

PRACTICE EXAM 7: 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 \$42300 and a variable cost of \$522000 spread over 2120 units. What is the average cost per unit?

- A. 21273.11 \$/unit
- B. 46800.85 \$/unit
- C. 42546.23 \$/unit
- D. 85092.45 \$/unit

2. A component is expected to experience 1061 MPa maximum stress, while its allowable design stress is 273.25 MPa. What design factor is implied?

- A. 3.88
- B. 1.94
- C. 4.38
- D. 7.77

3. A drawing dimension is 519.0 in. Convert this length to millimeters using 1 in = 25.4 mm.

- A. 6591.3 mm
- B. 19773.9 mm
- C. 13208 mm
- D. 13182.6 mm

4. A machine saves 12030 labor-hours annually at \$2131/h. Ignoring interest, its \$114300 residual value is credited evenly over a 6-year evaluation. What is the annual net benefit?

- A. 2126802.5 \$/year
- B. 4253605 \$/year
- C. 4291705 \$/year
- D. 8507210 \$/year

5. A proposed fixture has a fixed fabrication cost of \$42460 and a variable cost of \$524000 spread over 2128 units. What is the average cost per unit?

- A. 42706.24 \$/unit
- B. 21353.12 \$/unit
- C. 46976.86 \$/unit
- D. 85412.48 \$/unit

6. A component is expected to experience 1065 MPa maximum stress, while its allowable design stress is 274.25 MPa. What design factor is implied?

- A. 1.94
- B. 4.38
- C. 7.77
- D. 3.88

7. A drawing dimension is 521.0 in. Convert this length to millimeters using 1 in = 25.4 mm.

- A. 6616.7 mm
- B. 13233.4 mm
- C. 19850.1 mm
- D. 13258.8 mm

8. A machine saves 12070 labor-hours annually at \$2139/h. Ignoring interest, its \$114700 residual value is credited evenly over a 7-year evaluation. What is the annual net benefit?

- A. 1835930.71 \$/year
- B. 3704632.86 \$/year
- C. 3671861.43 \$/year
- D. 7343722.86 \$/year

9. A proposed fixture has a fixed fabrication cost of \$42620 and a variable cost of \$526000 spread over 2136 units. What is the average cost per unit?

- A. 21433.13 \$/unit
- B. 47152.88 \$/unit
- C. 42866.25 \$/unit
- D. 85732.51 \$/unit

10. A component is expected to experience 1069 MPa maximum stress, while its allowable design stress is 275.25 MPa. What design factor is implied?

- A. 1.94
- B. 4.38
- C. 7.77
- D. 3.88

11. A drawing dimension is 523.0 in. Convert this length to millimeters using 1 in = 25.4 mm.

- A. 6642.1 mm
- B. 13284.2 mm
- C. 19926.3 mm
- D. 13309.6 mm

12. A machine saves 12110 labor-hours annually at \$2147/h. Ignoring interest, its \$115100 residual value is credited evenly over a 8-year evaluation. What is the annual net benefit?

- A. 3235633.75 \$/year
- B. 1617816.88 \$/year
- C. 3264408.75 \$/year
- D. 6471267.5 \$/year

13. A proposed fixture has a fixed fabrication cost of \$42780 and a variable cost of \$528000 spread over 2144 units. What is the average cost per unit?

- A. 43026.27 \$/unit
- B. 21513.13 \$/unit
- C. 47328.9 \$/unit
- D. 86052.54 \$/unit

14. A component is expected to experience 1073 MPa maximum stress, while its allowable design stress is 276.25 MPa. What design factor is implied?

- A. 1.94
- B. 4.38
- C. 7.77
- D. 3.88

15. A drawing dimension is 525.0 in. Convert this length to millimeters using 1 in = 25.4 mm.

- A. 6667.5 mm
- B. 20002.5 mm
- C. 13335 mm
- D. 13360.4 mm

16. A machine saves 12150 labor-hours annually at \$2155/h. Ignoring interest, its \$115500 residual value is credited evenly over a 6-year evaluation. What is the annual net benefit?

- A. 2172312.5 \$/year
- B. 4344625 \$/year
- C. 4383125 \$/year
- D. 8689250 \$/year

17. A ductile member has yield strength 5350 MPa and calculated von Mises stress 2135 MPa. What factor of safety against yielding results?

- A. 1.25
- B. 1.51
- C. 2.51
- D. 3.51

18. A pin-ended column has $E = 200,000$ MPa, $I = 110100000$ mm⁴, and length 27725 mm. What is its Euler critical load?

- A. 282.73 kN
- B. 1130.93 kN
- C. 70.68 kN
- D. 90 kN

19. At a point, $\sigma_x = 2124$ MPa, $\sigma_y = 1052$ MPa, and $\tau_{xy} = 536.0$ MPa. What is the von Mises equivalent stress for plane stress?

- A. 2370.25 MPa
- B. 2060.47 MPa
- C. 1072 MPa

D. 1030.23 MPa

20. A part has alternating stress 2156 MPa and mean stress 1093 MPa. With $S_e = 3269$ MPa and $S_{ut} = 5615$ MPa, what Goodman fatigue factor of safety applies?

A. 1.52

B. 5.14

C. 1.39

D. 1.17

21. A prismatic bar carries 2088 kN axial tension over a net area of 5470 mm². What is the average normal stress?

A. 381.72 MPa

B. 190.86 MPa

C. 191.27 MPa

D. 572.58 MPa

22. A solid circular shaft of diameter 50 mm transmits 21400 N·m torque. What is its maximum torsional shear stress?

A. 435.96 MPa

B. 1743.83 MPa

C. 1744.38 MPa

D. 871.91 MPa

23. A rectangular beam 2132 mm wide and 2192 mm deep carries a maximum bending moment of 525.0 kN·m. What is the extreme-fiber bending stress?

A. 0.15 MPa

B. 0.56 MPa

- C. 0.31 MPa
- D. 0.7 MPa

24. A steel tie, length 21740 mm and area 5635 mm², carries 2104 kN. Using $E = 200,000$ MPa, what is its elastic elongation?

- A. 20.29 mm
- B. 40.59 mm
- C. 81.17 mm
- D. 20.84 mm

25. A ductile member has yield strength 5390 MPa and calculated von Mises stress 2151 MPa. What factor of safety against yielding results?

- A. 1.25
- B. 2.51
- C. 1.51
- D. 3.51

26. A pin-ended column has $E = 200,000$ MPa, $I = 110900000$ mm⁴, and length 27925 mm. What is its Euler critical load?

- A. 280.72 kN
- B. 1122.88 kN
- C. 70.18 kN
- D. 89.36 kN

27. At a point, $\sigma_x = 2140$ MPa, $\sigma_y = 1060$ MPa, and $\tau_{xy} = 540.0$ MPa. What is the von Mises equivalent stress for plane stress?

- A. 2388.14 MPa

- B. 1080 MPa
- C. 2075.96 MPa
- D. 1037.98 MPa

28. A part has alternating stress 2172 MPa and mean stress 1101 MPa. With $S_e = 3293$ MPa and $S_{ut} = 5655$ MPa, what Goodman fatigue factor of safety applies?

- A. 1.52
- B. 5.14
- C. 1.39
- D. 1.17

29. A prismatic bar carries 2104 kN axial tension over a net area of 5510 mm². What is the average normal stress?

- A. 381.85 MPa
- B. 190.93 MPa
- C. 191.34 MPa
- D. 572.78 MPa

30. A solid circular shaft of diameter 56 mm transmits 21560 N·m torque. What is its maximum torsional shear stress?

- A. 312.63 MPa
- B. 1250.5 MPa
- C. 1251.05 MPa
- D. 625.25 MPa

31. A rectangular beam 2148 mm wide and 2208 mm deep carries a maximum bending moment of 529.0 kN·m. What is the extreme-fiber bending stress?

- A. 0.15 MPa
- B. 0.3 MPa
- C. 0.56 MPa
- D. 0.7 MPa

32. A steel tie, length 21900 mm and area 5675 mm², carries 2120 kN. Using $E = 200,000$ MPa, what is its elastic elongation?

- A. 20.45 mm
- B. 81.81 mm
- C. 40.91 mm
- D. 21 mm

33. A ductile member has yield strength 5430 MPa and calculated von Mises stress 2167 MPa. What factor of safety against yielding results?

- A. 1.25
- B. 2.51
- C. 1.51
- D. 3.51

34. A pin-ended column has $E = 200,000$ MPa, $I = 111700000$ mm⁴, and length 28125 mm. What is its Euler critical load?

- A. 1114.96 kN
- B. 69.68 kN
- C. 88.73 kN
- D. 278.74 kN

35. At a point, $\sigma_x = 2156$ MPa, $\sigma_y = 1068$ MPa, and $\tau_{xy} = 544.0$ MPa. What is the von Mises equivalent stress for plane stress?

- A. 2406.03 MPa
- B. 1088 MPa
- C. 2091.45 MPa
- D. 1045.72 MPa

36. A part has alternating stress 2188 MPa and mean stress 1109 MPa. With $S_e = 3317$ MPa and $S_{ut} = 5695$ MPa, what Goodman fatigue factor of safety applies?

- A. 1.17
- B. 1.52
- C. 5.14
- D. 1.39

37. A prismatic bar carries 2120 kN axial tension over a net area of 5550 mm². What is the average normal stress?

- A. 381.98 MPa
- B. 190.99 MPa
- C. 191.4 MPa
- D. 572.97 MPa

38. A solid circular shaft of diameter 52 mm transmits 21720 N·m torque. What is its maximum torsional shear stress?

- A. 393.36 MPa
- B. 1573.44 MPa
- C. 1573.99 MPa
- D. 786.72 MPa

39. A rectangular beam 2164 mm wide and 2224 mm deep carries a maximum bending moment of 533.0 kN·m. What is the extreme-fiber bending stress?

- A. 0.15 MPa
- B. 0.56 MPa
- C. 0.3 MPa
- D. 0.7 MPa

40. A steel tie, length 22060 mm and area 5715 mm², carries 2136 kN. Using $E = 200,000$ MPa, what is its elastic elongation?

- A. 20.61 mm
- B. 41.22 mm
- C. 82.45 mm
- D. 21.16 mm

41. A lap joint uses 4 identical 12-mm-diameter rivets in single shear to carry 2085 kN. Assuming equal load sharing, what average shear stress acts in each rivet?

- A. 18435.45 MPa
- B. 4608.86 MPa
- C. 2304.43 MPa
- D. 9217.72 MPa

42. A bolt transfers 2102 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. 9554.55 MPa
- B. 3041.31 MPa
- C. 4777.27 MPa
- D. 19109.09 MPa

43. Using the relation $T = KFd$, estimate bolt preload when installation torque is 10500 N·m, nut factor $K = 0.2$, and nominal diameter is 18 mm.

- A. 2916.94 kN
- B. 4375 kN
- C. 2916.67 kN
- D. 583.33 kN

44. Two parallel fillet welds, each 2126 mm long with 6 mm leg size, carry 1043 kN direct shear. Using throat = 0.707h, what average weld throat stress results?

- A. 81.77 MPa
- B. 40.88 MPa
- C. 115.65 MPa
- D. 57.83 MPa

45. A lap joint uses 4 identical 14-mm-diameter rivets in single shear to carry 2093 kN. Assuming equal load sharing, what average shear stress acts in each rivet?

- A. 3399.09 MPa
- B. 13596.38 MPa
- C. 1699.55 MPa
- D. 6798.19 MPa

46. A bolt transfers 2110 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. 2798.47 MPa
- B. 4395.83 MPa
- C. 8791.67 MPa
- D. 17583.33 MPa

47. Using the relation $T = KF_d$, estimate bolt preload when installation torque is 10540 N·m, nut factor $K = 0.2$, and nominal diameter is 16 mm.

- A. 3294.02 kN
- B. 4940.62 kN
- C. 658.75 kN
- D. 3293.75 kN

48. Two parallel fillet welds, each 2134 mm long with 7 mm leg size, carry 1047 kN direct shear. Using throat = 0.707h, what average weld throat stress results?

- A. 70.09 MPa
- B. 49.57 MPa
- C. 35.04 MPa
- D. 99.14 MPa

49. A lap joint uses 4 identical 16-mm-diameter rivets in single shear to carry 2101 kN. Assuming equal load sharing, what average shear stress acts in each rivet?

- A. 10449.52 MPa
- B. 1306.19 MPa
- C. 2612.38 MPa
- D. 5224.76 MPa

50. A bolt transfers 2118 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. 10590 MPa
- B. 3370.9 MPa
- C. 5295 MPa
- D. 21180 MPa

51. Using the relation $T = KFd$, estimate bolt preload when installation torque is 10580 N·m, nut factor $K = 0.2$, and nominal diameter is 17 mm.

- A. 3112.03 kN
- B. 3111.76 kN
- C. 4667.65 kN
- D. 622.35 kN

52. Two parallel fillet welds, each 2142 mm long with 8 mm leg size, carry 1051 kN direct shear. Using throat = 0.707h, what average weld throat stress results?

- A. 61.33 MPa
- B. 30.67 MPa
- C. 86.75 MPa
- D. 43.38 MPa

53. A lap joint uses 4 identical 12-mm-diameter rivets in single shear to carry 2109 kN. Assuming equal load sharing, what average shear stress acts in each rivet?

- A. 18647.65 MPa
- B. 2330.96 MPa
- C. 4661.91 MPa
- D. 9323.83 MPa

54. A 18-tooth pinion rotating at 11950 rpm drives a 54-tooth gear. Neglecting slip, what is the gear speed?

- A. 3983.33 rpm
- B. 1991.67 rpm
- C. 7966.67 rpm
- D. 11950 rpm

55. A shaft transmits 1036 hp at 21620 rpm. Using $T(\text{in}\cdot\text{lbf}) = 63,025 \text{ hp/rpm}$, what torque is transmitted?

- A. 1510.03 in·lbf
- B. 4530.1 in·lbf
- C. 6040.14 in·lbf
- D. 3020.07 in·lbf

56. An open belt connects a 130-mm driver at 11120 rpm to a 320-mm driven pulley. Neglecting slip, what is driven speed?

- A. 2258.75 rpm
- B. 4517.5 rpm
- C. 6602.5 rpm
- D. 11120 rpm

57. A collar bearing supports 519.5 kN at mean friction radius 0.020 m with friction coefficient 0.080. What friction torque must be overcome?

- A. 1662.4 N·m
- B. 1246.8 N·m
- C. 831.2 N·m
- D. 1662.95 N·m

58. A power screw has lead 7 mm, input torque 2093 N·m, and raising efficiency 0.32. What axial load can it raise?

- A. 300.59 kN
- B. 601.18 kN
- C. 901.76 kN
- D. 1202.35 kN

59. A 19-tooth pinion rotating at 12000 rpm drives a 56-tooth gear. Neglecting slip, what is the gear speed?

- A. 4071.43 rpm
- B. 2035.71 rpm
- C. 7928.57 rpm
- D. 12000 rpm

60. A shaft transmits 1041 hp at 21720 rpm. Using $T(\text{in}\cdot\text{lbf}) = 63,025 \text{ hp/rpm}$, what torque is transmitted?

- A. 1510.34 in·lbf
- B. 4531.01 in·lbf
- C. 6041.35 in·lbf
- D. 3020.67 in·lbf

61. An open belt connects a 125-mm driver at 11170 rpm to a 310-mm driven pulley. Neglecting slip, what is driven speed?

- A. 2252.02 rpm
- B. 6665.97 rpm
- C. 4504.03 rpm
- D. 11170 rpm

62. A collar bearing supports 522.0 kN at mean friction radius 0.022 m with friction coefficient 0.090. What friction torque must be overcome?

- A. 2067.12 N·m
- B. 1550.34 N·m
- C. 2067.67 N·m
- D. 1033.56 N·m

63. A power screw has lead 6 mm, input torque 2103 N·m, and raising efficiency 0.33. What axial load can it raise?

- A. 726.74 kN
- B. 363.37 kN
- C. 1090.12 kN
- D. 1453.49 kN

64. A 20-tooth pinion rotating at 12050 rpm drives a 58-tooth gear. Neglecting slip, what is the gear speed?

- A. 2077.59 rpm
- B. 4155.17 rpm
- C. 7894.83 rpm
- D. 12050 rpm

65. A shaft transmits 1046 hp at 21820 rpm. Using $T(\text{in}\cdot\text{lbf}) = 63,025 \text{ hp/rpm}$, what torque is transmitted?

- A. 1510.64 in·lbf
- B. 4531.91 in·lbf
- C. 6042.54 in·lbf
- D. 3021.27 in·lbf

66. An open belt connects a 120-mm driver at 11220 rpm to a 300-mm driven pulley. Neglecting slip, what is driven speed?

- A. 4488 rpm
- B. 2244 rpm
- C. 6732 rpm
- D. 11220 rpm

67. A lever has an effort arm of 3180 mm and a load arm of 2080 mm. Neglecting friction, what is its ideal mechanical advantage?

- A. 0.65
- B. 1.53
- C. 2.29
- D. 3.06

68. A 314-V DC source is applied across a 7- Ω resistive sensor circuit. Neglecting lead resistance, what current flows?

- A. 22.43 A
- B. 67.29 A
- C. 44.86 A
- D. 89.71 A

69. A thin-walled cylindrical vessel has internal pressure 105.2 MPa, inside diameter 5510 mm, and wall thickness 14 mm. What is the membrane hoop stress?

- A. 10350.93 MPa
- B. 20701.86 MPa
- C. 41403.71 MPa
- D. 10351.48 MPa

70. A linear spring has stiffness 1048 kN/m and is compressed 46 mm. What force does it exert?

- A. 24104 N
- B. 72312 N
- C. 48208 N
- D. 24104.55 N

71. An undamped single-degree system has mass 1042 kg and stiffness 536000 N/m. What is its natural frequency in hertz?

- A. 1.8 Hz
- B. 5.41 Hz
- C. 7.22 Hz
- D. 3.61 Hz

72. A hydraulic cylinder must produce 524.5 kN using a piston area of 11150 mm². Neglecting losses, what gauge pressure is required?

- A. 47.04 MPa
- B. 23.52 MPa
- C. 23.93 MPa
- D. 94.08 MPa

73. A simply supported beam of span 2.6 m carries a central point load of 1044 kN. What is the maximum bending moment?

- A. 678.6 kN·m
- B. 1357.2 kN·m
- C. 339.3 kN·m
- D. 401.54 kN·m

74. A lever has an effort arm of 3201 mm and a load arm of 2094 mm. Neglecting friction, what is its ideal mechanical advantage?

- A. 0.65
- B. 2.29
- C. 3.06
- D. 1.53

75. A 316-V DC source is applied across a 9- Ω resistive sensor circuit. Neglecting lead resistance, what current flows?

- A. 17.56 A
- B. 35.11 A
- C. 52.67 A
- D. 70.22 A

76. A thin-walled cylindrical vessel has internal pressure 105.9 MPa, inside diameter 5545 mm, and wall thickness 12 mm. What is the membrane hoop stress?

- A. 12233.66 MPa
- B. 48934.62 MPa
- C. 24467.31 MPa
- D. 12234.21 MPa

77. A linear spring has stiffness 1055 kN/m and is compressed 44 mm. What force does it exert?

- A. 23210 N
- B. 46420 N
- C. 69630 N
- D. 23210.55 N

78. An undamped single-degree system has mass 1049 kg and stiffness 539500 N/m. What is its natural frequency in hertz?

- A. 3.61 Hz
- B. 1.8 Hz
- C. 5.41 Hz
- D. 7.22 Hz

79. A hydraulic cylinder must produce 528.0 kN using a piston area of 11220 mm². Neglecting losses, what gauge pressure is required?

- A. 23.53 MPa
- B. 23.94 MPa
- C. 94.12 MPa
- D. 47.06 MPa

80. A simply supported beam of span 2.5 m carries a central point load of 1051 kN. What is the maximum bending moment?

- A. 1313.75 kN·m
- B. 328.44 kN·m
- C. 656.88 kN·m
- D. 420.4 kN·m

81. A lever has an effort arm of 3222 mm and a load arm of 2108 mm. Neglecting friction, what is its ideal mechanical advantage?

- A. 0.65
- B. 1.53
- C. 2.29
- D. 3.06

82. A 318-V DC source is applied across a 6- Ω resistive sensor circuit. Neglecting lead resistance, what current flows?

- A. 26.5 A
- B. 79.5 A
- C. 106 A
- D. 53 A

83. A thin-walled cylindrical vessel has internal pressure 106.6 MPa, inside diameter 5580 mm, and wall thickness 13 mm. What is the membrane hoop stress?

- A. 11439 MPa
- B. 45756 MPa
- C. 22878 MPa
- D. 11439.55 MPa

84. A linear spring has stiffness 1062 kN/m and is compressed 42 mm. What force does it exert?

- A. 44604 N
- B. 22302 N
- C. 66906 N
- D. 22302.55 N

85. An undamped single-degree system has mass 1056 kg and stiffness 543000 N/m. What is its natural frequency in hertz?

- A. 1.8 Hz
- B. 3.61 Hz
- C. 5.41 Hz
- D. 7.22 Hz

86. A hydraulic cylinder must produce 531.5 kN using a piston area of 11290 mm². Neglecting losses, what gauge pressure is required?

- A. 23.54 MPa
- B. 23.95 MPa
- C. 47.08 MPa
- D. 94.15 MPa

87. A simply supported beam of span 2.4 m carries a central point load of 1058 kN. What is the maximum bending moment?

- A. 1269.6 kN·m
- B. 317.4 kN·m
- C. 440.83 kN·m
- D. 634.8 kN·m

88. A lever has an effort arm of 3243 mm and a load arm of 2122 mm. Neglecting friction, what is its ideal mechanical advantage?

- A. 1.53
- B. 0.65
- C. 2.29
- D. 3.06

89. A 320-V DC source is applied across a 8- Ω resistive sensor circuit. Neglecting lead resistance, what current flows?

- A. 20 A
- B. 40 A
- C. 60 A
- D. 80 A

90. A mating hole measures 1045.04 mm and its shaft measures 1044.98 mm. What diametral clearance exists?

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

91. Inspection accepts 5585 of 5605 manufactured parts. What is the observed percent yield?

- A. 99.64 %
- B. 49.82 %
- C. 149.46 %
- D. 100.36 %

92. A machining operation reduces a diameter from 1054 mm to 1050 mm. What percent reduction in diameter occurs?

- A. 0.65 %
- B. 0.57 %
- C. 0.76 %
- D. 0.38 %

93. Four repeated measurements are 60.25, 60.21, 60.24, and 60.22 mm. What is their arithmetic mean?

- A. 30.11 mm
- B. 240.92 mm
- C. 60.25 mm
- D. 60.23 mm

94. A mating hole measures 1049.05 mm and its shaft measures 1048.98 mm. What diametral clearance exists?

- A. 0.07 mm
- B. 0.05 mm
- C. 0.02 mm
- D. 0.03 mm

95. Inspection accepts 5605 of 5625 manufactured parts. What is the observed percent yield?

- A. 49.82 %

- B. 99.64 %
- C. 149.47 %
- D. 100.36 %

96. A machining operation reduces a diameter from 1058 mm to 1054 mm. What percent reduction in diameter occurs?

- A. 0.65 %
- B. 0.57 %
- C. 0.38 %
- D. 0.76 %

97. Four repeated measurements are 60.29, 60.25, 60.28, and 60.26 mm. What is their arithmetic mean?

- A. 30.14 mm
- B. 241.08 mm
- C. 60.29 mm
- D. 60.27 mm

98. A mating hole measures 1053.06 mm and its shaft measures 1052.98 mm. What diametral clearance exists?

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

99. Inspection accepts 5625 of 5645 manufactured parts. What is the observed percent yield?

- A. 99.65 %
- B. 49.82 %

- C. 149.47 %
- D. 100.36 %

100. A machining operation reduces a diameter from 1062 mm to 1058 mm. What percent reduction in diameter occurs?

- A. 0.65 %
- B. 0.56 %
- C. 0.38 %
- D. 0.75 %

Practice Exam 7: Answer Key and Explanations

1. C — C — 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 42546.23 \$/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 3.88 . Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents a numerically

3. D — D — Length conversion requires multiplying inches by 25.4 millimeters per inch so the inch unit cancels and millimeters remain. Substitution gives 13182.6 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. B — B — 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 4253605 \$/year. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis

5. 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 42706.24 \$/unit. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents

6. D — D — The design factor is the ratio of the expected maximum stress to the allowable design stress, not the inverse or a difference. Substitution gives 3.88 . Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents a numerically

7. B — B — Length conversion requires multiplying inches by 25.4 millimeters per inch so the inch unit cancels and millimeters remain. Substitution gives 13233.4 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. 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 3671861.43 \$/year. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis

9. C — C — 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 42866.25 \$/unit. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents

10. D — D — The design factor is the ratio of the expected maximum stress to the allowable design stress, not the inverse or a difference. Substitution gives 3.88 . Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents a numerically

11. B — B — Length conversion requires multiplying inches by 25.4 millimeters per inch so the inch unit cancels and millimeters remain. Substitution gives 13284.2 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. 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 3235633.75 \$/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 43026.27 \$/unit. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents

14. D — D — The design factor is the ratio of the expected maximum stress to the allowable design stress, not the inverse or a difference. Substitution gives 3.88 . Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents a numerically

15. C — C — Length conversion requires multiplying inches by 25.4 millimeters per inch so the inch unit cancels and millimeters remain. Substitution gives 13335 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. B — B — 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 4344625 \$/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 2.51 . Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path, sign

18. A — A — Euler buckling for a pin-ended column uses effective length equal to actual length, giving $\pi^2 EI$ divided by L^2 . Substitution gives 282.73 kN. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path,

19. B — B — Plane-stress von Mises stress combines both normal stresses and shear through the distortion-energy expression, including three times shear stress squared. Substitution gives 2060.47 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. D — D — 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 1.17 . 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 381.72 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 871.91 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

23. C — C — 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 0.31 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving

24. B — B — Elastic axial elongation follows PL divided by AE . Consistent newton and millimeter units make the modulus directly usable in megapascals. Substitution gives 40.59 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 2.51 . Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path, sign

26. A — A — Euler buckling for a pin-ended column uses effective length equal to actual length, giving $\pi^2 EI$ divided by L^2 . Substitution gives 280.72 kN. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path,

27. 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 2075.96 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. D — D — 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 1.17 . Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

29. 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 381.85 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

30. 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 625.25 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

31. B — B — Using $\sigma = \frac{Mc}{I}$ for a rectangle reduces to $6M$ divided by $b h^2$. The moment must be expressed in newton-millimeters. Substitution gives 0.3 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving

32. C — C — Elastic axial elongation follows PL divided by AE . Consistent newton and millimeter units make the modulus directly usable in megapascals. Substitution gives 40.91 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. 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 2.51 . 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 278.74 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 2091.45 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 1.17 . 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 381.98 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

38. 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 786.72 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

39. C — C — 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 0.3 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving

40. B — B — Elastic axial elongation follows PL/AE . Consistent newton and millimeter units make the modulus directly usable in megapascals. Substitution gives 41.22 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. B — B — 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 4608.86 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 9554.55 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

43. C — C — Rearranging the torque-preload approximation gives preload F equal to T divided by K_d , with diameter expressed in meters. Substitution gives 2916.67 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 57.83 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 3399.09 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. C — C — Average bearing stress uses the projected contact area, bolt diameter times plate thickness, rather than the bolt's circular area. Substitution gives 8791.67 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. D — D — Rearranging the torque-preload approximation gives preload F equal to T divided by K_d , with diameter expressed in meters. Substitution gives 3293.75 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 49.57 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 2612.38 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. A — A — Average bearing stress uses the projected contact area, bolt diameter times plate thickness, rather than the bolt's circular area. Substitution gives 10590 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 3111.76 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. D — D — The resisting throat area is two weld lengths multiplied by the effective fillet throat, 0.707 times leg size. Substitution gives 43.38 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 4661.91 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. A — A — For an external gear pair, pitch-line velocity is equal, so rotational speed is inversely proportional to tooth count. Substitution gives 3983.33 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. D — D — 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 3020.07 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. B — B — 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 4517.5 rpm. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the operating relationship

57. C — C — Collar friction torque equals friction coefficient times axial load times mean friction radius; kilonewtons are converted to newtons. Substitution gives 831.2 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 601.18 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 4071.43 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. D — D — 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 3020.67 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. C — C — Equal belt speed at both pulley rims gives N_1D_1 equal to N_2D_2 , so driven speed is driver speed times the diameter ratio. Substitution gives 4504.03 rpm. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the operating relationship

62. D — D — Collar friction torque equals friction coefficient times axial load times mean friction radius; kilonewtons are converted to newtons. Substitution gives 1033.56 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. A — A — 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 726.74 kN. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the

64. B — B — For an external gear pair, pitch-line velocity is equal, so rotational speed is inversely proportional to tooth count. Substitution gives 4155.17 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. D — D — 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 3021.27 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. A — A — Equal belt speed at both pulley rims gives N_1D_1 equal to N_2D_2 , so driven speed is driver speed times the diameter ratio. Substitution gives 4488 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 — 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 1.53 . Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding,

68. 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 44.86 A. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

69. B — B — Thin-cylinder hoop stress equals pressure times diameter divided by twice wall thickness; longitudinal stress would be half this value. Substitution gives 20701.86 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

70. 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 48208 N. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

71. D — D — 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 3.61 Hz. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied

72. A — A — Hydraulic pressure equals force divided by piston area. Newtons per square millimeter are numerically megapascals. Substitution gives 47.04 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

73. A — A — 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 678.6 kN·m. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before

74. D — D — 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 1.53 . Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding,

75. B — B — 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 35.11 A. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

76. C — C — Thin-cylinder hoop stress equals pressure times diameter divided by twice wall thickness; longitudinal stress would be half this value. Substitution gives 24467.31 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

77. 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 46420 N. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

78. A — A — 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 3.61 Hz. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied

79. D — D — Hydraulic pressure equals force divided by piston area. Newtons per square millimeter are numerically megapascals. Substitution gives 47.06 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

80. C — C — 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 656.88 kN·m. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before

81. B — B — 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 1.53 . Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding,

82. 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 53 A. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

83. C — C — Thin-cylinder hoop stress equals pressure times diameter divided by twice wall thickness; longitudinal stress would be half this value. Substitution gives 22878 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

84. 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 44604 N. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

85. B — B — 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 3.61 Hz. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied

86. C — C — Hydraulic pressure equals force divided by piston area. Newtons per square millimeter are numerically megapascals. Substitution gives 47.08 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

87. 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 634.8 kN·m. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before

88. 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 1.53 . Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding,

89. B — B — 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 40 A. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

90. C — C — 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 99.64 %. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units, manufacturing intent,

92. D — D — Percent reduction uses the original dimension as the reference denominator, after determining the absolute decrease. Substitution gives 0.38 %. 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 60.23 mm. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units,

94. A — A — 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. B — B — Percent yield is accepted quantity divided by total inspected quantity, multiplied by one hundred. The rejected fraction is a different quality metric. Substitution gives 99.64 %. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units, manufacturing intent,

96. C — C — Percent reduction uses the original dimension as the reference denominator, after determining the absolute decrease. Substitution gives 0.38 %. 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. 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 60.27 mm. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units,

98. 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 0.08 mm. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units, manufacturing intent,

99. 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 99.65 %. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units, manufacturing intent,

100. C — C — Percent reduction uses the original dimension as the reference denominator, after determining the absolute decrease. Substitution gives 0.38 %. 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