ISRO

Previous Year Paper
Refrigeration and Air Conditioning 2014

1. The condition of stable equilibrium for a floating body is :
   (a)metacentre coincides with centre of gravity
   (b)metacentre is below centre of gravity
   (c)metacentre is above centre of gravity
   (d)centre of buoyancy is above centre of gravity

2. The thickness of turbulent boundary layer at a distance x from the leading edge over a flat plate varies as
   (a) $x^{0.8}$ (b) $x^{0.5}$ (c) $x^{0.2}$ (d) $x^{0.6}$

3. The diameters of a pipe at the sections 1 and 2 are 10 cm and 15 cm respectively. Velocity of water flowing through the pipe at section 1 is 5 m/s. velocity at section 2 in m/s and discharge in cmm is
   (a) 2.2 & 2.4 (b) 2.7 & 2.8 (c) 2.1 & 2.4 (d) 2.4 & 2.6

4. The velocity distribution for flow over a flat plate is given $u = \frac{3}{4}y - y^2$ in which u is the velocity in m/s at a distance y meter above the plate. Shear stress at y =0.15m is (Take μ for fluid =8.5 poise)
   (a) 0.3825 Pa (b) 0.3815 Pa (c)0.3835 Pa (d) 0.3845 Pa

5. A gas weighs 16 N/m^3 at 288 K and at an adiabatic pressure of 25 N/cm^2. Its gas constant is
   (a) 532 J/kg K (b) 544 J/kg K (c) 553 J/kg K (d) 523 J/kg K

6. A pipe line AB of diameter 30 cm and of length 400 m carries water at the rate of 50 liters/sec. The flow takes place from A to B where point B is 30 meters above A. Pressure at B is 2 ksc. Pressure at A is (Take f=0.008)
   (a) 5.2 ksc (b) 5.3 ksc (c) 5.0 ksc (d) 5.1 ksc

7. A nozzle is fitted at the end of a pipe of length 300m and of diameter 10 cm for transmitting water. What is the diameter of the nozzle considering maximum transmission of power through the nozzle (f=0.009)
   (a) 2.6 cm (b) 2.5 cm (c) 2.4 cm (d) 2.7 cm

8. A turbine develops 500 kW under a head of 100 meters at 200 RPM. Its normal speed and power under a head of 81 meters
   (a) 184 RPM and 375 kW (b) 180 RPM and 365 kW
   (c) 184 RPM and 370 kW (d) 180 RPM and 361 kW

9. Number of degrees of freedom in a Ball and socket joint :
   (a) 1 (b) 2 (c) 3 (d) 0

10. Two inelastic spheres of masses 10 kg each move with velocities of 15m/s and 5m/s respectively in the same direction. The loss in kinetic energy when they collide
(a) 500 N m (b) 0 (c) 250 N m (d) 1000 N m

11. In order to have maximum power from a Pelton turbine, the bucket speed must be
(a) equal to the jet speed (b) equal to half of the jet speed
(c) equal to twice the jet speed (d) independent of the jet speed

12. The alloying element mainly used to improve the endurance strength of steel materials is
(a) Nickel (b) Vanadium (c) Molybdenum (d) Tungsten

13. The percentage improvement in power capacity of a flat belt drive, when the wrap angle at the driving pulley is increased from 150^{o} to 210^{o} by an idler arrangement for a friction coefficient of 0.3 is
(a) 25.21 (b) 33.92 (c) 40.17 (d) 67.85

14. In an interchangeable assembly, shaft of size $25.000^{+0.04}_{-0.01}$ mm. mates with a hole of size $25.000^{+0.03}_{+0.02}$ mm. Maximum interference in microns in the assembly is
(a) 40 (b) 30 (c) 10 (d) 20

15. A column has a rectangular cross section of 10 x 20 mm and a length of 1m. The slenderness ratio of the column is close to
(a) 200 (b) 346 (c) 477 (d) 1000

16. A thin cylinder of inner radius 500mm and thickness 10mm is subjected to an internal pressure of 5 MPa. The average hoop stress in MPa is
(a) 100 (b) 250 (c) 500 (d) 1000

17. A circular disk of uniform thickness 20mm, radius 200mm and mass 20 kg is used as flywheel. If it rotates at 600 rpm, kinetic energy of flywheel in Joule is
(a) 395 (b)790 (c)1580 (d)3160

18. A vibration system consists of a mass of 175 kg, a spring stiffness 700 N/cm and damper with a damping coefficient of 7 N cm^{-1} sec. Damping factor of the system is
(a) 0.15 (b) 0.25 (c) 0.2 (d) 0.1

19. Two cutting tools are being compared for a machining operation. The tool life equations are Carbide tool : $VT^{1.6}=3000$; HSS tool : $VT^{0.6}=200$, where V is the cutting speed in m/min and T is tool life in min. The carbide tool will provide higher tool life if the cutting speed in m/min exceeds
(a) 39.4 (b) 15 (c) 60 (d) 49.3

20. The diameter of suction side of a reciprocating compressor compared to its delivery side is

(a) smaller (b) equal

(c) bigger (d) varies according to capacity

21. Two crossed helical gears are used for speed reduction. Gear A has pitch circle diameter in the plane of rotation 80mm and helix angle 30 deg; Gear B . Gear A has pitch circle diameter in the plane of rotation 120mm and helix angle 22.5 deg; If the input speed is 1440 RPM, then output speed in RPM is

(a) 1200 (b) 875 (c) 900 (d) 700

22. The moisture in a refrigerant is removed by :

(a) dehumidifiers (b) safety relief valve

(c) driers (d) expansion valve

23. In an arc welding process, the voltage and current are 25 V and 300 A respectively. The arc heat transfer efficiency is 0.85 and welding speed is 8mm/sec. the net heat input (in J/mm) is:

(a) 64 (b) 797 (c) 1103 (d) 79700

24. Hardness of steel greatly improves with

(a) annealing (b) cyaniding (c) normalizing (d) tempering

25.

	Work Material		Type of Joining
P	Aluminium	1	Submerged Arc Welding
Q	Die Steel	2	Soldering
R	Copper Wire	3	Thermit Welding
S	Titanium Sheet	4	Atomic Hydrogen Welding
		5	Gas Tungsten Arc Welding
		6	Laser Beam Welding

(a) P-2, Q-5, R-1, S-3 (b) P-6, Q-3, R-4, S-4

(c) P-4, Q-1, R-6, S-2 (d) P-5, Q-4, R-2, S-6

26. For a perfect gas

	List A		List B
P	Isobaric thermal expansion coefficient	1	0
Q	Isothermal compressiblity	2	∞
R	Isentropic compressibility	3	1/v
S	Joule Thomson Coefficient	4	1/T
		5	1/p
		6	1/∂p

(a) P-4, Q-2,R-3,S-6 (b) P-3,Q-5,R-4,S-1

(c) P-2,Q-4,R-1,S-5 (d) P-4,Q-5,R-6,S-1

27. If a mass of moist air in an airtight vessel is heated to a higher temperature, then
(a) Specific humidity of air increases (b) Specific humidity of air decreases
(c) Relative humidity of air increases (d) Relative humidity of air decreases

28. Threaded bolts of A and B of same material and length are subjected to identical tensile load. If the elastic strain energy stored in bolt A is 4 times that of bolt B and the mean diameter of bolt A is 12mm, then mean diameter of bolt B is
(a) 16 (b) 24 (c) 36 (d) 48

29. In a condenser of a power plant, the steam condenses at a temperature of 333 K. The cooling water enters at 303 K and leaves at 318 K. The logarithmic mean temperature difference (LMTD) of the condenser is
(a) 16.2^0C (b) 21.6^0C (c) 30^0C (d) 37.5^0C

30. The shear strength of a sheet metal is 300 Mpa. The blanking force required to produce a blank of 100 mm diameter from a 1.5mm thick sheet is
(a) 45 kN (b) 70 kN (c) 141 kN (d) 350 kN

31. A heat engine is supplied heat at the rate of 1700 kJ/min and gives an output of 9 kW. Thermal efficiency and heat rejection in kW of heat engine is
(a) 34.0%, 11.0 (b) 28.3%, 10.0 (c) 31.76%, 19.33 (d) 32.3, 9.83

32. When we have combined free and forced convection, Gr/Re^2 is
(a) greater than 1 (b) less than 1
(c) almost equal to 1 (d) equal to Peclet Number.

33. A refrigerator and heat pump operate between the same temperature limits. COP of refrigerator is 4, COP of heat pump would be
(a) 3 (b) 5 (c) 4 (d) data not adequate

34. A carnot refrigerator requires 1.25 kW per ton of refrigeration to maintain a temperature of 233 K. Its higher operating temperature of the cycle
(a) 318 K (b) 313 K (c) 315 K (d) 316 K

35. The work input to air compressor is minimum if the compression law followed is
(a) isentropic (b) PV=C (c) $PV^{1.2} = C$ (d) $PV^{1.35} = C$

36. Operating pressures of the refrigerants at the evaporator in the ascending order for any application are
(a) R11, R12, R717, R22 (b) R22,R717,R12,R11
(c) R11,R12,R22,R717 (d) R717,R22,R11,R12

37. For vapour compression system using R717 the material of pipe is
(a) steel (b) copper (c) Brass (d) Aluminium

38. Air at DBT of 308 K and DPT of 293 K passes through a cooling coil which is maintained at 298 K. The process would be
(a) cooling and de humidification (b) sensible cooling
(c) cooling and humidification (d) cannot predict

39. Room sensible heat loss is 30000kJ/min and room latent heat loss is 20000 kJ/min. Sensible heat factor is
(a) –0.6 (b) 0.6 (c) 0.3 (d) 3

40. Domestic refrigerator working on vapour compression cycle uses the following type of expansion device
(a) Manually operated valve (b) thermostatic valve
(c) expansion valve (d) capillary tube

41. An incompressible fluid flows over a flat plate and its boundary layer thickness at certain location is 1mm for Reynolds Number of 1000. If the velocity is increased by a factor of 4, then the boundary layer thickness at that location in mm will be
(a) 4 (b) 0.25 (c) 0.5 (d) 2

42. A room contains 35 kg of dry air and 0.5 kg of water vapour. Total pressure and temperature in the room is 100kPa and 298 K. Saturation pressure of water at 298 K is 3.17 kPa. Relative humidity of air in that room is
(a) 67% (b) 55% (c) 83% (d) 71%

43. An ideal brayton cycle operating between the pressure limits of 1 bar and 6 bar, has minimum and maximum temperature of 300 and 1500 K. Ratio of specific heat of working fluid is 1.4. Approximate final temperatures in Kelvin at the end of compression and expansion respectively are
(a) 500 and 900 (b) 900 and 500 (c) 500 and 500 (d) 900 and 900

44. Condition of perfect Vacuum is attained at temperature of
(a) -273^0C (b) 0^0C (c) 273 K (d) can't be attained.

45. Two identical ball bearings P and Q are operating at loads 15 kN and 45 kN respectively. The ratio of life of bearing P to Q is
(a) 81 (b) 27 (c) 9 (d) 3

46. if a certain amount of dry ice is mixed with same amount of water at 80^0C, then the final temperature of the mixture is
(a) 0^0C (b) 80^0C (c) 40^0C (d) 60^0C

47. The leaks in a refrigeration system using Freon is detected using
(a) smell (b) halide torch (c) sulphur sticks (d) using reagents

48. Presence of moisture in the refrigerant affects the working of
(a) condenser (b) evaporator (c) expansion valve (d) compressor

49. In SI unit, one ton of refrigeration is
(a) 210 kJ/min (b) 21 kJ/min (c) 420 kJ/min (d) 840 kJ/min

50. On the pressure – enthalpy diagram, condensation and de-superheating is represented by a horizontal line because the process
(a) involves no change in volume (b) takes place constant temperature
(c) takes place at constant pressure (d) takes place at constant entropy

51. Generation of heating at one junction and cooling at other by passing direct current through a pair of dissimilar materials is
(a) Seebeck effect (b) Joule effect (c) Peltier effect (d) Thomson effect

52. Power consumption of centrifugal fans varies with speed (N) and diameter (D) as
(a) N^3D^4 (b) N^5D^3 (c) N^2D^5 (d) N^3D^5

53. Sol-air temperature for a wall of absorptivity 0.9, exposed to ambient temperature of 35^0C, solar radiation of 260 W/sqm, outside heat transfer coefficient 23 W/sqm K is
(a) 45.2^0C (b) 48^0C (c) 41.2^0C (d) 47.2^0C

54. The recovery factor in flow of gases is a function of
(a) Reynolds Number (b) Prandtl Number
(c) Peclet Number (d) Rayleigh Number

55. Adiabatic wall temperature is
(a) equal to stagnation temperature (b) greater than stagnation temperature
(c) less than stagnation temperature (d) the temperature of adiabatic surface

56. A composite slab has two layers of different materials having thermal conductivities k and 2k. If each layer has the same thickness, the equivalent thermal conductivity of the slab is
(a) 3k (b) N^5D^3 (c) 3/2k (d) 4k/3

57. When a liquid flows through a tube with subcooled or saturated boiling the process is known as

(a) Pool boiling (b) bulk boiling

(c) Convection boiling (d) forced convection boiling

58. For filmwise condensation, the heat transfer coefficient will be equal whether the tube is horizontal or vertical, when the ratio of length to diameter is

(a) 1.3 (b) 2.87 (c)0.77 (d) >10

59. Insulated tip temperature of a rectangular longitudinal fin will be equal to

(a) $\theta_o$tanh ml (b) θ_o /sinh ml (c) ($\theta_o$tanh ml)/ml (d) θ_o /cosh ml

60. The characteristic length computing Grashof number in the case of a horizontal cylinder is

(a) diameter of the cylinder (b) length of the cylinder

(c) radius of the cylinder (d) perimeter of the cylinder

61. In liquid metal heat transfer for a fluid flowing through a tube, Nusselt number is a function of

(a) Reynold Number (b) Prandtl Number

(c) Peclet Number (d) Reynolds and Peclet Number

62. Absorptivity of the grey body

(a) varies with temperature

(b) varies with wavelength of the incident ray

(c) varies with wavelength and temperature of the incident ray

(d) does not vary with wavelength and temperature of the incident ray

63. Gases have poor

(a) transmissivity (b) absorptivity (c) reflectivity (d) emissivity

64. Intensity of solar radiation in kW/sqm is about

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

65. Match the following:

A	Stanton Number	1	Surface Tension
B	Mach Number	2	Mass Transfer
C	Weber Number	3	Forced Convection
D	Schmidt Number	4	Compressiblity

(a) A-4, B-3, C-2, D-1 (b) A-3, B-4, C-1, D-2

(c) A-1, B-2, C-3, D-4 (d) A-2, B-3, C-4, D-1

66. In MLTθ system, the dimension of thermal conductivity is
(a) $ML^{-1}T^{-1}\theta^{-3}$ (b) $MLT^{-1}\theta^{-1}$ (c) $MLT^{-3}\theta^{-1}$ (d) $MLT^{-2}\theta^{-1}$

67. For infinite parallel planes with emissivities 0.4 and 0.2, the interchange view factor for a radiation from surface 1 to surface 2 is about
(a) 0.4 (b) 0.6 (c) 0.2 (d) 0.15

68. A chromel – alumel thermocouple of diameter 0.7mm is used to measure the temperature of a gas stream for which h= 600 W/sqm K. Acceptable reading of the temperature can be taken after (specific heat = 400 J/kg K, Density = 8600 kg/cum)
(a) 1 second (b) 4 seconds (c) 2 seconds (d) 3 seconds

69. On a hot summer day, surface of the concrete highway may reach 328 K. Suppose a stream of water is directed on the highway so that the surface is suddenly lowered to 308 K. Time taken in hours to cool the concrete to 318 K to a depth of 5 cm below the surface is: (Thermal diffusivity = 1.77E-03 m^2/h)
(a) 1.2 (b) 1.4 (c) 1.8 (d) 1.6

70. Hot surface at temperature 400 K having emissivity of 0.5 dissipates heat by radiation into a surrounding of 375 K. Its radiation heat transfer coefficient (W/sqm K) is
(a) 14.6 (b) 7.3 (c) 1.83 (d) 9.4

71. Hot steel sphere of diameter 40mm is immersed in oil. If the heat transfer coefficient between the sphere and oil is 300 W/sqm K , then Biot Number is:
Take k_{steel} = 50 W/m K and k_{oil} = 0.2 W/m K
(a) 0.04 (b) 0.12 (c) 10 (d) 0.24

72 A metallic surface is maintained at 1000 K, the wavelength at which maximum spectral intensity occurs
(a) 289.8 μm (b) 28.98 μm (c) 0.2898 μm (d) 0.002898 mm

73. Air at 293 K is flowing with velocity of 3m/s over a heated flat square plate. Plate is 0.3 m wide and is maintained at 330 K. Average heat loss from the plate due to convection is (Take ν= 16.768E-6 m^2/s, Pr =0.7, k=0.027 W/m K)
(a) 33 W (b) 37 W (c) 45 W (d) 41 W

74. Two fluids A and B exchange heat in counterflow heat exchanger. Fluid A enters at 700 K and fluid B enters at 300 K. Mass flow rate of A & B is 1 kg/s. Specific heat of fluid A and B is 1000 J/kg K and 4000 J/kg K. Net Effectiveness of heat exchange is 75 %. Exit temperature of Fluid B is
(a) 380 K (b) 385 K (c) 375 K (d) 370 K

75. If the following equations are consistent, then value of k is

$4x-3y+1=0$
$kx-8y+10=0$
$x+y-5=0$

(a) -6 (b) 7 (c) 6 (d) –7

76. If ω and ω^2 are cube roots of unity, then $(2-\omega+2\omega^2)(2+2\omega-\omega^2)$ is

(a) 0 (b) -9 (c) 8 (d) 9

77. Area of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

(a) ab (b) a/b (c) πab (d) ab/π

78. find $\lim_{x\to 0}\frac{1-\cos x}{x^2}$

(a) 0 (b) 1/2 (c) –1/2 (d) 1

79. Equation of the plane parallel to the x axis and passes through the point (4,6,2) and (4, -5, 3)

(a) y+11z+28=0 (b) y-11z+28=0
(c) y+11z-28=0 (d) y-11z-28=0

80. $\vec{a}$ and $\vec{b}$ are unit vectors such that $2\vec{a}-4\vec{b}$ and $10\vec{a}+8\vec{b}$ are perpendicular to each other. Angle between the vectors $\vec{a}$ and $\vec{b}$ is

(a) 90° (b) 120° (c) 110° (d) 100°