

# **Six Sigma Final Exam**

## **Estimated Time to complete 3.00 Hours**

### **INTRODUCTION TO QUALITY**

#### **TRUE/FALSE QUESTIONS**

1. The measure of efficiency defined as the amount of output achieved per unit of input is referred to as productivity.  
Answer:
2. Studies have shown that quality is positively related to increased market share and profitability.  
Answer:
3. Over the years, the term “quality assurance” was associated with measurement and inspection.  
Answer:
4. The contract awarded to manufacturers to supply mass produced guns to the US government occurred after the Industrial Revolution.  
Answer:
5. During the Middle Ages, the craftsperson was responsible for producing the product but not responsible for quality.  
Answer:
6. The desire to produce interchangeable parts in manufactured goods reduced the need for quality control.  
Answer:
7. Henry Ford Sr. is often referred to as the “father of scientific management.”  
Answer:
8. Under the scientific management philosophy, the worker’s task became specialized.  
Answer:
9. The institution of scientific management techniques in the early 1900s shifted responsibility for quality from the production department to the quality department.  
Answer:

# TOTAL QUALITY IN ORGANIZATIONS

## TRUE/FALSE QUESTIONS

1. Modern quality management in the United States began in the manufacturing sector.  
Answer:
2. Both the service and manufacturing sectors in the U.S. joined the quality management movement simultaneously.  
Answer:
3. Advances in service quality in the U.S. began to be observed after the year 2000.  
Answer:
4. In managing for quality, it is better to analyze systems by looking at their individual parts than to analyze the interaction between parts of the system.  
Answer:
5. Given their complexity, production systems cannot be managed as being composed of a number of smaller sub-systems.  
Answer:
6. The role of the marketing and sales function in a quality organization goes beyond advertising and selling.  
Answer:
7. An important role of marketing and sales personnel is to determine the needs and expectations of customers.  
Answer:
8. A customer's unwillingness to pay for a product's luxury features is an example of under-engineering.  
Answer:
9. Under-engineered products usually fail in the marketplace because they fail to meet customer needs.  
Answer:
10. Improving product design is viewed by Motorola as a means of improving overall product quality.  
Answer:
11. Henry Ford Sr. practiced many of the principles that came to be known in the 1980s as total quality.  
Answer:

## QUALITY PHILOSOPHIES AND FRAMEWORKS

### TRUE/FALSE QUESTIONS

1. Deming favored the use of slogans as a means to motivate workers.  
Answer:
2. Deming never defined or described quality precisely.  
Answer:
3. Under the Deming philosophy, each department should optimize its own individual performance.  
Answer:
4. According to Deming, managers have attempted and failed in using fear to motivate employees.  
Answer:
5. Deming advocated the use of numerical quotas.  
Answer:
6. Deming emphasized that experience alone is sufficient to establish a theory.  
Answer:
7. Deming proposed that payment alone is not a motivator of workers.  
Answer:
8. Deming advocated the use of relatively few suppliers as a means to reduce raw material variation.  
Answer:
9. Deming proposed a reliance on inspection to achieve quality levels.  
Answer:
10. Deming believed the vast majority of quality problems were the result of system problems.  
Answer:

## FOCUSING ON CUSTOMERS

### TRUE/FALSE QUESTIONS

1. Customers need to be loyal first and then customer satisfaction will follow.  
Answer:
2. Studies have demonstrated that customer retention is related to profitability.  
Answer:
3. The total package of products and services offered by a company is often called the provider's benefit package.  
Answer:
4. Producers should focus on a customer's perception of quality since perceived quality can influence consumer behavior.  
Answer:
5. Expected quality is a measure of what a manufacturer thinks customers want in a product or service.  
Answer:
6. The American Customer Satisfaction Index is a comparative quarterly survey of top U.S. business executives?  
Answer:
7. Overall, the American Customer Satisfaction Index has been continually increasing since its introduction in 1994?  
Answer:
8. If perceived quality is greater than expected quality, the customer will likely be satisfied.  
Answer:
9. Studies have demonstrated that loyal customers are willing to pay higher prices..  
Answer:
10. Profitable businesses focus more on customer satisfaction than on customer loyalty.  
Answer:

# LEADERSHIP AND STRATEGIC PLANNING

## TRUE/FALSE QUESTIONS

1. Successful implementation of total quality has revealed a prescription approach to leadership.

Answer:

2. Strategy can be viewed as a pattern of decisions that reveals a company's goals, policies, and plans to meet stakeholder needs.

Answer:

3. The study of leadership has resulted in a single theory of effective leadership performance.

Answer:

4. Being impulsive has been found to be one key leadership style that supports TQM.

Answer:

5. Effective leaders usually forego following their intuition and rely instead on quantitative recommendations of their analytical staff.

Answer:

6. Value congruency occurs when leaders examine their weaknesses and strengths relative to the organization's.

Answer:

7. Leaders who, in the face of uncertainty, anticipate the future and willingly make difficult decisions display intuition.

Answer:

8. Substitutes for Leadership theory supports expectations of staff members to behave like a team of oil-well firefighters.

Answer:

9. In firms committed to total quality, leaders rely on their strategic planning staffs to identify the strategic direction of the organization.

Answer:

10. A common practice of effective leaders is to delegate quality-related activities to their staff.

Answer:

## PROCESS MANAGEMENT

### TRUE/FALSE QUESTIONS

1. Process management consists of control and improvement but not design.  
Answer:
2. Value-creation (core processes) exist in manufacturing firms and not service firms.  
Answer:
3. Processes must be both measurable and repeatable to be improved.  
Answer:
4. Process owners are accountable for process performance but do not possess the authority to improve the process.  
Answer:
5. Leading companies employ systematic approaches for process improvement.  
Answer:
6. Benchmarking is the radical redesign of business processes to achieve new performance levels.  
Answer:
7. Service standards are inherently more difficult to define and measure than manufacturing specifications.  
Answer:
8. “Ninety percent of calls are answered within 30 seconds” is an example of a manufacturing specification.  
Answer:
9. Deming and Juran observed that the overwhelming majority of quality problems were associated with processes.  
Answer:
10. Value-creation (core) processes exist only in the manufacturing sector.  
Answer:

# PERFORMANCE MEASUREMENT AND STRATEGIC INFORMATION MANAGEMENT

## TRUE/FALSE QUESTIONS

1. One reason that organizations need performance measures is to drive strategies and organizational change.  
Answer:
2. Data and measurement are equivalent.  
Answer:
3. Information is derived from the analysis of data.  
Answer:
4. Traditional information systems emphasize financial and productivity information.  
Answer:
5. A “balanced scorecard” represents measures and indicators that focus only on financial performance measures.  
Answer:
6. Leading organizations in information management rigorously justify the return on investment of each expenditure in information technology.  
Answer:
7. Total quality firms concentrate on collecting product data rather than process data.  
Answer:
8. Studies have found that a specific set of performance measures and indicators apply equally to all companies.  
Answer:
9. Performance measures and indicators should reflect the most important factors that predict customer satisfaction and business performance.  
Answer:
10. Measurement-managed companies are more likely to be in the top third of their industry financially.  
Answer:

## **BUILDING AND SUSTAINING TOTAL QUALITY ORGANIZATIONS**

### **TRUE/FALSE QUESTIONS**

1. Most firms seek to adapt total quality philosophy because of threats to the organization's survival.  
Answer:
2. Lack of a formalized strategic plan for change is not a obstacle to implement TQM.  
Answer:
3. The TQM concept is best sold to the organization by positioning quality as a way to address the priority goals of customers only.  
Answer:
4. Traditional management practices can be traced to Frederick Taylor's scientific management era.  
Answer:
5. Japan built its management system not on Taylor's system but rather on the teachings of Deming, Juran, and other management philosophers, and thus avoided many of the problems US firms typically face when attempting implementing TQM.  
Answer:
6. Successful efforts to implement total quality have been based on one-dimensional approaches, such as utilizing teamwork.  
Answer:
7. Approaches to implementing TQM that are one dimensional are prone to failure.  
Answer:
8. Corporate culture is best reflected in the firm's value statement and not management policies.  
Answer:
9. A company's value system and its collection of guiding principles is known as a mission statement.  
Answer:
10. Examination of successful total quality implementation efforts has discovered that each successful firm has adopted the same model of total quality.  
Answer:



## PRINCIPLES OF SIX SIGMA

### TRUE/FALSE QUESTIONS

1. “dpmo” denotes defects per million occurrences.  
Answer:
2. Six Sigma quality levels can occur even with a mean shift equal to 1.5 times the standard deviation.  
Answer:
3. Half the tolerance is equal to the distance from the target to the upper specification limit.  
Answer:
4. A change in the quality level from 3 to 4-sigma represents a 5-fold improvement  
Answer:
5. 3.4 defects per million opportunities can occur with a quality level of 5 sigma but with a smaller mean shift than 1.5 times the standard deviation.  
Answer:
6. A problem is a deviation between what should be happening and what actually is happening that is important enough to need correcting.  
Answer:
7. The “5 Why” technique helps to identify the root cause of a problem.  
Answer:
8. General Electric is credited with originating the concept of Six Sigma.  
Answer:
9. The Six Sigma concept redefines quality performance in terms of defects per million opportunities (dpmo).  
Answer:
10. Six Sigma represents a quality level of 3.4 defects per thousand opportunities.  
Answer:

## STATISTICAL THINKING AND APPLICATIONS

### TRUE/FALSE and Other QUESTIONS

1. A principle of statistical thinking is that variation exists in all processes.  
Answer:
2. If a manager adopts the principles of statistical thinking, he/she has adopted the principle that reducing variation exist is an important responsible of management.  
Answer:
3. The mean time to reach the IEM bicycle parking lot from RK Hall as found from a randomized time study of 40 students is 10.4 minutes. The standard deviation of transit times is known to be 1.2 minutes. (Marks 2 + 2 + 2 + 2)
  - a) Find a two-sided 90% confidence interval for the mean transit time, and interpret it.
  - b) Find a two-sided 99% confidence interval for the mean transit time, and interpret it.
  - c) What assumptions are needed to answer parts a) and b)?
  - d) Professor Bagchi believes that the mean transit time is less than 10.8 minutes. Can he make this conclusion at a significance level  $\alpha$  of 0.05?

### Cumulative Normal Probability Tables (Z-Values)

<b>Z</b>	<b>0.09</b>	<b>0.08</b>	<b>0.07</b>	<b>0.06</b>	<b>0.05</b>	<b>0.04</b>	<b>0.03</b>	<b>0.02</b>	<b>0.01</b>	<b>0.00</b>
-4.0	0.00002	0.00002	0.00002	0.00002	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003
-3.9	0.00003	0.00003	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00005	0.00005
-3.8	0.00005	0.00005	0.00005	0.00006	0.00006	0.00006	0.00006	0.00007	0.00007	0.00007
-3.7	0.00008	0.00008	0.00008	0.00008	0.00009	0.00009	0.00010	0.00010	0.00010	0.00011
-3.6	0.00011	0.00012	0.00012	0.00013	0.00013	0.00014	0.00014	0.00015	0.00015	0.00016
-3.5	0.00017	0.00017	0.00018	0.00019	0.00019	0.00020	0.00021	0.00022	0.00022	0.00023
-3.4	0.00024	0.00025	0.00026	0.00027	0.00028	0.00029	0.00030	0.00031	0.00032	0.00034
-3.3	0.00035	0.00036	0.00038	0.00039	0.00040	0.00042	0.00043	0.00045	0.00047	0.00048
-3.2	0.00050	0.00052	0.00054	0.00056	0.00058	0.00060	0.00062	0.00064	0.00066	0.00069
-3.1	0.00071	0.00074	0.00076	0.00079	0.00082	0.00084	0.00087	0.00090	0.00094	0.00097
-3.0	0.00100	0.00104	0.00107	0.00111	0.00114	0.00118	0.00122	0.00126	0.00131	0.00135
-2.9	0.00139	0.00144	0.00149	0.00154	0.00159	0.00164	0.00169	0.00175	0.00181	0.00187
-2.8	0.00193	0.00199	0.00205	0.00212	0.00219	0.00226	0.00233	0.00240	0.00248	0.00256
-2.7	0.00264	0.00272	0.00280	0.00289	0.00298	0.00307	0.00317	0.00326	0.00336	0.00347
-2.6	0.00357	0.00368	0.00379	0.00391	0.00402	0.00415	0.00427	0.00440	0.00453	0.00466
-2.5	0.00480	0.00494	0.00508	0.00523	0.00539	0.00554	0.00570	0.00587	0.00604	0.00621
-2.4	0.00639	0.00657	0.00676	0.00695	0.00714	0.00734	0.00755	0.00776	0.00798	0.00820
-2.3	0.00842	0.00866	0.00889	0.00914	0.00939	0.00964	0.00990	0.01017	0.01044	0.01072
-2.2	0.01101	0.01130	0.01160	0.01191	0.01222	0.01255	0.01287	0.01321	0.01355	0.01390
-2.1	0.01426	0.01463	0.01500	0.01539	0.01578	0.01618	0.01659	0.01700	0.01743	0.01786
-2.0	0.01831	0.01876	0.01923	0.01970	0.02018	0.02068	0.02118	0.02169	0.02222	0.02275
-1.9	0.02330	0.02385	0.02442	0.02500	0.02559	0.02619	0.02680	0.02743	0.02807	0.02872
-1.8	0.02938	0.03005	0.03074	0.03144	0.03216	0.03288	0.03362	0.03438	0.03515	0.03593
-1.7	0.03673	0.03754	0.03836	0.03920	0.04006	0.04093	0.04182	0.04272	0.04363	0.04457
-1.6	0.04551	0.04648	0.04746	0.04846	0.04947	0.05050	0.05155	0.05262	0.05370	0.05480
-1.5	0.05592	0.05705	0.05821	0.05938	0.06057	0.06178	0.06301	0.06426	0.06552	0.06681
-1.4	0.06811	0.06944	0.07078	0.07215	0.07353	0.07493	0.07636	0.07780	0.07927	0.08076
-1.3	0.08226	0.08379	0.08534	0.08692	0.08851	0.09012	0.09176	0.09342	0.09510	0.09680
-1.2	0.09853	0.10027	0.10204	0.10383	0.10565	0.10749	0.10935	0.11123	0.11314	0.11507
-1.1	0.11702	0.11900	0.12100	0.12302	0.12507	0.12714	0.12924	0.13136	0.13350	0.13567
-1.0	0.13786	0.14007	0.14231	0.14457	0.14686	0.14917	0.15151	0.15386	0.15625	0.15866
-0.9	0.16109	0.16354	0.16602	0.16853	0.17106	0.17361	0.17619	0.17879	0.18141	0.18406
-0.8	0.18673	0.18943	0.19215	0.19489	0.19766	0.20045	0.20327	0.20611	0.20897	0.21186
-0.7	0.21476	0.21770	0.22065	0.22363	0.22663	0.22965	0.23270	0.23576	0.23885	0.24196
-0.6	0.24510	0.24825	0.25143	0.25463	0.25785	0.26109	0.26435	0.26763	0.27093	0.27425
-0.5	0.27760	0.28096	0.28434	0.28774	0.29116	0.29460	0.29806	0.30153	0.30503	0.30854
-0.4	0.31207	0.31561	0.31918	0.32276	0.32636	0.32997	0.33360	0.33724	0.34090	0.34458
-0.3	0.34827	0.35197	0.35569	0.35942	0.36317	0.36693	0.37070	0.37448	0.37828	0.38209
-0.2	0.38591	0.38974	0.39358	0.39743	0.40129	0.40517	0.40905	0.41294	0.41683	0.42074
-0.1	0.42465	0.42858	0.43251	0.43644	0.44038	0.44433	0.44828	0.45224	0.45620	0.46017
0.0	0.46414	0.46812	0.47210	0.47608	0.48006	0.48405	0.48803	0.49202	0.49601	0.50000

### Cumulative Normal Probability Tables (Z-Values)

<b>Z</b>	<b>0.00</b>	<b>0.01</b>	<b>0.02</b>	<b>0.03</b>	<b>0.04</b>	<b>0.05</b>	<b>0.06</b>	<b>0.07</b>	<b>0.08</b>	<b>0.09</b>
<b>0.0</b>	0.50000	0.50399	0.50798	0.51197	0.51595	0.51994	0.52392	0.52790	0.53188	0.53586
<b>0.1</b>	0.53983	0.54380	0.54776	0.55172	0.55567	0.55962	0.56356	0.56749	0.57142	0.57535
<b>0.2</b>	0.57926	0.58317	0.58706	0.59095	0.59483	0.59871	0.60257	0.60642	0.61026	0.61409
<b>0.3</b>	0.61791	0.62172	0.62552	0.62930	0.63307	0.63683	0.64058	0.64431	0.64803	0.65173
<b>0.4</b>	0.65542	0.65910	0.66276	0.66640	0.67003	0.67364	0.67724	0.68082	0.68439	0.68793
<b>0.5</b>	0.69146	0.69497	0.69847	0.70194	0.70540	0.70884	0.71226	0.71566	0.71904	0.72240
<b>0.6</b>	0.72575	0.72907	0.73237	0.73565	0.73891	0.74215	0.74537	0.74857	0.75175	0.75490
<b>0.7</b>	0.75804	0.76115	0.76424	0.76730	0.77035	0.77337	0.77637	0.77935	0.78230	0.78524
<b>0.8</b>	0.78814	0.79103	0.79389	0.79673	0.79955	0.80234	0.80511	0.80785	0.81057	0.81327
<b>0.9</b>	0.81594	0.81859	0.82121	0.82381	0.82639	0.82894	0.83147	0.83398	0.83646	0.83891
<b>1.0</b>	0.84134	0.84375	0.84614	0.84849	0.85083	0.85314	0.85543	0.85769	0.85993	0.86214
<b>1.1</b>	0.86433	0.86650	0.86864	0.87076	0.87286	0.87493	0.87698	0.87900	0.88100	0.88298
<b>1.2</b>	0.88493	0.88686	0.88877	0.89065	0.89251	0.89435	0.89617	0.89796	0.89973	0.90147
<b>1.3</b>	0.90320	0.90490	0.90658	0.90824	0.90988	0.91149	0.91308	0.91466	0.91621	0.91774
<b>1.4</b>	0.91924	0.92073	0.92220	0.92364	0.92507	0.92647	0.92785	0.92922	0.93056	0.93189
<b>1.5</b>	0.93319	0.93448	0.93574	0.93699	0.93822	0.93943	0.94062	0.94179	0.94295	0.94408
<b>1.6</b>	0.94520	0.94630	0.94738	0.94845	0.94950	0.95053	0.95154	0.95254	0.95352	0.95449
<b>1.7</b>	0.95543	0.95637	0.95728	0.95818	0.95907	0.95994	0.96080	0.96164	0.96246	0.96327
<b>1.8</b>	0.96407	0.96485	0.96562	0.96638	0.96712	0.96784	0.96856	0.96926	0.96995	0.97062
<b>1.9</b>	0.97128	0.97193	0.97257	0.97320	0.97381	0.97441	0.97500	0.97558	0.97615	0.97670
<b>2.0</b>	0.97725	0.97778	0.97831	0.97882	0.97932	0.97982	0.98030	0.98077	0.98124	0.98169
<b>2.1</b>	0.98214	0.98257	0.98300	0.98341	0.98382	0.98422	0.98461	0.98500	0.98537	0.98574
<b>2.2</b>	0.98610	0.98645	0.98679	0.98713	0.98745	0.98778	0.98809	0.98840	0.98870	0.98899
<b>2.3</b>	0.98928	0.98956	0.98983	0.99010	0.99036	0.99061	0.99086	0.99111	0.99134	0.99158
<b>2.4</b>	0.99180	0.99202	0.99224	0.99245	0.99266	0.99286	0.99305	0.99324	0.99343	0.99361
<b>2.5</b>	0.99379	0.99396	0.99413	0.99430	0.99446	0.99461	0.99477	0.99492	0.99506	0.99520
<b>2.6</b>	0.99534	0.99547	0.99560	0.99573	0.99585	0.99598	0.99609	0.99621	0.99632	0.99643
<b>2.7</b>	0.99653	0.99664	0.99674	0.99683	0.99693	0.99702	0.99711	0.99720	0.99728	0.99736
<b>2.8</b>	0.99744	0.99752	0.99760	0.99767	0.99774	0.99781	0.99788	0.99795	0.99801	0.99807
<b>2.9</b>	0.99813	0.99819	0.99825	0.99831	0.99836	0.99841	0.99846	0.99851	0.99856	0.99861
<b>3.0</b>	0.99865	0.99869	0.99874	0.99878	0.99882	0.99886	0.99889	0.99893	0.99896	0.99900
<b>3.1</b>	0.99903	0.99906	0.99910	0.99913	0.99916	0.99918	0.99921	0.99924	0.99926	0.99929
<b>3.2</b>	0.99931	0.99934	0.99936	0.99938	0.99940	0.99942	0.99944	0.99946	0.99948	0.99950
<b>3.3</b>	0.99952	0.99953	0.99955	0.99957	0.99958	0.99960	0.99961	0.99962	0.99964	0.99965
<b>3.4</b>	0.99966	0.99968	0.99969	0.99970	0.99971	0.99972	0.99973	0.99974	0.99975	0.99976
<b>3.5</b>	0.99977	0.99978	0.99978	0.99979	0.99980	0.99981	0.99981	0.99982	0.99983	0.99983
<b>3.6</b>	0.99984	0.99985	0.99985	0.99986	0.99986	0.99987	0.99987	0.99988	0.99988	0.99989
<b>3.7</b>	0.99989	0.99990	0.99990	0.99990	0.99991	0.99991	0.99992	0.99992	0.99992	0.99992
<b>3.8</b>	0.99993	0.99993	0.99993	0.99994	0.99994	0.99994	0.99994	0.99995	0.99995	0.99995
<b>3.9</b>	0.99995	0.99995	0.99996	0.99996	0.99996	0.99996	0.99996	0.99996	0.99997	0.99997
<b>4.0</b>	0.99997	0.99997	0.99997	0.99997	0.99997	0.99997	0.99998	0.99998	0.99998	0.99998

## DESIGN FOR SIX SIGMA

### TRUE/FALSE QUESTIONS

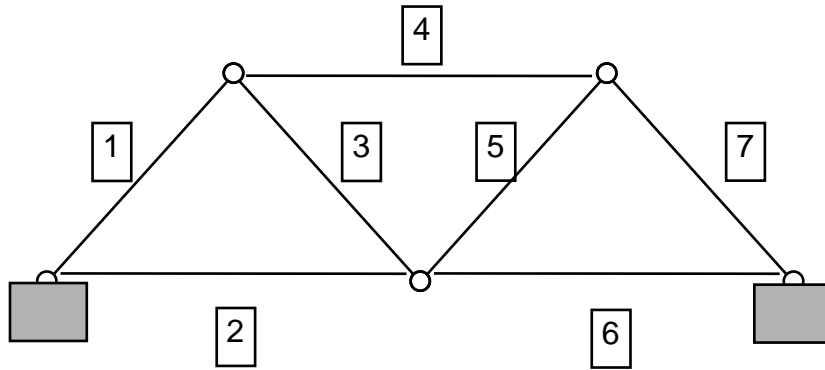
1. Design for Six Sigma does not include design verification.  
Answer:
2. The first question one must ask during concept development is: What is the product (good or service) intended to do?  
Answer:
3. Technical requirements are sometimes called design characteristics.  
Answer:
4. It is advocated in Six Sigma that design features and characteristics be dominated by engineering considerations rather than by customer requirements.  
Answer:
5. Competitive evaluation is done after the House of Quality is completed.  
Answer:
6. The voice of the designer is the primary input to the quality function deployment process.  
Answer:
7. The relationship matrix in QFD shows whether the final technical requirements adequately address the customer requirements.  
Answer:
8. Technical requirements need to be determined to build the House of Quality.  
Answer:
9. Quality function deployment (QFD) was developed at Motorola as part of their Six Sigma methodology.  
Answer:
10. QFD departs from traditional design planning processes.  
Answer:

## TOOLS FOR PROCESS IMPROVEMENT

### TRUE/FALSE QUESTIONS

1. The PDSA cycle was originally founded by Deming.  
Answer:
2. The acronym PDSA stands for plan-do-system-act.  
Answer:
3. The PDSA cycle was previously referred to by Deming as the PDCA cycle.  
Answer:
4. In Juran's quality improvement methodology, the diagnostic journey follows the remedial journey.  
Answer:
5. Calibration includes finding out repeatability of the measurement system.  
Answer:
6. The Gage R&R procedure includes finding the bias in the measurement system.  
Answer:
7. The use of histograms in the DMAIC phases would be primarily in the Measure, and Analyze phases.  
Answer:
8. The use of scatter diagrams in the DMAIC phases would be primarily in the Analyze and Control phases.  
Answer:
9. Flowcharts are best developed by having the people involved in the process (employees, supervisors, managers, and customers) construct the flowchart  
Answer:
10. Although flowcharts depict process steps, they are ineffective in understanding how employees fit into a process and who are their suppliers and customers.  
Answer:

1. A **bridge** structure consisting of 7 elements as shown below.



Let the event that element  $i$  of the structure fails be denoted by  $F_i$  and let the probability of failure be  $P(F_i)$ . It is assumed that the failure of the different elements is statistically independent, but not mutually exclusive. Also, the structure fails if any element of the structure fails. It is given that

$$P(F_1) = P(F_3) = P(F_5) = P(F_7) = 0.02,$$

$$P(F_2) = P(F_6) = 0.01; \quad P(F_4) = 0.03$$

How reliable is the Bridge?

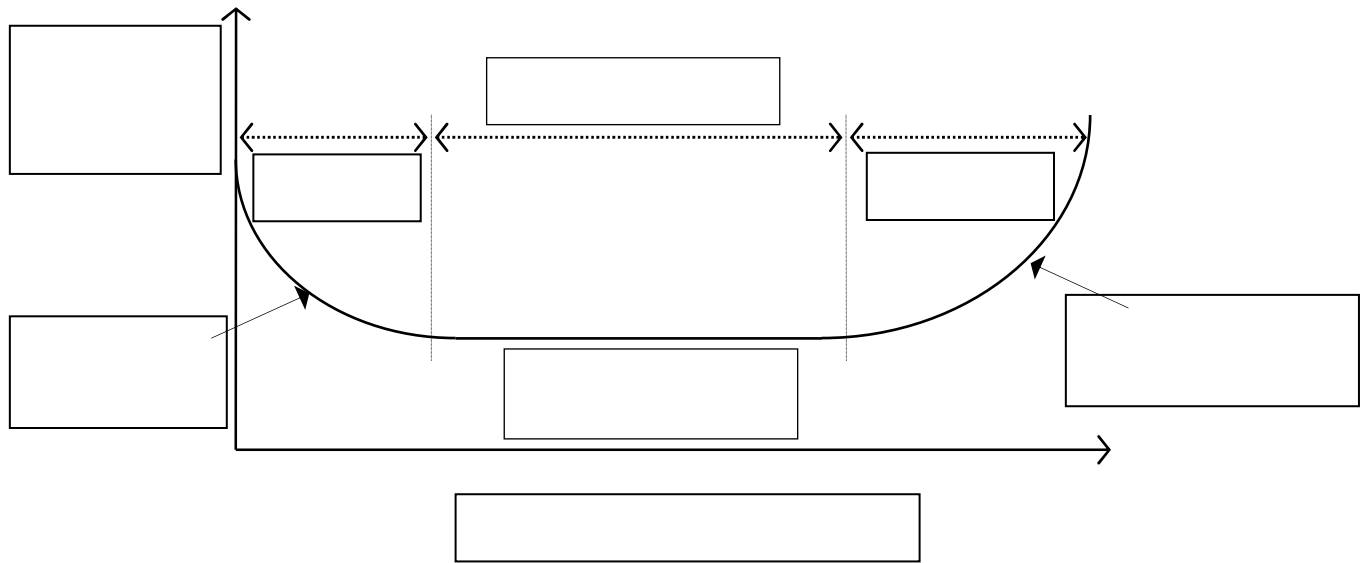
8 Marks

How would you improve its reliability?

2 Marks

Q2. Please provide labels for the eight elements of this picture in the writing spaces (boxes) shown. (8 marks)

Where would you use preventive maintenance and why? (2 marks)





Q 3 In an Orthogonal DOE conducted the results observed are shown below. (Marks 5 + 5 + 5 + 5)

What is the most robust combination of treatments for the response Leak %? \_\_\_\_\_

Does this combination also deliver the response within the stated goal for Leak %?

What is the most robust combination of treatment for the response Force ? \_\_\_\_\_

Does this combination also deliver the response within the stated goal for Force?

	Trial No	Process Parameters(Factors)							Leak (Goal: <1%)						Force (Goal: <3.4)								
		A	B	C	D	E	F	G	5 Replications					Mean	Range	5 Replications					Mean	Range	
Treatments	1	1	1	1	1	1	1	1	46.91	48.94	48.16	48.74	49.44	48.44	2.53	4.05	4.08	3.94	4.15	4.05	4.05	4.05	0.21
	2	1	1	1	2	2	2	2	10.03	9.84	9.87	10.40	10.33	10.09	0.56	4.06	4.15	4.20	4.19	4.08	4.14	4.14	0.14
	3	1	2	2	1	1	2	2	2.39	2.27	2.33	2.33	2.27	2.32	0.12	4.76	4.75	4.64	4.70	4.64	4.70	4.70	0.12
	4	1	2	2	2	2	1	1	2.32	2.45	2.23	2.38	2.36	2.35	0.22	3.62	3.54	3.64	3.72	3.70	3.64	3.64	0.18
	5	2	1	2	1	2	1	2	9.16	8.36	8.97	8.86	9.93	9.06	1.57	4.57	4.54	4.49	4.65	4.45	4.54	4.54	0.20
	6	2	1	2	2	1	2	1	0.41	0.42	0.43	0.44	0.44	0.43	0.03	6.65	6.80	6.71	6.77	6.81	6.75	6.75	0.16
	7	2	2	1	1	2	2	1	0.70	0.56	0.67	0.63	0.64	0.64	0.14	2.80	2.69	2.69	2.71	2.75	2.73	2.73	0.11
	8	2	2	1	2	1	1	2	3.53	3.91	3.77	3.73	3.94	3.78	0.41	2.59	2.60	2.56	2.52	2.50	2.55	2.55	0.10