Read the following instructions carefully.

1. All questions in this paper are of objective type.
2. There are a total of 65 questions carrying 100 marks.
3. Questions 1 to 25 will carry 1 mark each and questions 26 to 55 will carry 2 marks each.
4. Questions 48 to 51 (2 pairs) are common data questions and questions 52 to 55 (2 pairs) are linked answer questions. The answer to the second question of the linked answer questions depends on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is unattempted, then the answer to the second question in the pair will not be evaluated.
5. Questions 56 to 65 belong to General Aptitude (GA). Questions 56 to 60 will carry 1 mark each and questions 61 to 65 will carry 2 marks each.
6. Unattempted questions will carry zero marks.
7. Wrong answers will carry negative marks. For Q.1–Q.25 and Q.56–Q.60, $\frac{1}{3}$ mark will be deducted for each wrong answer. For Q.26–Q.51 and Q.61–Q.65, $\frac{2}{3}$ mark will be deducted for each wrong answer. The question pairs (Q.52, Q.53), and (Q.54, Q.55) are questions with linked answers. There will be negative marks only for wrong answer to the first question of the linked answer question pair *i.e.*, for Q.52 and Q.54, $\frac{2}{3}$ mark will be deducted for each wrong answer. There is no negative marking for Q.53 and Q.55.

(1 Mark Questions)

1. Which of the following functions $f(x, t)$ represents a wave?

(a) $\dfrac{x^2 - e^t}{x^2 + e^t}$ (b) $\dfrac{1}{x - t}$

(c) $\dfrac{e^{x^3}}{t^2 + 3x}$ (d) $\dfrac{x + 3t}{x - 3t}$

2. For a second order linear system, critical point is the saddle point if the characteristic equation has

(a) one negative real eigen value and one complex eigen value
(b) Both eigen values are complex
(c) one positive and one negative real eigen value
(d) one positive real eigen value and one complex eigen value

3. Find the value of $\int_0^\infty e^{-x} \cdot x^6 \, dx$.

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

(c) 720 (d) $\dfrac{\pi^2}{9}$

4. Consider the following matrix $M = \begin{bmatrix} a & b-a \\ 0 & b \end{bmatrix}$, then M^{19} equals to

(a) $\begin{bmatrix} a^{20} & b^{19} - a^{20} \\ 0 & b^{19} \end{bmatrix}$ (b) $\begin{bmatrix} a^{19} & b^{19} - a^{19} \\ 0 & b^{19} \end{bmatrix}$

(c) $\begin{bmatrix} a^{19} & b^{20} - a^{19} \\ 0 & b^{20} \end{bmatrix}$ (d) $\begin{bmatrix} a^{18} & b^{18} - a^{18} \\ 0 & a^{18} \end{bmatrix}$

5. Given, the vector

$$\vec{A} = \left(9yx^2 + \frac{5y}{x^2}\right)\hat{i} + \left(3x^3 - \frac{5}{x}\right)\hat{j} + e^z \hat{k}.$$

Find out $\nabla \times \vec{A}$ (curl of vector $\vec{A}$).

(a) $3x^2\hat{i} - 5e^z\hat{k}$ (b) $\vec{0}$

(c) $+e^z\hat{k}$ (d) $\dfrac{x^2}{y}e^z\hat{k}$

6. If ω denotes the displacements, then one of the boundary conditions along a free edge (of a rectangular plate aligned with the X and Y-axes) is (the free edge is $x = 0$)

(a) $\dfrac{\partial^2\omega}{\partial x^2} + \nu\dfrac{\partial^2\omega}{\partial y^2} = 0$ (b) $\dfrac{\partial^2\omega}{\partial x\,\partial y} + \nu\dfrac{\partial^2\omega}{\partial y^2} = 0$

(c) $\dfrac{\partial^3\omega}{\partial x^3} + (3 - \nu)\dfrac{\partial^3\omega}{\partial x\,\partial y^2} = 0$

(d) $\dfrac{\partial^3\omega}{\partial x^3} + (1 - \nu)\dfrac{\partial^3\omega}{\partial x\,\partial y^2} = 0$

7. In a turbojet engine nozzle, the temperature and Mach number of a particular cross-section are T and M respectively. If T^* is the temperature at the throat, then

$$\frac{T^*}{T} = a + bM^2$$

where, a and b are constants for calorically perfect gases. If γ is the ratio of specific heats, then a and b are respectively

(a) $\frac{1}{\gamma+1}, \frac{2}{\gamma+1}$ (b) $\frac{2}{\gamma-1}, \frac{\gamma-1}{\gamma+1}$

(c) $\frac{2}{\gamma+1}, \frac{\gamma-1}{\gamma+1}$ (d) $\frac{2}{\gamma+1}, \frac{1-\gamma}{\gamma+1}$

8. The relation between modulus of rigidity G, and modulus of elasticity E is

(a) $G = \frac{E}{1+2\nu}$ (b) $E = \frac{G}{1-2\nu}$

(c) $G = \frac{E}{2(1+\nu)}$ (d) $E = \frac{G}{2(1-\nu)}$

9. For a Hohmann transfer in a planar orbit rendezvous between two spacecrafts, initially in concentric orbits of radii r_i and r_f, the maximum value of the initial angular separation θ equals to

(a) 120° (b) 115.12°

(c) 125.5° (d) 116.36°

10. For a viscously damped one degree of freedom system with single frequency harmonic excitation, the governing equation can be written as

$$\ddot{X} + 2\xi\,\omega_n \dot{x} + \omega_n^2\, x = \frac{F_0}{m_{eq}} \sin(\omega t + \psi)$$

where, ω_n = natural frequency

ω = excited frequency

If the solution is of the form

$$X_p(t) = X_0 \sin(\omega t + \psi - \phi)$$

And given that $\xi = \frac{\omega}{\omega_n} = 0.5$, then the value of ϕ (in degree) is

(a) 32.69° (b) 34.69°

(c) 33.69° (d) 30.69°

11. If r, θ and x denote the radial, tangential and axial directions respectively, then the quantity that remains conserved in an ideal centrifugal compressor (impeller) is

(a) $h_0 + 2uc_\theta$ (b) $h_{0_{rel}} + \frac{1}{2}u^2$

(c) $h + \frac{1}{2}(u^2 + c_\theta^2)$ (d) $h_{0_{rel}} - \frac{1}{2}u^2$

where, $h_{0_{rel}}$ is the total enthalpy relative to the impeller blades.

12. Which of the following is not true for a Ramjet engine?

(a) A Ramjet engine has high thrust to weight ratio

(b) It works well at off design Mach numbers without a variable geometry diffuser and supersonic spike

(c) A Ramjet engine by nature of its air compressor does not provide static thrust

(d) Fuel consumption by a Ramjet engine at subsonic speeds is very high compared to other air breathing engines

13. Air flows from a reservoir at 550 kPa and 70°C. Assuming isentropic flow, calculate the density at a section with the Mach number of 0.6.

(a) 4.39 kg/m^3 (b) 5.39 kg/m^3

(c) 4.69 kg/m^3 (d) 2.22 kg/m^3

14. For an aircraft experiencing a non-dimensionalized lift coefficient $C_L = 1.2$ and having an aspect ratio of 4.8 with span efficiency of 0.92, the induced drag coefficient is

(a) 0.992 (b) 0.104

(c) 0.134 (d) 0.034

15. There are two geometrically similar aircrafts. However, due to operational requirements, the aircrafts have different sizes. If the surface area of the larger aircraft is twice the smaller one and its mass is 2.4 times the smaller one, by what percentage is the stall speed (at steady level flight) of the larger aircraft greater than smaller aircraft (at the same flight conditions)?

(a) 10.2% (b) 21.7%

(c) 3.3% (d) 9.5%

16. Consider a single stage rocket of payload mass m_L, structural mass m_S and propellant mass m_P.

If structural ratio σ is defined as $\sigma = \frac{m_S}{m_S + m_P}$

and payload ratio λ is defined as $\lambda = \frac{m_L}{m_0}$

where, m_0 = initial mass of the rocket

Then total velocity impulse obtained with negligible gravity is $\Delta v = v_f - v_0 = -v_e \times f(\sigma, \lambda)$

The function $f(\sigma, \lambda)$ is

(a) $\ln \frac{\sigma}{(1-\sigma)\lambda}$

(b) $\ln [\sigma + (1-\sigma)\lambda]$

(c) $\ln \frac{(\sigma+\lambda)\sigma}{(1+\lambda)}$

(d) $\ln [\sigma\lambda + (1-\sigma)(1-\lambda)]$

17. In a gas turbine engine thermodynamic cycle, heat injection takes place at 11.2 atm and heat rejection takes place at atmospheric pressure, then what is the efficiency of the cycle, given that the heat capacity ratio of the working substance is 1.3.

(a) 42.7% (b) 61.3%
(c) 55.5% (d) 33.2%

18. If X, Y, Z are a systems of mutually perpendicular axes and the Y-axis is perpendicular to the plane of symmetry of the vehicle and p, q and r represent the rotation rates about the axes, then $M - I_Y \dot{q} = ?$ Given that M is the moment about the Y-axis and I represents the inertia tensor.

(a) $(I_{XX} - I_{ZZ})\, pq - I_{XZ}\,(p^2 - q^2)$
(b) $(I_{XX} - I_{ZZ})\, qr - I_{XY}\,(p^2 - r^2)$
(c) $(I_{XX} - I_{YY})\, pr - I_{YZ}\,(r^2 - p^2)$
(d) $(I_{XX} + I_{ZZ})\, pr - I_{XZ}\,(p^2 - r^2)$

19. If the freestream flow over an airfoil increases from Mach 0.2 to Mach 0.6, *i.e.*, by a factor of 3, estimate using the Prandtl-Glauert compressibility correction, by what factor does the non-dimensionalized lift coefficient increase?

(a) 2.36 (b) 1.22
(c) 1.39 (d) 1.87

20. Which of the following sets a forward limit on the location of centre of gravity in an aircraft?

(a) Location of stick fixed and stick free neutral points
(b) Sensitivity of vehicle normal acceleration to control force being too small
(c) Damping in longitudinal dynamic stability
(d) To make the vehicle trimmable at $C_{L_{max}}$

21. For the Dutch-roll mode approximation to the aircraft flight (lateral – directional motion), the characteristic equation is of the form

$\lambda^3 + a_2 \lambda^2 + a_1 \lambda + a_0 = 0$

Then the value of a_0 equals

(a) $L_v N_p - L_p N_v$ (b) $L_v N_p + L_p N_v$
(c) $U_0 (L_v N_p + L_p N_v)$ (d) $U_0 (L_v N_p - L_p N_v)$

where, v is the sideslip velocity and other symbols have their usual meanings.

22. Consider a flow at Mach 0.8. Find out the ratio of the kinetic and internal energies per unit mass of a fluid element moving along a streamline. Assume that the fluid is a calorically perfect gas with heat capacity ratio of 1.5.

(a) 0.14 (b) 0.24
(c) 0.64 (d) 0.48

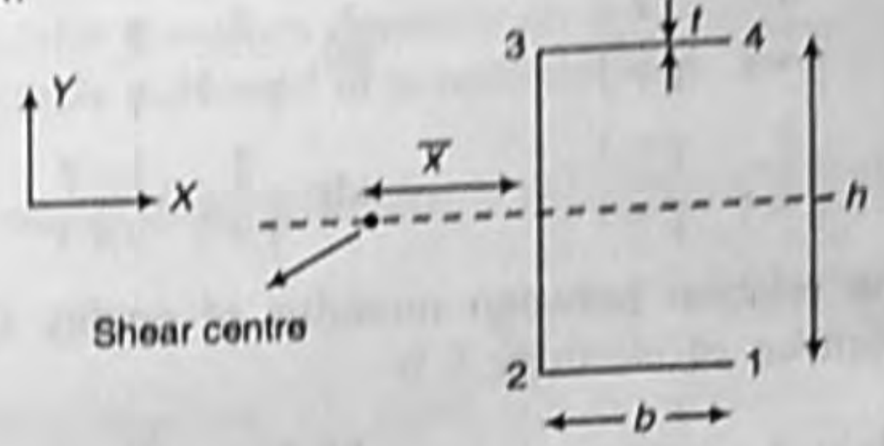
23. Consider a source of strength Λ and a sink of equal strength separated by a distance. If the source and sink are brought closer such that $\Lambda l = k$ and remains constant, then what is the stream function obtained for the configuration in a potential flow?

(a) $\psi = \dfrac{k}{2\pi} \dfrac{\sin^2\theta}{r}$ (b) $\psi = \dfrac{-k}{2\pi} \dfrac{\sin^2\theta}{r^2}$

(c) $\psi = \dfrac{k}{2\pi} \dfrac{\sin\theta}{r}$ (d) $\psi = \dfrac{-k}{2\pi} \dfrac{\sin\theta}{r}$

where, $\psi = \psi\,(r, \theta)$.

24. For the given channel-section, find out the distance $\bar{X}$.



Given that $b = \dfrac{h}{3}$.

(a) $\dfrac{h}{6}$ (b) $\dfrac{h}{7}$
(c) $\dfrac{h}{8}$ (d) $\dfrac{h}{9}$

25. For stability of combustion in solid propellant systems, which of the following factors is important?

(a) Mass flow rate of the exhaust out of the chamber
(b) Pressure in the combustion chamber
(c) Dependence of rate of consumption of the propellant grain on the chamber pressure
(d) Velocity of the exhaust gas over the propellant grain

26. Given the following information, calculate the orbital inclination of a sun synchronous earth satellite of semi-major axis a = 6700 km and eccentricity e = 0.01.

Data: $R_e = 6378.14$ km, $J_2 = 0.00108263$,
$\mu = 398600.44\ km^3/s^2$

Orbital inclination is (in degree, correct to first place of decimal)

(a) 88.2 (b) 92.0
(c) 80.1 (d) 90.1

27. The volumetric strain experienced by a body with coefficient of elasticity E and Poisson ratio $\nu = 0.3$, when subjected to a uniform hydrostatic pressure of magnitude $\dfrac{E \times 10^{-4}}{3}$, is $(\times\ 10^{-6})$

(a) –20 (b) – 40
(c) –25.5 (d) –30

28. Consider a helical coil spring. If the number of turns, the radius of the coil and the diameter of the coil rod are all doubled and the spring is modelled as a linear spring, then the stiffness increases by a factor of (given, $r/D >> 1$)
(a) 1 (b) 3
(c) 5 (d) 2

29. The $\frac{C_L}{C_D}$ ratio corresponding to maximum endurance during a steady level flight configuration (correct to the first decimal place) is
Data: Span efficiency factor = 0.91
Aspect ratio = 6
Zero lift drag coefficient = 0.018
(a) 12.2 (b) 13.4
(c) 11.5 (d) 10.0

30. A flow at Mach 3.0 encounters an oblique shock wherein the shock angle is 35°. If the freestream pressure is 1 atm, the pressure after the oblique shock is (in atm) (correct to two decimal places, the fluid involved is air)
(a) 4.20 (b) 2.30
(c) 3.29 (d) 2.00

31. If the amplitude of oscillations of a system reduces by half after 7 time periods, then the damping ratio of the system is
(a) 0.012 (b) 0.081
(c) 0.016 (d) 0.022

32. The value of the integral $\int_0^{\infty} \frac{\cos t - \cos 8t}{t} dt$ is
(a) 2.77 (b) 2.08
(c) 2.93 (d) 2.11

33. Consider the three-dimensional motion of fluid in the vicinity of vortex filaments, which one of the following statements is not a Helmholtz's theorem?
(a) The strength of a vortex filament is constant along its length
(b) A vortex filament cannot end in a fluid. It may extend to the boundaries of the fluid
(c) A vortex filament cannot form a closed path
(d) In the absence of rotational external forces, a fluid that is initially irrotational remains irrotational

34. Consider a two-dimensional boundary layer along a flat plate. If the boundary layer thickness is 2.3 mm at 7 cm from the leading edge of the flat plate, then what will the boundary layer thickness be at a station 10 cm from the leading edge if the uniform upstream velocity of the flow increases by 30%?
(a) 3.4 mm (b) 2.6 mm
(c) 2.1 mm (d) 2.4 mm

35. What is the primary reason for the aircrafts with delta wings having high stall angles?
(a) The wing's leading edge does not contact the shock wave boundary formed at the nose of the fuselage
(b) The delta planform maximizes wing area (generating lift) with a very low wing per unit loading
(c) Highly robust nature of the delta wings
(d) Generation of vortex at the leading edge that energizes the flow

36. An aircraft is flying at Mach 0.78 at a steady altitude. If the pressure at the compressor inlet is 1.4 times the outside freestream pressure, the efficiency of the diffuser in the engine intake is
(a) 81% (b) 83%
(c) 85% (d) 87%
[Assume that intake efficiency is 100%]

37. What is the effect of flaps on the C_L-α curve of the aircraft?
(a) $C_{L_{max}}$ increases
(b) Stalling angle increases
(c) The slope of C_L-α curve increases
(d) α (zero lift) increases

38. In the stick free longitudinal case of an aircraft with a tail and elevator as the control input, the lift-curve slope for the tail reduces by a factor of $1 - F$. Then F is equal to
(a) $\frac{C_{h_{\alpha t}} C_{L_{\alpha t}}}{C_{h_{\delta t}} C_{L_{\delta t}}}$ (b) $\frac{C_{L_{\delta t}}}{C_{L_{\alpha t}}} C_{h\alpha t} C_{h\delta t}$
(c) $\frac{C_{L_{\delta t}}}{C_{L_{\alpha t}}} \times \frac{C_{h_{\alpha t}}}{C_{h_{\delta t}}}$ (d) $\frac{C_{h_{\delta t}}}{C_{h_{\alpha t}}} C_{L\delta t} C_{L\alpha t}$

39. The value of integral $\int_1^2 e^x \ln x \, dx$ using the Simpson's rule of numerical integration is
(a) 2.06 (b) 2.02
(c) 2.08 (d) 2.11

40. Calculate the radius of a steady level turn made by an aircraft with turn speed 75 m/s and a bank angle of 6°.
(a) 4.55 km (b) 6.22 km
(c) 5.45 km (d) 5.21 km

41. The relationship between the body fixed angular velocity vector $[p \; q \; r]^T$ and the rate of change of Euler angles $\left[\dot{\phi} \; \dot{\theta} \; \dot{\psi}\right]^T$ is given by

$$\begin{bmatrix} p \\ q \\ r \end{bmatrix} = J^{-1} \begin{bmatrix} \dot{\phi} \\ \dot{\theta} \\ \dot{\psi} \end{bmatrix}$$

Then J^{-1} equals to

(a) $\begin{bmatrix} 1 & 0 & -\cos\theta \\ 0 & \cos\psi & \cos\phi\sin\theta \\ 0 & \sin\psi & -\sin\phi\sin\theta \end{bmatrix}$

(b) $\begin{bmatrix} \cos\psi & 0 & 0 \\ 1 & -\sin\theta & \cos\phi \\ 0 & \cos\theta & -\sin\phi \end{bmatrix}$

(c) $\begin{bmatrix} 1 & -\sin\theta & 0 \\ 0 & \cos\psi & \cos\theta\cos\phi \\ 0 & -\sin\psi & -\sin\theta\cos\phi \end{bmatrix}$

(d) $\begin{bmatrix} 1 & 0 & -\sin\theta \\ 0 & \cos\phi & \sin\phi\cos\theta \\ 0 & -\sin\phi & \cos\phi\sin\theta \end{bmatrix}$

42. Surface coating methods like sublimation visualization used on models tested in wind tunnels cannot be used to determine or infer
(a) areas of separated flow
(b) laminar to turbulent flow transition
(c) direction of flow in the spanwise direction
(d) vortical structures and separation bubble sizes

43. For a flat plate boundary layer with zero-pressure gradient and no wall transpiration, $\frac{d\theta}{dx}$ is equal to {where, θ = momentum thickness}

(a) $\frac{\theta}{u_e}(H+2)$ (b) $2C_f$

(c) $\frac{1}{2}\frac{\rho u_e^2}{\tau_w}$ (d) $\frac{\tau_w}{\rho u_e^2}$

where, H = shape factor
τ_w = shear stress exerted by the wall
u_e = freestream uniform velocity outside the boundary layer

44. For a spacecraft undergoing a plane change manoeuvre at a point in its trajectory when its flight speed is 7.2 km/s with a plane change by 60°, the impulse magnitude is equal to
(a) 7.5 km/s (b) 7.1 km/s
(c) 7.2 km/s (d) 6.9 km/s

45. What is the primary advantage of naturally aged duralumin over the fully heat treated form?
(a) Increased strength and stiffness
(b) Resistance to stress corrosion
(c) Fatigue endurance and resistance to crack erosion
(d) Less failure during forging and extrusion

46. A cantilever beam of length 3 m carrying a point load of 50 kN at a distance of 2 m from fixed end. If $I = 10^8$ mm^4 and $E = 2 \times 10^6$ N/mm^2. What is the deflection of the beam at the free end?
(a) 11.11 mm (b) 12.26 mm
(c) 11.67 mm (d) 10.67 mm

47. If $Y' = f(t, y)$, then by the two-step Adam-Bashforth method, the solution of the differential equation can be obtained by the iteration

$$\frac{y_{n+2} - y_{n+1}}{h} =$$

(a) $\frac{2}{3} f(t_{n+1}, y_{n+1}) + \frac{1}{3} f(t_n, y_n)$

(b) $\frac{2}{3} f(t_{n+1}, y_{n+1}) - \frac{1}{3} f(t_n, y_n)$

(c) $\frac{3}{2} f(t_{n+1}, y_{n+1}) - \frac{1}{2} f(t_n, y_n)$

(d) $\frac{3}{2} f(t_{n+1}, y_{n+1}) + \frac{1}{2} f(t_n, y_n)$

Common Data for Questions 48 and 49

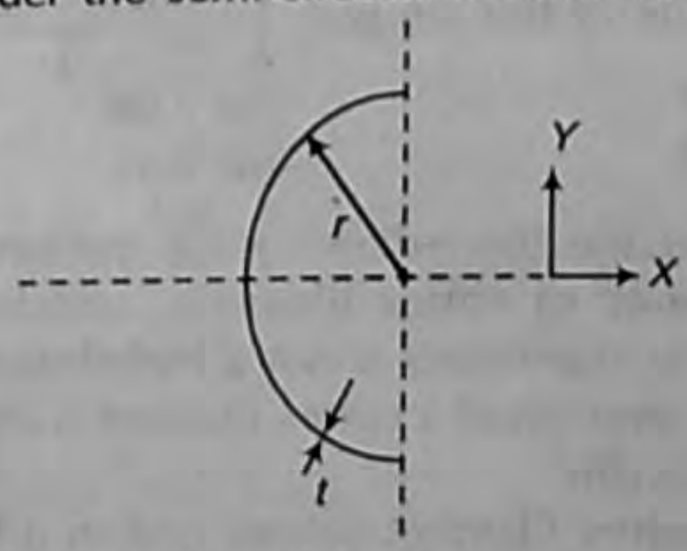
An aircraft propeller flies at a speed of 440 km/h. The diameter of the propeller is 4.1m and the speed ratio is 0.8. The ambient conditions of air at the flight altitude are $T = 255$ K and $p = 0.55$ bar.

48. The thrust obtained by the propeller engine is
(a) 42.67 kN (b) 41.67 kN
(c) 43.67 kN (d) 40.67 kN

49. Find out the propulsive efficiency in the above case.
(a) 83% (b) 88%
(c) 78% (d) 73%

Common Data for Questions 50 and 51

Consider the semi-circular section as given below



50. What is the value of I_{XX} ?

(a) $\frac{\pi r^3 t}{3}\left(1+\frac{r}{t}\right)$ (b) $\frac{\pi r^2 t^2}{4}\left(1+\frac{t^2}{r^2}\right)$

(c) $\frac{\pi r^3 t}{4}\left(1+\frac{t}{r}\right)$ (d) $\frac{\pi r^3 t}{2}$

51. Based on the same figure, determine I_{YY}.

(a) $\frac{\pi r^2 t^2}{2}\left(1+\frac{t}{r}\right)$ (b) $\frac{\pi r^3 t^2}{4}\left(1+\frac{t^2}{r^2}\right)$

(c) $\frac{4\pi}{3} r^3 t$ (d) $\frac{\pi r^3 t}{2}$

Linked Answer Questions 52 and 53

52. During the phugoid mode of an aircraft, which of the following two parameters are excited?
(a) Air speed and angle of attack
(b) Air speed and pitch angle
(c) Pitch rate and pitch angle
(d) Angle of attack and pitch rate

53. Using an approximation to the phugoid mode, determine $\frac{\partial \dot{\theta}}{\partial u}$ during this flight mode.

(a) $\frac{-Z_u}{mu - Z_{\dot{\alpha}}}$ (b) $\frac{Z_u}{mu + Z_{\dot{\alpha}}}$

(c) $\frac{Z_u}{mu + Z_q}$ (d) $\frac{-Z_u}{mu + Z_q}$

Statements for Linked Answer Questions 54 and 55

A body at temperature T_2 loses heat to the outside at temperature T_1 at a rate $K(T_2 - T_1)$. It is warmed by a heat pump operated as a Carnot cycle between T_1 and T_2. The power supplied by heat pump is $\frac{dW}{dT}$.

54. What is the maximum rate $\frac{dQ}{dt}$ at which the heat pump can deliver heat to the room?

(a) $\frac{T_2}{T_2 - T_1}\frac{dW}{dt}$ (b) $\frac{T_2 - T_1}{T_1}\frac{dW}{dt}$

(c) $\frac{T_1}{T_2}\frac{dW}{dt}$ (d) $\frac{T_2}{T_1}\frac{dW}{dt}$

55. What is the equilibrium temperature of the room?

(a) $T_1 + \frac{dW}{K\,dt} + \frac{1}{2K}\sqrt{\left(\frac{dW}{dt}\right)^2 + KT_1\left(\frac{dW}{dt}\right)}$

(b) $T_1 + \frac{dW}{2K\,dt} + \frac{1}{K}\sqrt{\left(\frac{dW}{dt}\right)^2 + 2KT_1\left(\frac{dW}{dt}\right)}$

(c) $T_1 + \frac{dW}{2K\,dt} + \frac{1}{2K}\sqrt{\left(\frac{dW}{dt}\right)^2 + 4KT_1\left(\frac{dW}{dt}\right)}$

(d) $T_1 + \frac{dW}{K\,dt} + \frac{1}{2K}\sqrt{2\left(\frac{dW}{dt}\right)^2 + 2KT_1\left(\frac{dW}{dt}\right)}$

General Aptitude

56. A train travels from *A* to *B* at the rate of 60 km/h and from *B* to *A* at the rate of 40 km/h, then the average rate for the whole journey is
(a) 46 km/h (b) 48 km/h
(c) 50 km/h (d) 52 km/h

57. A watch is offered for sale at ₹ 115 and if that price is reduced by 5%, the dealer who is selling it will still make $9\frac{1}{4}$% profit. How much did the watch cost him?
(a) ₹ 129.25 (b) ₹ 109
(c) ₹ 105 (d) ₹ 100

58. A company buys equal number of red pencils and green pencils. It uses $\frac{7}{8}$ of the red pencils and $\frac{5}{6}$ of the green pencils. Find what fraction of pencils bought remain unused?
(a) $\frac{7}{24}$ (b) $\frac{17}{24}$
(c) $\frac{13}{48}$ (d) $\frac{7}{48}$

59. If a man takes 2 h to row 7 km upstream or 15 km downstream, what is the speed of the current (in km/h)?
(a) 2 (b) 10.5
(c) 3.5 (d) 7.5

60. A reduction of 30% in the price of sugar enables a housewife to buy 6 kg more sugar for ₹ 20. What was the price per kg of sugar before the price reduction?
(a) ₹ $2\frac{1}{3}$ (b) ₹ $3\frac{1}{3}$
(c) ₹ $3\frac{1}{7}$ (d) ₹ $1\frac{3}{7}$

61. Speed of a railway engine is 42 km/h when no compartment is attached and the reduction in speed is directly proportional to the square root of the number of compartments attached. If speed of the train carried by this engine is 24 km/h when 9 compartments are attached, then maximum number of compartments that can be carried by the engine is
(a) 49 (b) 48
(c) 46 (d) 47

62. There is a leak in the bottom of a cistern. When the cistern had no leak, it was filled in 2.5 h. It now takes half an hour longer. If the cistern is full of water, how long will it take in leaking itself empty, in case the water leaks out at double the rate after half the cistern becomes empty?
(a) 15 h (b) 11 h 15 min
(c) 11 h 25 min (d) 7.5 h

63. A certain basketball team that has played 2/3 of its games has a record of 17 wins and 3 losses. What is the greatest number of the remaining games that the team can lose and still win at least 3/4 of the total games played?

(a) 4 (b) 7
(c) 5 (d) 6

64. Two typists undertake to do a job. The second typist begins working 1h after the first. 3h after, the first typist has begun working there is still 9/20th of the work to be done. When the assignment is completed, it turns out that each typist has done half the work. How many hours would it take each one to do the whole job individually?

(a) 12, 8 h (b) 8, 5.6 h
(c) 10, 8 h (d) 5, 4 h

65. Blood banks will shortly start to screen all donors for NANB hepatitis. Although the new screening tests are estimated to disqualify upto 5% of all prospective blood donors, they will still miss two-thirds of donors carrying NANB hepatitis. Therefore, about 10% of actual donors will still supply NANB contaminated blood.

The argument above depends on which of the following assumptions?

(a) Donors carrying NANB hepatitis do not, in a large percentage of cases, carry other infections for which reliable screening tests are routinely performed
(b) Donors carrying NANB hepatitis do not, in a large percentage of cases, develop the disease themselves at any point
(c) The number of donors who would be disqualified by tests for NANB hepatitis has been under-estimated
(d) The incidence of NANB hepatitis is lower among the potential blood donors then it is in the population at large