ISRO

Previous Year Paper
Refrigeration and Air Conditioning 2017

1. An insulated rigid vessel contains a mixture of fuel and air. The mixture is ignited by a minute spark. The contents of vessel experience

(a) increase in temperature, pressure and energy

(b) decrease in temperature, pressure and energy

(c) increase in temperature and pressure but increase in energy

(d) Increase in temperature and pressure but no change in energy

2. The specific heat of ideal gas depend on

(a) Temperature (b) Volume

(c) Molecular weight and structure (d) Pressure

3. Thermal power plant works on

(a) Carnot cycle (b) Joule cycle

(c) Rankine cycle (d) Brayton cycle

4. In an isothermal process, the internal energy of molecules

(a) Increases (b) Decreases

(c) Depends on temperature (d) Remains constant

5. For reversible adiabatic process, change in entropy is

(a) positive (b) negative

(c) zero (d) depends on pressure

6. A cylinder contains 5 m^3 of an ideal gas at a pressure of 1. This gas is compressed in a reversible isothermal process till its pressure increases to 5 bar. The work in kJ required for this process is

(a) 804.7 (b) 953.5

(c) 987.5 (d) 1012.3

7. A steel ball of mass 1 kg and specific heat 0.4 kj/kg is at a temperature of 60 deg C. It is dropped into 1 kg of water at 20 deg C. The final steady temperature of water is

(a) 23.48 deg C (b) 32.28 deg C

(c) 20 deg C (d) 30 deg C

8. A Bell-Coleman cycle is a reversed

(a) Carnot cycle (b) Otto cycle

(c) Joule cycle (d) Rankine cycle

9. A free bar of length l is uniformly heated from 0°C to a temperature t°C. α is the coefficient of linear expansion and E is the modulus of elasticity. The stress in the bar is

(a) αTE (b) E/ αT

(c) Zero (d) None of the above

10. The materials having same elastic properties in all directions are called

(a) elastic materials (b) uniform materials

(c) isotropic materials (d) plastic materials

11. A large cylindrical vessel was sealed in summer. What is likely to happen to it in winter?

(a) Nothing

(b) become lighter

(c) buckle and collapse

(d) seal getting loosened

12. A concentrated load P acts on a simply supported beam of span L at a distance of L/3 from left support. The bending moment at the point of application of load is given by

(a) PL/3 (b) PL/9

(c) 2PL/9 (d) PL/6

13. Moment of inertia (about its neutral axis) of hollow rectangular section with overall width and depth as B and D and hollow rectangular hole as *b* and *d* is

(a) $1/16\ (BD^3 - bd^3)$ (b) $1/32\ (BD^3 - bd^3)$

(c) $(BD^3 - bd^3)$ (d) $1/12\ (BD^3 - bd^3)$

14. Neutral plane of the beam

(a) Is in the middle

(b) Is one whose length remains unchanged during deformation

(c) Passes through centre of gravity

(d) Lies at the top most fiber

15. Section modulus is defined as

(a) Moment of inertia about the neutral axis/square of the distance of neutral axis from farthest point

(b) Moment of inertia about the neutral axis/ distance of the most distant point from neutral axis.

(c) Bending moment/Moment of Inertia

(d) None of the above

16. Maximum deflection in a beam of span l supported freely at both ends due to central load P at middle with Young's modulus E and moment of inertia I is

(a) $Pl^3 / 64\ EI$ (b) $Pl^3 / 32\ EI$

(c) $Pl^3 / 48\ EI$ (d) $Pl^3 / 96\ EI$

17. For a given material, Young's modulus = 200 GN/m^2 and modulus of rigidity = 80 GN/m^2. Its bulk modulus will be

(a) 100.22 GN/m^2 (b) 120.33 GN/m^2

(c) 133.33 GN/m^2 (d) 250.44 GN/m^2

18. A hollow shaft of 20 mm diameter and 16 mm inside diameter is subjected to a torque of 40 Nm. The shear stress at outside of the shaft will be:

(a) 53.12 N/mm^2 (b) 43.13 N/mm^2

(c) 62.52 N/mm^2 (d) 34.50 N/mm^2

19. If two shafts of same length, one of which is hollow, transmit equal torques and have equal maximum stress, then they should have equal

(a) polar moment of inertia (b) polar modulus of section

(c) diameter (d) angle of twist

20. Carbon content of mild steel can be

(a) 0.51% (b) 0.85% (c) 0.15% (d) 1.5%

21. There are fourteen atoms in a unit cell of

(a) body centered cubic space lattice

(b) face centered cubic space lattice

(c) close packed hexagonal space lattice

(d) none of the above

22. An alloy of copper, tin and zinc is known as

(a) Brass (b) Bronze

(c) Gun metal (d) Babbit metal

23. Cast iron and steel pipes are produced by

(a) slush casting (b) true centrifugal casting

(c) investment casting (d) die casting

24. Electron beam welding can be carried out in

(a) pressurized inert gas chamber (b) vaccum

(c) open air (d) shielded gas environment

25. The welding process used to join ends of two pipes of uniform cross section is

(a) spot welding (b) flash butt welding

(c) upset butt welding (d) seam welding

26. For a Newtonian fluid

(a) Shear stress is proportional to shear strain

(b) Rate of shear stress is proportional to shear strain

(c) Shear stress is proportional to rate of shear strain

(d) Rate of shear stress is proportional to rate of shear strain

27. Oil in a hydraulic cylinder is compressed from an initial volume 2 m^3 to 1.96 m^3 and the pressure increase is from 40 MPa to 80 MPa. The bulk modulus of elasticity of oil is

(a) 1000 MPa (b) 2000 MPa

(c) 4000 MPa (d) 8000 Mpa

28. Pitot tube is used for measurement of

(a) pressure difference (b) discharge through pipe

(c) velocity of flow at required point (d) viscosity of flowing liquid

29. For laminar flow through a long pipe, the pressure drop per unit length is

(a) In direct proportion to the cross sectional area

(b) In proportion to diameter of pipe

(c) In inverse proportion to the square of cross sectional area

(d) In inverse proportion to cross sectional area

30. Oil flows through 200 mm diameter horizontal cast iron pipe with friction factor of 0.0225 of length 500 mtr. The volumetric flow rate is 0.2 m^3/sec. The head loss in mtr. due to friction will be

(a) 232.36 (b) 0.116

(c) 116.18 (d) 18.22

31. A hydraulic turbine develops 1000 kW power for a head of 40 m. If the head is reduced to 20 m, power developed in kW is

(a) 177 (b) 354

(c) 500 (d) 607

32. Impulse turbine is used for

(a) low head of water (b) high head of water

(c) medium head of water (d) high discharge

33. Laminar flow occurs in pipes, when Reynolds number is

(a) Lies between 2000-3000 (b) Lies between 3000-4000

(c) Less than 2000 (d) Less than 1000

34. Power in kW required to drive Centrifugal pump with discharge of Q m^3/sec, Head in H mtr, specific weight of fluid as ω N/m^3 and overall efficiency of pump as η shall be

(a) $\omega H/Qx\eta$ (b) $\omega QH/\eta$

(c) $\omega Q/Hx\eta$ (d) $\omega Qx\eta/H$

35. If the net positive section head(NPSH) for the pump is not satisfied, then

(a) no flow take place
(b) efficiency will be low
(c) cavitation will be formed
(d) pump will not start

36. For a given heat flow and for the same thickness, the temperature drop across material will be maximum for

(a) Copper
(b) Steel
(c) Glass wool
(d) Brick

37. The rate of heat flow through a body is $Q = \frac{kA(T_1 - T_2)}{x}$, the term, $\frac{x}{kA}$ is known as

(a) thermal coefficient
(b) thermal resistance
(c) thermal conductivity
(d) thermal gradient

38. A furnace made of a red brick wall of thickness 0.5 mtr. and conductivity 0.7 W/mK is replaced by alternate material of conductivity 0.14 W/mK. For the same heat loss and temperature drop, required thickness of alternate material will be

(a) 0.2 mtr.
(b) 0.1 mtr.
(c) 0.3 mtr.
(d) 0.4 mtr.

39. The concept of overall coefficient of heat transfer is used in calculating heat transfer by

(a) conduction
(b) convection
(c) conduction and radiation
(d) conduction and convection

40. With an increase in the thickness of insulation around a circular pipe, heat loss to surroundings due to

(a) Convection and conduction increases

(b) Convection and conduction decreases

(c) Convection increases while due to conduction decreases

(d) Convection decreases while due to conduction increases

41. A long glass cylinder of inner diameter 0.03 m and outer diameter 0.05 m carries hot fluid inside. If the thermal conductivity of glass is 1.05 W/mK, the thermal resistance per unit length of the cylinder is

(a) 0.031 (b) 0.077 (c) 0.017 (d) 0.77

42. In heat exchangers, degree of approach is defined as the difference between temperatures of

(a) cold water inlet and outlet

(b) hot medium inlet and outlet

(c) hot medium outlet and cold water inlet

(d) hot medium outlet and cold water outlet

43. In counter flow heat exchangers between two fluids,

(a) Both the fluids at inlet are in their hottest state

(b) Both the fluids at exit are in their hottest state

(c) One fluid in hottest state and the other in coldest state

(d) Any combination possible depending heat exchanger design

44. Log mean temperature difference in case of counter flow heat exchanger compared to parallel flow heat exchanger will be :

(a) same (b) more

(c) less (d) depends on other factors

45. The emissive power of a body depends on:

(a) temperature (b) wave length

(c) physical nature (d) all of these

46. The outside diameter of hollow shaft is twice that of its inside diameter. The ratio of its torque carrying capacity to that of solid shaft of the same material and same outside diameter is :

(a) 15/16 (b) 1/8 (c) 3/4 (d) 1/16

47. The designation M 33×2 of a bolt means

(a) Metric thread of 33 nos in 2 cm

(b) Metric thread with cross section area of 33 mm^2

(c) Metric threads of 33 mm outside diameter and 2 mm pitch

(d) Bolt of 33 mm nominal diameter having 2 threads per cm.

48. The power transmitted by means of belt drives depends upon :

(a) Velocity of the belt

(b) Tension under which the belt is placed on the pulleys

(c) Arc of contact between the belt and the smaller pulley

(d) All of the above

49. The usual proportion for the width of the key used between shaft (of diameter d) and hub of pulley for transmitting power is

(a) d/8 (b) d/6 (c) d/2 (d) d/4

50. The helix angle for single helical gears ranges from

(a) 10° to 15° (b) 15° to 20° (c) 20° to 35° (d) 35° to 45°

51. The air standard efficiency of a standard otto cycle for compression ratio of 5.5 is

(a) 25% (b) 50% (c) 70% (d) 90%

52. The power actually developed by the engine cylinder of an I.C engine is known as

(a) Theoretical pressure (b) Actual power

(c) Indicated power (d) Break horse power

53. In a boiler, feed water is supplied per hour is 205 kg while coal fired per hour is 23 kg. Net enthalpy rise per kg of water is 145 kJ for conversion to steam. If the calorific value of coal is 2050 kJ/kg, boiler efficiency will be

(a) 78% (b) 74% (c) 63% (d) 58%

54. Which of the following power plant is least polluting and causing least environmental concern?

(a) Hydro electric plant (b) solar power plant

(c) Nuclear plant (d) gas power plant

55. A diesel power station has fuel consumption of 0.2 kg per kWh. If the calorific value of diesel is 11000 kcal per kg, overall efficiency of power station is

(a) 43.3% (b) 65.5% (c) 39.2% (d) 25.6%

56. In aircraft, air refrigeration is used because of

(a) low weight per ton of refrigeration (b) high heat transfer rate

(c) low temperature at high altitudes (d) higher coefficient of performance

57. A reversible engine has ideal thermal efficiency of 30%. When it is used as refrigerating machine with all other conditions unchanged, the coefficient of performance will be

(a) 1.33 (b) 2.33 (c) 3.33 (d) 4.33

58. In Vapour compression system, the condition of refrigerant before passing through the condenser is

(a) Saturated liquid (b) wet vapour

(c) Dry saturated vapour (d) superheated vapour

59. Lithium bromide in vapour absorption refrigeration system is used as

(a) refrigerant (b) lubricant

(c) cooling medium (d) absorbent

60. In refrigeration cycle, sub cooling occurs when

(a) Latent heat from refrigerant is removed

(b) Sensible heat from refrigerant is removed

(c) Refrigerant has low latent heat removed

(d) Refrigerant has high thermal conductivity

61. For air with a relative humidity of 80%

(a) The dry bulb temperature is less than wet bulb temperature

(b) The dew point temperature is less than wet bulb temperature

(c) The dew point and wet bulb temperatures are equal

(d) The dry bulb and dew point temperatures are equal

62. During evaporative cooling process, wet bulb temperature

(a) Increases (b) decreases

(c) remains constant (d) unpredictable

63. In a psychrometric process, the sensible heat added is 30 kJ/sec and latent heat added is 20 kJ/sec. The sensible heat factor for the process is

(a) 0.3 (b) 0.6 (c) 0.67 (d) 1.5

64. The bypass factor of cooling coil decreases with

(a) Decrease in fin spacing and increase in number of rows

(b) Increase in fin spacing and increase in number of rows

(c) Increase in fin spacing and decrease in number of rows

(d) Decrease in fin spacing and decrease in number of rows

65. The wet bulb depression is zero when relative humidity is

(a) 0% (b) 50% (c) 75% (d) 100%

66. In the metal cutting process, the high cutting speed and large angle of the tool will result in the formation of

(a) continuous chips

(b) discontinuous chips

(c) continuous chips with built up edge

(d) chips of irregular shapes

67. Gear hobbing produces more accurate gears than milling, because in hobbing

(a) There is continuous indexing operation

(b) Both hob and work piece are rotating

(c) Pressure angle is larger than in milling

(d) A special multi-tooth cutter is used

68. The type of tool used in milling machine and broaching machine is

(a) single point cutting tool (b) two point cutting tool

(c) three point cutting tool (d) multi-point cutting tool

69. The Ackerman steering gear mechanism is preferred to Davis steering mechanism because

(a) Whole of the mechanism in the Ackerman steering gear is on the back of the front wheels

(b) The Ackerman steering gear consists of sliding pairs

(c) The Ackerman steering gear is most economical

(d) Davis steering gear consists of turning pairs

70. The natural frequency of free torsional vibrations of a shaft with torsional stiffness q and I is the mass moment of inertia of the disc attached to the end of the shaft is

(a) $2\pi \times \sqrt{\frac{q}{I}}$ (b) $2\pi \sqrt{qI}$ (c) $\frac{1}{2\pi} \times \sqrt{\frac{q}{I}}$ (d) $\frac{1}{2\pi} \times \sqrt{qI}$

71. A is a 3 × 4 real matrix and Ax = b is a consistent system of equations. The highest possible rank of A is

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

72. The value of the quantity P where $P = \int_0^1 xe^x \, dx$ is equal to

(a) 0 (b) 1 (c) e (d) 1/e

73. The solution of the differential equation $\frac{dy}{dx} = \frac{-x}{y}$ at $x = 1$ and $y = \sqrt{3}$ is

(a) $x - y^2 = -2$ (b) $x + y^2 = -4$

(c) $x^2 - y^2 = 2$ (d) $x^2 + y^2 = 4$

74. The analytic function $f(z) = \frac{z-1}{z^2+1}$ has singularities at

(a) 1 and – 1 (b) 1 and 1

(c) 1 and $-i$ (d) i and $-i$

75. X is a uniformly distributed random variable that takes value between 0 and 1. The value of $E(X^3)$ will be

(a) 0 (b) $\frac{1}{8}$ (c) $\frac{1}{4}$ (d) $\frac{1}{2}$

76. The equation $e^x - 1 = 0$ is required to be solved using Newton's method with an initial guess of $x_0 = -1$. Then after one step of Newton's method, the estimate x_1 of the solution will be

(a) 0.71828 (b) 0.36784 (c) 0.20587 (d) 0.0000

77. Laplace transform of $f(t) = t^2 \sin t$ is

(a) $\frac{3s^2 - 1}{(s^2 + 1)^3}$ (b) $\frac{2(3s^2 - 1)}{(s^2 + 1)^3}$ (c) $\frac{(3s^2 + 1)}{(s^2 + 1)^3}$ (d) $\frac{(3s^2 - 1)}{(s^2 + 1)^3}$

78. The residue of a complex function $x(z) = \frac{1 - 2z}{z(z-1)(z-2)}$ at its poles are

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

(c) $\frac{1}{2}$, 1 and $-\frac{3}{2}$ (d) $\frac{1}{2}, -1$ and $\frac{3}{2}$

79. The solution of the differential equation $\frac{dy}{dx} + y^2 = 0$ is

(a) $Y = \frac{1}{x + c}$ (b) $Y = \frac{-x^3}{3} + c$

(c) $Y = ce^x$ (d) unsolvable as the equation is non-linear

80. A box contains 10 screws, 3 of which are defective. Two screws are drawn at random with replacement. The probability that none of the two screws will be defective is:

(a) 100% (b) 50% (c) 49% (d) none of these

Space for rough work

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