

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCES
BACHELOR OF APPLIED CHEMISTRY HONOUR DEGREE
Part Four Examinations December 2002

Quality Assurance Management and Control SCH 4111
Duration of Examinations 3 Hours

Instructions to Candidates

1. Answer **ALL** questions in section A, the marks are indicated
2. Answer any **TWO** questions from Section B each question carries 20 marks.
3. Start the answer for each question on a fresh page.

SECTION A

1. The actual sales of Havawa Tichachema Quality Company are as follows

YEAR	1968	1969	1971	1972	1972
SALES \$	45 000	56 000	78 000	46 000	75 000

By the method of least squares find the trend values for each of the five years?
Also estimate the annual sales for 1973 (4)

- (b) Suppose Ishmael Tafadzwa Muzenda is manufacturing rubber and finds the relationship between sales of rubber and the index of demand for care. The sales for the last five years are.

YEAR	1970	1971	1972	1973	1974
SALES	110	150	150	160	180
DEMAND					
INDEX	100	110	140	150	200

Find the relationship between the demand index and the sales of the automobile for the year 1975 supposing that the demand index rises to 210 (4)

- (c) In a factory it has been found that, on the average one circuit tester is issued from the electrical store each shift. Assuming that a borrowed circuit tester is not rewired until the end of the shift.
- (i) State the appropriate probability model (2)

- (ii) Calculate the probability that the store will be able to satisfy a request for circuit tester (3)
- (d) List two examples of different inherent costs of an industry which you are familiar with (2)
2. It is known from experience that the mean time between failures of a standard component is 1 640 hours.
- (a) Show by calculation that the probability of such a component operating continuously for 84 hrs without failure is 0.95 (4)
- (b) Estimate the reliability of an assembly of two of these two components in parallel over the same time period. (2)
- (c) In a factory 100 items of product per day, the following numbers of defective items are recorded on ten successive days.

Day	1	2	3	4	5	6	7	8	9	10
No. of Defective	20	18	19	19	17	18	20	16	17	18

Calculate the inner and outer limits for a percentage - defective chart based on these results (5)

- (d) State five main aspects which you would enquire about and record when dealing with a customer complaining about the quality of a product. (4)
3. (a) Explain what is meant by payback period (2)
- (b) Outline the way in which this technique might be used by a company to compare different company investment opportunities for quality improvement programme (3)
- (c) State two disadvantages of this method of investment appraisal (2)
- (d) Explain why there is a diminishing returns effect when prevention costs are increased (4)
- (e) State the main purpose of vendor rating (2)
- (f) What is meant by a quality audit (2)
4. (a) State three useful properties of the sampling distribution of the mean (3)

- (b) Murozvi Ndizvo have a production line that makes pipes with a mean length of 100 cm and standard deviation of 1 cm. What is the probability that a random sample of 35 pipes has a mean length of less than 99.6 cm ? (3)
- © Batches of raw materials are delivered to a factory with a guaranteed average weight of 25 kg a unit and standard deviation of 1 kg. A sample of 20 units is taken to test each delivery. Within what range should 95% of the sample means lie. (3)
- (e) A Harawa Gutu Ndizvo Pvt Ltd buys components in batches from a supplier. The supplier uses a acceptance quality level of 2% defective, while the company accepts batches with a maximum of 6% defective. What would be appropriate values of m and c . (3)
- (f) The process makes packed food with a mean weight of 1kg and standard deviation of 0.05kg. Samples of 10 are taken to make sure that the process is in control. Find the control limits which include 99% of sample means if the process is working, (3)

SECTION B

- (5) (a) Higher quality inevitably comes at higher cost. Do you think this is true. Discuss your answer (4)
- (b) What is the total cost of quality (3)
- (c) Why do internal failure costs decline with increasing quality (3)
- (d) How would you find the optimal level of quality for a product (3)
- (g) Why is it difficult to define quality (3)
6. "Total Quality Management", Discuss (20)
7. Discuss the meaning of
- (i) the craftsmanship theory (5)
 - (ii) the indifference theory (5)
- (b) Compare the contribution to quality made by the operator with that made by the shop floor inspector. (10)
8. (a) Explain the statistical basis of student's test. (10)
- (b) Explain the principle of "least squares" (10)
9. (a) Explain what is meant by "Quality" and describe how each of the following impact on quality (10).
- (i) market research
 - (ii) product research
 - (iii) product development
- (b) Discuss the need of quality requirements in purchasing specification (10)
10. (a) Explain the importance of employee involvement in the quest for quality. (10)
- (b) What is meant by the use of the term concession and product permit in connection with a product. (10)
11. Discuss "Process Reliability" or "Process capability" (20)

A copy to be made for each student.

TABLE XV Control Chart Constants

Number of observations in sample, n	CHART FOR AVERAGES				CHART FOR STANDARD DEVIATIONS						CHART FOR RANGES			
	Factors for control limits		Factors for central line		Factors for control limits		Factors for central line		Factors for control limits		Factors for central line		Factors for control limits	
	A_1	A_2	A_3	A_4	B_1	B_2	B_3	B_4	B_5	d_1	D_1	D_2	D_3	D_4
2	2.1121	3.760	1.880	0.5642	0	1.843	0	2.267	1.128	0	3.686	0	3.146	1.721
3	1.732	2.994	1.023	0.7236	0	1.858	0	2.368	1.093	0	4.358	0	3.146	1.721
4	1.500	1.880	0.729	0.7979	0	1.808	0	2.266	2.059	0	4.698	0	3.146	1.721
5	1.342	1.396	0.577	0.8407	0	1.756	0	2.089	2.336	0	4.918	0	3.146	1.721
6	1.225	1.410	0.483	0.8686	0.026	1.711	0.030	1.970	2.534	0	5.078	0	3.146	1.721
7	1.134	1.277	0.419	0.8882	0.105	1.672	0.118	1.882	2.704	0.205	5.203	0.076	3.146	1.721
8	1.061	1.175	0.373	0.9027	0.167	1.638	0.185	1.815	2.847	0.387	5.307	0.136	3.146	1.721
9	1.000	1.094	0.337	0.9139	0.219	1.609	0.239	1.761	2.970	0.546	5.394	0.184	3.146	1.721
10	0.949	1.028	0.308	0.9227	0.262	1.584	0.284	1.716	3.078	0.687	5.469	0.223	3.146	1.721
11	0.905	0.973	0.285	0.9300	0.277	1.561	0.321	1.679	3.173	0.812	5.514	0.256	3.146	1.721
12	0.866	0.925	0.266	0.9339	0.331	1.541	0.354	1.646	3.258	0.924	5.552	0.284	3.146	1.721
13	0.832	0.884	0.249	0.9410	0.339	1.523	0.382	1.618	3.336	1.023	5.606	0.308	3.146	1.721
14	0.802	0.848	0.235	0.9453	0.384	1.507	0.406	1.594	3.407	1.121	5.663	0.329	3.146	1.721
15	0.775	0.816	0.223	0.9490	0.406	1.492	0.428	1.572	3.472	1.207	5.727	0.348	3.146	1.721

Statistic	STANDARDS GIVEN		ANALYSIS OF PAST DATA	
	Central line	Limits	Central line	Limits
\bar{X}	\bar{X}	$\bar{X} \pm 3\sigma$	\bar{X}	$\bar{X} \pm 1.4\sigma$
σ	C_p	H_p, B_p	$\hat{\sigma}$	H_p, B_p
R	$d_2\sigma$	D_p, H_p	\bar{R}	D_p, H_p

Source: ASTM Manual on Quality Control in Materials, American Society for Testing and Materials, Philadelphia, Pa., 1951, by permission.

ANNEX J - The Standardized Normal Distribution Function

X-7



Area: Under the Normal Curve

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53585
0.1	.53983	.54380	.54776	.55172	.55567	.55962	.56356	.56749	.57142	.57535
0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
0.6	.72575	.72907	.73237	.73563	.73891	.74215	.74537	.74857	.75175	.75490
0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78521
0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
1.0	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91309	.91466	.91621	.91774
1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408
1.6	.94520	.94630	.94738	.94845	.94950	.95053	.95154	.95254	.95352	.95449
1.7	.95543	.95637	.95728	.95818	.95907	.95994	.96080	.96164	.96246	.96327
1.8	.96407	.96485	.96562	.96638	.96712	.96784	.96856	.96926	.96995	.97062
1.9	.97128	.97193	.97257	.97320	.97381	.97441	.97500	.97558	.97615	.97670
2.0	.97725	.97784	.97831	.97882	.97932	.97982	.98030	.98077	.98124	.98169
2.1	.98214	.98257	.98300	.98341	.98382	.98422	.98461	.98500	.98537	.98574
2.2	.98610	.98645	.98679	.98713	.98745	.98778	.98809	.98840	.98870	.98899
2.3	.98928	.98956	.98983	.99010	.99036	.99061	.99086	.99111	.99134	.99157
2.4	.99180	.99202	.99224	.99245	.99266	.99286	.99305	.99324	.99343	.99361
2.5	.99379	.99396	.99413	.99430	.99446	.99461	.99477	.99492	.99506	.99520
2.6	.99534	.99547	.99560	.99573	.99585	.99598	.99609	.99621	.99632	.99643
2.7	.99653	.99664	.99674	.99683	.99693	.99702	.99711	.99720	.99728	.99735
2.8	.99744	.99752	.99760	.99767	.99774	.99781	.99788	.99795	.99801	.99807
2.9	.99813	.99819	.99825	.99831	.99836	.99841	.99846	.99851	.99856	.99861
3.0	.99865	.99869	.99874	.99878	.99882	.99886	.99890	.99893	.99896	.99899
3.1	.99903	.99906	.99910	.99913	.99916	.99918	.99921	.99924	.99926	.99929
3.2	.99931	.99934	.99936	.99938	.99940	.99942	.99944	.99946	.99948	.99950
3.3	.99952	.99953	.99955	.99957	.99958	.99960	.99961	.99962	.99964	.99965
3.4	.99966	.99968	.99969	.99970	.99971	.99972	.99973	.99974	.99975	.99976
3.5	.99977	.99978	.99978	.99979	.99980	.99981	.99981	.99982	.99983	.99983
3.6	.99984	.99985	.99985	.99986	.99986	.99987	.99987	.99988	.99988	.99989
3.7	.99989	.99990	.99990	.99990	.99991	.99991	.99992	.99992	.99992	.99992
3.8	.99993	.99993	.99993	.99994	.99994	.99994	.99994	.99995	.99995	.99995
3.9	.99995	.99995	.99996	.99996	.99996	.99996	.99996	.99996	.99997	.99997