points out-of-control according to Western electric rules? Revise the limits if out-of-control points, if any, were eliminated.
- What would your reaction be to the development chemical engineer specifying a tolerance of 1.00 ± 0.07 ppm on the mercury concentration in the effluent?

