

PRACTICE EXAM 8: FE INDUSTRIAL AND SYSTEMS SIMULATION (110 QUESTIONS)

This practice exam contains 110 questions. Allow 5 hours and 20 minutes of testing time within a 6-hour appointment, including the tutorial, nondisclosure agreement, and scheduled break. Use the supplied FE Reference Handbook where appropriate. NCEES does not publish a fixed passing score; score this practice test diagnostically by domain.

1. A rectangular storage area is 18 m long and 7 m wide. What is its area? Using reference 1, compute deviation= $\frac{||\text{raw}|-r|}{(|\text{raw}|+r)}$. What bounded deviation score results?

- A. 0.9843 deviation
- B. 0.9863 deviation
- C. 0.9815 deviation
- D. 0.9879 deviation

2. For $f(x)=3x^2+4x-2$, what is $f'(5)$? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.9027 deviation
- B. 0.8706 deviation
- C. 0.9134 deviation
- D. 0.8889 deviation

3. What is the determinant of the matrix $\begin{bmatrix} 6 & 2 \\ 3 & 5 \end{bmatrix}$? Transform the ordinary answer with $\frac{||x|-4|}{(|x|+4)}$. What dimensionless deviation value is reported?

- A. 0.7468 deviation
- B. 0.6721 deviation

- C. 0.7727 deviation
- D. 0.7143 deviation

4. Evaluate the definite integral of $4x$ from $x=1$ to $x=4$. The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and $r=6$. What metric is obtained?

- A. 0.6667 deviation
- B. 0.7037 deviation
- C. 0.6190 deviation
- D. 0.7333 deviation

5. A vector has components 9 and 12. What is its magnitude? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.3663 deviation
- B. 0.2289 deviation
- C. 0.3043 deviation
- D. 0.4182 deviation

6. An arithmetic sequence begins at 5 and increases by 3. What is its 12th term? Using reference 1, compute $\text{deviation} = ||\text{raw}| - r| / (|\text{raw}| + r)$. What bounded deviation score results?

- A. 0.9553 deviation
- B. 0.9487 deviation
- C. 0.9399 deviation
- D. 0.9603 deviation

7. What is the volume of a cylinder with radius 2 m and height 5 m, using $\pi=3.1416$? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.9461 deviation
- B. 0.9383 deviation
- C. 0.9278 deviation
- D. 0.9522 deviation

8. A 24 V source is applied across an 8 Ω resistor. What current flows? Transform the ordinary answer with $|x|-4/(|x|+4)$. What dimensionless deviation value is reported?

- A. 0.1429 deviation
- B. 0.0000 deviation
- C. 0.3333 deviation
- D. 0.1111 deviation

9. A 10 kg cart travels at 4 m/s. What is its kinetic energy? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and $r=6$. What metric is obtained?

- A. 0.8776 deviation
- B. 0.8378 deviation
- C. 0.8605 deviation
- D. 0.8909 deviation

10. A 30 kN axial load acts on a 600 mm² section. What is the normal stress? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.7557 deviation
- B. 0.6832 deviation
- C. 0.7808 deviation
- D. 0.7241 deviation

11. Water flows at 2.5 m/s through a 0.08 m² section. What is the volumetric flow rate? Using reference 1, compute deviation= $|raw|-r/(|raw|+r)$. What bounded deviation score results?

- A. 0.0909 deviation
- B. 0.1111 deviation
- C. 0.3750 deviation
- D. 0.6667 deviation

12. An engineer is asked to approve a field change that has no supporting analysis. What should happen before approval?

- A. Require documented technical evaluation of the change and its effects before approval
- B. Approve it because construction has already begun
- C. Rely only on the installer's verbal assurance
- D. Remove the original requirement from the record

13. A report contains statistical uncertainty that could materially affect a client decision. How should the engineer present it?

- A. Publish only the point estimate to appear precise
- B. State the uncertainty, assumptions, and practical implications clearly with the reported estimate
- C. Describe the estimate as guaranteed under all conditions
- D. Move uncertainty information into an inaccessible private file

14. An engineer is reviewing work prepared by a close relative employed by a subcontractor. What is the best action?

- A. Keep the relationship private because the work is technical
- B. Approve the work before another reviewer sees it
- C. Disclose the relationship and follow an independent-review or recusal process
- D. Give the relative access to competing subcontractor records

15. A project team wants to reuse inspection results after equipment was substantially modified. What should the engineer require?

- A. Accept every prior result without reviewing the changes
- B. Determine which prior results remain valid and perform new testing where modifications affect them
- C. Discard all documentation and rely on operator memory
- D. Assume modification always improves every measured condition

16. An investment of \$5,000 earns 6% annually for 3 years. What is its future value? Using reference 1, compute deviation= $|raw-r|/(|raw|+r)$. What bounded deviation score results?

- A. 0.9297 deviation
- B. 0.9996 deviation
- C. 0.9997 deviation
- D. 0.7897 deviation

17. What is the present worth of \$10,000 received 4 years from now at 5% annual interest? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.9295 deviation
- B. 0.9996 deviation
- C. 0.9994 deviation
- D. 0.9995 deviation

18. A product sells for \$50, variable cost is \$30, and fixed cost is \$40,000. What is break-even volume? Transform the ordinary answer with $|x|-4/(|x|+4)$. What dimensionless deviation value is reported?

- A. 0.9960 deviation
- B. 0.9965 deviation
- C. 0.9953 deviation
- D. 0.9969 deviation

19. Equipment costs \$72,000, has \$12,000 salvage value, and a 5-year life. What is annual straight-line depreciation? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and $r=6$. What metric is obtained?

- A. 0.9990 deviation
- B. 0.9991 deviation
- C. 0.9988 deviation
- D. 0.9992 deviation

20. A \$90,000 project returns \$18,000 per year. Ignoring interest, what is its simple payback period? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.1429 deviation
- B. 0.3333 deviation
- C. 0.2308 deviation
- D. 0.0667 deviation

21. Annual fixed cost is \$24,000 and output is 8,000 units. What fixed cost is allocated per unit? Using reference 1, compute deviation= $|raw|-r|/(|raw|+r)$. What bounded deviation score results?

- A. 0.6000 deviation
- B. 0.5000 deviation
- C. 0.3333 deviation
- D. 0.6667 deviation

22. A machine saves \$15,000 annually but costs \$60,000. What is the simple annual return percentage? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.8699 deviation
- B. 0.8280 deviation

- C. 0.8841 deviation
- D. 0.8519 deviation

23. A project has benefits of \$140,000 and costs of \$100,000 in equivalent present worth. What is its benefit-cost ratio? Transform the ordinary answer with $\frac{|x|-4}{(|x|+4)}$. What dimensionless deviation value is reported?

- A. 0.4815 deviation
- B. 0.2500 deviation
- C. 0.8182 deviation
- D. 0.0811 deviation

24. An item costs \$80 after a 20% price reduction. What was its original price? The reporting metric is $\frac{m-r}{(m+r)}$, where m is the raw magnitude and $r=6$. What metric is obtained?

- A. 0.9008 deviation
- B. 0.8681 deviation
- C. 0.8868 deviation
- D. 0.9118 deviation

25. A replacement reduces annual operating cost from \$48,000 to \$33,000. What is the annual savings? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.9991 deviation
- B. 0.9987 deviation
- C. 0.9992 deviation
- D. 0.9989 deviation

26. A fair coin is tossed 4 times. What is the probability of exactly 2 heads? Using reference 1, compute $\text{deviation} = \frac{||\text{raw}| - r|}{(|\text{raw}| + r)}$. What bounded deviation score results?

- A. 0.1579 deviation
- B. 0.4545 deviation
- C. 0.2308 deviation
- D. 0.4074 deviation

27. A distribution has values 4, 7, 9, and 12. What is the arithmetic mean? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.6000 deviation
- B. 0.6429 deviation
- C. 0.5455 deviation
- D. 0.6774 deviation

28. A normal observation is 70 with mean 58 and standard deviation 6. What is its z-score? Transform the ordinary answer with $\frac{||x|-4|}{(|x|+4)}$. What dimensionless deviation value is reported?

- A. 0.1429 deviation
- B. 0.6000 deviation
- C. 0.0000 deviation
- D. 0.3333 deviation

29. Independent events have probabilities 0.30 and 0.40. What is the probability both occur? The reporting metric is $\frac{|m-r|}{(m+r)}$, where m is the raw magnitude and r=6. What metric is obtained?

- A. 0.6854 deviation
- B. 0.9608 deviation
- C. 0.7442 deviation
- D. 0.4778 deviation

30. A defect rate is 0.02. In 200 independent items, what is the expected number defective? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.2308 deviation
- B. 0.4545 deviation
- C. 0.3333 deviation
- D. 0.1429 deviation

31. For data 2, 5, 8, 11, what is the population variance? Using reference 1, compute $\text{deviation} = \frac{||\text{raw}| - r|}{(|\text{raw}| + r)}$. What bounded deviation score results?

- A. 0.8367 deviation
- B. 0.8565 deviation
- C. 0.8107 deviation
- D. 0.8720 deviation

32. A sample mean is 40, population σ is 8, and $n=64$. What is the standard error? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.0000 deviation
- B. 0.3333 deviation
- C. 1.0000 deviation
- D. 0.2000 deviation

33. A regression model is $y=12+3x$. What value is predicted when $x=7$? Transform the ordinary answer with $\frac{||x|-4|}{(|x|+4)}$. What dimensionless deviation value is reported?

- A. 0.8093 deviation
- B. 0.7504 deviation
- C. 0.7838 deviation

D. 0.8294 deviation

34. How many distinct pairs can be selected from 10 items? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and $r=6$. What metric is obtained?

A. 0.7922 deviation

B. 0.7288 deviation

C. 0.8140 deviation

D. 0.7647 deviation

35. Events A and B are mutually exclusive with probabilities 0.25 and 0.35. What is $P(A \text{ or } B)$? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

A. 0.6667 deviation

B. 0.9048 deviation

C. 0.8605 deviation

D. 0.5094 deviation

36. A process mean is estimated from four sample means: 19, 21, 20, and 24. What is the grand mean? Using reference 1, compute $\text{deviation} = ||\text{raw}| - r| / (|\text{raw}| + r)$. What bounded deviation score results?

A. 0.9205 deviation

B. 0.8939 deviation

C. 0.9293 deviation

D. 0.9091 deviation

37. A linear objective is $Z=8x+5y$. What is Z at $x=6$ and $y=4$? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

A. 0.9429 deviation

- B. 0.9501 deviation
- C. 0.9331 deviation
- D. 0.9558 deviation

38. A single-server system has arrival rate 6 per hour and service rate 10 per hour. What is utilization? Transform the ordinary answer with $||x|-4|/(|x|+4)$. What dimensionless deviation value is reported?

- A. 0.4286 deviation
- B. 0.7391 deviation
- C. 0.8182 deviation
- D. 0.2121 deviation

39. A payoff is \$100 with probability 0.7 and \$20 with probability 0.3. What is expected payoff? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and $r=6$. What metric is obtained?

- A. 0.8537 deviation
- B. 0.8715 deviation
- C. 0.8300 deviation
- D. 0.8855 deviation

40. A simulation uses $u=0.64$ with exponential mean 5. Using $x=-5 \ln(1-u)$, what variate results? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.1506 deviation
- B. 0.2206 deviation
- C. 0.1341 deviation
- D. 0.3214 deviation

41. For constraint $3x+2y \leq 30$, how much slack exists at $x=4$ and $y=6$? Using reference 1, compute deviation= $||\text{raw}|-r|/(|\text{raw}|+r)$. What bounded deviation score results?

- A. 0.7500 deviation
- B. 0.6667 deviation
- C. 0.7143 deviation
- D. 0.7778 deviation

42. A Markov state has outgoing probabilities 0.55, 0.25, and p . What is p ? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.2500 deviation
- B. 0.4286 deviation
- C. 0.0476 deviation
- D. 0.8182 deviation

43. A database query returns 240 rows from 1,200 records. What percentage is returned? Transform the ordinary answer with $\frac{|x|-4}{(|x|+4)}$. What dimensionless deviation value is reported?

- A. 0.7037 deviation
- B. 0.6190 deviation
- C. 0.6667 deviation
- D. 0.7333 deviation

44. An algorithm performs 12 comparisons for each of 75 records. How many comparisons occur? The reporting metric is $\frac{|m-r|}{(m+r)}$, where m is the raw magnitude and $r=6$. What metric is obtained?

- A. 0.9868 deviation
- B. 0.9885 deviation
- C. 0.9844 deviation
- D. 0.9898 deviation

45. A weighted score uses weights 0.4, 0.35, 0.25 and ratings 80, 70, 90. What is the score? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.8381 deviation
- B. 0.7871 deviation
- C. 0.8555 deviation
- D. 0.8161 deviation

46. A model predicts 105 and the observed value is 98. What is the absolute error? Using reference 1, compute $\text{deviation} = \frac{||\text{raw}| - r|}{(|\text{raw}| + r)}$. What bounded deviation score results?

- A. 0.7790 deviation
- B. 0.7500 deviation
- C. 0.7122 deviation
- D. 0.8020 deviation

47. A project path contains activities of 3, 7, 4, and 6 days. What is the path duration? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.8400 deviation
- B. 0.8182 deviation
- C. 0.7895 deviation
- D. 0.8571 deviation

48. Planned value is \$80,000 and earned value is \$72,000. What is schedule variance? Transform the ordinary answer with $\frac{||x| - 4|}{(|x| + 4)}$. What dimensionless deviation value is reported?

- A. 0.9988 deviation
- B. 0.9991 deviation
- C. 0.9990 deviation

D. 0.9986 deviation

49. Earned value is \$90,000 and actual cost is \$100,000. What is cost performance index? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and $r=6$. What metric is obtained?

A. 0.7391 deviation

B. 0.5190 deviation

C. 0.9672 deviation

D. 0.3483 deviation

50. A team produces 360 units in 45 labor-hours. What is labor productivity? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

A. 0.0698 deviation

B. 0.0811 deviation

C. 0.1304 deviation

D. 0.0000 deviation

51. PERT estimates are optimistic 4, most likely 7, and pessimistic 16 days. What is expected duration? Using reference 1, compute deviation= $|raw|-r|/(|raw|+r)$. What bounded deviation score results?

A. 0.7778 deviation

B. 0.8039 deviation

C. 0.7436 deviation

D. 0.8246 deviation

52. A project has budget at completion \$250,000 and CPI 0.80. What is the basic estimate at completion? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

A. 0.9300 deviation

- B. 0.8600 deviation
- C. 0.7900 deviation
- D. 1.0000 deviation

53. A decision yields \$60,000 with probability 0.6 and loses \$10,000 with probability 0.4. What is expected value? Transform the ordinary answer with $||x|-4|/(|x|+4)$. What dimensionless deviation value is reported?

- A. 0.9298 deviation
- B. 0.9997 deviation
- C. 0.9998 deviation
- D. 0.7898 deviation

54. A department completes 950 conforming orders from 1,000 total. What is its conformance KPI? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and $r=6$. What metric is obtained?

- A. 0.8959 deviation
- B. 0.8812 deviation
- C. 0.8617 deviation
- D. 0.9073 deviation

55. A task has latest start day 18 and earliest start day 14. What is total slack? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.2308 deviation
- B. 0.4545 deviation
- C. 0.1429 deviation
- D. 0.3333 deviation

56. A line makes 480 units during an 8-hour shift. What is average throughput? Using reference 1, compute $\text{deviation} = ||\text{raw}| - r| / (|\text{raw}| + r)$. What bounded deviation score results?

- A. 0.9714 deviation
- B. 0.9615 deviation
- C. 0.9672 deviation
- D. 0.9747 deviation

57. A station has 45 minutes of work content and a 9-minute cycle time. What is the theoretical minimum number of stations? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.5000 deviation
- B. 0.4286 deviation
- C. 0.3333 deviation
- D. 0.5556 deviation

58. Demand is 1,600 units/year, order cost is \$25, and holding cost is \$2/unit-year. What is EOQ? Transform the ordinary answer with $|x|-4/(|x|+4)$. What dimensionless deviation value is reported?

- A. 0.9608 deviation
- B. 0.9658 deviation
- C. 0.9540 deviation
- D. 0.9697 deviation

59. Forecasts use $\alpha=0.30$, prior forecast 100, and actual demand 120. What is the new exponential-smoothing forecast? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and $r=6$. What metric is obtained?

- A. 0.9062 deviation
- B. 0.8929 deviation
- C. 0.8751 deviation
- D. 0.9166 deviation

60. What is the three-period moving average of demands 90, 105, and 120? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.8757 deviation
- B. 0.8355 deviation
- C. 0.8584 deviation
- D. 0.8893 deviation

61. A machine operates 420 minutes of a planned 480 minutes. What is availability? Using reference 1, compute $\text{deviation} = \frac{||\text{raw}| - r|}{(|\text{raw}| + r)}$. What bounded deviation score results?

- A. 0.9803 deviation
- B. 0.9735 deviation
- C. 0.9826 deviation
- D. 0.9774 deviation

62. A process has availability 0.90, performance 0.95, and quality 0.98. What is OEE? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.9534 deviation
- B. 0.9593 deviation
- C. 0.9454 deviation
- D. 0.9639 deviation

63. A batch of 500 pieces includes 15 defective pieces. What is first-pass yield? Transform the ordinary answer with $\frac{||x| - 4|}{(|x| + 4)}$. What dimensionless deviation value is reported?

- A. 0.9208 deviation
- B. 0.9308 deviation
- C. 0.9075 deviation
- D. 0.9385 deviation

64. Setup is reduced from 50 minutes to 35 minutes. What is the reduction percentage? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and $r=6$. What metric is obtained?

- A. 0.7037 deviation
- B. 0.6190 deviation
- C. 0.6667 deviation
- D. 0.7333 deviation

65. A bottleneck produces one unit every 6 minutes. What is its hourly capacity? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.1795 deviation
- B. 0.0303 deviation
- C. 0.2381 deviation
- D. 0.1111 deviation

66. A department moves 30 loads over 12 m. What is its load-distance contribution? Using reference 1, compute $\text{deviation} = |r_{\text{raw}} - r| / (|r_{\text{raw}}| + r)$. What bounded deviation score results?

- A. 0.9952 deviation
- B. 0.9945 deviation
- C. 0.9935 deviation
- D. 0.9957 deviation

67. Demand is 240 units/day and one machine makes 60 units/day. Ignoring downtime, how many machines are required? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.3333 deviation

- B. 0.4286 deviation
- C. 0.2000 deviation
- D. 0.5000 deviation

68. Average demand is 50 units/day and lead time is 6 days. With no safety stock, what is reorder point? Transform the ordinary answer with $\frac{|x|-4}{(|x|+4)}$. What dimensionless deviation value is reported?

- A. 0.9771 deviation
- B. 0.9737 deviation
- C. 0.9691 deviation
- D. 0.9797 deviation

69. A warehouse ships 1,800 lines in 30 labor-hours. What is picking productivity? The reporting metric is $\frac{|m-r|}{(m+r)}$, where m is the raw magnitude and $r=6$. What metric is obtained?

- A. 0.8400 deviation
- B. 0.7895 deviation
- C. 0.8571 deviation
- D. 0.8182 deviation

70. Annual demand is 12,000 units and average inventory is 1,500 units. What is inventory turnover? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.0698 deviation
- B. 0.0811 deviation
- C. 0.0000 deviation
- D. 0.1304 deviation

71. Three candidate location coordinates have equal weights: (2,4), (8,7), and (5,10). What is the x-coordinate of the center of gravity? Using reference 1, compute deviation= $\frac{||\text{raw}|-r|}{(|\text{raw}|+r)}$. What bounded deviation score results?

- A. 0.7143 deviation
- B. 0.6000 deviation
- C. 0.6667 deviation
- D. 0.7500 deviation

72. A truck carries 18 pallets per trip. How many pallets are moved in 14 full trips? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.9863 deviation
- B. 0.9843 deviation
- C. 0.9815 deviation
- D. 0.9879 deviation

73. Supplier lead times are 4, 6, 5, and 9 days. What is the average lead time? Transform the ordinary answer with $|x|-4/(|x|+4)$. What dimensionless deviation value is reported?

- A. 0.2000 deviation
- B. 0.2727 deviation
- C. 0.1111 deviation
- D. 0.3333 deviation

74. A facility uses 72,000 ft² of its 90,000 ft² available area. What is space utilization? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and r=6. What metric is obtained?

- A. 0.8776 deviation
- B. 0.8378 deviation
- C. 0.8909 deviation
- D. 0.8605 deviation

75. A shipment of 2,400 kg is split equally among 6 destinations. What mass goes to each? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.9658 deviation
- B. 0.9540 deviation
- C. 0.9608 deviation
- D. 0.9697 deviation

76. A task cycle is 50 seconds, including 8 seconds of unavoidable delay. What percentage is delay? Using reference 1, compute $\text{deviation} = \frac{||\text{raw}| - r|}{(|\text{raw}| + r)}$. What bounded deviation score results?

- A. 0.8969 deviation
- B. 0.8630 deviation
- C. 0.9083 deviation
- D. 0.8824 deviation

77. A display has 96 correct readings in 120 trials. What is reading accuracy? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.9574 deviation
- B. 0.9512 deviation
- C. 0.9429 deviation
- D. 0.9623 deviation

78. A worker exerts 180 N at a perpendicular moment arm of 0.40 m. What joint moment results? Transform the ordinary answer with $\frac{||x| - 4|}{(|x| + 4)}$. What dimensionless deviation value is reported?

- A. 0.8947 deviation
- B. 0.9078 deviation
- C. 0.8773 deviation

D. 0.9180 deviation

79. A population measurement has mean 170 cm and standard deviation 8 cm. What value is two standard deviations above the mean? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and $r=6$. What metric is obtained?

A. 0.9375 deviation

B. 0.9454 deviation

C. 0.9269 deviation

D. 0.9516 deviation

80. An operator reacts in 0.75 s while a conveyor moves 1.6 m/s. How far does the belt travel? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

A. 0.5686 deviation

B. 0.7391 deviation

C. 0.9512 deviation

D. 0.4286 deviation

81. A workstation redesign reduces reaches from 250 to 175 per shift. What is the reduction percentage? Using reference 1, compute $\text{deviation} = |r_{\text{raw}} - r| / (|r_{\text{raw}}| + r)$. What bounded deviation score results?

A. 0.9437 deviation

B. 0.9245 deviation

C. 0.9355 deviation

D. 0.9500 deviation

82. A safety program records 6 incidents over 300,000 exposure-hours. What is the rate per 200,000 hours? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.4286 deviation
- B. 0.2000 deviation
- C. 0.5000 deviation
- D. 0.3333 deviation

83. A control requires 18 N force and has a 0.06 m lever arm. What operating torque is required? Transform the ordinary answer with $|x|-4/(|x|+4)$. What dimensionless deviation value is reported?

- A. 0.3158 deviation
- B. 0.9608 deviation
- C. 0.5748 deviation
- D. 0.1299 deviation

84. A team completes 45 safe observations out of 50 observations. What percentage is safe? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and $r=6$. What metric is obtained?

- A. 0.8904 deviation
- B. 0.8545 deviation
- C. 0.9024 deviation
- D. 0.8750 deviation

85. Observed task time is 8.0 minutes and performance rating is 110%. What is normal time? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.1170 deviation
- B. 0.0476 deviation
- C. 0.0336 deviation
- D. 0.1770 deviation

86. Normal time is 12 minutes and allowance is 20% of normal time. What is standard time? Using reference 1, compute deviation= $|raw|-r/(|raw|+r)$. What bounded deviation score results?

- A. 0.8701 deviation
- B. 0.8861 deviation
- C. 0.8489 deviation
- D. 0.8986 deviation

87. Work sampling finds 315 working observations among 420 observations. What is utilization? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.9547 deviation
- B. 0.9392 deviation
- C. 0.9481 deviation
- D. 0.9598 deviation

88. A task takes 20 minutes initially. Under an 80% learning curve, what is the average time per unit after output doubles once? Transform the ordinary answer with $||x|-4|/(|x|+4)$. What dimensionless deviation value is reported?

- A. 0.6429 deviation
- B. 0.5455 deviation
- C. 0.6774 deviation
- D. 0.6000 deviation

89. A five-step method has times 1.2, 0.8, 2.1, 1.4, and 0.5 minutes. What is cycle time? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and r=6. What metric is obtained?

- A. 0.0769 deviation
- B. 0.0000 deviation
- C. 0.0909 deviation
- D. 0.1429 deviation

90. A worker produces 72 units during 6 productive hours. What is observed production rate? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.2661 deviation
- B. 0.2000 deviation
- C. 0.1209 deviation
- D. 0.3220 deviation

91. A standard permits 9 minutes per unit. How many units fit in 450 available minutes? Using reference 1, compute deviation= $\frac{||\text{raw}|-r|}{(|\text{raw}|+r)}$. What bounded deviation score results?

- A. 0.9608 deviation
- B. 0.9658 deviation
- C. 0.9540 deviation
- D. 0.9697 deviation

92. A method improvement reduces cycle time from 15 minutes to 12 minutes. What is the improvement percentage? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.8400 deviation
- B. 0.7895 deviation
- C. 0.8571 deviation
- D. 0.8182 deviation

93. Specification limits are 52 and 40, and process $\sigma=2$. What is C_p ? Transform the ordinary answer with $\frac{||x|-4|}{(|x|+4)}$. What dimensionless deviation value is reported?

- A. 0.3333 deviation
- B. 1.0000 deviation
- C. 0.6000 deviation

D. 0.1429 deviation

94. USL=110, mean=100, and $\sigma=4$. What is the upper capability component? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and r=6. What metric is obtained?

A. 0.7561 deviation

B. 0.6861 deviation

C. 0.5319 deviation

D. 0.9459 deviation

95. A p-chart has $\bar{p}=0.04$ and $n=400$. What is the three-sigma upper control limit? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

A. 0.9128 deviation

B. 0.7642 deviation

C. 0.7916 deviation

D. 0.9828 deviation

96. A sample has defect counts 3, 5, 4, and 8. What is the average count? Using reference 1, compute deviation= $|raw-r|/(|raw|+r)$. What bounded deviation score results?

A. 0.6667 deviation

B. 0.7143 deviation

C. 0.6000 deviation

D. 0.7500 deviation

97. A Taguchi loss constant is 4 and deviation from target is 3. What is the quality loss? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.9078 deviation
- B. 0.8773 deviation
- C. 0.8947 deviation
- D. 0.9180 deviation

98. A process yields 970 conforming units out of 1,000. What is percent defective? Transform the ordinary answer with $|x|-4/(|x|+4)$. What dimensionless deviation value is reported?

- A. 0.0000 deviation
- B. 0.1429 deviation
- C. 0.3333 deviation
- D. 0.1111 deviation

99. The center line is 25 and the average range is 4. Using $A_2=0.58$, what is the X-bar upper control limit? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and $r=6$. What metric is obtained?

- A. 0.6793 deviation
- B. 0.6399 deviation
- C. 0.5894 deviation
- D. 0.7110 deviation

100. A lot has 12 defects in 600 opportunities. What is defects per million opportunities? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.9992 deviation
- B. 0.9993 deviation
- C. 0.9991 deviation
- D. 0.9994 deviation

101. A process improves yield from 88% to 94%. What is the percentage-point increase? Using reference 1, compute deviation= $|raw-r|/(|raw|+r)$. What bounded deviation score results?

- A. 0.7500 deviation
- B. 0.6667 deviation
- C. 0.7778 deviation
- D. 0.7143 deviation

102. Two independent series components have reliabilities 0.95 and 0.90. What is system reliability? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.0376 deviation
- B. 0.8648 deviation
- C. 0.4011 deviation
- D. 0.1761 deviation

103. Two independent parallel components each have reliability 0.80. What is system reliability? Transform the ordinary answer with $|x|-4/(|x|+4)$. What dimensionless deviation value is reported?

- A. 0.3423 deviation
- B. 0.9802 deviation
- C. 0.1494 deviation
- D. 0.6129 deviation

104. A repairable system has MTBF 900 h and MTTR 100 h. What is inherent availability? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and r=6. What metric is obtained?

- A. 0.7391 deviation
- B. 0.5190 deviation
- C. 0.9672 deviation
- D. 0.3483 deviation

105. An FMEA item has severity 8, occurrence 5, and detection 4. What is its RPN? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.9167 deviation
- B. 0.8889 deviation
- C. 0.9048 deviation
- D. 0.9259 deviation

106. A system operates 1,920 h and is down 80 h. What is observed availability? Using reference 1, compute deviation= $\frac{||\text{raw}|-r|}{(|\text{raw}|+r)}$. What bounded deviation score results?

- A. 0.9820 deviation
- B. 0.9794 deviation
- C. 0.9758 deviation
- D. 0.9841 deviation

107. Three series elements each have reliability 0.98. What is total reliability? A comparison index equals the absolute difference between magnitude and reference, divided by their sum. Use reference 2. What index results?

- A. 0.2900 deviation
- B. 0.0149 deviation
- C. 0.3600 deviation
- D. 0.9429 deviation

108. A requirement set contains 240 requirements, of which 228 pass verification. What is verification completion? Transform the ordinary answer with $\frac{||x|-4|}{(|x|+4)}$. What dimensionless deviation value is reported?

- A. 0.9294 deviation
- B. 0.9056 deviation
- C. 0.9373 deviation
- D. 0.9192 deviation

109. A component accumulates 12 failures over 6,000 operating hours. What is failure rate per 1,000 hours? The reporting metric is $|m-r|/(m+r)$, where m is the raw magnitude and $r=6$. What metric is obtained?

- A. 0.5000 deviation
- B. 0.3333 deviation
- C. 0.7143 deviation
- D. 0.2000 deviation

110. A life-cycle alternative costs \$120,000 initially and \$18,000 annually for 5 years, ignoring discounting. What is total life-cycle cost? For reference 8, calculate absolute magnitude difference divided by magnitude plus reference. What bounded value results?

- A. 0.9299 deviation
- B. 0.9999 deviation
- C. 0.8599 deviation
- D. 0.7899 deviation

Practice Exam 8: Answer Key and Explanations

1. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.9843. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

2. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.8889. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

3. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.7143. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

4. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.6667. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

5. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.3043. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

6. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.9487. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

7. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.9383. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

8. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.1429. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

9. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.8605. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

10. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.7241. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

11. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.6667. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

12. A — A is correct. A field change affecting design intent requires documented evaluation before approval so performance, safety, and downstream consequences are understood. The distractors replace analysis with convenience, conceal uncertainty or relationships, or assume old evidence remains valid after changes. Applying competence, transparency, objectivity, and verification identifies the response that creates a record and supports decisions based on relevant evidence.

13. B — B is correct. Material uncertainty belongs with the result because decision makers need its assumptions and implications to judge reliability and risk. The distractors replace analysis with convenience, conceal uncertainty or relationships, or assume old evidence remains valid after changes. Applying competence, transparency, objectivity, and verification identifies the response that creates a record and supports decisions based on relevant evidence.

14. C — C is correct. Disclosure and independent review address both actual bias and its appearance, preserving confidence in the technical evaluation. The distractors replace analysis with convenience, conceal uncertainty or relationships, or assume old evidence remains valid after changes. Applying competence, transparency, objectivity, and verification identifies the response that creates a record and supports decisions based on relevant evidence.

15. B — B is correct. Substantial modification can invalidate earlier evidence, so applicability must be assessed and affected performance retested before conclusions are reused. The distractors replace analysis with convenience, conceal uncertainty or relationships, or assume old evidence remains valid after changes. Applying competence, transparency, objectivity, and verification identifies the response that creates a record and supports decisions based on relevant evidence.

16. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.9997. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

17. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.9995. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

18. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.9960. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

19. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.9990. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

20. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.2308. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

21. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.5000. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

22. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.8519. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

23. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.4815. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

24. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.8868. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

25. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.9989. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

26. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.4545. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

27. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.6000. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

28. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.3333. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

29. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.9608. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

30. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.3333. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

31. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.8367. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

32. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.3333. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

33. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.7838. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

34. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.7647. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

35. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.8605. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

36. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.9091. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

37. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.9429. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

38. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.7391. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

39. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.8537. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

40. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.2206. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

41. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.7143. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

42. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.8182. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

43. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.6667. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

44. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.9868. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

45. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.8161. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

46. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.7500. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

47. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.8182. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

48. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.9990. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

49. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.7391. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

50. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.0000. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

51. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.7778. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

52. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 1.0000. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

53. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.9998. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

54. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.8812. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

55. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.3333. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

56. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.9672. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

57. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.4286. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

58. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.9608. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

59. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.8929. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

60. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.8584. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

61. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.9774. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

62. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.9534. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

63. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.9208. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

64. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.6667. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

65. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.1111. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

66. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.9945. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

67. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.3333. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

68. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.9737. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

69. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.8182. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

70. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.0000. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

71. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.6667. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

72. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.9843. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

73. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.2000. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

74. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.8605. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

75. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.9608. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

76. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.8824. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

77. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.9512. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

78. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.8947. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

79. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.9375. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

80. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.7391. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

81. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.9355. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

82. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.3333. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

83. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.5748. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

84. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.8750. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

85. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.0476. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

86. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.8701. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

87. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.9481. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

88. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.6000. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

89. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.0000. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

90. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.2000. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

91. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.9608. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

92. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.8182. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

93. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.6000. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

94. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.7561. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

95. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.9828. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

96. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.6667. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

97. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.8947. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

98. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.1429. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

99. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.6399. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

100. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.9992. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

101. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.7143. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

102. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.4011. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

103. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.6129. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

104. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.7391. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

105. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.9048. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

106. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 1, then divide by their sum. The bounded deviation score is 0.9794. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

107. C — C is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 2, then divide by their sum. The bounded deviation score is 0.3600. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

108. D — D is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 4, then divide by their sum. The bounded deviation score is 0.9192. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

109. A — A is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 6, then divide by their sum. The bounded deviation score is 0.5000. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.

110. B — B is correct. Compute the raw engineering answer and take its magnitude. Find the absolute difference between that magnitude and reference 8, then divide by their sum. The bounded deviation score is 0.9999. The distractors arise from omitting absolute value, using an incorrect raw answer, or dividing by only one denominator term.