1 **In nodular iron, graphite is in the form of**
a) Cementite b) Free carbon c) Flakes d) Spheroids

2 **Hardness of steel depends on**
a) Amount of carbon it contains
b) The shape and distribution of the carbides in iron
c) Method of fabrication
d) Contents of alloying elements

3 **Too high welding current in arc welding would result in**
a) Excessive spatter, under cutting along edges, irregular deposits, wasted electrodes
b) Excessive piling up of weld metal, poor penetration, wasted electrodes
c) Too small bead, weak weld and wasted electrodes
d) Excessive piling up of weld metal, overlapping without penetration of edges, wasted electrodes

4 **Which of the following processes would produce strongest components?**
a) Hot rolling b) Extrusion c) Cold rolling d) Forging

5 **If a quantity Q is dependent on three other quantities q_1, q_2 and q_3 related such that $Q = K \times (q_1)^{n_1} \times (q_0)^{n_2} \times (q_3)^{n_3}$ then overall error $\frac{\delta Q}{Q}$ =**

a) $n_1\left(\frac{\delta q_1}{q_1}\right)+n_2\left(\frac{\delta q_2}{q_2}\right)+n_3\left(\frac{\delta q_3}{q_3}\right)$

b) $\frac{1}{n_1}\frac{\delta q_1}{q_1}+\frac{1}{n_2}\frac{\delta q_2}{q_2}+\frac{1}{n_3}\frac{\delta q_3}{q_3}$

c) $\frac{\delta q_1}{q_1}+\frac{\delta q_2}{q_2}+\frac{\delta q_3}{q_3}$

d) $\left(\frac{\delta q_1}{q_1}\right)^{n_1}+\left(\frac{\delta q_2}{q_2}\right)^{n_2}+\left(\frac{\delta q_3}{q_3}\right)^{n_3}$

6 **Which of the following has maximum hardness**
a) Austenite b) Pearlite c) Troostite d) Martensite

7 **The main advantage of line organization is its**
a) Effective command and control
b) Defined responsibilities at all levels
c) Rigid discipline in the organization
d) All of the above

8 **The mathematical technique for finding the best use of limited resources in an optimum manner is known as**
a) Operation research
b) Linear programming
c) Network analysis
d) Queuing theory

9 **Which of the following errors are generally distributed in accordance with the Gaussian distribution**
a) Controllable errors
b) Calibration errors
c) Avoidable errors
d) Random errors

10 $\frac{PL^3}{3EI}$ Is the deflection under the load P of a cantilever beam (length L, modulus of elasticity E, moment of inertia I). The strain energy due to bending is

a) $\frac{P^2L^3}{3EI}$ b) $\frac{P^2L^3}{6EI}$ c) $\frac{P^2L^3}{4EI}$ d) $\frac{P^2L^3}{48EI}$

11 A mass m attached to a light spring oscillates with a period of 2 sec. If the mass is increased by 2 kg, the period increases by 1 sec. The value of m is

a) 1 kg b) 1.6 kg c) 2 kg d) 2.4 kg

12 A short column of external diameter D and internal diameter d carries an external load W. The greatest eccentricity which the load can have without producing tension on the cross section of the column is

a) (D+d)/8 b) $(D^2+d^2)/8$ c) $(D^2+d^2)/8D$ d) $(D^2+d^2)/8d$

13 If the radius of wire stretched by a load doubled, then its Young's modulus will

a) Be doubled
b) Be halved
c) Become four times
d) None of the above

14 Longitudinal stress in a thin cylinder subjected to internal pressure is

a) Half of the hoop stress
b) Twice the hoop stress
c) Equal to the hoop stress
d) One-fourth the hoop stress

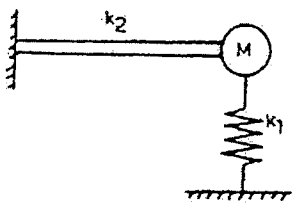
15 Maximum deflection in cantilever due to pure bending moment M at its end is

a) $\frac{ML^2}{2EI}$ b) $\frac{ML^2}{3EI}$ c) $\frac{ML^2}{4EI}$ d) $\frac{ML^2}{6EI}$

16 If Poisson's ratio for a material is 0.5, then the elastic modulus for the material is

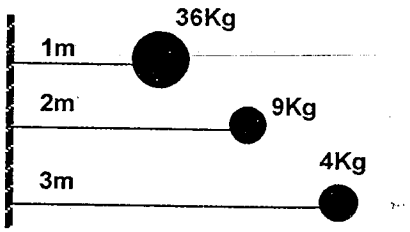
a) 3 times its shear modulus
b) 4 times its shear modulus
c) Equal to its shear modulus
d) Indeterminate

17 A cantilever beam of negligible weight is carrying a mass M at its free end, and is also resting on an elastic support of stiffness k_1 as shown in the figure below. If k_2 represents the bending stiffness of the beam, the natural frequency (rad/s) of the system is



a) $\sqrt{(k_1 k_2)/M (k_1+k_2)}$ b) $\sqrt{2(k_1+k_2)/M}$ c) $\sqrt{(K_1+k_2)/M}$ d) $\sqrt{(k_1-k_2)/M}$

18 **The figure shows 3 small spheres that rotate about a vertical axis. The perpendicular distance between the axis and the center of each sphere is given. Mass of highest rotational inertia about that axis, is**

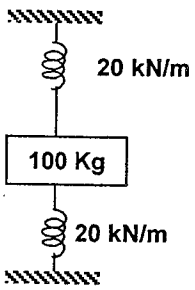


a) 36 b) 4 c) 9 d) All same

19 **Which of the following relationships between the force F on a particle and the particles position x implies simple harmonic oscillation**

a) $F = -7X$ b) $F = -200x^2$ c) $F = 10x$ d) $F = 5x^2$

20 **A mass of 100 kg is held between two springs as shown in figure. The natural frequency of vibration of the system in cycles/second is**



a) $\frac{10}{\pi}$ b) $\frac{5}{\pi}$

c) $\frac{1}{2\pi}$ d) $\frac{20}{\pi}$

21 **The bending equation is written as**

a) $\frac{I}{M} = \frac{f}{y} = \frac{E}{R}$ b) $\frac{M}{I} = \frac{f^2}{y} = \frac{E^2}{R^2}$

c) $\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$ d) $\frac{M^2}{I} = \frac{f^2}{y} = \frac{E^2}{R}$

22 **Hydraulic testing of boilers is done at pressures**

a) Below and above atmosphere
b) Slightly above atmospheric pressure
c) At half the working pressure of boiler
d) At 1.5 to 2 times the working pressure

23 **100 m of water column is equal to**

a) 1000 kN/m^2 b) 100 kN/m^2 c) 10 kN/m^2 d) 1 kN/m^2

24 **Gantry girders are invariably designed to resist**

a) Transverse loads only b) Lateral loads only
c) Transverse and lateral loads d) Transverse, lateral and axial load

25 **If the rotating mass of a rim type flywheel is distributed on another rim type flywheel whose mean radius is half the mean radius of the former, then energy stored in the later at the same speed will be**

a) Four times the first one b) Same as the first one
c) One fourth of the first one d) One and a half times the first one

26 A thin circular disc is rolling with a uniform linear speed, along a straight path on a plane surface. Consider the following statements in this regard:

1. *All points of the disc have the same velocity*
2. *The center of the disc has zero acceleration*
3. *The center of the disc has centrifugal acceleration*
4. *The point on the disc making contact with the plane surface has zero acceleration*

Of these statements

a) 1 and 4 are correct
b) 3 and 4 are correct
c) 3 alone is correct
d) 2 alone is correct

27 If a number of forces act on a rigid body, each force may be replaced by an equal and parallel force acting through a fixed point, together with a couple. For the rigid body to be in equilibrium

a) Both resultant force and couple must be zero
b) The resultant couple on the body must be zero
c) The resultant force at the fixed point must be zero
d) None of the above need be zero

28 Whirling speed of a shaft coincides with the natural frequency of its

a) Longitudinal vibration
b) Transverse vibration
c) Torsional vibration
d) Coupled bending torsional vibration

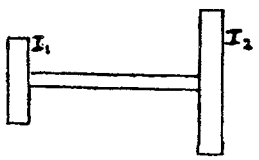
29 A fixed gear having 200 teeth is in mesh with another gear having 50 teeth. The two gears are connected by an arm. The number of turns made by the smaller gear for one revolution of arm about the center of the bigger gear is

a) 4
b) 3
c) $\frac{2}{4}$
d) 5

30 With symbols having the usual meanings, the single degree of freedom system, $m\ddot{x} + c\dot{x} + kx = F\sin\omega t$ represents

a) Free vibrations with damping
b) Free vibrations without damping
c) Forced vibrations with damping
d) Forced vibrations without damping

31 In the two – rotor system shown in the figure, ($I_1 < I_2$), a node of vibration is situated



a) Between I_1 and I_2 but nearer to I_1
b) Between I_1 and I_2 but nearer to I_2
c) Exactly in the middle of the shaft
d) Nearer to I_1 but outside

32 Which one of the following is not a friction clutch?

a) Disc or plate clutch
b) Cone clutch
c) Centrifugal clutch
d) Jaw clutch

33 **Polar moment of inertia (I_p) of a circular disc is to be determined by suspending it by a wire and noting the frequency of oscillations (f)**

a) $I_p \alpha \frac{1}{f^2}$ b) $I_p \alpha f^2$ c) $I_p \alpha f$ d) $I_p \alpha \frac{1}{f}$

34 **Pick up the wrong statement. A flywheel**

a) Is used to limit the inevitable fluctuation of speed during each cycle
b) Controls the mean speed of rotation
c) Stores up energy and gives up whenever required
d) Regulates the speed during one cycle of a prime mover

35 **Purpose of using differential gear in automobile is to**

a) Help in turning b) Control speed
c) Avoid jerks d) Obtain rear movement

36 **The acceleration of Simple Harmonic Motion of a pendulum is proportional to**

a) Length of pendulum b) Time period
c) Angular velocity d) Displacement

37 **A person walks up a stalled escalator in 90 seconds. When standing on the same escalator, now moving, he is carried up in 60 seconds. How much time would it take him to walk up the moving escalator?**

a) 30 sec b) 36 sec c) 45 sec d) 54 sec

38 **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-was down from the top d) At the bottom of the circle

39 **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) $\frac{a}{2}$ b) $\frac{\sqrt{3}}{2}a$ c) $\frac{2a}{\sqrt{3}}$ d) $3\sqrt{2}a$

40 **Two satellites, of masses m and 2m, are on the same circular orbit around earth. If the velocity of the lighter satellite is v_0, what is the velocity of the heavier satellite?**

a) $\frac{1}{2}v_0$ b) v_0 c) $2v_0$ d) $\frac{1}{4}v_0$

41 **$N_u = CR_e^m P_r^n$ represents heat transfer under**

a) Free convection b) Forced convection
c) Combined convection d) None of the above

42 If the inner and outer surfaces of a hollow cylinder (having radii r_1 and r_2 and length L) are at temperatures t_1 and t_2 then rate of radial heat flow will be

a) $\frac{k}{2\pi L}\frac{t_1-t_2}{\log\frac{r_2}{r_2}}$ b) $\frac{1}{2\pi Lk}\frac{t_1-t_2}{\log\frac{r_2}{r_1}}$ c) $\frac{2\pi L}{k}\frac{t_1-t_2}{\log\frac{r_2}{r_1}}$ d) $2\pi Lk\frac{t_1-t_2}{\log\frac{r_2}{r_1}}$

43 For infinite parallel planes with emissivities ε_1 and ε_2, the interchange factor for radiation from surface 1 to surface 2 is given by

a) $\frac{\varepsilon_1\varepsilon_2}{\varepsilon_1+\varepsilon_2-\varepsilon_1\varepsilon_2}$ b) $\frac{1}{\varepsilon_1}+\frac{1}{\varepsilon_2}$ c) $\varepsilon_1+\varepsilon_2$ d) $\varepsilon_1\varepsilon_2$

44 For a closed system, difference between the heat added to the system and work done by the gas, is equal to the change in

a) Internal energy b) Entropy c) Enthalpy d) Temperature

45 The condition for reversibility of a cycle is

a) Cyclic $\int\frac{dQ}{T}<0$ b) Cyclic $\int\frac{dQ}{T}>0$

c) Cyclic $\int\frac{dQ}{T}=0$ d) None of these

46 The state of a real gas if changed from pressure P_1, temperature T_1 to pressure p_2 temperature T_2. The change in enthalpy, $h_2 - h_1$, is given by

a) $\int_{T_1}^{T_2} C_p dT$

b) $\int_{T_1}^{T_2} C_p dT + \int_{p_1}^{p_2}\left(\frac{\partial V}{\partial p}\right)_T$ dp

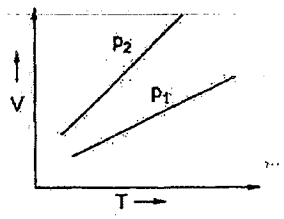
c) $\int_{T_1}^{T_2} C_v dT + \int_{p_1}^{p_2}\left[V - T\left(\frac{\partial V}{\partial T}\right)_p\right]$dp

d) $\int_{T_1}^{T_2} C_p dT + \int_{p_1}^{p_2}\left[V - T\left(\frac{dV}{dT}\right)_p\right]$ dp

47 One hundredth of a kilogram of air is compressed in a piston-cylinder device. At an instant of time when T = 400 K, the rate at which work is being done on the air is 8.165 kW, and heat is being removed at a rate of 1.0 kW, the rate of temperature rise will be

a) 10 K/s b) 100 K/s c) 1000 K/s d) 10000 K/s

48 **The volume V versus temperature T graphs for a certain amount of a perfect gas at two pressure P_1 and P_2 are as shown in the figure. It can be concluded that**



a) The pressure P_1 is greater than the pressure P_2
b) The adiabatic index for P_1 is higher than that for P_2
c) P_1 represents monoatomic gas and P_2 represents diatomic gas
d) None of the above

49 **In the polytropic process pv^n = Constant, if *n=1* the process will be at**
a) Constant volume b) Constant pressure
c) Constant temperature d) Adiabatic

50 **In case of ideal triatomic gas, the ratio of specific heats C_p/C_v would be**
a) 1 b) 1.33 c) 1.40 d) 1.41

51 **The formation of frost on cooling coils in a refrigerator**
a) Increases power consumption b) Improves C.O.P. of the system
c) Increases heat transfer d) Reduces power consumption

52 **An air-conditioned room has one of the walls, which is $5m \times 3m$ of 3.75 cm thick brick. The conditioned space is maintained at 27°C when the outside temperature is 47°C. Variation of thermal conductivity with temperature of the wall is given by $k = 1 + 2 \times 10^{-4} T$, where T is in degree Kelvin, and k is in W/m^0K. The heat gained by the conditioned space through this wall is**
a) 849.6 W b) 84.96 W c) 800 W d) 0

53 **A mild steel tank of wall thickness 12 mm contains water at 100°C. The atmospheric temperature is 20°C. The thermal conductivity of mild steel is 50 W/mK, and the heat transfer co-efficients for inside and outside the tank are 2850 and 10 W/m² K, respectively. Calculate the rate of heat loss per m² of tank surface and the temperature of the outside surface of the tank.**
a) 300.5 W/m², 45.5°C b) 495.2 W/m², 67.6°C
c) 602.6 W/m², 80.6°C d) 795.2 W/m², 99.52°C

54 **In order to burn 1 Kg of CH4 completely the minimum number of kilograms of Oxygen needed is (take atomic weight of H, C, O as 1, 12, 16 respectively)**
a) 3 b) 6 c) 5 d) 4

55 **The vector field $\vec{F} = x\hat{i} - y\hat{j}$ (where $\hat{i}$ and $\hat{j}$ are unit vectors) is**
a) Divergence free, but not irrotational
b) Irrotational, but not divergence free
c) Divergence free and irrotational
d) Neither divergence free nor irrotational

56 **For flow through a horizontal pipe, the pressure gradient $\frac{dp}{dx}$ in the flow direction is**
a) +ve b) 1 c) Zero d) -ve

57 **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, $\upsilon = 0.858 \times 10^{-6} m^2/s$)**
a) 1 m b) 0.43 m c) 43 m d) 103 m

58 **Between section 1 and 2 of a pipe a pump, a heater, a very rough pipe and an orifice plate are placed. The Bernoulli equation can be applied between 1 and 2 if**
a) Orifice plate and heater are removed
b) Heater pump and heater are removed
c) Heater and pump are removed
d) Heater, rough pipe and orifice plates are removed

59 **A one dimensional flow is one which**
a) Is uniform flow
b) Is steady uniform flow
c) Takes place in straight lines
d) Involves zero transverse component of flow

60 **A piece weighing 3 kg in air was found to weigh 2.5 kg when submerged in water. Its specific gravity is**
a) 1 b) 5 c) 6 d) 7

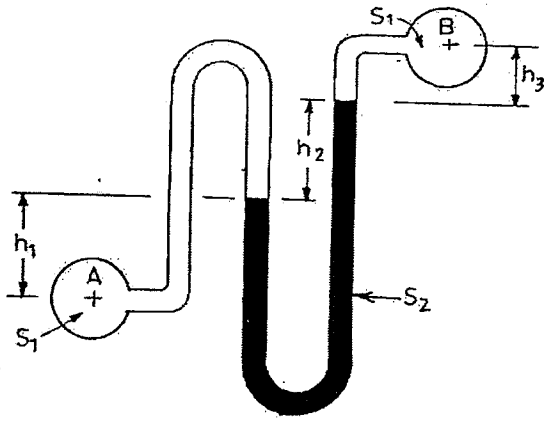
61 **The actual velocity at vena contracta for flow through an orifice from a reservoir of height H=**
a) $\sqrt{2gH}$ b) $C_v\sqrt{2gH}$ c) $\sqrt{2gH/C_v}$ d) $C_d\sqrt{2gH}$

62 **The horizontal component of force on a curved surface is equal to the**
a) Product of pressure at its centroid and area
b) Weight of liquid retained by the curved area
c) Force on a vertical projection of the curved surface
d) Weight of liquid vertically above the curved surface

63 The maximum depth from which a centrifugal pump can draw water is

a) Dependent on the speed N of the pump
b) Dependent on the power of the pump
c) Around 10 m
d) Dependent on N^2

64 Two pipe lines at a different pressures, p_A and p_B, each carrying the same liquid of specific gravity of S_1 are connected to a U tube with a liquid of specific gravity of S_2 resulting in the level differences h_1, h_2 and h_3 as shown in the figure. The difference in pressure head between points A and B in terms of head of water is



a) $h_1 S_2 + h_2 S_1 + h_3 S_1$
b) $h_1 S_1 + h_2 S_2 - h_3 S_1$
c) $h_1 S_1 - h_2 S_2 - h_3 S_1$
d) $h_1 S_1 + h_2 S_2 + h_3 S_1$

65 List I gives 4 dimensionless numbers and List II gives the types of forces, which are one of the constituents describing the numbers. Match list I with List II and select the correct answer using the codes given below the lists:

List I	List II
A. *Euler number*	1. *Pressure force*
B. *Froude number*	2. *Gravity force*
C. *Reynolds number*	3. *Elastic force*
D. *Webber number*	4. *Surface tension*
	5. *Viscous force*

	A	B	C	D
a)	2	3	4	5
b)	3	2	4	5
c)	1	2	5	4
d)	2	1	5	4

66 A single-stage impulse turbine with a diameter of 120 cm runs at 3000 rpm. If the blade speed ratio is 0.42, then, the inlet velocity of steam will be

a) 79 m/s b) 188 m/s c) 450 m/s d) 900 m/s

67 For laminar flow over a flat plate, the thickness of the boundary layer at a distance from the leading edge is found to be 5 mm. The thickness of the boundary layer at a downstream section, which is at twice the distance of the previous section from the leading edge, will be

a) 10 mm b) $5\sqrt{2}$ mm c) $5/\sqrt{2}$ mm d) 2.5 mm

68 If U_∞ = free stream velocity, u = velocity at y, and δ = boundary layer thickness, then in a boundary layer flow, the momentum thickness θ is given by

a) $\theta = \int_0^\delta \frac{u}{U_\infty}\left(1-\frac{u}{U_\infty}\right)dy$

b) $\theta = \int_0^\delta \frac{u}{U_\infty}\left(1-\frac{u^2}{U_\infty^2}\right)dy$

c) $\theta = \int_0^\delta \frac{u^2}{U_\infty^2}\left(1-\frac{u}{U_\infty}\right)dy$

d) $\theta = \int_0^\delta \left(1-\frac{u}{U_\infty}\right)dy$

69 An automobile moving at a velocity of 40km/hr is experiencing a wind resistance of 2kN. If the automobile is moving at a velocity of 50km/hr, the power required to overcome the wind resistance is

a) 43.4kW b) 3.125 kW c) 2.5 kW d) 27.776 kW

70 A constant-head water tank has, on one of its vertical sides two identical small orifices issuing two horizontal jets in the same vertical plane. The vertical distance between the centers of orifices is 1.5 m and the jet trajectories intersect at a point 0.5 m below the lower orifice. What is the approximate height of water level in the tank above the point of intersection trajectories?

a) 1.0 m b) 2.5 m c) 0.5 m d) 2.0 m

71 A unit vector perpendicular to the vectors $\vec{a} = 2i - 3j + k$ and $\vec{b} = i + j - 2k$, is

a) $\frac{1}{\sqrt{3}}(-i+j+k)$

b) $\frac{1}{\sqrt{3}}(i+j-k)$

c) $\frac{1}{\sqrt{3}}(i+j+k)$

d) $(i+j+k)$

72 The region of the z plane for which $\left|\frac{z-a}{z+a}\right| = 1 (\mathrm{Re}\, a \neq 0)$ is

a) x-axis

b) y-axis

c) The straight line $z = |a|$

d) None of the above

73 If $\propto, \beta, \gamma$ are the roots of equations $x^3 + Px^2 + qx + P = 0$, Then the value of $\tan^{-1}\propto + \tan^{-1}\beta + \tan^{-1}\gamma$ is

a) $n\pi/2$ b) $n\pi$ c) $2n\pi$ d) $\frac{n\pi}{4}$

74 The value of the determinant $\begin{vmatrix} 1 & a & b+c \\ 1 & b & c+a \\ 1 & c & a+b \end{vmatrix}$ is

a) 0 b) 1 c) $(a+b+c)$ d) 3

75 The value of $\int_0^1 \int_0^1 \frac{dxdy}{\sqrt{(1-x^2)(1-y^2)}}$ is

a) $\frac{\pi^2}{2}$ b) $\frac{\pi}{4}$ c) $\frac{\pi^2}{4}$ d) $\frac{\pi}{2}$

76 Solution of $(D^2+16)y = \cos 4x$, is

a) $y = A\cos 4x + B\sin 4x + \frac{1}{8}\cos 4x$ b) $y = A\cos 4x + B\sin 4x + \frac{x}{8}\sin 4x$

c) $y = A\cos 4x + B\sin 4x + \frac{1}{8}\sin 4x$ d) $y = A\cos 4x + B\sin 4x + \frac{x}{8}\cos 4x$

77 Laplace transform of t^2+2t+3 is

a) $\frac{-2}{s^3} - \frac{2}{s^2} - \frac{3}{s}$ b) $\frac{2}{s^3} + \frac{2}{s^2} - \frac{3}{s}$

c) $\frac{2}{s^3} + \frac{2}{s^2} + \frac{3}{s}$ d) $\frac{-2}{s^3} + \frac{2}{s^2} - \frac{3}{s}$

78 Equation of a straight line passing through the point (-1,2) and making equal intercepts on the axes is

a) $x-y=1$ b) $x-2y=1$ c) $x+y=1$ d) $x-y=2$

79 A bag contains eight white and six red marbles. The probability of drawing two marbles of same colour is

a) $\frac{8c_2.6c_2}{14c_2}$ b) $\frac{8c_2}{14c_2} + \frac{6c_2}{14c_2}$

c) $\frac{8c_2.6c_2}{14c_2.14c_2}$ d) $\frac{8c_2}{14c_2} + \frac{6c_2}{12c_2}$

80 The Algebraic multiplicity of the matrix $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & -3 & 3 \end{bmatrix}$ is

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