# ISRO

## Previous Year Paper
### Refrigeration and
### Air Conditioning 2015

1. A body is resting on a plane inclined at angle of 30° to horizontal. What force would be required to slide it down, if the coefficient of friction between body and plane is 0.3?

   (a)    5 kg                          (b)    1 kg

   (c)    zero                         (d)    0.5 kg

2. Compression members tend to buckle in the direction of

   (a)    least radius of gyration      (b)    axis of load

   (c)    perpendicular to axis of load (d)    minimum cross-section

3. A fluid jet discharging from 150 mm diameter orifice has a diameter of 100 mm at its vena contracta. The coefficient of contraction is

   (a)    0.44                          (b)    1.24

   (c)    0.24                          (d)    0.64

4. The escape velocity on the surface of the earth is

   (a)    11.2 km/sec                   (b)    1 km/sec

   (c)    3.6 km/sec                    (d)    8.8 km/sec

5. The heat to be supplied to a Carnot engine operating between 800 and 400 K and producing 100 kJ of work, is

   (a)    100 kJ                        (b)    200 kJ

   (c)    300 kJ                        (d)    400 kJ

6. A piece of wood having weight of 10 kg floats in water with 60% of its volume under the liquid. Determine the specific Gravity of wood.

   (a)    0.6                           (b)    0.83

   (c)    0.4                           (d)    0.3

7. If all the dimension of a prismatic bar be increased in the ratio of k:1, then maximum stress produced in the bar due to its own weight will increase in the following ratio

(a) $1:k$

(b) $k^2:1$

(c) $k^3:1$

(d) $k:1$

8. A house requires 60M cal/hr in winter for heating. Heat pump absorbs heat from cold air outside and requires 8M cal/hr of work. The COP will be

(a) 0.75

(b) 7.5

(c) 6.5

(d) 10

9. A body moves, from rest with a constant acceleration of 5 m per sec². The distance covered in 10 sec is most nearly

(a) 200 m

(b) 300 m

(c) 250 m

(d) 500 m

10. A cold storage plant of 20 tonne of refrigerator capacity operates between 200 and 300 k. The power required to run the plant if the plant has half COP of a Carnot cycle (Tonne of refrigerator = 3.5 kW) is

(a) 50 kW

(b) 60 kW

(c) 70 kW

(d) 80 kW

11. Two cars are 10 km apart and moving in the same direction at speed of 40 km/hr. A car moving in opposite direction meets these cars at interval of 10 minutes. At what speed the other car is moving?

(a) 40 km/hr

(b) 25 km/hr

(c) 30 km/hr

(d) 20 km/hr

12.  Diagram factor is defined as the ratio of

(a)  theoretical m.e.p. and actual m.e.p.

(b)  actual m.e.p. and theoretical m.e.p.

(c)  theoretical m.e.p. and swept volume

(d)  actual m.e.p and swept volume

13.  A liquid compressed in a cylinder has a volume of 0.04 m³ at 100 kg/cm² and a volume of 0.39 m³ at 200 kg/cm². The bulk modulus of elasticity of liquid is

(a)  4000 kg/cm²                    (b)  400 kg/cm³

(c)  $40 \times 10^5$ kg/cm²            (d)  $40 \times 10^6$ kg/cm²

14.  The equation $\left\{p + \dfrac{a}{v^2}\right\}(v - b) = R$ is known as

(a)  Real gas equation

(b)  Vander Waal's equation

(c)  Maxwell's equation

(d)  Avogadro's equation

15.  Tumbling is the process of

(a)  increasing fatigue limit

(b)  imparting luster to surface

(c)  cleaning the surface of small parts

(d)  improving the creep limit

16.  In Electrolux refrigerator

(a)  ammonia is absorbed in hydrogen

(b)  ammonia is absorbed in water

(c)  ammonia evaporates in hydrogen

(d)  hydrogen evaporates in ammonia

17. According to theorem of perpendicular axes, if $I_{xx}$ and $I_{yy}$ be the M.I. of a lamina about $xx$ and $yy$ axis, then M.I. of the lamina about axis $zz$, which is perpendicular to $xx$ and $yy$, equal to

   (a)   $I_{xx} \times I_{yy}$               (b)   $I_{xx} + I_{yy}$

   (c)   $\dfrac{I_{xx}}{I_{yy}}$                (d)   $\dfrac{I_{yy}}{I_{xx}}$

18. A perfect gas at 27°C is heated at constant pressure till its volume is double. The final temperature is

   (a)   54°C                (b)   654°C

   (c)   108°C               (d)   327°C

19. The value of acceleration due to gravity at moon is $g/6$, where $g$ is the value of acceleration due to gravity at earth. The value of frequency of oscillation of simple pendulum on moon as compared to earth will be

   (a)   $1/\sqrt{6}$ times           (b)   6 times

   (c)   1/6 times             (d)   $\sqrt{6}$ times

20. Maximum shear stress in a Mohr's circle is

   (a)   less than the radius of Mohr's circle

   (b)   greater than radius of Mohr's circle

   (c)   equal to radius of Mohr's circle

   (d)   none of the above

21. Froude number is the ratio of inertial force to

   (a)   elasticity                (b)   surface tension

   (c)   gravitational force        (d)   viscosity

22. Proof resilience per unit volume of a material is known as

    (a)   modulus of resilience       (b)   resilience

    (c)   proof resilience            (d)   toughness

23. Cooling range in cooling tower is the

    (a)   difference in temperature of hot water entering and cold water leaving

    (b)   amount of heat removed by the cooling tower in kcal/hr

    (c)   difference in temperature of the cold water and atmospheric temperature

    (d)   difference in temperature of the cold water leaving the cooling tower and the wet bulb temperature of surrounding air

24. The vapour compression refrigerator employs the following cycle

    (a)   Carnot             (b)   Reversed Carnot

    (c)   Rankine            (d)   Reversed Rankine

25. A certain high tensile strength steel has a modulus of elasticity of $2 \times 10^6$ kg/cm$^2$ and a yield point stress of 6,000 kg/cm$^2$. Find the minimum limiting value of the slenderness ratio for which Euler's equation is valid

    (a)   99             (b)   80

    (c)   57             (d)   75

26. The ratio of central deflection due to a central load in the case of a beam freely supported at both ends to the beam fixed at both ends will be

    (a)   1/2            (b)   4

    (c)   1/4            (d)   2

27. A framed structure is perfect if it contains members equal to

(a) $n - 1$

(b) $2n - 3$

(c) $2n - 1$

(d) $n - 2$

where $n$ = number of joints in a frame.

28. Prandtl number is expressed by

(a) $\dfrac{\text{Inside diameter of tube}}{\text{equivalent thickness of film}}$

(b) $\dfrac{\text{specfic heat} \times \text{viscosity}}{\text{thermal conductivity}}$

(c) $\dfrac{\text{thermal conductivity}}{\text{equivalent thickness of film}}$

(d) $\dfrac{\text{molecular diffusivity of momentum}}{\text{thermal diffusivity}}$

29. Coining is the operation of

(a) cold forging

(b) hot forging

(c) cold extrusion

(d) piercing

30. Moment of inertia of a square of side $d$ about the diagonal is

(a) $d^4/18$

(b) $d^4/24$

(c) $d^4/12$

(d) $d^4/8$

31. If the velocity of projection is $u$ m/sec and the angle of projection is $\alpha°$, the maximum height of the projectile on a horizontal plane is

(a) $\dfrac{u^2 \sin^2 \alpha}{2g}$

(b) $\dfrac{u^2 \cos^2 \alpha}{2g}$

(c) $\dfrac{u^2 \tan^2 \alpha}{2g}$

(d) $\dfrac{u^2 \sin^2 \alpha}{g}$

32. If air is heated without changing its moisture content, the dew point will

   (a) increase                     (b) remain same

   (c) decrease                     (d) unpredictable

33. In a tensile testing experiment on a specimen of 1 cm² area, the maximum load observed was 5 tonnes and neck area 0.25 cm². The ultimate tensile strength of specimen is

   (a) 2.5 tonnes/cm²               (b) 10 tonnes/cm²

   (c) 5 tonnes/cm²                 (d) 20 tonnes/cm²

34. For a given material assume, Young's modulus $E = 300$ GN/m² and modulus of rigidity $G = 150$ GN/m². Its bulk modulus $K$ will be

   (a) 120 GN/m²                    (b) 100 GN/m²

   (c) 200 GN/m²                    (d) 250 GN/m²

35. A steel wire hangs vertically under its own weight. If its density is 10000 kg/m³ and allowable stress is 3000 kg/cm² then how much length it can sustain.

   (a) 2500 m                       (b) 1250 m

   (c) 3000 m                       (d) 5000 m

36. Laser is produced by

   (a) graphite                     (b) ruby

   (c) diamond                      (d) emerald

37. M.I. of a triangular section of base $a$ and height $h$ about an axis passing through its c.g. and parallel to base is

   (a) $\dfrac{ah^3}{8}$            (b) $\dfrac{ah^3}{12}$

   (c) $\dfrac{ah^3}{24}$           (d) $\dfrac{ah^3}{36}$

38. To convert volumetric analysis to gravimetric analysis, the relative volume of each constituent of the flue gases is

    (a) multiplied by its molecular weight

    (b) divided by its molecular weight

    (c) multiplied by its density

    (d) multiplied by its specific weight

39. Film coefficient is defined as

    (a) $\dfrac{\text{Inside diameter of tube}}{\text{equivalent thickness of film}}$

    (b) $\dfrac{\text{specfic heat} \times \text{viscosity}}{\text{thermal conductivity}}$

    (c) $\dfrac{\text{thermal conductivity}}{\text{equivalent thickness of film}}$

    (d) $\dfrac{\text{molecular diffusivity or momentum}}{\text{thermal diffusivity}}$

40. The longitudinal stress induced in a thin walled cylindrical vessel is

    (a) $\dfrac{pD}{2t}$

    (b) $\dfrac{pD}{t}$

    (c) $\dfrac{pD}{4t}$

    (d) $\dfrac{pD}{3t}$

41. Electron beam machining process is suitable for the following type of material

    (a) low melting point and high thermal conductivity

    (b) low melting and low thermal conductivity

    (c) high melting point and low thermal conductivity

    (d) high melting point and high thermal conductivity

42. The length of a second's pendulum is

    (a)  99.0 cms                  (b)  100 cm

    (c)  101 cm                    (d)  99.4 cm

43. The period of oscillation of a simple pendulum depends on

    (a)  mass of bob              (b)  its effective length

    (c)  radium of bob            (d)  density of bob

44. A spherical vessel with an inside diameter of 2 m is made of material having an allowable stress in tension of 500 kg/cm². The thickness of a shell to withstand a pressure of 50 kg/cm² should be

    (a)  5 cm                     (b)  2.5 cm

    (c)  10 cm                    (d)  1.25 cm

45. For best hydraulic rectangular cross-section of an open channel, its depth should be equal to

    (a)  width/2                  (b)  2 width

    (c)  width                    (d)  √width

46. Compare the strengths of solid and hollow shafts both having outside diameter D and hollow shaft having inside diameter of D/2 in torsion. The ratio of strength of solid to hollow shafts in torsion will be

    (a)  0.5                      (b)  15/16

    (c)  0.75                     (d)  0.25

47. Following gases are used in Tungsten inert gas welding

    (a) Hydrogen and Oxygen

    (b) Argon and Helium

    (c) Argon and Neon

    (d) Helium and Neon

48. A heat engine is supplied heat at the rate of 30,000 J/s and gives an output of 9 kW. The thermal efficiency of engine will be

    (a) 40%

    (b) 33%

    (c) 30%

    (d) 50%

49. If a body is transmitting torque $T$ kgm at angular speed of $\theta$ radians/sec, then h.p. transmitted will be

    (a) $T\theta/75$

    (b) $T/\theta$

    (c) $T\theta/50$

    (d) $T\theta$

50. The critical radius of insulation for a spherical shell is

    (a) $\dfrac{\text{thermal conductivity of insulating material}}{\text{heat transfer coefficient at outer surface}}$

    (b) inverse of (a)

    (c) $\dfrac{2 \times \text{thermal conductivity of insulating material}}{\text{heat transfer coefficient at outer surface}}$

    (d) inverse of (c)

51. When a body slides down a surface inclined $\theta$ to horizontal, the acceleration ($f$) of the body is given by

    (a) $f = g$

    (b) $f = g\cos\theta$

    (c) $f = g\tan\theta$

    (d) $f = g\sin\theta$

52. If $\sigma_1$ and $\sigma_2$ be the major and minor tensile stresses, then maximum value of tangential stress is equal to

    (a)    $\sigma_2$                                (b)    $\sigma_1 - \sigma_2$

    (c)    $\sigma_1 + \sigma_2$                          (d)    $\dfrac{\sigma_1 - \sigma_2}{2}$

53. The pressure in the air space above an oil (sp. Gravity 0.7) surface in a tank is 0.1 kg/cm². The pressure at 5 m below the oil surface will be

    (a)    5 meters of water column

    (b)    4 meters of water column

    (c)    3.5 meters of water column

    (d)    4.5 meters of water column

54. Thermal welding is a form of

    (a)    resistance welding

    (b)    gas welding

    (c)    fusion welding

    (d)    forge welding

55. The ratio of heat flow $Q_1/Q_2$ from two walls of same thickness having their thermal conductivities as $K_1 = 2K_2$ will be

    (a)    1                                    (b)    0.5

    (c)    0.25                              (d)    2

56. A Carnot engine has an efficiency of 0.5. The COP of refrigerant working with the same temperature limit is

   (a)  0.5                              (b)  1

   (c)  2                                (d)  1.25

57. Slack represent the difference between the

   (a)  latest allowable time and normal expected time

   (b)  latest allowable time and earliest expected time

   (c)  proposed allowable time and earliest expected time

   (d)  normal allowable time and latest expected time

58. A refrigerator operates on a reverse Carnot cycle between 900 and 300 k. If heat at the rate of 3 kJ/s is extracted from the low temperature space, then the power required to drive the refrigerator

   (a)  3 kW                             (b)  6 kW

   (c)  9 kW                             (d)  4 kW

59. If $V$ is the mean velocity of flow, then according to Darcy-Weisbach equation for pipe flow energy loss over a length of pipeline is proportional to

   (a)  $V$                              (b)  $1/V$

   (c)  $1/V^2$                          (d)  $V^2$

60. 40% of incident radiant energy on the surface of a thermally transparent body is reflected back. If the transmissivitiy of the body be 0.15, then the emissivity of surface is

   (a)  0.40                             (b)  0.55

   (c)  0.45                             (d)  0.75

61. Study showed the percentage of occurrence of an activity as 50%. The number of observations for 95% confidence level and an accuracy of ± 2% is

    (a)   1500

    (b)   2000

    (c)   2500

    (d)   3000

62. 1 m³ of air at a pressure of 10 kg/cm² is allowed to expand freely to a volume of 10 m³. The work done will be

    (a)   +ve

    (b)   –ve

    (c)   zero

    (d)   $10^5$ kg m

63. Suppose that a particle moves on a coordinate line so that its velocity at time $t$ is $v(t) = t^2 - 2t$ m/s. The displacement of the particle during time interval $0 \leq t \leq 3$ is

    (a)   4 m

    (b)   0 m

    (c)   8/3 m

    (d)   3/8 m

64. Approach of cooling tower means

    (a)   difference in temperature of hot water entering the cold water leaving

    (b)   difference in temperature of the cold water and atmospheric temperature

    (c)   difference in temperature of the cold water leaving the cooling tower and the wet bulb temperature of surrounding air

    (d)   amount of heat thrown away by the cooling tower in kcal/hr

65. Which of the following is not the intensive property?

   (a)   pressure

   (b)   heat

   (c)   density

   (d)   temperature

66. A carnot cycle consists of

   (a)   two constant pressure and two adiabatic processes

   (b)   two isothermal and two adiabatic processes

   (c)   two constant volume and two adiabatic processes

   (d)   one constant pressure, one constant volume and two adiabatic processes

67. Two loads $P$ act at right angles to one another at the free end of a cantilever beam having square cross-section $d \times d$ and length $l$ on the vertical and horizontal faces. Maximum bending stress in the beam will be equal to

   (a)   $6\,Pl/d^3$           (b)   $24\,Pl/d^3$

   (c)   $12\,Pl/d^3$          (d)   $18\,Pl/d^3$

68. The head loss due to sudden expansion assuming incompressible flow is expressed by

   (a)   $\dfrac{V_1^2 - V_2^3}{2}$         (b)   $\dfrac{V_2^2 - V_1^3}{2}$

   (c)   $\dfrac{(V_1 - V_2)^2}{g}$        (d)   $\dfrac{(V_1 - V_2)^2}{2g}$

69. PERT has the following time estimate

    (a) one time estimate

    (b) two time estimate

    (c) three time estimate

    (d) four time estimate

70. Two plane slabs of equal areas and conductivities in the ratio 1 : 2 are held together and temperature in between surface ends are $t_1$ and $t_2$. If junction temperature in between two surfaces is desired to be $\dfrac{t_1 + t_2}{2}$, then their thicknesses should be in the ratio of

    (a) 2 : 1

    (b) 1 : 2

    (c) 1 : 1

    (d) 3 : 1

71. 300 kJ/s of heat is supplied at constant temperature of 500 k to a heat engine. The heat rejection takes place at 300 K. The following results are obtained (a) 210 kJ (b) 180 kJ (c) 150 kJ. Identify whether result is a reversible cycle, irreversible cycle or impossible cycle respectively

    (a) reversible/irreversible/impossible respectively

    (b) irreversible/ reversible/ impossible respectively

    (c) irreversible/impossible/reversible respectively.

    (d) none of the above

72. If cube root of unity are 1, $w$, $w^2$ then the roots of equation $(x-1)^3 + 8 = 0$ are

    (a) $-1, -1 + 2w, -1 - 2w^2$

    (b) $-1, -1, -1$

    (c) $-1, 1 - 2w, 1 - 2w^2$

    (d) $-1, -1 + 2w, 1 + 2w^2$

73.  If $1$, $w$, $w^2$ are cube roots of unity then the value of

$$\Delta = \begin{vmatrix} 1 & w & w^{2n} \\ w^n & w^{2n} & 1 \\ w^{2n} & 1 & w^n \end{vmatrix} \text{ is}$$

(a)  1

(b)  0

(c)  $w$

(d)  $w^2$

74.  Three houses are available in a locality. Three persons apply for the houses. Each applies for one house without consulting others. The probability that all the three apply for the same house is

(a)  2/9

(b)  1/9

(c)  8/9

(d)  7/9

75.  The rank of the matrix

$$A = \begin{bmatrix} -2 & 4 & 2 \\ 3 & -4 & -1 \\ 4 & -3 & 1 \end{bmatrix} \text{ is}$$

(a)  0

(b)  1

(c)  2

(d)  3

76.  If $3e^x \tan y\, dx + (1 - e^x)\sec^2 y\, dy = 0$, then $y$ is

(a)  $\tan y = c(1 + e^x)^3$

(b)  $y = c(1 - e^x)^3$

(c)  $\log y = c(1 + e^x)^3$

(d)  $\tan y = c(1 - e^x)^3$

77. Which of the following represents a wave equation?

    (a)    $\nabla^2 V = 0$

    (b)    $\partial^2 V / \partial t^2 = c^2 \nabla^2 V$

    (c)    $\partial V / \partial t = k \nabla^2 V$

    (d)    none of the above

78. $1 + x^2/2! + x^4/4! + x^6/6! +$ —————— stands for.

    (a)    $\sinh x$

    (b)    $\cosh x$

    (c)    $\cos x$

    (d)    $\sin x$

79. $\int \sec x \, dx$ is

    (a)    $\log(\sec x + \tan x) + c$

    (b)    $\tan x + c$

    (c)    $\sec x + \tan x + c$

    (d)    $\sec x \tan x + c$

80. Inverse Laplace transform of $S/S^2 + a^2$ is

    (a)    $\cos at$

    (b)    $\sin at$

    (c)    $\cosh at$

    (d)    $\sinh at$