1 **Only rocket engines can be propelled to space because**

a) They can generate very high thrust
b) They have high propulsion efficiency
c) These engines can work on several fuels
d) They are not air-breathing engines

2 **The universal gas constant of a gas is the product of molecular weight of the gas and**

a) Gas constant
b) Specific heat at constant pressure
c) Specific heat at constant volume
d) None of the above

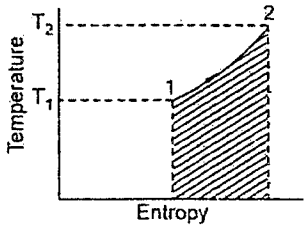
3 **Vander Waal's equation of state of a gas is**

a) PV =nRT
b) $\left(p+\frac{a}{V^2}\right)(v+b) = RT$
c) $\left(p+\frac{a}{V^2}\right)(v-b) = RT$
d) $\left(p-\frac{a}{V^2}\right)(v-b) = RT$

4 **The radiative heat transfer rate per unit area (W/m^2) between two plane parallel grey surfaces (emissivity = 0.9) maintained at 400 K and 300 K is (Stefan Bottzman constant $\sigma = 5.67 \times 10^{-8}\ W/m^2\ K^4$)**

a) 992 b) 812 c) 464 d) 567

5 **The efficiency η of any heat engine and efficiency η_R of a reversible heat engine operating between common heat source and heat sink are related as**



a) $\eta > \eta_R$ b) $\eta < \eta_R$ c) $\eta \geq \eta_R$ d) $\eta \leq \eta_R$

6 **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

7 **The velocity components in the x and y directions are given by $u = \lambda xy^3 - x^2y$; $v = xy^2 - \frac{3}{4}y^4$ The value of λ for a possible flow field involving an incompressible fluid is**

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

8 The temperature field in a body varies according to the equation $T(x,y) = x^3 + 4xy$. The direction of fastest variation in temperature at the point (1,0) is given by

a) $3\hat{i} + 8\hat{j}$ b) $\hat{i}$ c) $0.6\hat{i} + 0.8\hat{j}$ d) $0.5\hat{i} + 0.866\hat{j}$

9 The temperature distribution at a certain input of time in concrete slab during curing is given by $T = 3x^2 + 3x + 16$ where x is in cm and T is in K. The rate of change of temperature with time is given (α = 0.0003 cm^2/sec

a) 0.009 K/sec
b) 0.0048 K/sec
c) -0.0012 K/sec
d) -0.0018 K/sec

10 300 kJ/sec of heat is applied at a constant fixed temperature of 290°C to a heat engine. The heat rejection takes place at 8.5°C. then match the following:

Results obtained	Cycle
a) 215kJ/sec are rejected	1) reversible
b) 150kJ/sec are rejected	2) irreversible
c) 75kJ/sec are rejected	3) impossible

	A	B	C
a)	1	2	3
b)	2	1	3
c)	3	2	1
d)	1	3	2

11 If the governing equation for a flow field is given by $\nabla^2\phi = 0$ and the velocity is given by $\vec{V} = \nabla\phi, then$

a) $\nabla \times V = 0$
b) $\nabla \times \vec{V} = 1$
c) $\nabla^2 \times \vec{V} = 1$
d) $(\vec{V}.\nabla)\vec{V} = \frac{\partial \vec{V}}{\partial t}$

12 With rise in temperature thermal conductivity of air

a) Increases
b) Decreases
c) Remains constant
d) May increase or decrease depending on temperature

13 In a reversible adiabatic process, the ratio of T_1/T_2 is equal to

a) $\left(\frac{p_1}{p_2}\right)^{\frac{\gamma-1}{\gamma}}$ b) $\left(\frac{p_2}{p_1}\right)^{\frac{\gamma-1}{\gamma}}$ c) $\left(\frac{v_1}{v_2}\right)^{\frac{\gamma-1}{\gamma}}$ d) $\left(\frac{v_2}{v_1}\right)^{\frac{\gamma-1}{\gamma}}$

14 Chances of occurrence of cavitation are high if the

a) Local pressure becomes very high
b) Local pressure falls below the vapour pressure
c) Thoma cavitation parameter exceeds a certain limit
d) Local temperature becomes low

15 The general equation of continuity for three-dimensional flow of a incompressible fluid for steady flow is

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

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

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

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

16 A liquid compressed in cylinder has a volume of 0.04 m^3 at 50 kg/cm^2 and a volume of 0.039 m^3 at 150 kg/cm^2. The bulk modulus of liquid is

a) 400 kg/cm^2
b) 4000 kg/cm^2
c) 40 x 10^5 kg/cm^2
d) 40 x 10^6 kg/cm^2

17 The buoyancy depends on

a) Mass of liquid displaced
b) Viscosity of the liquid
c) Pressure of the liquid displaced
d) Depth of immersion

18 A fluid jet discharging from a 100 mm diameter orifice has a diameter of 80 mm at its vena contracta. The coefficient of contraction is

a) 0.8 b) 1.25 c) 0.2 d) 0.64

19 If a jet of water of area 'A' strikes with velocity 'V' a series of flat plates mounted on a wheel of mean diameter D rotating at N rpm, then force exerted will be equal to

a) $\frac{\rho AV^2}{g}$

b) $\frac{\rho AV}{g}\left(V-\frac{\pi DN}{60}\right)$

c) $\frac{\rho A}{g}\times\frac{\pi DN}{60}$

d) $\rho A\left(V-\frac{\pi DN}{60}\right)$

20 The maximum height of a siphon for a fluid of specific gravity ρ under atmospheric conditions is

a) $\rho/10 metres$

b) $\frac{10(1+\rho)}{\rho} metres$

c) $10/(1-\rho) metres$

d) $10/\rho$ $metres$

21 A centrifugal pump with peripheral speed 'V' was selected for a total lift of 100 m. Actually pump was to be operated for a total lift of 400 m. The peripheral speed should actually be (other conditions remaining same)

a) 2V b) 4V c) 8V d) 1V

22 The specific speed of pump and turbine respectively are given as

a) $\frac{N\sqrt{P}}{H^{5/4}}, \frac{N\sqrt{Q}}{H^{3/4}}$ b) $\frac{N\sqrt{Q}}{H^{3/4}}, \frac{N\sqrt{P}}{H^{5/4}}$

c) $\frac{N\sqrt{P}}{H^{3/4}}, \frac{N\sqrt{Q}}{H^{5/4}}$ d) $\frac{N\sqrt{Q}}{H^{5/4}}, \frac{N\sqrt{P}}{H^{3/4}}$

23 Match List I with List II and select the correct answer

List I (Forces)	List II (Dimensionless groups)
A. Viscous Force	1. Reynolds number
B. Elastic force	2. Froude number
C. Surface tension	3. Weber number
D. Gravity	4. Mach number

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

24 Given that

α_1 = nozzle angle

n = number of rows of moving blades, in a velocity compounded impulse turbine, the optimum blade speed ratio is

a) $2\cos\alpha_1.n$ b) $\frac{n\cos\alpha_1}{2}$ c) $\frac{\cos\alpha_1}{2(n+1)}$ d) $\frac{\cos\alpha_1}{2n}$

25 The following terms relate to floating bodies :

Centre of gravity ... G, Meta Centre ... M

Weight of floating body ... W, Buoyant force ... F_B

Match List I with List II and select the correct answer

List I (Condition)	List II (Result)
A. G is above M	1. Stable equilibrium
B. G and M coincide	2. Unstable equilibrium
C. G is below M	3. Floating body
D. $F_B \geq W$	4. Neutral equillibrium

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

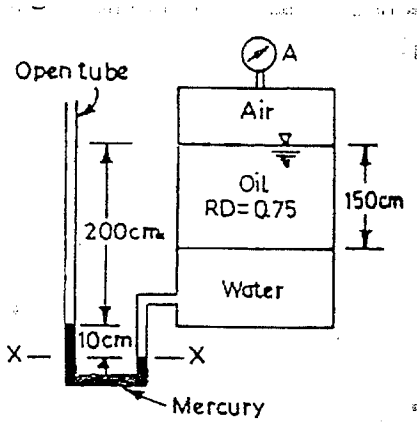
26 A pipeline connecting two reservoirs has its diameter reduced by 20% due to deposition of chemicals. For a given head difference in the reservoirs with unaltered friction factor, this would cause a reduction in discharge of

a) 42.8% b) 20% c) 17.8% d) 10.6%

27 An open rectangular box of base 2m x 2m contains a liquid of specific gravity 0.80 up to a height of 2.5 m. If the box is imparted vertically upward acceleration of 4.9m/s^2, what will be the pressure on the base of the tank?

a) 9.81 kPa b) 19.62 kPa c) 36.80 kPa d) 29.40 kPa

28 The tank shown in the figure below is closed at top and contains air at a pressure of P_A. The value of P_A for the manometer readings shown will be



a) -3.573 kPa b) -4.573 kPa c) -6.573 kPa d) -7.573 kPa

29 $\vec{P} = 2i - 3j, \vec{Q} = -3i + 4j - 2k$, and $\vec{R}$ are in equilibrium, if $\vec{R}$ is

a) $-i - j + 2k$ b) $i - j + 2k$ c) $i + j + 2k$ d) $i - j - 2k$

30 A rigid body is rotating with constant angular velocity ω about a fixed axis, if v is the velocity of a point of the body, then curl $v =$

a) ω b) ω^2 c) 2ω d) $2\omega^2$

31 Laplace transform of $\sin^3 2t$ is

a) $\frac{24}{(s^2+4)(s^2+36)}$ b) $\frac{1}{(s^2+4)(s^2+64)}$

c) $\frac{48}{(s^2+4)(s^2+36)}$ d) $\frac{64}{(s^2+4)(s^2+36)}$

32 The value of the determinant $\begin{vmatrix} \cos\theta & 0 & \sin\theta \\ 0 & 1 & 0 \\ -\sin\theta & 0 & \cos\theta \end{vmatrix}$ is

a) 0 b) -1 c) 1 d) 2

33 Solution of $(D^2 + 4)y = \sin^2 x$, is

a) $y = A\cos 2x + B\sin 2x - \frac{1}{8} - \frac{x}{8}\sin 2x$ b) $y = A\cos 2x + B\sin 2x + \frac{1}{8} + \frac{x}{8}\sin 2x$

c) $y = A\cos 2x + B\sin 2x - \frac{1}{8} + \frac{x}{8}\sin 2x$ d) $y = A\cos 2x + B\sin 2x + \frac{1}{8} - \frac{x}{8}\sin 2x$

34 The value of k for which the lines $2x+y-1=0, 4x+3y-3=0$ and $3x+ky-2=0,$ are concurrent is

a) -2 b) 3 c) 2 d) -3

35 A box contains 5 black and 5 red balls. Two balls are randomly picked one after another from the box, without replacement. The probability for both balls being red is

a) $\frac{1}{90}$ b) $\frac{1}{5}$ c) $\frac{19}{90}$ d) $\frac{2}{9}$

36 $x^3+x\sin x$ Is a _____ function

a) Constant function b) Odd function
c) Even function d) Periodic function

37 $\int\frac{dx}{x\sqrt{x^2-a^2}}$ is

a) $\frac{1}{a}\cos ec^{-1}\left(\frac{x}{a}\right)$ b) $\frac{1}{a}\sin^{-1}\left(\frac{x}{a}\right)$

c) $\frac{1}{a}\cos^{-1}\left(\frac{x}{a}\right)$ d) $\frac{1}{a}\sec^{-1}\left(\frac{x}{a}\right)$

38 Eigen values of $\begin{bmatrix}-5 & 2\\ 2 & -2\end{bmatrix}$ are

a) -6, -1 b) 6, -1 c) -6,1 d) 6,1

39 Hardness of martensite is about

a) RC 65 b) RC 48 c) RC 57 d) RC 80

40 Which is false statement about annealing. Annealing is done to

a) Relieve stresses b) Harden steel slightly
c) Improve machining characteristic d) Soften material

41 Materials exhibiting time bound behavior are known as

a) Visco elastic b) Anelastic c) Isentropic d) Resilient

42 Shrinkage allowance is made by

a) Adding to external and internal dimensions
b) Subtracting from external and internal dimensions
c) Subtracting from external dimensions and adding to internal dimensions
d) Adding to external dimensions and subtracting from internal dimensions

43 Machinablity depends on

a) Microstructure, physical and mechanical properties and composition of workpiece material
b) Cutting forces
c) Type of chip
d) Tool life

44 Spinning operation is carried out on

a) Hydraulic press b) Mechanical press c) Lathe d) Milling machine

45 Acceptance sampling is widely used in

a) Batch production b) Job production
c) Mass production d) All of the above

46 Gratings are used in connection with

a) Flatness measurement b) Roundness measurement
c) Surface texture measurement d) Linear displacement measurements

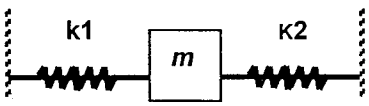
47 Which of the following errors are inevitable in the measuring system and it would be vainflul exercise to avoid them

a) Systematic errors b) Random errors
c) Calibration errors d) Environmental errors

48 A block whose mass is 650 gm is fastened to a spring of spring constant K equals 65 N/m whose other end is fixed. The block is pulled a distance x=11 cm from its equilibrium position at x = 0 on a smooth surface, and released from rest at t = 0. The maximum speed 'S' of the oscillating block is

a) 11 cm/sec b) 11 m/sec c) 11 mm/sec d) 1.1 m/sec

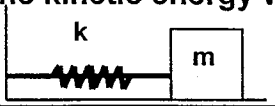
49 A block of mass 'm' is connected to two springs of stiffness K_1 and K_2 as shown in the figure f_1 and f_2 are the frequencies of the block when connected to K_1 and K_2 independently. Then the frequency of 'm' when connected to K_1 and K_2 as in the figure is



a) $f = f_1 + f_2$ b) $f = f_1^2 + f_2^2$

c) $f = \sqrt{f_1^2 + f_2^2}$ d) $f = \sqrt{f_1^2 - f_2^2}$

50 The block has a kinetic energy of 3J and the spring connecting the block has an elastic energy of 2J (shown in figure).
When the block is at x = +2.0cm. What is the kinetic energy when the block is at x = 0.



a) 3J b) 2J c) 1J d) 5J

51 For a body subjected to direct stresses σx, σy and σz the direct strain ε_x in x direction is (where E and γ are Young's Modulus and Poisson's ratio respectively)

a) $\varepsilon_x = \frac{1}{E}\{\sigma x + \gamma(\sigma y - \sigma z)\}$ b) $\varepsilon_x = \frac{1}{E}\{\sigma x - \gamma(\sigma y + \sigma z)\}$

c) $\varepsilon_x = \frac{1}{E}\{\sigma x - \gamma(\sigma y - \sigma z)\}$ d) $\varepsilon_x = \frac{1}{E}\{\sigma x + \gamma(\sigma y + \sigma z)\}$

52 A circular shaft subjected to torsion undergoes a twist of 1^0 in a length of 120 cm. If the maximum shear stress induced is limited to 1000kg/cm^2 and if modulus of rigidity G=0.8*10^6 Kg/cm^2, then the radius of the shaft should be

a) π/18 cm b) π/27 cm c) 18/π cm d) 27/π cm

53 A hollow shaft of same cross-section area as solid shaft transmits

a) Same torque b) Less torque
c) More torque d) Unpredictable

54 The extension of a mild steel bar 4m long, 2000 mm^2 cross section under the action of an axial load of 20kN, if E = 2(10^5) N/mm^2, is

a) 2mm b) 0.2mm c) 0.5mm d) 0.05mm

55 In I section shear load is resisted mainly by

a) Flanges only b) Web only
c) Both by flanges and web d) None

56 Shear force is

a) Rate of change of loading b) Sum of bending moments
c) Rate of change of bending moment d) None of the above

57 Maximum shear stress in Mohr's circle is equal to

a) Radius of circle b) Diameter of circle
c) Center of circle from y-axis d) Chord of circle

58 If a material expands freely due to heating it will develop

a) Thermal stresses b) Tensile stress
c) No stress d) Bending

59 When a column is fixed at both ends, corresponding Euler's critical load is

a) π^2 EI/L^2 b) $2\pi^2$ EI/L^2 c) $3\pi^2$ EI/L^2 d) $4\pi^2$ EI/L^2

60 A metal pipe of 1 m diameter contains a fluid having a pressure of 10

kgf/cm^2. If the permissible tensile stress in the metal is 200 kgf/cm^2, then the thickness of the metal required for making the pipe would be

a) 5 mm b) 10 mm c) 25 mm d) 20 mm

61 Circumferential and longitudinal strains in the cylindrical boiler under internal steam pressure are ε_1 and ε_2 respectively. Change in the volume of the boiler cylinder per unit volume will be

a) $\varepsilon_1 + 2\varepsilon_2$ b) $\varepsilon_1 \varepsilon_2^{\,2}$ c) $2\varepsilon_1 + \varepsilon_2$ d) $\varepsilon_1^{\,2} \varepsilon_2$

62 If water in closed pipe freezes, the pipe will

a) Rupture along a plane perpendicular to the axis of pipe
b) Rupture zig-zag along the length
c) Rupture along weakest circumferential section
d) Rupture along a line running longitudinally along the pipe

63 The notch angle of Izod impact test specimen is

a) 10^0 b) 20^0 c) $22\frac{1}{2}^0$ d) 45^0

64 Which of the following statements regarding laws governing the friction between dry surfaces are correct?

1. The friction force is dependent on the velocity sliding.
2. The friction force is directly proportional to the normal force.
3. The friction force is dependent on the materials of the contact surfaces.
4. The friction force is independent of the area of contact.

Select the correct answer using the codes given below:

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

65 A simple spring-mass vibrating system has a natural frequency of N. If the spring stiffness is halved and the mass is doubled, then the natural frequency will become

a) N / 2 b) 2 N c) 4 N d) 8 N

66 Under logarithmic decrement, the amplitude of successive vibrations are

a) Constant b) In arithmetic progression
c) In geometric progression d) In logarithmic progression

67 Periodic time of simple pendulum is given by

a) $2\pi\sqrt{\frac{l}{g}}$ b) $2\pi\sqrt{\frac{g}{l}}$ c) $\frac{1}{2\pi}\sqrt{\frac{g}{l}}$ d) $\frac{1}{2\pi}\sqrt{\frac{l}{g}}$

68 In a single reduction, a large velocity ratio is required. The best transmission is

a) Spur gear drive b) Helical gear drive
c) Worm gear drive d) Bevel gear drive

69 **Idler pulley is used**
a) For changing the direction of motion of the belt
b) For applying tension
c) For increasing velocity ratio
d) All of the above

70 **If two bodies one light and other heavy have equal kinetic energies, which one has a greater momentum**
a) Heavy body b) Light body
c) Both have equal momentum d) It depends on the actual velocities

71 **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) $\frac{v}{\mu g}$ b) $\frac{v2}{\sqrt{\mu g}}$ c) $\left(\frac{v}{\mu g}\right)^2$ d) $\frac{v^2}{2\mu g}$

72 **A car moving with uniform acceleration covers 450 m in a 5 second interval, and covers 700 m in the next 5 second interval. The acceleration of the car is**
a) 7 m/s^2 b) 50 m/s^2 c) 25 m/s^2 d) 10 m/s^2

73 **A particle starts with a velocity 2m/sec and moves on a straight-line track with retardation 0.1 m/sec^2. The time at which the particle is 15 m from the starting point would be**
a) 10 sec b) 20 sec c) 50 sec d) 40 sec

74 **Two particles with masses in the ratio 1:4 are moving with equal kinetic energies. The magnitude of their linear momentums will conform to the ratio**
a) 1:8 b) 1:2 c) $\sqrt{2}:1$ d) $\sqrt{2}$

75 **A stone is projected horizontally from a cliff at 10 m/sec and lands on the ground below at 20 m from the base of the cliff. Find the height of the cliff. Use g=10 m/sec^2**
a) 18 m b) 20 m c) 22 m d) 24 m

76 **Oscillation of a particle is prescribed by the equation x = 3 cos 0.25 πt Where t is the time in seconds.**
Then time taken by the particle to move from position of equilibrium to maximum displacement is
a) 0.5 sec b) 1.0 sec c) 2.0 sec d) 3.0 sec

77 **Which of the following is not a scalar quantity**
a) Time b) Mass
c) Volume d) acceleration

78 **Which of the following stresses are associated with the tightening of a**

nut on a stud?

1. Tensile stresses due to stretching of stud.
2. Bending stresses of stud.
3. Transverse shear stresses across threads.
4. Torsional shear stresses in threads due to frictional resistance.

Select the correct answer using the codes given below:

Codes:

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

79 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

80 The heat flow rate through parallel walls of thickness L_1, L_2 and L_3, having surface areas A_1,A_2 and A_3, thermal conductivities k_1, k_2, and k_3, respectively, with the first and last walls maintained at temperatures t_1 and t_2 will be

a) $\dfrac{t_1 - t_2}{\dfrac{L_1}{A_1 k_1} + \dfrac{L_2}{A_2 k_2} + \dfrac{L_3}{A_3 k_3}}$

b) $\dfrac{t_1 - t_2}{\dfrac{k_1}{A_1 L_1} + \dfrac{k_2}{A_2 L_2} + \dfrac{k_3}{A_3 L_3}}$

c) $\dfrac{t_1 - t_2}{\dfrac{k_1 A_1}{L_1} + \dfrac{k_2 A_2}{L_2} + \dfrac{k_3 A_3}{L_3}}$

d) $\dfrac{t_1 - t_2}{\dfrac{L_1 A1}{k_1} + \dfrac{L_2}{k_3} + \dfrac{L_3}{k_3}}$