1   The ultimate tensile strength and yield strength of most of the metals, when temperature falls from 0 to -150^0C will

(a) Increase   (b) Decrease   (c) Remain same   (d) First increase and then decrease

2.   "Troosite" is obtained when

(a)   Quenching steel during transformation

(b)   A fully hardened steel is finally drawn at about 677° C

(c)   Steel is rapidly quenched in oil

(d)   When alloy steels are rapidly quenched in water

3.   Induction hardening is the process of

(a) Hardening the core   (b) Uniform hardening

(c) Selective hardening   (d) Hardening surface for wear resistance

4.   Heavy water is used in atomic power plants as

(a) Fuel   (b) Source of energy   (c) Lubricant   (d) Moderator

5.   Which one is not the purpose of heat treatment of steels?

(a) Changing the composition of steel on the surface

(b) Changing the percentage of carbon and Si in the bulk

(c) Increasing or decreasing the grain size

(d) Removing undesirable residual stresses

6.   A cold chisel is made of

(a) Mild steel   (b) Cast iron   (c) H.S.S.   (d) High carbon

7.   A body which is permanently deformed is said to have undergone

(a) Elastic deformation   (b) Limit of elastic deformation

(c) Plastic deformation   (d) Uniform deformation

8.   The defect responsible for the phenomena of slip, by which most metals deform plastically, is known as

(a) Fracture   (b) Twinning   (c) Dislocation   (d) Strain hardening

9.   With a punch for which the maximum crushing stress is 4 times the maximum shearing stress of the plate, the biggest hole that can be punched in the plate would be of diameter equal to

(a) $\frac{1}{4} \times$ Thickness of plate   (b) $\frac{1}{2} \times$ Thickness of plate

(c) Plate thickness   (d) $2 \times$ plate thickness

10.   For traction applications, the type of motor best suited is

(a) Induction motor   (b) Synchronous motor   (c) DC shunt motor   (d) DC series motor

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MECHANICAL ENGINEERING - I

SET - D

11. On loading a ductile material in excess of a certain value, gradual increase in elongation occurs with time. Such phenomenon is known as

(a) Creep   (b) Fatigue   (c) Stress concentration   (d) None of the above

12. The failure occurs at a point in a member, when the maximum shear stress in a bi-axial stress system reaches the shear stress at elastic limit in simple tension test, This is according to

(a) Rankine's theory   (b) Guest's theory   (c) Lame's theory   (d) None of the above

13. The function of a washer is

(a) To fill the axial gap   (b) To provide cushioning effect
(c) To absorb shocks and vibrations   (d) To provide bearing area

14. Surface endurance limit of gear material depends on its

(a) Surface hardness   (b) Modulus of elasticity   (c) Elastic strength   (d) All of the above

15. A double strap butt joint is always in

(a) Single shear   (b) Double shear   (c) Either single or double shear   (d) None of the above

16. If $y = \tan^{-1} \dfrac{2x}{1 - x^2}$, then $\dfrac{dy}{dx}$ is

(a) $\dfrac{2}{1+x^2}$ (b) $\dfrac{2}{1-x^2}$ (c) $\dfrac{1}{1+x^2}$ (d) $\dfrac{2x}{\sqrt{1+x^2}}$

17. Rivets are made of

(a) Soft material   (b) Hard material   (c) Ductile material   (d) Brittle material

18. The purpose of providing multiple collars on a flat collar pivot bearing is to

(a) Increase frictional resistance
(b) To establish self – sustaining bearing conditions
(c) Distribute the frictional load because of limiting friction
(d) Distribute the axial load because of limiting bearing pressure on a collar

19. Angle of dwell of cam is defined as the angle

(a) during which the follower returns to its initial position
(b) of rotation of the cam for definite displacement of the follower
(c) through which the cam rotates during the period in which the follower remains in the highest position
(d) moved by the cam from the instant the follower begins to rise, till it reaches its highest position

20. The supply of working fluid to the engine to suit the load conditions is controlled by

(a) Meyer's expansion valve   (b) D-slide valve   (c) Governor   (d) Throttle valve

21. A pantograph is a device that reproduces a displacement

(a) On the same scale   (b) On any scale   (c) On reduced scale   (d) On enlarged scale

22. In the case of gyroscopic effect, the planes of spin, gyroscopic couple and precession are

(a) In same plane   (b) In different planes
(c) Any two in perpendicular planes and third in   (d) Mutually perpendicular
     different plane

23. Which of the following is a lower pair?

(a) Piston and cylinder   (b) Cam and follower   (c) Belt drive   (d) Gear

24. Match List-I (measuring Devices) with List-II (Measuring parameter) and select the correct answ using the codes given below the lists

List #1		List #2	
Device		Parameter	
A	Pitot tube	1	Flow static pressure
B	Micro-manometer	2	Rate of flow (indirect)
C	Pipe bend meter	3	Differential pressure
D	Wall pressure tap	4	Flow stagnation pressure

	A	B	C	D
(a)	1	3	2	4
(b)	4	3	2	1
(c)	1	2	3	4
(d)	4	2	3	1

25. The following data pertain to a worker: base rate = Rs. 20 per hour
Time taken for completing the job = 2 hours
Standard time = 3hours
Under Halsey plan the total earning of the worker is

(a) Rs. 36.67   (b) Rs.40.67   (c) Rs.46.67   (d) Rs.56.57

26. What is the correct sequence of the following parameters in order of their maximum to minimum influence on tool life?
     1. Feed rate
     2. Depth of cut
     3. Cutting speed
Select the correct answer using the codes given below

(a) 1,2,3   (b) 3,2,1   (c) 2,3,1   (d) 3,1,2

27. Given that cutting speed $= 9\,m/\text{min}$, the return time to cutting time ratio is $= 1{:}2$ the feed rate $= 0.3\,mm/stroke$, the clearance at each of cut $= 25$ mm and that the plate Is fixed 700 mm side along the direction of tool travel, the time required for finishing one flat surface of a plate of size 700 x 300 mm in a shaper, will be

   (a) 10 min   (b) 12.5 min   (c) 15 min   (d) 20 min

28. The least count of a metric vernier caliper having 25 divisions on vernier scale , matching with 24 divisions of main scale (1 main scale divisions= 0.5 mm)is

   (a) 0.005 mm   (b) 0.01 mm   (c) 0.02 mm   (d) 0.005mm

29. Standards to be used for reference purposes in laboratories and workshops are termed as

   (a) Primary standards   (b) Secondary standards   (c) Tertiary standards   (d) Working standards

30. For achieving a specific surface finish in single point turning the most important factor to be controlled is

   (a) Depth of cut   (b) Cutting speed   (c) Feed   (d) Tool rake angle

31. Interchangeability can be achieved by

   (a) Standardisation   (b) Better process planning   (c) Simplification   (d) Better product planning

32. The centre and radius of the circle $z\bar{z} - (2+3i)z - (2-3i)\bar{z} + 9 = 0$ are

   (a) $(2,3),2$ (b) $(2,-3),2$ (c) $(2,3),\sqrt{2}$ (d) $(2,-3),\sqrt{2}$

33. Enlarging an existing circular hole with rotating single point tool is called

   (a) Boring   (b) Drilling   (c) Reaming   (d) Internal turning

34. Plug gauges are used to

   (a) Measure the diameter of the workpieces
   (b) Measure the diameter of the holes in the workpieces
   (c) Check the diameter of the holes in the workpieces
   (d) Check the length of holes in the workpieces

35. Basic shaft and basic hole are those whose upper deviations and lower deviations respectively are

   (a) +ve,-ve   (b) -ve,+ve   (c) Zero,Zero   (d) None of the above

36. The general equation of continuity for three-dimensional flow of a compressible fluid for steady flow is (where u, v, w are components of velocity in x, y and z directions respectively)

(a) $\dfrac{\partial u}{\partial x} + \dfrac{\partial v}{\partial y} + \dfrac{\partial w}{\partial z} = 0$

(b) $\dfrac{\partial u}{\partial x} = \dfrac{\partial v}{\partial y} = \dfrac{\partial w}{\partial z} = 0$

(c) $\dfrac{\partial u}{\partial x} + \dfrac{\partial v}{\partial y} + \dfrac{\partial w}{\partial z} = 1$

(d) $\dfrac{\partial u}{\partial x} + \dfrac{\partial v}{\partial y} + \dfrac{\partial w}{\partial z} = u.v.w$

37. The density of air at $10°$ C and 1MPa abs, in SI units is

(a) 1.231   (b) 12.31   (c) 118.4   (d) 65.0

38. In centrifugal pumps, maximum efficiency is obtained when the blades are
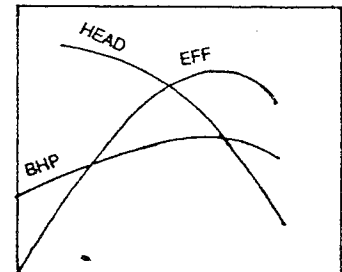
(a) Straight   (b) Bent forward   (c) Bent backward   (d) radial

39. If the characteristics of a pump are as shown in fig. What is represented by abscissa

(a) Head   (b) RPM

(c) Discharge   (d) Power

40. A rocket exists exhaust gases with $\rho = 0.5 kg/m^3$ out a 50 cm diameter nozzle at a velocity of $1200 m/s$ The thrust, is

(a) 420 kN   (b) 280 kN   (c) 140 kN   (d) 90 kN

41. Which of the following pairs of velocity components u and v satisfy the continuity equation for a two dimensional flow of an incompressible fluid?

(a) $u = (2x^2 + 3y^3); v = -3xy$

(b) $u = (3x - y); v = (2x + 3y)$

(c) $u = A\sin xy; v = -A\sin xy$

(d) $u = cx; v = -cy$

42. The flow of a fluid in a pipe takes place from

(a) Higher level to lower level
(c) Higher pressure to lower pressure

(b) Small end to large end
(d) Higher energy to lower energy

43. An aeroplane is flying at an height of 14km where temperature is $-45°C$. The speed of the plane is corresponding to M=2. Find the speed of the plane if R=287J/kg K and $\gamma = 1.4$.
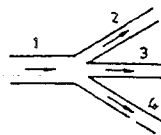
(a) 2179km/h   (b) 3010 km/h   (c) 3250km/h   (d) 3379km/h

44. Pipe 1, branches to three pipes as shown in the given figure. The areas and corresponding velocities are as given in the following table
The value of V_2 in cm per second will be

Pipe	Velocity (cm per second)	Area (sq cm)
1.	50	20
2.	V_2	10
3.	30	15
4.	20	10

(a) 15   (b) 20   (c) 30   (d) 35

45. The pressure difference measured by a mercury oil differential manometer on the two sides of the orifice meter gives a reading of 50 cm of mercury. Determine the differential pressure head in orifice. Take the specific gravity of oil as 0.9.

(a) 7.05 m of oil   (b) 5.05 m of oil   (c) 4.75 m of oil   (d) 3.35 m of oil

46. The transition Reynolds number for flow over a flat plate is 5×10^5. What is the distance from the leading edge at which transition will occur for flow of water with a uniform velocity of 1m/s? (For water, the kinematic viscosity, $v=0.858 \times 10^{-6}\,m^2/s$)

(a) 1 m   (b) 0.43 m   (c) 43 m   (d) 103 m

47. Pipes of lengths l_1, l_2 etc and diameters d_1, d_2, etc are connected in series. A single pipe of length $l_1 + l_2 + l_3 + \ldots$ having same pressure loss as all pipes in series will have diameter equal to

(a) $\left(\dfrac{l_1 + l_2 + l_3 + \ldots}{l_1/d_1^4 + l_2/d_2^4 + \ldots} \right)^{1/4}$

(b) $\left(\dfrac{l_1 + l_2 + l_3 + \ldots}{l_1/d_1^5 + l_2/d_2^5 + \ldots} \right)^{1/5}$

(c) $\left(\dfrac{l_1 + l_2 + l_3 + \ldots}{l_1/d_1^3 + l_2/d_2^3 + \ldots} \right)^{1/3}$

(d) $\left(\dfrac{l_1 + l_2 + l_3 + \ldots}{l_1/d_1^2 + l_2/d_2^2 + \ldots} \right)^{1/2}$

48. Let x have the density function $f(x) = \begin{cases} \dfrac{3}{4}\left(1 - x^2\right) & \text{if } -1 \le x \le 1 \\ 0 & \text{otherwise} \end{cases}$. Then the probability

$p\left(\dfrac{-1}{2} \le x \le \dfrac{1}{2} \right)$ is

(a) 68.75%   (b) 31.36%   (c) 95%   (d) 60.7%

49. If thermal conductivity of a material varies as $K_0(1 + \alpha T)$, temperature at the center of a 10 cm thick wall of material will be

(a) Average of the temperature at two ends of the wall

(b) More than the average of the temperature at two ends of the wall

(c) Less than the average of the temperature at two ends of the wall

(d) Depends on the range of temperature

50. What is the net radiant interchange per square meter for two very large plates at temperatures 800 K and 500 K respectively? (The emissivity of the hot and cold plates are 0.8 and 0.6 respectively. Stefan Boltzmann constant is $5.67*10^{-8}$ W/m^2 K^4).

(a) $10.26 \dfrac{kW}{m^2}$ (b) $1.026 \dfrac{kW}{m^2}$ (c) $102.6 \dfrac{kW}{m^2}$ (d) $1026 \dfrac{kW}{m^2}$

51. A 10 kg solid at 100^0C with a specific heat of 0.8kJ/kg.^{0}C is immersed in 40 kg of 20^0C liquid with a specific heat of 4.0 kJ/kg ^{0}C. Estimate the temperature after a long time if the container is insulated?

(a) 30^0C (b) 28^0C (c) 26^0C (d) 24^0C

52. A spherical shaped vessel of 1.4 m outer diameter is 90 mm thick. Find the rate of heat leakage, if the temperature difference between the inner and outer surfaces is 220^0C. Thermal conductivity of the material of the sphere is 0.083 W/m K.

(a) 0.2 kW (b) 0.5 kW (c) 1.088 kW (d) 1.6 kW

53. $\left(\dfrac{\partial p}{\partial V}\right)_T \left(\dfrac{\partial v}{\partial T}\right)_p \left(\dfrac{\partial T}{\partial p}\right)_v$ is equal to

(a) Zero (b) 1 (c) -1 (d) Infinity

54. A well insulated vessel containing air is heated to double the pressure and temperature 150% in excess of initial. The amount of air that leaked is

(a) 20% (b) 22.5% (c) 25% (d) 0%

55. An unconstraint thin circular disc has a concentric hole in it. On heating the diameter of the hole will

(a) increase (b) decrease (c) Remain constant (d) first increase then decrease

56. The specific heat of diatomic gas at constant pressure is given by (R = universal gas constant and M = molecular weight of gas)

(a) $\dfrac{5}{2}\dfrac{R}{M}$ (b) $\dfrac{5}{2}MR$ (c) $\dfrac{7}{2}\dfrac{R}{M}$ (d) $\dfrac{7}{2}MR$

57. The variation of temperature inside a wall is shown by three different curves. In which case thermal conductivity least varies with temperature

    (a) A
    (b) B
    (c) C
    (d) Cannot be ascertained on the basis of information provided
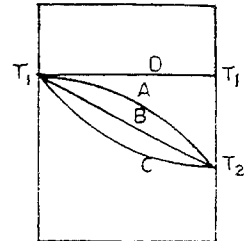
58. Kinetic energy of the molecules in terms of absolute temperature (T) is proportional to

    (a) T   (b) T^4 (c) T^2 (d) $\sqrt{T}$

59. Which type of heat exchanger an automobile radiator is?

    (a) Parallel flow type   (b) Counter flow type   (c) Regenerator type   (d) Cross flow type

60. Given that Nu =Nusselt number, Re = Reynolds number, Pr = Prandtl number, Sh = Sherwood number, Sc = Schmidt number and Gr = Grashoff number. The functional relationship for free convective heat transfer is given as,

    (a) Nu = f(Gr, Pr)   (b) Sh = f(Sc, Gr)   (c) Nu = f(Re, Pr)   (d) Sh = f(Re, Sc)

61. The quantity of heat required to change the temperature of 1 gm of ice from $-6^0 C$ to $-5^0 C$ is known as

    (a) Latent heat of   (b) Freezing heat   (c) Heat of vaporization   (d) Specific heat
    freezing

62. The spectral energy distribution for a body at temperature T is shown in figure. Now if the temperature of the body is increased

    (a) λ_m Will shift towards right

    (b) λ_m will shift towards left

    (c) The total energy emitted by the body will decrease

    (d) λ_m will remain the same but E_m will increase
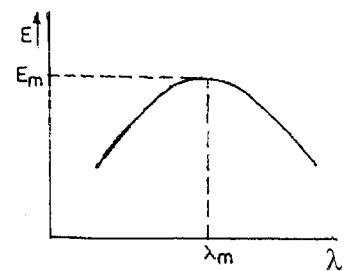
63. When K is the thermal conductivity, τ is the density and C_p is the specific heat of a substance, then thermal diffusivity is given by

    (a) $\dfrac{K}{\tau.C_p}$ (b) $\dfrac{K.C_p}{\tau}$ (c) $\dfrac{\tau.C_p}{K}$ (d) $\dfrac{K.\tau}{C_p}$

64. The determinant of the matrix $\begin{bmatrix} 7 & 0 & 0 & 0 \\ 9 & 3 & 0 & 0 \\ 4 & -6 & -2 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ is

(a) 0   (b) 1   (c) -42   (d) -68

65. A thin copper wire at 300° is suddenly immersed in water at 30°C. It cools down to 150°C in 70 seconds. It is then reheated to the initial temperature of 300°C and suddenly exposed to air at 30°C where it cools down to 150°C in 200 seconds. This difference in cooling time is due to

(a) Larger specific heat of water   (b) Larger heat transfer coefficient in water
(c) Smaller heat transfer coefficient in water   (d) None of the above

66. A heavy block of mass m is slowly placed on a conveyer belt moving with speed v. If coefficient of friction between block and the belt is μ, the block will slide on the belt through distance

(a) $\dfrac{v}{\mu g}$ (b) $\dfrac{v^2}{\sqrt{\mu g}}$ (c) $\left(\dfrac{v}{\mu g}\right)^2$ (d) $\dfrac{v^2}{2\mu g}$

67. A car moving with speed u can be stopped in minimum distance x when brakes are applied. If the speed becomes n times, the minimum distance over which the car can be stopped would take the value

(a) $\dfrac{x}{n}$ (b) nx (c) $\dfrac{x}{n^2}$ (d) $n^2 x$

68. Speed of particle executing simple harmonic motion with amplitude a is half of the maximum speed. At that instant, displacement of the particle is

(a) $\dfrac{a}{2}$ (b) $\dfrac{\sqrt{3}}{2}a$ (c) $\dfrac{2a}{\sqrt{3}}$ (d) $3\sqrt{2}a$

69. Two blocks with masses M and m are in contact with each other and are resting on a horizontal frictionless floor. When horizontal force is applied to the heavier, the blocks accelerate to the right. The force between the two blocks are
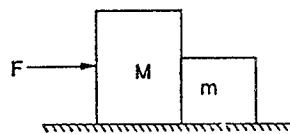
(a) $\dfrac{(M+m)F}{m}$ (b) $\dfrac{MF}{m}$ (c) $\dfrac{mF}{M}$ (d) $\dfrac{mF}{(M+m)}$

70. A stone of mass m at the end of a string of length l is whirled in a vertical circle at a constant speed. The tension in the string will be maximum when the stone is

(a) At the top of the circle
(b) Half-way down from the top
(c) Quarter-way down from the top
(d) At the bottom of the circle

71. Ratio of the radii of the planets P_1 and P_2 is k and ratio of the accelerations due to gravity on them is s. Ratio of escape velocities from them will be

(a) ks
(b) $\sqrt{ks}$
(c) $\sqrt{\dfrac{k}{s}}$
(d) $\sqrt{\dfrac{s}{k}}$

72. Couple M is applied at C on a simply supported beam AB. The maximum shear on AC will be

(a) Zero
(b) M
(c) $\dfrac{2M}{3}$
(d) $\dfrac{M}{3}$
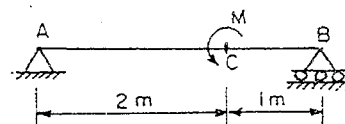
73. A short column of external diameter D and internal diameter d, is subjected to a load W, with an eccentricity e, causing zero stress at an extreme fiber. Then the value of 'e' must be

(a) $\dfrac{D^2 + d^2}{8\pi D}$
(b) $\dfrac{D^2 + d^2}{8D}$
(c) $\dfrac{D^2 - d^2}{8D}$
(d) $\dfrac{D^3 - d^3}{8D^2}$

74. A beam AB is hinge-supported at its ends and is loaded by couple P.c. as shown in the figure. The magnitude of shearing force at a section x of the beam is

(a) 0
(b) P
(c) P/2L
(d) P.c/2L
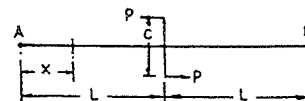
75. There are two bars of equal length and equal volume and same material, one having stepped diameters and other having uniform diameter. If maximum stress produced in both bars is same, then stored energy will be

(a) More in stepped diameter shaft
(b) More in uniform diameter shaft
(c) Equal in both
(d) Depend on other factors

76. The given figure shows the shear force diagram for the beam $ABCD$. Bending moment in the portion BC of the beam
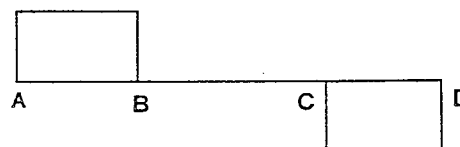
(a) Is a non-zero constant
(b) Is zero
(c) Varies linearly from B to C
(d) Varies parabolically from B to C

77. σ_x, σ_y and τ_{xy} are the rectangular stress components at a point. The radius of Mohr's circle is

(a) $\sqrt{\sigma_x^2 - \sigma_y^2 + \tau_{xy}^2}$

(b) $\sqrt{\left(\dfrac{\sigma_x + \sigma_y}{2}\right)^2 + \tau_{xy}^2}$

(c) $\sqrt{\sigma_y^2 - \sigma_x^2 + \tau_{xy}^2}$

(d) $\sqrt{\dfrac{\left(\sigma_y - \sigma_x\right)^2}{2} + \tau_{xy}^2}$

78. For the case of a slender column of length L and flexural rigidity EI built in at its base and free at the top, the Eulers critical buckling load is

(a) $\dfrac{4\pi^2 EI}{L^2}$

(b) $\dfrac{2\pi^2 EI}{L^2}$

(c) $\dfrac{\pi^2 EI}{L^2}$

(d) $\dfrac{\pi^2 EI}{4L^2}$

79. When a beam is subjected to a transverse shearing force, the shear stress in the upper fibers will be

(a) Maximum   (c) Minimum   (c) Zero   (d) Depends on other data

80. Angle made by $2i - 3j + 4k$ with the $z - axis$ is

(a) $\cos^{-1}\left(\dfrac{4}{\sqrt{29}}\right)$

(b) $\dfrac{4}{\sqrt{29}}$

(c) $\sin^{-1}\left(\dfrac{4}{\sqrt{29}}\right)$

(d) $\tan^{-1}\left(\dfrac{4}{\sqrt{29}}\right)$