MECHANICAL ENGINEERING

PAPER-I

1. In an open U tube containing mercury, kerosene of specific gravity 0-8 is poured into one of its limbs so that the length of column of kerosene is about 40 cm. The level of mercury column in that limb is lowered approximately by how much?
   a. 2.4 cm
   b. 1.2 cm
   c. 3.6 cm
   d. 0.6 cm

2. Which one of the following is correct? The capillary rise on depression in a small diameter tube is
   a. directly proportional to the specific weight of the fluid
   b. inversely proportional to the surface tension
   c. inversely proportional to the diameter
   d. directly proportional to the surface area

3. What is the pressure inside a soap bubble, over the atmospheric pressure if its diameter is 2 cm and the surface tension is $0.1 \frac{N}{m}$?
   a. 0.4 N/m^2
   b. 4.0 N/m^2
   c. 40.0 N/m^2
   d. 400. N/m^2

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

   List –I

   (Devices)

   A. Cooling tower
   B. Air coolers
   C. Evaporator coil
   D. Air cooled condenser

   List II

   (Process undergone by air)

   1. Heating
   2. Cooling and dehumidification
   3. Cooling and humidification
   4. Heating and humidification

   Code:

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

5. Which one of the following is correct? On psychrometric chart, the constant wet. bulb temperature lines coincide with
   a. constant relative humidity lines
   b. constant enthalpy lines
   c. constant dew point temperature lines
   d. constant volume lines

6. Which one of the following is correct? In a sensible heating or cooling process
   a. dry bulb temperature remains constant
   b. wet bulb temperature remains constant
   c. the humidity ratio remains constant
   d. the relative humidity remains constant

7. Which one of the following is correct? Equal friction method of designing ducts is preferred
   a. when system is balanced
   b. when system is not balanced
   c. only for return ducts
   d. for any system

8. Which non-dimensional number relates the thermal boundary layer and hydrodynamic boundary layer?
   a. Rayleigh number
   b. Peclet number
   c. Grashof number
   d. Prandtl number

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

List-I

(Application)

A. Gas to liquid.

B. Space vehicle

C. Condenser

D. Air pre-heater

List-II

(Type of Heat Exchanger)

1. Compact
2. Shell and Tube
3. Finned tube
4. Regenerative

Code :

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

10. Which one of the following is correct? Fins are used to increase the heat transfer from a surface by

a. increasing the temperature difference

b. increasing the effective surface area

c. increasing the convective heat transfer coefficient

d. none of the above

11. The value of thermal conductivity of thermal insulation applied to a hollow spherical vessel containing very hot material is 0.5 $\frac{W}{m-K}$. The convective heat transfer coefficient at the outer surface of insulation is 10 W/m^2 K. What is the critical radius of the sphere?

a. 0.1 m

b. 0.2 m

c. 1.0 m

d. 2.0 m

12. A composite wall of a furnace has 2 layers of equal thickness having thermal conductivities in the ratio of 3 : 2. What is the ratio of the temperature drop across the two layers?

a. 2 : 3

b. 3 : 2

c. 1 2

d. loge 2 : log$_e$ 3

13. In which one of the following materials, is the heat energy propagation minimum due to conduction heat transfer?

a. Lead

b. Copper

c. Water

d. Air

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

List I

A. Heat transfer through solid

B. Heat transfer from hot surface to surrounding fluid

C. Heat transfer in boiling liquid

D. Heat transfer from one body another body separated in space

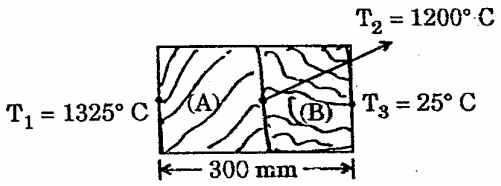
List II

1. Radiation heat transfer
2. Fourier's law of heat conduction
3. Convection heat transfer
4. Newton's law of cooling

Code:

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

15.



A wall as shown above, is made up of two layers (A) and (B). The temperatures are also shown in the sketch. The ratio of thermal conductivity of two layers is

$\frac{k_A}{k_B} = 2$

What is the ratio of thickness of two layers?

a. 0.105

b. 0.213

c. 0.555

d. 0.840

16. What is the critical radius of insulation for a sphere equal to?

$$\left(\frac{k = thermal\ conductivity\ in\ \frac{W}{m-K}}{h = heat\ transfer\ coefficient\ in\ \frac{W}{m^2 K}} \right)$$

a. 2kh

b. 2k/h

c. k/h

d. $\sqrt{2kh}$

Directions : Each of the following four (4) items consists of two statements, one labelled as the 'Assertion (A)' and the other as 'Reason (RY Yu are to examine these two statements carefully and select the answers to these items using the codes given below:

Codes:

(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

17. Assertion (A): In the boundary layer concept, the shear stress at the outer edge of the layer is considered to be zero.

Local velocity is almost equal to velocity in potential flow.

18. Assertion (A): A normal shock wave can occur at any section in a convergent-divergent nozzle.

Reason (R): A normal shock wave occurs only when the flow of the fluid is supersonic and the subsequent flow after the shock is subsonic.

19. Assertion (A): Non-metals are having higher thermal conductivity than metals.

Reason (R): Free electrons in the metals are higher than those of non metals.

20. Assertion (A): The centre of pressure for a vertical surface submerged in a liquid lies above the centroid (centre of gravity) of the vertical surface.

Reason (R): The distance of the centre of pressure from the free surface of the liquid for a vertical surface submerged in a liquid is independent of the density of the liquid.

21. A rectangular plate 0.75m x 2.4 m is immersed in a liquid of relative density 0.85 with its 0.75 m side horizontal and just at the water surface. If the plane of plate makes an angle of 60^0 with the horizontal, what is the approximate pressure force on one side of the plate?

a. 7.80 kN

b. 15.60 kN

c. 18.00 kN

d. 24.00 kN

22. The stream function in a flow field is given by $\psi = 2xy$. In the same flow field, what is the velocity at a point (2, 1)?

a. 4 unit

b. 5.4 unit

c. 1.73 unit

d. 4.47 unit

23. A steady, incompressible flow is given by:

$u = 2x^2 + y^2$ and $v = -4xy$

What is the convective acceleration along x-direction at point (1, 2)?

a. a_x = 6unit

b. a_x = 24 unit

c. a_x = 8 unit

d. a_x = -24 unit

24. Which one of the following is correct? For flow of an ideal fluid over a cylinder, from the front stagnation point,

a. pressure first decreases then increases

b. velocity first decreases then increases

c. pressure remains the same

d. velocity remains the same

25. Two flows are specified as

A. u y, v = - (3/2)x

B. $u = xy^2$, $v = x^2y$

Which one of the following can be concluded

a. Both flows are rotational

b. Both flows are irrotational

c. Flow A is rotational while flow B is irrotational

d. Flow A is irrotational while flow B is rotational

26. Which one of the following is correct? In the flow past bluff bodies

a. pressure drag is smaller than friction drag -

b. friction drag occupies the major part of total drag

c. pressure drag occupies the major part of total drag

d. pressure drag is less than that of streamlined body

27. Which one of the following is correct? In a fully developed region of the pipe flow,

a. the velocity profile continuously changes from linear to parabolic shape

b. the pressure gradient remains constant in the downstream direction

c. the pressure gradient continuously changes exceeding the wall shear stress in the downstream direction

d. the pipe is not running full

28. A balloon which is initially collapsed and flat is slowly filled with a gas at 100 kPa so as to form it into a sphere of 1 m radius. What is the work done by the gas in the balloon during the filling process?

a. 428.9 kJ

b. 420.9 kJ

c. 416.9 kJ

d. 418.9 kJ

29. An ideal gas at 27° C is heated at constant pressure till its volume becomes three times. What would be then the temperature of gas?

a. 81° C

b. 627° C

c. 543° C

d. 327° C

30. A 4 kW, 20 litre water heater is switched on for 10 minutes. The heat capacity C, for water is 4 kJ/kg K. Assuming all the electrical energy has gone into heating the water, what is the increase of the water temperature?

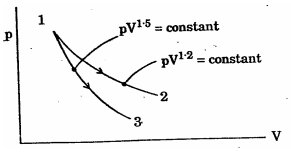
a. 15° C

b. 20°C

c. 26° C

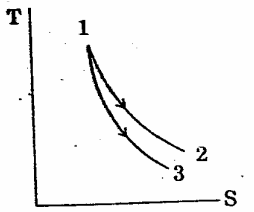
d. 30° C

31. Two polytropic processes undergone by a perfect gas are shown below in the pressure-volume co-ordinates.



Which representation shows correctly the above processes on the temperature - entropy co-ordinates ?

a.



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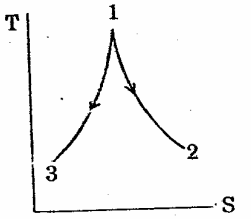
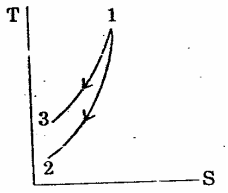
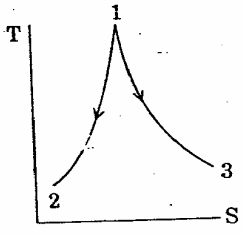


c.



d.



32. A Carnot engine operates between 327° C and 27°C. If the engine produces 300 kJ of work, entropy change during heat what is the addition?

a. 0.5 kJ/K

b. 1.0 kJ/K

c. 1.5 kJ/K

d. 2.0 kJ/K

33. Which of the following statements is correct?

a. The increase in entropy is obtained from a given quantity of heat transfer at a low temperature.

b. The change in entropy may be regarded as a measure of the rate, of the availability of heat for transformation into work.

c. The entropy represents the maximum amount of work obtainable per degree drop in temperature

d. All of the above

34. What is the loss of avai1able energy associated with the transfer of 1000 kJ of heat from a constant temperature system at 600 K to another at 400 K when the environmental temperature is 300 K?

a. 150 kJ

b. 250 kJ

c. 166.67 kJ

d. 180 kJ

35. Why is an air vessel used in a reciprocating pump?

a. To obtain a continuous supply of water at uniform rate

b. To reduce suction head..

c. To increase the delivery head

d. To reduce cavitation

36. Centrifugal pumps have which of the following advantages?

1. Low initial cost
2. Compact, occupying less floor space
3. Easy handling of highly viscous fluids

Select the correct answer using the code given below:

a. 1, 2 and 3

b. 1 and 2 only

c. 1 and 3 only

d. 2 and 3orily

37. Two pumps can operate independently at heads H_1, H_2 and discharge Q_1, Q_2, respectively; If the pumps are connected in parallel, then what are the resulting discharge (Q) and head (H)?

a. $Q = Q_1 + Q_2$, $H = H_1 + H_2$

b. $Q = Q_1 - Q_2$, $H = H_1 - H_2$

c. $Q = Q_1 = Q_2$, $H = H_1 = H_2$

d. $Q = Q_1 + Q_2$, $H = H_1 = H_2$

38. Why is multi-staging in centrifugal pumos used?

a. For high flow rate

b. For high head

c. For high speed

d. For high efficiency

39. Consider the following statements in respect of Kaplan Turbine:

1. It is a reaction turbine.
2. It is a mixed flow turbine.
3. It has adjustable blades.

Which of the statements given above are correct?

a. 1, 2 and 3

b. 2 and 3 only

c. 1 and 3 only

d. 1 and 2 only

40. Which one of the following is correct?

If the number of jets in a Peltron turbine is n, then the specific speed is

a. $\propto n^2$

b. $\propto n$

c. $\propto n^{1/2}$

d. independent of n

41. Which one of the following is correct?

A turbine pump is basically a centrifugal pump equipped additionally With

a. backward curved blades

b. vaned diffusion casing

c. inlet guide blades

d. adjustable blades

42. What does Euler's equation of turbo machines relate to ?

a. Discharge and power

b. Discharge and velocity

c. Head and power

d. Head and velocity

43. Which one of the following is correct?

A nydraulic coupling

a. connects two shafts rotating at about the same speed

b. connects two shafts running at different speeds

c. is used to augment the torque to the driven shaft

d. is used to connect the centrifugal pump and its electrical motor for efficient operation

44. Why are surge tanks used in a pipe line?

a. To reduce frictional loss in pipe

b. To ensure uniform flow in pipe

c. To relieve the pressure due to water hammer

d. To reduce cavitation

45. Which one of the following is correct? Water-tube boilers are preferred for

a. high pressure and high output

b. high pressure and low output

c. low pressure and high output

d. low pressure and low output

46. Which one of the following is correct? For incompressible flow a diverging section acts as a diffuser for upstream flow which is

a. subsonic only

b. supersonic only

c. both subsonic and supersonic

d. sonic

47. Given,

η_s = stage efficiency

η_n = nozzle efficiency

η_b = blade efficiency.

Which one of the following is correct?

a. $\eta_n = \eta_n\eta_n$

b. $\eta_b = \eta_s\eta_n$

c. $\eta_b \times \eta_b \times \eta_s = 1$

d. $\eta_s = \eta_b\eta_n$

48. Which one of the following types of impeller vanes are most commonly used in centrifugal type compressors?

a. Forward curved

b. Radial

c. Backward curved

d. Tangential

49. A centrifugal compressor is suitable for which of the following?

a. High pressure ratio, low mass flow

b. Low pressure ratio, low mass flow

c. High pressure ratio, high mass flow

d. Low pressure ratio, high mass flow

50. Which one of the following is correct? In ideal regenerative cycle the temperature of steam entering the turbine is same as that of

a. water entering the turbine

b. water leaving the turbine

c. steam leaving the turbine

d. water at any section of the turbine

51. Which one of the following is correct? In a gas turbine cycle with regeneration,

a. pressure ratio increases

b. work output decreases

c. thermal efficiency increases

d. heat input increases

52. Consider the following statements pertaining to specific speed of turbo machines:

1. Specific speed varies with shape of the runner and other parts of the machine.
2. Machines with highen specific speeds are limited to low heads.
3. Specific speed is dimensionless and 18 independent of variation of type of fluid used.

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

53. In which one of the following processes, in a dosed system the thermal energy transferred to a gas is completely converted to internal energy resulting in an increase in gas temperature?

a. Isochoric process

b. Adiabatic process

c. Isothermal process

d. Free expansion

54. Which one of the following expresses the reversible work done by the system (steady flow' between states 1 and 2?

a. $\int_1^2 p\,dv$

b. $-\int_1^2 v\,dp$

c. $-\int_1^2 p\,dv$

d. $\int_1^2 v\,dp$

55. The change In specific entropy of a system undergoing a reversible process is given by

$s_2 - s_1 (c_p - c_v)$ *I*n (v_2/v_1).

This is valid for which one of the following?

a. Adiabatic process undergone by an ideal gas

b. Isothermal process undergone by an ideal gas

c. Polytropic process undergone by a real gas

d. Isobaric phase change from liquid to vapour

56. Which one of the following is correct? The specific volume of water when heated from 0^0C

a. first increases and then decreases

b. first decreases and then increases

c. increases steadily

d. decreases steadily

57. Which one of the following is correct? At critical point the enthalpy of vaporization is

a. dependent on temperature only

b. maximum

c. minimum

d. zero

58. Which one of the following set of materials is most commonly used in catalytic converters for CI engines?

a. Platinum, palladium and rhodium

b. Palladium, rhodium and ruthenium

c. Rhodium, ruthenium and platinum

d. Ruthenium, platinum and palladium

59. Consider the following:

Carbon

Carbon-monoxide

Hydrogen, and

Sulphur

What is the amount of oxygen (in kg) required for complete combustion of each one of the above respectively?

a. 1, 8, 8/3, 4/7

b. 4/7, 1, 8, 8/3

c. 8/3, A./7, 8, 1

d. 8, 1, 4/7, 8/3

60. Consider the following nuclear fuels:

1. Pu^{239}
2. U^{235}
3. U^{233}
4. Th^{232}

What is the correct sequence of the above nuclear fuels in order of increasing half life?

a. 1-2-3-4

b. 1-3-2-4

c. 2-4-3-1

d. 4-1-2-3

61. Which one of the following statements is correct?

The mass defect is

a. a characteristic of certain elements

b. a term used to prove the relationship between mass and energy

c. a measure of fission energy

d. the difference between mass of the nucleus and sum of the masses of the nucleons

62. Uranium 238 is represented by $_{99}U^{238}$. What does it represent?

a. 92 neutrons and 238 protons

b. 92 protons and 238 neutrons

c. 92 neutrons and 146 protons

d. 92 protons and 146 neutrons

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

List I

(Law)

A. Fourier’s Law

B. Stefan Boltzmann Law

C. Newton’s Law of Cooling

D. Ficks Law

List II

(Effect)

1. Mass transfer
2. Conduction
3. Convection
4. Radiation

Code:

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

64. Two walls of same thickness and cross sectional area, have thermal conductivities in the ratio 1: 2. If same temperature difference is maintained across the two faces of both the walls, what is the ratio of heat flow Q_1/Q_2 ?

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

65. A fin of length *l* protrudes from a surface held at temperature T_0; it being higher than the ambient temperature T_a The heat dissipation from the free end of the fin is stated to be negligibly small. What is the temperature gradient $\left(\frac{dT}{dx}\right)_{x=l}$ at the tip of the fin?

a. Zero
b. $\frac{T_0 - T_l}{l}$
c. $h(T_0 - T_a)$
d. $\frac{T_1 - T_a}{T_0 - T_a}$

66. Which one of the following is correct? The effectiveness of a fin will be maximum in an environment with

a. free convection.
b. forced convection
c. radiation
d. convection and radiation

67. Consider the following statements related to the fluid properties:

1. Vapour pressure of water at 373 K is 101.5 X 10^3 N/m^2.
2. Capillary height in cm for water in contact with glass tube and air is (tube dia)/0.268.
3. Blood is a Newtonian fluid.

Which of the statements given above is/are correct?

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

68. What is the unit of dynamic viscosity of a fluid termed 'poise' equivalent to?

a. dyne/cm^2
b. gms/cm
c. dyne s/cm^2
d. gm-cm/s

69. What is the pressure difference between inside and outside of a droplet of water?

a. 2σ/d
b. 4σ/d
c. 8σ/d
d. 12σ/d

where 'σ' is the surface tension and 'd' is the diameter of the droplet.

70. The lower portion of a U-tube of uniform bore having both limbs vertical and open to atmosphere, is initially filled with a liquid of specific gravity 3S. A lighter liquid of specific gravity S is then poured into one of the limbs such that the length of column of lighter liquid is X. What is the resulting movement of the meniscus of the heavier liquid in the other limb?

a. X
b. X/2
c. X/3
d. X/6

71. How is the difference of pressure head, "h" measured by a mercury-oil differential manometer expressed?

a. $h = x\left[1 - \frac{S_g}{S_0}\right]$
b. $h = x\left[S_g - S_0\right]$

c. $h = x\left[S_0 - S_g\right]$

d. $h = x\left[\frac{S_g}{S_0} - 1\right]$

where x = manometer reading; S_g and S_0 are

the specific gravities of mercury and oil,

respectively.

72. What is the vertical component of pressure force on submerged curved surface equal to?

a. Its horizontal component

b. The force on a vertical projection of the curved surface

c. The product of the pressure at centroid and surface area

d. The gravity force of liquid vertically above the curved surface up to the free surface

73. What is the depth of centre of pressure of a vertical immersed surface from free surface of liquid equal to?

a. $\frac{I_G}{A\bar{h}} + \bar{h}$

b. $\frac{I_G A}{\bar{h}} + \bar{h}$

c. $\frac{I_G \bar{h}}{A} + \bar{h}$

d. $\frac{A\bar{h}}{I_G} + \bar{h}$

(Symbols have their usual meaning)

74. What is buoyant force?

a. Lateral force acting on a submerged body

b. Resultant force acting on a submerged body

c. Resultant force due to water on a body

d. Resultant hydrostatic force on a body due to fluid surrounding it

75. How is the metacentric expressed? height, GM

a. GM = BG-(I/V)

b. GM = (V/I)- BG

c. GM = U/V)-BG

d. GM = BG- (V/I)

where I = Moment of inertia of the plan of the floating body at the water surface

V = Volume of the body submerged in water

BG = Distance between the centre of gravity (G) and the centre of buoyancy (B).

76. Stability of a floating body can be improved by which of the following?

1. Making its width large
2. Making the draft small
3. Keeping the centre of mass low
4. Reducing its density

Select the correct answer using the code given below

a. 1, 2, 3 and 4

b. 1, 2 and 3 only

c. 1 and 2 only

d. 3 and 4 only

77. The distance from the centre of buoyancy to the meta-centre is given by I/V_d, where V_d is the volume of fluid displaced. What does I represent ?

a. Moment of inertia of a horizontal section of the body taken at the surface of the fluid

b. Moment of inertia about its vertical centroidal axis

c. Polar moment of inertia

d. Moment of inertia about its horizontal centroidal axis

78. What acceleration would cause the free surface of a liquid contained in an open tank moving in a horizontal track to dip by 45^0?

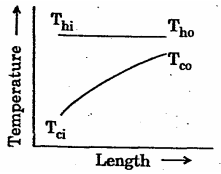
a. g/2

b. 2g

c. g

d. (3/2)g

79.



The temperature distribution curve for a heat exchanger as shown in the figure

above (with usual notations) refers to which one of the following?

a. Tubular parallel flow heat exchanger
b. Tube in tube counter flow heat exchanger
c. Boiler
d. Condenser

80. The 'NTU' (Number of Transfer Units) in a heat exchanger is given by which one of the following?

a. $\frac{UA}{C_{min}}$
b. $\frac{UA}{C_{max}}$
c. $\frac{UA}{E}$
d. $\frac{C_{max}}{C_{min}}$

A = Heat exchange area

U = Overall heat transfer coefficient

C = Heat capacity

E = Effectiveness

81. A sphere, a cube and a thin circular plate, all made of same material and having same mass are initially heated to a temperature of 250^0 C and then left in air at room temperature for cooling. Then, which one of the following is correct?

a. All will be cooled at the same rate
b. Circular plate will be cooled at lowest rate
c. Sphere will be cooled faster
d. Cube will be cooled faster than sphere but slower than circular plate

82. Natural convection heat transfer coefficients over surface of a vertical pipe and vertical flat plate for same height and fluid are equal. What is/are the possible reasons for this?

1. Some height
2. Both vertical
3. Same fluid
4. Same fluid flow pattern

Select the correct answer using the code given below

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

83. Schmidt number is ratio of which of the following?

a. Product of mass transfer coefficient and diameter to diffusivity of fluid
b. Kinematic viscosity to. Thermal diffusivity of fluid
c. Kinematic viscosity to diffusion coefficient of fluid
d. Thermal diffusivity to diffusion coefficient of fluid

84. What is the equivalent emissivity for radiant heat exchange between V a V small body (emissivity = 0.4) in a very large enclosure (emissivity = 0.5)?

a. 0.5
b. 0.4
c. 0.2
d. 0.1

85. The heat exchange between a small body having emissivity ε_1 and area A_1 and a large enclosure having emissivity ε_2 and area A_2 is given by:

$$q_{1-2} = A_1\varepsilon_1\sigma\left(T_1^4 - T_2^4\right)$$

What is the assumption for this equation?

a. $\varepsilon_2=1$
b. $\varepsilon_2 = 0$
c. A_1 is very small as compared to A_2
d. Small body is at centre of enclosure

86. For simple vapour compression cycle, enthalpy at suction = 1600 kJ/kg, V enthalpy at discharge from the compressor 1800 kJ/kg, enthalpy at exit from condenser = 600 kJ/kg. What is the COP for this refrigeration cycle?

a. 3.3
b. 5.0
c. 4
d. 4.5

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

List-I

(Cycle)

A. Air refrigeration
B. Vapour compression refrigeration
C. Vapour absorption refrigeration
D. Steam jet refrigeration

List-II
(Equipment)
1. Absorber
2. Flash chamber
3. Turbine
4. Compressor

Code:

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

88. What is an azeotrope?
a. A non-halogenic refrigerant
b. A refrigerant dissolved in alcohol
c. A mixture of refrigerants without phase separation
d. An eco-friendly refrigerant

89. Which one of the following is correct? Environmental protection agencies advise against the use of chlorofluorocarbon refrigerants because these react with
a. water vapour and cause acid rain
b. plants and cause green house effect
c. oxygen and cause its depletion
d. ozone layer and cause its depletion

90. What is hunting of thermostatic expansion valve?
a. A variation of evaporator load with degree of super heat
b. A variation in pressure of the evaporator with variation of load
c. Alternate overfeeding and starving of refrigerant flow in the evaporator
d. This is not used in connection with expansion valve

91. On a psychrometric chart, what does a vertical downward line represent?
a. Adiabatic saturation
b. Sensible cooling
c. Dehumidification
d. Humidification

92. Which of the folio wing properties decrease(s) with sensible heating of air-water vapour mixture?
1. Relative humidity
2. Humidity ratio
3. Specific enthalpy of air-vapour mixture
4. Wet bulb temperature

Select the correct answer using the code given below
a. 1 only
b. 1 and 3
c. 2 and 3
d. 2 and 4

93. Consider the following statements regarding psydnometric processes:
1. Sensible heating is a process in which moisture content remains unchanged.
2. In the dehumidification process the dew point temperature remains same.
3. The process of adding moisture at constant dry bulb temperature is known as pure humidification process.

Which of the statements given above is/are correct?
a. 1 and 2
b. 1 and 3
c. 2 and 3
d. 1 only

94. Consider the following statements:

In a psychrometric chart
1. vertical lines indicate wet bulb temperature.
2. horizontal lines indicate relative humidity.
3. sensible heating or cooling is' represented by an inclined line.

Which of the statements given above is/are correct?
a. 1 only
b. 2 only
c. 3 only
d. 1, 2 and 3

95. Which one of the following is correct? During sensible cooling of moist air, its relative humidity
a. increases

b. does not change
c. decreases
d. affects specific humidity

96. Which gas power cycle consists of four processes during which work alone is transferred during two processes and heat alone is transferred during the other two processes?
a. Atkinson cycle
b. Carnot cycle
c. Diesel cycle
d. Otto cycle

97. The suction pressure is 1 bar and delivery pressure is 125 bar. What is the ideal intermediate pressure at the end of first stage for a 3-stage air compressor?
a. 25 bar
b. 5 bar
c. 10 bar
d. 20 bar

98. In a SI engine, combustion stage I takes 1 ms and combustion stage II takes 1.5 ms when the engine runs at 1000 rpm. If stage I time duration is independent of engine speed what will be the additional spark advance necessary when the engine speed is doubled?
a. 0°
b. 6°
c. 12°
d. 24°

99. For minimizing knocking tendency is SI engine, where should the space plug be located?
a. Near inlet valve
b. Away from both the valves
c. Near exhaust valve
d. Midway between inlet and exhaust valves

100. The three way catalytic converter cannot control which one of the following?
a. HC emission
b. co emission
c. NO_x emission
d. PM emission

101. Oxides of nitrogen in the engine exhaust can be reduced by which of the following methods?
1. Decrease in compression ratio
2. Exhaust gas recirculation
3. Use of 5% lean mixture
4. Use of oxidation catalysts in exhaust manifold

Select the correct answer using the code given below:
a. 1 and 2 only
b. 1 and 3 only
c. 1, 2 and 4
d. 2 and 4 only

102. Which one of the following is correct?
A nuclear reactor is said to be critical when
the neutron population in the reactor core is
a. rapidly increasing leading to the point of explosion
b. decreasing from a specific value
c. reduced to zero
d. constant

103. In an experiment, the following shear stress-time rate of shear strain values are obtained for a fluid:
Time rate of shear : 0 2 3 4
strain (1/s)
Shear stress (kPa) : 0 1.4 2.6 4
How can the fluid be classified?
a. Newtonian fluid
b. Bingham plastic
c. Pseudo plastic
d. Dilatant

104. A gas turbine plant working on Joule cycle produces 4000 kW of power. If its work ratio is 40%, what is the power consumed by the compressor?
a. 2000 kW
b. 4000 kW
c. 6000 kW
d. 8000 kW

105. What is the ratio of the static enthalpy rise in the rotor to the static enthalpy rise in the stage of an axial flow compressor defined as?
a. Power input factor
b. Flow coefficient

c. Temperature coefficient

d. Degree of reaction

106. The volute casing of a centrifugal pump has which of the following functions?

1. Eliminating loss of head due to change in velocity after exit from impeller.
2. Directs the flow towards the delivery pipe
3. Converts a part of the velocity head to pressure head
4. Gives a constant velocity of flow

Select the correct answer using the code given below:

a. 1, 2 and 4

b. 2 and 3 only

c. 1 and 4 only

d. 2 and 4 only

107. Which one of the following statements is not correct in respect of hydraulic turbines?

a. (Speed) is proportional to (1/Diameter)

b. (Power) is proportional to $(\text{Speed})^3$

c. (Power) is proportional to $(\text{Head})^{3/2}$

d. (Speed) is proportional to $(\text{Head})^{1/2}$

108. A velocity field is given by u = 3xy and $v = \frac{3}{2}\left(x^2 - y^2\right)$. What is the relevant equation of a streamline?

a. $\frac{dx}{dy} = \frac{\left(x^2 - y^2\right)}{xy}$

b. $\frac{dx}{dy} = \frac{3xy}{\left(x^2 - y^2\right)}$

c. $\frac{dx}{dy} = \frac{2xy}{\left(x^2 - y^2\right)}$

d. $\frac{dx}{dy} = \frac{\left(x^2 - y^2\right)}{2xy}$

109. For steady incompressible flow, if the u-component of velocity is $u = Ae^x$, then what is the v-component of velocity?

a. Ae^y

b. $A\,e^x y$

c. $-Ae^x y$

d. $-Ae^x$

110. An incompressible fluid flows radially outward from a line source in a steady manner. How does the velocity in any radial direction vary?

a. r

b. r^2

c. $1/r^2$

d. 1/r

111. Consider the following statements:

1. The friction factor in laminar flow through pipes is independent of roughness.
2. The friction factor for laminar flow through pipes is directly proportional to Reynolds number.
3. In fully turbulent flow, through pipes, friction factor is independent of Reynolds number.

Which of the statements given above are correct?

a. 1, 2 and 3

b. 1 and 3 only

c. 2 and 3 only

d. 1 and 2 only

112. What is hydraulic diameter used in place of diameter for non-circular ducts equal to?

a. A/m

b. 4A/m

c. A/(4m)

d. 4m/A

where A area of flow and m = perimeter.

113. The velocity distribution in a turbulent boundary layer is given by $u/U = (y/\delta)^{1/7}$. What is the displacement thickness δ^*?

a. δ

b. $\delta/7$

c. $(7/8)\,\delta$

d. $\delta/8$

114. For hydraulically most efficient symmetric trapezoidal section of an open channel, which one of the following is the false characterization?

a. Wetted perimeter is minimum for a given area of flow section

b. Hydraulic radius is half the flow depth

c. Width at top liquid is twice the hydraulic depth

d. Discharge is maximum for given area of flow, bed slope and roughness

115. The power consumed per unit length in laminar flow for the same discharge, varies directly as D^n where D is the diameter of the pipe. What is the value of 'n'?

a. 1/2

b. -1/2

c. -2

d. -4

116. The velocity profile in a laminar boundary layer is given by $u/U = Y/\delta$. The ratio of momentum thickness to displacement thickness for the boundary is given by which one of the following?

a. 2 : 3

b. 1 : 2

c. 1 : 6

d. 1 : 3

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

List I

(Variable)

A. Dynamic Viscosity

B. Moment of momentum

C. Power

D. Volume modulus of elasticity

List II

(Dimensional Expression)

1. ML^2T^{-3}
2. $ML^{-1}T^2$
3. $ML^{-1}T^{-1}$
4. ML^2T^{-2}
5. ML^2T^{-1}

Code:

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

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

List I

(Dimensionless number)

A. Euler number

B. Weber number

C. Mach number

D. Froude number

List II

(Nature of forces involved)

1. Surface tension
2. Gravity
3. Pressure
4. Elastic

Code:

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

119. Which one of the following is correct?

In a normal shock wave in one dimensional flow

a. the entropy remains constant

b. the entropy increases across the shock

c. the entropy decreases across the shock

d. the velocity, pressure and density increase across the shock

120. Consider the following statements for compressible flow through a varying area passage:

1. For a convergent nozzle, if the exit pressure is less than critical, external flow will not be isentropic.
2. Supersonic-subsonic - diffuser would appear similar to nozzle and works without irreversibility.

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