MECHANICAL ENGINEERING

PAPER–I

1. For a fluid having Prandtl number equal to unity, how are the hydrodynamic boundary layer thickness δ, and the thermal boundary layer thickness δ_t related ?
   a. $\delta = \delta_t$
   b. $\delta > \delta_t$
   c. $\delta < \delta_t$
   d. $\delta_t = \delta^{1/3}$

2. If, in a pump, the discharge is halved, then, assuming that the speed remains unchanged, what would be the ratio of the heads H_1/H_2?
   a. $\sqrt{1/3}$
   b. $\sqrt{2/3}$
   c. $\sqrt[3]{0.25}$
   d. $\sqrt[3]{05}$

3. For calculation of heat transfer by natural convection from a horizontal cylinder, what is the characteristic length in Grashof number?
   a. Diameter of the cylinder
   b. Length of the cylinder
   c. Circumference of the base of the cylinder
   d. Half the circumference of the base of the cylinder

4. Which one of the following non-dimensional numbers is used for transition from laminar to turbulent flow in free convection?
   a. Reynolds number
   b. Grashof number
   c. Peclet number
   d. Rayleigh number

5. For steady, uniform flow through pipes with constant heat flux supplied to the wall, which is the value of Nusselt number?
   a. 48/11
   b. 11/48
   c. 24/11
   d. 11/24

6. Match List - I with List - II and select the correct answer using the code given below the lists

   List - I (Non-dimensional Number)
   A. Grashof number
   B. Stanton number
   C. Sherwood number
   D. Fourier number

   List-II (Application)
   1. Mass transfer
   2. Unsteady state heat conduction
   3. Free convection
   4. Forced convection

   Codes;

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

7. Usually fins are provided to increase the rate of heat transfer. But fins also act as insulation. Which one of the following non-dimensional numbers decides this factor?
   a. Eckert number
   b. Biot number
   c. Fourier number
   d. Peclet number

8. What is the expression for the thermal conduction resistance to heat transfer through a hollow sphere of inner radius r_1 and outer radius r_2, and thermal conductivity k?
   a. $\dfrac{(r_2 - r_1) r_1 r_2}{4\pi k}$

b. $\frac{4\pi k\left(r_2 - r_1\right)}{r_1 r_2}$

c. $\frac{r_2 - r_1}{4\pi k\, r_1 r_2}$

d. None of these

9. A composite wall having three layers of thickness 0.3 m, 0.2 m and 0.1 m and of thermal conductivities 0.6, 0.4 and 0.1 W/ mK, respectively, is having surface area 1 m^2. If the inner and outer temperatures of the composite wall are 1840 K and 340 K, respectively, what is the rate of heat transfer?

a. 150 W

b. 1500 W

c. 75 W

d. 750 W

10. For conduction through a spherical wall with constant thermal conductivity and with inner side temperature greater than outer wall temperature, (one dimensional heat transfer), what is the type of temperature distribution?

a. Linear

b. Parabolic

c. Hyperbolic

d. None of the above

11. A wall of thickness 0.6 m has width has a normal area 1.5 m^2 and is made up of material of thermal conductivity 0.4 W/mK. The temperatures on the two sides are 8000 C and 1000 C. What is the thermal resistance of the wall?

a. 1 W/K

b. 1.8 W/K

c. 1 K/W

d. 1.8 K/W

12. Match List - I with List - II and select the correct answer using the code given below the lists':

List-I

A. Heat Exchangers

B. Turbulent flow

C. Free convection

D. Radiation heat transfer

List-II

1. View factor
2. Effectiveness
3. Nusselt number
4. Eddy diffusivity

Codes;

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

13. Throttle governing, in steam turbines

a. Leads to significant pressure loss

b. Increases the efficiency

c. Increases heat losses

d. Decreases steam temperature

14. An open cycle constant pressure gas turbine uses a fuel of calorific value 40,000 kJ/kg, with air fuel ratio of 80 : 1 and develops a net output of 80 kJ/kg of air. What is the thermal efficiency of the cycle?

a. 61%

b. 16%

c. 18%

d. None of the above

15. Consider the following statements in respect of gas turbines:

A gas turbine plant with reheater leads to a

1. Considerable improvement in the work output.
2. Considerable improvement in the thermal efficiency.

Which of the statements given above is/are correct?

a. 1 only

b. 2 only

c. Both 1 and 2

d. Neither 1 nor 2

16. Consider the following statements:

Diesel knock can be reduced by

1. Increasing the compression ratio.
2. Increasing the engine speed.
3. Increasing the injection retard.
4. Decreasing the inlet air temperature.

Which of the statements given above are correct?

a. 2 and 4 only
b. 1, 2 and, only
c. 1 and 3 only
d. 1, 2, 3 and 4

17. Which one of the following is correct?
When a real gas undergoes Joule - Thomson expansion, the temperature
a. may remain constant.
b. always increases.
c. may increase or decrease.
d. always decreases.

18. Which one of the following is correct? For the same net power output
a. the turbine used in gas turbine power plants is larger than that used in steam power plants
b. the turbine used in gas turbine power plants is smaller than that used in steam power plants
c. the same turbine can be used for both plants
d. None of the above

19. Match List - I with List -II and select the correct answer using the code given below the lists
List - I (Prime Mover)
A. High speed diesel engine
B. IC engine having expansion ratio greater than compression ratio
C. Pulse jet engine
D. Gas turbine with multistage compression and multistage expansion
List -II (Air Standard Cycles)
1. Atkinson cycle
2. Dual combustion (limited pressure) cycle
3. Ericsson cycle
4. Lenoir cycle
Codes;

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

20. Which one of the following statements is correct?
a. Efficiency of the Carnot cycle for thermal power plant is high and work ratio is also high in comparison to the Rankine cycle
b. Efficiency of the Carnot cycle is high and work ratio is low in comparison to the Rankine cycle
c. Efficiency of the Carnot cycle is low and work ratio is also low in comparison to the Rankine cycle
d. Both the cycles have same efficiencies and work ratio

21. Which property of mercury is the main reason for its use in barometers?
a. High density
b. Negligible capillarity effect
c. Very low vapour pressure
d. Low compressibility

22. If the relationship between the shear stress τ and the rate of shear strain (du/dy) is expressed as $\tau = \mu (du/dy)^n$, then the fluid with exponent n > 1 is known as which one of the following?
a. Bingham plastic
b. Dilatant fluid
c. Newtonian fluid
d. Pseudo plastic fluid

23. What are the dimensions of kinematic viscosity of a fluid?
a. $L\ T^{-2}$
b. $L^2\ T^{-1}$
c. $M\ L^{-1}\ T^{-1}$
d. $M\ L^{-2}\ T^{-2}$

24. The pressure difference of two very light gases in two rigid vessels is being measured by a vertical U-tube water filled manometer. The reading is found to be 10 cm. What is the

25. A circular plate 15 m diameter is submerged in water with its greatest and least depths below the surface being 2 m and 075 m respectively. What is the total pressure (approximately) on one face of the plate?
a. 12 kN
b. l6 kN
c. 24 kN
d. None of the above

26. Whenever a plate is submerged at an angle with the direction of flow of liquid, it is subjected to some pressure. What is the component of this pressure in the direction of flow of liquid, known as?
    a. Stagnation pressure
    b. Lift
    c. Drag
    d. Bulk modulus

27. Which one of the following is the correct statement? Performance of mechanical draft cooling tower is superior to natural draft with
    a. increase in air wet bulb temperature
    b. decrease in air wet bulb temperature
    c. increase in dry bulb temperature
    d. increase in recirculation of air

28. Resultant pressure of the liquid in case of an immersed body acts through which one of the following?
    a. Centre of gravity'
    b. Centre of pressure
    c. Metacentre
    d. Centre of buoyancy

29. A hydrometer weighs 003 N and has a stem at the upper end which is cylindrical and 3 mm in diameter. It will float deeper in oil of specific gravity O75, than in alcohol of specific gravity 08 by how much amount?
    a. 10.7 mm
    b. 43.3
    c. 33 mm
    d. 36 mm

30. Which one of the following pumps is not a positive displacement pump?
    a. Reciprocating pump
    b. Centrifugal pump
    c. Vane pump
    d. Lobe pump

31. The overall efficiency of a pelton turbine is 70%. If the mechanical efficiency is 85 %, what is its hydraulic efficiency?
    a. 82.4%
    b. 59.5%
    c. 72.3%
    d. 81.5%

32. For maximum blade efficiency (utilization factor), what is the work (J/kg) done in a single stage 50% reaction turbine?

    (where u = mean peripheral speed of the rotor in m/s)
    a. $2\ u^2$
    b. $11u^2$
    c. u^3
    d. u^2

33. Which one of the following is the correct statement?

    Specific speed of a fluid machine
    a. refers to the speed of a machine of unit dimensions
    b. is a type-number representative of its performance
    c. is specific to the particular machine
    d. depends only upon the head under which the machine operates

34. Which one of the following accessories is connected to the steam supply pipe line to maintain constant pressure?
    a. Pressure reducing valve
    b. Steam separator
    c. Steam trap
    d. Injector

35. Which one of the following fittings is mounted on the boiler to put off the fire in the furnace, when water level falls to an unsafe limit?
    a. Feed check valve
    b. Safety valve
    c. Fusible plug
    d. Blow off cock

36. The combustion analysis carried out by the Orsat Apparatus renders which one of the following?
    a. The percentage composition by weight on the dry basis
    b. The percentage. composition by volume on the dry basis
    c. The percentage composition by weight on the wet basis
    d. The percentage composition by volume on the wet basis

37. Which one of the following boiler accessories does not need 'flue-gas' for its operation?
    a. Economizer
    b. Preheater
    c. Injector
    d. Super heater

38. Consider the following statements in respect of axial flow air compressors:
    1. An axial flow air compressor is often described as a reversed reaction turbine.
    2. With 50% degree of reaction, the velocity diagrams are symmetrical

    Which of the statements given above is/are correct?
    a. 1 only
    b. 2 only
    c. Both 1 and 2
    d. Neither 1 nor 2

39. In a subsonic diffuser
    a. Static pressure increases with Mach number
    b. Mach number decreases with increasing area ratio
    c. Static pressure decreases with Mach number
    d. Area ratio decreases in the flow direction

40. Which one of the following statements is correct when saturation pressure of water vapour increases?
    a. Saturation temperature decreases
    b. Enthalpy of evaporation decreases
    c. Enthalpy of evaporation increases
    d. Specific volume change of phase increases

41. Blade erosion in steam turbines takes place
    a. Due to high temperature steam
    b. Due to droplets in steam
    c. Due to high rotational speed
    d. Due to high flow rate

42. Use of maximum pressure ratio, corresponding to maximum to minimum cycle temperature ratio in case of Joule cycle gives which one of the following?
    a. Maximum efficiency but very less specific work output
    b. Maximum efficiency and very high specific work output
    c. Minimum efficiency and very less specific work output
    d. Minimum efficiency but very high specific work output

43. Which of the following techniques are employed for control of reciprocating compressors?
    1. Throttle control
    2. Clearance control
    3. Blowing air to waste

    Select the correct answer using the code given below
    a. 1, 2 and 3
    b. 1 and 2 only
    c. 2 and 3 only
    d. 1 and 3 only

44. Match List - I with List - II and select the correct answer using the code given below the lists

    List - I (Name of Equipment)
    A. Fan
    B. Blower
    C. Centrifugal air compressor
    D. Axial flow air compressor

    List - II (Pressure Ratio)
    1. 1.1
    2. 2.5
    3. 4
    4. 10

    Codes;

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

45. Stalling phenomena in an axial flow compressor stage is caused due to which one of the following?
    a. Higher mass flow rate than the designed value
    b. Lower mass flow rate than the designed value

c. Higher mass flow rate or non-uniformity in the blade profile

d. Lower mass flow rate or non-uniformity in the blade profile

46. In a multi-stage axial flow compressor with equal temperature rise in all stages, the pressure ratio in the subsequent stages

a. Remains constant

b. Increases gradually

c. Decreases

d. Increases rapidly

47. Consider the following statements in respect of gas turbines:

1. Supersonic flow leads to decrease in efficiency.
2. Supersonic flow leads to decrease in flow rate.

Which of the statements given above is/are correct?

a. 1 only

b. 2 only

c. Both 1 and 2

d. Neither 1 nor 2

48. The concentration of pressure pulses created by an object moving at Mach number of 0.5 is

a. Larger ahead of the object

b. Larger behind the object

c. Uniform within Mach cone

d. Uniform outside Mach cone

49. In a hydraulic coupling, what is the ratio of speed of the turbine runner to that of the pump impeller to maintain circulatory motion of oil?

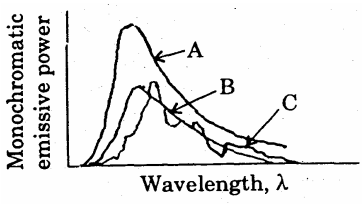
a. < 1

b. = 1

c. > 1

d. Can be any value

50.



Consider the diagram given above. Which one of the following is correct?

a. Curve A is for gray body, Curve B is for black body, and Curve C is for selective emitter

b. Curve A is for selective emitter, Curve B is for black body, and Curve C is for gray body

c. Curve A is for selective emitter, Curve B is for gray body, and Curve C is for black body

d. Curve A is for black body, Curve B is for gray body, and Curve C is for selective emitter

51. What is the basic equation of thermal radiation from which all other equations of radiation can be derived?

a. Stefan - Boltzmann equation

b. Planck's equation

c. Wien's equation

d. Rayleigh — Jeans formula

52. Which one of the following statements is correct?

For a hemisphere, the solid angle is measured

a. in radian and its maximum value is π.

b. in degree and its maximum value is 180°.

c. in steradian and its maximum value is 2π.

d. in steradian and its maximum value is π.

53. For the radiation between two infinite parallel planes of emissivity $\varepsilon 1$ and ε_2 respectively, which one of the following is the expression for emissivity factor?

a. $\varepsilon_1 \varepsilon_2$

b. $\frac{1}{\varepsilon_1}+\frac{1}{\varepsilon_2}$

c. $\frac{1}{\frac{1}{\varepsilon_1}+\frac{1}{\varepsilon_2}}$

d. $\frac{1}{\frac{1}{\varepsilon_1}+\frac{1}{\varepsilon_2}-1}$

54. What is the radiation intensity in a particular direction?

a. Radiant energy per unit time per unit area of the radiating surface

b. Radiant energy per unit time per unit solid angle per unit area of the radiating surface

c. Radiant energy per unit time per unit solid angle per unit projected area of the radiating surface in the given direction

d. Radiant energy per unit time per unit projected area of the radiating surface in the given direction

55. A refrigerating machine having coefficient of performance equal to 2 is used to remove heat at the rate of 1200 kJ/min. What is the power required for this machine?

a. 80kW

b. 60kW

c. 20 kW

d. 10 kW

56. When the Brayton cycle working in the pressure limits of P_1 and P_2 is reversed and operated as a refrigerator, what is the ideal value of COP for such a cycle?

a. $\left(p_2 / p_1\right)^{\gamma-1} - 1$

b. $\dfrac{1}{\left(p_2 / p_1\right)^{\gamma-1} - 1}$

c. $\dfrac{1}{\left(p_2 / p_1\right)^{((\gamma-1)/\gamma)} - 1}$

d. None of the above

57. The throttling of certain gases may be used for getting the refrigeration effect. What is the value of Joule-Thomson coefficient (μ) for such a throttling process?

a. $\mu = 0$

b. $\mu = 1$

c. $\mu < 1$

d. $\mu > 1$

58. A heat pump works on a reversed Carnot cycle. The temperature in the condenser coils is 27° C and that in the evaporator coils is - 23° C. For a work input of 1 kW, how much is the heat pumped?

a. 1 kW

b. 5 kW

c. 6 kW

d. None of the above

59. Assertion (A): The power transmitted through a pipe is maximum when the loss of head due to friction is equal to one-third of total head at the inlet.

Reason (R): Velocity is maximum when the friction loss is one-third of the total head at the inlet.

a. Both A and R are individually true and R is the correct explanation of A.

b. Both A and R are individually true but R is not the correct explanation of A.

c. A is true but R is false

d. A is false but R is true

60. Assertion (A): Blood is a Newtonian fluid.

Reason (R): The rate of strain varies non-linearly with shear stress for blood.

a. Both A and R are individually true and R is the correct explanation of A.

b. Both A and R are individually true but R is not the correct explanation of A.

c. A is true but R is false

d. A is false but R is true

61. Assertion (A): Runaway speed of a turbine is the speed under maximum head at full gate opening when the load is disconnected suddenly.

Reason (R): The various rotating components of the turbine are designed to remain safe at the runaway speed.

a. Both A and R are individually true and R is the correct explanation of A.

b. Both A and R are individually true but R is not the correct explanation of A.

c. A is true but R is false

d. A is false but R is true

62. Assertion (A): Though head is added during a polytrophic expansion process for which $\gamma > n > 1$, the temperature of the gas decreases during the process.

Reason (R): The work done by the system exceeds the heat added to the system.

a. Both A and R are individually true and R is the correct explanation of A.

b. Both A and R are individually true but R is not the correct explanation of A.

c. A is true but R is false

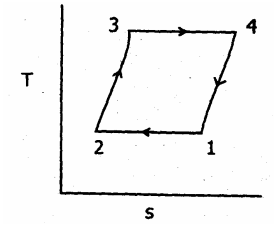
d. A is false but R is true

63. A Carnot engine uses nitrogen as the working fluid (γ = 14). The heat supplied is 52 kJ and adiabatic expansion ratio 32

1. The receiver temperature is 295 K. What is the amount of heat rejected?

a. 11kJ
b. 13 kJ
c. 26 kJ
d. 28 kJ

64.



Thermodynamic cycle shown above on the temperature entropy diagram pertains to which one of the following?

a. Stirling cycle
b. Ericsson cycle
c. Vapour compression cycle
d. Brayton cycle

65. Selection of .a refrigerant for a vapour-compression system depends on which among the following?

a. Toxicity
b. Environmental effect
c. Saturation pressure — temperature relationship
d. All of the above

66. Which of the following are intensive properties?

1. Kinetic energy
2. Thermal conductivity
3. Pressure
4. Entropy

Select the correct answer using the code given below

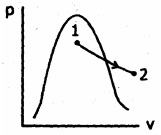
a. 1 and 2
b. 2 and 3 only
c. 2, 3 and 4
d. 1, 3 and 4

67. Which one of the following is the fluid whose properties in all its three phases are made use of in thermodynamics?

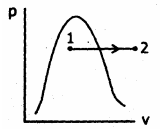
a. Ammonia
b. Freon 12
c. Helium
d. Water

68. Which p — v diagram for steam illustrates correctly the isothermal process undergone by wet steam till it becomes superheated?

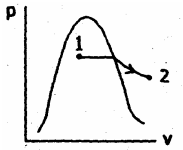
a.



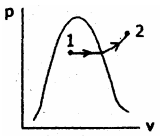
b.



c.



d.



69. Consider the following statements

1. A gas with a compressibility factor more than 1 is more compressible than a perfect gas.
2. The x and y axes of the compressibility chart are compressibility factor on y-axis and reduced pressure on x-axis.
3. The first and second derivatives of the pressure with respect to volume at critical points are zero.

Which of the statements given above is/are correct?

a. 2 and 3 only
b. 1 and 3 only
c. 1 and 2 only
d. 1, 2 and 3

70. Which one of the following relationships defines the Helmholtz function F?

a. FH + TS
b. F = H - TS
c. F = U - TS

d. $F = U + TV$

71. Consider the following statements in respect of the Clausius-Clapeyron equation:

1. It points to one possible way of measuring thermodynamic temperature.
2. It permits latent heat of vaporization to be estimated from measurements of specific volumes of saturated liquid, saturated vapour and the saturation temperatures at two nearby pressures.
3. It does not apply to changes from solid to the liquid phase and from solid to the vapour phase.

Which of the statements given above are correct?

a. 1, 2 and 3
b. 1 and 2 only
c. 2 and 3 only
d. 1 and 3 only

72. Assigning the basic dimensions to mass, length, time and temperature respectively as M, L, T and θ (Temperature), what are the dimensions of entropy?

a. $M L T^{-2} \theta$
b. $M L^2 T^{-1} \theta^{-1}$
c. $M L^2 T^{-2} \theta^{-1}$
d. $M L^3 T^2 \theta^{-1}$

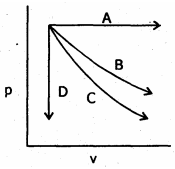
73. Which thermodynamic property is evaluated with the help of Maxwell equations from the data of other measurable properties of a system?

a. Enthalpy
b. Entropy
c. Latent heat
d. Specific heat

74. A fluid flowing along a pipe line undergoes a throttling process from 10 bar to 1 bar in passing through a partially open valve. Before throttling, the specific volume of the fluid is 0.5 m^3/kg and after throttling is 2.0 m^3/kg. What is the change in specific internal energy during the throttling process?

a. Zero
b. 100 kJ/kg
c. 200 kJ/kg
d. 300 kJ/kg

75.



Consider the four processes A, B, C and D shown in the graph given above:

Match List - I with List - II and select the correct answer using the code given below the lists:

List - I (Processes shown in the graph)

A. A
B. B
C. C
D. D

List - II (Index 'n' in the equation pv^n = Const)

1. 0
2. 1
3. 1.4
4. ∞

Codes;

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

76. Which one of the following is correct?

The cyclic integral of (δQ - δW) for a process is

a. positive
b. negative
c. zero
d. unpredictable

77. Which one of the following is correct on the basis of the second law of thermodynamics?

a. For any spontaneous process, the entropy of the universe increases
b. $\Delta S = q_{rev} / T$ at constant temperature
c. Efficiency of the Stirling cycle is more than that of a Carnot cycle
d. $\Delta E = q + w$

(the symbols have their usual meaning)

78. An insulated tank initially contains 0.25 kg of a gas with an internal energy of 200 kJ/kg. Additional gas with an internal energy of 300 d/kg and an enthalpy of 400 Id/kg enters the tank until the total mass of gas contained is 1 kg. What is the final internal energy (in Id/kg) of the gas in the tank?

a. 250
b. 275
c. 350
d. None of the above

79. Match List - I with List - II and select the correct answer using the code given below the lists

List - I (Type of Thermometer)

A. Mercury-in-glass
B. Thermocouple
C. Thermistor
D. Constant volume gas

List - II (Thermometric Property)

1. Pressure
2. Electrical resistance
3. Volume
4. Induced electric voltage

Codes;

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

80. Which one of the following statements is correct?

a. Compressibility factor is unity for ideal gases
b. Compressibility factor is zero for ideal gases
c. Compressibility factor is lesser than unity for ideal gases
d. Compressibility factor is more than unity for ideal gases

81. A wooden rectangular block of length *l* is made to float in water with its axis vertical. The centre of gravity of the floating body is 0.15 *l* above the centre of buoyancy. What is the specific gravity of the wooden block?

a. 0.6
b. 0.65
c. 0.7
d. 0.75

82. If B is the centre of buoyancy, G is the centre of gravity and M is the metacentre of a floating body, the body will be in stable equilibrium if

a. MG = 0
b. M is below G
c. BG = 0
d. M is above G

83. The metacentric height of a passenger ship is kept lower than that of a naval or a cargo ship because

a. Apparent weight will increase
b. Otherwise it will be neutral equilibrium
c. It will decrease the frequency of rolling
d. Otherwise it will sink and be totally immersed

84. An open circular cylinder 12 m high is filled with a liquid to its top. The liquid is given a rigid body rotation about the axis of the cylinder and the pressure at the centre line at the bottom surface is found to be 0.6 m of liquid. What is the ratio of volume of liquid spilled out of the cylinder to the original volume?

a. 1/4
b. 3/8
c. 1/2
d. 3/4

85. Which one ‘of the following is the correct statement?

Streamline, path line and streak line are identical when the

a. flow is steady
b. flow is uniform
c. flow velocities do not change steadily with time
d. flow is neither steady nor uniform

86. In a cylindrical vortex motion about a vertical axis, r_1 and r_2 are the radial distances of two points on the horizontal plane ($r_2 > r_1$). If for a given tangential fluid velocity at r_1, the pressure difference

between the points in free vortex is one-half of that when the vortex is a forced one, then what is the value of the ratio (r_2/r_1)?

a. $\sqrt{3/2}$

b. $\sqrt{2}$

c. 3/2

d. $\sqrt{3}$

87. The relation $\frac{\partial^2\varphi}{\partial x^2}+\frac{\partial^2\varphi}{\partial y^2}=0$ for an irrotational flow is known as which one of the following?

a. Navier-Stokes equation

b. Laplace equation

c. Reynolds equation

d. Euler's equation

88. Which one of the following stream functions ψ is a possible irrotational flow field?

a. $\psi = y^2 - x^2$

b. $\psi = Ax^2y^2$

c. $\psi = A\sin(xy)$

d. $\psi = Ax + By^2$

89. Match List - I with List -II and select the correct answer using the code given below the lists

List - I (Condition)

A. Existence of stream function

B. Existence of velocity potential

C. Absence of temporal variations

D. Constant velocity vector

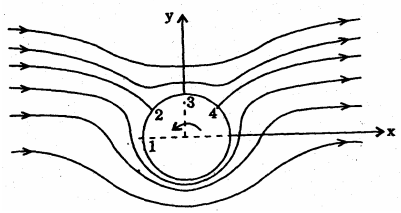
List - II (Regulating Fact)

1. Irrotationality of flow
2. Continuity of flow
3. Uniform flow
4. Steady flow

Codes;

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

90.



A cylindrical object is rotated with constant angular velocity about its symmetry axis in a uniform flow field of an ideal fluid producing streamlines as shown in the figure given above. At which point(s), is the pressure on the cylinder surface maximum?

a. Only at point 3

b. Only at point 2

c. At points 1 and 3

d. At points 2 and 4

91. Which one of the following statements is correct for reciprocating air compressor?

a. Its volumetric efficiency increases with increasing clearance ratio

b. Its volumetric efficiency increases with increasing pressure ratio

c. Its volumetric efficiency does not vary with change in clearance ratio and pressure ratio

d. Its volumetric efficiency decreases with increasing clearance ratio and pressure ratio, both

92. Piston compression rings are made of which one of the following?

a. Cast iron

b. Bronze

c. Aluminium

d. White metal

93. Which one of the following thermodynamic processes approximates the steaming of food in a pressure cooker?

a. Isenthalpic

b. Isobaric

c. Isochoric

d. Isothermal

94. For a conventional S.I. engine, what is the value of fuel-air ratio in the normal operating range?

a. 0.056 — 0.083

b. 0.083 — 0.56

c. 0.0056 — 0.83

d. 0.056 — 0.83

95. The Cetane number of automotive diesel fuel used in India is in which one of the following ranges?

a. 30—40

b. 41—50

c. 51 — 60

d. 61 — 70

96. The delay period in CI engine depends upon which of the following?

a. Temperature and pressure in the cylinder at the time of injection

b. Nature of the fuel mixture strength

c. Relative velocity between the fuel injection and air turbulence pressure of residual gases

d. All of the above

97. Match List - I with List -II and select the correct answer using the code given below the lists

List - I (SI Engine Operational Mode)

A. Idling

B. Cruising

C. Maximum Power

D. Cold starting

List-II (A/F Ratio Supplied by the Carburetor)

1. 3
2. 10
3. 13
4. 16
5. 20

Codes;

	A	B	C	D
a.	2	4	5	1
b.	4	5	3	2
c.	2	4	3	1
d.	4	5	3	1

98. What is the main objective of supercharging of the engine?

a. To reduce the mass of the engine per brake power

b. To reduce space occupied by engine

c. To increase the power output of engine

d. All of the above

99. Which one of the following is correct?

The turbine of the turbo-prop engine as compared to that of the turbojet engine is

a. similar

b. smaller

c. bigger

d. unpredictable

100. Which one of the following automobile exhaust gas pollutants is a major cause of photochemical smog?

a. CO

b. FK

c. NO_x

d. SO_x

101. The Orsat apparatus, which gives volumetric percentage of four constituents of diy flue gas, is arranged for absorption of three gases and the fourth content being obtained by difference.

Match List - I with List -II and select the correct answer using the code given below the lists:

List - I (Gases)

A. Carbon dioxide

B. Carbon monoxide

C. Oxygen

D. Nitrogen

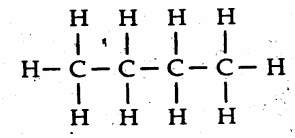
List - II (Solution for Absorption/By difference)

1. By difference
2. Caustic soda
3. Pyrogallic acid
4. Cuprous chloride

Codes;

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

102.



Which one of the following is represented by the molecular structure of the paraff1n family of hydrocarbon fuel given above, for an IC engine?

a. Ethane
b. Propane
c. Butane
d. Hexane

103. Uranium 238 is represented as $_{92}U^{238}$. What does it imply?
a. It has 92 protons and 146 neutrons
b. It has 146 protons and 92 electrons
c. It has 92 protons and 238 neutrons
d. It has 92 neutrons and 238 protons

104. For a pure substance, what are the numbers of the thermodynamic degree of freedom for saturated vapour and superheated vapour, respectively?
a. 1 and 1
b. 1 and 2
c. 2 and 1
d. 2 and 2

105. One kg of ice at 0°C is completely melted into water at 0°C at 1 bar pressure. The latent heat of fusion of water is 333 kJ/kg and the densities of water and ice at 0°C are 9990 kg/m^3 and 9160 kg/m^3, respectively. What are the approximate values of the work done and energy transferred as heat for the process, respectively?
a. - 94 J and 333.0 kJ
b. 94 J and 333.0 kJ
c. 333.0 kJ and - 94 J
d. None of the above

106. Velocity for flow through a pipe, measured at the centre is found to be 2 m/s. Reynolds number is around 800. What is the average velocity in the pipe 9
a. 2 m/s
b. 17 m/s
c. 1 m/s
d. 05 m/s

107. Match List - I with List-II and select the correct answer using, the code given below the lists

List - I (Measuring Instrument)
A. Hot-wire anemometer
B. Pitot-tube
C. V-notch weir
D. Tachometer

List -II (Variable to be measured)
1. Discharge
2. Rotational speed
3. Velocity fluctuations
4. Stagnation pressure

Codes;

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

108. An orifice meter, having an orifice of diameter d is fitted in a pipe of diameter D. For this orifice meter, what is the coefficient of discharge C_d?
a. A function of Reynolds number only
b. A function of d/D only
c. A function of d/D and Reynolds number
d. Independent of d/D and Reynolds number

109. The velocity of a water stream is being measured by a L-shaped Pitot-tube and the reading is 20 cm. Then, what is the approximate value of velocity?
a. 196 m/s
b. 20 m/s
c. 98 m/s
d. 20 cm/s

110. Which one of the following conditions will linearize the Navier — Stokes equations to make it amenable for analytical solutions?
a. Low Reynolds number (Re << 1)
b. High Reynolds number (Re >> 1)
c. Low Mach number (M << 1)
d. High Mach number (M >> 1)

111. The head loss in turbulent flow in pipe varies
a. Directly as the velocity
b. Inversely as the square of the velocity
c. Inversely as the square of the diameter
d. Approximately as the square of the velocity

112. A ship's model, with scale 1 : 100, has a wave resistance of 10 N at its design

speed. What is the corresponding Prototype wave resistance in kN?

a. 100
b. 1000
c. 10000
d. Cannot be determined because of insufficient data

113. In a fluid machine, the relevant parameters are volume flow rate, density, viscosity, bulk modulus, pressure difference, power consumption, rotational speed and characteristic dimension. Using the Buckingham pi (π) theorem, what would be the number of independent non-dimensional groups?

a. 3
b. 4
c. 5
d. None of the above

114. Across a normal shock wave in a converging-diverging nozzle for adiabatic flow, which of the following relations are valid?

a. Continuity and energy equations, equation of state, isentropic relation
b. Energy and momentum equations, equation of state, isentropic relation
c. Continuity, energy and momentum equations, equation of state
d. Equation of state, isentropic relation, momentum equation, mass — conservation principle

115. Which one of the following statements is correct about the Fanno flow?

a. For an initially subsonic flow, the effect of friction is to decrease the Mach number towards unity
b. For an initially supersonic flow, the effect of friction is to increase the Mach number towards unity
c. At the point of maximum entropy, the Mach number is unity
d. Stagnation pressure always increases along the Fanno line

116. The power absorbed by a hydrazine pump is directly proportional to which one of the following?

(Where N is the rotational speed of the pump)

a. N
b. N^2
c. N^3
d. N^4

117. The vanes of a centrifugal pump are generally

a. Radial
b. Curved backward
c. Curved forward
d. Twisted

118. The use of a draft tube in a reaction type water turbine helps to

a. Prevent air from entering
b. Increase the row rate
c. Convert the kinetic energy to pressure energy
d. Eliminate eddies in the downstream

119. Consider the following statements:

1. The phenomenon of lift produced by imposing circulation over a doublet in a uniform flow is known as Magnus effect.
2. The path-deviation of a cricket ball from its original trajectory is due to the Magnus effect.

Which of the statements given above is/are correct?

a. 1 only
b. 2 only
c. Both 1 and 2
d. Neither 1 nor 2

120. The specified speed (N_S) of a water turbine is expressed by which one of the following equations?

a. $N_s = \frac{N\sqrt{p}}{H^{5/4}}$
b. $N_s = \frac{N\sqrt{p}}{H^{3/4}}$
c. $N_s = \frac{N\sqrt{Q}}{H^{5/4}}$
d. $N_s = \frac{N\sqrt{Q}}{H^{3/4}}$