MECHANICAL ENGINEERING

PAPER-I

1. If N_{s1} is the specific speed of a pump handling larger discharges at low heads and N_{s2} is that of a pump handling low discharges at high heads, then which one of the following is correct ?
   a. $N_{s1} > N_{s2}$
   b. $N_{s1} < N_{s2}$
   c. $N_{s1} = N_{s2}$
   d. All the above three are possible under different situations

2. Consider the following statements in respect of impulse steam turbines
   1. Blade passages are of constant cross-sectional area.
   2. Partial admission of steam is permissible.
   3. Axial thrust is only due to change in flow velocity of steam at inlet and outlet of moving blade.

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

3. Consider the following statements
   1. Forward swept blade impeller is used in draft fans.
   2. Forward swept blade impeller is used in room air- conditioners.
   3. Radial tipped blade impeller is used in draft fans.
   4. Forward swept blade impeller is used in exhaust fans

   Which of the statements given above is/are correct ?
   a. Only 1
   b. Only 2 and 3
   c. Only 4
   d. 1, 2, 3 and 4

4. In an axial flow impulse turbine, energy transfer takes, place due to
   a. Change in relative kinetic energy
   b. Change in absolute kinetic energy
   c. Change in pressure energy
   d. Change in energy because of centrifugal force

5. Consider the following:
   1. Superheater
   2. Economizer
   3. Air pre-heater
   4. Condenser

   Which of the above improve overall steam power plant efficiency?
   a. Only 1, 2 and 3
   b. Only 2 and 3
   c. Only 1 and 4
   d. 1, 2, 3 and 4

6. Consider the following:
   1. Injector
   2. Economizer
   3. Blow-off cock
   4. Steam stop valve

   Which of the above is/are not boiler mountings ?
   a. Only 1
   b. Only 1 and 2
   c. 1, 2 and 3
   d. 2 and 4

7. In a steam nozzle, to increase the velocity of steam above sonic velocity by expanding steam below critical pressure
   a. A vacuum pump is added
   b. Ring diffusers are used
   c. Divergent portion of the nozzle is necessary
   d. Abrupt change in cross-section is needed

8. Wilson line is associated with which one of the following ?
   a. Total steam consumption with respect to power output:
   b. Supersonic flow o steam through a nozzle
   c. Nozzle flow with friction
   d. Supersaturated flow of steam through a nozzle

9. Which one of the following expresses the maximum blade efficiency of a Parson's turbine ?
   a. $\frac{2\cos^2\alpha}{1+\cos^2\alpha}$
   b. $\frac{\cos^2\alpha}{1+2\cos^2\alpha}$
   c. $\frac{\cos\alpha}{1+\cos^2\alpha}$
   d. $\frac{\cos\alpha}{2}$

   where α is the jet angle at the entrance.

10. When is the greatest economy obtained in a regenerative feed heating cycle ?
   a. Steam, is extracted from only one suitable point of a steam turbine
   b. Steam is extracted only from the last stage of a steam turbine
   c. Steam is extracted only from the first stage of a steam turbine
   d. Steam is extracted from several places in different stages of steam turbines

11. In a reaction turbine the enthalpy drop in a stage is 60 units. The enthalpy drop in the moving blades is 32 units.

   What is the degree of reaction ?
   a. 0.533
   b. 0.284
   c. 0.466
   d. 1.875

12. Which of the following can be the cause/causes of an air-cooled compressor getting overheated during operation ?
   1. Insufficient lubricating oil.
   2. Broken valve strip.
   3. Clogged intake filter.

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

13. In a centrifugal compressor, how can the pressure ratio be increased ?
   a. Only by increasing the tip speed
   b. Only by decreasing the inlet temperature
   c. By both a. and b.
   d. Only by increasing the inlet temperature

14. The power required to drive a turbo-compressor for a given pressure ratio decreases when
   a. Air is heated at entry
   b. Air is cooled at entry
   c. Air is cooled at exit
   d. Air is heated at exit

15. In an axial flow compressor, when the degree of reaction is 50%, it implies that
   a. Work done in compression will be the least
   b. 50% stages of the compressor will be ineffective
   c. Pressure after compression will be optimum
   d. The compressor will have symmetrical blades

16. In case of liquids, what is the binary diffusion coefficient proportional to?
   a. Pressure only
   b. Temperature only
   c. Volume only
   d. All the above

17. A copper block and an air mass block having similar dimensions are subjected to symmetrical heat transfer from one face of each block. The other face of the block will be reaching to the same temperature at a rate
   a. Faster in air block
   b. Faster in copper block
   c. Equal in air as well as copper block

d. Cannot be predicted with the given information

18. The equation of effectiveness $\in = 1 - e^{-NTU}$ for a heat exchanger is valid 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

19. Thermal diffusivity of a substance is

a. Inversely proportional to thermal conductivity
b. Directly proportional to thermal conductivity
c. Directly proportional to the square of thermal conductivity
d. Inversely proportional to the square of thermal conductivity

20. Air can be best heated by steam in a heat exchanger of

a. Plate type
b. Double pipe type with fins on steam side
c. Double pipe type with fins on air side
d. Shell and tube type

21. A metal plate has a surface area of $2m^2$, thickness 10 mm and a thermal conductivity of 200 W/mk. What is the thermal resistance of the plate ?

a. 4×10^4 K/W
b. 2.5×10^{-3} K/W
c. 1.5×10^{-5} K/W
d. 2.5×10^{-5} K/W

22. Which one of the following expresses the thermal diffusivity of a substance in terms of thermal conductivity (k), mass density (ρ) and specific heat (c) ?

a. $k^2\rho c$
b. $l/\rho kc$
c. $k/\rho c$
d. $\rho c/k^2$

23. What is the ratio of thermal conductivity to electrical conductivity equal to ?

a. Prandtl number
b. Schmidt number
c. Lorenz number
d. Lewis number

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

List - I

A. Radiation heat transfer
B. Conduction heat transfer
C. Forced convection
D. Transient heat flow

List - II

1. Biots number
2. View factor
3. Fourier's law
4. Stanton number

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

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

List - I (Phenomenon)

A. Transient conduction
B. Forced convection
C. Mass transfer
D. Natural convection

List - II (Associated Dimensionless Parameter)

1. Reynolds number
2. Grashoff number
3. Biot number
4. Mach number
5. Sherwood number

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

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

A nuclear fission is initiated when the critical energy as compared to neutron binding energy atoms is

a. less
b. same
c. more
d. exactly two times

27. What is the flash point of a liquid fuel ?

a. The temperature at which the fuel ignites spontaneously with a bang
b. The temperature at which the fuel emits vapours at a rate which produces an inflammable mixture with air
c. The temperature at which the fuel ignites with a clearly visible flash
d. The temperature at which the fuel ignites without a spark

28. What is the function of heavy water in a nuclear reactor ?

a. It serves as a coolant
b. It serves as a moderator
c. It serves as a coolant as well as a moderator
d. It serves as a neutron absorber

29. Consider the following statements :

1. The gases measured directly by Orsat apparatus from a flue gas sample are CO_2, O_2 and N_2.
2. Bomb calorimeter measures higher calorific value of fuel at constant pressure.
3. For burning 1 kg of fuel (carbon) to carbon monoxide, the stoichiometric quantity of air required is 8/3 kg.

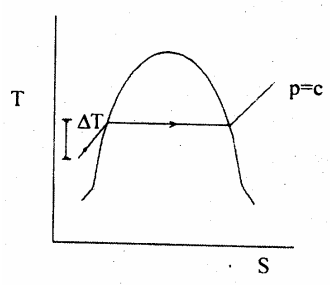
Which of the statements given above is/are correct ?

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

30. In a vapour compression refrigeration cycle for making ice, the condensing temperature for higher COP

a. Should be near the critical temperature of the refrigerant
b. Should be above the critical temperature of the refrigerant
c. Should be much below the critical temperature of the refrigerant
d. Could be of any value as it does not affect the COP

31.



The figure given above depicts saturation dome for water on the temperature-entropy plane. What is the temperature difference ΔT shown on a typical isobar line known as ?

a. Degree of wet bulb depression
b. Degree of saturation
c. Degree of subcooling
d. Degree of reheat

32. What does application of centrifugal air compressors lead to?

a. Large frontal area of aircraft
b. Higher flow rate through the engine
c. Higher aircraft speed
d. Lower frontal area of the aircraft

33. Consider the following statements indicating a comparison between rocket and jet propulsion systems :

1. Both rocket and jet engines carry the fuel and oxidant.
2. Rockets do not employ compressor or propellor.
3. Rockets can operate in vacuum also.
4. Rockets can use solid fuels and oxidants.

Which of the statements given above are correct?

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

34. What is the purpose of employing supercharging for an engine ?

a. To provide forced cooling air
b. To raise exhaust pressure

c. To inject excess fuel for coping with higher load

d. To supply an intake of air at a density greater than the density of the surrounding atmosphere

35. Consider the following statements :

1. Supercharging increases the power output of an engine.
2. Supercharging increases the brake thermal efficiency considerably.
3. Supercharging helps scavenging of cylinders.

Which of the statements given above are correct ?

a. Only 1 and 2

b. Only 2 and 3

c. Only 1 and 3

d. 1, 2 and 3

36. Where does mixing of fuel and air take place in case of diesel engine ?

a. Injection pump

b. Injector

c. Engine cylinder

d. Inlet manifold.

37. Consider the following statements :

1. In the SI engines detonation occurs near the end of combustion whereas in CI engines knocking occurs near the beginning of combustion.
2. In SI engines no problems are encountered on account of pre-ignition.
3. Low inlet pressure and temperature reduce knocking tendency in SI engines but increase the knocking tendency in CI engines.

Which of the statements given above are correct ?

a. 1, 2 and 3

b. Only 1 and 2

c. Only 2 and 3

d. Only 1 and 3

38. The tendency of petrol to detonate in terms of octane number is determined by comparison of fuel with which of the following?

a. Iso-octane

b. Mixture of normal heptane and iso-octane

c. Alpha methyl naphthalene

d. Mixture of methane and ethane

39. For the same indicated work per cycle, mean speed and permissible fluctuation of speed, what is the size of flywheel required for a multi-cylinder engine in comparison to a single-cylinder engine?

a. Bigger

b. Smaller

c. Same

d. Depends on thermal efficiency of the engine

40. Consider the following statements :

1. For a Diesel cycle, the thermal efficiency decreases as the cut off ratio increases.
2. In a petrol engine the high voltage for spark is in the order of 1000 V.
3. The material for centre electrode in spark plug is carbon.

Which of the statements given above is/are correct ?

a. Only 1

b. Only 1 and 2

c. Only 2 and 3

d. 1, 2 and 3

41. Consider the following statements :

Volumetric efficiency of a reciprocating air compressor increases with

1. increase in clearance ratio
2. decrease in delivery pressure
3. multistaging

Which of the statements given above is/are correct ?

a. Only 1 and 2

b. Only 2 and 3

c. Only 3

d. 1, 2 and 3

42. What is the preferred intercooler pressure for a two stage air compressor working between the suction pressure p_s and the delivery pressure p_d ?

a. $(p_s + p_d)/2$

b. $(p_d - p_s)/2$

c. $(p_s \times p_d)^{1/2}$

d. $(p_s \times p_d)^{1/4}$

43. Consider the following statements :

In order to prevent detonation in a spark-ignition engine, the charge away from the spark plug should have

1. low temperature
2. low density
3. long ignition delay

Which of the statements given above is/are correct ?

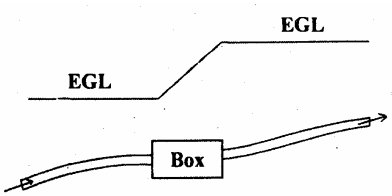
a. Only 1

b. Only 2

c. Only 3

d. 1, 2 and 3

44.



The energy grade line (EGL) for steady flow in a uniform diameter pipe is shown above.

Which of the following items is contained in the box ?

a. A pump

b. A turbine

c. A partially closed valve

d. An abrupt expansion

45. A compound pipeline consists of two pieces of identical pipes. The equivalent length of same diameter and same friction factor, for the compound pipeline is L_1 when pipes are connected in series, and is L_2 when connected in parallel. What is the ratio of equivalent lengths L_1/L_2 ?

a. 32 : 1

b. 8 : 1

c. 2 : l

d. $\sqrt{2}$: 1

46. For irrotational and incompressible flow, the velocity potential and stream function are given by φ and ψ, respectively.

Which one of the following sets is correct?

a. $\nabla^2\varphi = 0, \nabla^2\psi = 0$

b. $\nabla^2\varphi \neq 0, \nabla^2\psi = 0$

c. $\nabla^2\varphi = 0, \nabla^2\psi \neq 0$

d. $\nabla^2\varphi \neq 0, \nabla^2\psi \neq 0$

47. In a two-dimensional incompressible steady flow, the velocity component $u = Ae^x$ is obtained. What is the order component v of velocity ?

a. $v = Ae^{xy}$

b. $v = Ae^y$

c. $v = -Ae^x y + f(x)$

d. $v = -Ae^y x + f(y)$

48. For a steady two-dimensional flow, the scalar components of the velocity field are $V_x = -2x$; $V_y = 2y$, $V_z = 0$. What are the components of acceleration ?

a. $a_x = 0, a_y = 0$

b. $a_x = 4x, a_y = 0$

c. $a_x = 0, a_y = 4y$

d. $a_x = 4x, a_y = 4y$

49. Consider the following statements regarding a path line in fluid flow:

1. A path line is a line traced by a single particle over a time interval.
2. A path line shows the positions of the same particle at successive time instants.
3. A path line shows the instantaneous positions of a number of particles, passing through a common point, at some previous time instants.

Which of the statements given above are correct?

a. Only 1 and 3

b. Only 1 and 2

c. Only 2 and 3

d. 1, 2 and 3

50. A beaker of water is falling freely under the influence of gravity. Point B is on the surface and point C is vertically below B near the bottom of the beaker. If P is the pressure at point B and P the pressure at point C, then which one of the following is correct ?

a. $P_B = P_C$

b. $P_B < P_C$

c. $P_B > P_C$

d. Insufficient information to determine any of the above

51. A homogeneous solid of any arbitrary shape floats upright in a homogeneous liquid with immersed volume V and is in stable equilibrium. If the solid is overturned and made to float upside down in a different homogeneous liquid with exactly same volume V above the liquid surface, then the equilibrium

a. Would be stable

b. Would be neutral

c. Would be unstable

d. May or may not be stable

52. A 25 cm long prismatic homogeneous solid floats in water with its axis vertical and 10 cm projecting above water surface. If the same solid floats in some oil with axis vertical and 5 cm projecting above the liquid surface, what is the specific gravity of the oil ?

a. 0.60

b. 0.70

c. 0.75

d. 0.80

53. A semi-circular plane area of diameter 1 m, is subjected to a uniform gas pressure of 420 kN/m^2. What is the moment of thrust (approximately) on the area about its straight edge ?

a. 35 kNm

b. 41 kNm

c. 55 kNm

d. 82 kNm

54. A horizontal oil tank is in the shape of a cylinder with hemispherical ends. If it is exactly half full, what is the ratio of magnitude of the vertical component of resultant hydrostatic thrust on one hemispherical end to, that of the horizontal component?

a. $2/\pi$

b. $\pi/2$

c. $4/(3\pi)$

d. $3\pi/4$

55. The standard atmospheric pressure is 762 mm of Hg. At a specific location, the barometer reads 700 mm of Hg. At this place, what does an absolute pressure of 380 mm of Hg correspond to ?

a. 320 mm of Hg vacuum

b. 382 of Hg vacuum

c. 62 mm of Hg vacuum

d. 62 mm of Hg gauge

56. A manometer is made of a tube of uniform bore of 0.5 cm^2 cross-sectional areas, with one limb vertical and the other limb inclined at 30° to the horizontal. Both of its limbs are open to atmosphere and, initially, it is partly filled with a manometer liquid of specific gravity 1.25. If then an additional volume of 7.5 cm^3 of water is poured in the inclined tube, what is the rise of the meniscus in the vertical tube?

a. 4 cm

b. 75 cm

c. 12 cm

d. 15 cm

57. A vertical clean glass tube of uniform bore is used, as a piezometer to measure the pressure of liquid at a point. The liquid has a specific weight of 15 kN/m^3 and a surface tension of 0.06 N/m in contact with air. If for the liquid, the angle of contact with glass is zero and the capillary rise in the tube is not to exceed 2 mm, what is the required minimum diameter of the tube ?

a. 6 mm

b. 8 mm

c. 10 mm

d. 12 mm

58. When the pressure on a given mass of liquid is increased from 3.0 MPa to 3.5 MPa, the density of the liquid increases from 500 kg/m^3 to 501 kg/m^3. What is the average value of bulk modulus of the liquid over the given pressure range ?

a. 700 MPa

b. 600 MPa

c. 500 MPa

d. 250 MPa

59. Assertion (A) : Nozzle control governing cannot be used in reaction steam turbines.

Reason (R) : In reaction steam turbines, full admission of steam must take place.

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

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

c. A is true but R is false

d. A is false but R is true

60. Assertion (A) : Fire tube boilers do not operate at high pressures while water tube boilers operate at high pressures.

Reason (R) : Due to high temperature of flue gases, fire tubes may fail due to creep.

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

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

c. A is true but R is false

d. A is false but R is true

61. Assertion (A) : The internal energy depends on the internal state of a body, as determined by its temperature, pressure and composition.

Reason (R) : Internal energy of a substance does not include any energy that it may possess as a result of its macroscopic position or movement.

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

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

c. A is true but R is false

d. A is false but R is true

62. Assertion (A) : The change in availability of a system is equal to the change in the Gibbs function of the system at constant temperature and pressure.

Reason (R) : The Gibbs function is useful when evaluating the availability of systems in which chemical reactions occur.

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

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

c. A is true but R is false

d. A is false but R is true

63. Assertion (A) : All constant entropy processes are adiabatic, but all adiabatic processes are not isentropic.

Reason (R) : An adiabatic process which resists the exchange of energy to the surroundings may have irreversibility due to friction and heat conduction.

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

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

c. A is true but R is false

d. A is false but R is true

64. Assertion (A) : At very high densities, compressibility of a real gas is less than one.

Reason (R) : As the temperature is considerably reduced, the molecules are brought closer together and thermonuclear attractive forces become greater at pressures around 4 MPa.

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

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

c. A is true but R is false

d. A is false but R is true

65. Which one of the following is used to bring down the speed of an impulse steam turbine to practical limits ?

a. A centrifugal governor

b. Compounding of the turbine

c. A large flywheel

d. A gear box

66. Consider the following for a steam turbine power plant:

1. Reduction in blade erosion.
2. Increase in turbine speed.
3. Increase in specific output.
4. Increase in cycle efficiency.

Which of the above occur/occurs due to reheating of steam?

a. Only 1

b. 1 and 2

c. 1, 3 and 4

d. 2 and 3

67. Consider the following features for a gas turbine plant :

1. Intercooling
2. Regeneration

3. Reheat

Which of the above features in a simple gas turbine cycle increase the work ratio?

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

68. Which of the following parameters decrease across a normal shock wave?

1. Mach number
2. Static pressure
3. Stagnation pressure
4. Static temperature

Select the correct answer using the codes given below :

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

69. When are shock waves formed in air compressors ?

a. Mach number < 0.9
b. Mach number > 0.9
c. Mach number = 2
d. Mach number changes suddenly from one value to another

70. Which of the following statements are correct for multistaging in a reciprocating air compressor ?

1. It decreases the volumetric efficiency.
2. The work done can be reduced.
3. A small high-pressure cylinder is required.
4. The size of flywheel is reduced.

Select the correct answer using the codes given below :

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

71. What is the ratio of the isentropic work to Euler's work known as ?

a. Pressure coefficient
b. Slip factor
c. Work factor
d. Degree of reaction

72. Consider the following statements :

For a large aviation gas turbine, an axial flow compressor is usually preferred over centrifugal compressor because

1. the maximum efficiency is higher.
2. the frontal area is lower.
3. the pressure rise per stage is more.
4. the cost is lower.

Which of the statements given above are correct ?

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

73. What are the general comfort conditions in an air-conditioning system ?

a. 20°C DBT, 80% RH
b. 24°C DBT, 60% RH
c. 25°C DBT, 40% RH
d. 25°C DBT, 100% RH

74. The heat load from the occupants in air-conditioning load calculation is a source of:

a. Sensible heat only
b. Latent heat only
c. Both sensible and latent heat
d. None of the above

75. What is the sensible heat factor during the heating and humidification process equal to ?

a. $\frac{H_1 + H_2}{H_3 - H_1}$

b. $\frac{H_2 - H_1}{H_3 - H_1}$

c. $\frac{H_1 + H_2}{H_1 - H_2}$

d. $\frac{H_3 - H_1}{H_2 - H_1}$

Where, H_1 = Total heat of air entering the heating coil

H_2 = Total heat of air leaving the heating coil

H_3 = Total heat of air at the end of the humidification

76. What is Sol-air temperature ?

a. It is equal to the sum of outdoor air temperature, and absorbed total radiation divided by outer surface convective heat transfer coefficient

b. It is equal to the absorbed total radiation divided by convective heat transfer coefficient at outer surface

c. It is equal to the total incident radiation divided by convective heat transfer coefficient at outer surface

d. It is equal to the sum of indoor air temperature and absorbed total radiation divided by convective heat transfer coefficient at outer surface

77. Which type of valves is generally used in reciprocating refrigerant compressors ?

a. Mushroom valve

b. Puppet valve

c. Plate valve

d. Throttle valve

78. Consider the following statements pertaining to duct design :

1. Aspect ratio of ducts should be high.
2. In the equal friction, method of design, use of dampers cannot be eliminated by any means.
3. The static regain method is not suitable for long ducts.
4. The velocity reduction method is employed only in simple systems.

Which of the statements given above are correct ?

a. 1 and 2

b. 3 and 4

c. 1 and 3

d. 2 and 4

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

List - I (Apparatus)

A. Separating calorimeter

B. Throttling calorimeter

C. Sling psychrometer

D. Gas thermometer

List - II (Thermodynamic process)

1. Adiabatic process
2. Isobaric process
3. Isochoric process
4. Isenthalpic process

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

80. A thermoelectric engine which consists of two dissimilar electric conductors connected at two junctions maintained at different temperatures, converts

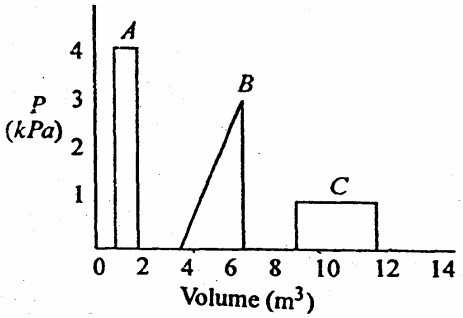
a. Electric energy into heat energy

b. Heat energy into electric energy

c. Mechanical work into electric energy

d. Electric energy into mechanical work

81.



Which one of the following is the correct sequence of the three processes A, B and C in the increasing order of the amount of work done by a gas following ideal-gas expansions by these processes ?

a. A-B-C

b. B-A-C

c. A-C-B

d. C-A-B

82. A Carnot refrigerator has a COP of 6. What is the ratio of the lower to the higher absolute temperatures ?

a. 1/6

b. 7/8

c. 6/7

d. 1/7

83. A heat source H_1 can supply 6000 kJ/min at 300°C and another heat source H_2 can supply 60000 kJ/min at 100°C. Which one of the following statements is correct if the surroundings are at 27°C ?

a. Both the heat sources have the same efficiency

b. The first heat source has lower efficiency

c. The second heat source has lower efficiency

d. The first heat source produces higher power

84. According to the Clapeyron equation, which one of the following gives the slope of the saturated liquid pressure temperature curve dp/dT? (suffix f and g denote saturated liquid and saturated vapour respectively)

a. $\left(u_g - u_f\right)/\left(v_g - v_f\right)$

b. $\left(h_g - h_f\right)/\left(v_g - v_f\right)$

c. $\left(u_g - u_f\right)/\left[T\left(v_g - v_f\right)\right]$

d. $\left(h_g - h_f\right)/\left[T\left(v_g - v_f\right)\right]$

85. Which one of the following is the characteristic equation of a real gas?

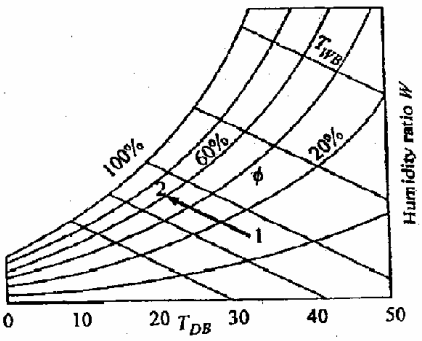
a. $(p + a/v^2)(v–b) = RT$

b. $(p – a/v^2)(v + b) = RT$

c. $pv = RT$

d. $pv = nRT$

86.



Which one of the following is correct for the process 1-2 shown above ?

a. The partial pressure of water vapour in air remains constant

b. Specific humidity of air remains constant

c. Enthalpy of air remains constant

d. Dry bulb temperature of air remains constant

87. Consider the following statements pertaining to the Clapeyron equation :

1. It is useful to estimate properties like enthalpy from other measurable properties.
2. At a change of phase, it can be used to find the latent heat at a given pressure.
3. It is derived from the relationship $\left(\frac{\partial p}{\partial v}\right)_T = \left(\frac{\partial s}{\partial T}\right)_V$

Which of the statements given above are correct ?

a. 1, 2 and 3

b. Only 1 and 2

c. Only 1 and 3

d. Only 2 and 3

88. A 12 cm diameter straight pipe is laid at a uniform downgrade and flow rate is maintained such that velocity head in the pipe is 0.5 m. If the pressure in the pipe is observed to be uniform along the length when the down slope of the pipe is 1 in 10, what is the friction factor for the pipe ?

a. 0.012

b. 0.024

c. 0.042

d. 0.050

89. A venturimeter in an oil (sp. gr. 0.8) pipe is connected to a differential manometer in which the gauge liquid is mercury (sp. gr. 13.6). For a flow rate of 0.16 m^3/s, the manometer registers a gauge differential of 20 cm. The oil-mercury manometer being unavailable, an air-oil differential manometer is connected to the same venturimeter. Neglecting variation of discharge coefficient for the venturimeter, what is the new gauge differential for a flow rate of 0.08 m^3/s ?

a. 64 cm

b. 68 cm

c. 80 cm

d. 85 cm

90. How are the velocity coefficient C_v, the discharge coefficient C_d, and the contraction coefficient C_c of an orifice related?

a. $C_v = C_c C_d$

b. $C_c = C_v C_d$

c. $C_d = C_c C_v$

d. $C_cC_vC_d = 1$

91. Which one of the following statements is correct ? While using boundary layer equations, Bernoulli's equation

a. can be used anywhere

b. can be used only outside the boundary layer

c. can be used only inside the boundary layer

d. cannot be used either inside or outside the boundary layer

92. The velocity distribution in the boundary layer over a flat plate, set parallel to the direction of an incompressible free stream, is given by one-sixth power law of the form $u/U = (y/\delta)^{1/6}$. What is the ratio of displacement thickness to boundary layer thickness ?

a. 1 : 8

b. 1 : 7

c. 7 : 72

d. 3 : 8

93. An open channel of symmetric right-angled triangular cross- section is conveying a discharge Q. Taking g as the acceleration due to gravity, what is the critical depth ?

a. $\left(\frac{Q^2}{g}\right)^{1/3}$

b. $\left(\frac{2Q^2}{g}\right)^{1/3}$

c. $\left(\frac{Q^2}{g}\right)^{1/5}$

d. $\left(\frac{2Q^2}{g}\right)^{1/5}$

94. In M-L-T system, what is the dimension of specific speed for a rotodynamic pump ?

a. $L^{-3/4}\ T^{3/2}$

b. $M^{1/2}\ L^{1/4}\ T^{-5/2}$

c. $L^{3/4}\ T^{-3/2}$

d. $L^{3/4}\ T^{3/2}$

95. In the boundary layer, the flow is

a. Viscous and rotational

b. Inviscid and irrotational

c. Inviscid and rotational

d. Viscous and irrotational

96. It is observed in a flow problem, that pressure, inertia and gravity forces are important. Then, similarity requires that

a. Reynolds and Weber numbers be equal

b. Mach and Froude numbers be equal

c. Euler and Froude numbers be equal

d. Reynolds and Mach numbers be equal

97. In a normal shock in a gas

a. Both the downstream flow and the upstream flow are supersonic

b. Only the upstream flow is supersonic

c. The downstream flow is sonic

d. The upstream flow is subsonic

98. The pressure drop in a pipe flow is directly proportional to the mean velocity. It can be deduced that the

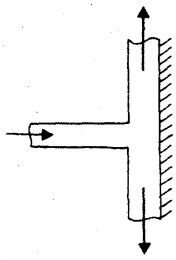
a. Flow is laminar

b. Flow is turbulent

c. Pipe is smooth

d. Pipe is rough

99.



A circular jet of water impinges on a vertical flat plate and bifurcates into two circular jets of half the diameter of the original. After hitting the plate

a. The jets move at equal velocity which is twice of the original velocity

b. The jets move at equal velocity which is 3 times of the original velocity

c. Data given is insufficient to calculate velocities of the two outgoing jets

d. The jets move at equal velocity which is equal to the original velocity

100. It is recommended that the diffuser angle should be kept less than 18° because

a. Pressure decreases in flow direction and flow separation may occur

b. Pressure decreases in flow direction and flow may become turbulent

c. Pressure increases in flow direction and flow separation may occur

d. Pressure increases in flow direction and flow may become turbulent

101. A converging diverging nozzle is connected to a gas pipeline. At the inlet of the nozzle (converging section) the Mach number is 2. It is observed that there is a shock in the diverging section. What is the value of the Mach number at the throat ?

a. < 1

b. Equal to I

c. > 1

d. ≥ l

102. Which one of the following is measured by a rotameter?

a. Velocity of fluids

b. Discharge of fluids

c. Viscosity of fluids

d. Rotational speed of solid shafts

103. In a jet pump

a. Kinetic energy of fluid is converted into potential energy

b. Energy of high velocity stream is converted into pressure energy

c. Energy of high pressure fluid is converted into energy of low pressure fluid

d. Potential energy of fluid is converted into kinetic energy

104. Which of the following water turbines does not require a draft tube ?

a. Propeller turbine

b. Pelton turbine

c. Kaplan turbine

d. Francis turbine

105. Which of the following water turbines maintain a high efficiency over a long range of the part load ?

1. Francis turbine
2. Kaplan turbine
3. Pelton turbine
4. Propeller turbine

Select the correct answer using the codes given below

a. 1 and 4

b. Only 2 and 3

c. 1, 2 and 3

d. 2, 3 and 4

106. Which of the following advantages is/are possessed by a Kaplan turbine over a Francis turbine ?

1. Low frictional losses.
2. Part load efficiency is considerably high.
3. More compact and smaller in size.

Select the correct answer using the codes given below

a. Only 1

b. Only 1 and 2

c. Only 2 and 3

d. 1, 2 and 3

107. Effective temperature depends on dry bulb temperature, and

a. Wet bulb temperature only

b. Relative humidity

c. Specific humidity

d. Wet bulb temperature and air motion

108. A human body feels comfortable when the heat produced by the metabolism of human body is equal to

a. Heat dissipated to the surroundings

b. Heat stored in the human body

c. Sum of a. and b.

d. Difference of a. and b.

109. In a vapour compression refrigeration plant, the enthalpy values at different points are :

1. Enthalpy at exit of the evaporator = 350 kJ/kg
2. Enthalpy at exit of the compressor 375 kJ/kg
3. Enthalpy at exit of the condenser = 225 kJ/kg

The refrigerating efficiency of the plant is 0.8. What is the power required per kW of cooling to be produced?

a. 0.25 kW

b. 4.0 kW

c. 12.5 kW

d. 11 kW

110. Thy bulb temperature and wet bulb temperature is 25°C each, and velocity of air passing over human body is 6 m/min. If velocity increases to 20 m/min, then which one of the following is correct?
   a. The effective temperature decreases
   b. The effective temperature remains the same
   c. The effective temperature increases
   d. The change in effective temperature cannot be estimated with the given information

111. The wet bulb depression is zero, when relative humidity is equal to :
   a. 100%
   b. 60%
   c. 40%
   d. Zero

112. Atmospheric air at 35°C and 60% RH can be brought to 20°C and 60% RH by:
   a. Cooling and dehumidification process
   b. Cooling and humidification process
   c. Adiabatic saturation process
   d. Sensible cooling process

113. Consider the following statements :
   Air washer can work as
   1. Humidifier only
   2. Dehumidifier only
   3. Filter only
   Which of the statements given above is/are correct ?
   a. Only I
   b. Only 2 and 3
   c. Only 1 and 3
   d. 1, 2 and 3

114. For small installations of refrigeration systems (up to 35 kW), which type of condenser is used ?
   a. Shell and tube type
   b. Shell and coil type
   c. Double tube type
   d. Air cooled type

115. In a vapour absorption refrigerator, heat is rejected in :
   a. Condenser only
   b. Generator only
   c. Absorber only
   d. Condenser and absorber

116. Where an air refrigeration cycle is generally employed?
   a. Domestic refrigerators
   b. Commercial refrigerators
   c. Air-conditioning
   d. Gas liquefaction

117. A heat pump is used to heat a house in the winter and then reversed to cool the house in the summer. The inside temperature of the house is to be maintained at 20°C. The heat transfer through the house walls is 7.9 kJ/s and the outside temperature in winter is 5°C.
   What is the minimum power (approximate) required to drive the heat pump?
   a. 40.5 W
   b. 405 W
   c. 42.5 W
   d. 425 W

118. The leaks in a refrigeration system Freon are detected by :
   a. A halide torch, which on detecting produces greenish flame light
   b. Sulphur sticks, which on detecting give the smoke
   c. Using reagents
   d. Sensing reduction in pressures.

119. What is the value of the shape factor of two infinite parallel surface separated by a distance d ?
   a. 0
   b. ∞
   c. 1
   d. d

120. If the temperature of a solid state changes from 27°C to 627°C, then emissive power changes which rate
   a. 6 : l
   b. 9 : 1
   c. 27 : 1
   d. 81 : 1