

PRACTICE EXAM 19: PE MECHANICAL—MACHINE DESIGN AND MATERIALS (100 QUESTIONS)

This practice exam contains 100 questions. Select the single best answer for each question. The official NCEES examination contains 80 questions and provides 8 hours of testing time within a 9-hour appointment. Use both SI and U.S. Customary units as indicated.

1. A proposed fixture has a fixed fabrication cost of \$123900 and a variable cost of \$1542000 spread over 6200 units. What is the average cost per unit?

- A. 62074.35 \$/unit
- B. 124148.71 \$/unit
- C. 136563.58 \$/unit
- D. 248297.42 \$/unit

2. A component is expected to experience 3101 MPa maximum stress, while its allowable design stress is 783.25 MPa. What design factor is implied?

- A. 3.96
- B. 1.98
- C. 4.46
- D. 7.92

3. A drawing dimension is 1539.0 in. Convert this length to millimeters using 1 in = 25.4 mm.

- A. 19545.3 mm
- B. 58635.9 mm
- C. 39090.6 mm
- D. 39116 mm

4. A machine saves 32430 labor-hours annually at \$6211/h. Ignoring interest, its \$318300 residual value is credited evenly over a 6-year evaluation. What is the annual net benefit?

- A. 16758702.5 \$/year
- B. 33623505 \$/year
- C. 67034810 \$/year
- D. 33517405 \$/year

5. A proposed fixture has a fixed fabrication cost of \$124060 and a variable cost of \$1544000 spread over 6208 units. What is the average cost per unit?

- A. 62154.36 \$/unit
- B. 136739.58 \$/unit
- C. 248617.42 \$/unit
- D. 124308.71 \$/unit

6. A component is expected to experience 3105 MPa maximum stress, while its allowable design stress is 784.25 MPa. What design factor is implied?

- A. 1.98
- B. 3.96
- C. 4.46
- D. 7.92

7. A drawing dimension is 1541.0 in. Convert this length to millimeters using 1 in = 25.4 mm.

- A. 19570.7 mm
- B. 58712.1 mm
- C. 39141.4 mm
- D. 39166.8 mm

8. A machine saves 32470 labor-hours annually at \$6219/h. Ignoring interest, its \$318700 residual value is credited evenly over a 7-year evaluation. What is the annual net benefit?

- A. 28801747.14 \$/year
- B. 14400873.57 \$/year
- C. 28892804.29 \$/year
- D. 57603494.29 \$/year

9. A proposed fixture has a fixed fabrication cost of \$124220 and a variable cost of \$1546000 spread over 6216 units. What is the average cost per unit?

- A. 62234.36 \$/unit
- B. 136915.58 \$/unit
- C. 248937.43 \$/unit
- D. 124468.71 \$/unit

10. A component is expected to experience 3109 MPa maximum stress, while its allowable design stress is 785.25 MPa. What design factor is implied?

- A. 1.98
- B. 3.96
- C. 4.46
- D. 7.92

11. A drawing dimension is 1543.0 in. Convert this length to millimeters using 1 in = 25.4 mm.

- A. 39192.2 mm
- B. 19596.1 mm
- C. 58788.3 mm
- D. 39217.6 mm

12. A machine saves 32510 labor-hours annually at \$6227/h. Ignoring interest, its \$319100 residual value is credited evenly over a 8-year evaluation. What is the annual net benefit?

- A. 12632541.88 \$/year
- B. 25344858.75 \$/year
- C. 25265083.75 \$/year
- D. 50530167.5 \$/year

13. A proposed fixture has a fixed fabrication cost of \$124380 and a variable cost of \$1548000 spread over 6224 units. What is the average cost per unit?

- A. 124628.71 \$/unit
- B. 62314.36 \$/unit
- C. 137091.59 \$/unit
- D. 249257.43 \$/unit

14. A component is expected to experience 3113 MPa maximum stress, while its allowable design stress is 786.25 MPa. What design factor is implied?

- A. 1.98
- B. 4.46
- C. 3.96
- D. 7.92

15. A drawing dimension is 1545.0 in. Convert this length to millimeters using 1 in = 25.4 mm.

- A. 19621.5 mm
- B. 39243 mm
- C. 58864.5 mm
- D. 39268.4 mm

16. A machine saves 32550 labor-hours annually at \$6235/h. Ignoring interest, its \$319500 residual value is credited evenly over a 6-year evaluation. What is the annual net benefit?

- A. 16885812.5 \$/year
- B. 33878125 \$/year
- C. 67543250 \$/year
- D. 33771625 \$/year

17. A ductile member has yield strength 15550 MPa and calculated von Mises stress 6215 MPa. What factor of safety against yielding results?

- A. 1.25
- B. 1.5
- C. 2.5
- D. 3.5

18. A pin-ended column has $E = 200,000$ MPa, $I = 314100000$ mm⁴, and length 78725 mm. What is its Euler critical load?

- A. 400.16 kN
- B. 100.04 kN
- C. 25.01 kN
- D. 31.84 kN

19. At a point, $\sigma_x = 6204$ MPa, $\sigma_y = 3092$ MPa, and $\tau_{xy} = 1556.0$ MPa. What is the von Mises equivalent stress for plane stress?

- A. 6931.82 MPa
- B. 3112 MPa
- C. 3005.44 MPa

D. 6010.88 MPa

20. A part has alternating stress 6236 MPa and mean stress 3133 MPa. With $S_e = 9389$ MPa and $S_{ut} = 15815$ MPa, what Goodman fatigue factor of safety applies?

A. 1.16

B. 1.51

C. 5.05

D. 1.37

21. A prismatic bar carries 6168 kN axial tension over a net area of 15670 mm². What is the average normal stress?

A. 393.62 MPa

B. 196.81 MPa

C. 197.22 MPa

D. 590.43 MPa

22. A solid circular shaft of diameter 50 mm transmits 62200 N·m torque. What is its maximum torsional shear stress?

A. 1267.13 MPa

B. 5068.51 MPa

C. 5069.06 MPa

D. 2534.26 MPa

23. A rectangular beam 6212 mm wide and 6272 mm deep carries a maximum bending moment of 1545.0 kN·m. What is the extreme-fiber bending stress?

A. 0.02 MPa

B. 0.04 MPa

- C. 0.43 MPa
- D. 0.57 MPa

24. A steel tie, length 62540 mm and area 15835 mm², carries 6184 kN. Using $E = 200,000$ MPa, what is its elastic elongation?

- A. 61.06 mm
- B. 244.24 mm
- C. 122.12 mm
- D. 61.61 mm

25. A ductile member has yield strength 15590 MPa and calculated von Mises stress 6231 MPa. What factor of safety against yielding results?

- A. 1.25
- B. 2.5
- C. 1.5
- D. 3.5

26. A pin-ended column has $E = 200,000$ MPa, $I = 314900000$ mm⁴, and length 78925 mm. What is its Euler critical load?

- A. 399.15 kN
- B. 24.95 kN
- C. 99.79 kN
- D. 31.76 kN

27. At a point, $\sigma_x = 6220$ MPa, $\sigma_y = 3100$ MPa, and $\tau_{xy} = 1560.0$ MPa. What is the von Mises equivalent stress for plane stress?

- A. 6949.71 MPa

- B. 3120 MPa
- C. 3013.19 MPa
- D. 6026.38 MPa

28. A part has alternating stress 6252 MPa and mean stress 3141 MPa. With $S_e = 9413$ MPa and $S_{ut} = 15855$ MPa, what Goodman fatigue factor of safety applies?

- A. 1.16
- B. 1.51
- C. 5.05
- D. 1.37

29. A prismatic bar carries 6184 kN axial tension over a net area of 15710 mm². What is the average normal stress?

- A. 196.82 MPa
- B. 393.63 MPa
- C. 197.23 MPa
- D. 590.45 MPa

30. A solid circular shaft of diameter 56 mm transmits 62360 N·m torque. What is its maximum torsional shear stress?

- A. 904.24 MPa
- B. 3616.95 MPa
- C. 1808.47 MPa
- D. 3617.5 MPa

31. A rectangular beam 6228 mm wide and 6288 mm deep carries a maximum bending moment of 1549.0 kN·m. What is the extreme-fiber bending stress?

- A. 0.02 MPa
- B. 0.43 MPa
- C. 0.57 MPa
- D. 0.04 MPa

32. A steel tie, length 62700 mm and area 15875 mm², carries 6200 kN. Using $E = 200,000$ MPa, what is its elastic elongation?

- A. 61.22 mm
- B. 122.44 mm
- C. 244.88 mm
- D. 61.77 mm

33. A ductile member has yield strength 15630 MPa and calculated von Mises stress 6247 MPa. What factor of safety against yielding results?

- A. 2.5
- B. 1.25
- C. 1.5
- D. 3.5

34. A pin-ended column has $E = 200,000$ MPa, $I = 315700000$ mm⁴, and length 79125 mm. What is its Euler critical load?

- A. 398.14 kN
- B. 24.88 kN
- C. 31.68 kN
- D. 99.54 kN

35. At a point, $\sigma_x = 6236$ MPa, $\sigma_y = 3108$ MPa, and $\tau_{xy} = 1564.0$ MPa. What is the von Mises equivalent stress for plane stress?

- A. 6967.59 MPa
- B. 3128 MPa
- C. 6041.87 MPa
- D. 3020.93 MPa

36. A part has alternating stress 6268 MPa and mean stress 3149 MPa. With $S_e = 9437$ MPa and $S_{ut} = 15895$ MPa, what Goodman fatigue factor of safety applies?

- A. 1.16
- B. 1.51
- C. 5.05
- D. 1.37

37. A prismatic bar carries 6200 kN axial tension over a net area of 15750 mm². What is the average normal stress?

- A. 393.65 MPa
- B. 196.83 MPa
- C. 197.24 MPa
- D. 590.48 MPa

38. A solid circular shaft of diameter 52 mm transmits 62520 N·m torque. What is its maximum torsional shear stress?

- A. 1132.27 MPa
- B. 4529.07 MPa
- C. 2264.54 MPa
- D. 4529.62 MPa

39. A rectangular beam 6244 mm wide and 6304 mm deep carries a maximum bending moment of 1553.0 kN·m. What is the extreme-fiber bending stress?

- A. 0.02 MPa
- B. 0.04 MPa
- C. 0.43 MPa
- D. 0.57 MPa

40. A steel tie, length 62860 mm and area 15915 mm², carries 6216 kN. Using $E = 200,000$ MPa, what is its elastic elongation?

- A. 61.38 mm
- B. 245.52 mm
- C. 61.93 mm
- D. 122.76 mm

41. A lap joint uses 4 identical 12-mm-diameter rivets in single shear to carry 6165 kN. Assuming equal load sharing, what average shear stress acts in each rivet?

- A. 54510.57 MPa
- B. 6813.82 MPa
- C. 13627.64 MPa
- D. 27255.28 MPa

42. A bolt transfers 6182 kN through a plate 11 mm thick with an effective bearing diameter of 20 mm. What is the average bearing stress in the plate?

- A. 28100 MPa
- B. 8944.51 MPa
- C. 14050 MPa
- D. 56200 MPa

43. Using the relation $T = KF_d$, estimate bolt preload when installation torque is 30900 N·m, nut factor $K = 0.2$, and nominal diameter is 18 mm.

- A. 8583.6 kN
- B. 8583.33 kN
- C. 12875 kN
- D. 1716.67 kN

44. Two parallel fillet welds, each 6206 mm long with 6 mm leg size, carry 3083 kN direct shear. Using throat = 0.707h, what average weld throat stress results?

- A. 82.8 MPa
- B. 41.4 MPa
- C. 117.11 MPa
- D. 58.55 MPa

45. A lap joint uses 4 identical 14-mm-diameter rivets in single shear to carry 6173 kN. Assuming equal load sharing, what average shear stress acts in each rivet?

- A. 10025.14 MPa
- B. 40100.55 MPa
- C. 5012.57 MPa
- D. 20050.27 MPa

46. A bolt transfers 6190 kN through a plate 12 mm thick with an effective bearing diameter of 20 mm. What is the average bearing stress in the plate?

- A. 8209.74 MPa
- B. 12895.83 MPa
- C. 51583.33 MPa
- D. 25791.67 MPa

47. Using the relation $T = KF_d$, estimate bolt preload when installation torque is 30940 N·m, nut factor $K = 0.2$, and nominal diameter is 16 mm.

- A. 9669.02 kN
- B. 14503.12 kN
- C. 9668.75 kN
- D. 1933.75 kN

48. Two parallel fillet welds, each 6214 mm long with 7 mm leg size, carry 3087 kN direct shear. Using $\text{throat} = 0.707h$, what average weld throat stress results?

- A. 70.97 MPa
- B. 50.19 MPa
- C. 35.48 MPa
- D. 100.38 MPa

49. A lap joint uses 4 identical 16-mm-diameter rivets in single shear to carry 6181 kN. Assuming equal load sharing, what average shear stress acts in each rivet?

- A. 30741.77 MPa
- B. 3842.72 MPa
- C. 7685.44 MPa
- D. 15370.89 MPa

50. A bolt transfers 6198 kN through a plate 10 mm thick with an effective bearing diameter of 20 mm. What is the average bearing stress in the plate?

- A. 9864.42 MPa
- B. 15495 MPa
- C. 61980 MPa
- D. 30990 MPa

51. Using the relation $T = KF_d$, estimate bolt preload when installation torque is 30980 N·m, nut factor $K = 0.2$, and nominal diameter is 17 mm.

- A. 9112.03 kN
- B. 9111.76 kN
- C. 13667.65 kN
- D. 1822.35 kN

52. Two parallel fillet welds, each 6222 mm long with 8 mm leg size, carry 3091 kN direct shear. Using throat = 0.707h, what average weld throat stress results?

- A. 43.92 MPa
- B. 62.1 MPa
- C. 31.05 MPa
- D. 87.83 MPa

53. A lap joint uses 4 identical 12-mm-diameter rivets in single shear to carry 6189 kN. Assuming equal load sharing, what average shear stress acts in each rivet?

- A. 54722.77 MPa
- B. 6840.35 MPa
- C. 13680.69 MPa
- D. 27361.39 MPa

54. A 18-tooth pinion rotating at 32350 rpm drives a 54-tooth gear. Neglecting slip, what is the gear speed?

- A. 5391.67 rpm
- B. 21566.67 rpm
- C. 32350 rpm
- D. 10783.33 rpm

55. A shaft transmits 3076 hp at 62420 rpm. Using $T(\text{in}\cdot\text{lbf}) = 63,025 \text{ hp/rpm}$, what torque is transmitted?

- A. 1552.91 in·lbf
- B. 3105.81 in·lbf
- C. 4658.72 in·lbf
- D. 6211.63 in·lbf

56. An open belt connects a 130-mm driver at 31520 rpm to a 320-mm driven pulley. Neglecting slip, what is driven speed?

- A. 6402.5 rpm
- B. 18715 rpm
- C. 31520 rpm
- D. 12805 rpm

57. A collar bearing supports 1539.5 kN at mean friction radius 0.020 m with friction coefficient 0.080. What friction torque must be overcome?

- A. 2463.2 N·m
- B. 4926.4 N·m
- C. 3694.8 N·m
- D. 4926.95 N·m

58. A power screw has lead 7 mm, input torque 6173 N·m, and raising efficiency 0.32. What axial load can it raise?

- A. 886.54 kN
- B. 1773.08 kN
- C. 2659.62 kN
- D. 3546.16 kN

59. A 19-tooth pinion rotating at 32400 rpm drives a 56-tooth gear. Neglecting slip, what is the gear speed?

- A. 10992.86 rpm
- B. 5496.43 rpm
- C. 21407.14 rpm
- D. 32400 rpm

60. A shaft transmits 3081 hp at 62520 rpm. Using $T(\text{in}\cdot\text{lbf}) = 63,025 \text{ hp/rpm}$, what torque is transmitted?

- A. 1552.94 in·lbf
- B. 4658.83 in·lbf
- C. 3105.89 in·lbf
- D. 6211.77 in·lbf

61. An open belt connects a 125-mm driver at 31570 rpm to a 310-mm driven pulley. Neglecting slip, what is driven speed?

- A. 12729.84 rpm
- B. 6364.92 rpm
- C. 18840.16 rpm
- D. 31570 rpm

62. A collar bearing supports 1542.0 kN at mean friction radius 0.022 m with friction coefficient 0.090. What friction torque must be overcome?

- A. 6106.32 N·m
- B. 4579.74 N·m
- C. 3053.16 N·m
- D. 6106.87 N·m

63. A power screw has lead 6 mm, input torque 6183 N·m, and raising efficiency 0.33. What axial load can it raise?

- A. 1068.35 kN
- B. 2136.69 kN
- C. 3205.04 kN
- D. 4273.38 kN

64. A 20-tooth pinion rotating at 32450 rpm drives a 58-tooth gear. Neglecting slip, what is the gear speed?

- A. 5594.83 rpm
- B. 21260.34 rpm
- C. 32450 rpm
- D. 11189.66 rpm

65. A shaft transmits 3086 hp at 62620 rpm. Using $T(\text{in}\cdot\text{lbf}) = 63,025 \text{ hp/rpm}$, what torque is transmitted?

- A. 3105.96 in·lbf
- B. 1552.98 in·lbf
- C. 4658.94 in·lbf
- D. 6211.92 in·lbf

66. An open belt connects a 120-mm driver at 31620 rpm to a 300-mm driven pulley. Neglecting slip, what is driven speed?

- A. 6324 rpm
- B. 18972 rpm
- C. 31620 rpm
- D. 12648 rpm

67. A linear spring has stiffness 3085 kN/m and is compressed 40 mm. What force does it exert?

- A. 61700 N
- B. 123400 N
- C. 185100 N
- D. 61700.55 N

68. An undamped single-degree system has mass 3079 kg and stiffness 1554500 N/m. What is its natural frequency in hertz?

- A. 1.79 Hz
- B. 5.36 Hz
- C. 3.58 Hz
- D. 7.15 Hz

69. A hydraulic cylinder must produce 1543.0 kN using a piston area of 31520 mm². Neglecting losses, what gauge pressure is required?

- A. 24.48 MPa
- B. 24.89 MPa
- C. 97.91 MPa
- D. 48.95 MPa

70. A simply supported beam of span 2.7 m carries a central point load of 3081 kN. What is the maximum bending moment?

- A. 4159.35 kN·m
- B. 2079.68 kN·m
- C. 1039.84 kN·m
- D. 1141.11 kN·m

71. A lever has an effort arm of 9312 mm and a load arm of 6168 mm. Neglecting friction, what is its ideal mechanical advantage?

- A. 1.51
- B. 0.66
- C. 2.26
- D. 3.02

72. A 898-V DC source is applied across a 6- Ω resistive sensor circuit. Neglecting lead resistance, what current flows?

- A. 74.83 A
- B. 224.5 A
- C. 149.67 A
- D. 299.33 A

73. A thin-walled cylindrical vessel has internal pressure 309.6 MPa, inside diameter 15730 mm, and wall thickness 12 mm. What is the membrane hoop stress?

- A. 101458.5 MPa
- B. 202917 MPa
- C. 405834 MPa
- D. 101459.05 MPa

74. A linear spring has stiffness 3092 kN/m and is compressed 46 mm. What force does it exert?

- A. 71116 N
- B. 213348 N
- C. 71116.55 N
- D. 142232 N

75. An undamped single-degree system has mass 3086 kg and stiffness 1558000 N/m. What is its natural frequency in hertz?

- A. 1.79 Hz
- B. 5.36 Hz
- C. 3.58 Hz
- D. 7.15 Hz

76. A hydraulic cylinder must produce 1546.5 kN using a piston area of 31590 mm². Neglecting losses, what gauge pressure is required?

- A. 48.96 MPa
- B. 24.48 MPa
- C. 24.89 MPa
- D. 97.91 MPa

77. A simply supported beam of span 2.6 m carries a central point load of 3088 kN. What is the maximum bending moment?

- A. 4014.4 kN·m
- B. 2007.2 kN·m
- C. 1003.6 kN·m
- D. 1187.69 kN·m

78. A lever has an effort arm of 9333 mm and a load arm of 6182 mm. Neglecting friction, what is its ideal mechanical advantage?

- A. 0.66
- B. 2.26
- C. 1.51
- D. 3.02

79. A 900-V DC source is applied across a 8- Ω resistive sensor circuit. Neglecting lead resistance, what current flows?

- A. 112.5 A
- B. 56.25 A
- C. 168.75 A
- D. 225 A

80. A thin-walled cylindrical vessel has internal pressure 310.3 MPa, inside diameter 15765 mm, and wall thickness 13 mm. What is the membrane hoop stress?

- A. 94074.61 MPa
- B. 376298.42 MPa
- C. 94075.16 MPa
- D. 188149.21 MPa

81. A linear spring has stiffness 3099 kN/m and is compressed 44 mm. What force does it exert?

- A. 68178 N
- B. 204534 N
- C. 136356 N
- D. 68178.55 N

82. An undamped single-degree system has mass 3093 kg and stiffness 1561500 N/m. What is its natural frequency in hertz?

- A. 3.58 Hz
- B. 1.79 Hz
- C. 5.36 Hz
- D. 7.15 Hz

83. A hydraulic cylinder must produce 1550.0 kN using a piston area of 31660 mm². Neglecting losses, what gauge pressure is required?

- A. 24.48 MPa
- B. 48.96 MPa
- C. 24.89 MPa
- D. 97.92 MPa

84. A simply supported beam of span 2.5 m carries a central point load of 3095 kN. What is the maximum bending moment?

- A. 3868.75 kN·m
- B. 967.19 kN·m
- C. 1238 kN·m
- D. 1934.38 kN·m

85. A lever has an effort arm of 9354 mm and a load arm of 6196 mm. Neglecting friction, what is its ideal mechanical advantage?

- A. 0.66
- B. 2.26
- C. 1.51
- D. 3.02

86. A 902-V DC source is applied across a 10- Ω resistive sensor circuit. Neglecting lead resistance, what current flows?

- A. 45.1 A
- B. 135.3 A
- C. 180.4 A
- D. 90.2 A

87. A thin-walled cylindrical vessel has internal pressure 311.0 MPa, inside diameter 15800 mm, and wall thickness 14 mm. What is the membrane hoop stress?

- A. 87746.43 MPa
- B. 175492.86 MPa
- C. 350985.71 MPa
- D. 87746.98 MPa

88. A linear spring has stiffness 3106 kN/m and is compressed 42 mm. What force does it exert?

- A. 130452 N
- B. 65226 N
- C. 195678 N
- D. 65226.55 N

89. An undamped single-degree system has mass 3100 kg and stiffness 1565000 N/m. What is its natural frequency in hertz?

- A. 1.79 Hz
- B. 5.36 Hz
- C. 3.58 Hz
- D. 7.15 Hz

90. A mating hole measures 3085.04 mm and its shaft measures 3084.98 mm. What diametral clearance exists?

- A. 0.04 mm
- B. 0.02 mm
- C. 0.03 mm
- D. 0.06 mm

91. Inspection accepts 15785 of 15805 manufactured parts. What is the observed percent yield?

- A. 99.87 %

- B. 49.94 %
- C. 149.81 %
- D. 100.13 %

92. A machining operation reduces a diameter from 3094 mm to 3090 mm. What percent reduction in diameter occurs?

- A. 0.4 %
- B. 0.13 %
- C. 0.19 %
- D. 0.26 %

93. Four repeated measurements are 80.65, 80.61, 80.64, and 80.62 mm. What is their arithmetic mean?

- A. 40.31 mm
- B. 322.52 mm
- C. 80.65 mm
- D. 80.63 mm

94. A mating hole measures 3089.05 mm and its shaft measures 3088.98 mm. What diametral clearance exists?

- A. 0.05 mm
- B. 0.07 mm
- C. 0.02 mm
- D. 0.04 mm

95. Inspection accepts 15805 of 15825 manufactured parts. What is the observed percent yield?

- A. 49.94 %
- B. 149.81 %

- C. 99.87 %
- D. 100.13 %

96. A machining operation reduces a diameter from 3098 mm to 3094 mm. What percent reduction in diameter occurs?

- A. 0.13 %
- B. 0.4 %
- C. 0.19 %
- D. 0.26 %

97. Four repeated measurements are 80.69, 80.65, 80.68, and 80.66 mm. What is their arithmetic mean?

- A. 40.34 mm
- B. 80.67 mm
- C. 322.68 mm
- D. 80.69 mm

98. A mating hole measures 3093.06 mm and its shaft measures 3092.98 mm. What diametral clearance exists?

- A. 0.06 mm
- B. 0.02 mm
- C. 0.04 mm
- D. 0.08 mm

99. Inspection accepts 15825 of 15845 manufactured parts. What is the observed percent yield?

- A. 49.94 %
- B. 149.81 %
- C. 99.87 %

D. 100.13 %

100. A machining operation reduces a diameter from 3102 mm to 3098 mm. What percent reduction in diameter occurs?

A. 0.13 %

B. 0.4 %

C. 0.19 %

D. 0.26 %

Practice Exam 19: Answer Key and Explanations

1. B — B — Average unit cost equals the fixed cost plus the allocated variable cost per unit; costs are combined only after using the common per-unit basis. Substitution gives 124148.71 \$/unit. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents

2. A — A — The design factor is the ratio of the expected maximum stress to the allowable design stress, not the inverse or a difference. Substitution gives 3.96 . Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents a numerically

3. C — C — Length conversion requires multiplying inches by 25.4 millimeters per inch so the inch unit cancels and millimeters remain. Substitution gives 39090.6 mm. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents a numerically tidy but physically inconsistent

4. D — D — Annual labor savings are first converted to dollars, the stated residual credit is subtracted, and the remaining benefit is distributed evenly across the evaluation life. Substitution gives 33517405 \$/year. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis

5. D — D — Average unit cost equals the fixed cost plus the allocated variable cost per unit; costs are combined only after using the common per-unit basis. Substitution gives 124308.71 \$/unit. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents

6. B — B — The design factor is the ratio of the expected maximum stress to the allowable design stress, not the inverse or a difference. Substitution gives 3.96 . Keeping the calculation consistent with

the stated units identifies the keyed option. Checking units and the stated design basis prevents a numerically

7. C — C — Length conversion requires multiplying inches by 25.4 millimeters per inch so the inch unit cancels and millimeters remain. Substitution gives 39141.4 mm. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents a numerically tidy but physically inconsistent

8. A — A — Annual labor savings are first converted to dollars, the stated residual credit is subtracted, and the remaining benefit is distributed evenly across the evaluation life. Substitution gives 28801747.14 \$/year. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis

9. D — D — Average unit cost equals the fixed cost plus the allocated variable cost per unit; costs are combined only after using the common per-unit basis. Substitution gives 124468.71 \$/unit. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents

10. B — B — The design factor is the ratio of the expected maximum stress to the allowable design stress, not the inverse or a difference. Substitution gives 3.96 . Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents a numerically

11. A — A — Length conversion requires multiplying inches by 25.4 millimeters per inch so the inch unit cancels and millimeters remain. Substitution gives 39192.2 mm. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents a numerically tidy but physically inconsistent

12. C — C — Annual labor savings are first converted to dollars, the stated residual credit is subtracted, and the remaining benefit is distributed evenly across the evaluation life. Substitution gives 25265083.75 \$/year. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis

13. A — A — Average unit cost equals the fixed cost plus the allocated variable cost per unit; costs are combined only after using the common per-unit basis. Substitution gives 124628.71 \$/unit. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents

14. C — C — The design factor is the ratio of the expected maximum stress to the allowable design stress, not the inverse or a difference. Substitution gives 3.96 . Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents a numerically

15. B — B — Length conversion requires multiplying inches by 25.4 millimeters per inch so the inch unit cancels and millimeters remain. Substitution gives 39243 mm. Keeping the calculation consistent

with the stated units identifies the keyed option. Checking units and the stated design basis prevents a numerically tidy but physically inconsistent

16. D — D — Annual labor savings are first converted to dollars, the stated residual credit is subtracted, and the remaining benefit is distributed evenly across the evaluation life. Substitution gives 33771625 \$/year. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis

17. C — C — For a ductile material evaluated by von Mises stress, the yield factor of safety is yield strength divided by equivalent stress. Substitution gives 2.5 . Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path, sign

18. B — B — Euler buckling for a pin-ended column uses effective length equal to actual length, giving $\pi^2 EI$ divided by L^2 . Substitution gives 100.04 kN. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path,

19. D — D — Plane-stress von Mises stress combines both normal stresses and shear through the distortion-energy expression, including three times shear stress squared. Substitution gives 6010.88 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path, sign convention,

20. A — A — The modified Goodman relation divides alternating stress by endurance limit and mean stress by ultimate strength; their sum equals the reciprocal safety factor. Substitution gives 1.16 . Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

21. A — A — Average axial stress is force divided by net resisting area. Converting kilonewtons to newtons makes newtons per square millimeter, numerically equal to megapascals. Substitution gives 393.62 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

22. D — D — For a solid circular shaft, maximum shear stress is $16T$ divided by π times diameter cubed. Torque is converted from newton-meters to newton-millimeters. Substitution gives 2534.26 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

23. B — B — Using σ equals $M c$ over I for a rectangle reduces to $6M$ divided by $b h^2$. The moment must be expressed in newton-millimeters. Substitution gives 0.04 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving

24. C — C — Elastic axial elongation follows PL divided by AE . Consistent newton and millimeter units make the modulus directly usable in megapascals. Substitution gives 122.12 mm. Keeping the

calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path, sign convention,

25. B — B — For a ductile material evaluated by von Mises stress, the yield factor of safety is yield strength divided by equivalent stress. Substitution gives 2.5 . Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path, sign

26. C — C — Euler buckling for a pin-ended column uses effective length equal to actual length, giving $\pi^2 EI$ divided by L^2 . Substitution gives 99.79 kN. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path,

27. D — D — Plane-stress von Mises stress combines both normal stresses and shear through the distortion-energy expression, including three times shear stress squared. Substitution gives 6026.38 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path, sign convention,

28. A — A — The modified Goodman relation divides alternating stress by endurance limit and mean stress by ultimate strength; their sum equals the reciprocal safety factor. Substitution gives 1.16 . Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

29. B — B — Average axial stress is force divided by net resisting area. Converting kilonewtons to newtons makes newtons per square millimeter, numerically equal to megapascals. Substitution gives 393.63 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

30. C — C — For a solid circular shaft, maximum shear stress is $16T$ divided by π times diameter cubed. Torque is converted from newton-meters to newton-millimeters. Substitution gives 1808.47 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

31. D — D — Using $\sigma = Mc/I$ for a rectangle reduces to $6M$ divided by $b h^2$. The moment must be expressed in newton-millimeters. Substitution gives 0.04 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving

32. B — B — Elastic axial elongation follows PL divided by AE . Consistent newton and millimeter units make the modulus directly usable in megapascals. Substitution gives 122.44 mm. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path, sign convention,

33. A — A — For a ductile material evaluated by von Mises stress, the yield factor of safety is yield strength divided by equivalent stress. Substitution gives 2.5 . Keeping the calculation consistent with the

stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path, sign

34. D — D — Euler buckling for a pin-ended column uses effective length equal to actual length, giving $\pi^2 EI$ divided by L^2 . Substitution gives 99.54 kN. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path,

35. C — C — Plane-stress von Mises stress combines both normal stresses and shear through the distortion-energy expression, including three times shear stress squared. Substitution gives 6041.87 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path, sign convention,

36. A — A — The modified Goodman relation divides alternating stress by endurance limit and mean stress by ultimate strength; their sum equals the reciprocal safety factor. Substitution gives 1.16 . Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

37. A — A — Average axial stress is force divided by net resisting area. Converting kilonewtons to newtons makes newtons per square millimeter, numerically equal to megapascals. Substitution gives 393.65 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

38. C — C — For a solid circular shaft, maximum shear stress is $16T$ divided by π times diameter cubed. Torque is converted from newton-meters to newton-millimeters. Substitution gives 2264.54 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

39. B — B — Using $\sigma = Mc/I$ for a rectangle reduces to $6M$ divided by $b h^2$. The moment must be expressed in newton-millimeters. Substitution gives 0.04 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving

40. D — D — Elastic axial elongation follows PL/AE . Consistent newton and millimeter units make the modulus directly usable in megapascals. Substitution gives 122.76 mm. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path, sign convention,

41. C — C — Equal load sharing divides the applied force among the rivets, and single-shear area is the circular cross-sectional area of one rivet. Substitution gives 13627.64 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting

42. A — A — Average bearing stress uses the projected contact area, bolt diameter times plate thickness, rather than the bolt's circular area. Substitution gives 28100 MPa. Keeping the calculation

consistent with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting area specified

43. B — B — Rearranging the torque-preload approximation gives preload F equal to T divided by K_d , with diameter expressed in meters. Substitution gives 8583.33 kN. Keeping the calculation consistent with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting area specified in

44. D — D — The resisting throat area is two weld lengths multiplied by the effective fillet throat, 0.707 times leg size. Substitution gives 58.55 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting area specified in

45. A — A — Equal load sharing divides the applied force among the rivets, and single-shear area is the circular cross-sectional area of one rivet. Substitution gives 10025.14 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting

46. D — D — Average bearing stress uses the projected contact area, bolt diameter times plate thickness, rather than the bolt's circular area. Substitution gives 25791.67 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting area specified

47. C — C — Rearranging the torque-preload approximation gives preload F equal to T divided by K_d , with diameter expressed in meters. Substitution gives 9668.75 kN. Keeping the calculation consistent with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting area specified in

48. B — B — The resisting throat area is two weld lengths multiplied by the effective fillet throat, 0.707 times leg size. Substitution gives 50.19 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting area specified in

49. C — C — Equal load sharing divides the applied force among the rivets, and single-shear area is the circular cross-sectional area of one rivet. Substitution gives 7685.44 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting

50. D — D — Average bearing stress uses the projected contact area, bolt diameter times plate thickness, rather than the bolt's circular area. Substitution gives 30990 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting area specified

51. B — B — Rearranging the torque-preload approximation gives preload F equal to T divided by K_d , with diameter expressed in meters. Substitution gives 9111.76 kN. Keeping the calculation consistent

with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting area specified in

52. A — A — The resisting throat area is two weld lengths multiplied by the effective fillet throat, 0.707 times leg size. Substitution gives 43.92 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting area specified in

53. C — C — Equal load sharing divides the applied force among the rivets, and single-shear area is the circular cross-sectional area of one rivet. Substitution gives 13680.69 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting

54. D — D — For an external gear pair, pitch-line velocity is equal, so rotational speed is inversely proportional to tooth count. Substitution gives 10783.33 rpm. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the operating relationship help reject the nearby

55. B — B — The stated horsepower-speed relation directly produces torque in inch-pounds; substituting horsepower and rotational speed avoids mixing foot-pounds and inch-pounds. Substitution gives 3105.81 in·lbf. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the operating relationship help reject the

56. D — D — Equal belt speed at both pulley rims gives $N_1 D_1$ equal to $N_2 D_2$, so driven speed is driver speed times the diameter ratio. Substitution gives 12805 rpm. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the operating relationship

57. A — A — Collar friction torque equals friction coefficient times axial load times mean friction radius; kilonewtons are converted to newtons. Substitution gives 2463.2 N·m. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the operating relationship help reject the nearby

58. B — B — Efficiency is output work divided by input work per revolution. Equating output F times lead to efficiency times 2π torque gives the load. Substitution gives 1773.08 kN. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the

59. A — A — For an external gear pair, pitch-line velocity is equal, so rotational speed is inversely proportional to tooth count. Substitution gives 10992.86 rpm. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the operating relationship help reject the nearby

60. C — C — The stated horsepower-speed relation directly produces torque in inch-pounds; substituting horsepower and rotational speed avoids mixing foot-pounds and inch-pounds. Substitution

gives 3105.89 in·lbf. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the operating relationship help reject the

61. A — A — Equal belt speed at both pulley rims gives $N_1 D_1$ equal to $N_2 D_2$, so driven speed is driver speed times the diameter ratio. Substitution gives 12729.84 rpm. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the operating relationship

62. C — C — Collar friction torque equals friction coefficient times axial load times mean friction radius; kilonewtons are converted to newtons. Substitution gives 3053.16 N·m. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the operating relationship help reject the nearby

63. B — B — Efficiency is output work divided by input work per revolution. Equating output F times lead to efficiency times 2π torque gives the load. Substitution gives 2136.69 kN. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the

64. D — D — For an external gear pair, pitch-line velocity is equal, so rotational speed is inversely proportional to tooth count. Substitution gives 11189.66 rpm. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the operating relationship help reject the nearby

65. A — A — The stated horsepower-speed relation directly produces torque in inch-pounds; substituting horsepower and rotational speed avoids mixing foot-pounds and inch-pounds. Substitution gives 3105.96 in·lbf. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the operating relationship help reject the

66. D — D — Equal belt speed at both pulley rims gives $N_1 D_1$ equal to $N_2 D_2$, so driven speed is driver speed times the diameter ratio. Substitution gives 12648 rpm. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the operating relationship

67. B — B — Hooke's law gives spring force as stiffness times deflection. Converting kilonewtons per meter to newtons per meter makes the result newtons. Substitution gives 123400 N. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

68. C — C — Natural circular frequency is the square root of stiffness divided by mass. Dividing radians per second by 2π converts it to cycles per second. Substitution gives 3.58 Hz. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied

69. D — D — Hydraulic pressure equals force divided by piston area. Newtons per square millimeter are numerically megapascals. Substitution gives 48.95 MPa. Keeping the calculation consistent with the

stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature rounding can shift a close design

70. B — B — For a simply supported beam with a centered point load, reactions are equal and the maximum moment at midspan is PL divided by four. Substitution gives 2079.68 kN·m. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before

71. A — A — Moment equilibrium about the fulcrum makes effort times effort arm equal load times load arm, so ideal mechanical advantage is their arm ratio. Substitution gives 1.51 . Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding,

72. C — C — Ohm's law gives current as applied voltage divided by resistance. Multiplication gives power-related units, while the inverse ratio has incorrect dimensions. Substitution gives 149.67 A. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

73. B — B — Thin-cylinder hoop stress equals pressure times diameter divided by twice wall thickness; longitudinal stress would be half this value. Substitution gives 202917 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature rounding can

74. D — D — Hooke's law gives spring force as stiffness times deflection. Converting kilonewtons per meter to newtons per meter makes the result newtons. Substitution gives 142232 N. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

75. C — C — Natural circular frequency is the square root of stiffness divided by mass. Dividing radians per second by 2 pi converts it to cycles per second. Substitution gives 3.58 Hz. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied

76. A — A — Hydraulic pressure equals force divided by piston area. Newtons per square millimeter are numerically megapascals. Substitution gives 48.96 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature rounding can shift a close design

77. B — B — For a simply supported beam with a centered point load, reactions are equal and the maximum moment at midspan is PL divided by four. Substitution gives 2007.2 kN·m. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before

78. C — C — Moment equilibrium about the fulcrum makes effort times effort arm equal load times load arm, so ideal mechanical advantage is their arm ratio. Substitution gives 1.51 . Keeping the

calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding,

79. A — A — Ohm's law gives current as applied voltage divided by resistance. Multiplication gives power-related units, while the inverse ratio has incorrect dimensions. Substitution gives 112.5 A. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

80. D — D — Thin-cylinder hoop stress equals pressure times diameter divided by twice wall thickness; longitudinal stress would be half this value. Substitution gives 188149.21 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature rounding can

81. C — C — Hooke's law gives spring force as stiffness times deflection. Converting kilonewtons per meter to newtons per meter makes the result newtons. Substitution gives 136356 N. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

82. A — A — Natural circular frequency is the square root of stiffness divided by mass. Dividing radians per second by 2 pi converts it to cycles per second. Substitution gives 3.58 Hz. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied

83. B — B — Hydraulic pressure equals force divided by piston area. Newtons per square millimeter are numerically megapascals. Substitution gives 48.96 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature rounding can shift a close design

84. D — D — For a simply supported beam with a centered point load, reactions are equal and the maximum moment at midspan is PL divided by four. Substitution gives 1934.38 kN·m. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before

85. C — C — Moment equilibrium about the fulcrum makes effort times effort arm equal load times load arm, so ideal mechanical advantage is their arm ratio. Substitution gives 1.51 . Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding,

86. D — D — Ohm's law gives current as applied voltage divided by resistance. Multiplication gives power-related units, while the inverse ratio has incorrect dimensions. Substitution gives 90.2 A. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

87. B — B — Thin-cylinder hoop stress equals pressure times diameter divided by twice wall thickness; longitudinal stress would be half this value. Substitution gives 175492.86 MPa. Keeping the calculation

consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature rounding can

88. A — A — Hooke's law gives spring force as stiffness times deflection. Converting kilonewtons per meter to newtons per meter makes the result newtons. Substitution gives 130452 N. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

89. C — C — Natural circular frequency is the square root of stiffness divided by mass. Dividing radians per second by 2π converts it to cycles per second. Substitution gives 3.58 Hz. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied

90. D — D — Diametral clearance is the actual hole diameter minus the actual shaft diameter. Radius differences would give only half the requested diametral value. Substitution gives 0.06 mm. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units, manufacturing intent,

91. A — A — Percent yield is accepted quantity divided by total inspected quantity, multiplied by one hundred. The rejected fraction is a different quality metric. Substitution gives 99.87 %. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units, manufacturing intent,

92. B — B — Percent reduction uses the original dimension as the reference denominator, after determining the absolute decrease. Substitution gives 0.13 %. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units, manufacturing intent, and the measurement definition used in the

93. D — D — The arithmetic mean is the sum of all readings divided by their count. Range and total are not estimates of the central measured value. Substitution gives 80.63 mm. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units,

94. B — B — Diametral clearance is the actual hole diameter minus the actual shaft diameter. Radius differences would give only half the requested diametral value. Substitution gives 0.07 mm. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units, manufacturing intent,

95. C — C — Percent yield is accepted quantity divided by total inspected quantity, multiplied by one hundred. The rejected fraction is a different quality metric. Substitution gives 99.87 %. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units, manufacturing intent,

96. A — A — Percent reduction uses the original dimension as the reference denominator, after determining the absolute decrease. Substitution gives 0.13 %. Keeping the calculation consistent with

the stated units identifies the keyed option. The result should also be checked against units, manufacturing intent, and the measurement definition used in the

97. B — B — The arithmetic mean is the sum of all readings divided by their count. Range and total are not estimates of the central measured value. Substitution gives 80.67 mm. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units,

98. D — D — Diametral clearance is the actual hole diameter minus the actual shaft diameter. Radius differences would give only half the requested diametral value. Substitution gives 0.08 mm. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units, manufacturing intent,

99. C — C — Percent yield is accepted quantity divided by total inspected quantity, multiplied by one hundred. The rejected fraction is a different quality metric. Substitution gives 99.87 %. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units, manufacturing intent,

100. A — A — Percent reduction uses the original dimension as the reference denominator, after determining the absolute decrease. Substitution gives 0.13 %. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units, manufacturing intent, and the measurement definition used in the