



**MECHANICAL ENGINEERING  
(OBJECTIVE TYPE)  
PAPER – I**

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**INSTRUCTIONS**

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES NOT HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. ENCODE CLEARLY THE TEST BOOKLET SERIES **A, B, C** OR **D** AS THE CASE MAY BE IN THE APPROPRIATE PLACE IN THE ANSWER SHEET.
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. **DO NOT** write *anything else* on the Test Booklet
4. This Test Booklet contains 120 items (questions), 60 in PART – A and 60 in PART – B. Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose **ONLY ONE** response for each item.
5. You have to mark all your responses **ONLY** on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator **only the Answer Sheet**. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.

**10. Penalty for wrong answers:**

THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.

- (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third (0.33)** of the marks assigned to that question will be deducted as penalty.
- (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
- (iii) If a question is left blank, i.e. no answer is given by the candidate, there will be **no penalty** for that question.

**DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO**

01 The following remarks pertain to the properties of gases and vapours:

1. The equation of state is not by itself sufficient for the calculation of properties such as  $u$ ,  $h$  and  $s$ .
2. Throttling process is an adiabatic steady flow process.
3. Increase in entropy in wet region is directly proportional to the increase in enthalpy.

Which of these remarks are correct?

- (a) 1, 2 and 3                      (b) 1 and 2 only                      (c) 1 and 3 only                      (d) 2 and 3 only

**Ans: (b)**

02. An ideal gas at  $27^{\circ}\text{C}$  is heated at constant pressure till the volume becomes three times. The temperature of the gas will then be

- (a)  $81^{\circ}\text{C}$                       (b)  $900^{\circ}\text{C}$                       (c)  $627^{\circ}\text{C}$                       (d)  $927^{\circ}\text{C}$

**Ans: (c)**

03. A gas turbine operating on Brayton cycle has the maximum temperature of  $1200\text{K}$  and the minimum temperature of  $300\text{K}$ . The cycle efficiency for the maximum work capacity will be

- (a) 75%                      (b) 60%                      (c) 50%                      (d) 25%

**Ans: (c)**

04. No substance can exist in the liquid phase in stable equilibrium

- (a) at temperature below the triple point temperature
- (b) at pressure below the triple point pressure
- (c) at pressure above the triple point pressure
- (d) at temperature above the triple point temperature

**Ans: (b)**

05. The COP of a refrigerator working on a reversed Carnot cycle is 5. The ratio of the highest absolute temperature to the lowest absolute temperature would be

- (a) 1.25                      (b) 1.3                      (c) 1.4                      (d) 1.2

**Ans: (d)**

06. This reversible cycle consists of constant volume heat addition, reversible adiabatic expansion and constant pressure heat rejection

- (a) Otto cycle                      (b) Lenoir cycle                      (c) Atkinson cycle                      (d) Brayton cycle

**Ans: (b)**

07. An ideal vapour compression refrigerator operates between a condenser pressure  $p_1$  and an evaporator pressure  $p_2$ . Which of the following changes would increase its COP?
- Increasing  $p_1$  by  $\Delta p$  and keeping  $p_2$  constant
  - Decreasing  $p_2$  by  $\Delta p$  and keeping  $p_1$  constant
  - Adopting wet compression
  - Subcooling the refrigerant

**Ans: (d)**

08. An absorption refrigeration system is supplied with energy  $Q_1$  in the form of heat at temperature  $T_1$ , while it extracts energy  $Q_3$  as heat from a cold space at temperature  $T_3$ . The ambient temperature is  $T_2$ . Then the COP of the refrigerator is (ignoring the small amount of energy supplied in the pump)

(a)  $\frac{T_1(T_2 - T_1)}{T_3(T_1 - T_2)}$       (b)  $\frac{T_3(T_2 - T_1)}{T_1(T_1 - T_2)}$       (c)  $\frac{T_3(T_1 - T_2)}{T_1(T_2 - T_3)}$       (d)  $\frac{T_1(T_1 - T_2)}{T_3(T_2 - T_3)}$

**Ans: (c)**

09. For a 2-stage air compressor for the maximum efficiency of compressor, consider the following statements:

- $p_2 = \frac{1}{2}(p_1 + p_3)$
- $p_2 = \sqrt{p_1 \cdot p_3}$
- Intercooling between the stages is complete.
- Work is equally shared by the two stages.

Which of these statements are correct?

- (a) 1 and 4 only      (b) 1, 3 and 4      (c) 2, 3 and 4      (d) 2 and 3 only

**Ans: (c)**

10. An IC engine has a bore and stroke each equal to 2 units. The total area to calculate heat loss from the engine can be taken as

- (a)  $4\pi$       (b)  $5\pi$       (c)  $6\pi$       (d)  $8\pi$

**Ans: (c)**

11. In a petrol engine, the tendency for detonation increases with

- retarded spark timing
- running the engine at high speed
- supercharging
- increasing the cooling rate

**Ans: (c)**

12. Consider the following statements:

- Diesel fuels are compared using an ignition delay criterion.
- Cetane number is equal to the percentage of cetane plus 15% of the percentage of heptamethyl nonane in the fuel.
- Cetane number of alphas-methyl naphthalene assigned the value of 15.

Which of these statements are correct?

- (a) 1, 2 and 3      (b) 1 and 2 only      (c) 2 and 3 only      (d) 1 and 3 only

**Ans: (b)**



19. The fouling factor in heat exchanger is defined as

- (a)  $R_f = U_{\text{dirty}} - U_{\text{clean}}$                       (b)  $R_f = \frac{1}{U_{\text{dirty}}} - \frac{1}{U_{\text{clean}}}$   
(c)  $\frac{1}{R_f} = \frac{1}{U_{\text{dirty}}} - \frac{1}{U_{\text{clean}}}$                       (d)  $\frac{1}{R_f} = U_{\text{dirty}} - U_{\text{clean}}$

**Ans: (b)**

20. For quick response of a thermocouple to observe varying temperatures of fluids

- (a) wire diameter must be large  
(b) wire material density must be large  
(c) wire material specific heat must be large  
(d) wire surface heat transfer coefficients must be large

**Ans: (d)**

21. A stream of moist air at dry-bulb temperature of 40 °C and dew-point temperature of 25 °C passes through a water shower whose temperature is maintained at 20 °C. The stream of air will undergo a process of

- (a) sensible cooling                      (b) evaporative cooling  
(c) cooling and humidification                      (d) cooling and dehumidification

**Ans: (d)**

22. When unsaturated air undergoes adiabatic saturation, which of the following properties decrease(s) ?

1. Relative humidity                      2. Specific humidity  
3. Dry-bulb temperature                      4. Wet-bulb temperature  
(a) 1,2,3 and 4                      (b) 2 only                      (c) 3 only                      (d) 4 only

**Ans: (c)**

23. In a VCR plant, the refrigerant leaves the compressor and evaporator with enthalpy of 205 kJ/kg and 177kJ/kg respectively. Enthalpy of the refrigerant leaving the condenser is 105 kJ/kg. If the mass flow rate of the refrigerant is 0.2kg/s, the refrigeration effect will be

- (a) 12.2kW                      (b) 14.4kW                      (c) 16.4kW                      (d) 20.2kW

**Ans: (b)**

24. Ammonia used as refrigerant is non-corrosive to

- (a) iron and steel                      (b) copper and copper alloys  
(c) Both (a) and (b)                      (d) Neither (a) nor (b)

**Ans: (a)**

25. The following readings refer to a vapour compression refrigerator:

The enthalpy per kg of refrigerant flow, from p-h chart

At inlet to compressor- 1500kJ/kg

At outlet to compressor -1700kJ/kg

At exit of condenser – 300kJ/kg

The COP of the refrigerator is

- (a) 3                      (b) 4                      (c) 5                      (d) 6

**Ans: (d)**

26. A refrigerator based on reversed Carnot cycle works between refrigeration and condenser temperatures of  $-23^{\circ}\text{C}$  and  $27^{\circ}\text{C}$ . If a cooling rate of 5kW is desired, What will be the required power in kW?

- (a) 1                      (b) 2.5                      (c) 5                      (d) 25

**Ans: (a)**

27. A vapour compression refrigerator has a COP of 4, and extracts 10kJ of heat from the cold reservoir. If this machine is worked as a heat pump, how much heat will it deliver to the environment?

- (a) 2 kJ                      (b) 2.5kJ                      (c) 12.5kJ                      (d) 25kJ

**Ans: (c)**

28. Consider the following statements

1. An ammonia absorption refrigerator has a COP more than 3 and is superior to vapour compression system.
2. Ammonia absorption machines are preferable where waste heat is available from an existing source.
3. Absorption refrigerator has no moving part and hence needs little maintenance.
4. The partial pressure of ammonia vapour varies, being high in the condenser and low in the evaporator.

Which of these statements are correct?

- (a) 1,2,3 and 4                      (b) 1, 2 and 3 only                      (c) 2, 3 and 4 only                      (d) 1 and 4 only

**Ans: (c)**

29. An oxygen and nitrogen mixture has transmissivity for heat radiations that is practically equal to

- (a) 1                      (b) 0.5                      (c) 2                      (d) 0

**Ans: (a)**

30. The Reynolds-Colburn analogy, which is used to determine heat transfer coefficient from the measurement of frictional drag, is applicable to

- (a) circumferential fins                      (b) flat plates  
(c) rectangular fins                      (d) triangular fins

**Ans: (b)**

31. The laminar boundary layer occurs when a cold fluid flows over a hot plate. In which of the following positions, the temperature gradient assumes zero value?
- At bottom of boundary layer
  - In mid free stream of fluid
  - At top of boundary layer
  - At the junction of laminar and turbulent boundary layer

**Ans: (c)**

32. Which of the following properties of air increase with rise in temperature?
- Specific gravity
  - Specific heat
  - Thermal conductivity
  - Kinematic viscosity
- 1,2,3 and 4
  - 1,2 and 3 only
  - 2,3 and 4 only
  - 1 and 4 only

**Ans: (d)**

33. In a double-pipe counter flow heat exchanger, 1000kg/h of oil having a specific heat 20J/kg-K is cooled from 150°C to 125°C by 1250kg/h of fluid of specific heat 16J/kg-K. The fluid leaves the heat exchanger at 75°C. In such case, the temperature at which the cooling fluid is entering the heat exchanger and LMTD will be
- 25°C and 50°C
  - 50°C and 50°C
  - 50°C and 75°C
  - 75°C and 50°C

**Ans: (c)**

34. In laminar flow over a flat plate, the convective heat transfer coefficient is proportional to (x is the distance from the leading edge)
- $x^{\frac{1}{2}}$
  - $x^{-\frac{1}{2}}$
  - $x^{\frac{1}{3}}$
  - $x^{-\frac{1}{5}}$

**Ans: (b)**

35. The correct sequence for different types of heat exchangers in the decreasing order of effectiveness is
- parallel-flow, counter flow, shell & tube and cross-flow
  - cross-flow, counter flow, shell & tube and parallel-flow
  - counterflow, shell & tube, cross-flow and parallel-flow
  - counterflow, cross-flow, shell & tube and parallel-flow

**Ans: (d)**

36. When is a transient heat transfer problem considered as a lump capacity problem?
- The internal resistance of the object is negative
  - The internal resistance of the object is zero
  - The internal resistance of the object is infinite
  - The internal resistance of the object is negligible

**Ans: (d)**

37. What does NTU indicate?  
(a) Effectiveness heat exchange (b) Efficiency of heat exchanger  
(c) size of heat exchanger (d) temperature drop in heat exchanger

**Ans: (c)**

38. In a heat exchanger, the hot gases enter with a temperature of  $150^{\circ}\text{C}$  and leave at  $75^{\circ}\text{C}$ . The cold fluid enters at  $25^{\circ}\text{C}$  and leaves at  $125^{\circ}\text{C}$ . The capacity ratio of the exchanger is  
(a) 0.65 (b) 0.75 (c) 0.85 (d) 0.95

**Ans: (b)**

39. Which one of the following statements is correct?  
(a) Fins should be attached on the side where heat transfer coefficients are high  
(b) Effectiveness of fins depends on thermal conductivity only  
(c) Fins must have small thickness for better heat dissipation  
(d) In boiling heat transfer appliances, fins will be very effective

**Ans: (c)**

40. A fin will be necessary and effective only when  
(a)  $k$  is small and  $h$  is large (b)  $k$  is large and  $h$  is also large  
(c)  $k$  is small and  $h$  is also small (d)  $k$  is large and  $h$  is small  
Where  $k$ =thermal conductivity of fin material,  $h$  = convective heat transfer coefficient between the fin surface and environment temperature.

**Ans: (d)**

41. When only sensible heat is added to a sample of air, the process is represented on the psychrometric chart as a  
(a) horizontal line moving towards left direction  
(b) vertical line moving towards upward direction  
(c) horizontal line moving towards right direction  
(d) vertical line moving towards downward direction

**Ans: (c)**

42. During the sensible cooling process, specific humidity  
(a) remains constant (b) increases (c) decreases (d) Unpredictable

**Ans: (a)**

43. The comfort conditions in air conditioning system are defined by  
(a)  $22^{\circ}\text{C}$  dbt and 60% RH (b)  $25^{\circ}\text{C}$  dbt and 100% RH  
(c)  $20^{\circ}\text{C}$  dbt and 75% RH (d)  $27^{\circ}\text{C}$  dbt and 75% RH

**Ans: (a)**

44. The most suitable pair of refrigerant and absorbent combination for solar refrigeration is  
 (a) ammonia and water (b) ammonia and sodium thiocyanide  
 (c) water and lithium bromide (d) R22 and dimethylformamide

**Ans: (c)**

45. At what depth below the free surface of oil having a density of  $784\text{kg/m}^3$  will the pressure be very nearly equal to 1 bar?  
 (a) 10 metres (b) 14 metres (c) 13 metres (d) 7.84 metres

**Ans: (c)**

46. The vapour pressure is the characteristic fluid property involved in the phenomenon of  
 (a) water hammer in a pipe flow (b) cavitation  
 (c) rise of sap in a tree (d) spherical shape of rainwater drop

**Ans: (b)**

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

**List - I**  
(Fluids)

- A. Ideal fluid  
 B. Newtonian fluid  
 C. Inviscid fluid  
 D. Real fluid

**List – II**

(Viscosity equal to)

1. Zero  
 2. Non-zero  
 3.  $\mu \frac{du}{dy}$

**Code:**

A	B	C	D
(a) 1	2	3	2
(b) 2	3	3	1
(c) 1	3	1	2
(d) 2	3	1	2

**Ans: (c)**

48. For stability of a floating body  
 (M = meta centre, G = centre of gravity and B = centre of buoyancy)  
 (a) M should coincide with B and G (b) M should lie below B and G  
 (c) M should lie above B and G (d) M should lie between B and G

**Ans: (c)**

49. The resultant of all normal pressures on a body immersed in liquid acts  
 (a) through the centre of gravity of the body  
 (b) through the centre of pressure  
 (c) vertically upwards  
 (d) at metaentre

**Ans: (b)**

50. A bucket of water is hanging from a spring balance. An iron piece is suspended into water without touching any of the sides of bucket from another support. The spring balance reading will
- (a) increase (b) decrease  
(c) remain the same (d) depend on the depth of immersion

**Ans: (c)**

51. The depth of centre of pressure of a rectangular lamina immersed vertically in water up to a height  $h$  is given by
- (a)  $\frac{h}{3}$  (b)  $\frac{h}{4}$  (c)  $\frac{h}{2}$  (d)  $\frac{2h}{3}$

**Ans: (d)**

52. A piece of wood of volume  $V$  and specific gravity 0.87 floats on the surface of a liquid of specific gravity 1.31. The portion of the body which is submerged in the liquid will be
- (a) 0.335V (b) 0.665V (c) 0.87V (d) 0.13V

**Ans: (b)**

53. During floods, water entered an office having wooden tables. The position of tables, if floating, will be
- (a) legs downwards (b) legs on sides (c) legs upwards (d) Any position

**Ans: (c)**

54. The Lagrangian description of fluid motion is analogous to
- (a) control volume analysis (b) transient analysis  
(c) system analysis (d) None of the above

**Ans: (a)**

55. The flow in a pipe whose valve is being opened or closed gradually is an example of
- (a) steady flow (b) nonsteady flow  
(c) steady uniform flow (d) steady non uniform flow

**Ans: (b)**

56. A velocity potential function exists only for
- (a) steady flow (b) uniform flow (c) irrotational flow (d) compressible flow

**Ans: (c)**

57. Flow commences between two parallel plates with the upper plate moving in the direction of flow, while the other plate is stationary. The resulting flow between the plates is called
- (a) creep flow (b) couette flow (c) plug flow (d) stokes flow

**Ans: (b)**

58. A steady irrotational flow of an incompressible fluid is called  
(a) streamline flow      (b) creeping flow      (c) shear flow      (d) potential flow

**Ans: (d)**

59. Bernoulli's equation is applicable between any two points in  
(a) rotational flow of an incompressible fluid  
(b) irrotational flow of compressible or incompressible fluid  
(c) steady, rotational flow of an incompressible fluid  
(d) steady, irrotational flow of an incompressible fluid

**Ans: (d)**

60. The piezometric head is the summation of  
(a) velocity head and pressure head  
(b) pressure head and elevation head  
(c) elevation head and velocity head  
(d) velocity head, pressure head and elevation head

**Ans: (b)**

61. In a nozzle designed to produce a supersonic jet, the flow in the convergent section will always be  
(a) subsonic      (b) sonic      (c) supersonic      (d) transonic

**Ans: (a)**

62. Supersaturated condition occurs in a steam expanding through a convergent-divergent nozzle because of the delay in  
(a) change of dryness fraction      (b) change of superheat  
(c) evaporation process      (d) condensation process

**Ans: (d)**

63. The pump preferred to be used for pumping highly viscous fluids belongs to the category of  
(a) screw pump      (b) turbine pump      (c) plunger pump      (d) centrifugal pump

**Ans: (a)**

64. An adjustable blade propeller turbine is called as  
(a) Banki turbine      (b) Pelton turbine      (c) Kaplan turbine      (d) Francis-Pelton turbine

**Ans: (c)**

65. The specific speed  $N_s = \frac{N\sqrt{Q}}{H^{\frac{3}{4}}}$  for a double-suction pump is to be evaluated. The

discharge would be taken as

- (a) half the actual discharge (b) actual discharge  
(c) double the actual discharge (d) square the actual discharge

**Ans: (a)**

66. When a hydraulic turbine is operated, it is found that it has high design efficiency and this efficiency remains constant over a wide range of regulation from the design condition. The turbine is

- (a) Francis turbine (b) Propeller turbine (c) Pelton turbine (d) Kaplan turbine

**Ans: (d)**

67. The specific speed of a hydraulic turbine depends upon

- (a) speed and power developed (b) discharge and power developed  
(c) speed and head of water (d) speed, power developed and head of water

**Ans: (d)**

68. The preferred type of pump for small discharge and high heads is

- (a) centrifugal type (b) reciprocating type  
(c) axial-flow type (d) radial-flow type

**Ans: (b)**

69. In supersonic flow, if cross-section is increasing in the direction of flow

- (a) both p and V increase (b) p decreases and V increases  
(c) both p and V decrease (d) p increases and V decreases

**Ans: (b)**

70. When the fluid at sonic velocity enters a convergent-divergent passage, the velocity of the fluid.

- (a) increases continuously (b) decreases continuously  
(c) increases and then decreases (d) decreases and then increases

**Ans: (d)**

71. Across the normal shock in a flow

- (a) both p and T decrease (b) p increases and T decreases  
(c) p decreases and T increases (d) both p and T increase

**Ans: (d)**

72. The Mach number of an aircraft when the dynamic (velocity) temperature of air at entry to the engine equals the static temperature is

- (a) 1.236 (b) 1.736 (c) 2.236 (d) 2.736

**Ans: (c)**

73. Normal shock wave occurs in a one dimensional steady  
(a) converging flow (b) diverging flow (c) subsonic flow (d) supersonic flow

**Ans: (d)**

74. Principles of similitude form the basis of  
(a) performing acceptance tests  
(b) comparing two identical equipments  
(c) comparing similarity between design and actual equipment  
(d) design and testing models of prototype based on results of models

**Ans: (d)**

75. Which of the following factors determine the friction for turbulent flow of incompressible fluids in a rough pipe?  
(a) Froude number and Mach number (b) Mach number and relative roughness  
(c) Reynolds number and relative roughness (d) Froude number and relative roughness

**Ans: (c)**

76. A flat plate of 4m length is kept parallel to air flowing at 5 m/s at 15°C. Assuming the density of air to be 1.2kg/m<sup>3</sup> and dynamic viscosity to be 1.76×10<sup>-5</sup>kg/m-s, and knowing that the flow becomes turbulent when Reynolds number exceeds 5×10<sup>5</sup>, the flow will become turbulent at  
(a) 1.25m (b) 1.47 m (c) 1.52m (d) 1.74m

**Ans: (c)**

77. Boundary layer separation is caused due to  
(a) laminar flow changing to turbulent flow  
(b) velocity gradient being zero at the wall  
(c) reduction in pressure to vapour pressure  
(d) decrease in boundary layer thickness to a negligible value

**Ans: (b)**

78. The Reynolds number of a fluid flowing over a flat plate at a distance of 16cm from the leading edge is 25600. The thickness of the boundary layer at this point will be  
(a) 5mm (b) 7.5mm (c) 10 mm (d) 10.5mm

**Ans: (a)**

79. The thickness of boundary layer in a turbulent flow is  
(a)  $\frac{5x}{\sqrt{R_{NX}}}$  (b)  $\frac{5.835x}{\sqrt{R_{NX}}}$  (c)  $\frac{0.377x}{(R_{NX})^{\frac{1}{5}}}$  (d)  $\frac{5.377x}{(R_{NX})^{\frac{1}{5}}}$

**Ans: (a)**

80. A venturi meter is a device based on the Bernoulli principle and is used for measuring  
(a) velocity      (b) pressure drop      (c) total head      (d) flow rate

**Ans: (d)**

81. In an impulse steam turbine, the enthalpy drop of steam takes place in  
(a) nozzles      (b) rotor blades      (c) stator blades      (d) exhaust pipe

**Ans: (a)**

82. The gas in a cooling chamber of a closed-cycle gas turbine is cooled at  
(a) constant volume      (b) constant temperature  
(c) constant pressure      (d) None of the above

**Ans: (c)**

83. The power consumed by a reciprocating air compressor will be minimum, if the compression follows the thermodynamic  
(a) isentropic process      (b) adiabatic process  
(c) isothermal process      (d) polytropic process

**Ans: (c)**

84. Losses in a centrifugal compressor are due to  
(a) impeller channel losses only      (b) inlet losses only  
(c) Both (a) and (b)      (d) Neither (a) nor (b)

**Ans: (c)**

85. Compressors used in gas turbines are of  
(a) reciprocating type      (b) centrifugal type  
(c) axial-flow type      (d) all of the above

**Ans: (c)**

86. Stalling of blades in axial-flow compressors is the phenomenon of  
(a) airstream blocking the passage  
(b) motion of air at sonic velocity  
(c) unsteady periodic and reverse flow  
(d) airstream not able to flow over the blade contour

**Ans: (d)**

87. The multistage compression of air as compared to single-stage compression  
(a) improves volumetric efficiency for the given pressure ratio  
(b) reduces work done per kg of air  
(c) gives more uniform torque  
(d) all of the above

**Ans: (d)**

88. In a compressible fluid flow field, the Mach number indicates the ratio of  
(a) viscous force to elastic force                      (b) inertia force to elastic force  
(c) inertia force to viscous force                      (d) viscous force to gravity force

**Ans: (b)**

89. In a gas turbine power plant, reheating of gases between the high pressure and low pressure turbine stages will  
(a) improve turbine output                              (b) decrease turbine output  
(c) increase compressor output                          (d) decrease compressor work

**Ans: (a)**

90. In a gas turbine plant, regeneration is done to  
(a) increase compression work                          (b) decrease turbine work  
(c) limit the maximum temperature                      (d) improve plant efficiency

**Ans: (d)**

**Directions:**

Each of the following ten (10) items consists of two statements, one labelled as statement (I)' and the other as statement (II)'. You are to examine these two statements carefully and select the answers to these items using the code given below:

Code:

- (a) Both statement (I) and statement (II) are individually true and Statement (II) is the correct explanation of statement (I)  
(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is not the correct explanation of Statement (I)  
(c) Statement (I) is true but Statement (II) is false  
(d) Statement (I) is false but Statement (II) is true

91. Statement (I):  
Thermodynamic work is given as the product of an intensive thermodynamic property and the differential of an extensive property  
Statement (II)  
Work is not a thermodynamic property.

**Ans: (b)**

92. Statement (I)  
The view factor from the surface, say  $A_i$ , of the enclosure to all surfaces of the enclosure, including to itself, when summed, should be equal to unity by definition of the view factor.  
Statement (II)  
This is called the summation relation among the view factors for enclosure.

**Ans: (a)**

93. Statement (I)

In a binary mixture charged refrigeration system, when a leakage occurs, first the high pressure refrigerant leaks and then the low-pressure refrigerant leaks.

Statement (II):

High-pressure refrigerant has the higher boiling point and low pressure refrigerant has the lower boiling point.

**Ans: (d)**

94. Statement (I)

The pressure drop in circular ducts is lesser when compared to that in equivalent rectangular ducts.

Statement (II)

The mean velocity in a rectangular duct will be less than that in its circular equivalent.

**Ans: (a)**

95. Statement (I) :

The hydraulic power transmitted by a pipe through certain distance by means of water under pressure will be maximum when the loss of head due to friction over this distance is one-third of total head supplied.

Statement (II):

The average velocity of flow should be less than the critical velocity which corresponds to the laminar flow.

**Ans: (b)**

96. Statement (I):

Hydraulic jump is similar to normal shock in gases where supersonic flow becomes subsonic across the shock plane resulting an increase in pressure.

Statement (II):

In hydraulic jump, the Froude number is less than one and the sub critical flow changes to supercritical across the jump.

**Ans: (c)**

97. Statement (I):

A normal shock wave can not occur in convergent portion of a convergent-divergent nozzle.

Statement (II)

Shock wave is generated only when the flow is supersonic.

**Ans: (b)**

98. Statement (I)

To satisfy the momentum equation for flow with heat transfer, it is necessary to use a divergent duct or a duct with large cross sectional area so that the changes in velocity are negligible.

Statement (II):

Heat addition to a fluid in a constant area duct cannot be achieved without a drop in pressure.

**Ans: (d)**

99. Statement (I)

When a convergent-divergent nozzle operates at off design conditions, a shock wave will enter the exit and move towards the throat and vanish there.

Statement (II):

The convergent section functioning as nozzle will have only subsonic flow where no shock can exist.

**Ans: (d)**

100. Statement (I):

Radial-flow machines are used mainly for pumps where multistaging will be useful to increase the delivery head.

Statement (II):

Axial-flow pumps are useful where the head is low and discharge is large.

**Ans: (b)**

101. Which gas shows a heating effect in the Joule-Thomson experiment, while undergoing throttling process through a porous plug of cotton wool?

- (a) Carbon dioxide      (b) Hydrogen      (c) Oxygen      (d) Nitrogen

**Ans: (b)**

102. Joule-Thomson coefficient is the slope of

- (a) constant enthalpy lines on T-s diagram  
(b) constant enthalpy lines on T-p diagram  
(c) inversion curve on T-s diagram  
(d) inversion curve on T-p diagram

**Ans: (d)**

103. The difference between constant pressure specific heat  $C_p$  and constant volume specific heat  $C_v$  for pure substance

- (a) approaches zero at triple point  
(b) approaches zero as the absolute temperature approaches zero  
(c) is always equal to the gas constant R  
(d) approaches zero at critical point

**Ans: (b)**

104. When a system reaches the state of equilibrium, the following property assumes its maximum value

- (a) Availability      (b) Entropy      (c) Gibbs function      (d) Helmholtz function

**Ans: (b)**

105. 100kJ of energy is transferred from a heat reservoir at 1000K to a heat reservoir at 500K. The ambient temperature is 300K. The loss of available energy due to heat transfer process is

- (a) 20kJ      (b) 30kJ      (c) 40kJ      (d) 50kJ

**Ans: (b)**

106. For steady flow through an insulated horizontal constant diameter pipe, this property remains constant  
(a) Enthalpy (b) Internal energy (c) Entropy (d) Volume

**Ans: (a)**

107. By integrating Euler equation between two sections 1 and 2 for flow of an incompressible inviscid fluid through a pipe, we get  
(a) steady flow energy equation (b) Bernoulli equation  
(c) continuity equation (d) variable flow equation

**Ans: (b)**

108. The enthalpy drop for flow through convergent horizontal nozzles is 100kJ/kg. If the velocity of approach at inlet to the nozzle is negligible, the exit velocity of the fluid is  
(a) 20 m/s (b) 400m/s (c) 447.2m/s (d) 520.8m/s

**Ans: (c)**

109. A Carnot heat pump is used to heat a house. The outside temperature is  $-3^{\circ}\text{C}$  and the indoor temperature is  $27^{\circ}\text{C}$ . If the heat loss from the house is 40kW, the power required to operate the heat pump is  
(a) 1kW (b) 2kW (c) 3kW (d) 4kW

**Ans: (d)**

110. If the work done on a closed system is 20kJ/kg, and 40kJ/kg heat is rejected from the system, its internal energy decreases by  
(a) 20kJ/kg (b) 60kJ/kg (c)  $-20\text{kJ/kg}$  (d)  $-60\text{kJ/kg}$

**Ans: (c)**

111. Consider the following statements for a throttling process:  
1. It is an adiabatic process.  
2. There is no work transfer in the process.  
3. Entropy increases in throttling process  
Which of these statements are correct ?  
(a) 1, 2 and 3 (b) 1 and 2 only (c) 2 and 3 only (d) 1 and 3 only

**Ans: (a)**

112. A heat engine is supplied with 2512kJ/min of heat at  $650^{\circ}\text{C}$ . Heat rejection with 900kJ/min takes place at  $100^{\circ}\text{C}$ . This type of heat engine is  
(a) ideal (b) irreversible (c) impossible (d) practical

**Ans: (c)**

113. For a given temperature  $T_1$ , as the difference between  $T_1$  and  $T_2$  increase, the COP of a carnot heat pump
- (a) increases (b) decreases  
(c) does not change (d) first decrease, then increases

**Ans: (b)**

114. The continual motion of a movable device in absence of friction
- (a) violates the first law of thermodynamics  
(b) violates the second law of thermodynamics  
(c) is the perpetual motion of the second kind  
(d) is the perpetual motion of the third kind

**Ans: (a)**

115. An inventor states that his new conceptual engine, while operating between temperature limits of  $377^{\circ}\text{C}$  and  $27^{\circ}\text{C}$ , will reject 50% of heat absorbed from the source. What type of cycle will this engine have?
- (a) Carnot cycle (b) Stirling cycle (c) Impossible cycle (d) Possible cycle

**Ans: (d)**

116. In which of the following processes, the heat is fully converted into work?
- (a) Reversible adiabatic process (b) Reversible isobaric process  
(c) reversible isometric process (d) Reversible isothermal process

**Ans: (d)**

117. This process is one in which there is only work interaction between the system and the surroundings
- (a) Diabatic process (b) Adiabatic process  
(c) isothermal process (d) Quasi-static process

**Ans: (b)**

118. There is no work transfer involved in this process
- (a) Adiabatic expansion (b) Isothermal expansion  
(c) Polytropic expansion (d) free expansion

**Ans: (d)**

119. The constant volume gas thermometer works on the principle that
- (a) at low pressure, the temperature of the gas is independent of its pressure at constant volume  
(b) at high pressure, the temperature of the gas is independent of its pressure at constant volume  
(c) at low pressure, the temperature of the gas is proportional to its pressure at constant volume  
(d) at high pressure, the temperature of the gas is proportional to its pressure at constant volume

**Ans: (c)**

120. In highly rarefied gases, the concept of this loses validity
- (a) Thermodynamic equilibrium (b) continuum  
(c) stability (d) Macroscopic view point

**Ans: (b)**