

PRACTICE EXAM 9: 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 $\text{similarity} = (m+r-|m-r|)/(m+r)$, where m is the raw magnitude. What score results?

- A. 0.0137 similarity
- B. 0.0185 similarity
- C. 0.0121 similarity
- D. 0.0157 similarity

2. For $f(x) = 3x^2 + 4x - 2$, what is $f'(5)$? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.1425 similarity
- B. 0.1881 similarity
- C. 0.1622 similarity
- D. 0.1271 similarity

3. What is the determinant of the matrix $\begin{bmatrix} 6 & 2 \\ 3 & 5 \end{bmatrix}$? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.3448 similarity
- B. 0.3067 similarity

- C. 0.3937 similarity
- D. 0.2762 similarity

4. Evaluate the definite integral of $4x$ from $x=1$ to $x=4$. The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.3373 similarity
- B. 0.3784 similarity
- C. 0.4308 similarity
- D. 0.3043 similarity

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

- A. 0.6857 similarity
- B. 0.8276 similarity
- C. 0.7500 similarity
- D. 0.6316 similarity

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

- A. 0.0447 similarity
- B. 0.0601 similarity
- C. 0.0397 similarity
- D. 0.0513 similarity

7. What is the volume of a cylinder with radius 2 m and height 5 m, using $\pi=3.1416$? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.0911 similarity
- B. 0.0797 similarity
- C. 0.1064 similarity
- D. 0.0709 similarity

8. A 24 V source is applied across an 8 Ω resistor. What current flows? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.8889 similarity
- B. 0.5714 similarity
- C. 0.7500 similarity
- D. 1.0000 similarity

9. A 10 kg cart travels at 4 m/s. What is its kinetic energy? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.1414 similarity
- B. 0.1867 similarity
- C. 0.1261 similarity
- D. 0.1609 similarity

10. A 30 kN axial load acts on a 600 mm² section. What is the normal stress? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.2707 similarity
- B. 0.3051 similarity
- C. 0.3495 similarity
- D. 0.2432 similarity

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

- A. 0.9091 similarity
- B. 0.3333 similarity
- C. 0.8889 similarity
- D. 0.6250 similarity

12. An engineer is asked to certify completion even though required acceptance tests remain unfinished. What is the proper response?

- A. Certify because the contractor promises later testing
- B. Mark every unfinished test as automatically passed
- C. Remove the testing requirement from the final report
- D. Decline certification until required tests are completed and results support acceptance

13. A client proposes excluding maintenance costs from a life-cycle comparison to favor one alternative. What should the engineer do?

- A. Omit maintenance costs because the client requested it
- B. Use different study periods for competing alternatives
- C. Include relevant life-cycle costs and explain the effect of any excluded assumptions
- D. Hide the exclusion in an unlabeled spreadsheet cell

14. An engineer learns that a colleague made an honest but significant calculation error. What is the best first action?

- A. Promptly notify the colleague and project authority so correction occurs
- B. Publicly accuse the colleague of misconduct immediately
- C. Ignore the error because it was unintentional
- D. Delete all project calculations before review

15. A design recommendation depends heavily on incomplete supplier data. How should the engineer proceed?

- A. Present the recommendation as fully verified
- B. Assume missing supplier values are always favorable
- C. Identify the data limitations, seek verification, and qualify any interim recommendation
- D. Remove all references to the supplier data source

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

- A. 0.0703 similarity
- B. 0.0004 similarity
- C. 0.2103 similarity
- D. 0.0003 similarity

17. What is the present worth of \$10,000 received 4 years from now at 5% annual interest? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.0707 similarity
- B. 0.0007 similarity
- C. 0.0006 similarity
- D. 0.0009 similarity

18. A product sells for \$50, variable cost is \$30, and fixed cost is \$40,000. What is break-even volume? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.0050 similarity
- B. 0.0043 similarity
- C. 0.0059 similarity
- D. 0.0038 similarity

19. Equipment costs \$72,000, has \$12,000 salvage value, and a 5-year life. What is annual straight-line depreciation? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.0010 similarity
- B. 0.0014 similarity
- C. 0.0009 similarity
- D. 0.0012 similarity

20. A \$90,000 project returns \$18,000 per year. Ignoring interest, what is its simple payback period? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.8000 similarity
- B. 0.7143 similarity
- C. 0.6154 similarity
- D. 0.8750 similarity

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

- A. 0.4000 similarity
- B. 0.6667 similarity
- C. 0.5000 similarity
- D. 0.3333 similarity

22. A machine saves \$15,000 annually but costs \$60,000. What is the simple annual return percentage? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.2143 similarity
- B. 0.1890 similarity

- C. 0.2474 similarity
- D. 0.1690 similarity

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 raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.6486 similarity
- B. 0.1481 similarity
- C. 0.4375 similarity
- D. 0.8095 similarity

24. An item costs \$80 after a 20% price reduction. What was its original price? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.1308 similarity
- B. 0.1148 similarity
- C. 0.1522 similarity
- D. 0.1022 similarity

25. A replacement reduces annual operating cost from \$48,000 to \$33,000. What is the annual savings? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.0010 similarity
- B. 0.0014 similarity
- C. 0.0009 similarity
- D. 0.0012 similarity

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

- A. 0.8421 similarity
- B. 0.5455 similarity
- C. 0.7692 similarity
- D. 0.5926 similarity

27. A distribution has values 4, 7, 9, and 12. What is the arithmetic mean? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.4918 similarity
- B. 0.6122 similarity
- C. 0.4478 similarity
- D. 0.5455 similarity

28. A normal observation is 70 with mean 58 and standard deviation 6. What is its z-score? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.7500 similarity
- B. 0.5714 similarity
- C. 0.3333 similarity
- D. 0.8889 similarity

29. Independent events have probabilities 0.30 and 0.40. What is the probability both occur? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.0337 similarity
- B. 0.2759 similarity
- C. 0.2234 similarity
- D. 0.4649 similarity

30. A defect rate is 0.02. In 200 independent items, what is the expected number defective? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.7143 similarity
- B. 0.5000 similarity
- C. 0.6154 similarity
- D. 0.8000 similarity

31. For data 2, 5, 8, 11, what is the population variance? Using reference 1, compute similarity= $(m+r-|m-r|)/(m+r)$, where m is the raw magnitude. What score results?

- A. 0.1633 similarity
- B. 0.1435 similarity
- C. 0.1893 similarity
- D. 0.1280 similarity

32. A sample mean is 40, population σ is 8, and $n=64$. What is the standard error? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.8000 similarity
- B. 0.0000 similarity
- C. 0.5000 similarity
- D. 1.0000 similarity

33. A regression model is $y=12+3x$. What value is predicted when $x=7$? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.2328 similarity
- B. 0.3026 similarity
- C. 0.2088 similarity

D. 0.2632 similarity

34. How many distinct pairs can be selected from 10 items? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

A. 0.2383 similarity

B. 0.2692 similarity

C. 0.3094 similarity

D. 0.2137 similarity

35. Events A and B are mutually exclusive with probabilities 0.25 and 0.35. What is $P(A \text{ or } B)$? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

A. 0.3019 similarity

B. 0.0851 similarity

C. 0.1250 similarity

D. 0.4483 similarity

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

A. 0.0795 similarity

B. 0.0909 similarity

C. 0.1061 similarity

D. 0.0707 similarity

37. A linear objective is $Z=8x+5y$. What is Z at $x=6$ and $y=4$? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.0845 similarity
- B. 0.0739 similarity
- C. 0.0987 similarity
- D. 0.0656 similarity

38. A single-server system has arrival rate 6 per hour and service rate 10 per hour. What is utilization? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.4848 similarity
- B. 0.1481 similarity
- C. 0.6842 similarity
- D. 0.2143 similarity

39. A payoff is \$100 with probability 0.7 and \$20 with probability 0.3. What is expected payoff? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.1483 similarity
- B. 0.1955 similarity
- C. 0.1687 similarity
- D. 0.1323 similarity

40. A simulation uses $u=0.64$ with exponential mean 5. Using $x=-5 \ln(1-u)$, what variate results? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.6542 similarity
- B. 0.8086 similarity
- C. 0.6268 similarity
- D. 0.7242 similarity

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

- A. 0.2857 similarity
- B. 0.2500 similarity
- C. 0.3333 similarity
- D. 0.2222 similarity

42. A Markov state has outgoing probabilities 0.55, 0.25, and p . What is p ? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.5714 similarity
- B. 0.1250 similarity
- C. 0.4211 similarity
- D. 0.8462 similarity

43. A database query returns 240 rows from 1,200 records. What percentage is returned? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.3571 similarity
- B. 0.4545 similarity
- C. 0.3226 similarity
- D. 0.4000 similarity

44. An algorithm performs 12 comparisons for each of 75 records. How many comparisons occur? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.0134 similarity
- B. 0.0154 similarity
- C. 0.0181 similarity
- D. 0.0119 similarity

45. A weighted score uses weights 0.4, 0.35, 0.25 and ratings 80, 70, 90. What is the score? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.2045 similarity
- B. 0.1803 similarity
- C. 0.2364 similarity
- D. 0.1611 similarity

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

- A. 0.2210 similarity
- B. 0.2878 similarity
- C. 0.2500 similarity
- D. 0.1980 similarity

47. A project path contains activities of 3, 7, 4, and 6 days. What is the path duration? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.2308 similarity
- B. 0.3000 similarity
- C. 0.2069 similarity
- D. 0.2609 similarity

48. Planned value is \$80,000 and earned value is \$72,000. What is schedule variance? Transform the raw answer with $(|x|+5-|x|-5)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.0015 similarity
- B. 0.0012 similarity
- C. 0.0011 similarity

D. 0.0018 similarity

49. Earned value is \$90,000 and actual cost is \$100,000. What is cost performance index? The reporting metric compares magnitude m with reference r using $2\min(m,r)/(m+r)$. What metric results?

A. 0.2278 similarity

B. 0.4270 similarity

C. 0.0282 similarity

D. 0.5859 similarity

50. A team produces 360 units in 45 labor-hours. What is labor productivity? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

A. 0.9890 similarity

B. 0.8608 similarity

C. 0.9278 similarity

D. 0.9412 similarity

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

A. 0.1961 similarity

B. 0.2564 similarity

C. 0.2222 similarity

D. 0.1754 similarity

52. A project has budget at completion \$250,000 and CPI 0.80. What is the basic estimate at completion? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.0000 similarity
- B. 0.0700 similarity
- C. 0.1400 similarity
- D. 0.2100 similarity

53. A decision yields \$60,000 with probability 0.6 and loses \$10,000 with probability 0.4. What is expected value? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.0703 similarity
- B. 0.0003 similarity
- C. 0.0004 similarity
- D. 0.0002 similarity

54. A department completes 950 conforming orders from 1,000 total. What is its conformance KPI? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.1204 similarity
- B. 0.1595 similarity
- C. 0.1373 similarity
- D. 0.1073 similarity

55. A task has latest start day 18 and earliest start day 14. What is total slack? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.7143 similarity
- B. 0.5000 similarity
- C. 0.8000 similarity
- D. 0.6154 similarity

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

- A. 0.0286 similarity
- B. 0.0385 similarity
- C. 0.0328 similarity
- D. 0.0253 similarity

57. A station has 45 minutes of work content and a 9-minute cycle time. What is the theoretical minimum number of stations? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.7500 similarity
- B. 0.6667 similarity
- C. 0.8571 similarity
- D. 0.6000 similarity

58. Demand is 1,600 units/year, order cost is \$25, and holding cost is \$2/unit-year. What is EOQ? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.0426 similarity
- B. 0.0488 similarity
- C. 0.0571 similarity
- D. 0.0377 similarity

59. Forecasts use $\alpha=0.30$, prior forecast 100, and actual demand 120. What is the new exponential-smoothing forecast? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.1086 similarity
- B. 0.1442 similarity
- C. 0.1239 similarity
- D. 0.0967 similarity

60. What is the three-period moving average of demands 90, 105, and 120? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.1579 similarity
- B. 0.1387 similarity
- C. 0.1832 similarity
- D. 0.1237 similarity

61. A machine operates 420 minutes of a planned 480 minutes. What is availability? Using reference 1, compute $\text{similarity} = (m+r-|m-r|)/(m+r)$, where m is the raw magnitude. What score results?

- A. 0.0197 similarity
- B. 0.0265 similarity
- C. 0.0174 similarity
- D. 0.0226 similarity

62. A process has availability 0.90, performance 0.95, and quality 0.98. What is OEE? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.0604 similarity
- B. 0.0691 similarity
- C. 0.0808 similarity
- D. 0.0536 similarity

63. A batch of 500 pieces includes 15 defective pieces. What is first-pass yield? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.0858 similarity
- B. 0.0980 similarity
- C. 0.1144 similarity
- D. 0.0763 similarity

64. Setup is reduced from 50 minutes to 35 minutes. What is the reduction percentage? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.3784 similarity
- B. 0.3373 similarity
- C. 0.4308 similarity
- D. 0.3043 similarity

65. A bottleneck produces one unit every 6 minutes. What is its hourly capacity? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.8780 similarity
- B. 0.9714 similarity
- C. 0.9474 similarity
- D. 0.8182 similarity

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

- A. 0.0048 similarity
- B. 0.0065 similarity
- C. 0.0043 similarity
- D. 0.0055 similarity

67. Demand is 240 units/day and one machine makes 60 units/day. Ignoring downtime, how many machines are required? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.7500 similarity
- B. 1.0000 similarity

- C. 0.8571 similarity
- D. 0.6667 similarity

68. Average demand is 50 units/day and lead time is 6 days. With no safety stock, what is reorder point? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.0328 similarity
- B. 0.0286 similarity
- C. 0.0385 similarity
- D. 0.0253 similarity

69. A warehouse ships 1,800 lines in 30 labor-hours. What is picking productivity? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.1842 similarity
- B. 0.2090 similarity
- C. 0.2414 similarity
- D. 0.1647 similarity

70. Annual demand is 12,000 units and average inventory is 1,500 units. What is inventory turnover? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.9890 similarity
- B. 0.8608 similarity
- C. 0.9278 similarity
- D. 0.9412 similarity

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 $\text{similarity} = (m+r-|m-r|)/(m+r)$, where m is the raw magnitude. What score results?

- A. 0.2857 similarity
- B. 0.4000 similarity
- C. 0.3333 similarity
- D. 0.2500 similarity

72. A truck carries 18 pallets per trip. How many pallets are moved in 14 full trips? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.0205 similarity
- B. 0.0276 similarity
- C. 0.0181 similarity
- D. 0.0235 similarity

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

- A. 0.9091 similarity
- B. 0.8333 similarity
- C. 1.0000 similarity
- D. 0.7692 similarity

74. A facility uses 72,000 ft² of its 90,000 ft² available area. What is space utilization? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.1414 similarity
- B. 0.1609 similarity
- C. 0.1867 similarity
- D. 0.1261 similarity

75. A shipment of 2,400 kg is split equally among 6 destinations. What mass goes to each? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.0384 similarity
- B. 0.0440 similarity
- C. 0.0516 similarity
- D. 0.0340 similarity

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

- A. 0.1031 similarity
- B. 0.1370 similarity
- C. 0.0917 similarity
- D. 0.1176 similarity

77. A display has 96 correct readings in 120 trials. What is reading accuracy? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.0632 similarity
- B. 0.0845 similarity
- C. 0.0723 similarity
- D. 0.0561 similarity

78. A worker exerts 180 N at a perpendicular moment arm of 0.40 m. What joint moment results? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.1299 similarity
- B. 0.1139 similarity

- C. 0.1511 similarity
- D. 0.1014 similarity

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 compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.0634 similarity
- B. 0.0848 similarity
- C. 0.0563 similarity
- D. 0.0725 similarity

80. An operator reacts in 0.75 s while a conveyor moves 1.6 m/s. How far does the belt travel? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.3929 similarity
- B. 0.0435 similarity
- C. 0.2353 similarity
- D. 0.5246 similarity

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

- A. 0.0563 similarity
- B. 0.0645 similarity
- C. 0.0755 similarity
- D. 0.0500 similarity

82. A safety program records 6 incidents over 300,000 exposure-hours. What is the rate per 200,000 hours? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.8571 similarity
- B. 0.7500 similarity
- C. 1.0000 similarity
- D. 0.6667 similarity

83. A control requires 18 N force and has a 0.06 m lever arm. What operating torque is required? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.5876 similarity
- B. 0.3553 similarity
- C. 0.0315 similarity
- D. 0.7624 similarity

84. A team completes 45 safe observations out of 50 observations. What percentage is safe? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.1267 similarity
- B. 0.1677 similarity
- C. 0.1129 similarity
- D. 0.1443 similarity

85. Observed task time is 8.0 minutes and performance rating is 110%. What is normal time? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.9414 similarity
- B. 0.9078 similarity
- C. 0.9888 similarity

D. 0.8806 similarity

86. Normal time is 12 minutes and allowance is 20% of normal time. What is standard time? Using reference 1, compute $\text{similarity} = (m+r-|m-r|)/(m+r)$, where m is the raw magnitude. What score results?

A. 0.1299 similarity

B. 0.1139 similarity

C. 0.1511 similarity

D. 0.1014 similarity

87. Work sampling finds 315 working observations among 420 observations. What is utilization? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

A. 0.0672 similarity

B. 0.0769 similarity

C. 0.0899 similarity

D. 0.0597 similarity

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 raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

A. 0.4274 similarity

B. 0.5376 similarity

C. 0.3876 similarity

D. 0.4762 similarity

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 compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.9231 similarity
- B. 1.0000 similarity
- C. 0.8333 similarity
- D. 0.9333 similarity

90. A worker produces 72 units during 6 productive hours. What is observed production rate? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.7895 similarity
- B. 0.9375 similarity
- C. 0.8571 similarity
- D. 0.7317 similarity

91. A standard permits 9 minutes per unit. How many units fit in 450 available minutes? Using reference 1, compute similarity= $(m+r-|m-r|)/(m+r)$, where m is the raw magnitude. What score results?

- A. 0.0342 similarity
- B. 0.0460 similarity
- C. 0.0392 similarity
- D. 0.0303 similarity

92. A method improvement reduces cycle time from 15 minutes to 12 minutes. What is the improvement percentage? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.2308 similarity
- B. 0.2609 similarity
- C. 0.3000 similarity
- D. 0.2069 similarity

93. Specification limits are 52 and 40, and process $\sigma=2$. What is C_p ? Transform the raw answer with $(|x| + 5 - ||x| - 5|) / (|x| + 5)$. What dimensionless similarity is reported?

- A. 0.3333 similarity
- B. 0.5714 similarity
- C. 0.0000 similarity
- D. 0.7500 similarity

94. $USL=110$, $mean=100$, and $\sigma=4$. What is the upper capability component? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.1428 similarity
- B. 0.4151 similarity
- C. 0.0465 similarity
- D. 0.2128 similarity

95. A p -chart has $\bar{p}=0.04$ and $n=400$. What is the three-sigma upper control limit? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.0853 similarity
- B. 0.0153 similarity
- C. 0.2124 similarity
- D. 0.1874 similarity

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

- A. 0.3333 similarity
- B. 0.2857 similarity
- C. 0.4000 similarity
- D. 0.2500 similarity

97. A Taguchi loss constant is 4 and deviation from target is 3. What is the quality loss? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.1351 similarity
- B. 0.1786 similarity
- C. 0.1538 similarity
- D. 0.1205 similarity

98. A process yields 970 conforming units out of 1,000. What is percent defective? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.8889 similarity
- B. 0.5714 similarity
- C. 1.0000 similarity
- D. 0.7500 similarity

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 compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.4079 similarity
- B. 0.3644 similarity
- C. 0.4632 similarity
- D. 0.3293 similarity

100. A lot has 12 defects in 600 opportunities. What is defects per million opportunities? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.0008 similarity
- B. 0.0011 similarity

- C. 0.0009 similarity
- D. 0.0007 similarity

101. A process improves yield from 88% to 94%. What is the percentage-point increase? Using reference 1, compute $\text{similarity} = (m+r-|m-r|)/(m+r)$, where m is the raw magnitude. What score results?

- A. 0.2500 similarity
- B. 0.2857 similarity
- C. 0.3333 similarity
- D. 0.2222 similarity

102. Two independent series components have reliabilities 0.95 and 0.90. What is system reliability? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.7642 similarity
- B. 0.0922 similarity
- C. 0.9752 similarity
- D. 0.4436 similarity

103. Two independent parallel components each have reliability 0.80. What is system reliability? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.5632 similarity
- B. 0.0159 similarity
- C. 0.7437 similarity
- D. 0.3221 similarity

104. A repairable system has MTBF 900 h and MTTR 100 h. What is inherent availability? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.2278 similarity
- B. 0.4270 similarity
- C. 0.0282 similarity
- D. 0.5859 similarity

105. An FMEA item has severity 8, occurrence 5, and detection 4. What is its RPN? For reference 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.0933 similarity
- B. 0.1241 similarity
- C. 0.1065 similarity
- D. 0.0829 similarity

106. A system operates 1,920 h and is down 80 h. What is observed availability? Using reference 1, compute $\text{similarity} = (m+r-|m-r|)/(m+r)$, where m is the raw magnitude. What score results?

- A. 0.0180 similarity
- B. 0.0206 similarity
- C. 0.0242 similarity
- D. 0.0159 similarity

107. Three series elements each have reliability 0.98. What is total reliability? A closeness score equals two times the smaller of magnitude and reference divided by their sum. Use reference 3. What score is obtained?

- A. 0.4776 similarity
- B. 0.4076 similarity
- C. 0.7857 similarity
- D. 0.0384 similarity

108. A requirement set contains 240 requirements, of which 228 pass verification. What is verification completion? Transform the raw answer with $(|x|+5-||x|-5|)/(|x|+5)$. What dimensionless similarity is reported?

- A. 0.0875 similarity
- B. 0.1000 similarity
- C. 0.1166 similarity
- D. 0.0778 similarity

109. A component accumulates 12 failures over 6,000 operating hours. What is failure rate per 1,000 hours? The reporting metric compares magnitude m with reference 7 using $2\min(m,r)/(m+r)$. What metric results?

- A. 0.6000 similarity
- B. 0.2500 similarity
- C. 0.4444 similarity
- D. 0.7273 similarity

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 9, calculate the sum minus absolute difference, divided by the sum. What bounded similarity value results?

- A. 0.0701 similarity
- B. 0.1401 similarity
- C. 0.2101 similarity
- D. 0.0001 similarity

Practice Exam 9: Answer Key and Explanations

1. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The

bounded similarity score is 0.0157. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

2. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1622. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

3. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.3448. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

4. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.3784. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

5. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.7500. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

6. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0513. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

7. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0911. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

8. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.7500. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

9. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1609. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

10. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The

bounded similarity score is 0.3051. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

11. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.3333. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

12. D — D is correct. Certification communicates professional assurance, so required evidence must exist and support acceptance before the engineer signs. The distractors substitute promises for evidence, manipulate assumptions, ignore correctable errors, or overstate conclusions from incomplete data. Applying competence, candor, consistency, and verification identifies the response that creates a technical record and enables informed decisions.

13. C — C is correct. A fair economic comparison uses consistent assumptions and relevant costs, with exclusions disclosed so decision makers understand their effect. The distractors substitute promises for evidence, manipulate assumptions, ignore correctable errors, or overstate conclusions from incomplete data. Applying competence, candor, consistency, and verification identifies the response that creates a technical record and enables informed decisions.

14. A — A is correct. A significant technical error requires timely correction; direct, documented communication permits responsible parties to assess consequences and revise affected work. The distractors substitute promises for evidence, manipulate assumptions, ignore correctable errors, or overstate conclusions from incomplete data. Applying competence, candor, consistency, and verification identifies the response that creates a technical record and enables informed decisions.

15. C — C is correct. When essential inputs are incomplete, limitations and conditional conclusions must be communicated while verification is pursued. The distractors substitute promises for evidence, manipulate assumptions, ignore correctable errors, or overstate conclusions from incomplete data. Applying competence, candor, consistency, and verification identifies the response that creates a technical record and enables informed decisions.

16. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0003. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

17. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0007. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

18. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The

bounded similarity score is 0.0050. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

19. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0012. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

20. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.7143. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

21. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.5000. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

22. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2143. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

23. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.4375. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

24. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1308. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

25. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0012. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

26. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.5455. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

27. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The

bounded similarity score is 0.5455. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

28. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.5714. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

29. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0337. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

30. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.6154. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

31. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1633. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

32. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.5000. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

33. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2632. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

34. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2692. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

35. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1250. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

36. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The

bounded similarity score is 0.0909. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

37. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0845. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

38. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2143. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

39. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1687. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

40. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.7242. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

41. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2857. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

42. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1250. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

43. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.4000. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

44. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0154. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

45. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The

bounded similarity score is 0.2045. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

46. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2500. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

47. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2609. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

48. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0012. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

49. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2278. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

50. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.9412. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

51. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2222. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

52. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0000. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

53. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0003. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

54. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The

bounded similarity score is 0.1373. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

55. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.6154. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

56. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0328. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

57. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.7500. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

58. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0488. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

59. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1239. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

60. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1579. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

61. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0226. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

62. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0691. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

63. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The

bounded similarity score is 0.0980. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

64. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.3784. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

65. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.9474. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

66. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0055. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

67. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.8571. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

68. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0328. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

69. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2090. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

70. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.9412. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

71. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.3333. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

72. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The

bounded similarity score is 0.0235. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

73. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.9091. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

74. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1609. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

75. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0440. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

76. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1176. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

77. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0723. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

78. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1299. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

79. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0725. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

80. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2353. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

81. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The

bounded similarity score is 0.0645. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

82. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.8571. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

83. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.3553. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

84. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1443. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

85. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.9888. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

86. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1299. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

87. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0769. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

88. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.4762. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

89. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.9231. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

90. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The

bounded similarity score is 0.8571. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

91. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0392. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

92. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2609. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

93. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.3333. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

94. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2128. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

95. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0153. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

96. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.3333. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

97. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1538. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

98. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.7500. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

99. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The

bounded similarity score is 0.4079. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

100. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0009. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

101. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2857. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

102. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.4436. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

103. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.3221. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

104. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.2278. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

105. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.1065. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

106. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 1, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0206. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

107. A — A is correct. Compute the raw engineering answer and take its magnitude. With reference 3, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.4776. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

108. B — B is correct. Compute the raw engineering answer and take its magnitude. With reference 5, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The

bounded similarity score is 0.1000. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

109. C — C is correct. Compute the raw engineering answer and take its magnitude. With reference 7, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.4444. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.

110. D — D is correct. Compute the raw engineering answer and take its magnitude. With reference 9, subtract the absolute magnitude-reference difference from their sum, then divide by that same sum. The bounded similarity score is 0.0001. The distractors reflect using an incorrect raw answer, omitting the difference, or dividing by only one component.