MECHANICAL ENGINEERING

PAPER–I

1. Which one of the following sets of thermodynamic laws/is directly involved in determining the final properties during an adiabatic mixing process?
   a. The first and second laws of thermodynamics
   b. The second law of thermodynamics and steady flow relations
   c. Perfect gas relationship and steady flow relations
   d. The first law of thermodynamics and perfect gas relation ship

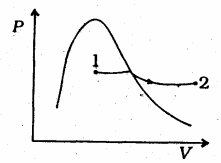
2. The air with enthalpy of 100 kJ/kg is compressed by an air compressor to a pressure and Y temperature at which its enthalpy becomes 200 kJ/kg. The loss of heat is 40 kJ/kg from the compressor as the air passes through it. Neglecting kinetic and potential energies, the power required for an air mass flow of 0.5 kJ/s is
   a. 30 kW
   b. 50 kW
   c. 70 kW
   d. 90 kW

3. Consider the following statements:
   1. The first law of thermodynamics is a law of conservation of energy.
   2. Perpetual motion machine of the first kind converts energy into equivalent work.
   3. A closed system does not exchange work or energy with its surroundings.
   4. The second law of thermodynamics stipulates the law of conservation of energy and entropy.

   Which of these statements are correct?
   a. 1 land 3
   b. 2 and 4
   c. 2, 3 and 4
   d. 1, 2 and 3

4. A heat engine receives 1000 kW of heat at a constant temperature of 285. C and rejects 492 kW of heat at 5° C. Consider the following thermodynamic cycles in this regard
   1. Carnot cycle
   2. reversible cycle
   3. Irreversible cycle

   Which of these cycles could possibly be executed by the engine?
   a. 1 alone
   b. 3 alone
   c. 1 and 2
   d. None of 1, 2 and 3

5. 

   The process 1—2 for steam shown in the given figure is
   a. isobaric
   b. isentropic
   c. isenthalpic,
   d. isothermal

6. In which one of the following working substances, does the relation $T_2 / T_1 = (p_2 / p_1)$ 0.286 hold good if the process takes place with zero heat transfer?
   a. Wet steam
   b. Superheat steam
   c. Petrol vapour and air mixture
   d. Air

7. Consider the following statements
   When dry saturated steam is throttled from a higher pressure to a lower pressure, the
   1. pressure decreases and the volume increases
   2. temperature decreases and the steam becomes superheated
   3. temperature and the dryness fraction increase
   4. entropy increases without any change in enthalpy

Which of these statements are correct?

a. 1 and 4

b. 1, 2 and 4

c. 1 and 3

d. 2 and 4.

8. 10 kg of water is heated from 300 K to 350 K in an insulated tank due to churning action by a stirrer. The ambient temperature is 300 K. In this context, match List I with list II and select the correct answer :

List I

A. Enthalpy change

B. Entropy change / kg

C. Availability / kg

D. Loss of availability

List II

1. 12.2 kJ/kg
2. 1968 kJ
3. 2090 kJ
4. 656 J /kg – K

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

9. In which one of the following situations the entropy change will be negative?

a. Air expands isothermally from 6 bars to 3 bars

b. Air is compressed to half the volume at constant pressure

c. Heat is supplied to air at constant volume till the pressure becomes three folds

d. Air expands isentropically from 6 bars to 3 bars

10. Consider the following thermodynamic relations:

1. Tds = du + pdv
2. Tds = du - pdv
3. Tds = dh + vdp
4. Tds = dh – vdp

Which of these thermodynamic relations are correct?

a. 1 and 3

b. 1 and 4

c. 2 and 3

d. 2 and 4

11. The head added to a closed system during a reversible process is given by $Q = \alpha T + \beta T^2$, where α and β are constant. The entropy change of .the system as its temperature changes from T_1 to T_2 is equal to

a. $\alpha + \beta(T_2 - T_1)$

b. $\left[\alpha + \beta(T_2 - T_1) + \beta/2\left(T_2^2 - T_1^2\right)\right]/T_1$

c. $\left[\alpha/2 + \left(T_2^2 - T_1^2\right) + \beta/3\left(T_2^3 - T_1^3\right)\right]/T_1^2$

d. $\alpha \ln(T_2/T_1) + 2\alpha(T_2 - T_1)$

12. The internal energy of a gas obeying van der Waals equation $\left(p + \frac{a}{v^2}\right)(v - b) = RT$ depends on its

a. Temperature

b. Temperature and pressure

c. Temperature and specific volume

d. Pressure and specific volume

13. Consider the following statements:

A real gas obeys perfect gas law at very

1. high temperatures
2. high pressures
3. low pressures

Which of these statements is/are correct?

a. 1 alone

b. 1 and 3

c. 2 alone

d. 3 alone

14. The Clapeyron equation with usual notations is given by

a. $(dT/dP)_{sat} = h_{fg}/Tv_{fg}$

b. $(dP/dT)_{sat} = h_{fg}/Tv_{fg}$

c. $(dT/dP)_{sat} = Th_{fg}/v_{fg}$

d. $(dP/dT)_{sat} = Th_{fg}/v_{fg}$

15. The capacity of an air compressor is specified as 10 m^3/min. It means that the compressor is capable of

a. supplying 3 m^3 of compressed air per minute

b. compressing 3 m^3 of free air per minute

c. supplying 3 m^3 of compressed air at NTP

d. compressing 3 m^3 of standard air per minute

16. A two -stage compressor takes in air at 1.1 bars and discharges at 20 bars. For maximum efficiency, the intermediate pressure is

a. 10.55 bars

b. 7.33 bars

c. 5.5 bars

d. 4.7 bars

17. For the same maximum pressure and heat input, the most efficient cycle is

a. Otto cycle

b. Diesel cycle

c. Brayton cycle

d. Dual combustion cycle

18. Consider the following statements:

1. Octane rating of gasoline is based on iso-octane and iso-heptane fuels which are paraffin's.
2. Tetraethyl lead is added to gasoline to increase octane number.
3. Ethylene dibromide is added as scavenging agent to remove lead deposits on spark plugs.
4. Surface ignition need not necessarily cause knocking.

Which of these statements are correct?

a. 1, 2, 3 and 4

b. 2, '3 and 4

c. 1 and 4

d. 1, 2 and 3

19. Consider the following statements:

1. Recycling exhaust gases with intake increases emission of oxides of nitrogen from the engine.
2. When the carburetor throttle is suddenly opened, the fuel-air mixture leans out temporarily causing engine stall.
3. The effect of increase in altitude on carburettor is to enrich the entire part-throttle operation.
4. Use of multiple venturi, system makes it possible to obtain a high velocity air stream when the fuel is introduced at the main venturi throat.

Which of these statements are correct?

a. 1 and 3

b. 1 and 2

c. 2 and 3

d. 2 and 4

20. Match List I (Air-fuel ratio by mass) with List II (Engine operation mode) and select the correct answer:

List I

A. 10: 1

B. 16: 1

C. 35 : 1

D. 12.5: 1

List II

1. CI engine part load
2. SI engine part load
3. SI engine idling
4. CI full load
5. SI full load

Codes;

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

21. Consider the following statements:

In down draft carburettor, a hot spot is formed at the bottom wall which is common for intake and exhaust manifolds. This helps to

1. improve evaporation of liquid fuel
2. provide higher thermal efficiency
3. reduce fuel consumption
4. lower the exhaust gas temperature

Which of these statements are correct?

a. 1, 2 and 4

b. 1, 2 and 3

c. 1, 3 and 4

d. 2, 3 and 4

22. In a petrol engine car, which one of the following performance characteristics is affected by the front - end volatility of the gasoline used?

a. Hot starting and vapour lock

b. Engine warm-up. and spark plug fouling

c. Spark plug fouling and hot starting
d. Vapour lock, engine warm-up and spark plug fouling

23. In turbo prop, the expansion of gases takes place approximately
a. 100% in the turbine
b. 80% in the turbine and 20% in the nozzle
c. 50% in the turbine and 50% in the nozzle
d. 100% in the nozzle

24. The most commonly used moderator in nuclear power plants is
a. heavy water
b. concrete and bricks
c. steel
d. graphite

25. Shielding in a nuclear reactor is generally done to protect against
a. excess electrons
b. X-.rays
c. α- and β-rays
d. neutron and gamma rays

26. Assertion (A): If a cube is placed in a liquid with two of its surfaces parallel to the free surface of the liquid, then the pressures on the two surfaces which are parallel to the free surface, are the same.
Reason (R): Pascal's law states that when a fluid is at rest, the pressure at any plane is the same in all directions.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

27. Assertion (A): Catalytic converters for reduction of oxides of nitrogen in engine exhaust cannot be used with leaded fuels.
Reason (R): Catalyst will be removed due to chemical corrosion by lead salts.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

28. Assertion (A): The CI engine is basically more suitable for supercharging than the SI engine.
Reason (R): In the CI engine supercharging tends to prevent diesel knocking.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

29. Assertion (A): With the help of a Bomb calorimeter, the lower calorific value of a solid or liquid fuel can be determined, as the water vapour formed is carried away by the exhaust gases.
Reason (R): The lower calorific value of a fuel is the net value of heat available found by subtracting the latent head of the water formed and carried away by exhaust gas from the higher calorific value.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

30. Assertion (A): The thermal efficiency of Brayton cycle would not necessarily increase with reheat.
Reason (R): Constant pressure lines on the T-s diagram slightly diverge with increase in entropy.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

31. Assertion (A): A thermodynamic system may be considered as a quantity of working substance with which interactions of heat and work are studied.
Reason (R): Energy in the form of work and heat are mutually convertible.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

32. Assertion (A): All analyses of heat transfer in turbulent flow must eventually rely on experimental data.

Reason (R): The eddy properties vary across the boundary layer and no adequate theory is available to predict their behaviour.

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

b. Both A and R are 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

33. Assertion (A): The leakage heat transfer from the outside surface of a steel pipe carrying hot gases is reduced to a greater extent on providing refractory brick lining on the inside of the pipe as compared to that with brick lining on the outside.

Reason (R): The refractory brick lining on the inside of the pipe offers a higher thermal resistance.

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

b. Both A and R are 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

34. Assertion (A): Thermal conductance of heat pipe is several hundred times that of the best available metal conductor under identical conditions.

Reason (R): The value of latent heat is far greater than that of specific heat.

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

b. Both A and R are 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

35. Assertion (A): The efficiency of a pump is generally less than that of a turbine.

Reason (R): Although the losses in the two types of machines are of the same kind, the losses in pumps are more due to eddies and turbulence.

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

b. Both A and R are 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

36. Assertion (A): Modem turbines have velocity compounding at the initial stages and pressure compounding in subsequent stages.

Reason (R): Excessive tip leakage occurs in the high pressure region of reaction balding.

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

b. Both A and R are 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

37. Assertion (A): The air-fuel ratio employed in a gas turbine is around 60 : 1.

Reason (R): A lean mixture of 60 : 1 in a gas turbine is mainly used for complete combustion.

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

b. Both A and R are 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

38. Which one of the following pairs of features and compressors type is NOT correctly matched?

a. Intake and delivery ports compression is attained by back flow and internal compression cylindrical rotor set to eccentric casing : Vane compressor

b. Intermittent discharge requires receiver, produces high pressure, slow speed and lubrication problems : Reciprocating compressor

c. Continuous flow, radial flow, handles large volume, much higher speed and fitted into design of aero- engines: Centrifugal compressor

d. Successive pressure drops through contracting passages, blades are formed from a number of circular arcs, axial flow

39. Consider the following statements:

1. Forced circulation is always used in high pressure power boilers.
2. Soot blowers are used for cleaning tube surfaces at regular intervals.
3. Electrostatic precipitator is used to remove fly ash from flue gases.

Which of these statements are correct?

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

40. Once - through boilers operate at

a. subcritical pressure
b. supercritical pressure
c. subcritical as well as supercritical pressure
d. critical pressure only

41. Match List I (Components) with List II (Functions) and select the correct answer:

List I

A. Steam trap
B. Fusible plug
C. Blow-off cock
D. Feed check valve

List II

1. Controls steam flow rate
2. Controls rate of water flow to boiler
3. Puts off furnace fire when water level reaches unsafe limit
4. Removes mud and dirt collected at the bottom of boiler
5. Drains off water collected by partial condensation of steam in pipes

Codes;

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

42. Partial admission steam turbine refers to the situation where the

a. steam is admitted partially into the blades through nozzles
b. nozzles occupy the complete circumference leading into the blade annulus
c. nozzles do not occupy the complete circumference leading into the blade annulus
d. steam is admitted partially into the blades directly

43. Consider the following statements regarding a 100% reaction turbine

1. Change in absolute velocity of steam across the moving blades is zero.
2. Change in absolute velocity of steam across the moving blades is negative.
3. Enthalpy drop in fixed blades is zero.

Which of these statements is /are correct?

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

44. Which one of the following pairs is NOT correctly matched?

a. Internal efficiency of steam turbine : Product of stage efficiency and reheat factor
b. Stage efficiency of a turbine : Ratio of adiabatic heat drop to the isentropic heat drop per stage
c. Dryness fraction of a steam within a stage. : Decreases due to reheating
d. Steam condensation during expansion through the turbine : Enhances blade erosion

45. Consider the following statements:

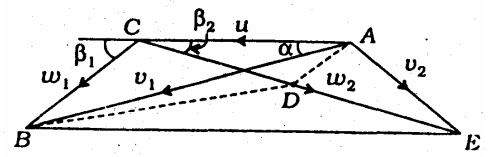
For supersaturated flow through a steam nozzle, the

1. enthalpy drop reduces further
2. exit temperature increases
3. flow rate increases

Which of these statements are correct?

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

46. Velocity triangle for a reaction turbine stage is shown in the given figure. (AB = v_1 = absolute velocity at rotor blade inlet; CB = w_1 = relative velocity at rotor blade intel; CE = w_2 = relative velocity at rotor balade exit and CD = CB)



The ratio of reaction force to impulse force is

a. CE/CB
b. CD/CE
c. DE/BD
d. AE/AB

47. Consider the following statements:

1. Throttle governing improves quality of steam in the last few stages.
2. Internal efficiency of steam is not seriously effected by throttle governing.
3. Throttle governing is better than nozzle governing.

Which of these statements are correct?

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

48. Which one of the following statements is correct?

a. Reheat factor is zero if efficiency of the turbine is close to unity
b. Lower the efficiency, higher will be the reheat factor
c. Reheat factor is independent of steam conditions at turbine inlet
d. Availability of reheat is higher at lower pressure end

49. In a steam power plant, the ratio of the isentropic heat drop in the prime mover to the amount of heat supplied per unit mass of steam is known as

a. stage efficiency
b. degree of reaction
c. Rankine efficiency
d. relative efficiency

50. The critical pressure ratio for maximum discharge through a nozzle is given by

a. $\left(\frac{n+1}{2}\right)^{\frac{n}{n-1}}$

b. $\left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$

c. $\left(\frac{n+1}{2}\right)^{\frac{n-1}{n}}$

d. $\left(\frac{2}{n+1}\right)^{\frac{n-1}{n}}$

51. Consider the following statements:

The volumetric efficiency of a reciprocating compressor can be enhanced by

1. heating the intake air
2. decreasing the clearance volume
3. cooling the intake air

Which of these statements is / are correct?

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

52. Reciprocating compressors are provided with

a. simple disc/ plate valve
b. poppet valve
c. spring-loaded disc valve
d. solenoid valve

53. Consider the following statements : In centrifugal compressors, there is a tendency of increasing surge when

1. the number of diffuser vanes is less than the number of impeller vanes
2. the number of diffuser vanes is greater than the number of impeller vanes
3. the number of diffuser vanes is equal to the number of impeller vanes
4. mass flow is greatly in excess of that corresponding to the design mass flow

Which of these statements is/are correct?

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

54. In an axial flow compressor design, velocity diagrams are constructed from the experimental data of aerofoil cascades. Which one of the following statements in this regard is correct?

a. Incidence angle of the approaching air is measured from the trailing edge of the blade

b. δ is the deviation angle between the angle of incidence and tangent to the camber line

c. The deflection ε of the gas stream while passing through the cascade is given by $\varepsilon = \alpha_1 - \alpha_2$

d. ε is the sum of the angle of incidence and camber less any deviation angle, i.e. $\varepsilon = i + \theta - \delta$

55. The efficiency of a simple gas turbine can be improved by using a regenerator, because the

a. work of compression is reduced

b. heat required to be supplied is reduced

c. work output of the turbine is increased

d. heat rejected is increased

56. Which one of the following pairs of formulae represents the specific speeds of turbine and pump respectively? (Notations have their usual meanings)

a. $NQ^{1/2} / H^{3/4}$ and $NP^{1/2} H^{5/4}$

b. $NQ^{1/2} / H^{3/4}$ and $NP^{1/2} H^{3/4}$

c. $NP^{1/2} / H^{3/4}$ and $NQP^{1/2} H^{5/4}$

d. $NP^{1/2} / H^{5/4}$ and $NQ^{1/2} H^{3/4}$

57. Consider the following turbines / wheels:

1. Francis turbine
2. Pelton wheel with two or more jets
3. Pelton wheel with a single jet
4. Kaplan turbine

The correct sequence of these turbines/ wheels in increasing order of their specific speeds is

a. 2, 3, 1, 4

b. 3, 2, 1, 4

c. 2, 3, 4, 1

d. 3, 2, 4, 1

58. The gross head available to a hydraulic power plant is 100 m. The utilized head in the runner of the hydraulic turbine is 72 m. If the hydraulic efficiency of the turbine is 90%, the pipe friction head is estimated to be

a. 20m

b. 18m

c. 16.2m

d. 1.8m

59. Match List I (Outlet vane angle 3 2) with List II (Curves labelled 1, 2 and 3 in the given figure) for a pump and select the correct answer

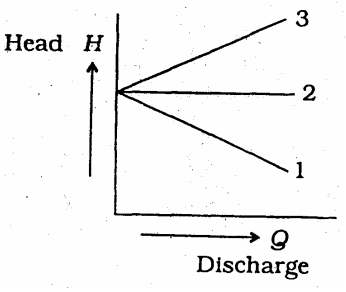
List I

A. $\beta_2 < 90°$

B. $\beta_2 = 90°$

C. $\beta_2 > 90°$

List II



Codes;

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

60. Consider the following statements regarding the volute casting of a centrifugal pump

1. Loss of heat due to change in velocity is eliminated.
2. Efficiency of the pump is increased.
3. Water from the periphery of the impeller is collected and transmitted to the delivery pipe at constant velocity.

Which of these statements are correct?

a. 1, 2 and 3

b. 1 and 2

c. 2 and 3

d. 1 and 3

61. The cavitations number of any fluid machinery is defined $\sigma = \frac{p - p'}{\rho V^2 / 2}$ (P is absolute pressure, ρ is density and V is free stream velocity) The symbol p' denotes

a. static pressure of fluid

b. dynamic pressure of fluid

c. vapour pressure of fluid

d. shear stress of fluid

62. Consider the following statements,:

A water turbine governor

1. helps in starting and shutting down the turbo unit.
2. controls the speed of turbine set to match it with the hydroelectric system
3. sets the amount of load' which a turbine unit has to carry

Which of these, statements are correct?

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

63. Consider the following, statements regarding a torque converter:

1. Its maximum efficiency is less than that of the fluid coupling.
2. It has two runners and a set of stationary vanes interposed between them.
3. It has two runners.
4. The ratio of secondary to primary torque is zero for the zero value of angular velocity of secondary.

Which of these statements are correct?

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

64. Consider the following statements:

The reheat cycle helps to reduce

1. field consumption
2. steam flow
3. the condenser size

Which of these statements are correct?

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

65. The outer surface of a long cylinder is maintained at constant temperature. The cylinder does not have any heat source The temperature in the cylinder will

a. increase linearly with radius
b. decrease linearly with radius
c. be independent of radius
d. vary logarithmically, with radius

66. A composite plane wall is made up of two different materials of the same thickness and having thermal conductivities of k_1 and k_2 respectively. The equivalent thermal conductivity of the slab is

a. $k_1 + k_2$
b. $k_1 k_2$
c. $\dfrac{k_1 + k_2}{k_1 k_2}$
d. $\dfrac{2k_1 k_2}{k_1 + k_2}$

67. A copper wire of radius 0.5 mm is insulated with a sheathing of thickness 1 mm having a thermal conductivity of 0.5 W/m -K. The outside surface convective heat transfer coefficient is 10 W/m^2 - K. If the thickness of. insulation sheathing is' raised by 10 mm, then the electrical current-carrying capacity of the wire will

a. increase
b. decrease
c. remain the same
d. vary depending upon the electrical conductivity of the wire

68. For the fully developed laminar flow and heat transfer in a uniformly heated long circular tube, if the flow velocity is doubled and the tube diameter is halved, the' heat transfer coefficient will be

a. double of the original value
b. half of the original value
c. same as before
d. four times of the original value

69. Heat transfer by radiation between two grey bodies of emissivity is proportional to (notations have their usual meanings)

a. $\dfrac{(E_b - J)}{(1-\varepsilon)}$
b. $\dfrac{(E_b - J)}{(1-\varepsilon)/\varepsilon}$
c. $\dfrac{(E_b - J)}{(1-\varepsilon)^2}$
d. $\dfrac{(E_b - J)}{(1-\varepsilon^2)}$

70. Solar radiation of 1200 W/m^2 falls perpendicularly on a grey opaque surface of emissivity 05 If the surface temperature is 50°C and surface emissive power is 600 W/m^2, the radiosity of that surface will be

a. 600 W/m^2
b. 1000 W/m^2
c. 1200 W/m^2
d. 1800 W/m^2

71. The overall heat, transfer coefficient U for a plane composite wall of n layers is given by (the thickness of the i th layer is t_i, thermal conductivity of the i th layer is k_i, convective, heat transfer coefficient. Is h)

a. $\dfrac{1}{\dfrac{1}{h_1}+\sum_{i=1}^{n}\dfrac{t_i}{k_i}+\dfrac{1}{h_n}}$

b. $h_1+\sum_{i=1}^{n}\dfrac{t_i}{k_i}+h_n$

c. $\dfrac{1}{\dfrac{1}{h_1}+\sum_{i=1}^{n}\dfrac{t_i}{k_i}+h_n}$

d. $\dfrac{1}{h_1}+\sum_{i=1}^{n}\dfrac{t_i}{k_i}+\dfrac{1}{h_n}$

72. The equation of effectiveness $\varepsilon = 1 - e^{-NTU}$ of a heat exchanger is valid (NTU is number of transfer units) in the case of

a. boiler and condenser for parallel flow
b. boiler and condenser for counterflow
c. boiler and condenser for both parallel flow and counterflow
d. gas turbine for both parallel flow and counterflow

73. Match List I with list II and select the correct answer:

List I

A. Fin
B. Heat exchanger
C. Transient conduction
D. Heisler chart

List II

1. UA/C_{min}
2. $x/2\sqrt{\alpha\tau}$
3. $\sqrt{hp/kA}$
4. hL / K

Codes;

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

74. The Nusselts number is related to Reynolds number in laminar and turbulent flows respectively as

a. $Re^{-1/2}$ and $Re^{0.8}$
b. $Re^{1/2}$ and $Re^{0.8}$
c. $Re^{-1/2}$ and $Re^{0.8}$
d. $Re^{-1/2}$ and $Re^{-0.8}$

75. In respect of free convection over a vertical flat plate the Nusselt number varies with Grashof number 'Gr' as

a. Gr and $Gr^{1/4}$ for laminar and turbulent flows respectively
b. $Gr^{1/2}$ and $Gr^{1/3}$ for laminar and turbulent flows respectively
c. $Gr^{1/4}$ and $Gr^{1/3}$ for laminar and turbulent flows respectively
d. $Gr^{1/3}$ and $Gr^{1/4}$ for laminar and turbulent flows respectively

76. Consider the following conditions for heat transfer (thickness of thermal boundary layer is δ_t velocity of boundary layer is δ_t, and δ Prandtl number is P_r)

1. $\delta_t(x)=\delta(x) if \quad P_r=1$
2. $\delta_t(x)>>\delta(x) if \quad P_r<<1$
3. $\delta_t(x)<<\delta(x) if \quad P_r>>1$

Which of these conditions apply for convective heat transfer?

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

77. The enthalpies at the beginning of compression, at the end of compression and at the end of condensation are respectively 185 kJ/kg, 210 kJ/kg and 85 kJ/kg. The COP of the vapour compression refrigeration system is

a. 0.25
b. 5.4
c. 4

d. 1.35

78. Consider the following statements regarding refrigerants:

1. Refrigerant NH_3 is used in reciprocating compressors.
2. Refrigerant CO_2 is used in reciprocating compressors.
3. Refrigerant R -11 is used in centrifugal compressors.

Which of these statements are correct?

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

79. The COP of a heat pump β_{HP} and the COP of a refrigerator β_{Ref} are related as

a. $\beta_{HP} + \beta_{Ref} = 1$
b. $\beta_{HP} - \beta_{Ref} = 1$
c. $\beta_{Ref} - \beta_{HP} = 1$
d. $\beta_{HP} + \beta_{Ref} = 0$

80. Consider the following statements:

The pressure in a horizontal capillary tube of a refrigeration system decreases due to the

1. frictional resistance offered by the tube wall
2. acceleration of refrigerant in the tube
3. heat transfer from the tube wall
4. decrease in the potential energy

Which of these statements are correct?

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

81. The discharge pressure of the compressor in the refrigeration system goes up due to the

a. Lower volumetric efficiency of the compressor
b. Formation of scale in the condenser
c. Large size of the condenser
d. Undercharge of the refrigerant

82. The leakage in a Freon-based refrigeration system can be detected by using a/an

a. Oxy-acetylene torch
b. Halide torch
c. Sulphur torch
d. Blue litmus paper

83. Consider the following statements:

1. Azeotropes are the mixtures of refrigerants and behave like pure substances.
2. Isomers refrigerants are compounds with the same chemical formula but have different molecular structures.
3. The formula n + p + q = 2m I used for unsaturated chlorofluorocarbon compounds (m, n, p and q are the numbers of atoms of carbon, hydrogen, fluorine and chlorine respectively)

Which of the statements are correct?

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

84. Consider the following statements:

The typical air velocities in the ducts of air-conditioning systems are

1. lower in residential buildings as compared to those of public buildings
2. higher in residential building as compared to those of public buildings
3. higher in industrial buildings as compared to those of public buildings
4. equal in all types of buildings

Which of these statements s/are correct?

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

85. When warm saturated air is cooled

a. excess moisture condenses
b. excess moisture condenses but relative humidity remains unchanged
c. excess moisture condenses and specific humidity increase but relative humidity remains unchanged
d. specific humidity increases and relative humidity decreases

86. When d-bulb and wet-bulb temperatures are identical, it means that the

a. air is fully saturated and dew-point temperature has reached
b. air is fully saturated

c. dew-point temperature has reached and humidity is 100%

d. partial pressure of water vapour is equal to total pressure

87. Consider the following parameters:

1. Dry-bulb temperature
2. Humidity ratio
3. Air velocity
4. Solar radiation intensity

Which of these parameters are taken into account for determining effective temperature for human comfort?

a. 1 and 2

b. 1 and 4

c. 2, 3 and 4

d. 1, 2 and 3

88. The desirable air velocity in the occupied zone for comfort for summer air-conditioners is in the range of

a. 6 - 7 m/minute

b. 4 - 5 m/minute

c. 2 - 3 m/minute

d. 0.5 - 1.5 m/minute

89. Consider the following statements:

1. The recommended outside air required per person for an auditorium is approximately 0.25 m^3/min.
2. Outside air for ventilation purposes causes sensible heat load and also latent heat load.
3. The sensible heat factor for an auditorium is generally kept as 0.7.

Which of these statements are correct?

a. 1 and 2

b. 2 and 3

c. 1 and 3

d. 1, 2 and 3

90. An air-conditioned room of volume 10 m^3 has infiltration of air equivalent to 3 air changes. Density of air is 1.2 kg/m^3, specific heat C_p is 1 kJ/kg - K and temperature difference between room and ambient air is 20 K. The sensible heat load due to infiltrated air is

a. 60 kJ/hr

b. l2 kJ/hr

c. 6 kW

d. 0.2 kW

91. If heat and mass transfer take place simultaneously the ratio of heat transfer coefficient to the mass transfer coefficient is a function .of the ratio of

a. Schmidt and Reynolds numbers

b. Schmidt and Prandtl numbers

c. Nusselt and Lewis numbers

d. Reynolds and Lewis numbers

92. An aeroplane travels at 400 km/hr at sea level where the temperature is 15° C. The velocity of the aeroplane at the same Mach number at an altitude where a temperature of - 25 °C is prevailing, would be

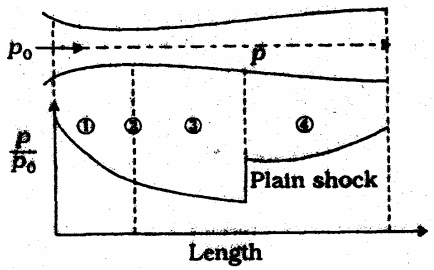
a. 126.78 km/hr

b. 130.6 km/hr

c. 371.2 km/hr

d. 400.10 km/hr

93.



The plot for the pressure ratio along the length of the convergent -divergent nozzle is shown in the given figure. The sequence of the flow conditions labelled ①, ②, ③ and ④ in the figure is respectively

a. supersonic, sonic, subsonic and supersonic

b. Sonic, supersonic subsonic and supersonic.

c. subsonic, supersonic, sonic and subsonic

d. sonic, sonic supersonic and subsonic

94. If the full-scale turbine is required to work under a head of 30 m and to run at 428 r.p.m., then a quarter-scale turbine model tested under a head of 10 m must run at

a. 143 r.p.m.

b. 341 r.p.m.

c. 428 r.p.m.

d. 988 r.p.m.

95. The dimensionless group formed by wavelength λ, density of fluid ρ, acceleration due to gravity g and surface tension σ, is

a. $\sigma / \lambda^2 g \rho$

b. $\sigma / \lambda g^2 \rho$

c. $\sigma g / \lambda^2 \rho$

d. $\sigma / \lambda^2 g \sigma$

96. Which one of the following sets of standard flows is superimposed to represent the flow around a rotating cylinder?

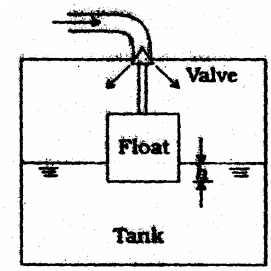
a. Doublet, vortex and uniform flow

b. Source, vortex and uniform flow

c. Sink, vertex and uniform flow

d. Vertex and uniform flow

97.



A float of cubical shape has sides of 10 cm. The float valve just touches the valve seat to have a flow area of 0.5 cm^2 as shown in the given figure. If the pressure of water in the pipeline is 1 bar, the rise of water level h in the tank to just stop the water flow will be

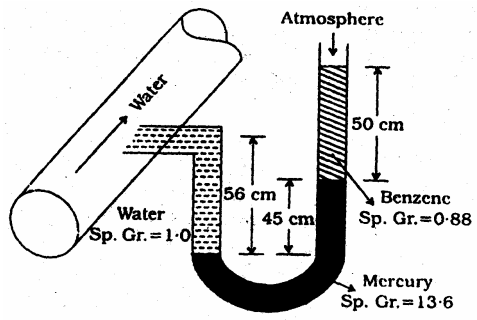
a. 7.5 cm

b. 5.0 cm

c. 2.5cm

d. 0.5 cm

98.



A U- tube manometer is connected to a pipeline conveying water as shown in the given figure. The pressure head of water in the pipeline is

a. 7.12 m

b. 6.56 m

c. 6.0 m

d. 5.12 m

99. The eye of a tornado has a radius of 40 m. If the maximum wind velocity is 50 m/s, the velocity at a distance of 80 m radius is

a. 100 m/s

b. 2500 m/s

c. 31.25 m/s

d. 25 m/s

100. If a vessel containing liquid moves downward with constant acceleration g, then

a. the pressure throughout the liquid mass is atmospheric

b. the pressure in the liquid mass is greater than the hydrostatic pressure

c. there will be vacuum in the liquid

d. the pressure throughout the liquid mass is greater than atmospheric

101. Improved streamlining produces 25% reduction in the drag coefficient of a torpedo. When it is traveling fully submerged and assuming the driving power to remain the same, the increase in speed will be

a. 10%

b. 20%

c. 25%

d. 30%

102. If a bullet is fired in standard air at 15 °C at the Mach angle of 30°, the velocity of the bullet would be

a. 513.5 m/s

b. 585.5 m/s

c. 645.5 m/s

d. 680.5 m/s

103. A stream function is given by $(x^2 - y^2)$. The potential function of the flow will be

a. 2xy + f(x)

b. 2xy + constant

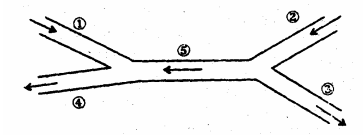
c. $2(x^2 - y^2)$

d. 2xy + f(y)

104. The height of a cylindrical container is twice that of its diameter. The ratio of the horizontal forces on the wall of the cylinder when it is completely filled to that when it is half filled with the same liquid, is

a. 2
b. 3
c. 3.5
d. 4

105.



The velocities and corresponding flow areas of the branches labelled ①, ②, ③, ④ and ⑤ for pipe system shown in the given figure are given in the following table

Pipe Label 1	Velocity	Area
①	5 cm/s	4 sq cm
②	6 cm/s	5 sq cm
③	V_3 cm/s	2 sq cm
④	4 cm/s	10 sq cm
⑤	V_5 cm/s	8 sq cm

The velocity V_5 would be

a. 2.5 cm/s
b. 5 cm/s
c. 7.5 cm/s
d. 10 cm/s

106. A pipe is connected in series to another pipe whose diameter is twice and length is 32 times that of the first pipe. The ratio of frictional head losses for the first pipe to those for the second pipe is (both the pipes have the same frictional constant)

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

107. Which one of the following statements is correct?

a. Hydraulic grade line and energy grade line are the same in fluid flow problems
b. Energy grade line lies above the hydraulic grade line and is always parallel to it
c. Energy grade line lies above the hydraulic grade line and they are separated from each other by a vertical distance equal to the velocity head
d. The hydraulic grade line slopes upwards meeting the energy grade line only at the exit of flow

108. If laminar flow takes place in two pipes, having relative rough nesses of 0.002 and 0.003, at a Reynolds number of 1815, then

a. the pipe of relative roughness of 0.003 has a higher friction factor
b. the pipe of relative roughness of 0.003 has a lower friction factor
c. both pipes have the same friction factor
d. no comparison is possible due to inadequate data

109. A pipeline connecting two reservoirs has its diameter reduced by 20% due to deposition of chemicals. For a given head difference in the reservoirs with unaltered friction factor, this would cause a reduction in discharge of

a. 42.8%
b. 20%
c. 17.8%
d. 10.6%

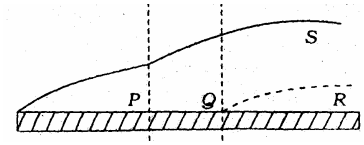
110. A tank containing water has two orifices of the same size at depths of 40 cm and 90 cm below the free surface of water. the ratio of discharges through these orifices is

a. 1:1
b. 2:3
c. 4:9
d. 16:81

111. A Pitot static tube is used to measure the velocity of water using a differential gauge which contains a manometric fluid of relative density 1.4. The deflection of the gauge fluid when water flows at a velocity of 1.2 m/s will be (the coefficient of the tube may be assumed to be 1)

a. 183.5 mm
b. 52.4 mm
c. 5.24 mm
d. 73.4 mm

112. The development of boundary layer zones labelled F Q, R and S over a flat plate is shown in the given figure



Based on this figure, match List I (Boundary layer zones) with List II (Types of boundary layer) and select the correct answer:

List I

A. P

B. Q

C. R

D. S

List II

1. Transitional
2. Laminar viscous sub-layer
3. Laminar
4. Turbulent

Codes;

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

113. A pipe of 20 cm diameter and 30 km length transports oil from a tankers to the shore with a velocity of 0.318 m/s. The flow is laminar. If μ = 0.1 N – m/s^2, the power required for the flow would be

a. 9.25 kW

b. 8.36 kW

c. 7.63 kW

d. 10.13 kW

114. In a turbulent boundary layer over the entire length of a plate, the boundary layer thickness increases with its distance X from the leading edge as

a. $X^{1/2}$

b. $X^{1/5}$

c. $X^{2/5}$

d. $X^{4/5}$

115. Separation of fluid flow is caused by

a. Reduction of pressure in the direction of flow

b. Reduction of the boundary layer thickness

c. Presence of adverse pressure gradient

d. Presence of favourable pressure gradient

116. When pressure drag over a body is large as compared to the friction drag, then the shape of the body is that of

a. An aerofoil

b. A streamlined body

c. A two-dimensional body

d. A bluff body

117. A circular cylinder of 400 mm diameter is rotated about its axis is a stream of water having a uniform velocity of 4 m/s. When both the stragnation points coincide, the lift force experienced by the cylinder is

a. 160 kN/m

b. 10.05 kN/m

c. 80 kN/m

d. 40.2 kN/m

118. An automobile moving at a velocity of 40 km/hr is experiencing a wind resistance of 2 kN. If the automobile is moving at a velocity of 50 km/hr, the power required to over-come the wind resistance is

a. 43.4 kW

b. 3.125 kW

c. 2.5 kW

d. 27.776 kW

119. When a cylinder is placed in an ideal fluid and the flow is uniform, the pressure coefficient C_p is equal to

a. $1 - \sin^2 \theta$

b. $1 - 2 \sin^2 \theta$

c. $1 - 4 \sin^2 \theta$

d. $1 - 8 \sin^2 \theta$

120. If the upstream Mach number of a normal shock occur-ring in air (k = 1.4) is 1.68, then the Mach number after the shock is

a. 0.84

b. 0.646

c. 0.336

d. 0.564