I.E.S-(OBJ) 2002

MECHANICAL ENGINEERING

PAPER-I

1. Which of the following is/are related to measure the discharge by a rectangular notch?

   1. 2/3 Cd. b $\sqrt{2g}$ H^2
   2. 2/3 Cd. b $\sqrt{2g}$ $H^{3/2}$
   3. 2/3 Cd. b $\sqrt{2g}$ $H^{5/2}$
   4. 2/3 Cd. b $\sqrt{2g}$ $H^{1/2}$

   Select the correct answer using the codes given below:

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

2. The critical value of Reynolds number for transition from laminar to turbulent boundary layer in external flows is taken as

   a. 2300
   b. 4000
   c. 5×10^5
   d. 3×10^6

3. The boundary layer flow separates from the surface if

   a. du/dy = 0 and dp/dx = 0
   b. du/dy = 0 and dp/dx > 0
   c. du/dy = 0 and dp/dx < 0
   d. The boundary layer thickness is zero

4. The laminar boundary layer thickness, δ at any point x for flow over a flat plate is given by δ/x =

   a. $\frac{0.664}{\sqrt{Re_x}}$
   b. $\frac{1.328}{\sqrt{Re_x}}$
   c. $\frac{1.75}{\sqrt{Re_x}}$
   d. $\frac{5.0}{\sqrt{Re_x}}$

5. Volumetric flow rate Q, acceleration due to gravity g arid head H form a dimensionless group, which is given by

   a. $\sqrt{\frac{gH^5}{Q}}$
   b. $\frac{Q}{\sqrt{gH}}$
   c. $\frac{Q}{\sqrt{g^3H}}$
   d. $\frac{Q}{\sqrt{g^2H}}$

6. A model test is to be conducted in a water tunnel using a 1: 20 moel of a submarine, which is to travel at a speed of 12 km/h deep under sea surface. The water temperature in the tunnel is maintained, so that its kinematics viscosity is half that of sea water. At what speed is the model test to be conducted to produce useful data for the prototype?

   a. 12 km/h
   b. 240 km/h
   c. 24 km/h
   d. 120 km/h

7. A model test is to be conducted for an under water structure, which is likely to be exposed to strong water currents. The significant forces are known to be dependent on structure geometry, fluid velocity, fluid density and viscosity, fluid depth and acceleration due to gravity. Choose from the codes given below, which of the following numbers must match for the model with that of the prototype

   1. Mach number
   2. Weber number
   3. Froude number
   4. Reynolds number

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

d. 3 and 4

8. During subsonic, adiabatic flow of gases in pipes with friction, the flow properties go through particular mode of changes. Match List I (Flow properties) with List II (Mode of changes) and select the correct answer:

List I

A. Pressure

B. Density

C. Temperature

D. Velocity

List II

1. Increase in flow direction
2. Decreases with flow direction

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

9. Which of the 1øllowih statements is/are true in case of one-dimensional flow of perfect gas through a converging-diverging nozzle?

1. The exit velocity is always supersonic
2. the exit velocity can be subsonic or supersonic
3. If the flow is isentropic, the exit velocity must be supersonic
4. If the exist velocity is supersonic, the flow must be isentropic

Select the correct answer using the codes given below:

a. 2 and 4

b. 2, 3 and 4

c. 1, 3 and 4

d. 2 alone

10. In a normal shock in a gas

a. The stagnation density remains the same on both sides of the shock

b. The stagnation density remains the same on both sides of the shock

c. The stagnation temperature remains the same on both sides of the shock

d. The Mach number remains the same on both sides of the shock

11. A normal shock

a. Causes a disruption and reversal of flow pattern

b. May occur only in a diverging passage

c. Is more severe than an oblique shock

d. Moves with a velocity equal to the sonic velocity

12. Fluid flow machines are using the principle of either (i) supplying energy to the fluid or (ii) extracting energy from the fluid. Some fluid flow machines are a combination of both (i) and (ii). They are classified as

a. Compressors

b. Hydraulic turbines

c. Torque converters

d. Wind mills

13. Consider the following statements:

1. Pelton wheel is a tangential flow impulse turbine
2. Francis turbine is an axia flow reaction turbine
3. Kaplan turbine is a radial flow reaction turbine

Which of the above statements is/are correct?

a. 1 and 3

b. 1 alone

c. 2 alone

d. 3 alone

14. Match List I (Hydraulic Turbine) with List II (Application Area) and select the correct answer:

List I

A. Pelton turbine

B. Francis turbine

C. Kaplan turbine

List II

1. Low head, large discharge
2. Medium head, medium discharge
3. High head, low discharge

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

15. Efficiency of Pelton wheel shall be maximum if the ratio of jet velocity to tangential velocity of the wheel is

a. 1/2

b. 1

c. 2

d. 4

16. The maximum efficiency in the case of Pelton wheel is (angle of deflection of the jet = 180 – β)

a. $\frac{1-\cos\beta}{2}$

b. $\frac{1+\cos\beta}{2}$

c. $\frac{\cos\beta}{2}$

d. $\frac{1+\cos\beta}{4}$

17. If H is the head available for a hydraulic turbine the power speed and discharge respectively are proportional to

a. $H^{1/2}, H^{1/2}, H^{3/2}$

b. $H^{3/2}, H^{1/2}, H^{1/2}$

c. $H^{1/2}, H^{3/2}, H^{1/2}$

d. $H^{1/2}, H^{1/2}, H$

18. In the phenomenon of cavitations, the characteristic fluid property involved is

a. Surface tension

b. Viscosity

c. Bulk modulus of elasticity

d. Vapour pressure

19. A pump running at 1000 RPM consumers 1kW and generates head of 10m of water. When it is operated at 2000 RPM, its power consumption and head generated would be

a. 4 kW, 50 m of water

b. 6kW, 20 m of water

c. 3 kW, 30 m of water

d. 8kW, 40 m of water

20. A centrifugal pump gives maximum efficiency when its blades are

a. Bent forward

b. Bend backward

c. Straight

d. Wave shaped

21. In utilizing scaled models in the designing of turbo machines, which of the following relationships must be satisfied?

a. $\frac{H}{ND^3} = \text{constant}; \frac{Q}{N^2D^2} = \text{constant}$

b. $\frac{H}{D^2\sqrt{H}} = \text{constant}; \frac{H}{N^3D} = \text{constant}$

c. $\frac{P}{QH} = \text{constant}; \frac{H}{N^2D^2} = \text{constant}$

d. $\frac{NQ^{1/2}}{H^{3/2}} = \text{constant}; \frac{NP^{1/2}}{H^{3/4}} = \text{constant}$

22. The correct sequence of the centrifugal pump components through which the fluid flows is

a. Impeller, Suction pipe, foot value and strainer, Delivery pipe

b. Foot value and strainer, suction pipe, Impeller, Delivery pipe

c. Impeller, Suction pipe, Delivery pipe, Foot value strainer

d. Suction pipe, Delivery pipe, Impeller, Foot valva and strainer

23. A centrifugal pump driven by a directly coupled 3kW motor of 1450-rpm speed, is proposed to be connected to another motor of 2900-rpm speed. The power of the motor should be

a. 6kW

b. 12kW

c. 18kW

d. 4kW

24. A draft tube is used in a reaction turbine

a. To guide water downstream without splashing

b. To converter residual pressure energy into kinetic energy

c. To convert residual kinetic energy into pressure energy

d. To streamline the flow in the tailrace

25. A hydraulic press has a ram of 20 cm diameter and a plunger of 5cm diameter. The force required at the plunger to lift a weight of 16×10^4 N shall be:

a. 256×10^4 N

b. 64×10^4 N

c. 4×10^4 N

d. 1×10^4 N

26. Slowing down of boiler water is the process to

a. Reduce the boiler pressure

b. Increase the steam temperature

c. Control the solids concentration in the boiler water

d. Control the drum level

27. A device which is used to drain off water from steam pipes without escape of steam is called

a. Steam separator
b. Steam trap
c. Pressure reducing valve
d. Injector

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

List I (Type of Coal)

A. Lignite
B. Anthracite
C. Bituminous
D. Coke

List II (Coal properties)

1. Artificial fuel derived from coal
2. Contains inflammable gas (volatile matter) and bums. with flame
3. Very hard and high heating value
4. High ash content and less volatile matter

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

29. Pressure reaches a value of absolute zero

a. At a temperature of – 273 K
b. Under vacuum condition
c. At the earth's centre
d. When molecular momentum of system becomes zero

30. A reversible engine operates between temperatures T_1 and T_2. The energy rejected by this engine is received by a second reversible engine at temperature T_2 and rejected to a reservoir at temperature T_3. if the efficiencies of the engines are same then the relationship between T_1, T_2 and T_3 is given by

a. $T_2 = \frac{(T_1 + T_3)}{2}$

b. $T_2 = \sqrt{T_1^2 + T_3^2}$

c. $T_2 = \sqrt{T_1 T_3}$

d. $T_2 \frac{(T_1 + 2T_3)}{2}$

31. The heat absorbed or rejected during a polytrophic process is equal to

a. $\left(\frac{\gamma - n}{\gamma - 1}\right)^{1/2} \times$ Work done

b. $\left(\frac{\gamma - n}{n - 1}\right) \times$ Work done

c. $\left(\frac{\gamma - n}{\gamma - 1}\right) \times$ Work done

d. $\left(\frac{\gamma - n}{\gamma - 1}\right)^{2} \times$ Work done

32. A system comprising of a pure substance executes reversibly a cycle 1-2-3-4-1 consisting of two isentropic and two isochoric processes as shown in the Fig. 1.

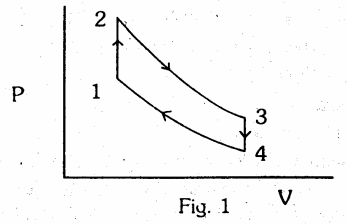
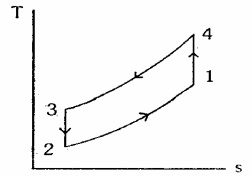


Fig. 1

Which one of the following is the correct representation of this cycle on the temperature - entropy coordinates?

a.



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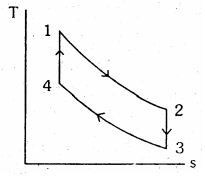

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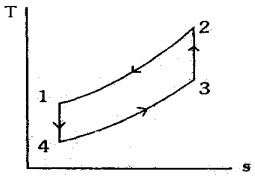

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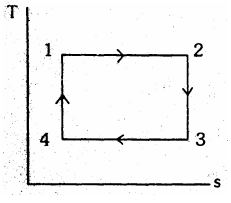


33. With increase of pressure, the latent heat of stream
    a. Remains same
    b. Increases
    c. Decreases
    d. Behaves unpredictably

34. Consider the following statements regarding the throttling process of wet steam:
    1. The steam pressure and temperature decrease but enthalpy remains constant
    2. The steam pressure decreases, the temperature increases but entropy remains constant
    3. The entropy, specific volume, and dryness frication increases
    4. The entropy increases but the volume and dryness fraction decreases.

    Which of the above statements are correct?
    a. 1 and 4
    b. 2 and 3
    c. 1 and 4
    d. 2 and 4

35. Availability function for a closed system is expressed as:
    a. $\phi = u + p_0 v - T_0 S$
    b. $\phi = du + p_0\, dv - T_0\, ds$
    c. $\phi = du + p_0\, dv - T_0\, ds$
    d. $\phi = u + p_0 v - T_0 S$

36. T ds equation can, be expressed as
    a. $Tds = C_v\, dt + \frac{T\beta dv}{k}$
    b. $Tds = C_v\, dt + \frac{T}{k} dv$
    c. $Tds = C_v\, dt + \frac{Tk}{\beta} dv$
    d. $Tds = C_v\, dt + \frac{T\beta}{k} dp$

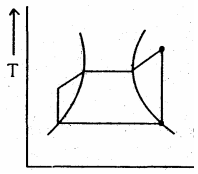
37. A reversible heat engine receivers 6 kJ of heat from thermal reservoir at temperature 800 K, and 8 kJ of heat from another thermal reservoir at temperature 600 K. if it rejects heat to a third thermal reservoir at temperature 100 K, then the thermal efficiency of the engine is approximately equal to:
    a. 65%.
    b. 75%
    c. 80%
    d. 85%

38. The value of compressibility factor for an ideal gas may be
    1. Less or more than one
    2. Equal to one
    3. Zero
    4. Less than zero

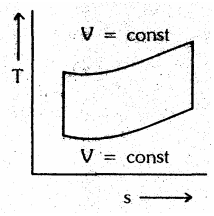
    The correct value (s) is/are given by
    a. 1 and 2
    b. 1 and 4
    c. 3 only
    d. 1 only

39. Which one of the following functions represents the Clapeyron equation pertaining to the change of phase of a pure substance?
    a. $f\left(T, p, h_{fg}\right)$
    b. $f\left(T, p, h_{fg}, v_{fg}\right)$
    c. $f\left(T, p, h_{fg}, s_{fg}\right)$
    d. $f\left(T, p, h_{fg}, s_{fg}, v_{fg}\right)$

40. In an air standard Otto cycle, r is the volume compression ratio and γ is an adiabatic index (C_p/C_v), the air standard efficiency is given by
    a. $\eta = 1 - \frac{1}{r^{\gamma} - 1}$
    b. $\eta = 1 - \frac{1}{r^{\gamma}}$
    c. $\eta = 1 - \frac{1}{r^{\frac{\gamma-1}{\gamma}}}$
    d. $\eta = 1 - \frac{1}{r^{\frac{\gamma-1}{2r}}}$

41.
    1. 

    2.



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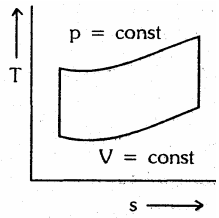
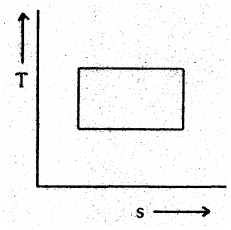


4.



The correct sequence of the given four cycles on T-s plane in Figure (1), (2), (3), (4) is

a. Rankine, Otto, Carnot and Diesel
b. Rankine, Otto, Diesel and Carnot
c. Ott, Rankine, Diesel and Carnot
d. Otto, Rankine, Carnot and Diesel

42. The main advantage of a reheat Rankine cycle is

a. Reduced moisture content in L.P. side of turbine
b. Increase efficiency
c. Reduced load on condenser
d. Reduced load on pump

43. The order of values of thermal efficiency of Otto, Diesel and Dual cycle, when they have equal compression ratio and heat rejection, is given by

a. $\eta_{otto} > \eta_{diesel} > \eta_{dual}$
b. $\eta_{diesel} > \eta_{dual} > \eta_{otto}$
c. $\eta_{dual} > \eta_{diesel} > \eta_{otto}$
d. $\eta_{otto} > \eta_{dual} > \eta_{diesel}$

44. In an air-standard Diesel cycle, r is the compression ratio, ρ is the fuel cut-off ratio and γ is the adiabatic index (C_p/C_v).

a. $\eta = 1 - \left[\frac{1}{\gamma r^{\gamma}} \cdot \frac{\left(\rho^{\gamma} - 1\right)}{\left(\rho - 1\right)}\right]$
b. $\eta = 1 - \left[\frac{1}{\gamma r^{\gamma-1}} \cdot \frac{\left(\rho^{\gamma-1} - 1\right)}{\left(\rho - 1\right)}\right]$
c. $\eta = 1 - \left[\frac{1}{\gamma r^{\gamma-1}} \cdot \frac{\left(\rho^{\gamma} - 1\right)}{\rho - 1}\right]$
d. $\eta = 1 - \left[\frac{1}{\gamma r^{\gamma}} \cdot \frac{\left(\rho^{\gamma-1} - 1\right)}{\left(\rho - 1\right)}\right]$

45. Stoichiometric air-fuel ratio by volume for combustion of methane in air is:

a. 15:1
b. 17.16:1
c. 9.52:1
d. 10.58:1

46. Auto ignition time for petrol-air mixture is minimum when the ratio of actual fuel-air ratio and chemically correct fuel-air ratio is

a. 0.8
b. 1.0
c. 1.2
d. 1.5

47. Consider the following statements regarding knock rating of SI engine fuels:

1. Iso-octane is assigned a rating of zero-octane number
2. normal heptane is assigned a rating of hundred octane number
3. Iso-octane is assigned a rating of hundred octane number
4. Normal heptane is assigned a rating of zero octane number.

Which of the above statements are correct?

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

48. In spark ignition engines knocking can be reduced by:

a. Increasing the compression ratio
b. Increasing the cooling water temperature
c. Retarding the spark advance
d. Increasing the inlet air temperature

49. The tendency of knocking in CI engine reduces by

a. High self-ignition temperature of fuel

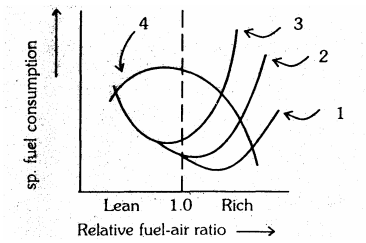
b. Decrease in jacket water temperature
c. Injection of fuel just before TDC
d. Decrease in injection pressure

50. Consider the following statements relevant to the ignition system of SI engine:
1. Too small a dwell angle will lead to the burning of condenser and contact points.
2. Too small a dwell angle will result in misfiring.
3. Too large a dwell angle will result in burning of condenser and contact points.
4. Too large a dwell angle will result in misfiring.

Which of the above statements are correct?
a. 1 and 2
b. 2 and 3
c. 3 and 4
d. 4 and 1

51. The volumetric efficiency of a well designed S.I. engine is in the range of
a. 40% – 50%
b. 50% – 60%
c. 60% – 70%
d. 70% – 90%

52.



Variation of specific fuel consumption with fuel-air ratio for spark ignition engine is represented by which of the curves shown above?
a. Curve 1
b. Curve 2
c. Curve 3
d. Curve 4

53. For a jet propulsion unit, ideally the ratio of compressor work and turbine work is
a. 2
b. 1
c. Not related to each other
d. Unpredictable

54. A 0.5 m thick plane wall has its two surfaces kept at 300°C and 200°C. Thermal conductivity of the wall varies linearly with temperature and its values at 300°C and 200°C are 25 W/mK and 15 W/mK, respectively. Then the steady heat flux through the wall is
a. 8 kW/m^2
b. 5 kW/m^2
c. 4 kW/m^2
d. 3 kW/m^2

55. A 320 cm high vertical pipe at 150 °C wall temperature is in a room with still air at 10°C. This pipe supplies heat at the rate of 8 kW into the room air by natural convection. Assuming laminar flow, the height of the pipe needed to supply 1 kW only is
a. 10 cm
b. 20 cm
c. 40 cm
d. 80 cm

56. The average Nusselt number in laminar natural convection from a vertical wall at 180°C with still air at 20°C is found to be 48. If the wall temperature becomes 30°C, all other parameters remaining same, the average Nusselts number will be
a. 8
b. 16
c. 24
d. 32

57. A fluid of thermal conductivity 1.0W/m-K flows in fully developed flow with Reynolds number of 1500 through a pipe of diameter 10 cm. The heat transfer coefficient for uniform heat flux and uniform wall temperature boundary conditions are, respectively
a. 36.57 and 43.64 $\frac{W}{m^2K}$
b. 43.64 and 36.57 $\frac{W}{m^2K}$
c. $43.64\frac{W}{m^2K}$ for both the cases
d. $36.57\frac{W}{m^2K}$ for both the cases

58. Two large parallel grey plates with a small gap, exchange radiation at the rate of 1000 W/m^2 when their emmissivities are 0.5

each. By coating one plate, its emissive is reduced to 0.25. Temperatures remain unchanged. The new rate of heat exchange shall become

a. 500 W/m^2
b. 600 W/m^2
c. 700W/m^2
d. 800W/m^2

59. Two long parallel plates of same emissive 0.5 are maintained at different temperatures and have radiation heat exchange between them. The radiation shield of emissive o.25 placed in the middle will reduce radiation heat exchange to

a. 1/2
b. 1/4
c. 3/10
d. 3/5

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

List I (Type of radiation)

A. Black body
B. Grey body
C. Specular
D. Diffuse

List II (Characteristic)

1. Emissive does not depend on wavelength
2. Mirror like reflection
3. Zero reflectivity
4. Intensity same in all directions

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

61. Match List I (Type of heat transfer) with List II (Governing dimensionless parameter) and select the correct answer:

List I

A. Forced convection
B. Natural convection
C. Combined free and forced convection
D. Unsteady conduction with convection at surface

List II

1. Reynolds, Grashof and Prandtl number
2. Reynolds and Prandtl number
3. Fourier modulus and Biot number
4. Prandtl number and Grashof number

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

62. The insulated tip temperature of a rectangular longitudinal fin having an excess (over ambient) root temperature of θ_0 is

a. $\theta_0 \tanh(ml)$
b. $\dfrac{\theta_0}{\sin h(ml)}$
c. $\dfrac{\theta_0 \tanh(ml)}{(ml)}$
d. $\dfrac{\theta_0}{\cos h\,(ml)}$

63. Consider the following statements pertaining to large heat transfer rate using fins:

1. Fins should be used on the side where heat transfer coefficient is small
2. Long and thick fins should be used
3. Short and thin fins should be used
4. Thermal conductivity of fin material should be large

Which of the above statements are correct?

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

64. Using thermal-electrical analogy in heat transfer, match List I (Electrical quantities) with List Il (Thermal quantities) and select the correct answer:

List I

A. Voltage
B. Current
C. Resistance
D. Capacitance

List II

1. Thermal resistance
2. Thermal capacity
3. Heat flow

4. Temperature

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

65. Prandtl number of a flowing fluid greater than unity indicates that hydrodynamic boundary layer thickness is
   a. Greater than thermal boundary layer thickness
   b. Equal to thermal boundary layer thickness
   c. Greater than hydrodynamic boundary layer thickness
   d. Independent Of Thermal Boundary Layer Thickness

66. A standard vapour compression refrigeration cycle consists of the following 4 thermodynamic processes in sequence:
   a. Isothermal expansion, isentropic compression, isothermal compression and isentropic expansion
   b. Constant pressure heat addition, isentropic compression, constant pressure heat rejection and isentropic expansion
   c. Constant pressure heat addition, isentropic compression, constant pressure heat rejection and isentropic expansion
   d. Isothermal expansion, constant pressure heat addition, isothermal compression and constant pressure heat rejection

67. Sub cooling heat exchanger is used in a refrigeration cycle. The enthalpies at condenser outlet and evaporator outlet are 78 and 182 kJ/kg respectively. The enthalpy at outlet of isentropic compressor is 230 kJ/kg and enthalpy of sub cooled liquid is 68 kJ/kg. the COP of the cycle is
   a. 3.25
   b. 2.16
   c. 3.0
   d. 3.5

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

List I (Refrigeration equipment)

A. Hermetically sealed compressor
B. Semi-hermitically sealed compressor
C. Open type compressor
D. Expansion device

List II (Characteristic)

1. Capillary tube
2. Both compressor and motor enclosed in a shell or casting
3. Both compressor and motor enclosed in a shell or casing with a removable cylinder cover
4. Driving motor of enclosed ma shill or casing and connected to the shaft driving the compressor

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

69. The ratio of the clearance volume to the displacement volume of a R12 reciprocating compressor is 0.05 Specific volume at inlet and outlet of compressor are 0.04 and 0.02 m^3/kg respectively. Volumetric efficiency of the compressor is
   a. 95.0%
   b. 47.5%
   c. 38.0%
   d. 19.0%

70. Consider the following statements in relation to a convergent-divergent steam nozzle operating under choked conditions:
   1. In the convergent portion steam velocity is less than sonic velocity
   2. In the convergent portion steam velocity is greater than sonic velocity
   3. In the divergent portion the steam velocity is less than sonic velocity
   4. In the divergent portion the steam velocity is greater than sonic velocity

   Which of the above statements are correct?
   a. 1 and 3
   b. 1 and 4
   c. 2 and 3
   d. 2 and 4

71. For maximum discharge through a convergent nozzle the pressure ratio p_2 / p_1 should be (where n is the isentropic expansion index)

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

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

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

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

72. For a reaction turbine with degree of reaction equal to 50%, (V is the absolute steam velocity at inlet and α is the angle made by it to the tangent on the wheel) the efficiency is maximum what the blade speed is equal to

a. $V\cos\alpha/2$

b. $2V\cos\alpha$

c. $V\cos^2\alpha$

d. $V\cos\alpha$

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

List I (Equipment)

A. Anticipatory gear

B. Labyrinth

C. Inverted T-attachment

D. Deaerator

List II (Application area)

1. Sealing system
2. Steam power plant
3. Turbine governing system
4. Blades

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

74. The pressure rise in the impeller of centrifugal compressor is achieved by

a. Decrease in volume and diffusion action

b. Centrifugal action and decrease in volume

c. The centrifugal and diffusion action

d. Centrifuga1. And push-pull action

75. Compared to axial compressors centrifugal compressors are more suitable for

a. High head, low flow rate

b. Low head, low flow rate

c. Low head, high flow rate

d. High head, high flow rate

76. Stalling of blades in axial- flow compressor is the phenomenon of

a. Air stream blocking the passage

b. Motion of air at sonic velocity

c. Unsteady, periodic and reversed flow

d. Air steam not able to follow the blade contour

77. In a reaction turbine the heat drop is fixed blade is 8 kJ/kg and the total head drop per stage is 20 kJ/kg. The degree of reaction is

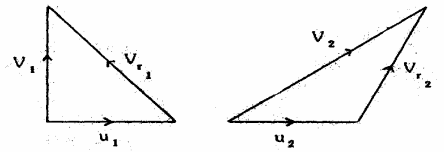
a. 40%

b. 66.7%

c. 60%

d. 25%

78. The inlet and exit velocity diagrams of a turbo machine rotator are shown



The turbo machine is

a. An axial compressor with backward curved blades

b. A radial compressor with backward curved blades

c. A radial compressor with forward curved blades

d. An axial compressor with forward curved blades

79. In an axial flow compressor

α_1 = exit angle from stator

β_1 = inlet angle to rotor

α_2 = inlet angle to stator

β_1 = outlet angle from rotor

The condition to have a 50% degree of reaction is

a. $\alpha_1 = \beta_2$

b. $\alpha_2 = \beta_1$

c. $\alpha_1 = \beta_2$ and $\beta_1 = \alpha_2$

d. $\alpha_1 = \alpha_2$ and $\beta_1 = \beta_2$

80. Brayton cycle with infinite inter cooling and reheating stages would approximate a

a. Stirling cycle
b. Ericsson cycle
c. Otto cycle
d. Atkinson cycle

81. **Assertion (A):** Efficiency of a reversible engine operating between temperature limits T_1 and T_2 is maximum.

Reason (R): Efficiency of a reversible engine is greater than that of an irreversible engine.

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 false

82. **Assertion (A):** Specific heat at constant pressure for an ideal gas is always greater than the specific heat at constant volume.

Reason (R): Heat added at constant volume is not utilized for doing any external work.

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 false

83. **Assertion (A):** The performance of a simple Rankine cycle is not sensitive to the efficiency of the feed pump.

Reason (R): The net work ratio us practically unity for a Rankine cycle.

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 false

84. **Assertion (A):** A pintle nozzle is employed to mix the fuel properly even with the slow air movement available with the many open combustion chambers in CI engines.

Reason (R): The mixing of fuel and air is greatly affected by the nature of the air movement in the combustion chamber of CI engines.

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 false

85. **Assertion (A):** Heat transfer at high temperature is dominated by radiation rather than convection.

Reason (R): Radiation depends on fourth power of temperature while convection depends on unit power.

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 false

86. **Assertion (A):** It is not possible to determine LMTD in a counter flow heat exchanger with equal heat capacity rates of hot and cold fluids.

Reason (R): Because the temperature difference is invariant along the length of the heat exchanger.

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 false

87. **Assertion (A):** In a liquid-to-gas heat exchanger fins are provided in the gas side.

Reason (R): The gas offers less thermal resistance than liquid.

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 false

88. **Assertion (A):** A hydraulic ram is a device used to left water from deep walls.

Reason (R): Hydraulic ram works on the principle of water hammer.

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 false

89. **Assertion (A):** COP of heat pump is more than the COP of its refrigerator version.

Reason (R): Pumping of heat requires less work relative to extraction of heat from the evaporator.

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 false

90. **Assertion (A):** In general, viscosity in liquids increases and in gases it decreases with rise in temperature.

Reason (R): Viscosity is caused by intermolecular forces of cohesion and due to transfer of molecular momentum between fluid layers; of which in liquids the former and in gases the later contribute the major part towards viscosity.

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 false

91. **Assertion (A):** Stream lines are drawn in the flow field such that at a given instant of time they are perpendicular to the direction of flow at every point in the flow field.

Reason (R): Equation for a stream line in a two dimensional flow is given by $V_x\,dy - V_y\,dx = 0$.

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 false

92. **Assertion (A):** The mass flow rate through a compressor for various refrigerants at same temperature arid pressure is proportional to their molecular weights.

Reason (R): According to Avogardo's law all gases have same number of moles in a given volume at same pressure and temperature.

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 false

93. **Assertion (A):** Rankine efficiency would approach Carnot cycle efficiency by providing a series of regenerative feed heating.

Reason (R): With regenerative feed heating, expansion through the turbine approaches an isentropic process.

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 false

94. **Assertion (A):** The specific speed of a Pelton turbine is low

Reason (R): Pelton turbine works under a high head and handles low discharge.

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 false

95. The sensing bulb of the thermostatic expansion valve is located at the

a. Exit of the evaporator
b. Inlet of the evaporator
c. Exit of the condenser
d. Inlet of the condenser

96. Experimental measurements on a refrigeration system indicate that rate of heat extraction by the evaporator rate of heat rejection in the condenser and rate of heat rejection by the compressor body to environment are 70 kW, 90 kW and 5 kW respectively. The power input (in kW) required to operate the system is

a. 15
b. 20
c. 25
d. 75

97. Ozone depletion by CFCs occurs by breakdown of

a. Chlorine atoms from refrigerant by UV radiation and reaction with ozone in troposphere

b. Fluorine atoms from refrigerant by UV radiation and reaction with ozone in troposphere

c. Chlorine atoms from refrigerant by UV radiation and reaction with ozone in stratosphere

d. Fluorine atoms from refrigerant by UV radiation and reaction with ozone in stratosphere

98. Maximum possible COP of a solar absorption refrigeration system with generator temperature of 360 K, absorber temperature of 300 K, condenser temperature of 300 K and evaporator temperature of 270 K is

a. 9

b. 6

c. 3

d. 1.5

99. In case A, moist air is adiabatically saturated and in case B, moist air is isobaric ally saturated. The saturation temperatures in case A and B are respectively

a. Dry bulb temperature and wet bulb temperature

b. Dew point temperature and wet bulb temperature

c. Wet bulb temperature and dew point temperature

d. Wet bulb temperature and dry bulb temperature

100. In a system: Metabolic rate = M, work done by man = W, rate of convective, radiative and evaporative heat losses = Q and rate of heat storage = S. Then heat exchange between man and his environment is given by

a. M + W = Q + S

b. M – W = Q – S

c. M + W = Q – S

d. M – W = Q + S

101. For cooling and dehumidifying of unsaturated moist air it must be passed over a coil at a temperature

a. Of adiabatic saturation of incoming stream

b. Which is lower than the dew point of incoming stream

c. Which lies between dry bulb and wet bulb temperature

d. Which lies between wet bulb and dew point temperature of incoming stream

102. The latent heat load in an auditorium is 25% of the sensible heat load. The value of sensible heat factor (S H F) is equal to

a. 0.25

b. 0.5

c. 0.8

d. 1.0

103. For an office building the outdoor design conditions are 45°C dbt and humidity ratio of 0.015. The indoor design conditions are 25°C dbt and 0.01 humidity ratio. The supply air state is 15°C dbt and 0.007 humidity ratio. If the supply air flow rate is 1000 m^3/min and fresh air flow rate is m^3/min, room sensible ands room latent head loads are, respectively

a. 408 kW and 400 kW

b. 408 kW and 150 kW

c. 204 kW and 400 kW

d. 204 kW and 150 kW

104. Hydrostatic law of pressure is given as

a. $\partial p / \partial z = \rho g$

b. $\partial p / \partial z = 0$

c. $\partial p / \partial z = z$

d. $\partial p / \partial z =$ Constant

105. In a pipe-flow pressure is to be measured at a particular cross-section using the most appropriate instrument. Match List I (Expected pressure range) with List II (Appropriate measuring device) and select the correct answer:

List I

A. Steady flow with small positive gauge pressure

B. Steady flow with small negative and positive gauge pressure

C. Steady flow with high gauge pressure

D. Unsteady flow with fluctuating pressure

List II

1. Bourdon pressure gauge
2. Pressure transducer
3. Simple piezometer
4. U-tube manometer

	A	B	C	D
a.	3	2	1	4

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

106. The capillary rise at 20°C in clean glass tube of 1 mm diameter containing water is approximately
   a. 15 mm
   b. 50 mm
   c. 20 mm
   d. 30 mm

107. Pressure drop of water flowing through a pipe (density 1000 kg/m^3) between two points is measured by using a vertical U-tube manometer. Manometer uses a liquid with density 2000 kg/m^3. The difference in height of man metric liquid in the two limbs of the manometer is observed to be 10 cm. the pressure drop between the two points is:
   a. 98.1 N/m^2
   b. 981 N/m^2
   c. 1962 N/m^2
   d. 19620 N/m^2

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

List I (Stability)

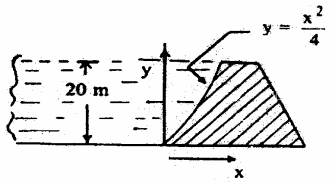
A. Stable equilibrium of a floating body
B. Stable equilibrium of a submerged body
C. Unstable equilibrium of a floating body
D. Unstable equilibrium of a submerged body

List II (Conditions)

1. Centre of buoyancy below the centre of gravity
2. Met centre above the centre of gravity
3. Centre of buoyancy above the centre of gravity
4. Met centre below the centre of gravity

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

109. A dam is having a curved surface as shown in the figure.



The height of the water retained by the darn is 20 m density of water is 1000 kg/m^3. Assuming g as 9.81 m/s^2, the horizontal force acting on the darn per unit length is
   a. 1.962× 10^{2}N
   b. 2×10^{5}N
   c. 1.962×10^{6}N
   d. 3.924×10^{6}N

110. The velocity potential of a velocity field is given by $\phi = x^2 - y^2 + const.$ its stream function will be given by:
   a. – 2xy + constant
   b. +2xy + constant
   c. – 2xy + f(x)
   d. –2 2xy + f(y)

111. A streamline is a line
   a. Which is along the path of the particle
   b. Which is always parallel to the main direction of flow
   c. Along which there is no flow
   d. On which tangent drawn at any point gives the direction of velocity

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

List I (Example)

A. Flow in a straight long pipe with varying flow rate
B. Flow of gas through the nozzle of a jet engine
C. Flow of water through the hose of a fire fighting pump
D. Flow in a river during tidal bore

List II (Type of flow)

1. Uniform, steady
2. Non-uniform steady
3. Uniform, unsteady
4. Non-uniform unseady

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

d. 3 4 1 2

113. Match List I (Type of fluid) with List II (Variation of shear stress) and select the correct answer:

List I

A. Ideal fluid

B. Newtonian fluid

C. Non-new-tonian fluid

D. Bingham plastic

List II

1. Shear stress varies linearly with the rate of strain
2. Shear stress does not vary hnea1y with the rate of strain
3. Fluid behaves like a solid until a minimum yield stress beyond which it exhibits a linear relationship between shear stress and the rate of strain
4. Shear stress is zero

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

114. The equation of a velocity distribution over a plate is given by $u = 2y - y^2$ where u is the velocity in m/s at a point y meter from the plate measured perpendicularly. Assuming μ = 8.60 poise, the shear stress at a point 15 cm from the boundary is

a. 1.72 N/m^2

b. 1.46 N/m^2

c. 14.62 N/m^2

d. 17.20 N/m^2

115. Match List I (Fluid parameters) with List II (Basic dimensions) and select the correct answer:

List I

A. Dynamic viscosity

B. Chews roughness coefficient

C. Bulk modulus of elasticity

D. Surface tension (σ)

List II

1. M/t^2
2. M/Lt^2
3. M/Lt
4. $\sqrt{L/t}$

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

116. The force of impingement of a jet on a vane Increases if

a. The vane angle. Is increased

b. The vane angle is decreased

c. The pressure is reduced

d. The vane is moved against the jet

117. Which of the following assumptions are made for denying Bernoulli's equation?

1. Flow is steady and incompressible
2. Flow is unsteady and compressible
3. Effect of friction is neglected arid flow is along a stream line
4. Effect of friction is taken into consideration and flow is along a stream line

Select the correct answer using the codes given below:

a. 1 and 3

b. 2 and 3

c. 1 and 4

d. 2 and 4

118. While measuring the velocity of air $(\rho = 1.2 kg/m^3)$, the difference in the stagnation and static pressures of a pitot-static tube was found to be 380 Pa. The velocity at that location in m/s is

a. 24.03

b. 4.02

c. 17.8

d. 25.17

119. The drag force exerted by a fluid on a body immersed in the fluid is due to

a. Pressure and viscous forces

b. Pressure and gravity forces

c. Pressure and surface tension forces

d. Viscous and gravity forces

120. The hydraulic means depth (where A = area and P = wetted perimeter) is given by

a. P/A

b. P^2/A

c. A/P

d. $\sqrt{A/P}$