

PRACTICE EXAM 21: 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 \$137500 and a variable cost of \$1712000 spread over 6880 units. What is the average cost per unit?

- A. 68874.42 \$/unit
- B. 137748.84 \$/unit
- C. 151523.72 \$/unit
- D. 275497.67 \$/unit

2. A component is expected to experience 3441 MPa maximum stress, while its allowable design stress is 868.25 MPa. What design factor is implied?

- A. 1.98
- B. 4.46
- C. 3.96
- D. 7.93

3. A drawing dimension is 1709.0 in. Convert this length to millimeters using 1 in = 25.4 mm.

- A. 43408.6 mm
- B. 21704.3 mm
- C. 65112.9 mm
- D. 43434 mm

4. A machine saves 35830 labor-hours annually at \$6891/h. Ignoring interest, its \$352300 residual value is credited evenly over a 7-year evaluation. What is the annual net benefit?

- A. 17610873.57 \$/year
- B. 35322404.29 \$/year
- C. 70443494.29 \$/year
- D. 35221747.14 \$/year

5. A proposed fixture has a fixed fabrication cost of \$137660 and a variable cost of \$1714000 spread over 6888 units. What is the average cost per unit?

- A. 68954.42 \$/unit
- B. 137908.84 \$/unit
- C. 151699.72 \$/unit
- D. 275817.68 \$/unit

6. A component is expected to experience 3445 MPa maximum stress, while its allowable design stress is 869.25 MPa. What design factor is implied?

- A. 1.98
- B. 4.46
- C. 3.96
- D. 7.93

7. A drawing dimension is 1711.0 in. Convert this length to millimeters using 1 in = 25.4 mm.

- A. 21729.7 mm
- B. 65189.1 mm
- C. 43484.8 mm
- D. 43459.4 mm

8. A machine saves 35870 labor-hours annually at \$6899/h. Ignoring interest, its \$352700 residual value is credited evenly over a 8-year evaluation. What is the annual net benefit?

- A. 30889303.75 \$/year
- B. 15444651.88 \$/year
- C. 30977478.75 \$/year
- D. 61778607.5 \$/year

9. A proposed fixture has a fixed fabrication cost of \$137820 and a variable cost of \$1716000 spread over 6896 units. What is the average cost per unit?

- A. 69034.42 \$/unit
- B. 151875.72 \$/unit
- C. 138068.84 \$/unit
- D. 276137.68 \$/unit

10. A component is expected to experience 3449 MPa maximum stress, while its allowable design stress is 870.25 MPa. What design factor is implied?

- A. 1.98
- B. 4.46
- C. 7.93
- D. 3.96

11. A drawing dimension is 1713.0 in. Convert this length to millimeters using 1 in = 25.4 mm.

- A. 21755.1 mm
- B. 43510.2 mm
- C. 65265.3 mm
- D. 43535.6 mm

12. A machine saves 35910 labor-hours annually at \$6907/h. Ignoring interest, its \$353100 residual value is credited evenly over a 6-year evaluation. What is the annual net benefit?

- A. 41279545 \$/year
- B. 20639772.5 \$/year
- C. 41397245 \$/year
- D. 82559090 \$/year

13. A proposed fixture has a fixed fabrication cost of \$137980 and a variable cost of \$1718000 spread over 6904 units. What is the average cost per unit?

- A. 69114.42 \$/unit
- B. 152051.73 \$/unit
- C. 138228.84 \$/unit
- D. 276457.68 \$/unit

14. A component is expected to experience 3453 MPa maximum stress, while its allowable design stress is 871.25 MPa. What design factor is implied?

- A. 1.98
- B. 4.46
- C. 7.93
- D. 3.96

15. A drawing dimension is 1715.0 in. Convert this length to millimeters using 1 in = 25.4 mm.

- A. 43561 mm
- B. 21780.5 mm
- C. 65341.5 mm
- D. 43586.4 mm

16. A machine saves 35950 labor-hours annually at \$6915/h. Ignoring interest, its \$353500 residual value is credited evenly over a 7-year evaluation. What is the annual net benefit?

- A. 17731482.14 \$/year
- B. 35462964.29 \$/year
- C. 35563964.29 \$/year
- D. 70925928.57 \$/year

17. A prismatic bar carries 6840 kN axial tension over a net area of 17350 mm². What is the average normal stress?

- A. 197.12 MPa
- B. 197.53 MPa
- C. 591.35 MPa
- D. 394.24 MPa

18. A solid circular shaft of diameter 52 mm transmits 68920 N·m torque. What is its maximum torsional shear stress?

- A. 2496.35 MPa
- B. 1248.17 MPa
- C. 4992.7 MPa
- D. 4993.25 MPa

19. A rectangular beam 6884 mm wide and 6944 mm deep carries a maximum bending moment of 1713.0 kN·m. What is the extreme-fiber bending stress?

- A. 0.02 MPa
- B. 0.03 MPa
- C. 0.43 MPa

D. 0.57 MPa

20. A steel tie, length 69260 mm and area 17515 mm², carries 6856 kN. Using $E = 200,000$ MPa, what is its elastic elongation?

- A. 67.78 mm
- B. 271.11 mm
- C. 135.55 mm
- D. 68.33 mm

21. A ductile member has yield strength 17270 MPa and calculated von Mises stress 6903 MPa. What factor of safety against yielding results?

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

22. A pin-ended column has $E = 200,000$ MPa, $I = 348500000$ mm⁴, and length 87325 mm. What is its Euler critical load?

- A. 360.84 kN
- B. 22.55 kN
- C. 28.71 kN
- D. 90.21 kN

23. At a point, $\sigma_x = 6892$ MPa, $\sigma_y = 3436$ MPa, and $\tau_{xy} = 1728.0$ MPa. What is the von Mises equivalent stress for plane stress?

- A. 7701.02 MPa
- B. 3456 MPa

- C. 6677.04 MPa
- D. 3338.52 MPa

24. A part has alternating stress 6924 MPa and mean stress 3477 MPa. With $S_e = 10421$ MPa and $S_{ut} = 17535$ MPa, what Goodman fatigue factor of safety applies?

- A. 1.16
- B. 1.51
- C. 5.04
- D. 1.37

25. A prismatic bar carries 6856 kN axial tension over a net area of 17390 mm². What is the average normal stress?

- A. 197.12 MPa
- B. 394.25 MPa
- C. 197.53 MPa
- D. 591.37 MPa

26. A solid circular shaft of diameter 58 mm transmits 69080 N·m torque. What is its maximum torsional shear stress?

- A. 1803.18 MPa
- B. 901.59 MPa
- C. 3606.35 MPa
- D. 3606.9 MPa

27. A rectangular beam 6900 mm wide and 6960 mm deep carries a maximum bending moment of 1717.0 kN·m. What is the extreme-fiber bending stress?

- A. 0.02 MPa

- B. 0.43 MPa
- C. 0.03 MPa
- D. 0.57 MPa

28. A steel tie, length 69420 mm and area 17555 mm², carries 6872 kN. Using $E = 200,000$ MPa, what is its elastic elongation?

- A. 67.94 mm
- B. 271.75 mm
- C. 68.49 mm
- D. 135.87 mm

29. A ductile member has yield strength 17310 MPa and calculated von Mises stress 6919 MPa. What factor of safety against yielding results?

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

30. A pin-ended column has $E = 200,000$ MPa, $I = 349300000$ mm⁴, and length 87525 mm. What is its Euler critical load?

- A. 360.02 kN
- B. 22.5 kN
- C. 90 kN
- D. 28.65 kN

31. At a point, $\sigma_x = 6908$ MPa, $\sigma_y = 3444$ MPa, and $\tau_{xy} = 1732.0$ MPa. What is the von Mises equivalent stress for plane stress?

- A. 7718.91 MPa
- B. 3464 MPa
- C. 3346.26 MPa
- D. 6692.53 MPa

32. A part has alternating stress 6940 MPa and mean stress 3485 MPa. With $S_e = 10445$ MPa and $S_{ut} = 17575$ MPa, what Goodman fatigue factor of safety applies?

- A. 1.16
- B. 1.51
- C. 5.04
- D. 1.37

33. A prismatic bar carries 6872 kN axial tension over a net area of 17430 mm². What is the average normal stress?

- A. 394.26 MPa
- B. 197.13 MPa
- C. 197.54 MPa
- D. 591.39 MPa

34. A solid circular shaft of diameter 54 mm transmits 69240 N·m torque. What is its maximum torsional shear stress?

- A. 1119.74 MPa
- B. 4478.95 MPa
- C. 2239.47 MPa
- D. 4479.5 MPa

35. A rectangular beam 6916 mm wide and 6976 mm deep carries a maximum bending moment of 1721.0 kN·m. What is the extreme-fiber bending stress?

- A. 0.02 MPa
- B. 0.03 MPa
- C. 0.43 MPa
- D. 0.57 MPa

36. A steel tie, length 69580 mm and area 17595 mm², carries 6888 kN. Using $E = 200,000$ MPa, what is its elastic elongation?

- A. 68.1 mm
- B. 272.39 mm
- C. 68.65 mm
- D. 136.19 mm

37. A ductile member has yield strength 17350 MPa and calculated von Mises stress 6935 MPa. What factor of safety against yielding results?

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

38. A pin-ended column has $E = 200,000$ MPa, $I = 350100000$ mm⁴, and length 87725 mm. What is its Euler critical load?

- A. 359.2 kN
- B. 89.8 kN
- C. 22.45 kN
- D. 28.58 kN

39. At a point, $\sigma_x = 6924$ MPa, $\sigma_y = 3452$ MPa, and $\tau_{xy} = 1736.0$ MPa. What is the von Mises equivalent stress for plane stress?

- A. 7736.8 MPa
- B. 3472 MPa
- C. 6708.02 MPa
- D. 3354.01 MPa

40. A part has alternating stress 6956 MPa and mean stress 3493 MPa. With $S_e = 10469$ MPa and $S_{ut} = 17615$ MPa, what Goodman fatigue factor of safety applies?

- A. 1.16
- B. 1.51
- C. 5.04
- D. 1.37

41. A lap joint uses 4 identical 14-mm-diameter rivets in single shear to carry 6845 kN. Assuming equal load sharing, what average shear stress acts in each rivet?

- A. 11116.49 MPa
- B. 44465.94 MPa
- C. 5558.24 MPa
- D. 22232.97 MPa

42. A bolt transfers 6862 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. 9101.01 MPa
- B. 14295.83 MPa
- C. 57183.33 MPa
- D. 28591.67 MPa

43. Using the relation $T = KF_d$, estimate bolt preload when installation torque is 34300 N·m, nut factor $K = 0.2$, and nominal diameter is 16 mm.

- A. 10719.02 kN
- B. 10718.75 kN
- C. 16078.12 kN
- D. 2143.75 kN

44. Two parallel fillet welds, each 6886 mm long with 7 mm leg size, carry 3423 kN direct shear. Using throat = 0.707h, what average weld throat stress results?

- A. 71.01 MPa
- B. 35.51 MPa
- C. 50.22 MPa
- D. 100.44 MPa

45. A lap joint uses 4 identical 16-mm-diameter rivets in single shear to carry 6853 kN. Assuming equal load sharing, what average shear stress acts in each rivet?

- A. 34084.03 MPa
- B. 4260.5 MPa
- C. 8521.01 MPa
- D. 17042.01 MPa

46. A bolt transfers 6870 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. 10933.94 MPa
- B. 34350 MPa
- C. 17175 MPa
- D. 68700 MPa

47. Using the relation $T = KF_d$, estimate bolt preload when installation torque is 34340 N·m, nut factor $K = 0.2$, and nominal diameter is 17 mm.

- A. 10100 kN
- B. 10100.27 kN
- C. 15150 kN
- D. 2020 kN

48. Two parallel fillet welds, each 6894 mm long with 8 mm leg size, carry 3427 kN direct shear. Using $\text{throat} = 0.707h$, what average weld throat stress results?

- A. 62.14 MPa
- B. 31.07 MPa
- C. 87.89 MPa
- D. 43.94 MPa

49. A lap joint uses 4 identical 12-mm-diameter rivets in single shear to carry 6861 kN. Assuming equal load sharing, what average shear stress acts in each rivet?

- A. 15166.14 MPa
- B. 60664.56 MPa
- C. 7583.07 MPa
- D. 30332.28 MPa

50. A bolt transfers 6878 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. 9951.52 MPa
- B. 15631.82 MPa
- C. 62527.27 MPa
- D. 31263.64 MPa

51. Using the relation $T = KF_d$, estimate bolt preload when installation torque is 34380 N·m, nut factor $K = 0.2$, and nominal diameter is 18 mm.

- A. 9550.27 kN
- B. 14325 kN
- C. 9550 kN
- D. 1910 kN

52. Two parallel fillet welds, each 6902 mm long with 6 mm leg size, carry 3431 kN direct shear. Using throat = 0.707h, what average weld throat stress results?

- A. 82.85 MPa
- B. 58.59 MPa
- C. 41.43 MPa
- D. 117.19 MPa

53. A lap joint uses 4 identical 14-mm-diameter rivets in single shear to carry 6869 kN. Assuming equal load sharing, what average shear stress acts in each rivet?

- A. 11155.46 MPa
- B. 44621.85 MPa
- C. 5577.73 MPa
- D. 22310.92 MPa

54. A 18-tooth pinion rotating at 35750 rpm drives a 54-tooth gear. Neglecting slip, what is the gear speed?

- A. 5958.33 rpm
- B. 23833.33 rpm
- C. 11916.67 rpm
- D. 35750 rpm

55. A shaft transmits 3416 hp at 69220 rpm. Using $T(\text{in}\cdot\text{lbf}) = 63,025 \text{ hp/rpm}$, what torque is transmitted?

- A. 1555.14 in·lbf
- B. 3110.28 in·lbf
- C. 4665.42 in·lbf
- D. 6220.55 in·lbf

56. An open belt connects a 120-mm driver at 34920 rpm to a 300-mm driven pulley. Neglecting slip, what is driven speed?

- A. 6984 rpm
- B. 20952 rpm
- C. 34920 rpm
- D. 13968 rpm

57. A collar bearing supports 1709.5 kN at mean friction radius 0.021 m with friction coefficient 0.085. What friction torque must be overcome?

- A. 3051.46 N·m
- B. 6102.91 N·m
- C. 4577.19 N·m
- D. 6103.46 N·m

58. A power screw has lead 8 mm, input torque 6853 N·m, and raising efficiency 0.32. What axial load can it raise?

- A. 861.17 kN
- B. 2583.52 kN
- C. 1722.35 kN
- D. 3444.69 kN

59. A 19-tooth pinion rotating at 35800 rpm drives a 56-tooth gear. Neglecting slip, what is the gear speed?

- A. 6073.21 rpm
- B. 12146.43 rpm
- C. 23653.57 rpm
- D. 35800 rpm

60. A shaft transmits 3421 hp at 69320 rpm. Using $T(\text{in}\cdot\text{lbf}) = 63,025 \text{ hp/rpm}$, what torque is transmitted?

- A. 3110.34 in·lbf
- B. 1555.17 in·lbf
- C. 4665.5 in·lbf
- D. 6220.67 in·lbf

61. An open belt connects a 130-mm driver at 34970 rpm to a 320-mm driven pulley. Neglecting slip, what is driven speed?

- A. 7103.28 rpm
- B. 20763.44 rpm
- C. 34970 rpm
- D. 14206.56 rpm

62. A collar bearing supports 1712.0 kN at mean friction radius 0.020 m with friction coefficient 0.080. What friction torque must be overcome?

- A. 5478.4 N·m
- B. 4108.8 N·m
- C. 2739.2 N·m
- D. 5478.95 N·m

63. A power screw has lead 7 mm, input torque 6863 N·m, and raising efficiency 0.33. What axial load can it raise?

- A. 1016.44 kN
- B. 3049.31 kN
- C. 4065.74 kN
- D. 2032.87 kN

64. A 20-tooth pinion rotating at 35850 rpm drives a 58-tooth gear. Neglecting slip, what is the gear speed?

- A. 6181.03 rpm
- B. 12362.07 rpm
- C. 23487.93 rpm
- D. 35850 rpm

65. A shaft transmits 3426 hp at 69420 rpm. Using $T(\text{in}\cdot\text{lbf}) = 63,025 \text{ hp/rpm}$, what torque is transmitted?

- A. 3110.4 in·lbf
- B. 1555.2 in·lbf
- C. 4665.59 in·lbf
- D. 6220.79 in·lbf

66. An open belt connects a 125-mm driver at 35020 rpm to a 310-mm driven pulley. Neglecting slip, what is driven speed?

- A. 7060.48 rpm
- B. 14120.97 rpm
- C. 20899.03 rpm
- D. 35020 rpm

67. A lever has an effort arm of 10320 mm and a load arm of 6840 mm. Neglecting friction, what is its ideal mechanical advantage?

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

68. A 994-V DC source is applied across a 7- Ω resistive sensor circuit. Neglecting lead resistance, what current flows?

- A. 71 A
- B. 213 A
- C. 284 A
- D. 142 A

69. A thin-walled cylindrical vessel has internal pressure 343.2 MPa, inside diameter 17410 mm, and wall thickness 12 mm. What is the membrane hoop stress?

- A. 124481.5 MPa
- B. 248963 MPa
- C. 497926 MPa
- D. 124482.05 MPa

70. A linear spring has stiffness 3428 kN/m and is compressed 46 mm. What force does it exert?

- A. 157688 N
- B. 78844 N
- C. 236532 N
- D. 78844.55 N

71. An undamped single-degree system has mass 3422 kg and stiffness 1726000 N/m. What is its natural frequency in hertz?

- A. 1.79 Hz
- B. 5.36 Hz
- C. 3.57 Hz
- D. 7.15 Hz

72. A hydraulic cylinder must produce 1714.5 kN using a piston area of 34950 mm². Neglecting losses, what gauge pressure is required?

- A. 24.53 MPa
- B. 24.94 MPa
- C. 98.11 MPa
- D. 49.06 MPa

73. A simply supported beam of span 2.6 m carries a central point load of 3424 kN. What is the maximum bending moment?

- A. 2225.6 kN·m
- B. 4451.2 kN·m
- C. 1112.8 kN·m
- D. 1316.92 kN·m

74. A lever has an effort arm of 10341 mm and a load arm of 6854 mm. Neglecting friction, what is its ideal mechanical advantage?

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

75. A 996-V DC source is applied across a 9-Ω resistive sensor circuit. Neglecting lead resistance, what current flows?

- A. 55.33 A
- B. 110.67 A
- C. 166 A
- D. 221.33 A

76. A thin-walled cylindrical vessel has internal pressure 343.9 MPa, inside diameter 17445 mm, and wall thickness 13 mm. What is the membrane hoop stress?

- A. 115371.84 MPa
- B. 461487.35 MPa
- C. 230743.67 MPa
- D. 115372.39 MPa

77. A linear spring has stiffness 3435 kN/m and is compressed 44 mm. What force does it exert?

- A. 75570 N
- B. 226710 N
- C. 151140 N
- D. 75570.55 N

78. An undamped single-degree system has mass 3429 kg and stiffness 1729500 N/m. What is its natural frequency in hertz?

- A. 1.79 Hz
- B. 3.57 Hz
- C. 5.36 Hz
- D. 7.15 Hz

79. A hydraulic cylinder must produce 1718.0 kN using a piston area of 35020 mm². Neglecting losses, what gauge pressure is required?

- A. 49.06 MPa
- B. 24.53 MPa
- C. 24.94 MPa
- D. 98.12 MPa

80. A simply supported beam of span 2.5 m carries a central point load of 3431 kN. What is the maximum bending moment?

- A. 4288.75 kN·m
- B. 1072.19 kN·m
- C. 1372.4 kN·m
- D. 2144.38 kN·m

81. A lever has an effort arm of 10362 mm and a load arm of 6868 mm. Neglecting friction, what is its ideal mechanical advantage?

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

82. A 998-V DC source is applied across a 6- Ω resistive sensor circuit. Neglecting lead resistance, what current flows?

- A. 166.33 A
- B. 83.17 A
- C. 249.5 A
- D. 332.67 A

83. A thin-walled cylindrical vessel has internal pressure 344.6 MPa, inside diameter 17480 mm, and wall thickness 14 mm. What is the membrane hoop stress?

- A. 107564.43 MPa
- B. 430257.71 MPa
- C. 215128.86 MPa
- D. 107564.98 MPa

84. A linear spring has stiffness 3442 kN/m and is compressed 42 mm. What force does it exert?

- A. 72282 N
- B. 216846 N
- C. 72282.55 N
- D. 144564 N

85. An undamped single-degree system has mass 3436 kg and stiffness 1733000 N/m. What is its natural frequency in hertz?

- A. 1.79 Hz
- B. 5.36 Hz
- C. 3.57 Hz
- D. 7.15 Hz

86. A hydraulic cylinder must produce 1721.5 kN using a piston area of 35090 mm². Neglecting losses, what gauge pressure is required?

- A. 24.53 MPa
- B. 49.06 MPa
- C. 24.94 MPa
- D. 98.12 MPa

87. A simply supported beam of span 2.4 m carries a central point load of 3438 kN. What is the maximum bending moment?

- A. 2062.8 kN·m
- B. 4125.6 kN·m
- C. 1031.4 kN·m
- D. 1432.5 kN·m

88. A lever has an effort arm of 10383 mm and a load arm of 6882 mm. Neglecting friction, what is its ideal mechanical advantage?

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

89. A 1000-V DC source is applied across a 8- Ω resistive sensor circuit. Neglecting lead resistance, what current flows?

- A. 125 A
- B. 62.5 A
- C. 187.5 A
- D. 250 A

90. A mating hole measures 3425.05 mm and its shaft measures 3424.98 mm. What diametral clearance exists?

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

91. Inspection accepts 17485 of 17505 manufactured parts. What is the observed percent yield?

- A. 49.94 %
- B. 149.83 %
- C. 99.89 %
- D. 100.11 %

92. A machining operation reduces a diameter from 3434 mm to 3430 mm. What percent reduction in diameter occurs?

- A. 0.39 %
- B. 0.17 %
- C. 0.23 %
- D. 0.12 %

93. Four repeated measurements are 84.05, 84.01, 84.04, and 84.02 mm. What is their arithmetic mean?

- A. 84.03 mm
- B. 42.02 mm
- C. 336.12 mm
- D. 84.05 mm

94. A mating hole measures 3429.06 mm and its shaft measures 3428.98 mm. What diametral clearance exists?

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

95. Inspection accepts 17505 of 17525 manufactured parts. What is the observed percent yield?

- A. 49.94 %

- B. 149.83 %
- C. 99.89 %
- D. 100.11 %

96. A machining operation reduces a diameter from 3438 mm to 3434 mm. What percent reduction in diameter occurs?

- A. 0.39 %
- B. 0.12 %
- C. 0.17 %
- D. 0.23 %

97. Four repeated measurements are 84.09, 84.05, 84.08, and 84.06 mm. What is their arithmetic mean?

- A. 42.03 mm
- B. 84.07 mm
- C. 336.28 mm
- D. 84.09 mm

98. A mating hole measures 3433.04 mm and its shaft measures 3432.98 mm. What diametral clearance exists?

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

99. Inspection accepts 17525 of 17545 manufactured parts. What is the observed percent yield?

- A. 49.94 %
- B. 149.83 %

- C. 99.89 %
- D. 100.11 %

100. A machining operation reduces a diameter from 3442 mm to 3438 mm. What percent reduction in diameter occurs?

- A. 0.12 %
- B. 0.39 %
- C. 0.17 %
- D. 0.23 %

Practice Exam 21: 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 137748.84 \$/unit. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents

2. 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

3. A — A — Length conversion requires multiplying inches by 25.4 millimeters per inch so the inch unit cancels and millimeters remain. Substitution gives 43408.6 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 35221747.14 \$/year. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis

5. 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 137908.84 \$/unit. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents

- 6. 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
- 7. D — D —** Length conversion requires multiplying inches by 25.4 millimeters per inch so the inch unit cancels and millimeters remain. Substitution gives 43459.4 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 30889303.75 \$/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 138068.84 \$/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 3.96 . 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 43510.2 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 41279545 \$/year. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis
- 13. 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 138228.84 \$/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 3.96 . Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis prevents a numerically

15. A — A — Length conversion requires multiplying inches by 25.4 millimeters per inch so the inch unit cancels and millimeters remain. Substitution gives 43561 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 35462964.29 \$/year. Keeping the calculation consistent with the stated units identifies the keyed option. Checking units and the stated design basis

17. D — D — 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 394.24 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

18. A — A — 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 2496.35 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load

19. 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 0.03 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving

20. C — C — Elastic axial elongation follows $\Delta L = \frac{PL}{AE}$. Consistent newton and millimeter units make the modulus directly usable in megapascals. Substitution gives 135.55 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,

21. 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

22. D — D — Euler buckling for a pin-ended column uses effective length equal to actual length, giving $P = \frac{\pi^2 EI}{L^2}$. Substitution gives 90.21 kN. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path,

23. 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 6677.04 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,

- 24. 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
- 25. 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 394.25 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load
- 26. A — A —** 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 1803.18 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load
- 27. C — C —** 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 0.03 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving
- 28. D — D —** Elastic axial elongation follows $\frac{PL}{AE}$. Consistent newton and millimeter units make the modulus directly usable in megapascals. Substitution gives 135.87 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,
- 29. 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
- 30. C — C —** Euler buckling for a pin-ended column uses effective length equal to actual length, giving $\frac{\pi^2 EI}{L^2}$. Substitution gives 90 kN. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path,
- 31. 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 6692.53 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,
- 32. 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

- 33. 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 394.26 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load
- 34. 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 2239.47 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load
- 35. 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 0.03 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving
- 36. D — D —** Elastic axial elongation follows $\frac{PL}{AE}$. Consistent newton and millimeter units make the modulus directly usable in megapascals. Substitution gives 136.19 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,
- 37. D — D —** 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
- 38. B — B —** Euler buckling for a pin-ended column uses effective length equal to actual length, giving $\frac{\pi^2 EI}{L^2}$. Substitution gives 89.8 kN. Keeping the calculation consistent with the stated units identifies the keyed option. The competing choices represent common errors involving geometry, load path,
- 39. 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 6708.02 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,
- 40. 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
- 41. 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 11116.49 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. D — D — Average bearing stress uses the projected contact area, bolt diameter times plate thickness, rather than the bolt's circular area. Substitution gives 28591.67 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

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 10718.75 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

44. C — C — The resisting throat area is two weld lengths multiplied by the effective fillet throat, 0.707 times leg size. Substitution gives 50.22 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. 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 8521.01 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. B — B — Average bearing stress uses the projected contact area, bolt diameter times plate thickness, rather than the bolt's circular area. Substitution gives 34350 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. A — A — Rearranging the torque-preload approximation gives preload F equal to T divided by K_d , with diameter expressed in meters. Substitution gives 10100 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. D — D — The resisting throat area is two weld lengths multiplied by the effective fillet throat, 0.707 times leg size. Substitution gives 43.94 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. 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 15166.14 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting

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 31263.64 MPa. Keeping the calculation consistent with the stated units identifies the keyed option. Connection calculations must use the actual load path and the resisting area specified

51. C — C — Rearranging the torque-preload approximation gives preload F equal to T divided by K_d , with diameter expressed in meters. Substitution gives 9550 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. B — B — The resisting throat area is two weld lengths multiplied by the effective fillet throat, 0.707 times leg size. Substitution gives 58.59 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. 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 11155.46 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. C — C — For an external gear pair, pitch-line velocity is equal, so rotational speed is inversely proportional to tooth count. Substitution gives 11916.67 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 3110.28 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 13968 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 3051.46 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. C — C — 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 1722.35 kN. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the

59. B — B — For an external gear pair, pitch-line velocity is equal, so rotational speed is inversely proportional to tooth count. Substitution gives 12146.43 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. 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 3110.34 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. D — D —** 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 14206.56 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 2739.2 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
- 63. D — D —** 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 2032.87 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 12362.07 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 3110.4 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. B — B —** 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 14120.97 rpm. Keeping the calculation consistent with the stated units identifies the keyed option. A dimensional check and a comparison with the operating relationship
- 67. 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,
- 68. 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 142 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 248963 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. 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 157688 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. 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 3.57 Hz. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied

72. D — D — Hydraulic pressure equals force divided by piston area. Newtons per square millimeter are numerically megapascals. Substitution gives 49.06 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

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 2225.6 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 1.51. 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 110.67 A. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding, because premature

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 230743.67 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. 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 151140 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. 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 3.57 Hz. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied

79. A — A — Hydraulic pressure equals force divided by piston area. Newtons per square millimeter are numerically megapascals. Substitution gives 49.06 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. 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 2144.38 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 1.51. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding,

82. 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 166.33 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 215128.86 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

84. 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 144564 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. 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 3.57 Hz. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied

86. B — B — Hydraulic pressure equals force divided by piston area. Newtons per square millimeter are numerically megapascals. Substitution gives 49.06 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

87. 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 2062.8 kN·m. Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before

88. 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 1.51 . Keeping the calculation consistent with the stated units identifies the keyed option. The governing component relation must be applied before rounding,

89. 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 125 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. 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,

91. 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 99.89 %. 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 0.12 %. 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. A — A — 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 84.03 mm. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units,

94. 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,

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 99.89 %. Keeping the calculation consistent with the stated units identifies the keyed option. The result should also be checked against units, manufacturing intent,

96. B — B — Percent reduction uses the original dimension as the reference denominator, after determining the absolute decrease. Substitution gives 0.12 %. 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 84.07 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 0.06 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 99.89 %. 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 0.12 %. 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