MECHANICAL ENGINEERING

PAPER–I

1. A small sphere of outer area 0.6 m^2 is totally enclosed by a large cubical hail. The shape factor of hail with respect to sphere is 0.004. What is the measure of the internal side of the cubical hail?
   a. 4 m
   b. 5 m
   c. 6 m
   d. 10 m

2. In a vapour compressor refrigeration system, the compressor capacity is 2100 kj/minute and heat rejection factor is 1.2. What will, respectively be the heat rejected from the condenser and C. O0. P.?
   a. 5040 kJ/minute and 5
   b. 2520 kJ/minute and 5
   c. 2520 kJ/minute and 4
   d. 5040 kJ/minute and 4

3. Which one of the following statements is correct?
   In a domestic refrigerator periodic defrosting is required because frosting
   a. causes corrosion of materials
   b. reduces heat extraction
   c. overcools food stuff
   d. partially blocks refrigerant flow

4. Air at 35°C DBT and 25°C dew point temperature passes through the water shower, hose temperature is maintained at 20°C. What is the process involved?
   a. Cooling and humidification
   b. Sensible cooling
   c. Cooling and dehumidification
   d. Heating and humidification

5. Consider the following statements:
   1. The specific humidity is the ratio of the mass of water vapour to the mass of dry air in a given volume of the mixture
   2. The relative humidity of the atmospheric air is the ratio of the actual mass of the water vapour in a given volume to that which it would have if it were saturated at the same temperature
   3. The degree of saturation is defined as the ratio of the specific humidity of a mixture to the specific humidity of the mixture when saturated at the same temperature
   Which of the statements given above are correct?
   a. 1 and 2
   b. 2 and 3
   c. 1 and 3
   d. 1, 2 and 3

6. Atmospheric air at dry bulb temperature of 15°C enters a heating coil whose surface temperature is maintained at 40°C. The air leaves the heating coil at 25°C. What will be the by-pass factor of the heating coil?
   a. 0.376
   b. 0.4
   c. 0.6
   d. 0.67

7. Velocity of air passing through a rectangular duct and a circular duct is same. Which one of the following is the correct expression for the equivalent diameter of the circular duct in respect of a rectangular duct for the same pressure loss per unit length? (a and b are the length and breath of the rectangular duct cross-section)
   a. $\dfrac{a+b}{ab}$
   b. $\dfrac{2ab}{a+b}$
   c. $\dfrac{2a}{a-b}$
   d. $\dfrac{2b}{a+b}$

8. Which one of the following statements is correct?

   a. Effective temperature is the index which correlates the combined effects of air dry bulb temperature, air humidity and air movement upon human comfort

   b. The value of effective temperature in winter and summer should be same for human comfort

   c. Effective temperature and wet bulb temperature are one and the same

   d. The value of effective temperature should be higher in winter than in summer for comfort

9. Which of the following are normally desired comfort conditions in an air conditioning system?

   a. 25°C DBT and 50% RH

   b. 22°C DBT and 90% RH

   c. 15°C DBT and 75% RH

   d. 15°C DBT and 40% RH

10. In an air conditioning plant the refrigeration load on the coil is 100 TR. The mass and enthalpy of air leaving the coil are 420 kg/minute and 40 kJ/kg respectively. What will be the enthalpy of the air at the inlet to the coil under these conditions?

   a. 80 kJ / kg

   b. 90 kJ / kg

   c. 100 kJ/kg

   d. 102.5 kJ/kg

11. If coefficient of contraction at the vena contract a is equal to 0.62, then what will be the dynamic loss coefficient in sudden contraction in air-conditioning duct?

   a. 0.25

   b. 0.375

   c. 0.55

   d. 0.65

12. An oil of specific gravity 0.9 has viscosity of 0.28 Stokes at 38°C. What will be its viscosity in Ns/m2.?

   a. 0.2520

   b. 0.0311

   c. 0.0252

   d. 0.0206

13. Which one of the following is the correct expression for the critical pressure ratio of a nozzle?

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

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

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

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

14. What is the critical pressure ratio for isentropic nozzle flow with ratio of specific heats as 1.5?

   a. $(0.8)^3$

   b. $(0.8)^{06}$

   c. $(1.25)^{0.33}$

   d. $(1.25)^3$

15. Consider the following statements

   1. The speed of rotation of the moving elements of gas turbines is much higher than those of steam turbines

   2. Gas turbine plants. are heavier and larger in size than steam turbine plants

   3. Gas turbines require cooling water for its operations

   4. Almost any kind of fuel can be used with gas turbines

Which of the statements given above are correct?

   a. 1 and 2

   b. 1 and 3

   c. 1 and 4

   d. 3 and 4

16. Which one of the following is the feature of pressure –compounding (Reteau staging.)?

   a. Low efficiency at low rotational speeds

   b. High efficiency with low fluid velocities

   c. High efficiency with high fluid velocities

   d. Low efficiency at high rotational speeds

17. In Parson's reaction turbines, the velocity diagram triangles at the inlet arid outlet are which of the following?

   a. Asymmetrical

b. Isosceles

c. Right-angled

d. Congruent

18. Which one of the following statements is correct?

In reciprocating compressors, one should aim at compressing the air

a. Adiabatically

b. Isentropic ally

c. isothermally

d. polytropically

19. In Parson's turbine if (α) is nozzle angle, then what is the maximum efficiency of the turbine?

a. $\dfrac{2\cos\alpha}{(1+\cos\alpha)}$

b. $\dfrac{2\cos^2\alpha}{(1+\cos^2\alpha)}$
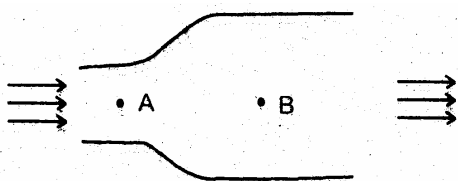
c. $\dfrac{2\cos^2\alpha}{(1-\cos\alpha)}$

d. $\dfrac{\cos^2\alpha}{(1+2\cos^2\alpha)}$

20. What is the value of the reheat factor in multi-stage turbine?

a. 1.03 to 1.04

b. 1.10 to 1.20

c. 0.90 to 1.00

d. 1.20 to 1.25

21.

A compressible fluid flows through a passage as shown in the above diagram. The velocity of the fluid at the point A is 400 m/s.

Which one of the following is correct?

At the point B, the fluid experiences

a. an increase in velocity and decrease in pressure

b. a decrease in velocity and increase in pressure

c. a decrease in velocity and pressure

d. an increase in velocity and pressure

22. In which one of the following steam turbines, steam is taken from various points along the turbine, solely for feed water heating?

a. Extraction turbine

b. Bleeder turbine

c. Regenerative turbine

d. Reheat turbine

23. Which one of the following is the correct expression for the degree of reaction for an axial-flow air compressor?

a. $\dfrac{\text{Work input to the rotor}}{\text{Work input to the stage}}$

b. $\dfrac{\text{Change of enthalpy in the rotor}}{\text{Change of enthalpy in the stage}}$

c. $\dfrac{\text{Pressure rise in the rotor}}{\text{Pressure rise in the stage}}$

d. $\dfrac{\text{Isentropic work}}{\text{Actual work}}$

24. Assertion (A): A simple or elementary carburetor provides progressively rich mixture with increasing air flow.

Reason (R): The density of the air tends to increase as the rate of air flow increases.

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

25. Assertion (A): In lumped heat capacity systems the temperature gradient within the system is negligible.

Reason (R): In analysis of lumped capacity systems, the thermal conductivity of the system material is considered very high irrespective of the size of the system.

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

26. Assertion (A): Sub cooling of refrigerant liquid increases the coefficient of performance of a refrigeration cycle.

Reason (R): Sub cooling reduces the work requirement of a refrigeration cycle.

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

27. Assertion (A): A circular plate is immersed in a liquid with its periphery touching the free surface and the plane makes an angle θ with the free surface With different values of θ, the position of centre of pressure will be different.

Reason (R): Since the centre of pressure is dependent on second moment of area, with different values θ of, second moment of area for the circular plate will change.

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

28. Assertion (A): In a supersonic nozzle, with sonic condition at the throat, any reduction of downstream pressure will not be felt at the inlet of the nozzle.

Reason (R): The disturbance caused downstream of supersonic flows travels at sonic velocity which cannot propagate upstream by Mach cone.

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

29. Assertion (A): For the same power, the rotor of an impulse turbine need not be as large as that of a reaction turbine.

Reason (R): In the case of a reaction turbine, water has to be admitted to the runner around its entire circumference.

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

30. Assertion (A): For higher specific speeds radial flow pumps have the greatest efficiency.

Reason (R): Pumps having larger discharge under smaller heads have higher specific speeds.

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

31. Assertion (A) : The volute casing of a centrifugal pump helps in creating the high velocity head necessary for enabling water flow upwards to a higher level.

Reason (R): The water flows through a diverging passage in the volute chamber.

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

32. Which one of the following correctly defines 1 K, as per the internationally accepted definition of temperature scale?

a. 1/100th of the difference between normal boiling point and normal freezing point of. water
b. 1/273. 15th of the normal freezing point of water
c. 100 times the difference between the triple point of water and the normal freezing point of water
d. 1/273. 15th of the triple point of water

33. In a steady-flow adiabatic turbine, the changes in the internal energy, enthalpy, kinetic energy and potential energy of the working fluid, from inlet to exit, are -100 kJ/kg, -140 kJ/kg, -10 kJ/kg and 0 kJ/kg respectively. Which one of the following gives the amount of work developed by the turbine?

a. 100 kJ/kg
b. 110 kJ/kg
c. 140 kJ/kg
d. 150 kJ/kg

34. An ideal gas undergoes an isothermal expansion from state R to state S in a

turbine as shown in the diagram given below:
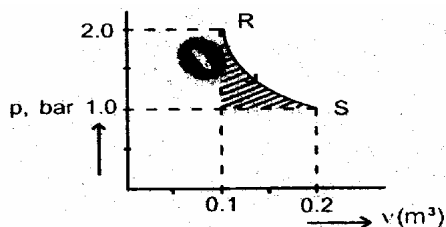
The area of shaded region is 1000 Nm. What is the amount is turbine work done during the process?

a. 14,000 Nm
b. 12,000 Nm
c. 11,000 Nm
d. 10,000 Nm

35. 170 kJ of heat is supplied to a system at constant volume. Then the system rejects 180 kJ of heat at constant pressure and 40 kJ of work is done on it. The system is finally brought to its original state by adiabatic process. If the initial value of internal energy is 100 kJ, then which one of the following statements is correct?

a. The. highest value of internal energy occurs at the end of the constant volume process
b. The highest value of internal energy occurs at the end of constant pressure process
c. The highest value of internal energy occurs after adiabatic expansion
d. Internal energy is equal at all points

36. An insulated box containing 0.5 kg of a gas having $C_v = 0.98$ kJ/kg. K falls from a balloon 4 km above the earth's surface. What will be the temperature rise of the gas when the box hits the ground?

a. 0 K
b. 20 K
c. 40 K
d. 60 K

37. In a heat engine operating in a cycle between a source temperature of 606°C and a sink temperature of 20°C, what will be the least rate of heat rejection per kW net output of the engine?

a. 0.50kW
b. 0.667 kW
c. 1.5 kW
d. 0.0341 kW

38. Two reversible engine operate between thermal reservoirs at 1200 K, T_2 K and 300 K such that 1st, engine receives heat from 1200 K reservoir and rejects heat to thermal reservoir at T_2 K, while the 2nd engine receives heat from thermal reservoir at T_2 K and rejects heat to the thermal reservoir at 300 K. The efficiency of both the engines is equal

What is the value of temperature T_2?

a. 400 K
b. 500 K
c. 600 K
d. 700 K

39. A perfect gas at 27°C was heated until its volume was doubled using the following three different processes separately

1. Constant pressure process
2. Isothermal process
3. Isentropic process

Which one of the following is the correct sequence in the order of increasing value of the final temperature of the gas reached by using the above three different processes?

a. 1-2-3
b. 2-3-1
c. 3-2-1
d. 3-1-2

40. A system undergoes a process during which the heat transfer to the system per degree increase in temperature is given by the equation

dQ / dT = 2.0 kJ/°C. The work done by the system per degree increase in temperature is given by the equation

dW/dT = 2 - 0.1 T, where T is in °C. If during the process, the temperature of water varies from 100°C to 150°C, what will be the change in internal energy?

a. 125 kJ
b. - 250 kJ
c. 625 kJ
d. – 1250 kJ

41. One kg of air is subjected to the following processes:

1. Air expands isothermally from 6 bar to 3 bar.

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

3. Heat is supplied to air at constant. volume till the

4. pressure becomes three fold

In which of the above processes, the change in entropy will be positive?

a. 1 and 2

b. 2 and 3

c. 1 and 3

d. 1, 2 and 3

42. What will be the loss of available energy associated with the transfer of 1000 kj of heat from constant temperature system at 600 K to another at 400 K when the environment temperature is 300 K?

a. 150 kJ

b. 250 kJ

c. 500 kJ

d. 700 kJ

43. The variation of saturation pressure with saturation temperature for a liquid is 0.1 bar/K at 400 K. The specific volumes of saturated liquid and dry saturated vapour at 400 K are 0 251 and 0.00 1 rn3/kq. What will be the value of latent heat of vaporization using Clausius Clayperon equation?

a. 16000 kJ/kg

b. 1600 kJ/kg

c. 1000 kJ/kg

d. 160 kJ/kg

44. Which one of the following represents the condensation of a mixture of saturated liquid and saturated vapour on the enthalpy-entropy diagram

a. A horizontal line

b. An inclined line of constant slope

c. A vertical line

d. A curved line

45. For a two-stage reciprocating air compressor, the suction pressure is 1.5 bar and the delivery pressure is 54 bar. What is the value of the ideal intercooler pressure?

a. 6 bar

b. 9 bar

c. 27.75 bar

d. $9/\sqrt{2}$ bar

46. Which of the following action(s) increase(s) the knocking tendency in the SI engine?

a. Increasing mixture strength beyond equivalence ratio (ϕ) = 1.4

b. Retarding the spark and increasing the compression ratio

c. Increasing the compression ratio and reducing engine speed

d. Increasing both mixture strength beyond equivalence ratio (ϕ) = 1 .4 and the compression ratio

47. Which of the following feature(s) is/are used in the combustion chamber design to reduce SI engine knock?

a. Spark plug located away from exhaust value, wedge shaped combustion chamber and short flame travel distance.

b. Wedge shaped combustion chamber

c. Wedge shaped combustion chamber and short flame travel distance

d. Spark plug located away from exhaust value, short flame travel distance and side value design

48. Which of the following factor(s) increase(s) the tendency for knocking in the C.I. engine?

a. Increasing both the compression ratio and the coolant temperature

b. Increasing both the speed and the injection advance

c. Increasing the speed, injection advance and coolant temperature

d. Increasing the compression ratio

49. Match List I (SI. Engine Operational Mode) with List II (Air fuel Ratio by Mass) and select the correct answer:

List I

A. Idling

B. Cruising

C. Maximum power

D. Cold starting

List II

1. 4:1

2. 10 : 1

3. 12.5 : I

4. 16 : 1

5. 14.8:1

Codes;

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

50. Consider the following statements for a multi-jet carburetor:

1. Acceleration jet is located just behind the throttle value
2. Idle jet is located close to the choke
3. Main jet alone supplies petrol at normal engine speeds

Which of the statements given above are correct?

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

51. The stoichiometric air/fuel ratio for petrol is 15 : 1. What is the air/fuel ratio required for maximum power?

a. 16 : 1 - 18:1
b. 15:1
c. 12 : 1 - 18 : 1
d. 9 : 1 - 11 : 1

52. Consider the following statements with reference to supercharging of IC. engines

1. Reciprocating compressors are invariably used for high degree of supercharging
2. Rotary compressors like roots blowers are quite suitable for low degree of supercharging
3. Axial flow compressors are most commonly employed for supercharging diesel engines used in heavy duty transport vehicles
4. Centrifugal compressors are used for turbo -charging

Which of the statements given above are correct?

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

53. The relative jet exit velocity from a rocket is 2700 m/s. The forward flight velocity is

1350 m/s. What is the propulsive efficiency of the unit?

a. 90%.
b. 66 .66%
c. 50%
d. 33.33%

54. What is the ratio of displacement thickness to momentum thickness for linear velocity distribution over a flat plate?

a. 1.5
b. 2.0
2. 2.5
3. 3.0

55. Consider the following statements regarding laminar sublayer of boundary layer flow

1. The laminar sublayer exists only in a region that occurs before the formation of laminar boundary layer
2. The laminar sublayer is a region next to the wall where the viscous force is predominant while the rest of the flow is turbulent
3. The laminar sublayer occures only in turbulent flow past a smooth plate

Which of the statements given above is/are correct?

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

56. Match List I (Flow Depth) with List II (Basic Hydraulic Condition Associated Therewith) and select the correct answer

List I

A. Conjugate depth
B. Critical depth
C. Alternate depth
D. Normal depth

List II

1. Uniform flow
2. Same specific energy
3. Minimum specific energy
4. Same specific force
5. Same bed slope

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

c.   4   3   2   1

d.   5   4   1   2

57. A 40 mm diameter 2m long straight uniform pipe carries a steady flow of water (viscosity 1 .02 centipoises) at the rate of 3.0 liters per minute. What is the approximate value of the shear stress on the internal wall of the pipe?

a. 0.0166 dyne/cm^2

b. 0.0812 dyne/cm^2

c. 8.12 dyne/cm^2

d. 0.9932 dyne/cm^2

58. Which one of the following is the correct expression for the area of flow for a circular channel? (Where θ = half the angle subtended by Water surface at the centre and R = radius of the circular channel)

a. $R^2\left(2\theta - \dfrac{\sin 2\theta}{2}\right)$

b. $R^2\left(\theta - \dfrac{\sin 2\theta}{2}\right)$

c. $2R^2\left(2\theta - \sin 2\theta\right)$

d. $2R^2(\theta - \sin 2\theta)$

59. A 1.0 m long model of a ship is towed at a speed pf 81 cm/s in a towing tank. To what speed of the ship, 64m long does this correspond to?

a. 7.20 m/s

b. 6.48 m/s

c. 5.76 m/s

d. 3.60 m/s

60. In a flow condition where both viscous and gravity forces dominate and both the Froude number and the Reynolds number are the same in model and prototype; and, the ratio of kinematic viscosity of model to that of the prototype is 0.0894.What is the model scale ?

a. 1 : 3.3

b. 3.3 :1

c. 5 : 1

d. 1 : 5

61. A ship whose full length is 100 m is to travel at 10 m/s For dynamic similarity, with what velocity should a 1 : 25 model of the ship be towed?

a. 2 m/s

b. 10 m/s

c. 25 m/s

d. 250 m/s

62. Match List I (Type of Model) with List II Transference Ratio for Velocity) and select the correct answer:

List I

A. Reynolds model

B. Froude model

C. Weber model

D. Mach model

List II

1. $\sqrt{K_r / \rho}$

2. $\sqrt{\rho_r / (\rho_r l_r)}$

3. $\mu_r / (\rho_r l_r)$

4. $\sqrt{g_r l_r}$

(where symbols g, μ, ρ, σ and k have their usual meanings and subscript r 'refers to the ratio)

Codes;

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

63. An aircraft is flying at a speed of 800 km/h at an altitude, where the atmospheric temperature is - 20°C. What is the approximate value of the Mach number of the aircraft?

a. 0.653

b. 0.697

c. 0.240

d. 0.231

64. In a perfect gas having ratio of specific heats as 1.4 what is the strength of a normal shock with upstream Mach number equal to 5.0?

a. 27

b. 28

c. 29

d. 24

65. Which one of the following statements is relevant to the specific speed of a centrifugal pump?

a. Head developed is unity and discharge is unity

b. Head developed is unity and power absorbed is unity

c. Discharge is unity and power absorbed is unity

d. Each of head developed, power absorbed and discharge is equal to unity

66. A centrifugal pump needs 1000 W of power when operating at 1500 rpm. What is the power requirement if the speed of the pump is increased to 3000 rpm?

a. 2000 W

b. 4000 W

c. 6500 W

d. 8000 W

67. Two centrifugal pumps have impellers with outer dimensions of each equal to twice the inner dimensions. The inner diameter of the second impeller is three times the inner diameter & the first one. What is the speed ratio N_2/N_1 of pumps, if the pumps are required to develop the same man metric head to Start delivery of water?

a. 9

b. 4

c. 1/2

d. 1/3

68. Water is required to be lifted by a 10 kW pump from a depth of 100 m. If the pump is unable to lift the water, then which one of the following is correct?

a. A greater capacity pump has to be used

b. A lager diameter delivery pipe has to be used

c. A larger diameter suction pipe has to be used

d. A multistage pump has to be used

69. Which one of the following is correct?

In positive displacement pumps, the slip can sometimes be negative when the actual discharge is greater than the theoretical discharge. This happens in

a. small suction pipes coupled with a low delivery head

b. small suction pipes coupled With a medium delivery head

c. long suction pipes' coupled with a low delivery head

d. long suction pipes coupled with medium delivery head

70. A centrifugal pump operating at 1000 rpm develops a head of 30 m. If the speed is increased to 2000 rpm and the pump operates with the same efficiency, what is the head developed by the pump?

a. 60 m

b. 90 m

c. 120 m

d. 150 m

71. What is the range of the speed ratio ϕ for Kaplan turbine for its most efficient operation?

a. 0.10 to 0.30

b. 0.43 to 0.65

c. 0.85 to 1.20

d. 1.40 to 2.00

72. Match List I (Type of Model) with List II (Liquid Handled) and select the' correct answer:

List I

A. Closed impeller pump

B. Semi-open impeller pump

C. Open impeller pump

List II

1. Sandy water

2. Acids

3. Sewage water

Codes;

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

73. An impulse turbine operating with a single nozzle has a special speed of 5. What will be the approximate specific speed of the turbine if the turbine is operated with one more additional nozzle of the same size?

a. 4

b. 6

c. 7

d. 10

74. Two centrifugal pumps 'A' and 'B' operate at their maximum efficiencies at

1000 rpm and 500 rpm respectively. Against the same delivery head, pump 'A' discharge 1 m³/s and pump B discharge 4 m³/s respectively. What is the ratio of specific speeds $(N_s)_A : (N_s)_B$?

a. 1 : 2

b. 1 : 1

c. 1 : 4

d. 4 : 1

75. Match list I (Specific Speed) with List II (Expression / magnitude) and select the correct answer:

List I

A. Specific speed of turbine

B. Specific speed of pump

C. Specific speed of pelton wheel

D. Specific speed of Francis turbine

List II

1. $N\sqrt{Q} / H^{3/4}$

2. $N\sqrt{P} / H^{5/4}$

3. 50 – 250

4. 10 – 50

Codes;

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

76. Which one of the following pairs is not correctly matched?

a. Centrifugal pump : Rotating blades in the motor create centrifugal head

b. Reciprocating pump: Positive displacement pump

c. Turbine pump : Centrifugal pump with guide vanes

d. Gear pump : Gear teeth work like rotating blades to create centrifugal head

77. Match List I (Flow Parameter) with List II (Type of Turbine) and select the correct answer:

List I

A. High head

B. Axial flow

C. Mixed flow

D. High specific speed

List II

1. Francis turbine

2. Pelton wheel

3. Kaplan turbine

Codes;

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

78. Which one of the following statements is correct?

When a fluid passes from the inlet to exit of the rotor in a centrifugal pump, tangential momentum

a. increases and energy increases

b. decreases and energy increases

c. remains unchanged and energy decreases

d. increases and energy remains unchanged

79. A Francis turbine is coupled to an alternator to generate electricity with a frequency of 50 Hz. If the alternator has 12 poles, then the turbine should be regulated to run at which one of the following constant speeds?

a. 250 rpm

b. 500 rpm

c. 600 rpm

d. 1000 rpm

80. Consider the following statements regarding waste heat boilers

1. Waste--heat boilers placed in the path of exhaust gases

2. These are fire tube boilers

3. The greater portion of the heat transfer in such boilers is due to convection

Which of the statements given above are correct?

a. 1, 2 and 3

b. 1 and 2

c. 2 and 3

d. 1 and 3

81. Consider the following statements regarding performance of turbojet engines

1. The thrust decreases, at higher altitude due to reduced density of air and consequently lower mass flow of air.
2. At subsonic speeds, the effect of increased velocity is to increase the air flow and the thrust increases
3. The relative velocity of jet with respect to the medium decreases at higher speeds which tends to reduce the thrust
4. For turbojet engine the thrust of. jet at subsonic speeds remains relatively constants

Which of the statements given above are correct?

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

82. Consider the following 'statements for NO_x emissions from I.C. engines
   1. Formation of NO_x depends upon combustion temperature
   2. Formation of NO depends upon type of coolant used
   3. Exhaust gas recirculation is an effective means for control of NO_x
   4. Activated Platinum is used for reduction of NO_x

   Which of the statements given above are correct?

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

83. Consider the following statements Exhaust emissions of carbon monoxide from spark ignition engine are.
   1. mainly fuel—air mixture strength dependent
   2. in the range of zero to 10%
   3. measured with the help of an instrument working on the principle of non—dispersive infra—red analysis
   4. controlled by the use of a two way catalytic convertor

   Which of the statements given above are correct?

   a. 1 and 4
   b. 2 and 3

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

84. Which one of the following orders is the correct order of passing the flue gases through the different absorbents (in the flasks) during analysis in Orsat apparatus?
   a. Potassium hydroxide solution — alkaline solution of pyrogallic acid — cuprous chloride solution
   b. Potassium hydroxide solution — cuprous chloride solution — alkaline solution of pyrogallic acid
   c. Alkaline solution of pyrogallic acid — cuprous chloride solution — potassium hydroxide solution
   d. Cuprous chloride solution — potassium hydroxide solution — alkaline solution of pyrogallic acid

85. An engine using octane—air mixture has N_2, O_2 CO_2, CO and H_2O as constituents in the exhaust gas. Which one of the following can be concluded?
   a. Supply mixture is stoichiometric
   b. Supply mixture has incomplete combustion
   c. Supply mixture is rich
   d. Supply mixture is lean

86. Which one of the following statements is correct?

   In CANDU type nuclear reactor
   a. natural uranium is used as fuel and water as moderator
   b. natural uranium is used as fuel and heavy water as moderator
   c. enriched uranium is used as fuel and water as moderator
   d. enriched uranium is used as fuel and heavy water as moderator

87. Match List I (Material) with List II (Application) kind select the correct answer:

   List I
   A. Plutonium—239
   B. Thorium—232
   C. Cadmium
   D. Graphite

   List II
   1. Fertile material
   2. Control cods

3. Moderator

4. Fissile material

Codes;

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

88. Which one of the following statements is correct?

The curve for unsteady state cooling or heating of bodies is

a. parabolic curve asymptotic to time axis

b. exponential curve asymptotic to time axis

c. exponential curve asymptotic both to time and temperature axis

d. Hyperbolic curve asymptotic both to time and temperature axis

89. What will be the geometric radius of heat transfer for a hollow sphere of inner and outer radii r_1 and r_2?

a. $\sqrt{r_1 r_2}$

b. $r_r r_2$

c. r_2 / r_r

d. $(r_2 - r_r)$

90. A composite wall is made of two layers of thickness δ_1 and δ_2 having thermal conductive K and 2K and equal surface areas normal to the direction of heat flow. The outer surfaces of the composite wall are at 100°C and 200°C respectively. The heat transfer takes place only by conduction and the required surface temperature at the junction is 150° C. What will be the ratio of their thicknesses $\delta_1 : \delta_2$?

a. 1 : 1

b. 2 : 1

c. 1 : 2

d. 2 : 3

91. A hollow pipe of 1 cm outer diameter is to be insulated by thick cylindrical insulation having thermal conductivity 1 W/mk. The surface heat transfer coefficient on the insulation surface is 5 W/m^{2}K. What is the minimum effective thickness of insulation for causing the reduction in heat leakage from the insulated pipe?
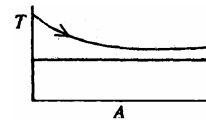
a. 10 cm

b. 15 cm

c. 19.5 cm

d. 20 cm

92. Match List I (Heat Exchanger Process) with List II (Temperature Area Diagram) and select the correct answer:
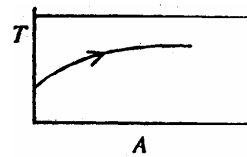
List I

A. Counter flow sensible heating

B. Parallel flow sensible heating

C. Exaporating

D. Condensing

List II
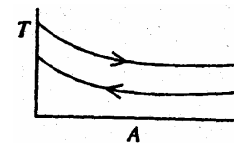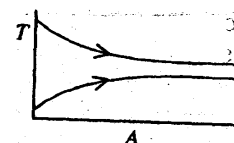
1.

2.

3.

4.

5.
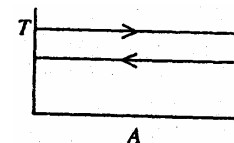
Codes;

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

93. Nusset number for a pipe flow heat transfer coefficient is given by the

equation $Nu_D = 4.36$. Which one of the following combinations of conditions do exactly apply for use of this equation?

a. Laminar flow and constant wall temperature
b. Turbulent flow and constant wall heat flux.
c. Turbulent flow and constant wall temperature
d. Laminar flow and constant wall heat flux

94. Match List I (Process) with List II (Predominant Parameter Associated with the Flow) and select the correct answer:

List I
A. Transient conduction
B. Mass transfer
C. Forced convection
D. Free convection

List II
1. Sherwood Number
2. Mach Number
3. Biot Number
4. Grashof Number
5. Reynolds number

Codes;

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

95. Which one of the following statements is correct? The non—dimensional parameter known as Stanton number (St) is used in

a. forced convection heat transfer in flow over flat plate
b. condensation heat transfer with laminar film layer
c. natural convection heat transfer over flat plate
d. unsteady heat transfer from bodies in which internal temperature gradients cannot be neglected

96. In a convective heat transfer situation Reynolds number is very large but the Prandtl number is so small that the product $Re \times Pr$ is less than one. In such a condition which one of the following is correct?

a. Thermal boundary layer does not exist
b. Viscous boundary layer thickness is less than the thermal boundary layer thickness
c. Viscous boundary layer thickness is equal to the thermal boundary layer thickness
d. Viscous boundary layer thickness is greater than the thermal boundary layer thickness

97. Match List I (Surface with Orientations) with List II (Equivalent Emissivity) and select the correct answer:

List I
A. infinite parallel planes
B. Body 1 completely enclosed by body 2 but body 1 is very small
C. Radiation exchange between two small gray bodies
D. Two concentric cylinders with large lengths
E. List II

1. ϵ_1

2. $\dfrac{1}{\dfrac{1}{\epsilon_1}+\dfrac{1}{\epsilon_2}-1}$

3. $\dfrac{1}{\dfrac{1}{\epsilon_1}+\left(\dfrac{A_1}{A_2}\right)\left(\dfrac{1}{\epsilon_2}-1\right)}$

4. $\epsilon_1 \epsilon_2$

Codes;

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

98. Two spheres A and B of same material have radii 1m and 4m and temperature 4000 K and 2000 K respectively. Which one of the following statements is correct? The energy radiated by sphere A is

a. greater than that of sphere B
b. less than that of sphere B
c. equal to that of sphere B
d. equal to double that of sphere B

99. For n opaque plane surface the irradiation, radiosity and emissive power are respectively 20, 12 and 10 W/m^2.

What is the emissivity of the surface?

a. 0.2

b. 0.4

c. 0.8

d. 1.0

100. Two long parallel surfaces, each of emissivity 0.7 are maintained at different temperatures and accordingly have radiation exchange between them. It is desired to reduce 75% of this radiant heat transfer by inserting thin parallel shields of equal emissivity (0.7) on both sides. What would be the number of shields?

a. 1

b. 2

c. 3

d. 4

101. The earth receives at its surface radiation from the sun at the rate of 1400 W/m^2. The distance of centre of sun from the surface of earth is 1.5×10^{11} m and the radius of sun is 7.0×10^8 m. What is approximately the surface temperature of the sun treating the sun as a black body?

a. 3650 K

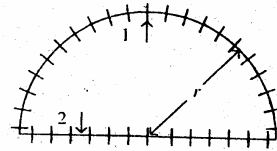b. 4500 K

c. 5800

d. 6150 K

102.
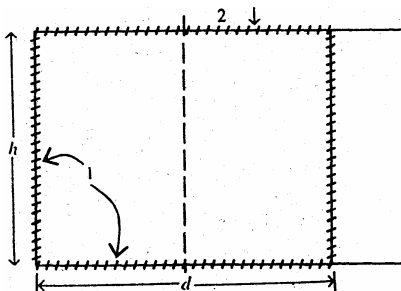
What is the value of the shape factor F_{12} in a cylindrical cavity of diameter d and height h between bottom face known as surface 1 and top flat surface known as surface 2?

a. $\dfrac{2h}{2h+d}$

b. $\dfrac{d}{d+4h}$

c. $\dfrac{4d}{4d+h}$

d. $\dfrac{2d}{2d+h}$

103.

A hemispherical surface 1 lies over a horizontal plane surface 2 such that convex portion of the hemisphere is facing sky. What is the value of the geometrical shape factor?

a. 1/4

b. 1/2

c. 3/4

d. 1/8

104. A heat engine with 30% efficiency drives a refrigerator of COP. 5.0. What would be the net heat input to the engine for each MW of heat removed in the refrigerator?

a. 66 67 kJ

b. 600 kJ

c. 666.67 kJ

d. 6600 kJ

105. Mercury—water manometer has a gauge difference of 500 mm (difference in elevation of menisci). What will be the difference in pressure?

a. 0.5 m

b. 6.3 m

c. 6.8 m

d. 7.3 m

106.
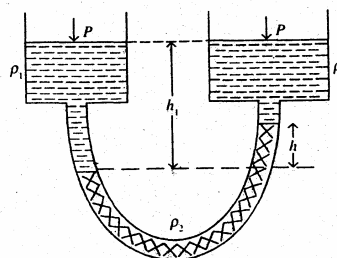
The balancing column shown in the above diagram contains 3 liquids of different densities ρ_1, ρ_2 and ρ_3. The liquid level of one Limb is h1 below the top level and

there is a difference of h relative to that in the other limb.

What will be the expression for h?

a. $\dfrac{\rho_1 - \rho_2}{\rho_1 - \rho_3} h_1$

b. $\dfrac{\rho_2 - \rho_3}{\rho_1 - \rho_3} h_1$

c. $\dfrac{\rho_1 - \rho_3}{\rho_2 - \rho_3} h_1$

d. $\dfrac{\rho_1 - \rho_2}{\rho_2 - \rho_3} h_1$

107. A circular annular plate bounded by two concentric circles of diameter 1.2 m and 0.8 m is immersed in water with its plane making an angle of 45° with the horizontal. The centre of the circles is 1.625 m below the free surface. What will be the total pressure force on the face of the plate?

a. 7.07 kN

b. 10.00 kN

c. 14.14 kN

d. 18.00 kN

108. A plate of rectangular shape having the dimensions of 0.4 m x 0.6 m is immersed in water with its longer side vertical. The total hydrostatic thrust on one side of the plate is estimated as 18.3 kN. All other conditions remaining the same, the plate is turned through 90° such that its longer side remains vertical. What would be the total force on one face of the plate?

a. 9.15 kN

b. 18.3 kN

c. 36.6 kN

d. 12.2 kN

109. An open rectangular box of base 2m × 2m contains a liquid of specific gravity 0.80 up to a height of 2.5m. If the box is imparted a vertically upward acceleration of 4.9 m/s^2, what will the pressure on the base of the tank?

a. 9.81 kPa

b. 19.62 kPa

c. 36.80 kPa

d. 29.40 kPa

110. A constant—head water tank has, on one of its vertical sides two identical smell orifices issuing two horizontal jets in the same vertical plane. The vertical distance between the centers of orifices is 1 .5 m and the jet trajectories intersect at a point 0.5 m below the lower orifice. What is the approximate height of water level in the tank above the point of intersection of trajectories?

a. 1.0 m

b. 2.5 m

c. 0.5 m

d. 2.0 m

111. The components of velocity in a. two dimensional frictionless incompressible, flow are u t^2 + 3y and V = 3t + 3x. What is the approximate resultant total acceleration at the point (3, 2) and t = 2?

a. 5

b. 49

c. 59

d. 54

112. The stream function $\psi = x^3 - y^3$ is observed for a two dimensional flow field. What is the magnitude of the velocity at point (1, -1)?

a. 4.24

b. 2.83

c. 0

d. - 2.83

113. Which one of the following statements is correct?

Irrigational flow is characterized as the one in which

a. the fluid flows along a straight line

b. the fluid does not rotate as it moves along

c. the net rotation of fluid particles about their mass centers remains zero

d. the streamlines of flow are curved and closely spaced

114. A 20 cm diameter 500 m long water ripe with friction factor u$_t$ = 0025, leads from a constant-head reservoir and terminates at the delivery end into a nozzle discharging into air. (Neglect all energy losses other than those due to pipe friction). What is the approximate diameter of the jet for maximum power?

a. 6.67 mm

b. 5.98 mm

c. 66.7 mm

d. 59.8 mm

115. Which of the following functions represent the velocity potential in a two-dimensional flow of an ideal fluid?

1. $2x + 3y$
2. $4x^2 - 3y^2$
3. $\cos(x - y)$
4. $\tan^{-1}(x/y)$

Select the correct answer using the codes given below

a. 1 and 3

b. 1 and 4

c. 2 and 3

d. 2 and 4

116. The pressure drop for a relatively low Reynolds number flow in a 600 mm, 30m long pipeline is 70 kPa. What is the wall shear stress?

a. 0 Pa

b. 350 Pa

c. 700 Pa

d. 1400 Pa

117. A pitot--static tube (C = 1) is used to measure air flow. With water in the differential manometer and a gauge deterrence of 75 mm, what is the value of air speed if p 1.16 kg/m³?

a. 1.21 m/s

b. 16.2 m/s

c. 5.6 m/s

d. 71.2 m/s

118. Match List I (Measuring Devices) with List II (Measured Parameter) and select the correct answer using the codes given below:

List I

A. Pitot tube

B. Micro--manometer

C. Pipe bend meter

D. Wall pressure tap

List II

1. Flow static pressure

2. Rate of flow (indirect)

3. Differential pressure

4. Flow stagnation pressure

Codes:

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

119. Match List I (Variables in Laminar Boundary Layer Flow over a Flat Plate Set Parallel to the Stream) with List II (Related Expression with usual notations) and select the correct answer using the codes given below:

List I

A. Boundary layer thickness

B. Average skin--friction coefficient

C. Shear stress at boundary

D. Displacement thickness

List II

1. $1.729 / \sqrt{Ux/v}$

2. $0.332\rho U^2 / \sqrt{Ux/v}$

3. $5 / \sqrt{vx/U}$

4. $0.864\sqrt{v/Ux}$

5. $1.328 / \sqrt{UL/v}$

Codes;

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

120. A flat plate, 2m × 0.4m is set parallel to a uniform stream of air (density 1.2kg/m³ and viscosity 16 centistokes) with its shorter edges along the flow. The air velocity is 30 km/h. What is the approximate estimated thickness of boundary layer at the downstream end of the plate?

a. 1.96 mm

b. 438 mm

c. 13.12 mm

d. 9.51 mm