

MDSP REFRESHER COURSE

MACHINE DESIGN & S.

MDSP REFRESHER 1.1

- What is the tensile load if a $\frac{1}{2}'' \times 4'' \times 12'$ steel tie rod experience an 80°F temperature decrease from no stress temperature?
 A. 31200 lb (C) C. 42400 lb (C)
 B. 23000 lb (C) D. 23400 lb (C)
- Compute the force that is required to punch a $\frac{1}{4}$ inch hole in the 3/8-inch thick plate. Note: Plate's has ultimate shearing strength of 50,000 psi.
 A. 45,000 lb C. 44,500 kg
 B. 20,045 kg D. 34,500 lb
- The process of forming metal parts by the use of dies after the metal is heated to its plastic range.
 A. rolling C. forging
 B. turning D. casting
- The total weight of a steel plate's size $\frac{3}{4}'' \times 3' \times 20$ ft is
 A. 1838 kg C. 8.2 kN
 B. 1698 lbs. D. 1.848 tons
- A manganese steel containing approximately 0.20% carbon.
 A. SAE 1320 C. SAE 1230
 B. SAE 2340 D. SAE 4230
- The limiting stress for a threaded bolt material at 12-mm root diameter is 400 Mpa. Calculate the maximum load that can be safely supported by the bolt.
 A. 45.2 kN C. 44.7 kN
 B. 39.6 kN D. 38.2 kN
- Determine the minimum mean diameter of a taper pin for use to fix lever to a shaft if it transmits a max torque of 700 in-lbs. The shaft diameter is 50.8 mm and the material allowable stress is 15000 psi and a factor of safety of 2 is to be used.
 A. 7.0 mm C. 0.54 inch
 B. 0.24 inch D. 6.2 cm
- Calculate the torque needed for a 2.0-m diameter flywheel of mass of 350 kg if it is accelerated at 120 per minute in one second.
 A. 2.2 kN-m C. 4.3 kN-m
 B. 36.65 kN-m D. 13.2 kN-m
- Heating to some 100°F above the transformation range with subsequent cooling to below that range in still air at room temperature to produce uniform structure of the metal
 A. Annealing C. Hardening
 B. Normalizing D. Tempering
- Calculate the elongation of a steel bar supporting a load of 15,000 lbs if its cross-sectional area is $\frac{1}{2}$ square inch and a length of 10 ft.
 A. 1.2 in C. 0.304 cm
 B. 0.12 ft D. 2.54 mm
- If the cross-sectional areal of a column is 144 sq ft and the compressive stress cannot exceed 200 lb/in^2 , compute the maximum load that can be applied on the column.
 A. 20 kips C. 22 kips
 B. 28.8 kips D. 30 kips
- What is the decrease in height of a steel member if the tensile design load is 31.14 kN. Assume a safety factor of 5 based on an ultimate strength of 60,000 psi.
 A. 0.9872 in. C. 0.7566 in.
 B. 21.89 mm D. 0.8618 cm
- A 76.2 mm diameter shafting of SAE 1040 grade cold rolled, having a yield point of 50 ksi and with a $\frac{3}{4}'' \times \frac{3}{4}'' \times 5$ inches key. Compute the minimum yield point in the key in order to transmit the torque of the shaft. The factor of safety to used is 2 and $Sys = 0.5Sys$.
 A. 39.120 ksi C. 279.20 ksi
 B. 42.130 ksi D. 47.120 ksi

critical speed: $N = 4,370,000 \frac{(l)}{L^2}$

- The ability of metal to be deformed considerably without rupture.
 A. Ductility C. plasticity
 B. Malleability D. elasticity
- Calculate torsional deflection in degrees of a 110 mm diameter shaft material that is 1.4 m long subjected to a twisting moment of $3 \times 10^6 \text{ N-mm}$.
 A. 0.2 C. 0.20
 B. 0.36 D. 0.27
- The specimen for material testing is a cube with measured edge 50 mm each. When 25 Mpa pressure was applied to the sample then change in volume was observed. Calculate decrease in volume if Bulk modulus of the material is given to be 125 Gpa.
 A. 25 mm³ C. 30 mm³
 B. 15 mm³ D. 40 mm³

$$K = \frac{\Delta P}{\Delta V}$$
- Compute the angle required in degrees, for the road to be slanted to prevent an automobile travelling at 25 m/s from tending to slip. The radius of curvature is 200 m.
 A. 21 C. 18
 B. 14 D. 16
- A type of bolt intended for use in bolting wooden parts together or wood to metal. It has a short portion of shank just underneath a round head, which is designed to keep the bolt from turning in the wood when the nut is tightened.
 A. U-bolt C. Carriage bolt
 B. Eye bolt D. Stud bolt
- Compute the cutting speed in fpm of a workpiece with 50.8 mm diameter and running at 100 rpm?
 A. 72 C. 62
 B. 102 D. 52
- A steel specimen is subjected to a tensile force F of 400 kips. If the poison ratio is 0.29, calculate the dilatation considering that the and the modulus of elasticity E, is given to be 2.8×10^{10} (raise to 7) psi, find the dilatation if the specimen radius is 10 inches.
 A. 6.5×10^{-5} in C. 7.65×10^{-4} in
 B. 7.65×10^{-3} in D. 65 in
- A multiple disk clutch with maximum permissible pressure of 320 kPa, a coefficient of friction is 0.25 and operating force of 1.5 kN. Calculate the inside diameter of the contact surfaces if the outside diameter is given to be 120 mm.
 A. 92 mm C. 82 mm
 B. 86 mm D. 70 mm
- The number of teeth per inch of pitch diameter and which gives some indications of the size of the gear teeth.
 A. Module C. pitch circle
 B. diametral pitch D. circular pitch
- A liquid bucket of height 1.2 m, half-full is to be rotated in the vertical plane. What minimum angular velocity in radian/sec is needed to keep the liquid no spilling out if the rotating arm is 1.2 meters?
 A. 2.26 C. 1.10
 B. 25.6 D. 2.86
- The angle made by the helix of the thread (in a straight thread) a the pitch diameter with a plane perpendicular to the axis called:
 A. angle of thread C. lead angle
 B. truncation D. lead
- A motor-pulley system lifts 1000 kg load to a height of 10 m in about 15 seconds. What is the efficiency of the system if 10-hp motor is used to drive the pulley?
 A. 85% C. 88%
 B. 95% D. 92%
- The operation of cooling a heated piece of work rapidly by dipping it in water, brine or oil.
 A. quenching C. tempering
 B. normalizing D. annealing

$$T_{max} = \frac{1}{2} (\theta_{max} - \theta_{min})$$

principal $\rightarrow \Theta$

$$F_{cr} = \frac{\pi^2 EI}{(KL)^2}, I = Ak^3$$

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27. A link has a load factor of 0.8 the surface factor of 0.8; the surface factor is 0.92 and the endurance strength is 28 ksi. Compute the alternating stress of the link if it is subjected to a reversing load. Assume a factor of safety of 3.
- A. 8150
B. 10920
C. 9,333
D. 7260
28. Compute the speed a satellite must have to orbit the earth at an elevation of 100 km. Earth's radius is at 6400 km. Assume no change of gravity with the elevation
- A. 6320 m/s
B. 7120 m/s
C. 8740 m/s
D. 7920 m/s
29. The total permissible variation in the size of a dimension; the difference between the limits of size
- A. Allowance
B. Variance
C. Tolerance
D. interface
30. What is the approximate load in kN on a 2.5 cm diameter, 3.937 ft long steel shaft if its maximum elongation exceeds 1 mm.
- A. 85
B. 125
C. 103
D. 93
31. An elevator weighing 2000 lbs. is moving vertically upward with an acceleration of 3 ft/sec². A man standing in said elevator weighs 180 lbs. Compute the tension in the supporting cable under this condition
- A. 2180 lbs
B. 10.43 kN
C. 1820 lbs
D. 2366 kg
32. An elevator weighing 2000 lbs. is moving vertically upward with an acceleration of 1.5 ft/sec². Compute the work exerted against the gravity if the constant frictional force of 10 lbs exists on the elevator system as it travelled a total distance of 100 ft
- A. 20,000 ft-lb
B. 19,900 ft-lb
C. 1000 ft-lb
D. 201,000 ft-lb
33. The process of checking or producing checkers on the surface of a piece by rolling checkered depressions into the surface
- A. knurling
B. breading
C. hemming
D. embossing
34. A copper column of annular cross section has an outer diameter of 15 ft and is subjected to a force of 45 kips. The allowable compressive stress is 300 lb/ft². What should be the wall thickness?
- A. 3
B. 3.52
C. 4.59
D. 5.03
35. High strength steel band saw, 20 mm wide and 0.8 mm thick runs over the pulley 600 mm in diameter. Compute the minimum diameter of pulleys can be used without exceeding the flexural stress of 400 MPa.
- A. 400 mm
B. 200 mm
C. 300 mm
D. 100 mm
36. Compute the elongation of an aluminum bar 1.2 m long that is subjected to a tensile stress of 175 Mpa. Note: Modulus of Elasticity of Aluminum is 70 Gpa.
- A. 4.0 mm
B. 3.0 mm
C. 5.2 mm
D. 7.1 mm
37. Steel balls for ball bearings are manufactured by:
- A. Turning
B. Casting
C. rolling
D. cold heading
38. The power needed to lift a 6000-lb load by means of a hoist is 50 hp. The lifting is done using a cable that is wrapped around a drum rotating at 30 rpm. What is the diameter of the drum?
- A. 40 in
B. 28 in.
C. 37 in.
D. 35 in.
39. The pitch radii of two gears A and B used to connect two shafts are 5 inches and 25 inches respectively. What is the speed reduction factor if shaft A rotates 600 rpm and is subjected to a twisting moment of 1200 inch-pound?
- A. 5
B. 4
C. 3
D. 25
40. A horizontal beam 16 ft long is subjected to a load of 500 lb located to its center. The dimension of the beam is 2 x 4 inches respectively and its unit weight is 100 lb/ft. Compute its flexural stress.
- A. 80.62 Mpa
I = $\frac{\pi r^4}{4}$ Area at moment $D_1 \times r$
B. 79.5 MPA
41. Given the modulus of elasticity ($E = 207$ Gpa) and Poisson's ratio ($\mu = 0.28$), calculate the modulus of elasticity(G).
- A. 83.5 Gpa
B. 81.4 Gpa
C. 80.8 Gpa
D. 82.9 Gpa
42. A railroad track is laid at a temperature of 10°F with gaps of 0.01 feet between the ends of the rails. The rails are 33 feet long. If they are prevented from buckling, what stress will result from a temperature of 110°F?
- A. 10,000 psi
B. 9,450 psi
C. 8,530 psi
D. 10409 psi
43. A tensile stress of 7000 psi is developed in the straight shank of a $\frac{1}{2}$ in. diameter bolt that is used to secure two pieces of wood. If there are washers employed at both the head and nut, what is the approximate area of the washers considering that the allowable bearing stress in the wood is 95 psi?
- A. 12.2 sq. in
B. 14.5 sq. in
C. 11.7 sq. in
D. 10.1 sq. in
44. Joining metal by means of high current at low voltage. During the passage of current, pressure by the electrodes produces a forge weld.
- A. spot welding
B. steam welding
C. resistance welding
D. gas welding
45. A tensile stress of 8 ksi and a shear stress of 4 ksi are induced in a brittle material whose working strength in straight tension is 10000 psi what is the maximum tensile stress?
- A. 6000 psi
B. 4590 psi
C. 9656 psi
D. 5048 psi
46. A 1.0-m long shaft is being tapered at 6 mm per meter over a length of 500 mm at one end. Calculate the bigger diameter if the minimum diameter is 87 mm.
- A. 82 mm
B. 90 mm
C. 70 mm
D. 65 mm
47. A steel bar 24 in. in length is to withstand a tensile impact load caused by a weight of 100 lb having a velocity of 140 fpm. Find the stress in the bar if the diameter is 1 1/2 in.
- A. 12 ksi
B. 11 ksi
C. 10,000 psi
D. 15 N
48. If the critical load for the valve push for an overhead valve engine is 380 lbs, calculate the steel valve engine diameter if its length is 1 ft?
- A. 1/4 in
B. 1/32 in
C. 1/12 in
D. 1/8 in
49. Two masses of 100 kg are suspended by wires that are five mm in diameter. One wire is of aluminum and the other is of steel. The wires are ten meters long. How much lower will the mass held by the aluminum wire be?
- A. 4.37 mm
B. 2.37 mm
C. 487 mm
D. 4.54 mm
50. A hoist with a 120-hp engine is capable of lifting a 17,000 load to a height of 25 ft in 30 seconds. Calculate the efficiency of this machine.
- A. 21.48 %
B. 23.44 %
C. 35.42 %
D. 40.23 %

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51. A tensile stress of 6 ksi and a shear stress of 4 ksi are induced in a brittle material whose working strength in straight tension is 10 ksi what is the maximum tensile stress?
 A. 6000 psi
 B. 11400 psi
 C. 8000 psi
 D. 9656 psi
52. A steel railroad rails 10 m long are laid with clearance of 3 mm at a temperature of 15°C. Calculate at what temperature will the rails just touch if there were no initial clearance?
 A. 40.64°C
 B. 23.45°C
 C. 34.56°C
 D. 45.43°C
53. A steel bar, initially free of stress, is held between rigid supports. Calculate the stress in the bar if the temperature drops 110°F.
 A. 147.85 Mpa
 B. 213.57 Mpa
 C. 54,350 psi
 D. 25.54 ksi
54. A hand tool used to measure engine crank web deflections.
 A. distortion gage
 B. line center gage
 C. feeler gage
 D. deflection gage
55. During inspection, gaps of 0.012 ft were found between the ends of the rails of the railroad track laid at a temperature of 15°F. During possible expansion the rails must be prevented from buckling. Compute the resulting stress at 110 deg F if the original length of the rails is 35 ft.
 A. 7350 psi
 B. 7720 psi
 C. 8205 psi
 D. 8228 psi
56. A rigidly built-in cantilever has cross-section of $\frac{1}{2}$ in deep, 3/8 inches wide, and is loaded 1 foot from the support. Determine the bending stress in the beam assuming that a load of 8 lb is applied gradually.
 A. 6150 psi
 B. 3245 psi
 C. 1560 psi
 D. 5430 psi
57. An elevator weighing 2000 lbs. is moving vertically upward with an acceleration of 1.5 ft/sec². If there are 210,317.2 ft-lb of work that is within the elevator system, compute the distance travelled by the elevator considering that the friction is said to be constant at 10 lbs.
 A. 2,000 ft
 B. 19,900 ft-lb
 C. 100 ft
 D. 201,000 ft-lb
58. A material that can wear away a substance softer than itself.
 A. abrasive
 B. tungsten
 C. corrosive
 D. alloy
59. A tensile stress of 8000 psi and a shear stress of 6000 psi are induced in a brittle material whose working strength in straight tension is 10000 psi what is the maximum tensile stress?
 A. 8 000 psi
 B. 11 400 psi
 C. 11 211 psi
 D. 10 876 psi
60. A short cylindrical cast-iron post supports a compressive load of 15 tons. Compressive stress is equal to 85 ksi and the factor of safety of 12. Compute the post diameter if the slenderness ratio is to be neglected and it is also assumed that there is no buckling.
 A. 59 mm
 B. 77 mm
 C. 4.54 inch
 D. 7.45 inch
61. A 1-in. diameter circular shaft is subjected to a shearing stress that is not to exceed 55.143 Mpa, calculate the maximum allowable torque.
 A. 140.50 ft-lb
 B. 1570 in-lb
 C. 167.65 ft-lb
 D. 1430 in-lb

62. The process of working metals by the application of sudden blows or by steady pressure.
 A. Welding
 B. forging
 C. extrusion
 D. swaging
63. An 8-in long steel has a cross-section area of 0.25 in². After a load of 5 kips has been applied the length is found to be 8.0065 in. What is the unit deformation induced?
 A. 0.00081
 B. 0.4100
 C. 0.00041
 D. 0.8100
64. What minimum distance can a truck side on a horizontal asphalt road if it is travelling 25 m/s? The coefficient of sliding friction between asphalt and rubber tire is at 0.6. the weight of the truck is 8500 kg.
 A. 44.9
 B. 58.5
 C. 53.2
 D. 63.8
65. Find the pressure required to punch a hole, 2.0-inch diameter, through a 1/4 inch thick steel?
 A. 40 tons
 B. 25 tons
 C. 20 tons
 D. 80 tons
66. The mass of a flywheel is 175 kg and its radius of gyration is 380 mm. Find the torque required to attain a speed of 500 rpm from rest in 30 seconds.
 A. 40.46 N-m
 B. 35.66 N-m
 C. 44.12 N-m
 D. 38.48 N-m
67. Height of tooth above pitch circle or the radial distance between pitch circle and top land of the tooth.
 A. top root
 B. addendum
 C. land
 D. hunting tooth
68. What load P which cause a total deformation of 0.036 inch of a steel rack which has a cross-sectional area of 4 sq. inches and a length of 6 ft.
 A. 55 kips
 B. 40 kips
 C. 60 kips
 D. 50 kips
69. A tie-bar of rectangular section 150 mm broad by 25 mm thick is subjected to a pull of 300 kN applied at 5 mm off the center of the thickness of the section. Calculate the maximum stress induced at the outer skin.
 A. 167 MPa
 B. 175 MPa
 C. 156 MPa
 D. 176 MPa
70. A machine tool used to machine flat surfaces.
 A. shaper
 B. Grinder
 C. planer
 D. Lathe
71. Given the modulus of elasticity 30 x 10 (raised to 6) psi (steel) and Poisson's ratio of 0.28 calculate the shear modulus of elasticity.
 A. 11.7 x 10 (raised to 6) psi
 B. 10.45 x 10 (raised to 6) psi
 C. 12.45 x 10 (raised to 6) psi
 D. 9.45 x 10 (raised to 5) psi
72. A machine tool in which an abrasive wheel is used as a cutting tool to obtain a very smooth finish.
 A. Broaching Machine
 B. Tool Grinder
 C. Planer
 D. Milling Machine
73. A 6 inches pulley is fastened to a 1 1/4-in shaft by a set screw. If a net tangential force of 75 lb is applied to the surface of the pulley, what is the holding force when the load is steady and Factor of safety (N = 3)?
 A. 2054 lbf
 B. 1080 lbf
 C. 2056 lbf
 D. 1456 lbf
74. A kind of gear used to transmit motion from one shaft to another shaft at an angle to the first.
 A. worm gear
 B. helical gear
 C. bevel gear
 D. spur gear

75. A horizontal shaft of 1-in. in diameter rotates at 500 rpm in a sleeve-type bearing. The coefficient of friction is 0.15. If the reaction between the shaft and the bearing is 800 lbs, compute the horsepower lost in the bearing.
 A. 0.48
 B. 0.54
 C. 0.78
 D. 0.43
76. A circle coinciding with a tangent to the bottom of the tooth spaces.
 A. pitch circle
 B. base circle
 C. root circle
 D. outside circle
77. A flywheel weighing 2031.75 kg has a radius of gyration of 3 feet. If there is a driving torque of 800 lb-ft and a resisting torque of 220 lb-ft, calculate the time required to increase its speed from 40 rpm to 80 rpm.
 A. 10.92 s
 B. 9.04 s
 C. 22.5 s
 D. 3.45 s
78. The maximum steam pressure of 120 psi is occurring in a 1-ft diameter cast iron steam engine cylinder. Assuming a varying load condition (with a factor of safety of 8), calculate the thickness of the cylinder wall if its ultimate stress is 20 ksi.
 A. 0.36 in
 B. 0.29 in
 C. 13.54 mm
 D. 7.45 cm
79. A flanged bolt coupling has ten (10) steel 25.4 mm diameter bolts evenly tighten around a 415 mm bolt circle. Determine the torque capacity of the connection if the allowable shearing stress in the bolt is 50 MN/m².
 A. 59.95 KN-m
 B. 52.6 KN-m
 C. 46.15 KN-m
 D. 43.8 KN-m
80. A 6.098 m steel line shaft has bending action of pulleys. What power in hp can the shaft deliver at a speed of 360 rpm. Consider that the torsional deflection will not exceed 0.08 deg. per ft length.
 A. 2600
 B. 1200
 C. 1250
 D. 900
81. A welding operation in which a non-ferrous filler metal melts at a temperature below that of the metal joined but is heated above 450°C.
 A. arc welding
 B. spot welding
 C. brazing
 D. butt welding
82. Compute the polar section modulus of a solid shaft with a diameter of 4 inches.
 A. 209.5 cm³
 B. 205.9 cm³
 C. 209.5 cm⁴
 D. 205.9 cm⁴
83. The process of working metals by the application of sudden blows or by a steady pressure.
 A. Trimming
 B. forging
 C. welding
 D. lancing
84. A keyed sprocket deliver a torque of 778 Nm thru the shaft of 54 mm OD. The key thickness is 1.5875 cm and the width is 1.11 cm compute the length of the same key. The permissible stress value of 60 MPa for shear and 90 MPa for tension
 A. 39.12 cm
 B. 4.82 cm
 C. 52.22 cm
 D. 4.32 cm
85. A property of material which relates the lateral strains to the longitudinal strain.
 A. Rigidity
 B. Poisson's ratio
 C. Elasticity
 D. Deflection
86. Find the pressure required to punch a hole, 1.75-inch diameter, through a 1/4 inch thick brass?
 A. 28.4 tons
 B. 35 tons
 C. 40 tons
 D. 22.5 tons
87. A steel has a BHN = 300. What is its approximate ultimate strength in ksi?
 A. 300 ksi
 B. 75 ksi
 C. 150 ksi
 D. 200 ksi
88. The maximum stress induced in a material when subjected to alternating or repeated loading without causing failure.
 A. elastic limit
 B. rupture strength
 C. proportional limit
 D. endurance limit
89. Compute the diameter of a solid shaft transmitting 75 Hp at 1800 rpm. The nature of the load and the type of service is such that the allowable Ss based on pure torsion is 6000 psi
 A. 1 7/8"
 B. 2 1/16"
 C. 1 5/16"
 D. 3 1/8"
90. A coating material used to produce galvanized iron.
 A. Zirconium
 B. Aluminum
 C. zinc
 D. chromium
91. A hollow iron pipe to be designed as a column has an outside diameter of 240 mm and is subjected to a force of 80 KN. Find the pipe thickness if the compressive stress is limited to 16 MPa
 A. 5.85 mm
 B. 7.85 mm
 C. 6.85 mm
 D. 8.85 mm
92. A uniform beam 12 meters long is fixed at one end. It has a uniform weight of 50 kg/m along its length. A load of 20 kgs. is suspended on the beam 8 m from the free end. The moment at the fixed end is:
 A. 3760 kg-m
 B. 60 kg-m
 C. 0.0 kg-m
 D. 4800 kg-m
93. Ratio of pitch diameter to the number of teeth.
 A. diamteral pitch
 B. contact ratio
 C. module
 D. helical overlap
94. Two barges, one weighing 10 tons, the other weighing 20 tons are connected by a cable in quiet water. Initially the barges are at rest 100 feet apart. The cable is reeled in until the barges are 50 feet apart. If the friction is negligible, calculate the distance moved by the 10 ton barge.
 A. 33.3 ft
 B. 55.5 ft
 C. 44.4 ft
 D. 22.2 ft
95. What load in N must be applied to a 25 mm round steel bar 2.5 m long to stretch the bar 1.3 mm?
 A. 42 000 N
 B. 53 000 N
 C. 52 840 N
 D. 60 000 N
96. What is the decrease in height of a steel member if the tensile design load is 7 kips? Note: Assume a safety factor of 5 based on an ultimate strength of 60 ksi.
 A. 0.9872 in.
 B. 0.4322 in.
 C. 0.7566 in.
 D. 0.8618 in.
97. The maximum stress to which a material can be subjected without a trace of any permanent set remaining upon a complete withdrawal of the stress.
 A. ultimate limit
 B. endurance limit
 C. proportional limit
 D. elastic limit
98. Determine the Poisson's ratio of a material whose modulus of elasticity is 200 GPa and whose modulus of rigidity is 80 GPa.
 A. 0.33
 B. 0.38
 C. 0.25
 D. 0.22
99. A body weighing 1.5 lb hangs at the end of the spring and is slightly displaced and released. What is the approximate frequency of vibration given the spring constant of 20 lb/in.
 A. 4.66 Hz
 B. 3.29 Hz
 C. 1.45 Hz
 D. 3.45 Hz
100. A machining operation whereby the tool reciprocates and the feed is stationary is called:
 A. Shaping
 B. Planning
 C. reaming
 D. turning

MDSP 3.1

1. The root diameter of a double square thread is 0.55 in. The screw has a pitch of 5.08 mm. Compute the number of threads per inch.
 A. 4 C. 2
 B. 5 D. 10
2. The rocker arm is used to actuate the inlet and exhaust valves motion as directed by the:
 A. cam and follower C. crank
 B. crankshaft D. none of these
3. The shaft's nominal diameter is 35 mm. Calculate the shaft's tolerance given that its diameter has tolerance range of 34.91 mm to 35.12 mm?
 A. 0.03 C. 0.01
 B. 0.21 D. 0.32
4. The length of the piston usually varies between:
 A. D and 1.5 D C. 1.5 D to 2 D
 B. 2D and 2.5 D D. 2.5D and 3 D
5. A wheel accelerates from rest at 5 radian/s². Compute how many revolutions made in 4 seconds?
 A. 5.71 rev C. 7.00 rev
 B. 6.36 rev D. 20.00 rev
6. For high speed engines, a rocker arm of _____ should be used.
 A. Rectangular section C. I-section
 B. T-section D. circular
7. Calculate the curve correction factor of a helical-coil spring that has a mean coil diameter of 1 inch and a wire diameter of 1/8 inch.
 A. 1.016 C. 1.32
 B. 1.114 D. 1.0625
8. Hooke's law holds good up to:
 A. Yield point C. elastic limit
 B. Plastic limit D. breaking point
9. What is the approximate deflection for a semi-elliptical single (steel) leaf spring of thickness 1/6 inch carrying a load of 90 lb at its center of the given length of 8 inches. Note: width of the leaf is 1/2 inch.
 A. 0.1658 inch C. 0.2508 inch
 B. 0.1247 inch D. 0.2132 inch
10. A localised compressive stress at the area of contact between two members is known as:
 A. Tensile stress C. bending stress
 B. Bearing stress D. shear stress
11. A 2 ton weight is lowered at a constant acceleration of 2 ft/s². If the weight is raised at the same rate of acceleration, what is the cable stress?
 A. 4248.45 lb C. 3751.55 lb
 B. 5234.7 lb D. 3751.55 lb
12. Poisson's ratio of steel varies from which of the following?
 A. 0.21 to 0.25 C. 0.25 to 0.33
 B. 0.33 to 0.38 D. 0.38 to 0.45
13. A wire rope lifts a load of 10 kips at a maximum speed of 1000 feet per minute, attained in 5 seconds starting from rest. The rope has a metallic cross-sectional area of 0.4 in². Determine the maximum tensile stress on the rope in ksi.
 A. 26.2 C. 25.0
 B. 27.6 D. 32.4
14. The stress in a bar when load is applied suddenly is _____ as compared to the stress induced due to gradually applied load.
 A. Same C. double
 B. Three times D. four times
15. Find the maximum load in kgs of an elevator having a net inside platform area of 2 m²
 A. 279.85 kgs C. 792.85 kgs
 B. 579.28 kgs D. 892.75 kgs

2.A 12.C 22.B
 4.A 14.C 23.D
 6.C 16.B 25.C
 8.C 18.A 27.C

16. In flat belt drive, the belt can be subjected to a maximum tension (T) and centrifugal tension (T_c). The condition for transmission of maximum power is given by:
 A. $T = T_c$ C. $T = 2T_c$
 B. $T = 3T_c$ D. $T = \sqrt{3} T_c$
17. Calculate the pressure that is required for punching a 1 inch by 2-inch rectangular hole in a 1/2-inch thick brass.
 A. 15.5 tons C. 32.5 tons
 B. 65 tons D. 70 tons
18. How many elevators are required if there are 1850 people are occupying the whole building other than that of the first or ground floor?
 A. 8 C. 10
 B. 9 D.
19. Two metal plates of thickness "t" and width "w" are joined by a filler weld of 45 deg. What stress induced by the pulling force "F" along the plates?
 A. $F / wt \sin 45^\circ$ C. F/wt
 B. $F \sin 45^\circ / wt$ D. $2F/wt$
20. A bolt is initially preloaded to 34 kN. What is the maximum load of the bolt used in a joint that experiences alternating tensile load from 0 kN to 12 kN a bolt? Note: the joint coefficient is 0.25.
 A. 37 kN C. 31 kN
 B. 32 kN D. 17 kN
21. A flywheel weighing 457 kg has a radius of 375 mm. How much energy, in N-m, does the flywheel loss from 3 rps to 2.8 rps?
 A. 368 C. 150
 B. 1474 D. 38
22. The helix angle for single helical gears ranges from:
 A. 10° to 15° C. 15° to 20°
 B. 20° to 35° D. 35° to 50°
23. A roller chain of given pitch 1/4 inch operates at 1200 rpm between 18 and 32 tooth sprockets. Calculate the diameter of the driven sprocket given that the center distance between sprockets is 22 inches and the chain is in normal running condition.
 A. 2.55 C. 3.24
 B. 3.20 D. 2.87
24. In a shearing machine the energy is 29,264 ft-lb, the ultimate shearing stress of the steel plate is 40,000 psi, the plate thickness is 1 inch the length of the plate which can be sheared is:
 A. 7055 in C. 10.55 in
 B. 12.75 in D. 17.56 in
25. The root angle of bevel gear is equal to:
 A. pitch angle - addendum angle
 B. pitch angle + addendum angle
 C. pitch angle - dedendum angle
 D. pitch angle + dedendum angle
26. Determine the length of belt needed for a two flat belt pulleys having a diameter of 70 cm and 30 cm. The center distance is 400 cm and pulleys rotate in same direction. Assume power transmitted is 10 hp at 200 rpm.
 A. 958 cm C. 589 cm
 B. 859 cm D. 895 cm
27. The crankshaft in an internal combustion engine
 A. is a disc which reciprocates in a cylinder
 B. is used to retain the working and guide the piston
 C. converts reciprocating motion of the piston into rotary motion and vice versa
 D. none of the above
28. A 20-kW motor, running at 1200 rpm, drives a 15.75 inch diameter pulley at a belt tension ratio of 2.4. If the belt's tight side tension is only 1200 N, determine the transmission efficiency.
 A. 87.97 % C. 84.58 %
 B. 85.66 % D. 86.55 %

29. The ratio of linear stress to linear strain is called :
 A. Modulus of elasticity C. modulus of rigidity
 B. Bulk modulus D. Poisson's ratio
30. A load of 44.5 kN is to be raised by a short jack. The screw has an outside diameter of $2\frac{1}{2}$ in and an ACME single thread of two turns per in. If the coefficient of friction is 0.2 determine the torque required to raise the load.
 A. 3166 in-lb C. 3425 in-lb
 B. 3455 in-lb D. 3213 in-lb
31. In designing connecting rod, it is considered like _____ for buckling about x-axis.
 A. Both ends fixed
 B. one end fixed and the other hinged
 C. Both ends hinged
 D. One fixed end and the other end free
32. A helical-coil spring has a mean coil diameter of 1 inch and a wire diameter of $\frac{1}{8}$ inch. Determine the value of Bergstrassar factor of the spring.
 A. 1.172 C. 1.712
 B. 1.217 D. 1.271
33. The factor of safety for steel and for steady load is usually of what value?
 A. 2 C. 4
 B. 6 D. 8
34. Compute how many $\frac{3}{8}$ inch diameter set screws required to transmit 3 Hp at a shaft speed of 1000 rpm. The shaft diameter is 25.4 mm.
 A. $1\frac{1}{2}$ C. 3
 B. 2 D. 1
35. Determine the width of a 6 ply rubber belt required for a ventilating fan running at 150 rpm driven from a 12 inch pulley on a 70 Hp at 800 rpm. The center distance between pulley is 12 ft. and the rated belt tension is 78.0 lb/in width
 A. 12" C. 10"
 B. 8" D. 15"
36. The worm gears are widely used for transmitting power at _____ velocity ratios between non-intersecting shafts.
 A. high C. medium
 B. low D. intermediate
37. Compute the effective belt pull for a belt that runs over a 30-inch pulley that rotates 150 rpm if there 10 hp transmitted.
 A. 270.3 lb C. 12.3 kN
 B. 127.12 kg D. All of these
38. A 1 m diameter wheel has 1 mm-thick ring made of cast iron and is to be shrunk into a tire. If the interference fits 0.05 mm, calculate the stress in the ring if the modulus of elasticity is 2.1×10^{11} Pa.
 A. 10.5 Mpa C. 12.5 Mpa
 B. 12.5 ksi D. 19.7 ksi
39. Compute the working strength of 1 inch bolt which is screwed up tightly in packed joint when the allowable working stress is 13000 psi.
 A. 3600 lb C. 3950 lb
 B. 3900 lb D. 3800 lb
40. The helix angle for double helical gears may be made up of up to:
 A. 45° C. 30°
 B. 75° D. 40°
41. A single square thread power screw is to raise a load of 70 kN. The screw has a major diameter of 36 mm and a pitch of 6 mm. The coefficient of thread friction and collar friction are 0.13 and 0.10 respectively. If the collar mean diameter is 90 mm and the screw turns at 60 rpm, find the axial linear speed of the screw.
 A. 5 mm/s C. 6 mm/s
 B. 7 mm/s D. 5.5 mm/s
42. When material is loaded within elastic limit, then the stress is _____ to strain.
 A. Equal C. directly proportional
 B. Inversely proportional D. any of these
43. A double thread ACME screw driven by a motor at 400 rpm raises the attached load of 900 kg at a speed of 10 m/min. The screw has a pitch diameter of 36 mm; the coefficient of friction on threads is 0.15. The friction torque on the thrust bearing of the motor is taken as 20% of the total input. Determine the lead angle.
 A. 12.465° C. 14.265°
 B. 15.462° D. 16.452°
44. The power transmitted by means of a belt depends upon
 A. Velocity of the belt
 B. Tension under which the belt is placed on the pulleys
 C. Arc of contact between the belt and the smaller pulley
 D. All of the above
45. The root diameter of a double square thread is 0.55 inch. The screw has a pitch of 0.2 inch. Find the number of threads per inch.
 A. 0.2 threads/inch C. 10 threads/inch
 B. 5 threads/inch D. 2.5 threads/inch
46. A triple thread worm has a pitch diameter of 3 inches. The wheel has 25 teeth and a pitch diameter of 5 inches. Material for both the worm and the wheel is of phosphor bronze. Compute the helix angle ($\tan \phi$)
 A. 0.20 C. 0.40
 B. 0.30 D. 14
47. The modulus of elasticity for mild steel is approximately equal to:
 A. 80 kN/m^2 C. 100 kN/m^2
 B. 110 kN/m^2 D. 210 kN/m^2
48. A single square thread power screw is to raise a load of 70 kN. The screw has a major diameter of 36 mm and a pitch of 6 mm. The coefficient of thread friction and collar friction are 0.13 and 0.10 respectively. If the collar mean diameter is 90 mm and the screw turn at 60 rpm, find the combined efficiency of the screw and collar.
 A. 15.32 % C. 12.53 %
 B. 13.52 % D. 15.97 %
49. The face angle of a bevel gear is equal to:
 A. pitch angle - addendum angle
 B. pitch angle + addendum angle
 C. pitch angle - dedendum angle
 D. pitch angle + dedendum angle
50. A pulley 600 mm in diameter transmits 40 kW at 500 rpm. The arc of contact between the belt and pulley is 155° , the coefficient of friction between belt and pulley is 0.35 and the safe working stress of the belt is 2.1 MPa. Determine the belt tensions ratio, neglecting the effect of centrifugal force.
 A. 2.578 C. 2.857
 B. 5.287 D. 5.782

MDSP 3.2

51. When a hole of diameter "d" is punched in a metal with thickness "t" then the force required to punch a hole is equal to:
 A. $d \times t \times S_u$ C. $\pi \times d \times t \times S_u$
 B. $\pi/4 \times d^2 \times S_u$ D. $\pi/4 \times d^2 \times t \times S_u$
52. A 20-tooth motor sprocket, running at 1200 rpm, drives a blower at a speed ratio of 4:1. Using the largest permissible chain size and the largest permissible center distance of 80 pitches, what length of chain in pitches is required to connect the sprockets?
 A. 200 pitches C. 212 pitches
 B. 216 pitches D. 220 pitches
53. For maximum power, the velocity of the belt will be:
 A. $\sqrt{T/m}$ C. $\sqrt{(T/3)m}$
 B. $\sqrt{T/2m}$ D. $\sqrt{2m/T}$

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54. A set screw is necessary to fasten a pulley to a 2 in. shaft while transmits 3 Hp and rotates at 150 rpm. Find the holding force if the factor of safety is 3 (for steady loading).

A. 1245 lbf
B. 3780 lbf
C. 4520 lbf
D. 3102 lbf

55. What is the frictional HP acting on a collar loaded with 100 kg weight? The collar has an outside diameter of 100 mm and an internal diameter of 40mm. The collar rotates at 1000 rpm and the coefficient of friction between the collar and the pivot surface is 0.15.

A. 0.8 HP
B. 0.5 HP
C. 0.3 HP
D. 1.2 HP

56. The tension in the slack side of the belt is _____ the tension in the tight side of the belt.

A. equal to
B. less than
C. greater than
D. exponential

57. If two parallel shafts are connected by cylinders in pure rolling contact and turning in the same direction and having a speed ratio of 2.75, what is the center distance of the two shafts assuming that the diameter of the smaller cylinder is 22 cm?

A. 18.25 cm
B. 20.25 cm
C. 19.25 cm
D. 17.25 cm

58. In worm gears, the angle between the tangent to the thread helix on the pitch cylinder and the plane normal to the axis of the worm is called:

A. pressure angle
B. helix angle
C. lead angle
D. friction angle

59. A soft surface cone clutch must handle 215 N-m of torque at 1200 rpm. The clutch large diameter is 35 cm, its face width is 7.5 cm and the coefficient of friction 0.2. If the included angle is 20° then calculate the normal force required to engage the clutch.

A. 6.38 kN
B. 2.36 kN
C. 3.45 kips
D. 1.34 kips

60. The centrifugal tension in the belt.

A. Increases the power transmitted
B. Has no effect on the power transmitted
C. Decrease the power transmitted
D. Is equal to the maximum tension on the belt

61. A soft surface cone clutch must handle 215 N-m of torque at 1200 rpm. The clutch large diameter is 35 cm, its face width is 7.5 cm and the coefficient of friction 0.2. If the included angle is 20° then calculate the axial unit pressure required when the clutch is operating its capacity with the assumption of uniform pressure.

A. 665.8 kPa
B. 462.7 kPa
C. 321.48 kPa
D. 324.54 kPa

62. The included angle for V-belt is usually of what value?

A. 10 deg to 20 deg
B. 30 deg to 40 deg
C. 20 deg to 30 deg
D. 60 deg to 80 deg

63. How long will it take to mill a 3/4" by 2" long keyway in a 3" diameter shafting with a 24 tooth cutter turning at 100 rpm and 0.005" feed/tooth?

A. 0.136 min.
B. 0.196 min.
C. 0.166 min.
D. 0.106 min.

64. Compute the cutting speed in fpm of a workpiece with 2 inches diameter and running at 100 rpm?

A. 72
B. 102
C. 62
D. 52

65. The material suitable for the belts used in agricultural equipments.

A. Cotton
B. Leather
C. Rubber
D. Balata belt

66. Calculate the cutting speed in fpm when spindle speed of a lathe is turning 8 inch diameter bronze casting using a spindle speed of 120 rpm.

A. 220 fpm
C. 2510 fpm

B. 3016 fpm
D. 251 fpm

67. The strain energy stored in a body, when suddenly loaded is _____ the strain energy stored when same load is applied gradually.

A. Equal to
B. Twice
C. one-half
D. four times

68. Calculate the rpm for machining a cast iron workpiece 6 inches in diameter. The lowest cutting speed for cast iron is 50 fpm.

A. 35.5
B. 31.8
C. 43.3
D. 53.32

69. A machine shop fabricates a pair of spur gear, 2.5 module to be mounted on shafts with a center line distance of 90 mm. The speed required is 3:1. (Use 20° pressure angle). Determine the pitch diameter.

A. 45 mm and 135 mm
B. 40 mm and 120 mm
C. 35 mm and 105 mm
D. 30 mm and 90 mm

70. A steel flywheel of 6 ft diameter has to absorb 2,400 ft-lb of energy and maintain a coefficient of fluctuation of 0.10. If the mean rim speed is 80 ft/s and the effects of the arms and hub accounts 10% of the rim weight, calculate the approximate cross-volume of the rim.

A. 386.52 cu. in.
B. 302.44 cu. in.
C. 112.43 cu. in.
D. 396.24 cu. in.

71. The casting produced by forcing molten metal under pressure into permanent metal mould is known as:

A. Permanent mould casting
B. Die casting
C. slush casting
D. centrifugal casting

72. A machine shop fabricates a pair of spur gear, 2.5 module to be mounted on shafts with a center line distance of 90 mm. The speed required is 3:1. (Use 20° pressure angle). Calculate number of teeth.

A. 18 teeth and 54 teeth
B. 16 teeth and 48 teeth
C. 10 teeth and 30 teeth
D. 12 teeth and 36 teeth

73. A machine shop fabricates a pair of spur gear, 2.5 module to be mounted on shafts, with a center line distance of 90 mm. The speed required is 3:1. (Use 20° pressure angle). Determine the circular pitch.

A. 6.540 mm/teeth
B. 7.854 mm/teeth
C. 5.405 mm/teeth
D. 3.450 mm/teeth

74. The maximum energy that can be stored in a body due to external loading up to the elastic limit.

A. Resilience
B. Strain energy
C. proof resilience
D. impact energy

75. A machine shop fabricates a pair of spur gear, 2.5 module to be mounted on shafts with a center line distance of 90 mm and a pressure angle of 20° deg. Solve for the addendum if the speed ratio is 3:1.

A. 2.5 mm
B. 1.5 mm
C. 3.0 mm
D. 2.2 mm

76. A machine shop fabricates a pair of spur gear, 2.5 module to be mounted on shafts with a center line distance of 90 mm. The speed required is 3:1. (Use 20° pressure angle). Calculate the clearance.

A. 0.564 mm
B. 0.625 mm
C. 0.405 mm
D. 0.504 mm

77. A machine shop fabricates a pair of spur gear, 2.5 module to be mounted on shafts with a center line distance of 90 mm. The speed required is 3:1. (Use 20° pressure angle). Calculate the whole depth.

A. 5.625 mm
B. 6.252 mm
C. 5.256 mm
D. 7.245 mm

78. If T is the actual number of teeth on a helical gear and ϕ is the helix angle for the teeth, the format of the number of teeth is written as:

A. $T \sec^3 \phi$
C. $T / \sec^3 \phi$

B. Tsec²

D. T csc²

79. A machine shop fabricates a pair of spur gear, 2.5 module to be mounted on shafts with a center line distance of 90 mm. The speed required is 3:1. (Use 20° pressure angle). Find the working depth.

A. 5 mm
B. 7 mm

C. 8 mm

D. 3 mm

$$Work = \frac{L}{P_d}$$

80. A machine shop fabricates a pair of spur gear, 2.5 module to be mounted on shafts with a center line distance of 90 mm. The speed required is 3:1. (Use 20° pressure angle). Calculate its backlash.

A. 0.0785 mm
B. 0.0786 mm

$$C. 0.0875 \text{ mm } b = \frac{0.13}{P_d} = \frac{0.075}{0.4} \\ D. 0.0546 \text{ mm } = 0.075 = 0.08$$

81. When the belt is transmitting maximum power.

- A. Effective tension is equal to the centrifugal tension
- B. Effective tension is half of the centrifugal tension
- C. Driving tension in slack side is equal to the centrifugal tension
- D. Driving tension in tight side is twice the centrifugal tension

82. A machine shop fabricates a pair of spur gear, 2.5 module to be mounted on shafts with a center line distance of 90 mm. The speed required is 3:1. (Use 20° pressure angle). Compute the tooth thickness w/ backlash.

A. 3.88325 mm
B. 3.34525 mm

$$C. 2.4450 \text{ mm } \text{Tooth T} = \frac{1.5708}{P_d} \\ D. 2.5450 \text{ mm }$$

83. The centrifugal tension in the belt.

- A. Increases the power transmitted
- B. Has no effect on the power transmitted
- C. Decrease the power transmitted
- D. Is equal to the maximum tension on the belt

84. A machine shop fabricates a pair of spur gear, 2.5 module to be mounted on shafts with a center line distance of 90 mm. The speed required is 3:1. (Use 20° pressure angle). Calculate the space width.

A. 3.97075 mm
B. 2.8977 mm

$$C. 3.405 \text{ mm } SW = TT + b \\ D. 3.0495 \text{ mm }$$

85. In helical gears, the distance between similar faces of adjacent teeth along a helix on the pitch cylinders normal to the teeth, is called:

- A. Normal pitch
- B. Diametral pitch
- C. axial pitch
- D. module

86. Lewis equation in spur gear is applied :

- A. only to the pinion
- B. only to the gear
- C. to stronger of the pinion
- D. to weaker of the pinion or gear

87. A 15-tooth, 20 deg involute spur gear pinion is rotating at 500 rpm. This is to transmit 25 hp to a mild-steel gear rotating at 250 rpm. Calculate the number of teeth in the gear.

A. 30
B. 50

C. 40

D. 60

$$\frac{15(500)}{250} = 750(x)$$

88. A pair of gear with gear ratio of 3 and 60 gear teeth of 14 1/2 degree full depth tooth. The diametral pitch is 10. Compute the tooth thickness on the pitch circle

A. 0.570 inch
B. 0.352 inch

$$C. 0.157 \text{ inch } \frac{1.5708}{P_d} \\ D. 0.142 \text{ inch }$$

89. V-Belts are usually used for which drive(s)?

- A. Long drives
- B. Long and short drives
- C. short drives
- D. none of the above

90. A pair of gear/pinion of 42 tooth and 18 tooth with a diametral pitch of 0.7478 teeth/cm and the addendum is 0.8/p and dedendum 1/p. The gear pressure angle of 20°. Compute the center distance of the pair of gears in meters

A. 0.5026 m
B. 0.3426 m

C. 0.3516 m
D. 0.4013 m

$$C = \frac{T_a + T_p}{2P_d} \frac{\text{feet}}{\text{cm}}$$

81. D 85. A 92. B
A. D 93. C

83. B 87. 96. C
84. 89. C 99. D
A. 90. 100.

91. A triple threaded worm has a pitch diameter of 3 inches. The wheel has 25 teeth and a pitch diameter of 5 inches. Material for both the wheel and the wheel is phosphor bronze. Determine the helix angle of the gear.

A. 11.31°
B. 11.43°

C. 13.11°
D. 10.13°

92. The energy stored in a body when strained within elastic limit is called what?

- A. Resilience
- B. Strain energy
- C. proof resilience
- D. impact energy

93. A keyed-gears deliver a torque of 912.4 Nm thru its shaft of 63.5 mm outside diameter. If the key has thickness of 15.875 mm and width of 11.1125 find the length of the key. Assume the permissible stress values of 61.2 MPa for shear and tension at 99.8 MPa.

A. 47.42 mm
B. 39.72 mm

C. 42.22 mm
D. 46.92 mm

94. What is the surface velocity of a pulley 45.72 cm in diameter mounted on a shaft running at 250 rpm?

- A. 4.5 fpm
- B. 1178 fpm
- C. 125 rpm
- D. 0.04 rps

95. A 20° straight-tooth bevel pinion having 14 teeth and a diametral pitch of 6 teeth/inch drives a 42-tooth gear. The two shafts are at right angles and in the same plane. Find the pitch angle of the pinion.

A. 18.4°
B. 14.5°

C. 20°
D. 20.5°

96. The static tooth load should be _____ the dynamic load.

- A. less than
- B. greater than
- C. equal to
- D. all of these

$$DP = \frac{\text{Diametral Pitch}}{P_d}$$

97. A 20° straight-tooth bevel pinion having 14 teeth and diametral pitch of 6 teeth/inch drives a 32-tooth gear. The two shafts are at right angles and in the same plane. The pinion is to transmit 1800 rpm and transmitting 50 hp. Determine the pitch diameters of the gears.

A. 2.33 inches and 5.33 inches
B. 3.33 inches and 3.56 inches
C. 3.23 inches and 3.56 inches
D. 2.33 inches and 2.33 inches

98. The pitch radius of gear A is 5 inches while that of gear B is 20 inches. Shaft A rotates at 800 rpm and is subjected to a twisting moment of 83.33 ft-lb. Calculate the tooth pressure of gear B as the two shafts are being connected by these spur gears.

- A. 200 lb
- B. 50 lb
- C. 300 lb
- D. 400 lb

99. When bevel gears having equal teeth and equal pitch angles connect two shafts whose axes intersect at right angle, they are known as:

- A. Angular bevel gears
- B. Internal bevel gears
- C. crown bevel gears
- D. mitre gears

100. A heavy brass plumb bob suspended from a 38 inches cord was observed to have a natural period of oscillation of about two seconds if pulled 24 inches to one side and then allowed to swing freely. If an astronaut was to repeat this experiment on the moon where the gravitational attraction is approximately 1/6th that of the earth, the observed period would be:

- A. 0.33 seconds
- B. 0.82 seconds
- C. 4.90 seconds
- D. 12.00 seconds

$$a) T = \pi \left(\frac{D}{2} \right) \\ 83.33 \text{ ft-lb} = F \left(\frac{5}{2} \times 24 \right) \\ F = 400 \text{ lb}$$

$$b) T = 2\pi \sqrt{\frac{38/12 \text{ ft}}{\frac{1}{6}(32.2f/J_2)}} \\ T = 4.825$$

MDSP REFRESHER COURSE

MDSP 4.1

1. A 25-kW, 900 rpm, induction motor is driving a compressor running at 600 rpm. The pulley mounted on the motor shaft is 270 mm. Determine the compressor pulley diameter.
 A. 210 mm C. 120 mm
 B. 405 mm D. 540 mm
2. A 25-kW, 900 rpm, induction motor is driving a compressor running at 600 rpm. The pulley mounted on the motor shaft is 270 mm. Calculate the belt speed of the set-up.
 A. 12.72 m/s C. 52.55 m/s
 B. 13.42 m/s D. 42.13 m/s
3. A 25-kW, 900 rpm, induction motor is driving a 405 mm compressor pulley running at 600 rpm. The pulley mounted on the motor shaft is 270 mm. If the center-to-center distance is 1.5 m, determine the length of belt used.
 A. 1,234.55 mm C. 3,604.44 mm
 B. 2,005.11 mm D. 4,063.33 mm
4. An open belt drive connects a 450 mm driving pulley to a 1000 mm driven pulley. The center distance between shafts is 4 meters. Find the belt tension ratio if the coefficient of friction is 0.3.
 A. 1.57 C. 2.46 ✓
 B. 3.03 D. 4.75
5. An open belt drive is running at 20 m/s. If the effective Net Belt pull is 2000 N, solve for the Power transmitted.
 A. 40 kW ✓ C. 10 kW
 B. 20 kW D. 30 kW
6. A 25-kW, 900 rpm, induction motor is driving a compressor running at 600 rpm. The pulley mounted on the motor shaft is 270 mm. Assuming a 150x10 mm belt with an allowable stress of 2.86 MPa is used, determine the Tight-side Tension.
 A. 3,920 N C. 1,380 N
 B. 4,290 N ✓ D. 2,040 N
7. An open belt drive is running at 20 m/s with an effective Net Belt pull of 2000 N. If the coefficient of friction is 0.3 and a 3 radian contact angle is observed, solve for the slack-side tension.
 A. 3,369.86 N C. 1,369.86 N ✓
 B. 2,369.86 N D. 4,379.87 N
8. A leather belt running at 15 m/s transmits 20 kW from a cast iron pulley rotating at 150 rpm. If the belt density is 968.625 kg/m³, calculate for the Centrifugal stress experienced by the belt during the run.
 A. 2.108 MPa C. 0.218 MPa
 B. 0.518 MPa D. 0.812 MPa
9. An cross belt drive connects a 450 mm driving pulley to a 1000 mm driven pulley. The center distance between shafts is 4 meters. Find the length of the belt.
 A. 10.4 m C. 8.45 m
 B. 4.01 m D. 11.8 m
10. An 20" pulley, mounted on a lineshaft rotating at 360 rpm, is connected by belt to a 10" pulley on a countershaft. From the same countershaft, a 15" pulley is transmitting motion to the machine. Determine the required pulley diameter of the machine so that the spindle speed is 660 rpm.
 A. 16.4 in C. 8.45 in
 B. 4.01 in D. 12.8 in
11. In a chain drive design, RC60 will be used to transmit power and motion. What should be the pitch of the sprocket to be used?
 A. 5/8 in. C. 1 1/4 in.
 B. 3/4 in. ✓ D. 1/2 in.

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12. Solve for the Pitch Diameter of a sprocket with 18 teeth and pitch of 1/4 in.
 A. 2.9 in. C. 2.6 in.
 B. 1.75 in. D. 1/2 in.
13. A fan, running at 320 rpm, is driven by a second-hand motor rated at 5 hp and 1750 rpm through chain & sprocket. Determine the recommended size of the driven sprocket if the smaller sprocket has 18 teeth.
 A. 75T C. 89T
 B. 81T D. 98T
14. A 20T sprocket is driving a larger sprocket with 80 teeth. The chain used has a pitch of 1/2 inch and the center-to-center distance is 17 inches. Determine the length of chain.
 A. 60.5 inches C. 40 inches
 B. 56.5 inches D. 70 inches
15. A 15 inches sprocket is driven by a 5 inches driving sprocket. Find the recommended center distance.
 A. 17.5 inches C. 10 inches ✓
 B. 12.5 inches D. 15 inches
16. What is the RC No. of a roller chain with a pitch of 1 1/4 inches?
 A. RC60 C. RC100 ✓
 B. RC50 D. RC80 $10 \times \frac{1}{8} = 10$
17. An 18 teeth sprocket, rotating at 320 rpm is driven by a 98 teeth driving sprocket. Determine how fast the driver is turning.
 A. 60.0 rpm C. 58.8 rpm ✓
 B. 40.0 rpm D. 85.5 rpm
18. A motor, rated at 5 Hp and 1750 rpm, is driving an industrial fan. Determine the torque transmitted by chain & sprocket.
 A. 180 lb-in ✓ C. 360 rpm
 B. 810 lb-in D. 750 rpm
19. A motor, rated at 360 rpm, is driving an industrial fan through chain & sprocket. Determine the power transmitted by motor if its spindle has a diameter of 2 1/4 in and allowable stress of 0.73 ksi.
 A. 7.77 HP C. 5.33 HP ✓
 B. 8.88 HP D. 9.33 HP
20. A motor, rated at 5 HP and 360 rpm, is driving an industrial fan through chain & sprocket. Determine the sprocket's bore diameter if its spindle has a allowable stress of 0.73 ksi.
 A. 2.33 in. C. 3.85 in.
 B. 1.75 in. D. 1.83 in. ✓
21. Find the TPI of a screw with 2/9 pitch.
 A. 3.5 C. 4.5 ✓
 B. 5.4 D. 0.35
22. A 1.5 in. bolt is screwed up tightly in a packed joint. If the allowable working stress is 12 ksi, calculate its working strength.
 A. 10,350 lbs ✓ C. 12,500 lbs
 B. 20,400 lbs D. 15,250 lbs
23. A 2 inches double threaded square screw has a TPI of 2. Find how long the Lead is.
 A. 1 in. C. 0.5 in.
 B. 2 in. D. 1.25 in.
24. A 2 inches single threaded square screw has a TPI of 2. Solve for the Pitch Diameter.
 A. 1 in. C. 0.5 in. ✓
 B. 2 in. D. 1.75 in.

$$1) RC 6 \times \frac{1}{8}$$

$$1) D_{Nc} = 900(270)$$

$$D_{Nc} = 900(270)$$

$$2) \frac{1}{2}(f_1d) + c_1 \frac{(d-d_1)^2}{4c}$$

$$2) S = \frac{F}{A}$$

$$2.8F = \frac{F}{150 \times 10}$$

$$24) D_m = D_b - h$$

$$h = \frac{1}{2}P$$

$$h = \frac{1}{2}(1/2)$$

$$h = 1/4$$

$$D_m = 2 - \frac{1}{4}$$

$$D_m = 1.75 \text{ in.}$$

$$12) D = \frac{P}{S \cdot (1/T)}$$

MDSP REFRESHER COURSE

$$36.) T = 1.59 \text{ kN.m}$$

$$T_o = F \cdot \frac{D}{2} \quad r = 1.59 \\ 1.59 = F \left(\frac{0.67}{2} \right) \quad F = 45.5 \text{ N}$$

$$h = \frac{D-d}{2} = \frac{7.5-0.07}{2} = 3.715 \text{ mm}$$

MACHINE DESIGN & SHOP PRACTICE

25. A double threaded square screw has a TPI of 2 and a pitch diameter of $1\frac{1}{4}$. Determine the screw's Lead Angle.
 A. 15.5 deg. C. 10.3 deg. D. 5.02 deg.
26. How many $\frac{3}{8}$ inch diameter set screws are required to transmit 3 HP if the shaft has a diameter of 1 in rotating at 1000 rpm?
 A. 4 C. 2
 B. 3 D. 1
27. An SAE C1040 eyebolt is lifting a 350 lbs block. Determine the stress area of the bolt if it is under the Unified Coarse Series Thread and has an ultimate strength of 67 ksi and yield strength of 55 ksi.
 A. 0.3411 in^2 C. 0.1041 in^2
 B. 0.4301 in^2 D. 0.1134 in^2
28. A double thread Square Screw driven by a motor at 400 rpm raises the attached load of 1000 kg at a speed of 10 m/min. Determine the Lead of the screw.
 A. 15.25 mm C. 0.025 mm
 B. 17.75 mm D. 25 mm
29. A double square-threaded screw is used to raise a load of 100 kN. Pitch diameter of screw and collar mean diameter are 60 mm and 125 mm, respectively. Thread friction coefficient is 0.10 and collar friction is 0.12. If the lead angle is 15° , determine the Torque required to raise the load and overcome thread friction.
 A. 1,134.24 kN-mm C. 1,884.24 kN-mm
 B. 570 kN-mm D. 750 kN-mm
30. A double square-threaded screw is used to raise a load of 100 kN. Pitch diameter of screw and collar mean diameter are 60 mm and 125 mm, respectively. Thread friction coefficient is 0.10 and collar friction is 0.12. If the lead angle is 15° , determine the Torque required to overcome collar friction.
 A. 1,134.24 kN-mm C. 1,884.24 kN-mm
 B. 570 kN-mm D. 750 kN-mm
31. A double square-threaded screw is used to raise a load of 100 kN. The torque required to overcome thread and collar frictions are 1000 kN-mm and 750 kN-mm, respectively. If the power screw rotates at 20 rpm, determine the power needed to drive the screw.
 A. 3.7 kW C. 2.5 kW
 B. 3.7 kW D. 7.7 kW
32. A double thread ACME screw is used to raise a load of 900 kg. Pitch diameter of screw and coefficient of friction on threads are 36 mm and 0.15, respectively. If the lead angle is 12.5° , determine the Torque required to raise the load and overcome thread friction.
 A. 6.20 kg-m C. 3.24 kg-m
 B. 5.75 kg-m D. 8.25 kg-m
33. A spline connection $8 \times 50 \times 60$ is used for gear and shaft. Determine the mean diameter.
 A. 75mm C. 55 mm
 B. 100 mm D. 45 mm
34. A spline connection $8 \times 50 \times 60$ is used for gear and shaft. Determine the depth h .
 A. 7 mm C. 5 mm
 B. 10 mm D. 4 mm
35. A spline connection $8 \times 50 \times 60$ is used for gear and shaft. If the length is 275 mm, compute for the active surface area of one spline.
 A. $1,257 \text{ mm}^2$ C. 500 mm^2
 B. 750.5 mm^2 D. $1,375 \text{ mm}^2$

36.) The mean diameter of a splined fitting is 70 mm, the depth is 7.5 mm and the coefficient of friction f is 0.10. The number of splines is 6. For a 20 kW power transmission at 120 rpm, determine the Normal Force.

- A. 45.5 kN C. 75.75 kN
 B. 56.86 kN D. 80.50 kN

37. A spline connection $8 \times 50 \times 60$ is used for gear and shaft. If the coefficient of friction is 0.10 and the Normal force is 50 kN, determine the force needed to slide the splines axially under load.

- A. 7 kN C. 5 kN
 B. 10 kN D. 4 kN

38. A spline connection $8 \times 50 \times 60$ is used for gear and shaft. The length and depth are 275 mm and 5 mm, respectively. For a 50 kN normal force, determine the pressure in the active surface of a spline.

- A. 7.5 MPa C. 3.75 MPa
 B. 5.7 MPa D. 4.55 MPa

39. The mean diameter of a splined fitting is 70 mm, the depth is 7.5 mm and the length is 70.5 mm. The number of splines is 10. Determine the total surface area subject to sliding.

- A. $1,257 \text{ mm}^2$ C. $5,000.5 \text{ mm}^2$
 B. 750.5 mm^2 D. $5,287.5 \text{ mm}^2$

40. A spline connection $10 \times 60 \times 75$ is used for gear and shaft. Determine the mean radius.

- A. 33.75 mm C. 40.75 mm
 B. 25.75 mm D. 25.75 mm

41. A type of transmission belt used with sheaves or groove pulleys and provides stronger grip at short distance between shafts.

- A. Flat Belt C. Toothed Belt
 B. V-Belt D. None of these

42. _____ belt is used when exposed to moisture, acids and alkalis.

- A. Chrome leather C. Rubber Belt
 B. Oak-tanned leather D. Fabric and Canvas belts

43. Very long center distance causes catenary tension in chain. To avoid this, consider a maximum safe center distance of sprockets to be how many pitches?

- A. 50 C. 70
 B. 60 D. 80

44. The recommended center-to-center distance between sprockets should not be _____ $1\frac{1}{2}$ times the bigger sprocket.

- A. Less than C. Equal
 B. Greater than D. None of the above

45. For maximum _____ in sprocket drive operation, it is ideal to choose 27 or more teeth.

- A. Quietness C. Efficiency
 B. Power transmission D. Speed

46. A type of thread used in aeronautical equipment and where very fine adjustment is required.

- A. Unified National Course (UNC) C. Unified National Fine (UNF)
 B. Unified National Extra Fine (UNEF) D. Any of these

47. In a metric thread series M - 20 x 3 - 5g, g represents

- A. Nominal Size C. External thread
 B. Tolerance D. Internal thread

42. C

43. D

44. A

45. A

46. A

47. C

48. C

49. F = PA

P = $\frac{F}{A} = hL n$

P = $\frac{10 \text{ MN}}{5(275)(8)}$

$$h = \frac{D-d}{2} = \frac{60-50}{2} = 5 \text{ mm}$$

$$A = hL = \frac{(60-50)}{2} (275) = 1375 \text{ mm}^2$$

42. C

43. D

44. A

45. A

46. A

47. C

48. C

MDSP REFRESHER COURSE

48. In an American and Unified National Thread Series 2 - 6UNC - 1A - RH, 1A represents _____.

- A. Widest Tolerance & External Thread
- B. Normal Fit & Internal Thread
- C. Closest Fit & External Thread
- D. Widest Tolerance & Internal Thread

49. Permanent keys made integral with the shaft and fitting into keyways broached into the mating hub.

- | | |
|------------|----------------|
| A. Splines | C. Saddle key |
| B. Keyway | D. Kennedy key |

50. Tapered square keys with the diagonal dimension in a circumferential direction.

- | | |
|------------------------|-----------------|
| A. Gib-head taper keys | C. Saddle keys |
| B. Flat keys | D. Kennedy keys |

MDSP 4.2

51. To stop a drum rotating at 250 rpm, a band brake is installed. Determine the torque applied at the end of the brake arm if 60 kW is being absorbed.

- | | |
|--------------|--------------|
| A. 2.29 kN-m | C. 1.91 kN-m |
| B. 3.55 kN-m | D. 1.75 kN-m |

52. To stop a drum rotating at 250 rpm, a band brake is installed. The angle of contact is 1.5π radians and the coefficient of friction is 0.25. Calculate the ratio of tensions in the band.

- | | |
|---------|---------|
| A. 2.25 | C. 1.75 |
| B. 1.45 | D. 3.25 |

53. To stop a drum rotating at 250 rpm, a band brake is installed. The steel band used has maximum tensile stress of 55 MPa and a thickness of 5 mm. What should be the width in millimeters if the tight-side tension is 6 kN?

- | | |
|----------|----------|
| A. 11 mm | C. 33 mm |
| B. 22 mm | D. 44 mm |

54. To stop a 1000 mm drum rotating at 250 rpm, a band brake is installed. The steel band used has a width of 20 mm. Determine the maximum pressure of the lining and the drum if the tight-side tension is 6 kN.

- | | |
|-----------|------------|
| A. 10 MPa | C. 0.6 MPa |
| B. 0.8 Pa | D. 0.7 kPa |

55. Consider a 1 ft long section of a single-riveted lap joint made up with plates of $\frac{1}{4}$ in. thickness and 6 rivet holes, $\frac{1}{4}$ in. in diameter. Each plate and the five rivets carry the entire load. Design stress for bearing and tension are 20 ksi and 10 ksi, respectively. If the rivets will not tear or shear through the plate to the edge of the joints, determine the allowable tensile load if the plate is unpunched.

- | | |
|---------------|---------------|
| A. 30.00 kips | C. 22.50 kips |
| B. 15.23 kips | D. 18.75 kips |

56. Consider a 1 ft long section of a single-riveted lap joint made up with plates of $\frac{1}{4}$ in. thickness and 6 rivet holes, $\frac{1}{4}$ in. in diameter. Each plate and the five rivets carry the entire load. Design stress for bearing and tension are 20 ksi and 10 ksi, respectively. If the rivets will not tear or shear through the plate to the edge of the joints, determine the tensile load that will cause tearing of plate between rivets.

- | | |
|---------------|---------------|
| A. 30.00 kips | C. 22.50 kips |
| B. 15.23 kips | D. 18.75 kips |

48. A
49. A
50. D

$$J_3 = \frac{F}{bt}$$

MACHINE DESIGN & SHOP PRACTICE

57. Consider a 1 ft long section of a single-riveted lap joint made up with plates of $\frac{1}{4}$ in. thickness and 6 rivet holes, $\frac{1}{4}$ in. in diameter. Each plate and the five rivets carry the entire load. Design stress for bearing and tension are 20 ksi and 10 ksi, respectively. If the rivets will not tear or shear through the plate to the edge of the joints, determine the bearing load that will cause crushing of plate.

- | | |
|---------------|---------------|
| A. 30.00 kips | C. 22.50 kips |
| B. 15.23 kips | D. 18.75 kips |

58. Consider a 1 ft long section of a single-riveted lap joint made up with plates of $\frac{1}{4}$ in. thickness and 6 rivet holes, $\frac{1}{4}$ in. in diameter. Each plate and the five rivets carry the entire load. Design stress for bearing and tension are 20 ksi and 10 ksi, respectively. If the rivets will not tear or shear through the plate to the edge of the joints, determine the safe tensile load.

- | | |
|---------------|---------------|
| A. 30.00 kips | C. 22.50 kips |
| B. 15.23 kips | D. 18.75 kips |

59. Consider a 1 ft long section of a single-riveted lap joint made up with plates of $\frac{1}{4}$ in. thickness and 6 rivet holes, $\frac{1}{4}$ in. in diameter. Each plate and the five rivets carry the entire load. Design stress for bearing and tension are 20 ksi and 10 ksi, respectively. If the rivets will not tear or shear through the plate to the edge of the joints, determine the efficiency of the joint.

- | | |
|-----------|-----------|
| A. 62.5 % | C. 73.5 % |
| B. 65.7 % | D. 45.5 % |

60. A double fillet welded joint with parallel fillet weld of 305 mm length and 10 mm leg is subjected to a tensile force of 1 kN. Assuming uniform stress distribution, determine the throat thickness.

- | | |
|------------|------------|
| A. 10 mm | C. 12.5 mm |
| B. 7.07 mm | D. 8.08 mm |

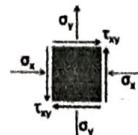
61. A double fillet welded joint with parallel fillet weld of 305 mm length and 10 mm leg is subjected to a tensile force of 1 kN. Assuming uniform stress distribution, determine the shear stress in the weld.

- | | |
|-------------|-------------|
| A. 0.15 MPa | C. 0.57 MPa |
| B. 0.75 MPa | D. 0.23 MPa |

62. The maximum pressure inside a cylindrical tank is 1.75 MPa. Inside diameter is 1.75 m while the riveted joint has a longitudinal pitch of 50 mm and there are two straps placed. The design stress for the rivets and the plate are 200 MPa and 160 MPa, respectively. Assuming 80% joint efficiency, determine the thickness of the plate.

- | | |
|----------|----------|
| A. 12 mm | C. 15 mm |
| B. 10 mm | D. 20 mm |

63. Refer to the figure. The element is subjected to the plane stress condition shown ($\sigma_x = -200$ MPa, $\sigma_y = 140$ MPa, & $\tau_{xy} = 70$ MPa). What is the maximum shear stress?



- | | |
|---------------|----------------|
| A. 183.85 MPa | C. -213.85 MPa |
| B. 153.85 MPa | D. -153.85 MPa |

$$(63) t_{max} = \sqrt{\frac{(\sigma_x - \sigma_y)^2}{4} + \tau_{xy}^2}$$

$$= \sqrt{\frac{(-200 - 140)^2}{4} + 70^2}$$

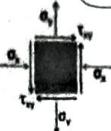
$$= 183 \text{ MPa}$$

$$\begin{aligned}
 66) \sigma_{max} &= \frac{\sigma_x + \sigma_y}{2} + \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} \\
 &= \frac{-200 + 140}{2} + 163.85 \\
 &= 153.85 \text{ MPa}
 \end{aligned}$$

MDSP REFRESHER COURSE

MACHINE DESIGN & SHOP PRACTICE

64. Refer to the figure. The element is subjected to the plane stress condition shown ($\sigma_x = -200 \text{ MPa}$, $\sigma_y = 140 \text{ MPa}$, & $\tau_{xy} = 70 \text{ MPa}$). What is the maximum normal stress?



- A. 183.85 MPa
B. 153.85 MPa
C. -213.85 MPa
D. -153.85 MPa

65. Refer to the figure. The element is subjected to the plane stress condition shown ($\sigma_x = -200 \text{ MPa}$, $\sigma_y = 140 \text{ MPa}$, & $\tau_{xy} = 70 \text{ MPa}$). What is the minimum normal stress?

$$\begin{aligned}
 \sigma_{min} &= \frac{\sigma_x + \sigma_y}{2} - \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} \\
 &= \frac{-200 + 140}{2} - 163.85 \\
 &= -213.85 \text{ MPa}
 \end{aligned}$$

- A. 183.85 MPa
B. 153.85 MPa
C. -213.85 MPa
D. -153.85 MPa

66. Refer to the figure. The element is subjected to the plane stress condition shown ($\sigma_x = -200 \text{ MPa}$, $\sigma_y = 140 \text{ MPa}$, & $\tau_{xy} = 70 \text{ MPa}$). What is the orientation of the principal stress plane?

$$\begin{aligned}
 \tan 2\theta_p &= \frac{2\tau_{xy}}{\sigma_x - \sigma_y} \\
 2\theta_p &= \tan^{-1} \left(\frac{2(70)}{-200 - 140} \right) \\
 2\theta_p &= -22.38^\circ \\
 \theta_p &= -11.2^\circ
 \end{aligned}$$

A. -11.2°
B. -33.82°
C. 11.2°
D. 33.82°

67. Refer to the figure. The element is subjected to the plane stress condition shown ($\sigma_x = -200 \text{ MPa}$, $\sigma_y = 140 \text{ MPa}$, & $\tau_{xy} = 70 \text{ MPa}$). What is the orientation of the shear stress plane?

$$\begin{aligned}
 \tan 2\theta_s &= \frac{\sigma_x - \sigma_y}{2\tau_{xy}} \\
 2\theta_s &= \tan^{-1} \left(\frac{-200 - 140}{2(70)} \right) \\
 2\theta_s &= 69.63^\circ \\
 \theta_s &= 33.82^\circ
 \end{aligned}$$

A. -11.2°
B. -33.82°
C. 11.2°
D. 33.82°

68. Refer to the figure. The element is subjected to the plane stress condition shown ($\sigma_x = 200 \text{ MPa}$ & $\sigma_y = 100 \text{ MPa}$). What is the maximum shear stress?



- A. 0 MPa
B. 25 MPa
C. 50 MPa
D. -75 MPa

$$\begin{aligned}
 \sigma_{max} &= \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} \\
 &= \sqrt{\left(\frac{200 - 100}{2}\right)^2 + 0^2} \\
 &= 50 \text{ MPa}
 \end{aligned}$$

69. A 1 m long 50 mm Ø solid circular shaft is subjected to torsion and bending. It transmits 50 kW at 900 rpm and is simply supported by bearings at both ends. Determine the equivalent torque if there is a concentrated load of 1 kN at midspan.

- A. 586.5 N-m
B. 548.2 N-m
C. 418.2 N-m
D. 486.5 N-m

70. A 1 m long 50 mm Ø solid circular shaft is subjected to torsion and bending. It transmits 50 kW at 900 rpm and is simply supported by bearings at both ends. Determine the equivalent bending moment if there is a concentrated load of 1 kN at midspan.

- A. 586.5 N-m
B. 548.2 N-m
C. 418.2 N-m
D. 486.5 N-m

71. A solid circular shaft is subjected to 530 N-m torque and 370 N-m bending moment. What is the diameter of the shaft if the allowable shear stress is 43 MPa?

- A. 42.5 mm
B. 35.2 mm
C. 27.5 mm
D. 54.3 mm

72. The position of a particle that moves along the x-axis is defined by $x = -5t^2 + 10t - 5$ ft, where t is in seconds. At what time t will the particle come to a stop ($v = 0$ ft/s)?

- A. 1 s
B. 3 s
C. 1.67 s
D. 3.67 s

73. The position of a particle that moves is defined by $x = 10t$ m and $y = 10t - 4.9t^2$ m, where t is in seconds. Determine the magnitude of the velocity vector when $t = 1.5$ s.

- A. 11.05 m/s
B. 5.11 m/s
C. 15.5 m/s
D. 10.15 m/s

74. A cyclist on a circular track of radius $r = 700$ m. is traveling at 25 m/s. His speed in the tangential direction increases at the rate of 3 m/s². Determine the cyclist's normal acceleration.

- A. 11.05 m/s²
B. 5.11 m/s²
C. 5 m/s²
D. 0.893 m/s²

$$a_n = \frac{v^2}{r} = \frac{25^2}{700}$$

75. A cyclist on a circular track is traveling at 25 m/s. His speed in the tangential direction increases at the rate of 4 m/s². Determine the cyclist's total acceleration if normal acceleration is 3 m/s².

- A. 11.05 m/s²
B. 5.11 m/s²
C. 5 m/s²
D. 0.893 m/s²

$$a_t = \sqrt{a_r^2 + a_n^2} = \sqrt{4^2 + 3^2}$$

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MDSP REFRESHER COURSE

76. Determine the theoretical number of Degrees of Freedom (DOF) of the mechanism shown.



higher (circle count)

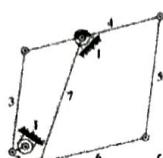
- A. -1
B. 2

$$\text{Links} \quad C. 1 - 1 \quad \text{lower pair}$$

$$DOF = 3(N-1) - 2P_1 - P_2$$

$$3(4-1) - 2(4) - 0$$

77. Compute the DOF of the mechanism shown.



$$3(N-1) - 2P_1 - P_2$$

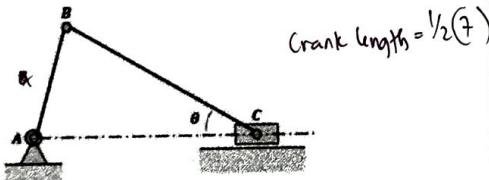
$$3(7-1) - 2(8) - 0$$

$$= 2$$

- A. -1
B. 2

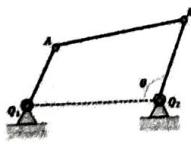
- C. 1
D. 0

78. In the slider-crank mechanism shown, find the length of crank AB if the stroke of C is 7 in.



- A. 2.5 in.
B. 4.5 in.
- C. 1.5 in.
D. 3.5 in.

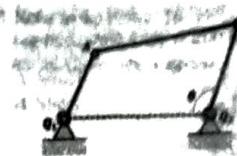
79. In the crank-rocker four-bar mechanism shown, $Q_1A = 0.5 \text{ in.}$, $AB = 3.5 \text{ in.}$, $Q_2B = 2 \text{ in.}$, and $Q_1Q_2 = 3 \text{ in.}$. Find θ_{\min} .



- A. 55.7°
B. 104.48°
- C. 70.53°
D. 127.17°

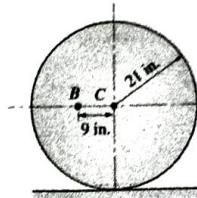
80. In the crank-rocker four-bar mechanism shown, $Q_1A = 0.5 \text{ in.}$, $AB = 3.5 \text{ in.}$, $Q_2B = 2 \text{ in.}$, and $Q_1Q_2 = 3 \text{ in.}$. Find θ_{\max} .

MACHINE DESIGN & SHOP PRACTICE



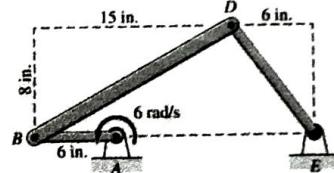
- A. 55.7°
B. 104.48°
- C. 70.53°
D. 127.17°

81. The wheel rolls without slipping. In the position shown, the vertical component of the velocity of point B is 9 ft/s directed upward. For this position, calculate the angular speed in rad/s of the wheel.



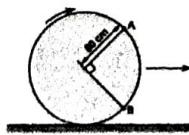
- A. 12 rad/s
B. 10 rad/s
- C. 13 rad/s
D. 11 rad/s

82. The link AB of the mechanism rotates with the constant angular speed of 5 rad/s counterclockwise. Calculate the angular velocity of link BD in the position shown.



- A. 2.74 rad/s (CCW)
B. 1.43 rad/s (CCW)
- C. 2.74 rad/s (CW)
D. 1.43 rad/s (CW)

83. As shown in the diagram, an 80 cm wheel rolls along a flat surface at 4 m/s. If points A and B are 90° away from each other, what is the velocity of A when B contacts the ground?



- A. 3.75 m/s
B. 2.25 m/s
- C. 5.65 m/s
D. 4.24 m/s

MDSP REFRESHER COURSE

MACHINE DESIGN & SHOP PRACTICE

84. The flywheel of a steam engine is 10 ft in diameter and rotates at 120 rpm. Find the linear speed in feet per minute of a point located on the spoke midway between the center and rim of the wheel.

A. 62.83 fpm
B. 45.75 fpm

C. 80.0 fpm
D. 95.12 fpm

$$v = \omega r$$

85. A flywheel rotating at 100 rpm decelerates uniformly at $\pi \text{ rad/s}^2$. How long will it take for the flywheel to stop?
 A. 10.47 s C. 2.58 s E. $100 \times \frac{\pi}{60}$
 B. 5.82 s D. 3.33 s

86. A type of welding which utilizes the heat of the flame which is produced by combustion of a gas. The most commonly used are acetylene, hydrogen and natural gas in combination with oxygen.
 A. Electric Arc Welding
 B. Gas Welding
 C. Thermit Welding (TW)
 D. Electric Resistance Welding

87. Also known as flux shielded arc welding or stick welding. It forms the weld with a flux-coated electrode, which is a rod or metal stick held in an electrode holder connected to a power source. Electricity passes through the electrode and touches the base metal, while a gas is formed by the flux that shields the electric arc between the metal being welded and the electrode.
 A. Gas Metal Arc Welding (GMAW)
 B. Shielded Metal Arc Welding (SMAW)
 C. Flux-cored Arc Welding (FCAW)
 D. Gas Tungsten Arc Welding (GTAW)

88. A combination of rigid bodies so arranged that the motion of one compels the motion of the others, according to a law depending on the nature of the combination.
 A. Machine C. Structure
 B. Mechanism D. Frame

89. A combination of resistant bodies so arranged that by their means the mechanical forces of nature can be compelled to produce some effect or work accompanied with certain determinate motions.
 A. Machine C. Structure
 B. Mechanism D. Frame

90. A pair of elements where surface contact exists between the two members.
 A. Higher Pair C. Inversion
 B. Lower Pair D. Elements

91. A pair where the elements do not enclose each other and the members are either in point or line contact.
 A. Higher Pair C. Inversion
 B. Lower Pair D. Elements

92. The exchange of fixedness of an element with its partner where in any closed or lower pair it does not affect either the absolute or the relative motion.
 A. Higher Pair C. Inversion of Pairs
 B. Lower Pair D. Elements

93. An arm rotating or oscillating about an axis.
 A. Bearings C. Collars & Keys
 B. Crank D. Levers

86. B 93. B

99. A

87. B 94. D

88. B 95. C

89. A 96. A

90. B 97. D

91. A 98. B

92. C

94. In a slider-crank mechanism, the crank has a length equal to one-half of the slider's displacement. The crank length is often called the _____

A. Stroke
B. Slider
C. Bone
D. Crank Throw

95. Gruebler's Criterion computes the theoretical number of DOF in a mechanism. However, the actual number of DOF in a mechanism is called _____
 A. Degrees of Freedom
 B. Kinematic Chain
 C. Mobility
 D. Motion

96. A four bar kinematic chain from which the shortest link is capable of making a complete revolution relative to each of the three longer links. The three longer links can only oscillate relative to each other.

A. Grashof four bar kinematic chain
 B. Non-Grashof four bar kinematic chain
 C. Gruebler's Criterion
 D. Degrees of Freedom

97. A plane motion in which the body moves without rotation; that is, any line in the body remains parallel to its initial position. Because all points in the body have the same displacement, the motion of one point determines the motion of the entire body.
 A. General C. Retardation
 B. Rotation D. Translation

98. A plane motion in which a line in the body, called the axis, is fixed in space. Each point not on the axis moves in a circle about the axis.
 A. General C. Retardation
 B. Rotation D. Translation

99. _____ plane motion is the superposition of translation and rotation. A rolling disk is an example of such motion: the disk is translating and rotating simultaneously.
 A. General C. Retardation
 B. Rotation D. Translation

100. When a particle is moving along a path which is also in motion, a compound supplementary acceleration is considered. This acceleration is equal to twice the product of the velocity of the particle relative to the path and the angular velocity of the path.

A. Coriolis' Acceleration C. Normal Acceleration
 B. Tangential Acceleration D. Relative Acceleration

MDSP REFRESHER COURSE

MDSP 5.1

0.248 m $\frac{3.77 \text{ ft}}{\text{in}}$

1. What should be the diameter of pulley in inches with a belt speed of 22.866 m/s and the motor running at 1760 rpm?

A. 9.76 B. 7.76 C. 6.76 D. 8.76

2. The maximum stress induced in a material when subjected to alternating or repeated loading without causing failure.

A. ultimate strength C. yield strength
B. endurance limit D. rupture strength

3. A machine shop fabricates a pair of spur gear, 2.5 module to be mounted on shafts with a center line distance of 90 mm. The speed required is 3:1. (Use 20° pressure angle). Find the outside root diameter.

A. 24.6 mm and 120.45 mm C. 38.75 mm and 128.75 mm
B. 32.45 mm and 145.25 mm D. 12.34 mm and 110.45 mm

4. The newly installed motor drives a hoist that is used in lifting a 4-ton load at a given distance of 30 ft in 30 seconds. What is the power supplied to the hoist assuming hoist efficiency of 48%?

A. 42.70 hp C. 14.54 hp
B. 30.30 hp D. 37.53 hp

5. A set screw is necessary to fasten a pulley to a 2 in. shaft while transmits 3 Hp and rotates at 150 rpm. Find the torque on the set screw.

A. 110 ft-lb C. 120 ft-lb
B. 105 ft-lb D. 130 ft-lb

6. The breaking strength of a steel cable is 20 kN. If one pulls horizontally with this cable, what is the maximum horizontal acceleration with can be given to an 8-metric ton resting on a rough horizontal surface if the coefficient of kinetic friction is 0.15?

A. 1.03 m/s² C. 3.01 m/s²
B. 2.05 m/s² D. 4.03 m/s²

7. It is the ability of a material to absorb energy when deformed elastically and to return it when unloaded.

A. creep
B. fatigue strength
C. resilience
D. toughness

8. An inclined plane 12 ft long has been used to slide a 250-lb box up to a loading space that is 7 ft above the ground. If 185 lbf is needed for loading the cargo upward, what is the efficiency of the inclined plane for this job?

A. 85.48 % C. 82.41 %
B. 78.82 % D. 74.52%

9. A hydraulic press has a pressure inside its cylinder equal to 1.2 ksi. What is the thickness of the cylinder if its diameter is 10 inches and the allowable tensile stress is 2.5 ksi?

A. 4.5 in C. 5.2 in
B. 3.9 in D. 1.5 in

10. The maximum bending moment of a beam simply supported at both ends and subject to a total load W uniformly distributed over its length L is expressed by the formula

A. WL/8 C. WL/2
B. WL²/8 D. WL²/2

11. If the gear has tooth thickness of 0.30 inch and the backlash of 0.007 inch, calculate its space width.

A. 0.307 inch C. 0.254 inch
B. 0.203 inch D. 0.365 inch

$$\text{P} = F_{\text{net}} v$$

$$\text{P} = (100 - 120) \times (200 \text{ lb}) \frac{100 \text{ ft}}{\text{min}} \frac{1 \text{ hp}}{33000}$$

$$(15) 8 - \frac{P}{K_E} = 5 \frac{L}{E}$$

MACHINE DESIGN & SHOP PRACTICE

12. Compute the power to be taken off the driven shaft on an open belt drive operated by a driving pulley 76 inches in diameter at 200 rpm. Note: the diameter of driven pulley is 32 inches and the total tensions on the tight and slack sides are 300 and 100 lbs respectively.

A. 20 hp C. 18 hp
B. 24 hp D. 26 hp

13. Calculate the pressure is required to punch a hole 2 in. diameter through a $\frac{1}{4}$ in. steel plate.

A. 60 tons C. 22 tons whole D_s = 2.15
B. 30 tons D. 19 tons W_{or} = 12.70

14. Determine the minimum whole depth of spur gear of 14.5° involute type with diametral pitch of 24 and circular pitch of 0.1309 inch.

A. 0.09000 inch C. 0.08879 inch
B. 0.0899 inch D. 0.086535 inch

15. What is the elongation of a 1.5 m aluminum bar of modulus of elasticity 70 Gpa when subjected to a tensile stress of 150 MPa?

A. 4.32 mm C. 1.24 mm
B. 3.21 mm D. 2.34 mm

16. Solve the tooth thickness of a 14.5° spur gear with diametral pitch of 5.

A. 0.24352 inch C. 0.31416 inch
B. 0.53452 inch D. 0.05643 inch

17. Calculate the tooth thickness on the tooth circle of a 20-degree full depth involute tooth having a circular pitch of 20 mm and whole depth of tooth at 16 mm.

A. 12 mm C. 14 mm Wh = $\frac{2.57}{P_d}$ $P_d = \frac{2.57}{0.1406}$
B. 10 mm D. 17 mm t = $\frac{15.708}{P_d}$ $P_d = \frac{15.708}{0.1406}$

18. What is the chordal thickness at the standard pitch diameter for a pinion that has 15 teeth of 3 diametral pitch?

A. 0.3255 in C. 0.2342 in
B. 0.2375 in D. 0.5226 in

19. Determine the Hp lost when a collar is loaded with 2000 lb, rotates at 50 rpm, and has a coefficient of friction of 0.15. The outside diameter of the collar is 4 inches and the inside diameter is 2 inches.

A. 0.7314 Hp C. 0.3702 Hp
B. 0.4713 Hp D. 0.4371 Hp

20. What is the average time to cut by automatic oxy-acetylene (machine) crosswise a 4 ft. x 8 ft x 4 in thick steel plate given that the rate is 9 in/min?

A. 3.32 min C. 12 min
B. 320 sec D. 540 sec

21. A steel tape was used to measure a distance from A to B and found out to be 5,368.25 ft at 22°F. Compute the true distance between A and B if the tape was a standard 100.00 ft at 68°F and the tape's coefficient of expansion is 0.0000065.

A. 5366.5 ft C. 5363.5 ft
B. 5348.7 ft D. 2358.7 ft

22. A piece of stock of length 24 inches has taper per foot of $\frac{1}{4}$ in., compute the diameter of one end given that the smaller end is 1.5 inches in diameter.

A. 1.75 in C. 1.25 in
B. 2.0 in D. 2.75 in

23. How many $\frac{5}{16}$ inch holes can be punch in one motion in a steel plate made of SAE 1010 steel $\frac{7}{16}$ inch thick using a force of 55 tons. The ultimate strength for shear is 50 ksi and use 2 factor of safety

A. 5.8 C. 5 ✓
B. 3.7 D. 6.5

24. The helix angle between for helical gears varies between:

A. 20 deg. to 45 deg. C. 64 deg to 72 deg
B. 10 deg. to 12 deg. D. none of these

$$(2) \text{ Space width} > t + b$$

$$2) \text{ True Distance} = \text{Original length} + \frac{\text{Strain}}{\text{AL}}$$

$$= 5368.25 + 4.5 \times 10^{-6} (5368.25) / 22$$

$$= 5366.67$$

$$(3) t_c = \frac{F_{cW}}{3.14}$$

$$T_c = \left(\frac{0.15}{2} \right) \left(\frac{4+2}{2} \right) 200 \text{ lb}$$

$$P = 2\pi TN \frac{2}{2}$$

$$(4) t = \frac{d-d}{L} = 2$$

$$y_4 \frac{in}{ft} = \frac{(D-1.5)in}{24in (ft/12in)}$$

$$N = dP +$$

$$P = \frac{W+dF}{time}$$

$$P' = \frac{4 \text{ ton} (200 \text{ lb}) (1 \text{ min})}{20 \text{ sec} (.48)} \times \frac{1 \text{ hp}}{5 \text{ min ft/lb}} = 185 \text{ lb (12 ft)}$$

$$P = 30.30 \text{ hp}$$

MDS REFRESHER COURSE

25. Compute the speed of the gear mounted on a 52.5 mm diameter shaft receiving power from a driving motor with 250 hp.
 A. 2182 rpm
 B. 2265 rpm
 C. 2321 rpm
 D. 2341 rpm

26. A point moving in space describes a line called its _____.
 A. Motion
 B. Path
 C. Direction
 D. Oscillation

27. Three extension springs are hooked in series that support a single weight of 100 kg. The first spring is rated at 4 kN/m and the other two springs are rated 6 kN/m each. Determine the equivalent stiffness of the three springs.
 A. 1.71 kN/m
 B. 2.71 kN/m
 C. 5 kN/m
 D. 3.71 kN/m

28. What is the speed of the tip of the second hand relative to the watch if it is 2.5 cm long?
 A. 0.00267 m/s
 B. 0.10914 m/s
 C. 0.00987 m/s
 D. 0.00197 m/s

29. If the lowest cutting speed for cast iron is 50 fpm, calculate the rpm for machining a cast iron workpiece 6 inches in diameter.
 A. 32.5
 B. 31.8
 C. 45.7
 D. 52.6

30. A 36-tooth pinion turning at 300 rpm drives 120-tooth gear of 14.5° involute full depth pressure angle. Determine the rpm of the driven gear.
 A. 60 rpm
 B. 75 rpm
 C. 45 rpm
 D. 90 rpm

31. The newly installed motor drives a hoist that is used in lifting a 4-ton load at a given distance of 30 ft in 30 seconds. What is the power supplied to load if the hoist efficiency is 48% and motor efficiency is 90%?
 A. 42.7 hp
 B. 30.3 hp
 C. 24.54 hp
 D. 14.54 hp

32. What is the mass of a 120-lbf man standing in an elevator?
 A. 3.73 lb
 B. 3.73 slugs
 C. 5.45 lb
 D. 2.86 slugs

33. A vise is equipped with a 1-inch single square thread, with 4 threads per inch. The frictional radius of the collar is 0.5 inch. The coefficient of friction for both the collar and threads is 0.20. How much external torque must be applied to produce a force of 200 lb against the jaws of the vise?
 A. 39.73 in-lb
 B. 35.93 in-lb
 C. 33.97 in-lb
 D. 39.37 in-lb

34. In a power screw square threads, the torque required to raise the given load is found to be 8800 N-m. Compute the shear stress caused by this torque considering that the core diameter of the screw is 40 mm.
 A. 700 Mpa
 B. 350 Mpa
 C. 24.5 ksi
 D. 10.5 ksi

35. A ball with speed of 20 cm/s rolls off the edge of the table 90 cm high. How long does it take to drop to the ground?
 A. 0.34 s
 B. 0.43 s
 C. 0.54 s
 D. 0.25 s

36. A 10-lb weight is attached to a 1.5-ft cord and is whirled in a vertical circle with an angular velocity of 120 rpm. Compute the tension in the cord in the event that the weight is at the bottom of the circle.
 A. 73.5 lbf
 B. 83.5 lbf
 C. 63.5 lbf
 D. 53.5 lbf

37. What is the time needed to saw a 5 in wood using a handsaw with a cutting rate of 0.010 mm/rev and speed of 200 rpm?
 A. 63.5 min.
 B. 52.4 min.
 C. 35.2 min.
 D. 60.7 min.

$$38) M = \frac{1}{Pd} \quad 2.5 = \frac{1}{Pd}$$

$$Pd = 0.4$$

$$d = \frac{1.25}{Pd} = \frac{1.25}{0.4}$$

$$d = 3.125$$

MACHINE DESIGN & SHOP PRACTICE

38. A pair of spur gears with 2.5 module to be mounted on shafts with a center line distance of 90 mm. The speed required is 3:1 and pressure angle of 20°. Calculate its dedendum distance.
 A. 3.125 mm
 B. 2.136 mm
 C. 1.145 mm
 D. 2.435 mm

39. A machine shop fabricates a pair of spur gear, 2.5 module to be mounted on shafts with a center line distance of 90 mm. The speed required is 3:1. (Use 20° pressure angle). Find the inside and outside diameter.
 A. 50 mm and 140mm
 B. 30 mm and 120 mm
 C. 24 mm and 120 mm
 D. 13 mm and 130 mm

40. Calculate the tooth thickness of on the tooth circle of a 20-deg full depth involute tooth having a diametral pitch of 5.
 A. 0.3142 inch
 B. 0.2509 inch
 C. 0.4428 inch
 D. 0.9734 inch

41. An eyebolt is lifting a block weighing 350 lbs. The eyebolt is of SAE C 1040 material with $S_u = 67$ ksi and $S_2 = 55$ ksi what is the stress area (in inches square) of the bolt if it is under the unified coarse series thread?
 A. 1341
 B. 0.1134
 C. 0.991
 D. 1043

42. The power hacksaw does 120 strokes/min and the feed/stroke is 0.127 mm. How much is the time need to saw a rectangular magnesium bar 5 in. wide and 2 in. thick if the length of cut is 5 in?
 A. 250 s
 B. 500 s
 C. 450 s
 D. 120 s

43. If there 440 persons occupying the whole building other than the first floor, how many elevators are required?
 A. 2
 B. 3
 C. 4
 D. 1

No. of People

44. A 900-N man stands on a scale on the floor of an elevator. The scale records the force it exerts on whatever is on it. What is the scale reading if the elevator has an acceleration of 1.2 m/s^2 down?
 A. 870 N
 B. 790 N
 C. 640 N
 D. 820 N

Up

45. Calculate the average time to cut by oxy-acetylene (automatic machine) lengthwise a 5ft. x 10 ft. x 4 in thick steel plate. Oxy acetylene cuts 25.4 cm of length every minute.

- A. 540 s
 B. 320 s
 C. 720 s
 D. 450 s

$$D = \pi - \frac{O}{C}$$

46. Find the angle of contact on the small pulley for a belt drive with a 72-in center distance if the pulley diameters are 6 inches and 12 inches respectively.

- A. 175.22 deg.
 B. 145.45 deg.
 C. 125.7 deg.
 D. 152.2 deg.

$$D = \pi - \frac{O}{C}$$

47. A pulley system used in a machine shop with an ideal mechanical advantage of 5 requires a force of 12 N to lift a load of 45 N. Compute the actual mechanical advantage of the pulley system.

- A. 3.75
 B. 0.267
 C. 135
 D. 1.067

$$AMA = \frac{F_{out}}{F_{in}} = \frac{45}{12} = 3.75$$

48. A single square thread power screw is to raise a load of 70 kN. The screw has a major diameter of 36 mm and a pitch of 6 mm. The coefficient of thread friction and collar friction are 0.13 and 0.10 respectively. If the collar mean diameter is 90 mm and the screw turns at 60 rpm, find the combined efficiency of screw and collar.

- A. 13.4%
 B. 14.5%
 C. 15.5%
 D. 12.5%

$$\frac{\text{Wet}}{\text{Min}} \frac{\text{In.}}{\text{Gos}}$$

$$39) S = \frac{16T}{\pi d^3} = \frac{16(8800 \text{ N.m})}{\pi (40)^3} \times \frac{1000 \text{ mm}}{\text{cm}}$$

$$S = 700 \text{ mfd}$$

- 36) B

- 38)

- 39) A

- 44) B

$$45) = \frac{L}{r} = \frac{10 \text{ ft}}{\frac{1 \text{ in}}{3.281 \text{ ft}}} = \frac{10 \text{ ft}}{25.4 \text{ cm}} = \frac{1000 \text{ in}}{635.4 \text{ mm}}$$

$$44) B \quad 900 = X \left(1 + \frac{1.2}{0.81} \right)$$

$$26. B$$

$$27) \frac{1}{T_{tot}} = \frac{1}{4} + \frac{1}{6} + \frac{1}{6}$$

$$\text{Total} = 1.171 \text{ kN/m}$$

$$31) P = \frac{\text{Work}}{\text{Time}}$$

$$P = \frac{4 \text{ ton} \left(\frac{2000 \text{ lb}}{1 \text{ ton}} \right) (30 \text{ ft})}{5 \text{ sec} / \text{s}}$$

$$P = 14.54 \text{ hp}$$

$$T = Id$$

$$Tr = 52$$

$$\left(\frac{1\text{m}}{100\text{mm}}\right) = 0.01 \text{kg m}^2/\text{N}$$

$$1 \text{ rad/s}$$

MACHINE DESIGN & SHOP PRACTICE

- Q. How fast is the drill turning if it penetrates 100 mm every minute considering a steel drill with a feed of 0.005 inches?
- A. 1520 rpm
 - B. 787 rpm
 - C. 495 rpm
 - D. 620 rpm

- Q. The maximum stress induced in a material when subjected to fluctuating or repeated loading without causing failure.
- A. shear load
 - B. fatigue strength
 - C. proportional limit
 - D. endurance limit

49.)

v)

$$T = \frac{1}{f} f = \frac{w}{2\pi} w = \sqrt{\frac{w}{m}}$$

$$T = \frac{1}{\sqrt{\frac{600}{2\pi}}} = 0.314 \quad \text{or} \quad 2\pi \sqrt{\frac{1.5}{600}}$$

MDSP REFRESHER COURSE

MDSP S.2

51. If the weight of 7° $\theta \times 5^{\circ}$ long SAE 1030 shafting is 297.4 kg, then what will be the weight of aluminum SAE 51416 of same size?

A. 344.4 lbs
B. 655.8 lbs
C. 378.9 lbs
D. 877.2 lbs

52. Find the horsepower required to drive a power screw lifting a load of 4000 lbs. A 2 and $\frac{1}{2}$ inch double square thread with two threads/in is to be used. The friction radius of the collar is 2 inches and the coefficients of friction are 0.1 for the threads and 0.15 for the collar. The velocity of the nut is 10 ft/min.

A. 5.245 HP
B. 2.453 HP
C. 4.395 HP
D. 3.342 HP

53. A pulley system used in a machine shop with an ideal mechanical advantage (IMA) of 5 requires a force of 12 N to lift a load of 45 N. What is the efficiency of the pulley system?

A. 3.75
B. 0.267
C. 135
D. 1.067

54. A flywheel weighing 457 kg has radius of 375 mm. How much energy in N-m does the flywheel loss from 3.0 rev/sec to 2.8 rev/sec?

A. 1542 N-m
B. 1472 N-m
C. 120 N-m
D. 40 N-m

55. A mechanic uses a pulley system to raise a 120-lbf load 12 ft from the ground. For job to be done, he needed to exert a force on the rope equivalent to 40 lbf through a distance of 38 ft. Calculate the work the mechanic must do.

A. 1440 N-m
B. 1952.8 N-m
C. 480 ft-lb
D. 1920 ft-lb

56. A ball with speed of 20 cm/s rolls off the edge of the table 90 cm high. How far horizontally from the table edge does the ball strike the ground?

A. 9.54 m
B. 8.56 m
C. 7.32 s m
D. 5.48 s m

57. A mechanic uses a pulley system to raise a 120-lbf load that is 12 ft from the ground. For job to be done, he exerted a force on the rope equivalent to 40 lbf through a distance of 38 ft. Calculate the efficiency of the machine used by the mechanic.

A. 85 %
B. 94.7 %
C. 89.7 %
D. 95.4 %

58. The newly installed motor drives a hoist that is used in lifting a 4-ton load at a given distance of 30 ft in 30 seconds. What is the power supplied to the motor assuming hoist and motor efficiencies are 48 % and 87% respectively?

A. 42.70 hp
B. 34.83 hp
C. 76.43 hp
D. 65.98 hp

59. By applying a constant torque to a grindstone, its flywheel reaches an angular velocity of 1100 rpm in 10 seconds. Assuming it started from rest. Calculate its angular acceleration if the grindstone's moment of inertia is equal to $1.2 \times 10^{-3} \text{ kg-m}^2$

A. 10.54 rad/s²
B. 12.54 rad/s²
C. 11.52 rad/s²
D. 9.54 rad/s²

60. A 120-lbf man is standing in an elevator. What is the force on the man's feet when the elevator stand still?

A. 80 lbf
B. 120 lbf
C. 100 lbf
D. 90 lbf

61. A 900-N man stands on a scale on the floor of an elevator. The scale records the force it exerts on whatever is on it. What is the scale reading if the elevator has an acceleration of 1.2 m/s^2 up?

A. 828.5 N
B. 1010.1 N

C. 0
D. 940 N

$$T = m(a + g)$$

(62) Rotational Torque

$$T = J\alpha \quad \alpha = \frac{\omega - \omega_0}{t}$$

$$63) T = Id$$

$$F \times r = Id \quad 15N(12cm) \left(\frac{1m}{100cm}\right) = 0.03 \text{ kg-m}^2/\text{s}^2$$

$$T = 1.2 \times 10^{-3} \text{ kg-m}^2 \left(\frac{1m}{s}\right) (11.52 \text{ rad/s}) \quad \alpha = 60 \text{ rad/s}^2$$

$$T = 0.03 \text{ kg-m}^2/\text{s}^2$$

MACHINE DESIGN & SHOP PRACTICE

62. By applying a constant torque to a grindstone, the flywheel reaches an angular velocity of 1100 rpm in 10 seconds. With the moment of inertia equivalent to $1.2 \times 10^{-3} \text{ kg-m}^2$, find the torque if it started from rest.

A. 0.210 N-m
B. 0.124 N-m
C. 0.138 N-m
D. 0.329 N-m

63. The moment of inertia of a 12-cm grinding disc is 0.03 kg-m^2 . What is the angular acceleration if the 15 N force is applied to the periphery of the disk?

A. 50 rad/s²
B. 40 rad/s²
C. 60 rad/s²
D. 80 rad/s²

64. What is the moment of inertia of a 6-kg wheel if the radius of gyration is 30 cm?

A. 0.32 kg-cm²
B. 0.42 kg-cm²
C. 0.54 kg-cm²
D. 0.74 kg-cm²

65. What is the frequency of revolution of the second hand which is 2.5 cm long?

A. 0.017 rev/s
B. 0.109 rev/s
C. 0.208 rev/s
D. 0.098 rev/s

66. Calculate the rotational KE of a 20-kg wheel rotating at 5 rev/s if the radius of gyration of the wheel is 0.18 m?

A. 320 J
B. 400 J
C. 140 J
D. 120 J

67. A small motor delivers 0.25 hp when its shaft is turning at 1200 rev/min. Compute the torque.

A. 1.48 ft-lb
B. 1484 N-mm
C. 3.24 ft-lb
D. 2310 N-mm

68. The shaft having an interference fit has a maximum diameter of 4.0 cm and a nominal diameter of 3.990 cm. What is the minimum diameter of the shaft if its upper and lower deviations are 0.006 and 0.005 cm respectively?

A. 3.995 cm
B. 3.985 cm
C. 3.991 cm
D. 3.9955 cm

$$d_{\min} = d_{\text{nominal}} + d_{\text{lower}} \\ = 3.990 + 0.005 \\ = 3.995$$

69. An engine delivers 120 hp at 600 rpm. What is the angle of twist in the 6-ft drive shaft if its diameter is 2.5 inches and modulus of rigidity is 12,000 ksi.

A. 2.04 deg
B. 1.12 deg
C. 3.09 deg
D. 4.05 deg

70. What is the angular frequency of the block having a mass of 3 kg that is hung from a spring with spring modulus equal to 700 N/m?

A. 12.5 rad/s
B. 15.3 rad/s
C. 11.2 rad/s
D. 10.3 rad/s

$$W = \sqrt{k/m} \sqrt{2\pi} \\ = 15.3$$

71. A block of mass 1.5 kg hangs from a spring of modulus 600 N/m. The block is pulled 12 cm below equilibrium and released. What is the period of the motion?

A. 0.423 s
B. 0.314 s
C. 0.114 rad/s
D. 0.415 rad/s

72. A certain vibrator obeys the following equation $y = 1.20 \sin(1.10t - 0.25)$ cm, for t is in seconds, and the angle is in radian. Calculate its velocity at t = 0.

A. 2.34 cm/s
B. 1.39 cm/s
C. 1.27 cm/s
D. 3.24 cm/s

Mode road
derivative

= 0

73. Calculate the tooth thickness on the pitch circle of $14\frac{1}{2}$ deg full depth tooth of 16 diametral pitch?

A. 0.0982 in
B. 0.1209 in
C. 0.0897 in
D. 0.0789 in

74. What is the length in meters of a pendulum given that the period is 3.6 s?

A. 3.22 m
B. 2.43 m
C. 1.66 m
D. 0.45 m

$$T = 2\pi \sqrt{\frac{L}{g}} \\ 3.6 = 2\pi \sqrt{\frac{L}{9.8}}$$

(75) B

$$58) D = \frac{w}{t} = \frac{FD}{t \cdot e_f} \quad e_f = \frac{100}{2000} = 0.05$$

$$D = \frac{4\pi m}{30.5} \left(0.48\right) \left(0.67\right) \times \frac{50 \text{ ft/lb}}{1 \text{ hp}}$$

$$P = 34.83 \frac{\text{ft}}{\text{hp}}$$

$$59) W = W_0 + \alpha t \quad \alpha = \frac{W - W_0}{t}$$

$$= 100 \text{ rad/s} \left(\frac{\text{rad}}{\text{min}}\right)^2 \left(\frac{\text{min}}{\text{sec}}\right) \left(\frac{\text{sec}}{0.8}\right)$$

$$= 11.52 \text{ rad/s}$$

72. C

$$\sigma = \frac{\text{Actual Mechanical Advantage}}{\text{Ideal Mc}}$$

$$\sigma = \frac{15}{12} = 0.75$$

$$(55) W = F \times d \\ = (12)(120 \text{ lb})(12 \text{ ft}) \\ = 1440 \text{ ft-lb} \\ = 1453.2 \text{ ft-lb}$$

$$76) \frac{d}{dt} = 1.25 \sin(1.1t - 0.25)$$

$$= 1.25 \cos(1.1t - 0.25)(1.1) t=0$$

$$= 0.357 = 0.36 \text{ cm/p}$$

MDS REFRESHER COURSE

75. What is the value of the bending stress for a beam 40 mm wide and 50 mm deep that is subjected to a 7 N-m bending moment at each end?

A. 222 MPa C. 332 MPa
B. 322 MPa D. 232 MPa

✓

76. A certain vibrator obeys the following equation $y = 1.20 \sin(1.10t - 0.25)$ cm, for t is in seconds, and the angle is in radian. Calculate its acceleration at $t = 0$.

A. 0.16 cm/s² C. 0.56 cm/s²
B. 0.36 cm/s² D. 0.26 cm/s²

✓

77. A ventilating fan having an 18-in. cast iron pulley is driven from a 25-hp at 870 rpm normal-torque motor placed directly below it. The steel pulley on the motor is 10 in. in diameter, and the center distance is 5 ft. Calculate the belt speed.

A. 2280 fpm C. 1320 fpm
B. 2050 fpm D. 1540 fpm

78. A brass condenser tube 1 in. in diameter and 4 ft long has a wall thickness equivalent to No. 16 BWG (wall thickness = 0.065 in.). Calculate the collapsing pressure.

A. 3,591 psi C. 1,250 psi
B. 2,450 psi D. 4,250 psi

$$= \frac{\pi d^4 N_p}{16t} = \frac{\pi (1)^4 \times 700}{16 \times 0.065} = 2700$$

$$P_c = \frac{\pi d^4 \sigma}{16t} = \frac{\pi (1)^4 \times 36,000}{16 \times 0.065} = 2474$$

79. Two gear wheels are meshed together. The larger wheel has a diameter of 0.75 cm and the smaller is 0.25 cm. How many revolutions does the smaller wheel turn when the larger turns 4 revolutions?

A. 10 C. 12 ✓
B. 14 D. 16

80. A 12-in. diameter pulley is belt driven with a net torque of 120 ft-lb. Calculate the minimum tension in the belt if the ratio of tensions in the tight to slack sides of the belt is 3 is to 1?

A. 360 lbf C. 240 in-lbf
B. 120 lbf D. 320 in-lbf

LF

81. A brass condenser tube 1 in. in diameter and 4 ft long has a wall thickness equivalent to No. 16 BWG (wall thickness = 0.065 in.). Determine the permissible working pressure with an apparent factor of safety of 10.

A. 359.1 psi C. 253.2 psi
B. 254.7 psi D. 425.3 psi

UF

82. The ratio of the absolute angular speed of the last wheel or driven to the absolute angular speed of the first wheel or driver.

A. Train Value C. Speed Ratio
B. Efficiency D. Mechanical Advantage

83. A multiple-disk clutch has 22 pairs of identical mating friction surfaces each with 10.25 in. outside diameter and 3.125 in. inside diameter annular contact area. The disks are cast iron and steel operating in an oil bath with maximum pressure of 1,200 psi. After this clutch has been in operation for a period of time and has become worn, determine the probable power rating of this clutch at 1,800 rpm. Note: $f = 0.06$ for cast iron against steel (wet).

A. 2,590 hp C. 1,590 hp
B. 5,290 hp D. 5,390 hp

LF

Wear

$N = 22$

$$P = 441 N$$

$$P = F_2 q_1 h_F$$

$$T = F_a m N f$$

$$F_a = P A \quad P = \frac{F}{A} \quad A = \pi d^2 / 4 \quad t = \frac{D_o - d}{2}$$

MACHINE DESIGN & SHOP PRACTICE

86. A steel bandsaw blade is 0.60 mm thick. If the modulus of elasticity of steel is given to be 206 GPa, calculate the bending stress of the blade that is passing around the pulley of 420 mm diameter.

A. 298.6 MPa C. 259.8 MPa
B. 329.8 MPa D. 429.6 MPa

LT

87. The minimum number of independent joints variables in a mechanism that must be specified in order to completely define the mechanism's configuration.

A. Degrees of Freedom C. Mobility
B. Kinematic Chain D. Motion

88. A multiple-disc clutch consists of 8 steel discs and 6 bronze discs. The effective diameters are 6 in and 4 in respectively. Compute its power capacity if an axial force of 100 lb is applied to the shaft rotating at 1000 rpm given the coefficient of friction of 0.32 using uniform wear theory.

A. 20.5 hp C. 43.2 hp
B. 16.5 hp D. 13.4 hp

$$T = \frac{1}{2} F_r r \times F_m$$

$$n = 14 - 1 = 13$$

89. A ventilating fan having an 18-in. cast iron pulley is driven from a 25-hp at 870 rpm normal-torque motor placed directly below it. The steel pulley on the motor is 10 in. in diameter, and the center distance is 5 ft. What is the total length of the belt?

A. 176.5 in C. 109.7 in
B. 164.25 in D. 280.2 in

$$\frac{1}{2} (6 + 10) + 2C + \frac{(18+10)}{2}$$

90. A plate, cylinder, or other solid with a surface of contact so designed as to cause or modify the motion of a second piece, or itself.

A. Cam C. Train
B. Roller D. Follower

91. A plate clutch has single friction surface with outside diameter of 12 inches and inside diameter of 6 inches. Calculate the torque that the clutch can carry given that the axial force is equal to 4000 lbf and a coef. of friction of 0.20. Note: use uniform pressure theory and $f = 0.2$.

A. 4350 in-lbf C. 4508 in-lbf
B. 3733 in-lbf D. 2039 in-lbf

$$t_m = \frac{1}{3} \left(\frac{D_o^3 - D_i^3}{D_o^2 - D_i^2} \right)$$

92. The surfaces of contact between two pieces that have relative motion, one of which supports or partially supports the other. One of the pieces may be stationary or both pieces may be moving.

A. Bearings C. Collars & Keys
B. Crank D. Levers

93. It consists of a number of pairs of elements connected by links.

A. Linkage C. Kinematic Chain
B. Mechanism D. Kinematic Inversions

94. A railroad track with rails 33 feet long is laid at a temperature of 15°F with gaps of 0.01 feet between the ends of the rails. What stress will result from a temperature at 110°F with a condition that they are prevented from buckling?

A. 9434 psi C. 9097 psi
B. 9787 psi D. 9654 psi

95. A combination of rigid bodies so arranged that the motion of one compels the motion of the others, according to a law depending on the nature of the combination.

A. Machine C. Structure
B. Mechanism D. Frame

$$S = E \Delta T$$

$$\Delta T = \alpha L \Delta T$$

$$0.01 = (6 \times 10^{-6}) (33)(\Delta T - 15)$$

$$\Delta T = 61.62^\circ F$$

$$S = E \Delta T$$

$$= (130 \times 10^6 \text{ ps}) ((6.5 \times 10^{-6}) (61.62 - 110))$$

$$S = 924,949.4 \text{ psi}$$

85. Mechanisms that are derived from the same kinematic chain but have a different link fixed to ground.

A. Linkage C. Kinematic Chain
B. Mechanism D. Kinematic Inversions

87. A

86. D

81. A

82. A

83. A

84. A

85. D

86. A

87. A

88. A

89. A

90. A

91. A

92. A

93. B

94. B

95. B

96. B

97. B

98. B

99. B

100. B

MDSF REFRESHER COURSE

26. What is the maximum normal stress on an element of hollow sphere of radius 10" and thickness 0.1" that is subjected to an internal pressure of 100 psi?

- A. 5,000 psi
- B. 7,070 psi
- C. 10,000 psi
- D. 14,140 psi

27. What is the cutting speed in fpm for a spindle speed of a lathe that is turning an 8 in. diameter bronze using a spindle speed of 120 rpm?

- A. 220 fpm
- B. 301.6 fpm
- C. 2510 fpm
- D. 251 fpm

28. A helical-coil spring has a mean coil diameter of 1 inch and a wire diameter of 1/8 inch. Determine the Wahl factor of the spring.

- A. 1.148
- B. 1.41
- C. 1.184
- D. 1.814

29. The reciprocal of a diametral pitch or the ratio of the pitch diameter to the number of teeth.

- A. Clearance
- B. Lead
- C. Involute
- D. Module

100. A 912 mm driving pulley and a 1220 mm driven pulley are being set-up on a 3 meter center distance. The output of the driven shaft is 72 Hp. Compute the rpm of the driven shaft considering that the belt speed is 1280 m/min with a coefficient of friction of 0.30 and a slip of 1.5% each pulley.

- A. 329 rpm
- B. 454 rpm
- C. 452.9 rpm
- D. 543.5 rpm

MACHINE DESIGN & SHOP PRACTICE

$$q_6) \quad S = \frac{P_d}{q_{4b}} = \frac{100 \text{ psi} (20)}{4 (0.118)}$$

$$S = 5000 \text{ psi}$$

q9. D

100.

$$100.) \quad V = \pi DN$$

$$1280 \text{ m/min} = \pi (1.912 \text{ m}) N (1 - 1.5\%)$$

$$100.) \quad V = \pi DN$$

$$\approx (1 - 1.5\% \text{ slip}) = \pi DN$$

$$\frac{12080 \text{ m}}{\text{min}} (1 - 1.5\%) = \pi (1220 \text{ mm}) \left(\frac{1 \text{ m}}{100 \text{ mm}} \right) N$$

$$N = 728.96 = 729$$

$$V = \pi DN$$

$$(1280)(1 - 1.5\%) = \pi (912) N$$