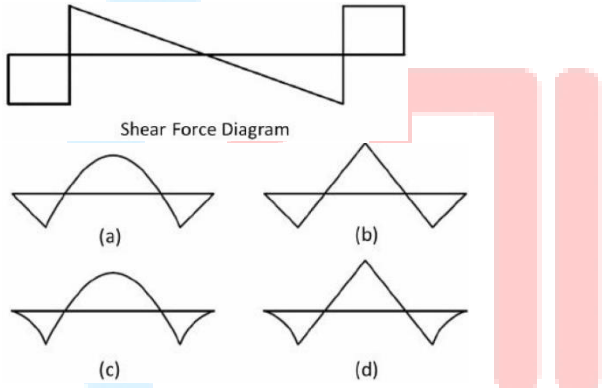
ISRO VSSC TA 2021

Q1. A mass of 2 kg is hung from the ceiling by a helical spring. When hung, the spring suffers an extension of 100 mm. If the mass is slightly displaced downward and released, it will oscillate at a frequency of (acceleration due gravity at the location is 10 m/s^2)

a. 1.6 hz
b. $\sqrt{50}\ Hz$
c. $10\ Hz$
d. $50\ Hz$

Q2. The shear force diagram is shown for a loaded beam. The corresponding bending moment is represented by



a. a
b. b
c. c
d. d

Q3. A dimension is stated as 25 H7 in a drawing. The lower limit is:

a. 24.75
b. 25.00
c. 25.25
d. none of the above

Q4. One fourth chain of mass M and length L is hanging down from a table. The work done to pull the hanging part of the chain on to the table is

a. Mgl/8
b. Mgl/16
c. Mgl/4
d. Mgl/32

Q5. If the atomic radius of Aluminium (FCC) is r, what is unit cell volume

a. $\left(\frac{2r}{\sqrt{2}}\right)^3$
b. $\left(\frac{4r}{\sqrt{2}}\right)^3$
c. $\left(\frac{2r}{\sqrt{3}}\right)^3$
d. $\left(\frac{4r}{\sqrt{3}}\right)^3$

Q6. A cylindrical specimen of steel having an original diameter of 11mm is tensile tested to fracture and found to have engineering fracture strength of 400 MPa. If the cross sectional diameter of fracture is 10mm, the true stress at fracture is

a. 440 MPa
b. 484 MPa
c. 400 MPa
d. none of the above

Q7. On evaluating $\sqrt{\frac{44.1}{0.169}}$ We get

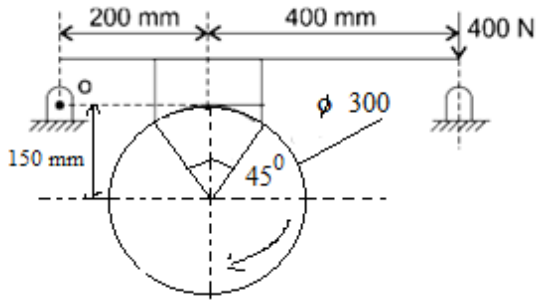
a. 21
b. $20\sqrt{2}$
c. $16\frac{2}{13}$
d. $17\sqrt{3}$

Q8. Bin card is used in

a. workshop
b. foundry
c. purchase department
d. stores department

Q9. A brake-block shown below has a face width of 300mm. The mean coefficient of

friction is 0.25. For van activating force of 400N, the braking torque in Nm is



a. 30
b. 40
c. 45
d. 60

Q10. ABC analysis deals with
a. inventory control
b. scheduling and routing
c. statistical quality control
d. process planning

Q11.Which of the following processes does not cause tool wear?
a. ultrasonic machining
b. electric discharge machining
c. electrochemical machining
d. all of them

Q12. Which is the following is not a property of a thermodynamic system?
a. internal energy
b. heat
c. pressure
d. temperature

Q13. Which of the following represents a form tolerance?
a. flatness
b. parallelism
c. concentricity
d. total run out

Q14. Which of the following phase of steel is NOT present in Iron-Carbon phase diagram?
a. ferrite
b. cementite
c. austenite
d. martensite

Q15. A cam is used to impart a desired motion to a follower by direct contact. Which of the follower motion will produce least jerk to the system?
a. simple harmonic
b. constant acceleration
c. cycloidal
d. constant velocity

Q16. The equation of the tangent to y = $\sqrt{10-3x}$ At the point where x =3 is
a. 3x – 2y = 11
b. 2x + 3y = 11
c. 2x – 3y = 11
d. 3x + 2y = 11

Q17. In a machine , if 'MA' is the mechanical advantage , 'VR' is the velocity ratio and 'η' is the efficiency , then
a. $\eta = \frac{VR}{MA}$
b. $\eta = \frac{MA}{VR}$
c. $\eta = MA \times VR$
d. $\eta = \frac{(MA-1)}{VR}$

Q18. During tensile testing of a specimen using Universal Testing Machine, the parameters actually measured are
a. true stress and strain
b. poison's ratio and young's modulus
c. engineering stress and engineering strain
d. load and elongation

Q19. If the mean coil diameter and wire diameter of a helical compression or

tension spring are doubled, then the deflection of the spring under the same applied load will be

a. halved
b. doubled
c. increased by four times
d. reduced to one-fourth

Q20. A pinion having 20° full depth involute profile has 19 tooth and the meshing gear has 37 tooth. If the module is 5mm, the center distance between the gear pair will be

a. 140 mm
b. 150 mm
c. 280 mm
d. 300 mm

Q21. A rectangular box with square base has its length 15 cm greater than its breadth and the total length of its edges is 1.8m. Its volume is

a. 1250 cm^3
b. 1500 cm^3
c. 2000 cm^3
d. 2500 cm^3

Q22. The exact relationship between modulus of rigidity C, modulus of elasticity E and Poisson's ratio $\boldsymbol{\nu}$ is expressed as

a. $E = C(1 + \boldsymbol{\nu})$
b. $C = E(2 + \boldsymbol{\nu})$
c. $C = E/2(1 + \boldsymbol{\nu})$
d. $C = \frac{E}{1+2\nu}$

Q23. A steel rail, rigidly fixed at its ends is assumed to be stress free at $20°C$. If the stress required to cause the buckling of the rail is $-75\ MPa$, at what temperature will the rail buckle?(E = 200 GPa and $\alpha = 12.5 \times 10^{-6}/°C$)

a.-10 $℃$
b. 50 $℃$
c. 30 $℃$
d. 80 $℃$

Q24. The extrusion process used for t he production of tooth paste tube is:

a. forward extrusion
b. deep drawing
c. impact extrusion
d. tube extrusion

Q25. Rankine cycle efficiency of a steam power plant may be in the range of

a. 5-10%
b. 35-45%
c. 70-80%
d. >90%

Q26. In the finish turning of a 40 mm diameter job in a lathe, the tangential cutting force is 50 N, when the spindle is running at 300 rpm. The power required is

a. 10π
b. 20π
c. 6 watts
d 63 watts

Q27. In power transmission shafts, if the polar moment of inertia of a shaft is doubled, then what is the torque required to produce the same angle of twist

a. one fourth of the original value
b. half of the original value
c. same as the original value
d. double of the original value

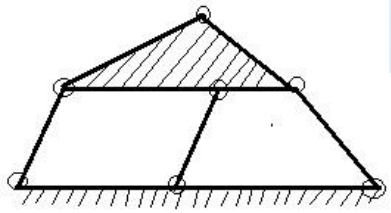
Q28. In an isothermal process, internal energy of the gas molecules

a. increases
b. decreases
c. remains constant
d. may increase or decrease

Q29. By solving the simultaneous equations $\frac{2}{x}+\frac{3}{y}=7$ and $\frac{1}{x}-\frac{4}{y}=-2$, solution obtained for (x,y) is

a. $(\frac{1}{2},1)$
b. $(2,3)$
c. (4,7)
d. (7,-2)

Q30. The number of degree of freedom for the arrangement given below is



a. 0
b. 1
c. 2
d. 3

Q31. A simple pendulum of length 5m, having a bob of mass 1 kg, is in simple harmonic motion. The net force on the bob at the mean position is

a. zero
b. 2.5 n
c. 5 n
d. 25 n

Q32. Steam enters a De Laval steam turbine with an inlet velocity of 30 m/s and leaves with an outlet velocity of 10 m/s. The work done by 1 kg of steam is

a. 400 Nm
b. 600 Nm
c. 800 Nm
d. 1200 Nm

Q33. For two rubber bands of identical free length, the first rubber band extends 60 mm under a force of 300 N, while the second rubber band extends 20 mm under 200 N force. When both the rubber bands are paralleled together and applied a force of 60N, its extension is

a. 80 mm
b. 40 mm
c. 4 mm
d. 3 mm

Q34. An impulse turbine produces 50 kW of power when the blade speed is 400 m/s. The rate of change of momentum tangential to the rotor is

a.200 N
b. 175 N
c. 150 N
d. 125 N

Q35. A 50 mm diameter shaft is made rotate in a bush. The tolerances for both shaft and bush are 0.050 mm. With the Hole basis tolerance system, determine the dimensions of the shaft and bush to ensure a minimum clearance of 0.075 mm.

a. bush: $50^{+0.050/0}$ and shaft: $50^{+0.025/-0.075}$
b. bush:$50^{0/-0.050}$ and shaft: $50^{-0.075/-0.125}$
c. bush: $50^{+0.050/0}$ and shaft: $50^{-0.075/-0.125}$
d. bush: $50^{0/-0.050}$ and shaft: $50^{+0.025/-0.075}$

Q36. A car travelling at speed V can just take a turn around a bend of radius R without skidding sideways. Under identical road conditions, if this person wants to double the speed, the minimum turn radius he can make without skidding is

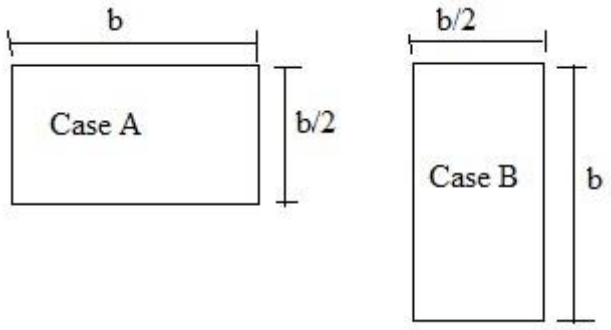
a. 4R
b. 2R
c. R/4
d. R/2

Q37. For a floating body, the Center of Gravity 'G', Center of buoyancy 'B' and the Metacenter 'M' are considered for verifying the conditions of stability. Which of the

condition is essential to achieve stability of the floating body?

a. G should be below B
b. M should be above G
c. B should be below G
d. M should be below G

Q38. A beam of same cross section is used in two different orientations as shown in figure. Bending moment applied to the beam in both cases are same. The maximum bending stress induced in case A and B are related to



a. $\sigma_A = 2\sigma_B$
b. $\sigma_A = \sigma_B$
c. $\sigma_A = \sigma_B/2$
d. $\sigma_A = \sigma_B/4$

Q39. A grindstone used in a grinding machine is of diameter 210 mm and is capable of being opened at 1200 rpm. What is the maximum grinding speed possible with this machine? $(\pi = 22/7)$

a. 26.4 m/s
b. 13.2 m/s
c. 79.2 m/s
d. 6.6 m/s

Q40. To evaluate the impact strength of a material, a notched specimen was used in an Izod impact testing machine. The impact mass is 20 kg and the swing arm is 1 m long. The mass is swung 120° from the lowest vertical point to its release point and and released to impact the specimen. After impacting the specimen , the mass swings 90° from the lowest vertical point towards the opposite direction. What is the energy absorbed by the specimen?

a. 100 j
b. 50 j
c. 150 j
d. 120 j

Q41. The maximum distortion energy theory of failure is suitable to predict the failure of which one of the following types of materials.

a. brittle materials
b. composite materials
c. plastics
d. ductile materials

Q42. In a horizontal pipe line at location 1, the fluid pressure head is 32 cm and velocity head is 4cm. The reduction in area ta location 2 in the same pipe is such that the pressure head drops down to zero. The ratio of velocities at location 2 to that of location 1 is

a. 3
b. 2.5
c. 2
d. 1.5

Q43. In a shaper machine the, mechanism for tool feed is

a. geneva mechanism
b. ratchet and pawl mechanism
c. ward-leonard system
d. whit worth mechanism

Q44. A mass of 2 kg oscillating in simple harmonic motion has a maximum displacement of 20 mm and a time period of 1.57s. At time t = 0, the displacement is 0. Then the acceleration is

a. -0.32 sin(4t)
b. -0.02 cos(4t)

c. -0.32cos (4t)
d. none of the above

Q45. Which one of the following pump is not a positive displacement pump?
a. reciprocating pump
b. centrifugal pump
c. vane pump
d. gear pump

Q46. A key having a square cross section of side d/4 and length l is used to transmit torque T from the shaft of diameter d to the hub of a pulley. Assuming the length of the key to be equal to the thickness of the pulley, the average shear stress developed in the key is given by
a. $\frac{4T}{ld}$
b. $\frac{16T}{ld^2}$
c. $\frac{8T}{ld^2}$
d. $\frac{16T}{ld^3}$

Q47. A slotted head screw is torque to 4 Nm using a screw driver having a blade of 5mm width. The couple force exerted by the blade edges on the screw slot is
a. 4 N
b. 800 N
c. 400 N
d. 20 N

Q48. Air at $20℃$ blows over a hot plate $50\text{cm} \times 75\text{cm}$ maintained at 250 ℃. The convection heat transfer coefficient is 25 W/m²℃. The heat transfer rate is
a. 2.156 kW
b. 3.863 kW
c. 1.764 kW
d. none of the above

Q49. A 150 mm long, 12.5 mm diameter stainless steel rod is being reduced to a diameter of 12 mm by turning operation. The lathe spindle rotates at N =400 rpm. Calculate the cutting speed.
a. 16 m/min
b. 20m/min
c. 15.7m/min
d. 31.4 m/min

Q50. In a single row deep groove ball bearing, cages are needed to
a. separate the two races
b. separate the balls from inner race
c. separate the outer race from the balls
d. ensure that the balls do not cluster at one point

Q51. On expressing the decimal 0.121212…. As fraction gives
a. 12/101
b. 12/99
c. 11/90
d. 1212/10000

Q52. If the load on a ball bearing is reduced to one third, then its life would increase by
a. 3 times
b. 27 times
c. 9 times
d. 81 times

Q53. A fillet welded joint is subjected to transverse loading F as shown in the figure. Both legs of the fillets are of size h and the weld length is l. The average shear stress on the throat area is

a. $\frac{0.707F}{hl}$
b. $\frac{F}{0.5hl}$
c. $\frac{2F}{hl}$
d. $\frac{F}{hl}$

Q54. The force experience by a key used in a gear train for power transmission is
a. tensile force
b. shear force
c. shear and crushing force
d. torsional force

Q55. A point on a rigid flywheel of radius 750mm undergoes a uniform linear acceleration of 3m/s^2. The flywheel's angular acceleration is
a. 0.25 rad/s^2
b. 2.5 rad/s^2
c. 4 rad/s^2
d. 250 rad/s^2

Q56. During winter season in Delhi, the Temperature was 5℃. Ravi takes 21 litres of water in a bucket for bathing (water temperature – ambient). How much boiling water (100℃) should be added to the bucket to increase the temperature of total quantity of water in the bucket to 30℃? (Sp. Heat of water = 4.2 J/g, Water density = 1g/cc)
a. 10 liters
b. 2 liters
c. 5 liters
d. 7.5 liters

Q57. Maximum shear stress developed on the surface of a solid circular shaft under pure torsion is 240 MPa. If the shaft diameter is doubled, what is the maximum shear stress developed for the same torque
a. 30 MPa
b. 60 MPa
c. 120 MPa
d. 15 MPa

Q58. If A is the number of units consumed per year, P is the procurement cost per order and C is the annual inventory cost per unit, the economic order quantity is given by
a. $\frac{2AP}{C}$
b. $\frac{\sqrt{2AP}}{C}$
c. $\sqrt{\frac{2AP}{C}}$
d. none of the above

Q59. If there are two springs A and B of stiffness K_A And K_B Respectively, and if $K_A > K_B$, then on application of the same force, work done is more in
a. b
b. a
c. same in both
d. information sufficient

Q60. The minimum torque required for rotating a flywheel of moment of inertia 2.1 kgm^2 from rest to a speed of 1200 rpm in 6s? ($\pi = 22/7$)
a. 22 Nm
b. 2.64 kNm
c. 5.28 Nm
d. 44 Nm

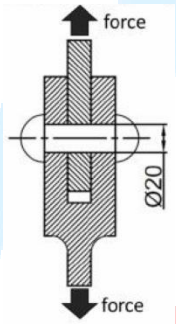
Q61. Rate of change of bending moment is
a. load intensity
b. half of shear force
c. half of load intensity
d. shear force

Q62. The specific speed of a turbine is the speed of an imaginary turbine, identical with the given turbine, which
a. delivers unit discharge under unit speed
b. delivers unit discharge under unit head
c. develops unit power under unit speed
d. develops unit power under unit head

Q63. A wheel makes 360 rev in one minute. Through how many radians does it turn in one sec.

a. 37.7
b. 75.4
c. 6.3
d. 18.85

Q64. To evaluate the shear strength of a rivet material, a tensile test was done with a 20 mm diameter rivet in a configuration as shown in figure. At 8.8 kN, the rivet shears off. The ultimate shear strength of the rivet material is ? $(\pi = \frac{22}{7})$



a. 21 MPa
b. 14 MPa
c. 18 MPa
d. 10 MPa

Q65. Radius of gyration (k) of a body is not dependent on
a. shape of the body
b. mass of the body
c. position of the axis of rotation
d. size of the body

Q66. Vehicle of mass m moves on a rough horizontal road with momentum p. The stopping distance for 'μ) (road friction) is
a. $\frac{p^2}{2\mu mg^2}$
b. $\frac{5p}{2\mu mg}$
c. $\frac{3p}{2\mu m^2 g}$
d. $\frac{p^2}{2\mu m^2 g}$

Q67. $\frac{X}{(X+2)(X+3)}$ **=**
a. $\frac{2}{5(X+2)} - \frac{3}{5(X-3)}$
b. $\frac{2}{5(X+2)} + \frac{3}{5(X-3)}$
c. $\frac{2}{5(X-2)} - \frac{3}{5(X+3)}$
d. $\frac{2}{5(X-2)} + \frac{3}{5(X+3)}$

Q68. For an organization producing a product, the fixed cost per month is Rs.12,000. The variable cost per product is Rs.24. The unit selling price of the product is Rs.48. To achieve break-even, the minimum production per month shall be
a. 400
b. 480
c. 500
d. 600

Q69. If the shear force acting at every section of a beam is of the same magnitude and of the same direction, then it represents
a. simple supported beam with point load at centre
b. overhung beam having equal point loads acting in the same direction at the free ends
c. cantilever subjected to concentrated load at the free end
d. simply supported beam having point loads of equal magnitude and in same direction at equal distances from the supports

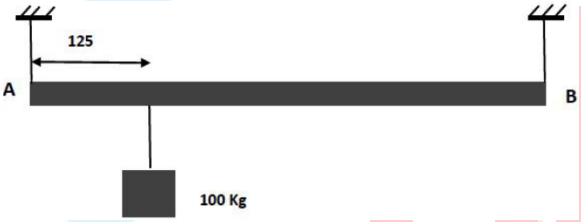
Q70. While considering collision of bodies, which of the following statements are true?
A. Energy and momentum are conserved during elastic collisions
B. Momentum is conserved during inelastic collisions
C. Energy is conserved during inelastic collisions
D. Energy and momentum are conserved during completely inelastic collisions
a. B & C
b. C & D

c. A & B
d. A & C

Q71. A metal block of mass 5 kg and temperature 100℃ cools to a temperature of 50℃. The specific heat of the metal is 600 J/kg℃ and its density is 8000 kg/m^3. The heat lost by the metal block is

a. 600 kJ
b. 800 kJ
c. 150 kJ
d. 120 kJ

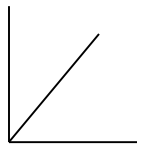
Q72. A uniform rigid bar of length 500 mm and weight 20 kgf is supported horizontally by two vertical strings at its ends and carries a load F = 100 kgf as shown. The tension in the strings at A and B respectively are



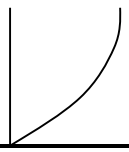
a. 75 kgf and 25 kgf
b. 125 kgf and 375 kgf
c. 25 kgf and 75 kgf
d. 85 kgf and 35 kgf

Q73. A toy train is moving horizontally on a frictionless straight track under the influence of a constant power supplying source. Which of the plot shown below represents the displacement time curve for its motion.(horizontal-x axis; vertical y-axis):

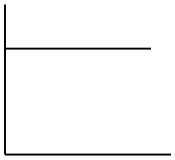
a.



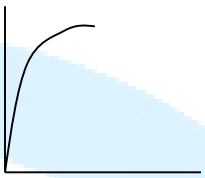
b.



c.



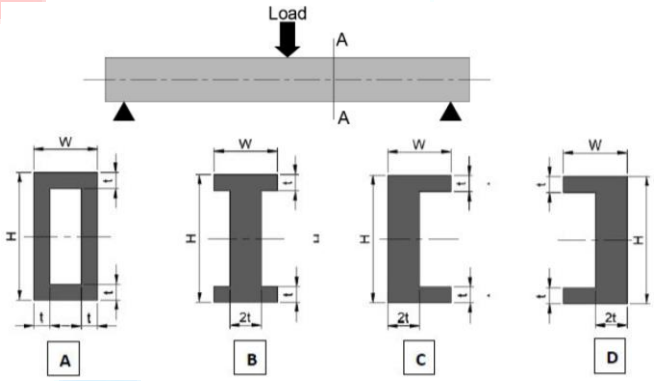
d.



Q74. Elastic limit of cast iron as compared to its ultimate breaking strength is

a. half
b. double
c. same
d. none of the above

Q75. The various options of uniform sections (A-A) were considered while designing a beam (loading details shown). Which section will have the minimum deflection?



a. option A
b. option B
c. option C and D
d. all of the above

Q76. If the enthalpy drop in the moving blades and fixed blades of a steam turbine

are 10 kJ/kg and 15 kJ/kg respectively, then the degree of reaction is

a. 67%
b. 60%
c. 40%
d. 33%

Q77. The value of $16^{\log_2 3}$ Is

a. 64
b. $\frac{\sqrt{3}}{2}$
c. $\sqrt{\frac{3}{2}}$
d. 81

Q78. Why multistaging is used in centrifugal pumps?

a. for high flow rate
b. for high speed
c. for high head
d. for high efficiency

Q79. In a batch of 100 resistors of $1k\Omega$ resistance , 80 numbers are within the required tolerance values and 11 numbers are below the required tolerance values, the remaining are above the required tolerance values. If two resistors are drawn one after the other without replacement, the probability of the first one drawn is below and the second one drawn is above the required tolerance value is

a. 0.01
b. 0.09
c. .11
d. 0.89

Q80. For discharge Q, the specific speed of a pump is N. For double the discharge with the same head, the specific speed will be

a. $\frac{N}{2}$
b. $\sqrt{2}N$
c. $\frac{N}{\sqrt{2}}$
d. $2N$

VSSC TA 2021 SOLUTION

Ans1. a

Sol. Given

Mass(m) = 2kg

Extended length (L) = 100 mm

L = 0.1m

G = 10 m/s^2

As we kNow that :

Frequency(ν) = $\frac{1}{2\pi}\sqrt{\frac{g}{L}}$

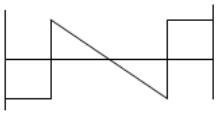
$= \frac{1}{2\times 3.14} \times \sqrt{\frac{10}{0.001}}$

= 1.59 ~1.6 Hz

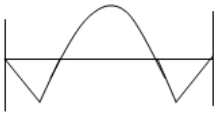
Ans2.a

Sol. Dear students always remember in your mind is that:

For straight line in SFD there will be inclined line for BMD, for inclined line in SFD there will be parabolic curve for BMD, for parabolic curve in SFD there will be cubic curve for BMD and vice versa.



SFD



BMD

Ans3. b

Sol. A dimension is stated as Dia 25 H7 in a drawing. The lower limit is 25.00mm.

For 25 H7 Tolerance Grade

Basic Size = 25.000 mm

ES = +21 Microns = 0.021mm

EI = 0 Microns = 0.000 mm

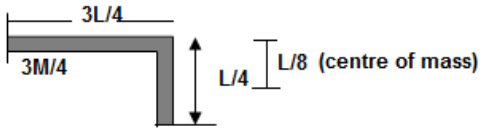
Hence

Lower limit = Basic size + EI = 25.000 + 0.000 = 25.000mm

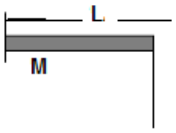
Upper limit = Basic size + ES = 25.000 + 0.021 = 25.021 mm

Ans4. d

Sol. Step-1 : Draw free body diagram of given situation



Initial Position



Final position

Step-2 Potential energy in initial and final condition

If reference is taken at table then in initial condition 3/4th part of chain is at table so potential energy of 3/4th part is zero and potential energy of 1/4th part lies at centre of mass.

So initial potential energy $U_i = \frac{M}{4} g \frac{L}{8}$

$U_i = \frac{MgL}{32}$

In final condition whole chain lies on table so final potential energy is zero, U_f =0

Step-3 Apply Work Energy theorem

Work done by all forces are equal to kinetic energy.

$$W_{ext} + W_{mg} = \Delta K$$

As initial and final kinetic energy is same so change in kinetic energy is zero.

$\Delta K = 0$

So $W_{ext} - \Delta U = 0$

$\rightarrow W_{ext} = \Delta U$

$\rightarrow W = U_f - U_i$

$\rightarrow W = 0 - \frac{MgL}{32}$

$\rightarrow W = \frac{MgL}{32}$

Ans5. b

Sol. Unit cell volume (FCC) = $\left(\frac{4r}{\sqrt{2}}\right)^3$

Ans6. b

Sol.

True stress at fracture σ_t = $\sigma_o(1+e)$

OR

$\sigma_t = \sigma_f(A_i/A_f)$

D_i = 11mm

d_f = 10mm

σ_f = 400 MPa

$\Sigma_t = 400\times \frac{\frac{\pi}{4}11^2}{\frac{\pi}{4}10^2} = 400\times \frac{121}{100} = 4 \times 121 = 484$

Ans7. c

Sol.

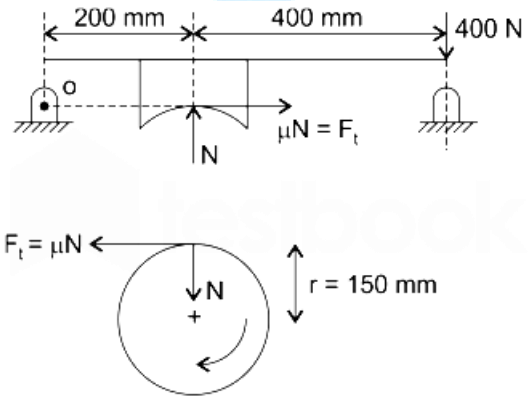
$\sqrt{\frac{44.1}{0.169}} = \sqrt{\frac{441}{169\times10^{-2}}} = \frac{210}{13} = 16\frac{2}{13}$

Ans8. d

Sol. Bin cards, which are sometimes referred to as inventory cards or stock cards, are record-keeping documents used in retail and other businesses that require a stock room.

Ans9. c

Sol.



For lever moment about O, $\sum M_o = 0$

$\rightarrow (400N) \times (400 + 200)mm = N \times 200mm$

$Normal\ force, N = \frac{400\times600}{200} = 1200\ N$

Tangential force , $F_t = \mu N = 0.25 \times 1200 = 300N$

Braking torque = $T_b = F_t \times r = 300 \times 0.15 = 45\ N.m$

Ans10. a

Sol. ABC analysis is an inventory management technique that determines the value of inventory items based on their importance to the business. ABC ranks items on demand, cost and risk data, and inventory mangers group items into classes based on those criteria.

Ans11. c

Sol. Electrochemical machining (ECM) is a machining process in which electrochemical process is used to remove materials from the work piece. In the process, work piece is taken as anode and tool is taken as cathode. The two electrodes work piece and tool is immersed in an electrolyte (such as NaCl).

Ans12. b

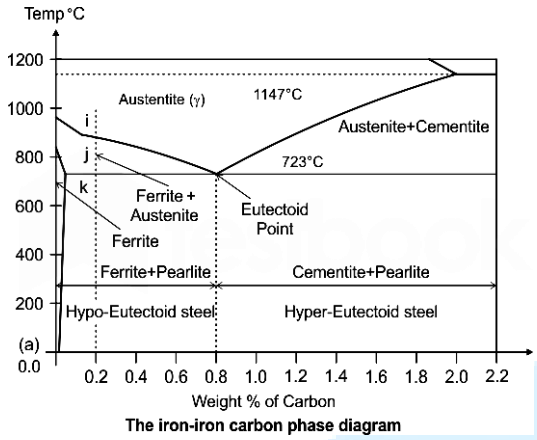
Sol. Heat is not a property of a thermodynamic system. It is path function and not an exact differential.

Ans13. a

Sol. Form tolerances can be state by four tolerance zone. These form tolerances are Straightness, Flatness, Circularity, and Cylindricity.

Ans14.d

Solution:



The iron-iron carbon phase diagram

The phase diagram has all three phases ferrite, pearlite, cementite but not martensite.

Ans15. c

Sol. In cycloidal motion, there are no abrupt changes in the velocity and acceleration at any stage of the motion. Thus in this type, there are least jerks and this is the most ideal motion for high-speed follower motion. Cycloidal motion curve has the best dynamic characteristics.

Ans16. d

Sol.

$Y = \sqrt{10 - 3x}$

Putting x = 3

$Y = \sqrt{10 - 9} = 1$

$\left(\frac{dy}{dx}\right)_{(3,1)}$ = ?

On differentiating equation

$\frac{dy^2}{dx} = \frac{d}{dx}(10 - 3x)$

$2\frac{dy}{dx} = 0 - 3$

$\frac{dy}{dx} = -\frac{3}{2}$

Equation of line

$(y - y_1) = m(x - x_1)$

$Y - 1 = -3/2(x - 3)$

$2y - 2 = -3x + 9$

$3x + 2y = 11$

Ans17. b

Sol. Efficiency of machine = $\frac{Mechanical\ advantage}{Velocity\ Ratio}$

Ans18. d

Sol. A tensile test, or tension test, is done by pulling on a tensile (normalized) specimen, to determine how the material reacts to forces being applied in tension. As the material is pulled, you determine the material's tensile strength and how much it will elongate.

Ans19. a

Sol. Given

$d' = 2d; D' = 2D$

Deflection of the spring $\delta = \frac{8D^3n}{Cd^4}$

$\delta' = \frac{8\times(2D)^3n}{C(2d)^4}$

$\delta' = \frac{\delta}{2}$

Ans20. a

Sol. Given

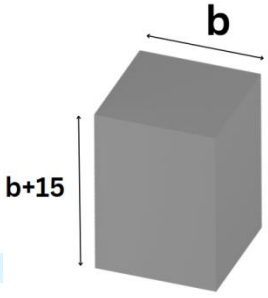
M = 5mm

$T_1 = 19\ tooth\ ;\ T_2 = 37\ tooth$

Centre distance $(R_1 + R_2) = m\left(\frac{T_1+T_2}{2}\right)$

Ans21. d

Sol.



2×4b + 4(b + 15) = 180

B = 10

Therefore volume = (15 + 10)×10×10 = 2500 cm^3

Ans22. c

Sol. $C = \frac{E}{2(1+\nu)}$

Ans23. b

Sol.

$\Sigma_t = E \alpha \Delta T$

As σ_t is negative while it is sure that E and α are not negative therefore ΔT has to be negative I.e. $-(T_2 - T_1) = (T_1 - T_2)$ and also because at 20 degree C there is no resistance, so to have the resistance the steel obviously has to be higher than 20 degree C, hence ΔT has to be negative.

$-7.5 \times 10^6 = 200 \times 10^9 \times 12.5 \times 10^9 (20 - T_1)$

$T_1 = 20 + 30 = 50℃$

Ans24. c

Sol. IMPact extrusion is a manufacturing process similar to extrusion and drawing by which products are made with a metal slug. The slug is pressed at a high velocity with extreme force into a die or mold by a punch.

Ans25. b

Sol. Rankine cycle efficiency of a steam power plant may be in the range of 35-45%.

Ans26. a

Sol. Given

D = 0.04 m

F = 50 N

N = 300 rpm

Power = Force × Velocity

$= 50 \times \frac{\pi DN}{60}$

$= 50 \times \frac{\pi \times 0.04 \times 300}{60}$

$= 10\pi$ Watts

Ans27. d

Sol. Torsion equation

$\frac{T}{J} = \frac{\tau}{R} = \frac{C\theta}{l}$

You can see that

$T \propto J$

If J doubles then Torque also becomes double.

Ans28. c

Sol. Internal energy is the function of temperature, during isothermal process the temperature remains constant so the internal energy remains constant.

Ans29. a

Sol.

$\frac{2}{x} = 7 - \frac{3}{y}$ .....1)

$\frac{1}{x} - \frac{4}{y} = -2$ .....2)

$\frac{2}{x} = -4 + \frac{8}{y}$

Putting value of 2/x from 1)

$7 - \frac{3}{y} = -4 + \frac{8}{y}$

Y = 1; x = 1/2

Ans30. a

Sol.

3(n-1) - 2j - h

= 3(5-1) - 2(6) - 0 = 0

Ans31. a

Sol. Bob has maximum velocity at it mean position. The bob crosses the mean position due to this velocity, though the force on bob is balanced at the mean position. This is the inertia of motion.

Ans32. a

Sol. Given

M = 1 kg

$V_1 = 30\ m/s$

$V_2 = 10\ m/s$

Work = $\frac{1}{2} m(V_2^2 - V_1^2)$

$= \frac{1}{2} \times 1 \times (10^2 - 30^2)$

= -400 Nm

Ans33. c

Sol.

Elongation = $\frac{P}{A}\frac{L}{E}$

60 = $\frac{300 \times L}{A_1 \times E_{rubber}}$ .....1)

20 = $\frac{200 \times L}{A_2 \times E_{rubber}}$ .....2)

$A_1 + A_2 = \left[\frac{300}{60} + \frac{200}{20}\right]\frac{L}{E} = \frac{60 \times L}{15 \times \frac{L}{E} \times E}$

X = $\frac{60 \times L}{(A_1 + A_2) \times E_{rubber}} = \frac{60 \times L}{15 \times \frac{L}{E} \times E}$ = 4

Ans34. d

Sol. Given

P = 50 kW = $50 \times 10^3\ W$

V = 400 m/s

Power = Force × Velocity

$50 \times 10^3 = Force \times 400$

$Force = 125\ N$

Ans35. c

Sol. Hole basis system

Size of hole is kept constant and the size of the shaft is varied to get the different class of fits.

Lower deviation of hole is zero.

So here: Lower limit of hole = 50mm

Tolerance is the difference between the maximum limit and minimum limit of size.

Upper limit of hole = Lower Limit + Tolerance = 50 + 0.05 = 50.05 mm

Calculation

Lower limit of shaft = Upper limit of hole +Minimum clearance = 50.05 + 0.075 = 50.125

Upper limit of shaft = Lower limit of shaft + Tolerance = 50.125 - 0.05 = 50.075

Ans36. a

Sol. You can solve this question by the concept i.e;

Centripetal force = Frictional force

$\frac{mv^2}{R} = \mu mg$

$R = \frac{v^2}{\mu g}$

If speed becomes double then

$R' = \frac{(2v)^2}{\mu g}$

$R' = \frac{4v^2}{\mu g}$

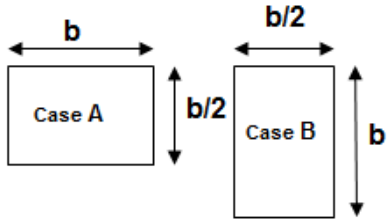
$R' = 4R$

Ans37. b

Sol. For floating body , metacentre M should be above centre of gravity G.

Ans38. a

Sol. According to question



We need t apply Pure bending equation firstly

$\frac{M}{I} = \frac{\sigma_b}{Y}$

$\frac{\sigma_A}{\sigma_B} = \frac{Z_B}{Z_A}$ ∴

$Z = \frac{I}{A}$

For rectangle : Z = $\frac{bd^2}{6}$

$\frac{\sigma_B}{\sigma_A} = \frac{(b \times \left(\frac{b}{2}\right)^2/6)}{(b \times (\frac{b}{2})/6)}$

$\frac{\sigma_B}{\sigma_A} = \frac{1}{2}$

$\sigma_A = 2\sigma_B$

Ans39. b

Sol. Given

D = 210mm

N = 1200 rpm

As we know that

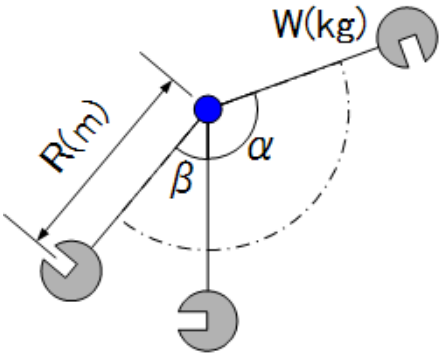
$V = \frac{\pi DN}{60}$

= $\frac{22 \times 210 \times 1200}{7 \times 1000 \times 60}$

V = 13.2 m/s

Ans40. a

Sol.



$E\,(J) = WgR\,(\cos\beta - \cos\alpha) - L$

E = wgr(cosβ - cosα) - L

= 20×10×1(cos90° - cos120°)

= $\frac{200}{2}$ = 100J

Ans41. d

Sol. Maximum distortion energy theory is most appropriate for the ductile material.

Maximum distortion energy theory (Von mises theory)

According to this theory, the failure or yielding occurs at a point in a member when the distortion strain energy per unit volume reaches the limiting distortion energy (i.e. Distortion energy at yield point) per unit volume as determined from simple tension test.

Ans42. a

Sol. Given

$\frac{P_1}{\rho g} = 32\ cm\ ; \frac{V_1}{2g} = 4\ cm$

$\frac{P_2}{2g} = 0; \frac{V_2}{2g} = ?$

Using Bernoulli's equation

$\frac{P_1}{\rho g} + \frac{V_1}{2g} + Z_1 = \frac{P_2}{2g} + \frac{V_2}{2g} + Z_2$

As pipe is horizontal so the $Z_1 = Z_2$

$32 + 4 = 0 + \frac{V_2^2}{2g}$

$\frac{V_2^2}{2g} = 36$

So the ratio of both velocity head becomes

$\frac{V_2^2}{V_1^2} = \frac{36}{4}$

$\frac{V_2}{V_1} = 3$

Ans43. d

Sol. A shaper Machine is a reciprocating type of machine that is used for producing horizontal, vertical flat surfaces. The work piece is fixed on the table and the Ram holds the single point cutting tool. During forwarding stroke, (the single point tools attached to the ram and work piece is fixed on a table).In a shaper machine, the mechanism for tool is Whitworth mechanism.

Ans44. a

Sol.

M = 2kg

A = 20mm = 0.02m

T = 1.57

X = Asin(ωt)

V = Aωcos(ωt)

A = $\frac{dv}{dt}$ = AΩ².-sin(ωt)

Ω = $\frac{2\pi}{T}$ = $\frac{2 \times 3.14}{1.57}$ = 4

A = -0.32sin(4t)

Ans45. b

Sol. A centrifugal pump is categorized as a non-positive displacement pump. Traps a certain amount of liquid and forces it from the suction to the discharge port. Flow rate remains constant as change in pressure. The internal clearances allow higher viscosity handling.

Ans46. c

Sol. Force of the shaft circumference is given by

$F = \frac{T}{\frac{d}{2}}$

$F = \frac{2T}{d}$

Shearing area = width× $length$

= $\frac{d}{4} \times l = \frac{ld}{4}$

Average shear stress= $\frac{P}{shear\ area}$

= $\frac{\frac{2T}{d}}{\frac{ld}{4}} = \frac{8T}{ld^2}$

Ans47. b

Sol. Given

Torque (T) = 4 Nm

Length = 5mm

Torque = $Force \times distance$

$T = F \times a$

$4\times 10^3 = F \times 5$

F = 800 N

Ans48. a

Sol. Given

$T_1 = 20℃ ; T_2 = 250℃$

Area (A) = 0.5×0.75m

$h = 25\ W℃/m^2$

$q = hA\Delta T$

$q = 25 \times 0.5 \times 0.75 \times (250 - 20)$

Q = 2156.25 W

$q = 2.156\ kW$

Ans49. c

Sol . Given

D = 12mm

N = 400

V = πDN

$V = \pi \times 0.012 \times 400$

$V = 15.079\ m/min$

Ans50. d

Sol. The function of a bearing cage (also known as a separator or a retainer) is to hold rolling elements in proper orientation so they don't group together. Bearing cages are produced in a wide variety of materials and for a wide variety of manufacturing processes.

Ans51. b

Sol. Let x = 0.121212……1)

100x = 12.1212…….2)

On subtracting equation (1) from equation (2)

99x = 12

X = 12/ 99 or 4/33

Ans52. b

Sol . We know

$L = \left(\frac{C}{P}\right)^k \times 10^6\ revolution$

Where

L is rating life , C is a basic dynamic load, P is the equivalent dynamic load

K = 3 for ball bearing

K = 10/3 for roller bearing

AS per question

$L = \left(\frac{C}{P}\right)^3 \Rightarrow L \propto \frac{1}{P^3}$

$\frac{L_1}{L_2} = \left(\frac{P_2}{P_1}\right)^3 = \frac{1^3}{3}$

$L_1 = \frac{L_2}{27}$

$L_2 = 27\ times\ L_1$

Ans53. a

Sol. Average shear stress on the throat area is:

$$\tau_{avg} = \frac{0.707F}{hl}$$

Ans54. c

Sol. The force experience by a key used in a gear train for power transmission is shear and crushing force.

Ans55. c

Sol. Given

Linear acceleration (a) = 3 m/s^2

R = 0.750 m

Angular acceleration(α) =?

We know

$a = r.\alpha$

$3 = 0.750 \times \alpha$

$\alpha = 4\ rad/s^2$

Ans56. d

Sol. Given

For water = 1 L = 1 kg

$\therefore$m = 1000 kg/m^3 x 21/1000 m^3

M_1 = 21 L = 21 kg

M_2 = ?

$C_1 = c_2 = c$ = 4.2 J/g

T_1 = 5°C

T_2 = 100°C

T_f = 30°C

$30 = \frac{21\times4.2\times5+m_2\times4.2\times100}{21\times4.2+m_2\times4.2}$

$30 = \frac{21\times5+100\times m_2}{21+m_2}$

$630 + 30m_2 = 105 + 100m_2$

$630-105 = 100m_2 - 30m_2$

$525 = 70m_2$

$$\therefore m_2 = \frac{525}{70} = 7.5\ kg$$

M_2 = 7.5 kg

Ans57. a

Sol. Given

$\tau_1 = 240\ MPa$

WE know

$\tau_1 = \frac{16T}{\pi d^3}$ $\quad\quad$ $\therefore \tau \propto \frac{1}{d^3}$

If the diameter becomes doubles then the shear stress

$\tau_2 = \frac{1}{8}\times\frac{16T}{\pi d^3}$

$\tau_2 = \frac{1}{8}\times 240$

$\tau_2 = 30\ MPa$

Ans58. c

Sol. EOQ = $\sqrt{\frac{2AP}{C}}$

Ans59. a

Sol. Let's consider the spring constant of two spring A and B are K_A And K_B Respectively and are stretched by applying the force of the same magnitude.

Extension in spring is x, the spring force is

$f = -Kx$.....(1)

Energy stored in spring is,

$E = \frac{1}{2}Kx^2$ .....(2)

From equation (1) and (2), we get

$E = \frac{f^2}{2K}$

From the above , $E \propto \frac{1}{K}$.....(3)

Given,

$K_A = 2K_B$

$\frac{E_A}{E_B} = \frac{K_B}{K_A} = \frac{K_B}{2K_B}$

$K_B = 2E_A$

Ans60. d

Sol. Given

I = 2.1 kgm^2

$N = 1200\ rpm$

$t = 6s$

$\omega = \frac{2\pi N}{60} = \frac{2\times\pi\times1200}{60}$

$\omega = 125.6637\ rad/s$

$\alpha = \frac{\omega}{t} = \frac{125.6637}{6} = 20.94\ rad/s^2$

And we know that

$T = I.\alpha$

= $2.1 \times 20.94\ rad/s^2$

Ans61. d

Sol. Rate of change of bending moment is shear force.

Ans62. d

Sol. Here's the formula for specific speed of turbine

$N_S = N\sqrt{P}/H^{5/4}$

Ans63. a

Sol. Given

$N = 360\ rpm$

T = 1 sec

$\omega = \frac{2\pi N}{60}$

$\omega = \frac{2\times\pi\times360}{60}$

$\omega = 37.699\ rad/s$

Ans64. b

Sol. Given

$P = 8.8\ kN$

$d = 20mm$

Double shear strength

$P_S = \tau \times 2 \times \frac{\pi}{4} d^2$

$\tau = \frac{P \times 2}{\pi \times d^2}$

$\tau = \frac{8.8 \times 10^3 \times 2}{\pi \times 20^2} = 13.528 \frac{N}{mm^2}$

$\tau = 14\ MPa$

Ans65. b

Sol. Radius of gyration (k) of a body is not dependent on mass of the body.

Ans66. d

Sol. Initial velocity (u) = $\frac{p}{m}$

Final velocity (v) = 0 (at the end vehicle must stop)

Force of friction = μmg (where g is acceleration due to gravity)

Acceleration due to friction = $-\frac{\mu mg}{m} = -\mu g$

(-ve sign shows that it is retardation)

Using the kinematic expression

$v^2 - u^2 = 2as$

$(0)^2 - \left(\frac{p}{m}\right)^2 = 2 \times (-\mu g)s$

$s = \frac{p^2}{2m^2 \mu g}$

Ans67. b

Sol. $\frac{X}{(X+2)(X+3)} = \frac{A}{x+2} + \frac{B}{x+3}$.....1)

X = A(x+3) + B (x+2)

X = Ax + 3A + Bx + 2B

X = x(A + B) + (3A + 3B)

Comparing both sides

A + B = 1; (3A + 3B) = 0

Hence A = 1 - B

B = 3/5

A = 2/5

Therefore from equation 1)

$\frac{X}{(X+2)(X+3)} = \frac{2}{5(X+2)} + \frac{3}{5(X-3)}$

Ans68. c

Sol. Given

$\text{Fixed cost} = \text{Rs. } 12000$

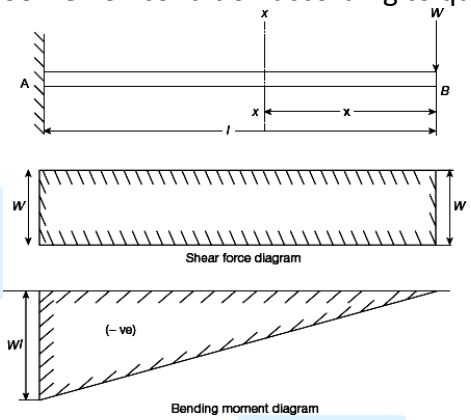
$\text{Selling cost(S)} = \text{Rs. } 48$

Variable cost (V) = Rs. 24

X = $\frac{12000}{48-24} = 500$

Ans69. c

Sol. Given condition according to question



Ans70. d

Sol.

Ans71. c

Sol. Given

M = 5kg

$T_1 = 100°C$

$T_2 = 50°C$

$C_P = 600\ J/kg°C$

$\rho = 8000\ kg/m^3$

Heat less can be calculated as

$Q = mC_p dT$

$Q = 5 \times 600 \times (100 - 50)$

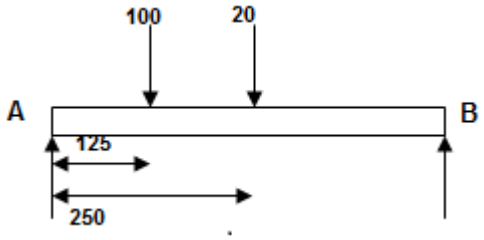
$Q = mC_p dT$

$Q = 5 \times 600 \times (100 - 50)$

$Q = 150\ kJ$

Ans72. d

Sol. As the weight of uniform rigid bar is given so this will be considered as the case of uniform distributed load . So 20kgf weight taken at the centre of the bar.



$R_A + R_B = 100 + 20 = 120$
Taken moment about A
$R_B \times 500 = 20 \times 250 + 100 \times 125$
$R_B = 35\ kgf$
$R_B = 85\ kgf$

Ans73. b
Sol.

Ans74. c
Sol. Elastic limit of cast iron as compared to its ultimate strength is same.

Ans75.b
Sol.
Constant power,
$P = \frac{\vec{F}.\vec{ds}}{dt} = \vec{F}.\vec{v} =$ constant
Now, will by dimensional analysis
[F].[v]=constant
$[MLT^{-2}].[LT^{-1}]$=constant
L^2T^{-3}=constant
$d^2 \propto t^3$
$d \propto t^{3/2}$
displacement$\propto$(time)$^{3/2}$

Ans76. c
Sol. Given
$h_m = 10\ kJ/kg;\quad h_f = 15\ kJ/kg$
Degree of reaction (DOR) = $\frac{h_m}{h_m + h_f}$
DOR = $\frac{10}{10+15} = 40\%$

Ans77. d
Sol.
$16^{\text{Log}_2 3}$ = $2^{4 \times \text{Log}_2 3}$
Since, log M^N = nlog(m)
= $2^{\text{Log}_2 3^4}$ = 3^4 = 81

Since, $a^{log_a m}$ = m

Ans78. c
Sol. In a multi-stage pump, more than one impeller is used on the same shaft and enclosed in the same casing. It is used to raise a high head. If a centrifugal pump consists of two or more impellers, the pump is called a multistage centrifugal pump.

Ans79. a
Sol. Given
Total resistors(n_t) = 100
No. of resistor below the required tolerance (n_b) = 11
No. of resistor above the required tolerance (n_a) = 9
Probability without replacement = $\frac{n_b}{n_T} \times \frac{n_a}{n_T - 1}$
= $\frac{11}{100} \times \frac{9}{99}$
= 0.01

Ans80. b
Sol.
$N_S = \frac{N\sqrt{nQ}}{H^{\frac{3}{4}}}$