ISRO LPSC 2020

Q1. $\lim_{x\to 0}\left(\frac{1}{x}-\frac{1}{sinx}\right)$
(a) -1
(b) 1
(c) 0
(d) ∞

Q2. Value of $2\sin 15^0\cos 15^0$
(a) 1/2
(b) $\frac{\sqrt{3}}{2}$
(c) 1
(d) $1/\sqrt{2}$

Q3.If $Y = e^x \sin x$, then which of the following differential equation holds true?
(a) $\frac{d^2y}{dx^2}+\frac{dy}{dx}+y=0$
(b) $\frac{d^2y}{dx^2}-\frac{2dy}{dx}+2y=0$
(c) $\frac{d^2y}{dx^2}-\frac{dx}{dy}+y=0$
(d) $\frac{d^2y}{dx^2}+2\frac{dy}{dx}-2y=0$

Q4. Open cycle gas turbine works on
(a) Ericson cycle
(b) Rankine cycle
(c) Carnot cycle
(d) Brayton cycle

Q5. In steam nozzle, the inlet pressure of superheated steam is 10 bar. The exit pressure is decreased from 3 bar to 1 bar. The discharge rate will.
(a) remain constant
(b) decrease
(c) increase slightly
(d) increase or decrease depending on whether nozzle is convergent or divergent

Q6. When a block of ice floating on water in a container melts, the level of water in the container
(a) rises
(b) falls
(c) first falls then rises
(d) remains same

Q7. Addition of Vanadium to steel results in improvement of
(a) Hardenability
(b) Fatigue Strength
(c) Heat treatability by quenching
(d) Resistance to oxidation at elevated temperature

Q8. Maximum carbon percentage in mild steel is
(a) 0.1
(b) 0.8
(c) 0.4
(d) 0.6

Q9. Small amounts of which of the following elements/pairs is added to steel to increase its machinability
(a) nickel
(b) sulphur and phosphorous
(c) silicon
(d) manganese and copper

Q10. High speed electron of Electron Beam Welding is focused on the weld spot using
(a) vacuum lens
(b) inert gas lens
(c) optical lens
(d) magnetic lens

Q11. A manometer is used to measure the pressure of a gas in a tank. The fluid used has a specific gravity of 0.85, and the manometer column height is 55cm, as shown in figure. If the local atmospheric pressure is 96 kPa, what is the absolute pressure in the tank?

(a) 4.6 kPa
(b) 98.6 kPa
(c) 100.6 kPa
(d) 200.6 kPa

Q12. The loss of head in a pipe of certain length carrying in a flow rate Q is found to be H. If a pipe of twice the diameter but the same length is to carry a flow rate of 2Q the head loss will be
(a) H/8
(b) H/4
(c) H/2

Q13. A centrifugal pump running at 200 rpm and at its maximum efficiency is delivering a head of 30m at a flow rate of 60 l/min. If the speed of the pump is increased to 400 rpm, then head H in meters and flow rate Q in l/min at maximum efficiency is
(a) H = 60, Q =120
(b) H = 120, Q = 120
(c) H = 120, Q = 240
(d) H =60, Q =240

Q14. Pitot tube is used for the measurement of
(a) velocity
(b) pressure
(c) flow
(d) viscosity

Q15. A ratchet screw in micrometer is provided to
(a) lock the reading measured
(b) maintain constant pressure on the job
(c) prevent wearing of screw threads
(d) allow zero adjustment

Q16. The torque that can be transmitted safely by the spur gear tooth at zero pitch line velocity is known as
(a) Average torque
(b) Maximum torque
(c) minimum torque
(d) stalling torque

Q17. A circular disc of uniform thickness 10mm, radius 100 mm and mass 10 kg is used as flywheel. If it rotates at 600 rpm the kinetic energy of flywheel is
(a) 98.70 J
(b) 49.35 J
(c) 24.67 J
(d) 197.39 J

Q18. In a gear with pitch circle diameter 'd' and total number of teeth 'T', the circular pitch of gear is defined as
(a) d/T
(b) $\pi d/T$
(c) T/d
(d) $\pi T/d$

Q19. Forty bolts are to be selected for fixing the cover plate of a cylinder subjected to a maximum load of 990 kN. If the design stress for bolt material is 330 N/mm^2, what is the diameter of each bolt ?
(a) 9.8mm
(b) 4.9mm
(c) 23.9mm
(d) 30.90mm

Q20. A key connecting a flange coupling to shaft is likely to fail in
(a) Torsion
(b) Tension
(c) Shear
(d) Bending

Q21. The determinant of matrix

$$\begin{matrix} 4 & 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & -1 & 0 \\ 0 & 0 & 2 & 1 & 0 \\ 0 & 0 & 0 & -1 & 2 \\ 0 & 0 & 0 & 0 & -3 \end{matrix}$$

(a) 8
(b) 24
(c) 0
(d) 3

Q22. If A is m x n matrix such that AB & BA both are defined, then B is a matrix of order
(a) n x n
(b) m x m
(c) m x n
(d) n x m

Q23. Value of $\lim_{x\to 0}\left(\frac{1-cosx}{xsinx}\right)$
(a) 0
(b) ∞
(c) 1/2
(d) 1

Q24. If 5cotθ =12, the value of cosecθ + secθ is close to
(a) 3.68
(b) 2.48
(c) 6.28
(d) 5.38

Q25. The ductility of a material with work hardening
(a) increases
(b) remains unaffected
(c) decreases
(d) unpredictable

Q26. Eutectic reaction of Iron-Carbon occurs at
(a) 525 C
(b) 723 C
(c) 1493 C
(d) 1147 C

Q27. For a fully developed laminar flow of water (dynamic viscosity 0.001 Pa-s) through a pipe of radius 10cm, the axial pressure gradient is -10 Pa/m. The magnitude of maximum velocity (in m/s) is
(a) 25
(b) 50
(c) 75
(d) 100

Q28. The viscosity in a fluid is caused mainly by
(a) intermolecular force of cohesion
(b) molecular momentum exchange
(c) both a and b
(d) none of the above

Q29. Falling drops of water becomes sphere due to the property of
(a) surface tension
(b) adhesion
(c) cohesion
(d) viscosity

Q30. Hydraulic diameter used in place of diameter for a non-circular duct is equal to (A: area of flow, m: wetted perimeter)
(a) A/m
(b) 4 A/m
(c) A/4 m
(d) 4 m/A

Q31. Oil flows through a 200 mm diameter horizontal pipe with friction factor (4f) = 0.02. The length of the pipe is 50 m and volumetric flow rate is 0.314 m^3/s. The head loss in the pipe due to friction is (g = 10 m/s^2)
(a) 50m
(b) 25m
(c) 100m
(d) 5m

Q32. If a fluid jet discharging from a 50 mm diameter orifice has a 40 mm diameter as its vena contracta then its coefficient of contraction will be

(a) 0.80
(b) 0.90
(c) 1.25
(d) 0.64

Q33. A smooth pipe of diameter 500 mm carries water. The pressure in the pipe at Section 'A' (elevation: 10m) is 100 kPa. At section 'B' (elevation:12m) the pressure is 75 kPa and velocity is 4 m/s. Which of the following is true (g = 10 m/s^2)
(a) Flow from A to B and head loss is 1 m
(b) Flow from A to B and head loss is 0.5 m
(c) Flow from B to A and head loss is 0.5 m
(d) Flow from B to A and head loss is 0.75 m

Q34. The relation between tool life (T) and cutting speed (V) is VT^n = Constant. In this relation, the value of n depends upon
(a) work material
(b) tool material
(c) working conditions
(d) type of chip produced

Q35. In order to have an interference fit, it is essential that lower limit of the shaft should be
(a) lesser than the upper limit of the hole
(b) greater than the lower limit of the hole
(c) lesser than lower limit if the hole
(d) greater than the upper limit of the hole

Q36. Gantt chart is used for
(a) inventory control
(b) material handling
(c) production schedule
(d) machine repair schedules

Q37. Routing in production planning and control refers to the
(a) balancing of load on machines
(b) authorization of work to be performed
(c) progress of work performed '
(d) sequence of operation to be performed

Q38. The maximum interference in mm after assembly between a bush of size $30^{+0.06}_{-0.03}$ Mm and shaft of size $30^{+0.04}_{-0.02}$ Mm is
(a) 0.07
(b) 0.05
(c) 0.02
(d) 0.01

Q39. A solid shaft can resist a bending moment of 6 kN-m and a torque of 8 kN-m applied together. The maximum torque that the shaft can resist when applied alone is
(a) 10 kN-m
(b) 14 kN-m
(c) 7 kN-m
(d) 5 kN-m

Q40. A 1 kg block is resting on a surface with coefficient of friction, $\mu = 0.1$. A force of 0.8n is applied to the block as shown in figure. The friction force in Newton is
(a) 0
(b) 0.98
(c) 1.2
(d) 0.8

Q41. When a weight of 500 N falls on a spring stiffness 0.5kN/m from a height of 2m. What is the maximum deflection caused in the first fall?
(a) 2m
(b) 4m
(c) 1m
(d) 0.63 m

Q42. The value of

$$\int_0^2 \int_0^x y\,dy\,dx$$

(a) 2/3
(b) 1
(c) 4/3
(d) 3/4

Q43. Maximum shear stress developed on the surface of solid circular shaft under pure torsion is 400 MPa. If shaft diameter is doubled, then the maximum shear stress developed corresponding to the same torque will be

(a) 200 MPa
(b) 1600 MPa
(c) 100 MPa
(d) 50 MPa

Q44. A steel bar of 20mm x 20mm diameter transmits a torque of 1570 Nm. The value of maximum shear stress developed is nearly

(a) 1000 MPa
(b) 20 MPa
(c) 50 MPa
(d) 20 GPa

Q45. A solid circular shaft of 20mm diameter transmits a torque of 1570 Nm. The value of maximum shear stress developed is nearly

(a) 1000 MPa
(b) 20 MPa
(c) 50 MPa
(d) 20 GPa

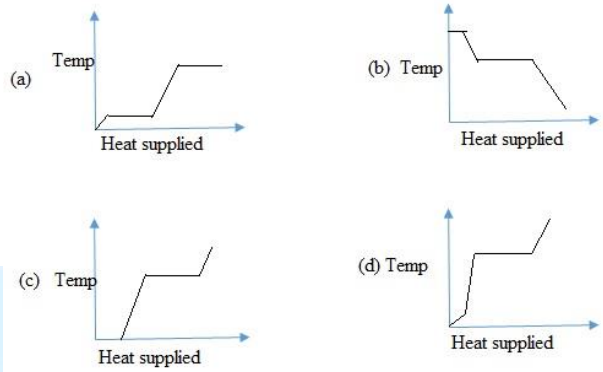
Q46. Shock resisting steels should have

(a) low wear resistance
(b) low hardness
(c) low tensile strength
(d) toughness

Q47. Dye penetrant method is generally used to locate

(a) core defects
(b) surface defects
(c) superficial defects
(d) temporary defects

Q48. A block of ice at -10 C is slowly heated and converted to steam at 100C. Which of the following curves represent the phenomena qualitatively ?



(a) A
(b) B
(c) C
(d) D

Q49. Paddle wheel work and expansion of gas into vacuum (free expansion) is a

(a) Quasi equilibrium process
(b) Quasi static process
(c) Isotropic process
(d) Non-equilibrium process

Q50. In jet engines, for efficient production of large power, fuel is burnt in an atmosphere of

(a) Vacuum
(b) Atmospheric air
(c) Compressed air
(d) Oxygen alone

Q51. The specific speed of a turbine is given by

(a) $\frac{N\sqrt{P}}{H^{\frac{3}{4}}}$
(b) $\frac{N\sqrt{Q}}{H^{\frac{3}{4}}}$
(c) $\frac{N\sqrt{Q}}{H^{\frac{5}{4}}}$
(d) $\frac{N\sqrt{P}}{H^{\frac{5}{4}}}$

Q52. The rate of heat addition and rejection in a industrial heat pump is 750 kW and 1000 kW respectively. If the heat pump operates between 30 C and 15 C. The COP for heat pump is
(a) 3
(b) 4
(c) 6.5
(d) 7.5

Q53. A refrigerator working on a reversed Carnot cycle has a COP of 4. If it works as a heat pump and consumes 1 kW, the heating effect will be
(a) 1 kW
(b) 4 kW
(c) 5 kW
(d) 6 kW

Q54. The significant advantage of using Ammonia as a refrigerant is
(a) Characteristic order
(b) High latent heat
(c) Solubility
(d) Inflammability

Q55. In ECM (Electro Chemical Machining) the material removal is due to
(a) Ion displacement
(b) Corrosion
(c) Erosion
(d) Fusion

Q56. The use of mixtures mainly reduces
(a) only operation time
(b) tooling cost
(c) only setting time
(d) both setting and operation time

Q57. In a point to point type of Numerical Control System
(a) control of only position of tool is sufficient
(b) control of only velocity of tool is sufficient
(c) control of position and velocity of tool is essential
(d) neither position nor velocity need to be controlled

Q58. A car travelling at a constant speed of 36 km/hr. In a circular path of radius 200 m, then normal acceleration (an) and tangential (at) in m/s^2 is given by
(a) an = 0, at = 0
(b) an = 0, at = $0.5m/s^2$
(c) an = $0.5m/s^2$, at =0
(d) an =0 , at=$6.5m/s^2$

Q59. For the spring system given in figure, the equivalent stiffness is
(a) 0.4K
(b) 4K
(c) 2.5K
(d) K

Q60. An elastic rod, 30 cm long, of negligible weight hangs downwards from a support. In one case load is applied on rod 20 cm below the support and in the other case the same load is applied at bottom of rod. The reactions at supports will be
(a) more in first case
(b) same in both the cases
(c) more in second case
(d) none of the above

Q61. For a closed system, the difference between the heat added to the system and work done by the system is equal to
(a) enthalpy
(b) entropy
(c) temperature
(d) internal energy

Q62. Considering the variation of static pressure and absolute velocity in an impulse steam turbine, across one row of moving blades

(a) both pressure and velocity decreases
(b) pressure remains constant, while velocity decreases
(c) pressure decreases while velocity increases
(d) pressure remains constant while velocity increases

Q63. If a ladder of 10m long reaches a window 8m above the ground, then the distance of the foot of the ladder from the base of the wall is
(a) 18m
(b) 8m
(c) 4m
(d) 6m

Q64. The value of integral $x/\cos^2 x$ is equal to
(a) x tanx
(b) x tanx + log cosx
(c) log cosx
(d) x tanx - log cos x

Q65. The length, Young's modulus and coefficient of thermal expansion of bar 'A' are twice that of bar 'B'. What will be the ratio of stress developed in bar 'A' to that in 'B' if the temperature of both bar is increased by same amount (both ends are constrained).
(a) 2
(b) 8
(c) 4
(d) 16

Q66. Chills are used in casting moulds to
(a) achieve directional solidification
(b) reduce possibility of blow holes
(c) reduce freezing time
(d) increase smoothness of casting surface

Q67. In forging operation, fullering is done to
(a) upset the material
(b) bend the material
(c) draw out the material
(d) extrude the material

Q68. A cycle consisting of two isothermal and two isentropic process is known as
(a) Stirling cycle
(b) Carnot cycle
(c) Ericson cycle
(d) Joule cycle

Q69. Which of the following is an intensive property of a system ?
(a) pressure
(b) mass
(c) enthalpy
(d) volume

Q70. For the same maximum pressure and temperature
(a) Otto cycle is more efficient than diesel cycle
(b) dual cycle is more efficient than Otto and diesel cycle

Q71. The use of draft tube in a reaction type turbine helps to
(a) prevent air from entering
(b) convert the kinetic energy to pressure energy
(c) increase flow rate
(d) eliminate eddies in the downstream

Q72. Centrifugal pumps when arranged in parallel
(a) increase the discharge only
(b) increase both the discharge the head
(c)increase the head only
(d) increase the head but decrease the discharge

Q73. The thermal efficiency of Carnot engine is 0.5. If the engine is operated as refrigerator what is COP of refrigerator?
(a) 0.5
(b) 0.75
(c) 2
(d) 1

Q74. A 'block' of information in a Numerical Control Machine program means
(a) one row on tape
(b) a work comprising several rows on tape
(c)one complete instruction
(d) one complete program for a job

Q75. A good refrigerant should have
(a) high latent heat of vaporization and low freezing point
(b) High operating pressure and low freezing point
(c) High specific volume and high latent heat of vaporization
(d) Low coefficient of performance and low freezing point

ISRO LPSC 2020 SOLUTION

Ans1.c

Solution: $\lim_{X\to 0}\left(\frac{1}{X}\right) - \lim_{X\to 0}\frac{1}{\sin x}$

$\infty - \frac{1}{\lim_{X\to 0}\sin x}$

$\infty - \frac{1}{0} = \infty - \infty = 0$

Ans2. a

Solution:

$2 \times \sin 15° \times \cos 15°$, $\therefore 2 \times \sin 15° \times \cos 15° = \sin 30° = 1/2$

Since, $\sin 2x = 2\sin x \cos x$

Ans3. b

Solution:

$Y = e^x \sin x$

Differentite w.r.t x,

$$\frac{dy}{dx} = e^x(\cos x) + \sin x\,(e^x)$$

$$\frac{dy}{dx} = e^x(\sin x + \cos x)$$

Again Differentiating w.r.to x,

$$\frac{d^2y}{dx^2} = e^x(\cos x - \sin x) + (\sin x + \cos x)e^x$$

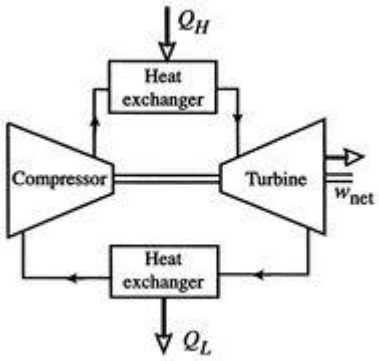
$$\frac{d^2y}{dx^2} = e^2(2\cos x)$$

Now put the above value in the option 2 then,

$$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 2y = 0$$

Ans4.d

Solution: The modified Brayton cycle is used for both gas turbines and jet engines. The turbine is designed to produce a usable torque at the output shaft,



While the jet engine allows most of the hot gases to expand into the atmosphere, producing usable thrust.

Ans5.a

Solution: Inlet pressure $P_1 = 10\ bar$, Exit pressure decreases from 3 bar to 1 bar,

For superheated steam n = 1.30,

Critical Pressure Ratio = 0.545

Now, $10 \times 0.545 = 5.45$

Therefore, discharge rate will remain the same.

Exit pressure 3 bars less than throat pressure hence with a further decrease of pressure from 3 bar to 1 bar discharge rate will remain the same.

Ans6.d

Solution: When the ice was floating, the volume of water displaced has a mass equal to that of ice. After melting, that mass of ice has been converted into water. Therefore , there is no net change in level.

Ans7. b

Solution:

Ans8.c

Solution:

Ans9.b

Solution: According to given option, option (b) will be correct answer.

Ans10.d

Solution: Electron beam welding: By increasing the beam current and the accelerating voltage, the beam power can be increased to practically any desired value. Using magnetic lenses, by which the beam can be shaped into a narrow cone and focused to a very small diameter. This allows for a very high surface power density on the surface to be welded.

Ans11.c

Solution: Given

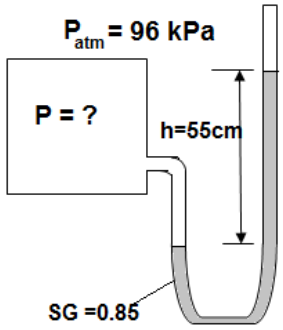
$P_{atm} = 96\ kPa$

H = 0.55cm

SG = 0.85

$\rho = 850\ kg/mm^3$

According to question



$P_{atm} + \rho gh = P$

$96 + 850 \times 9.81 \times 0.55 \times 1000 = P$

$P = 4.6\ kPa$

(d) H

Ans12. a

Solution: We know

$H = \frac{fLQ^2}{12D^5}$

According to question

D' = 2D ; Q' = 2Q

H' = $\frac{fL(2Q)^2}{12(2D)^5}$

$H' = \frac{H}{8}$

Ans13.b

Solution: Given

$H_1 = 30m, Q_1 = 60\ litres\ per\ min, N_1 = 200\ rpm, N_2 = 400\ rpm, D_1 = D_2$

By using the relation $N \propto \sqrt{H}$

$\Rightarrow \frac{H_2}{H_1} = \left(\frac{N_2}{N_1}\right)^2 \Rightarrow \frac{H_2}{30} = \left(\frac{400}{200}\right)^2 \Rightarrow H_2 = 120m$

From the equation , $\frac{Q_!}{D_1^3 N_1} = \frac{Q_2}{D_1^3 N_2}$

$\frac{60}{200} = \frac{Q_2}{400}$

$\Rightarrow Q_2 = \left(\frac{400}{200}\right) \times 60 = 120 \frac{Lit}{Min}$

$\therefore$ Head $(H_2) =$ 120 meters and flow rate $(q_2) =$ 120 litres per min at a maximum efficiency of the pump.

Ans14.a

Solution: Pitot Tube is a device used for calculating the velocity of flow at an point in a pipe or a channel.

Ans15. b

Solution: Micrometers used to take the outside measurements are known as outside micrometers. The ratchet-stop or simply ratchet ensures uniform pressure between the measuring surfaces.

Ans16.d

Solution: Stalling torque is the torque produced by the spur gear tooth at zero pitch line velocity and it is the torque that produces maximum stress in the arm and teeth.

Ans17.a

Solution: Given

M = 10kg

R = 100mm = 0.1m

N = 600 rpm

$I = \frac{mR^2}{2} = \frac{10 \times 0.1^2}{2} = 0.05\ kg - m^2$

$\omega = \frac{2\pi N}{60} = 62.84\ rad/s$

$\therefore K.E = \frac{1}{2} I\omega^2 = \frac{1}{2} \times 0.05 \times (62.84)^2 = 98.72\ J$

Ans18.b

Solution: Module (m) = $\frac{D}{T}$

$P_c = \pi m$

$P_c = \frac{\pi D}{T}$

Ans19. A

Solution: Given

No. Of bolts = 40, Maximum load = 990 kN,

Strength of bolt material = 330 N/mm^2

Strength of bolt material = $\frac{Maximum\ load}{N \times (Aera\ of\ cross\ section of\ bolt)}$

$330 = \frac{990 \times 10^3}{40 \times \frac{\pi}{4} \times d^2}$

$d^2 = 95.5\ mm$

$d = 9.77mm$

D~$9.8mm$

Ans20.c

Solution: Keys of flange coupling fail under two modes

I. By shearing of key

Ii. By crushing of key

Ans21.b

Solution:

The matrix is an upper triangular matrix.

$$\begin{bmatrix} 4 & 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & -1 & 0 \\ 0 & 0 & 2 & 1 & 0 \\ 0 & 0 & 0 & -1 & 2 \\ 0 & 0 & 0 & 0 & -3 \end{bmatrix}$$

The determinant of the upper or lower triangular matrix is given by multiplying the diagonal elements.

Determinant is = 4 × 1 × 2 × (-1) × (-3) = 24

Ans22. d

Solution:

Two matrices $A_{m \times n}$ and $B_{p \times q}$

If AB and BA are defined then p = n and q = m

AB and BA are defined. So the order of the matrix B is $B_{n \times m}$

Ans23. c

Solution:

First of all, since as x → 0, sinx → 0 also, we can rewrite the denominatorr as x^2.

Hence we need to find: $\lim_{x \to 0} \left(\frac{1-cosx}{x^2}\right)$

Since this still results in an indeterminate 0/0, we apply Lee Hospital's Rule.

$\frac{\frac{d}{dx}(1-cosx)}{\frac{d}{dx}(x^2)} = \frac{sin\ x}{2x}$

If we substitute 'approaching zero' as a less formal $\frac{1}{\infty}$, we arrive at the expression:

$\frac{\frac{1}{\infty}}{\frac{2}{\infty}}$.

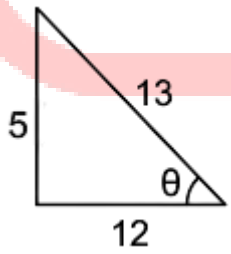
After cancelling out the infinities, this leaves $\frac{1}{2}$.

Or simply let sinx = x again, which gives:

$\frac{sinx}{2x} = \frac{x}{2x} = \frac{1}{2}$

Ans24. A

Sol :



Cotθ = $\frac{12}{5} = \frac{b}{p}$

Cosecθ + secθ = $\frac{13}{5} + \frac{13}{12}$ = 3.683

Ans25.c

Solution: Strain hardening or work hardening is the strengthening of a metal by plastic deformation. This strengthening occurs because of dislocation movements and dislocation generation within the crystal structure of the material. Due to strain

hardening, yield strength increases and ductility decreases.

Ans26.d

Solution: Eutectic reaction

At temperature 11467℃ and carbon composition 4.3%.

Liquid Iron (L) ⇌ Austenite (S) + Cementite (S)

One liquid converts into two solids.

Ans27.a

Solution: Given

$\mu = 0.001\ Pa.s$

$r = 0.01cm$

Ans28.c

Solution: The causes of viscosity in a fluid are possibly attributed to two factors:

1. Intermolecular force of cohesion
2. Molecular momentum exchange

Ans29.a

Solution: Surface tension is the property by virtue of which the free surface of a liquid at rest behaves like elastic stretched membrane tending to contract so as to occupy the minimum surface area.

Ans30.b

Solution: $D_H = \frac{4A}{m}$

Ans31.b

Solution: Given

D = 200mm = 0.2 m

L = 50m

Q = 0.314 m^3/s

Friction factor(4f) = 0.02

$V = \frac{Q}{A} = \frac{0.314}{\frac{\pi}{4}\times 0.2^2} = 9.994 = 10\ m/s$

$h_f = \frac{4flV^2}{2gD} = \frac{0.02\times 50\times 10^2}{2\times 10\times 0.2} = 25m$

Ans32.d

Solution: Given

$D_O = 50\text{mm}$

$D_C = 40\text{mm}$

Coefficient of contraction $(C_C) = \frac{\text{Area of vena contracta } (V_C)}{\text{Area of orifice } (A_O)}$

$C_C = \frac{\frac{\Pi}{4}D_C^2}{\frac{\Pi}{4}D_O^2}$

$= \frac{40^2}{50^2}$

$C_C = 0.64$

Ans33.b

Solution: Given

$P_1 = 100\ \text{kPa}; Z_1 = 10\text{m}, P_2 = 75\ \text{kPa}, Z_2 = 12\text{m}, v = 4\ \text{m/s}, d = 500\text{mm} = 0.5\text{m}$

At section 1

$\frac{P_1}{Pg} + \frac{V_1^2}{2g} + Z_1 = \frac{100\times 10^3}{1000\times 10} + \frac{4^2}{2\times 10} + 10 = 20.8\text{m}$

At Section 2

$\frac{P_2}{Pg} + \frac{V_2^2}{2g} + Z_2 = \frac{75\times 10^3}{1000\times 10} + \frac{4^2}{2\times 10} + 12 = 20.3\text{m}$

$(\text{Total Energy})_1 > (\text{Total Energy})_2$

∴ Flow takes place from section 1 to section 2 with a head loss of 0.5m.

Ans34.b

Solution: Taylor's tool life equation is given by

$VT^n = C$

Where , V = cutting speed (m/min)

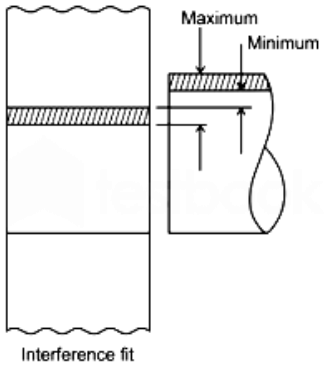
$T =$ time (in m/s)

N = an exponent that largely depends on tool material.

C = constant based on tool and work material and cutting conditions.

Ans35.d

Solution: Interference fit : A negative difference between the diameter of the hole and the shaft is called interference. In such cases, the diameter of the shaft is always larger than the hole diameter.



It is used for components where motion, power has to be transmitted.

Ans36.c

Solution: Gantt charts:

Gantt charts are mainly used to allocate resources to activities i.e. Production schedule.

The resources allocated to activities include staff, hardware and software.

Gantt charts are useful for resource planning.

A Gantt chart is a special type of bar chart where each bar represents an activity.

Ans37.d

Solution: Routing is the first step in production planning and control. Routing can be defined as the process of deciding the path (route) of work and the sequence of operations. Routing fixes in advance: The quantity and quality of the product.

Ans38.d

Solution: Given

Hole $30^{+0.06}_{+0.03}$ Mm, Shaft $30^{+0.04}_{-0.02}$ Mm

Upper limit of shaft = 30 + 0.04 = 30.04 mm

Lower limit of hole = 30 + 0.03 = 30.03 mm

Maximum interference = Upper limit of the shaft – Lower limit of hole

Maximum Interference = 30.04 – 30.03 = 0.01mm

Ans39.a

Solution: Given

$M = 6\ kN - m\ ; T = 8\ kN - m$

Equivalent Torque can be calculated as

$T_{eq} = \sqrt{M^2 + T^2}$

$= \sqrt{6^2 + 8^2}$

$T_{eq} = 10\ kN/m$

Ans40.d

Solution: Friction force is equal to the applied force in opposite direction.

So Friction force = 0.8 N

Ans41.cancelled(a)

Solution: Given

Weight (W) = 500 N; h = 2m; k = 0.5 kN/m = 500 N/m

Weight (W) = mg = 500N

$\rightarrow 500 \times (2 + x) = \frac{1}{2} \times 500 \times x^2$

X = 3.24 m

Hence the deflection caused in the first fall will be 3.24 m

Ans42. c

Solution:

$\int_0^2 \left[\frac{y^2}{2} dy\right]_0^x$ Dx

$\int_0^2 \left[\frac{x^2}{2}\right]$Dx

$\frac{1}{2}\left[\frac{x^3}{3}\right]_0^2 = \frac{4}{3}$

Ans43.d

Solution: Given

$\tau_{max} = \frac{16T}{\pi D^3}$ = 400 MPa

If D' =2D

Then

$\tau'_{max} = \frac{16T}{\pi(2D)^3}$

$\tau'_{max} = \frac{\tau_{max}}{8} = \frac{400}{8}$

$\tau'_{max} = 50\ MPa$

Ans44.b

Solution: Given

P = 200 × 1000 N

L = 1m
A = 0.02×0.02 m^2
E = 100×10^9 N/mm^2
Elongation of the bar
$\delta L = \frac{PL}{AE}$
$\delta L = \frac{200 \times 1000}{0.02 \times 0.02 \times 100 \times 10^9}$
$\delta L = 5 \times 10^{-3} = 5mm$

Ans45.a
Solution: Given
$T = 1570\ Nm$
$D = 0.20\ m$
$\tau_{max} = \frac{16T}{\pi D^3}$
$= \frac{16 \times 1570}{\pi \times 0.20^3}$
$\tau_{max} = 999.46 \approx 1000\ MPa$

Ans46.d
Solution: Shock resisting steels are designed to have high impact resistance (toughness), along with other properties such as strength, hardness.

Ans47.b
Solution: Dye penetrant test:
It is non-destructive testing method.
This test is based on the principle that colored liquid dyes and fluorescent liquid penetrate into the cracks.
These can be used to check for surface defects in metals, plastics, ceramics and glass.
It can also be used to detect minute surface cracks in a weldment of non-magnetic alloy.

Ans48.a
Solution: Initially on heating temperature rises from -10℃ to 0℃. Then ice melt and remains constant until all the ice melts into liquid, hence the temperature does not rise. After the whole ice has melted temperature begins to rise until reaches 100℃. Then it becomes constant as, at the boiling point, t he temperature will not rise.

Ans49.d
Solution: Paddle wheel work is a process involving friction in which the volume of the system does not change at all, and still work is done on the system.
Friction makes this process irreversible, hence the process is in a non-equilibrium process.
Work increases the stored energy (internal energy) of the system. Hence the temperature of the system increases in this process.

Ans50.c
Solution: JET ENGINE :
A jet engine is a gas turbine engine.
A jet engine develops thrust by accelerating a relatively small mass of air to very high velocity.
The basic cycle of operation in a jet engine is compression, combustion , expansion and exhaust.
Combustion is a reaction within the mixture of fuel and air. The more air available , the more fuel can be mixed up, resulting in a more energy release and more power will generate.

Ans51.d
Solution: Specific speed of turbine : $N_S = \frac{N\sqrt{P}}{H^{\frac{5}{4}}}$
For pump ; $N_s = \frac{N\sqrt{Q}}{H^{\frac{3}{4}}}$

Ans52.b
Solution: Given
$Q_1 = 1000\ kW$
$Q_2 = 750\ kW$
$COP = \frac{Q_1}{Q_1 - Q_2}$

$$COP = \frac{1000}{1000-750} = 4$$

Ans53.c

Solution: Given

$COP_R = 4$

By relation

$COP_H = COP_R + 1$

$COP_H = 5$

$W = Q_1 - Q_2 = 1\ kW$

$COP_H = \frac{H.E}{Work} = \frac{Q_1}{W}$

$5 = \frac{Q_1}{1}$

$H.E(Q_1) = 5kW$

Ans54.b

Solution: option (b) will be correct answer given in the answer key.

Ans55.a

Solution: Electrochemical Machining: In electrochemical machining, the metal is removed due to electrochemical action i.e. Ion displacement where the work piece is made anode and the tool is made the cathode.

Ans56.c

Solution: Fixture: It is a production tool that locates and holds the work piece. It does not guide the cutting tools, but the tools can be positioned before cutting with the help of setting blocks and feeler gauges etc. and reduces setting time. Fixtures of different types are made for milling, turning, grinding, welding, bending etc.

Ans57.a

Solution: Point to Point (PTP) Control System: When only endpoint movement of a tool is important whereas the path followed by the tool in between endpoint movement is not important is called point to point control system.

Ans58.c

Solution:

R = 200m, v = 36 km/hr. = $36 \times \frac{5}{18}$M/s, α = 0 (since not mentioned)

Normal acceleration,

$A_n = \frac{v^2}{R} = \frac{10^2}{200} = 0.5\ m/s^2$

Tangential acceleration,

$A_t = R \times \alpha = 200 \times 0 = 0$

Ans59.a

Solution: From

From parallel connection we get the equivalent stiffness

$K' = K + K = 2K$

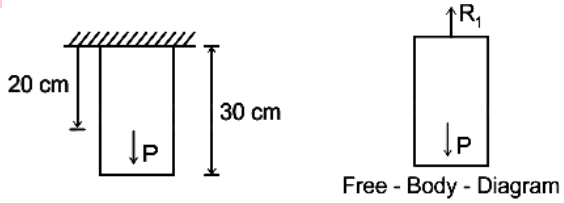
If we combine K' with other two stiffness which is series in connection we can calculate the equivalent stiffness of series connection:

$\frac{1}{K''} = \frac{1}{2K} + \frac{1}{K} + \frac{1}{K}$

$K'' = 0.4K$

Ans60.b

Solution: For the first case when the load is applied at 20 cm below the support, let reaction at support is R_1



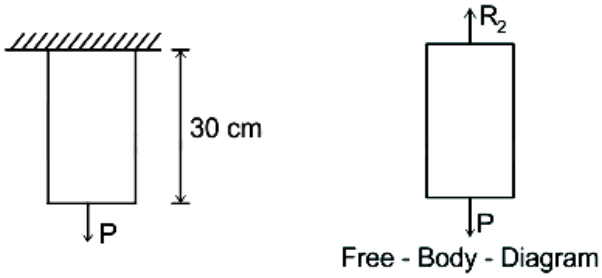
From , $\sum F_y = 0$

$R_1 = Load\ Applied\ (P)$

For the second case when the load is applied at the bottom of the rod , let reaction at support is R_2

From, $\sum F_Y = 0$

$R_2 = Load\ Applied\ (P)$



Free - Body - Diagram

Hence in both the cases reaction at the support will be same which is equal to the load applied on the rod.

Ans61.d

Solution: From first law of thermodynamics

$\delta Q = dU + \delta W$

$dU = \delta Q - \delta W$

Ans62.b

Solution: Impulse turbine : There is no drop of pressure in the moving blade after coming out of the nozzle and is equal to atmospheric pressure generally.

Ans63.d

Solution:

$(10)^2 = (8)^2 + (x)^2$

$X^2 = 36$

X = 6

Ans64.b

Solution:

$I = x/\cos^2(x) = \int x sec^2(x) dx$

Using integration by parts, which takes the form

$\int udv = uv - \int vdu$

For the given integral $\int x sec^2(x) dx$, Let

U = x

du/dx = 1

du = dx

dv = $sec^2(x)dx$

$\int dv = \int sec^2(x)dx$

V = tan(x)

Thus :

$I = x\tan(x) - \int tan(x)dx$

$I = x\tan(x) + \int \frac{-Sinx}{cosx} dx$

Let y = cosx such that dy = -sinx dx

$I = x\tan x + \int \frac{dy}{y}$

$I = x\tan(x) + \ln(|y|)$

I = x tanx + log(cosx) + c

Ans65.c

Solution: We know that

$\sigma_T = E\alpha\Delta T$

For Bar A

$\sigma_A = 4E\alpha\Delta T$

$\sigma_B = E\alpha\Delta T$

Then

$\frac{\sigma_A}{\sigma_B} = \frac{4}{1}$

Ans66.a

Solution: Chills and padding are used to provide uni-directional solidification. Chills are metallic objects, which are placed in the mold to increase the cooling rate of castings. Tapering of thinner section towards thicker section is known as 'padding'.

Ans67.c

Solution: The fullering is done to draw out the material. In the fullering, the material is distributed away from the forging area. Fullering is the process of reducing the cross-section of the work piece or lengthening a preparation of the stock in preparation for the subsequent operation.

Ans68.b

Solution: Carnot cycle is hypothetical cycle consists of 2 isothermal and 2 isentropic processes.

Ans69.a

Solution: Pressure is intensive property which is independent of mass.

Ans70.c

Solution: In case of same compression ratio the Otto cycle is more efficient than Diesel cycle.

Ans71.b

Solution: The principal purpose of the draft tube is to convert water kinetic energy into pressure energy. To decrease the velocity of the water and to raise the pressure of the water before joining the tailrace, the pipe is used to steadily increase the cross-sectional area.

Ans72.a

Solution: When two or more pumps are arranged in parallel their resulting performance curve is obtained by adding the pumps flow rates at the same head as indicated in the figure below. Centrifugal pumps in parallel are used to overcome larger volume flows than one pump can handle alone.

Ans73.d

Solution: Given

$\eta = 0.5$

We know

$COP_H = \frac{1}{\eta} - \frac{1}{0.5} = 2$

$COP_R = COP_H - 1$

$COP_R = 2 - 1 = 1$

Ans74.c

Solution: A 'block' of information in a Numerical Control machine program means one complete instruction control automatic tool machine.

Ans75. a

Solution: