ISRO VSSC TA 2019

Q1. In slider crank mechanism, secondary forces fluctuate at
(a) The rotating frequency
(b) Twice the rotating frequency
(c) Four times the rotating frequency
(d) Half the rotating frequency
Answer: b
Solution: The primary unbalanced force is maximum when θ = 0° or θ = 180°. Thus, the primary force is maximum twice in one revolution of the crank. While The secondary unbalanced force is maximum, when θ = 0°, θ = 90°, θ = 180°, and θ = 360°.Thus, the secondary force is maximum for four angles in one revolution of the crank.
Therefore, it is seen that the frequency of secondary unbalanced force is twice of a primary unbalanced force.

Q2. Venturimeter works on the basis of
(a) Newton's principle
(b) Pascal's law
(c) Bernoulli's principle
(d) Archimedes law
Answer: c
Solution:

Q3. In thermodynamics, a process in which the system undergoes a succession of equilibrium states is a
1. Quasi-static process
2. Reversible process
3. Irreversible process
4. Path independent process
(a) 1 & 3
(b) 1 & 2
(c) 3 & 4
(d) 2 & 4
Answer: b
Solution: A quasi-static process in thermodynamics is defined as the process in which the system slowly undergoes thermodynamic changes in order to remain in internal equilibrium. All the reversible process are called as quasi-static process while entropy production in quasi static is a non-reversible process.

Q4. In thermodynamics, which of the following statements are true?
1. Work is path independent function
2. Work is path dependent function
3. Work is area under the curve in a PV diagram

4. Work and heat energy are completely interchangeable
(a) 1 & 4
(b) 1 & 2
(c) 3 & 4
(d) 2 & 3
Answer: d
Solution:

Q5. Which of the following statements are true?
1. Heat and Work are completely interchangeable forms of energy
2. Heat and Work are not completely interchangeable forms of energy
3. Work can be converted completely into heat
4. Heat can be converted completely into work
(a) 1 & 4
(b) 1 & 3
(c) 2 & 4
(d) 2 & 3
Answer: d
Solution:

Q6. If for a turning job, the length of the work is 200mm and the taper is 1:50, the set over required for the tail stock to achieve the taper is
(a) 3mm
(b) 2mm
(c) 4mm
(d) 1mm
Answer: b
Solution: Set over = $\left(\frac{D-d}{2}\right) \times \frac{L}{L}$
Where; K (taper ratio) = $\left(\frac{D-d}{2l}\right) = \frac{1}{50}$

∴Set over = $\frac{1}{50} \times 200 = 2mm$

Q7. The SI unit of Thermal Conductivity is
(a) $Wm^{-2}K^{-1}$
(b) wmk^{-1}
(c) $W(mk)^{-1}$
(d) wmk
Answer: c
Solution:

Q8. In a simultaneous throw of two coins, the probability of getting at least one head is

(a) 1/2
(b) 1/3
(c) 2/3
(d) ¾
Answer: d
Solution: Possible outcomes = (H, H), (H, T), (T, H), (T, T)
Total number of possible outcomes = 4
At least one head occurs 3 times.
So, the total number of favourable outcomes = 3
Now, the probability of getting at least one head = 3/4
∴ In a simultaneous throw of two coins, the probability of getting at least one head is 3/4

Q9. The angle of elevation of tree from a point on the level ground 15m from its base is 45°. The height of the tree is
(a) 10m
(b) 15m
(c) $15/\sqrt{2}$ M
(d) $15\sqrt{2}$ M
Answer: b
Solution: L = 15 m, θ = 45°
H = height of the tree, L = distance between tree and observer on the plane ground, θ = angle of elevation.
$\text{Tan}(\theta) = \frac{\text{Opposite side}}{\text{Adjacent side}} = \frac{H}{L}$
$\text{Tan}(45°) = \frac{\text{Opposite side}}{\text{Adjacent side}} = \frac{H}{L} = \frac{H}{15}$
H = tan(45°) × 15
H = 15m

Q10. The perimeter of a right triangle is 24m. Its hypotenuse is 10m. The area of the triangle is
(a) 25 m^2
(b) $\sqrt{24}$ M^2
(c) 24 m^2
(d) 36 m^2
Answer: c
Solution: Let, A, B, and C are sides of a right-angle triangle where C is the hypotenuse of the triangle, B is the base of the triangle, and A is the height of the triangle.
P is the perimeter of the triangle.
P = A + B + C
24 = A + B + 10
A + B = 14.....(1)
For Right angle triangle
$C^2 = A^2 + B^2$
$100 = A^2 + B^2$

Putting B = 14 - A from equation 1.
$100 = A^2 + (14 - A)^2$
$100 = A^2 + 14^2 - (2 \times 14 \times A) + A^2$
$2A^2 - 28A + 96 = 0$
$A^2 - 8A - 6A + 14 = 0$
$A(A - 8) - 6 (A - 8) = 0$
We get A = 8 and A =6
Hence considering A = 8 m we will get a value of B = 6 m.
Area of triangle = $\frac{1}{2}\ 8\ \times\ 6 = 24\ m^2$.

Q11. The diagonal of a cube is $10\sqrt{3}$M. Its volume is
(a) 1000 m^3
(b) 100 m^3
(c) 10 m^3
(d) $\pi d\ m^3$

Q12. Buoyant force for a floating body passes through
(a) CG of body
(b) Centroid of the displaced volume
(c) Midpoint joining CG and Meta centre
(d) None of the above

Q13. The bolts in a rigid flanged coupling connecting two shafts transmitting power are subjected to
(a) Shear force and Bending moment
(b) Pure shear
(c) Axial tension only
(d) No load

Q14. Absolute pressure is measured as
(a) Gauge pressure - atmospheric pressure
(b) Gauge pressure + atmospheric pressure
(c) Gauge pressure/atmospheric pressure
(d) Gauge pressure $\times$ atmospheric pressure

Q15. H7g6 fit provided on an assembly is
(a) An interference fit
(b) A transition fit
(c) A clearance fit
(d) A non standard fit

Q16. The pressure head loss experienced by fluid flow due to friction in a pipe reduces with
(a) Increased length of pipe

(b) Increased diameter of pipe
(c) Decreased length of pipe
(d) Both b and c

Q17. If you plot shear strain vs. Shear stress graph for a Newtonian fluid, the shape of the curve will be
(a) Straight line
(b) Elliptic
(c) Hyperbolic
(d) Parabolic

Q18. Which of the following is correct for a body in Simple Harmonic Motion?
(a) Acceleration is proportional to displacement from mean position
(b) Velocity is minimum at the mean position
(c) Acceleration is maximum at mean position
(d) None of the above

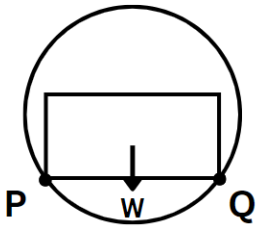
Q19. Which of the following is true about amount of heat flow in unit time by conduction?
(a) Decreases with increase in area of body
(b) Increases with increase in area of body
(c) Increases with increase in thickness of body
(d) Decreases with increase in temperature difference between faces of the body

Q20. When a beam is subjected to a bending moment, the strain in a layer is ___the distance from the neutral axis
(a) Equal to
(b) Inversely proportional to
(c) Directly proportional to
(d) Independent of

Q21. The involute function is defined as
(a) $\text{inv}\varphi = \tan\varphi - \varphi$
(b) $\text{inv}\varphi = \tan\varphi - \sin\varphi$
(c) $\text{inv}\varphi = \tan\varphi - \cos\varphi$
(d) $\text{inv}\varphi = \frac{\text{Tan}\varphi}{\Phi} - \sin\varphi$

Q22. A body falls freely from rest from the top of a tall cliff. The distance it travelled in the first second is ($g = 10m/sec^2$)
(a) 9.8m
(b) 10m
(c) 5m
(d) 1m

Q23. A rectangular block is resting inside a circular tunnel as shown. The reaction at the contacts P and Q are directed



(a) Along PQ
(b) Perpendicular to PQ
(c) Through the center of mass of the block
(d) Through the center of the circular tunnel

Q24. If an unconstrained steel bar is heated uniformly, there develops
(a) Thermal stress
(b) Tensile stress
(c) Compressive stress
(d) No stress

Q25. Which mechanism produces mathematically exact straight line motion?
(a) Watt's mechanism
(b) Peaucellier mechanism
(c) Ackermann mechanism
(d) Grasshopper mechanism

Q26. A pendulum clock calibrated at earth's surface will read on the surface of the moon (acceleration due to gravity on the moon is 1/6th of that on earth)
(a) Identically the same
(b) $\sqrt{6}$ Times faster
(c) $\sqrt{6}$ Times slower
(d) 6 times faster

Q27. An electron has a constant acceleration of +3.2m/s^2. At a certain instant its velocity is +9.6m/s. The velocity of the electron 2.5s earlier was
(a) +3.6m/s
(b) +1.6m/s
(c) +2.4m/s
(d) +1.9m/s

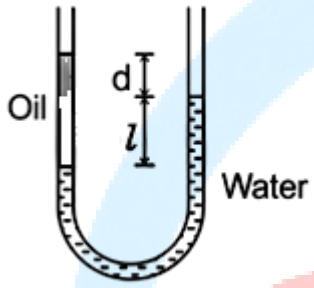
Q28. $(2+\sqrt{2}) + \frac{1}{2+\sqrt{2}} + \frac{1}{\sqrt{2}-2}$ Simplifies to
(a) 1 - $\sqrt{2}$
(b) 2 + $\sqrt{2}$
(c) 2

(d) $2\sqrt{2}$

Q29. A rotating fan completes 1200 revolutions every minute. If the tip of the blade is at a radius of 0.7m, then the blade tip speed is

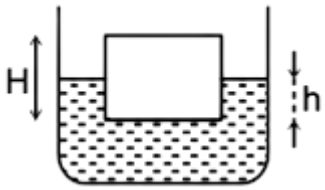
(a) 44 m/s
(b) 22 m/s
(c) 66 m/s
(d) 88 m/s

Q30. The U tube in the figure contains two liquids in static equilibrium. Water of density P_w (1000kg/m^3) is in the right arm and oil of unknown density ρ_x is in the left arm. If I = 80mm and d = 20mm, then the density ρ_x of the oil is



(a) 1000 kg/m^3
(b) 200 kg/m^3
(c) 600 kg/m^3
(d) 800 kg/m^3

Q31. A block (rectangular cuboid) of density 800kg/m^3 floats face down in a fluid of density 1200 kg/m^3 as shown in the figure. The block has a height H = 6cm and it will be submerged by a depth h. Then h is equal to



(a) 3cm
(b) 2cm
(c) 4cm
(d) 5cm

Q32. A can has a total volume of 1200 cm^3 and a mass of 200g. How many grams of lead shots of density 11.4 g/cm^3 could it carry without sinking in water? (density of water : 1 g/cm^3)

(a) 800 g
(b) 1200 g
(c) 1140 g
(d) 1000 g

Q33. In a closed thermodynamic system undergoing a change of state, if Q is the amount of the heat transferred to the system, W the amount of work done by the system and ΔE is the change in the internal energy of the system, then which of the following expressions are correct?
(a) Q - W = ΔE
(b) Q + W = ΔE
(c) W - ΔE = Q
(d) W - Q = ΔE

Q34. If f(x) = $\frac{ax+b}{cx+d}$ And f(f(x)) = x then
(a) d = a
(b) d = -a
(c) a = b = c = d = 1
(d) a = c = 1

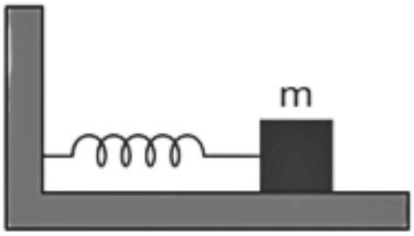
Q35. Which of the following statements are correct when related to a thermodynamic system?
1. Internal energy is a property
2. Internal energy is path independent
3. Internal energy is path dependent
4. Internal energy is the area under the PV curve
(a) 1 & 4
(b) 1 & 2
(c) 1 & 3
(d) 2 & 4

Q36. On a hot day at Chennai, an oil tanker was loaded with 40000 litres of diesel fuel. The tanker was then driven to Ooty where the temperature was 20K lower than in Chennai and the entire load was delivered at Ooty. If the coefficient of volume expansion for diesel fuel is 1×10^{-3}/K, the quantity of diesel delivered at Ooty was
(a) 40000 litre
(b) 39000 litre
(c) 40800 litre
(d) 39200 litre

Q37. The number of Oxygen atoms in 64 grams of Oxygen gas is
(a) 6.023×10^{23}
(b) 16.023×10^{32}
(c) 24.092×10^{23}
(d) 6.023×10^{32}

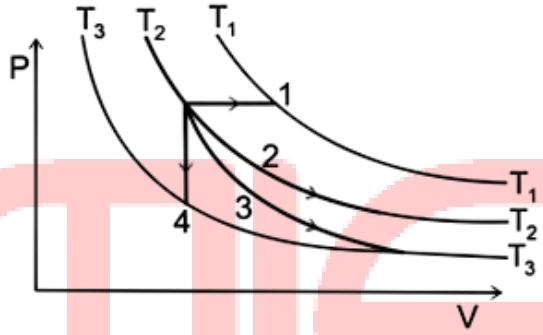
Q38. A block whose mass m = 4kg is fastened to a spring with a spring constant k = 64N/m. The block is pulled from its equilibrium position on a frictionless surface and released. The period

of the resulting motion in seconds is



(a) π/4
(b) π/2
(c) 2π
(d) π

Q39. A PV diagram is shown in the figure with three isotherms at temperature T1, T2 and T3. Four processes are represented in the diagram and are identified as 1,2,3 & 4. Then the processes indicated in the diagram are



(a) 1 - Isothermal, 2 - Isobaric, 3 - Isochoric, 4 - Adiabatic
(b) 1 - Isochoric, 2 - Isothermal, 3 -Adiabatic , 4 - Isobaric
(c) 1 - Isobaric, 2 - Isothermal , 3 - Adiabatic, 4 - Isochoric
(d) 1 -Isobaric , 2 - Adiabatic, 3 - Isothermal, 4 – Isochoric

Q40. If $\log_a ab = x$ then, $\log_b ab$ is equal to
(a) 1/x
(b) x/1+x
(c) x/1-x
(d) x/x-1

Q41. Which of the following equation represents a function?
(a) $|X| + |Y| = 2$
(b) $|X + y| = 4$
(c) $|Y| = x^2 + \text{Sin}x$
(d) $|x|^2 - x$

Q42. The value of $4^{2\log_9 3}$ is
(a) 4
(b) 2

(c) 3
(d) 1

Q43. If $\sqrt{1+\frac{x}{225}} = \frac{17}{15}$, then the value of x is ……

(a) 25
(b) $3\sqrt{15}$
(c) $4\sqrt{17}$
(d) 64

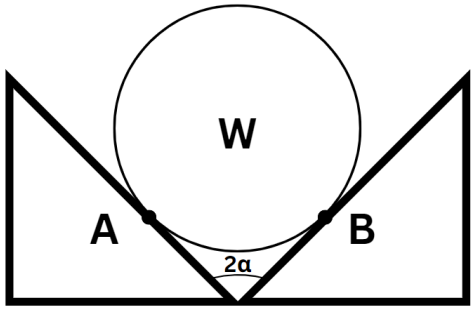
Q44. If x = 7 - $4\sqrt{3}$ Then the value of x + $\frac{1}{x}$ Is

(a) $3\sqrt{3}$
(b) $8\sqrt{3}$
(c) 14
(d) 14 + $8\sqrt{3}$

Q45. Pressure intensity at a point in a fluid at rest is 4N/cm^2. The corresponding height of water would be (assume g = 10 m/s^2)

(a) 4m
(b) 2m
(c) 0.4m
(d) 40m

Q46. A short cylinder of circular cross section and weight N is resting on a V block of angle 2α is shown in fig. The reaction at point A is ?



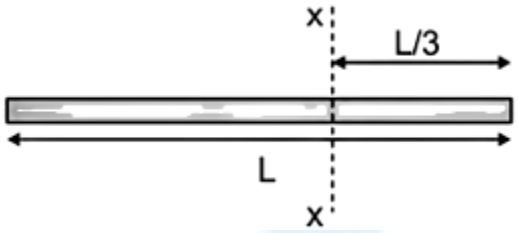
(a) W/2
(b) W/(2sinα)
(c) W/(2cosα)
(d) (Wsinα)/2

Q47. The head of water over an orifice of area 0.1m^2 is 5m. The actual discharge in m^3 per second if C_d = 0.4 is

(a) 0.4
(b) 4
(c) 2

(d) 0.2

Q48. Moment of inertia of a rod having mass M and length L about an axis XX is



(a) $Ml^2/9$
(b) $Ml^2/12$
(c) $4Ml^2/9$
(d) Ml^2

Q49. Two mating spur gears have 40 and 120 teeth respectively. The pinion transmits a torque of 20Nm rotating at 1200rpm. The torque transmitted by the gear is
(a) 6.6 Nm
(b) 20 Nm
(c) 40 Nm
(d) 60 Nm

Q50. A metallic body floats at the interface of mercury (of specific gravity 13.6) and water such that 40% of its volume is in mercury and 60% in water. Total buoyant force (in kN) experienced by body is (V = Volume of the floating body, g = 10m/s^2)
(a) 60.4 V
(b) 48.4 V
(c) 30.2 V
(d) Cannot be determined since density of floating body is not provided

Q51. The magnitude of the resultant of two equal coplanar forces acting at a point is equal to either of the forces. What is the angle between the forces?
(a) 45 degree
(b) 90 degree
(c) 60 degree
(d) 120 degree

Q52. A steel ball of mass 2.4kg is tied to a string and whirled it in a horizontal plane in a circle of diameter 2m at a constant speed of 20rpm. The tension in the string is (ignore gravity)
(a) 5.0 N
(b) 10.5 N
(c) 100 N
(d) 50.5 N

Q53. A 10 kg Aluminium block is dragged on a plain horizontal surface at a constant velocity of 2m/s A frictional force of 60N acts on it. What is the net force acting on the block?
(a) 60 N
(b) 100 N
(c) 160 N
(d) 0 N

Q54. A crane lifts a mass of 200 kg from rest and it attains as upward velocity of 3m/s in 2s uniformly. The tension in the supporting cable is
(a) 200 N
(b) 2000 N
(c) 300 N
(d) 2300 N

Q55. Two bodies m1 and m2 (m1>m2) have the same kinetic energy. Then their momentum P1 and P2 satisfy
(a) P1 = P2
(b) P1 > P2
(c) P1 < P2
(d) P1 = -P2

Q56. The Earth, Jupiter, Saturn, and Uranus all revolve around the sun. The earth takes 1year, Jupiter takes 12 years, Saturn takes 30 years and Uranus takes 84 years to complete one revolution around the Sun. At what periodicity, all these four planets line-up with each other?
(a) 84 years
(b) 168 years
(c) 420 years
(d) 1020 years

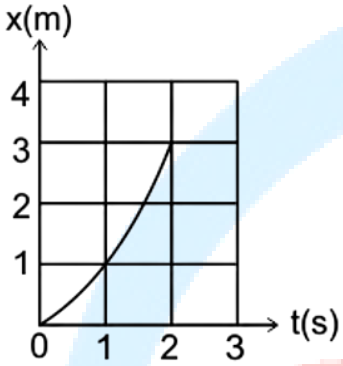
Q57. Maximum power transmission in a belt is met when the total tension in the belt equals
(a) centrifugal tension
(b) 2π times centrifugal tension
(c) Thrice centrifugal tension
(d) Half the centrifugal tension

Q58. Ravi is attending an interview at Kochi which is 400 km from his home. He plans to leave home at 7.00 AM and drive at 100 km/hr. so that he reaches for the interview scheduled at 11.00 AM on time. Ravi drives at that speed of 100 km/hr. for the first 200 km, but due to bad road he is forced to slow to 40 km/hr. for 40 km. The least speed needed for the rest of the trip to arrive in time for the interview is
(a) 100 km/hr.
(b) 180 km/hr.
(c) 160 km/hr.
(d) 140 km/hr

Q59. The position of a particle moving along the x axis is given by $X = 12t^2 - 2t^3$, where x is in meters and t is in seconds. The acceleration of the particle at t = 3.0s is

(a) $-12m/s^2$
(b) $+9m/s^2$
(c) $+12m/s^2$
(d) $-9m/s^2$

Q60. The figure depicts the motion of a particle along x axis with a constant acceleration. The acceleration of the particle along the x axis is



(a) $2\ m/s^2$
(b) $0.5\ m/s^2$
(c) $1\ m/s^2$
(d) $1.5\ m/s^2$

Q61. A stone is dropped into a river from a stationary balloon 405m above water . Another stone is thrown vertically down 1.00s after the first is dropped. The stones strike the water at the same time. The initial speed of the second is (acceleration due to gravity $g = 10m/s^2$)

(a) 12.625 m/s
(b) 16.625 m/s
(c) 8.635 m/s
(d) 10.625 m/s

Q62. The head loss due to friction in a pipe of 1m diameter and 1.5km long when water is flowing with a Velocity of 1m/s is (Darcy's friction factor $F_D = 0.02$ and acceleration due to gravity $g = 10m/s^2$)

(a) 1.5 m
(b) 0.5 m
(c) 1 m
(d) 2 m

Q63. A stationary mass of gas is compressed without friction from an initial state of $0.3m^3$ and 0.105 MPa to a final state of $0.15m^3$ and 0.105 MPa, the pressure remaining constant during

the process. There is a transfer of 37.6 KJ of heat from the gas during the process. The internal energy of the gas changes by

(a) -21.85 kJ
(b) 3.85 kJ
(c) -37.6 kJ
(d) -15.75 kJ

Q64. A turner is turning a job of 350mm long and 50 mm diameter at a cutting speed of 44m/min. And a feed of 0.5mm per revolution. The time required for one complete cut is (take π =22/7)

(a) 2.5 minutes
(b) 2 minutes
(c) 4 minutes
(d) 1 minute

Q65. The heat that must be absorbed by ice of mass 500g at -10℃ is (Specific heat of ice is 2.2kJ/kgK, specific heat of water is 4.2 kJ/kgK and latent heat of fusion of ice is 300KJ/Kg)

(a) 53 kJ
(b) 243 kJ
(c) 192 kJ
(d) 203 kJ

Q66. There are five numbers 2,3,4,5 and 6. The average value η_{avg} and root mean square (rms) value η_{rms} of these numbers are

(a) $\eta_{avg} = 4$ $\eta_{rms} = 4$
(b) $\eta_{avg} = 4$ $\eta_{rms} = 4.242$
(c) $\eta_{avg} = 5$ $\eta_{rms} = 4$
(d) $\eta_{avg} = 4$ $\eta_{rms} = 5$

Q67. $\sqrt[3]{\sqrt{0.000739}}$ **=**

(a) $\sqrt{3}$
(b) 0.03
(c) 0.3
(d) 0.00314

Q68. Which of the processes gives the least surface roughness?

(a) Turning
(b) Milling
(c) Filing
(d) Lapping

Q69. Which of the following material cannot be machined by EDM?

(a) Steel

(b) cast steel
(c) Titanium
(d) Glass

Q70. When a dimension is specified as 20mm +0.020/-0.010, the tolerance provided is
(a) 20 microns
(b) 10 microns
(c) 30 microns
(d) 200 microns

Q71. Lower critical temperature of steel is
(a) 950℃
(b) 1560℃
(c) 800℃
(d) 723℃

Q72. Reynolds's number is the ratio of
(a) Thermal conductivity to kinematic viscosity
(b) Inertia force to viscous force
(c) Heat convected to heat conducted
(d) None of the above

Q73. Efficiency of a Carnot cycle is ……..where T_2 is the highest temperature and T_1 is the lowest temperature during the cycle is
(a) $\frac{T_1}{T_2}$ - 1
(b) $\frac{T_1}{T_2}$
(c) 1 - $\frac{T_1}{T_2}$
(d) 1 + $\frac{T_1}{T_2}$

Q74. When the Mach number is less than the unity, the flow is
(a) Supersonic
(b) Subsonic
(c) Sonic
(d) Hypersonic

Q75. The moment of inertia of a circular section of diameter d about its diameter is
(a) $\frac{\pi d^3}{12}$
(b) $\frac{\pi d^4}{64}$
(c) $\frac{\pi d^2}{32}$
(d) $\frac{\pi d}{12}$

Q76. Unit of stress in SI unit is
(a) kg/mm^2
(b) N/m^2
(c) ksi
(d) ksc

Q77. Bernoulli's equation is the statement about fluid flow for
(a) Conversation `of mass
(b) Conversation of momentum
(c) Net work done
(d) Conversation of energy

Q78. The locus of a point on a string unwound from a circular disc is
(a) A circle
(b) A cycloid
(c) An involute
(d) A parabola

Q79. The CLA value is used for the measurement of
(a) Surface flatness
(b) Hardness
(c) Surface roughness
(d) Internal voids

Q80 The path of contact in involute gears is
(a) Along an involute
(b) Along a straight line
(c) Along the base circle
(d) Along the pitch circle

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Ans1.b
Solution: The primary unbalanced force is maximum when θ = 0° or θ = 180°. Thus, the primary force is maximum twice in one revolution of the crank. While The secondary unbalanced force is maximum, when θ = 0°, θ = 90°, θ = 180°, and θ = 360°.Thus, the secondary force is maximum for four angles in one revolution of the crank.
Therefore, it is seen that the frequency of secondary unbalanced force is twice of a primary unbalanced force.

Ans2.c
Solution:

Ans3.b
Solution: A quasi-static process in thermodynamics is defined as the process in which the system slowly undergoes thermodynamic changes in order to remain in internal equilibrium. All the reversible process are called as quasi-static process while entropy production in quasi static is a non-reversible process.

Ans4.d
Solution:

Ans5.d
Solution:

Ans6.b
Solution:
Set over = $\left(\frac{D-d}{2}\right) \times \frac{L}{L}$
Where; K (taper ratio) = $\left(\frac{D-d}{2l}\right) = \frac{1}{50}$

∴Set over = $\frac{1}{50} \times 200 = 2mm$

Ans7.c
Solution:

Ans8.d
Solution: Possible outcomes = (H, H), (H, T), (T, H), (T, T)
Total number of possible outcomes = 4
At least one head occurs 3 times.

So, the total number of favourable outcomes = 3
Now, the probability of getting at least one head = 3/4
∴ In a simultaneous throw of two coins, the probability of getting at least one head is 3/4

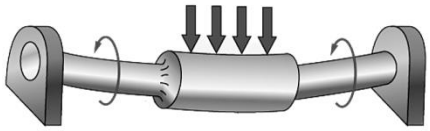
Ans9.b
Solution:
L = 15 m, θ = 45°
H = height of the tree, L = distance between tree and observer on the plane ground, θ = angle of elevation.
$\text{Tan}(\theta) = \frac{\text{Opposite side}}{\text{Adjacent side}} = \frac{H}{L}$
$\text{Tan}(45°) = \frac{\text{Opposite side}}{\text{Adjacent side}} = \frac{H}{L} = \frac{H}{15}$
$H = \tan(45°) \times 15$
H = 15m

Ans10.c
Solution:
Let, A, B, and C are sides of a right-angle triangle where C is the hypotenuse of the triangle, B is the base of the triangle, and A is the height of the triangle.
P is the perimeter of the triangle.
P = A + B + C
24 = A + B + 10
A + B = 14.....(1)
For Right angle triangle
$C^2 = A^2 + B^2$
$100 = A^2 + B^2$
Putting B = 14 - A from equation 1.
$100 = A^2 + (14 - A)^2$
$100 = A^2 + 14^2 - (2 \times 14 \times A) + A^2$
$2A^2 - 28A + 96 = 0$
$A^2 - 8A - 6A + 14 = 0$
A(A - 8) - 6 (A - 8) = 0
We get A = 8 and A =6
Hence considering A = 8 m we will get a value of B = 6 m.
Area of triangle = $\frac{1}{2}\ 8\ \times\ 6$ = 24 m^2.

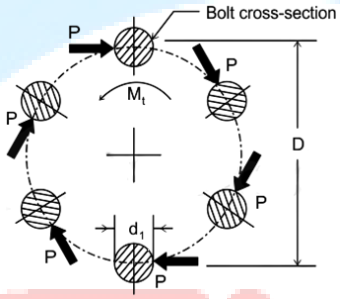
Ans11.a
Solution:
Diagonal of the cube is $10\sqrt{3}$ M
$10\sqrt{3} = \sqrt{3}A$
A = 10m
Volume of the cube is:
Volume = $a^3 = 10^3 = 1000\ m^3$

Ans12.b
Solution:

Ans13.a
Solution:



Bending moment on flange coupling



Shear force on bolts

Ans14.b
Solution:

Ans15.c
Solution: Here H specifies the hole basis assembly meaning the lower deviation of the hole is zero. G specifies the shafts whose upper deviation is below the zero line. The lower limit of the hole is above the upper limit of the shaft, hence Hole diameter is always bigger than the shaft diameter so the fit will be a clearance fit.

Ans16.d
Solution:

Ans17.a
Solution:

Ans18.a
Solution: Motion of an undamped pendulum, undamped spring-mass system. Force (F) = - k x
But according to Newton second law, F = ma
Therefore,
A = $\frac{-kx}{m}$
Where a is acceleration, x is the displacement of the system from its equilibrium position, m is the mass of the system and k is a constant associated with the system. In simple harmonic

motion, the acceleration is proportional to the distance from the point of reference and directed towards it. At x = 0 (mean position), Acceleration is zero.

Ans19.b

Solution: Heat conduction through solid body is given as:

$Q = -KA\frac{dT}{dX}$

Where k = thermal conductivity of material, A = cross-section area through which heat passes, ΔT = temperature difference , t = thickness of solid body,

$Q \propto k$, $Q \propto A$, $Q \propto \Delta T$ and $Q \propto \frac{1}{t}$

Hence conduction heat flow increases with increasing Area of body

Ans20.c

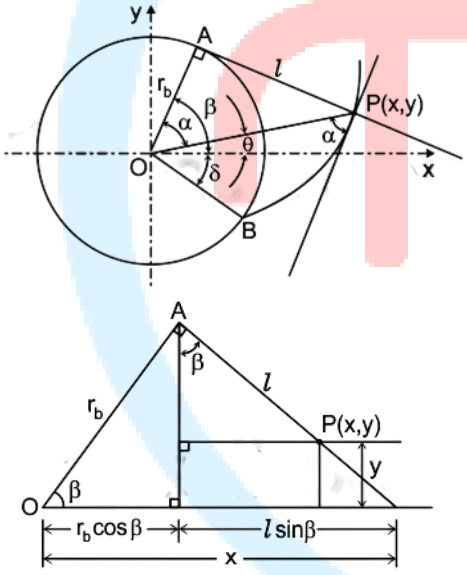
Solution:

Bending stress $(\sigma) = \frac{M \times y}{I}$

Where, M = Bending moment, Y = Distance from the neutral axis and I = the moment of inertia

Ans21.a

Solution:



Consider the involute of a circle shown in first figure

L = length of unwrapped

L = AB arc = $r_b(\beta \quad \delta) = r_b \tan\alpha$

Where r_b = base radius

Thus $(\beta + \delta) = \tan\alpha$

Also from second figure

$X = r_b\cos\beta + l \sin\beta = r_b[\cos\beta + (\beta + \delta)\sin\beta]$

$Y = r_b[\sin\beta - (\beta + \delta)\cos\beta]$

Also $\theta = \alpha = \beta = \tan\alpha - \delta$

Θ = tanα - α - δ = inv (α) - δ
Where inv(α) = tanα - α
Here in this question α = φ
∴ Inv φ = tan φ - φ represents the involute function
Where φ = pressure angle

Ans22.c
Solution:
S = ut + $\frac{1}{2}AT^2$
S = 0 + $\frac{1}{2} \times 10 \times 1^2$
S = 5m

Ans23.d
Solution:

Ans24.d
Solution:

Ans25.b
Solution:

Ans26.c
Solution:
T = $2\pi\sqrt{\frac{L}{G}}$
At moon gravity due to acceleration = g/6
T' = $2\pi\sqrt{\frac{6l}{G}}$
T' = $\sqrt{6}$ T
As time period for oscillation increases $\sqrt{6}$ Times, therefore speed becomes $\sqrt{6}$ Slower.

Ans27.b
Solution:
V = u + at
9.6 = u + 3.2×2.5
u = 9.6 - 8 = 1.6m/s

Ans28.c
Solution:
Assuming the given expression as n,
$(2 + \sqrt{2}) + \frac{1}{2+\sqrt{2}} + \frac{1}{\sqrt{2}-2}$ = n

Here, we can rationalize the denominator of n by taking LCM, so the value of the given equation becomes

N = (2 + $\sqrt{2}$) - $\sqrt{2}$

N = 2

Ans29.d

Solution:

Fan blade rpm (N) = 1200 rpm, Radius of blade, r = 0.7 m

In completing one revolution blade tip will cover a distance of 2πr,

So Velocity of blade tip = 2 π r × 1200 m/min = $\frac{2\,\pi\,0.7\times 1200}{60}$M/s

Velocity of blade tip = 88 m/s

Ans30.d

Solution:

$P_{oil} \times g \times (20+80) - \rho_{water} \times g \times (80) = 0$

$P_{oil} \times (100) = 1000 \times (80)$

$P_{oil} = 800\ kg/m^3$

Ans31.c

Solution: Density of block = 800 kg/m^3 ,Density of fluid = 1200 kg/m^3, Height of block H = 6cm, Submerged depth = h

Let us assume that the cross-sectional area = Am^2

So, Volume of the block 6×A

Weight of the block = 6×A×800……(1)

Since h is the submerged depth,

Buoyancy force = h × A × 1200

For floating bodies, we have

Weight of the block = Buoyancy force

So, by equating equation (!) And (2),

6 ×A × 800 = h × A × 1200

H = 4 cm

Hence, the height of the submerged part will be 4cm.

Ans32.d

Solution: Volume of the can = 1200 cm3, Mass of the can = 200 g, Density of lead shot = 11.4 g/cm^3, Density of water = 1 g/cm^3

Maximum buoyancy force = 1200 × 1 × g ----------(1)

Maximum possible weight of the can when it is completely filled with lead balls = (200 + 1200 × 11.4) × g

Maximum possible weight of the can when it is completely filled with lead balls = 13880 × g ----------(2)

From eq^n (1) and (2)

Since the maximum buoyancy force is less than the maximum possible weight of the can when it is completely filled with lead balls.
Let us assume that m is the total mass of lead ball just sufficient enough to balance the maximum buoyance force.
$1200 \times 1 \times g = (200 + m) \times g$
M = 1000 grams.

Ans33.a
Solution:

Ans34.b
Solution: f of f(x) = $\frac{af(x)+b}{cf(x)+d}$
F(f(x)) = $\frac{a\frac{ax+b}{cx+d}+b}{c\frac{ax+b}{cx+d}+d} = x$
= $\frac{a^2x+ab+bcx+bd}{cax+cb+cdx+d^2} = x$
$a^2x + ab + bcx + bd = cax^2 + cbx + cdx^2 + d^2x$
$a^2x + ab + bd = cax^2 + cdx^2 + d^2x$
compare x coefficient
$a^2 = d^2$
$a = \pm d$
compare x^2 coefficient
ca + cd = 0
a = -d
compare constant's coefficient
ab + bd = 0
a = -d

Ans35.b
Solution:

Ans36.d
Solution:
V_1 = 40000 litres
$A = 1 \times 10^{-3}K$
$\Delta V = \alpha v \Delta T$
As with decrease in temperature volume increases there $\Delta V = V_1 - V_2$
$40000 - V_2 = 10^{-3} \times 40000 \times 20$
V_2 = 40000-800 = 39200 litre

Ans37.c
Solution: The molar mass of oxygen gas is 32 g/mol Thus, the number of moles of oxygen gas in 64 grams is given by, Since, 32 grams of oxygen gas

= 1 moles of oxygen gas (O_2) thus, 64 grams of oxygen gas will have = 2 moles of oxygen gas (O_2) Again, 1 mole oxygen gas (O_2) contains = 2 mole of oxygen atoms, hence, 2 mole of oxygen gas (O_2) will have =4 mole oxygen atoms
Further, from the mole concept, 1 mole of any substance contains =6.023×1023 atoms
Hence, 4 moles of oxygen atoms = 4× 6.023×1023 atoms
4 moles of oxygen atoms =24.092 × 1023 atoms
Therefore, 64 grams of oxygen contains 24.092 × 1023 atoms of oxygen.

Ans38.b

Solution: $T = 2\pi\sqrt{\frac{M}{K}}$

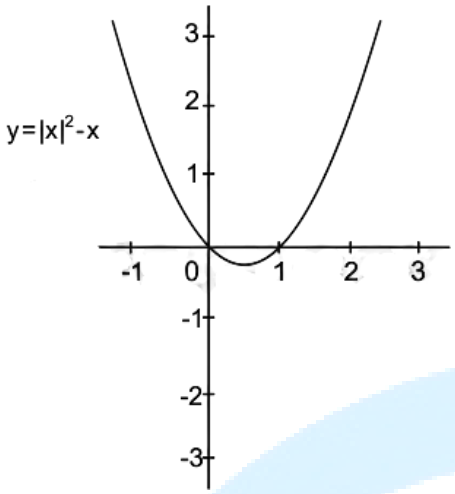
$= 2\pi\sqrt{\frac{4}{64}} = \frac{2\pi \times 2}{2 \times 4} = \frac{\Pi}{2}$

Ans39.c
Solution:

Ans40.d
Solution:
$Log_a ab = x$
We can rewrite it as,
$\log_a a + \log_a b = x$
$1 + \log_a b = x$
$1 + \frac{1}{Log_B A} = x$
$\frac{1}{Log_B A} = x - 1$
$Log_B A = \frac{1}{X-1}$.....(1)
Also, we have
$Log_b ab = \log_b a + \log_b b$
$\log_b ab = \log_b a + 1$.....(2)
Placing the value of $\log_b a$ from equation (1) in equation (2)
$Log_B Ab = \frac{1}{X-1} + 1$
$Log_B Ab = \frac{X}{X-1}$

Ans41.c
Solution: An equation is said to be a function if, for each possible input value, there is exactly one output value.

Here the equation can be f(x) or f(y), so the equation which will satisfy the above criteria can be called a function.



Assuming the equation as y = $|x|^2$ - x, it becomes a function of x. For every x, there is only one value of y.

Ans42.a
Solution:
Here we can rewrite the above term as $4^{2\log_9 3}$
$4^{2\log_9 3} = 4^{2\log_3 23} = 4^{(2\times\frac{1}{2}\times \mathrm{Log}_3 3)} = 4$
Or Using; $\mathrm{Log}_{a^m} a^n = \frac{n}{m}$

Ans43.d
Solution:
We have,
$\sqrt{1 + \frac{x}{225}} = \frac{17}{15}$
Squaring both side we get,
$1 + \frac{x}{225} = \frac{289}{225}$
$\frac{x}{225} = \frac{289 - 225}{225}$
$\frac{x}{225} = \frac{64}{225}$
X = 64

Ans44.c
Solution:
$X = 7 + 4\sqrt{3}$
$1/x = 7 - 4\sqrt{3}$
X + 1/x
$7 + 4\sqrt{3} + 7 - 4\sqrt{3}$
= 14

Ans45.a

Solution:

$P = 4N/cm^2 = 4 \times 10^4\ N/m^2$

We know that

$P = \rho_w \times g \times h$

$4 \times 10^4 = 1000 \times 10 \times h$

$H = 4\ m$

Ans46.b

Solution: As the diagram is symmetric therefore cosine component of both the normal forces acting upward at A and B is equal to the weight of the cylinder.

Hence, $N\cos(90-\alpha)\times 2 = W$ where ($N_A = N_B = N$)

$N = \frac{W}{2\sin\propto}$

Ans47.a

Solution:

$C_d = \frac{Q_{Act}}{Q_{Th}} = \frac{Q_{Act}}{\text{Area of orifice} \times \text{Velocity of flow}}$

$0.4 = \frac{Q_{Act}}{0.1 \times \sqrt{2gh}}$

$Q_{act} = 0.4 \times 0.1 \times \sqrt{2 \times 5 \times 10} = 0.04 \times 10 = 0.4\ m^3/s$

Ans48.a

Solution:

Here, the moment of inertia of the rod about the centroidal axis = $\frac{ML^2}{12}$

Let the distance between the centroidal axis and the axis x-x = d

$D = \frac{l}{2} - \frac{l}{3}$

$D = \frac{l}{6}$

From parallel axis theorem we have,

$I_{x-x} = I_c + Md^2$

$I_{x-x} = \frac{Ml}{12} + \frac{Ml^2}{36} = \frac{Ml^2}{9}$

Ans49.d

Solution:

Number of teeth on pinion $Z_p = 40$, Number of teeth on gear $Z_g = 120$, Rotational speed of pinion $N_p = 1200$rpm, Torque $T_p = 20$Nm

As we know,

$\frac{N_P}{N_G} = \frac{Z_G}{Z_P}$

$N_G = \frac{Z_G}{Z_P} \times N_P$

$N_G = \frac{40}{120} \times 1200 = 400$rpm

Since the power transmitted by the two mating gears will be equal.

Thus, $T_P\Omega_P = T_G\Omega_G$
$T_P N_P = T_G N_G$
T_G = 60 Nm

Ans50.a
Solution:
Buoyant force = Weight of volume of fluid displaced by the body

$F_B = \rho \times g \times V_{\text{Fluid displaced}}$

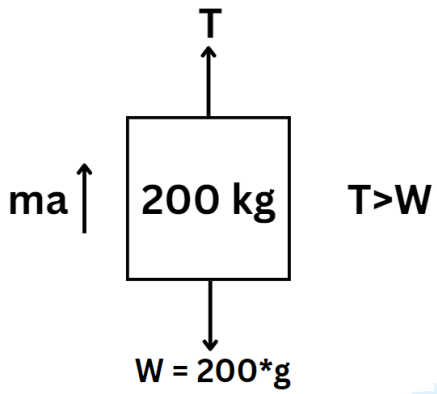
Where F_B = Buoyant force, ρ_{fluid} = Density of fluid displaced by the body, V = volume of fluid displaced
Volume of body = V, %Volume of body in water = 0.4V, Volume of body in water = 0.6V Specific gravity of fluid (mercury) = 13.6.
Let density of water = 1000 kg/m^3, then density of mercury = s.g. ×1000 = 13600 kg/m^3
Total Buoyant force = Buoyant force due to water + Buoyant force due to mercury
Buoyant force = $(P_{\text{Water}} \times g \times 0.6V) + (P_{\text{Mercury}} \times g \times 0.4V)$
Buoyant force = 60.4 V kN

Ans51.d
Solution:
$R = \sqrt{P^2 + Q^2 + 2pq\cos\theta}$
$F = \sqrt{F^2 + F^2 + 2F^2\cos\theta}$
$F^2 = 2F^2(1+\cos\theta)$
$\cos\theta = -1/2$
$\Theta = 120°$

Ans52.b
Solution:
Given: m = 2.4 kg, Speed (N) = 20rpm, diameter od circle of rotation d = 2m, so radius of circle of rotation r =1m
Angular speed of rotation $\omega = \frac{2\pi n}{60}$
$\Omega = \frac{2\pi \times 20}{60}$
Ω = 2.094 rad/sec
Now Tension T = $2.4 \times 1 \times 2.094^2$
T = 10.52N

Ans53.d
Solution: As velocity of 2m/s is constant ∴ a = 0
$F_{net} = m \times 0 = 0$ N

Ans54.d
Solution:



T > W since, Crane lifts a mass upward
T - W = m.a
T - 200×10 = 200×3/2
T = 2300 N

Ans55.b
Solution:
$m_1 > m_2$ and,
Two bodies have the same kinetic energy
$1/2m_1v_1^2 = 1/2m_2v_2^2$
We can rewrite it as,

$$\frac{1}{2} \times \frac{(M_1 \times V_1)^2}{M_1} = \frac{1}{2} \times \frac{(M_2 \times V_2)^2}{M_2}$$

$$\frac{P_1^2}{M_1} = \frac{P_2^2}{M_2}$$

$$\frac{P_1}{P_2} = \sqrt{\frac{M_1}{M_2}} \quad \text{.....(3)}$$

Since $m_1 > m_2$ RHS becomes greater than 1, which implies

$$\frac{P_1}{P_2} > 1$$

$P_1 > P_2$

Ans56.c
Solution:
Revolution time around sun of Earth = 1 years, Jupiter = 12 years, Saturn = 30 years, Uranus = 84 years
To find LCM express each revolution in product of prime no,
1 = 1 12 = 2 × 2 × 3
30 = 2 × 3 × 5
80 = 2 × 2 × 3 × 5
Now LCM = 1 × 2 × 2 × 3 × 5 × 7
LCM = 420 Hence Planets will line-up with each other periodically after 420 years

Ans57.c
Solution:

$P = (T_1 - T_2).v$
For maximum power: $T_1 = T/3$
Where T_1 = Tension in the tight side, T = Maximum tension to which the belt is subjected.

Ans58.c
Solution:
Ravi has to reach for interview in = 7.00 Am - 11.00 AM = 4hour
Speed for first 200km = 100km/hr.,
For next 40 km = 40 km/hr.,
Let for last (400 - 200 - 40) = 160km, Ravi should drive with x km/hr. so that he can reach the venue in time.
Time taken in 200km + time taken in 40 km + time taken 160 km = total time taken to reach the venue
$\frac{200}{100} + \frac{40}{40} + \frac{160}{x} = 4$
$\frac{160}{x} = 4 - 2 - 1$
X = 160km/hr.
Hence Ravi should drive at 160 km/hr. for the remaining 160km so that he can reach on the venue in time.

Ans59.a
Solution:
$V = \frac{Dx}{Dt} = 2\times12t - 2\times3t^2 = 24t - 6t^2$
$\frac{Dv}{Dt} = 24 - 12t$
At t = 3.0s
$A = \frac{Dv}{Dt} = 24 - 12(3) = -12 m/s^2$

Ans60.c
Solution:
For position (x_1) = 1 m, at time t_1 = 1 s, for final position (x_f) = 3 m, at time (t_f) = 2 s
So, $1 = (v_0 \times 1) + (\frac{1}{2} \times a \times 1^2)$.....(1)
$1 = v_0 + a/2$
And, $3 = (v_0 \times 2) + (\frac{1}{2} \times a \times 2^2)$.....(2)
From equation (1) and equation (2), put the value of v0 in equation (2)
3 = 2(1 - a/2) + 2a
3 = 2 - a + 2a
$A = 1 m/s^2$

Ans61.d
Solution:
Using; $S = ut + \frac{1}{2}AT^2$

$405 = 0\times t + \frac{1}{2}\times 10 \times T^2$

$T = \sqrt{81}$

T = 9 sec

After 1 sec the other stone is thrown vertically, therefore it will take 8sec to hit the water at the same time when first stone hits.

Taking t = 8sec

Using; $S = ut + \frac{1}{2}AT^2$

$405 = u\times 8 + \frac{1}{2}\times 10 \times 8^2$

U = 10.625 m/s

Ans62.a

Solution:

$H = \frac{Flv^2}{2dg} = \frac{0.02\times 1500\times 1^2}{2\times 1\times 10} = \frac{20\times .15}{20}$ = 1.5m

Ans63.a

Solution:

đq = du + đw

$-37.6 = du + 0.105\times(0.15)\times 10^6$

Du = 15.75 - 37.6

= -21.85 KJ

Ans64.a

Solution:

$V = \frac{\Pi dn}{1000}$ M/min

$V = \frac{22\times 50\times N}{7\times 1000}$

$N = \frac{44\times 7\times 1000}{22\times 50} = \frac{7\times 1000}{25}$ = 7×40 = 280 rpm

Now, $t = \frac{L}{Fn} = \frac{350}{0.5\times 280} = \frac{35}{14}$ = 2.5 minutes

Ans65.d

Solution:

Q = heat absorbed in sensible heating + heat absorbed in latent heating + heat absorbed in sensible heating

$Q = mcdt + ml_h + mcdt$

$Q = 0.5\times 2.2\times 10 + 0.5\times 300 + 0.5\times 4.2\times 20$

Q = 11 + 150 + 42

Q = 203 kJ

Ans66.b

Solution:

Numbers: 2,3,4,5,6

$\eta_{avg} = \frac{\text{Sum of all data}}{\text{Total number of data}} = \frac{2+3+4+5+6}{5} = \frac{20}{5} = 4$

And

$\eta_{rms} = \sqrt{\frac{\text{Sum of squares of all data}}{\text{number of data}}} = \sqrt{\frac{2^2+3^2+4^2+5^2+6^2}{5}} = \sqrt{\frac{90}{5}} = 4.242$

Ans67.c
Solution:

Let's assume the required value of $\sqrt[3]{\sqrt{0.000739}}$ Is x so,

$X = \sqrt[3]{\sqrt{0.000729}}$

On factorizing the most inner term 0.000729 in two equal terms, we get

$X = \sqrt[3]{\sqrt{0.027 \times 0.027}}$

$X = \sqrt[3]{\sqrt{(0.027)^2}}$ (Again if needed inner most term must be factorized)

X = 0.3

Ans68.d
Solution:

Ans69.d
Solution:

Ans70.c
Solution:

Tolerance = Upper limit - lower limit

= 20.02 - 19.09 = 0.03mm = 30×10^{-6} = 30 microns

Ans71.d
Solution:

Ans72.b
Solution:

Ans73.c
Solution:

Ans74.b
Solution:

Ans75.b
Solution:

Ans76.b

Solution:

Ans77.d

Solution: The Bernoulli Equation can be considered to be a statement of the conservation of energy principle appropriate for flowing fluids.

Assumptions:

The fluid is ideal i.e. Viscosity is zero.
The flow is steady.
The flow is incompressible.
The flow is one dimensional.
The flow is along the streamline.

Ans78.c

Solution:

Ans79.c

Solution: Evaluation of surface roughness:

1. Root mean square value: r.m.s. Value
2. Centre line average (CLA) or arithmetic mean deviation (Ra)
3. Maximum peak to valley height (Rt or Rmax)
4. The average of five highest peaks and five deepest valleys in the sample (Rz)
5. The average or levelling depth of the profile (Rp)

Ans80.b

Solution: The path of contact in involute gear is a straight line and the path of contact in cycloid gear is a circle. Cycloid curve: A cycloid is a curve traced by a point on the circumference of a circle that rolls without slipping on a fixed straight line.