



AERTM
QUESTION BOOKLET
MECHANICAL ENGINEERING
PAPER - I (04)

666054

Time Allowed : 2 Hours

Maximum Marks : 200

INSTRUCTIONS FOR CANDIDATES

1. Please do not open this Question Booklet until you are told to do so.
2. Candidate must fill up the necessary informations in the space provided on the OMR answer sheet before commencement of the examination.
3. Answer sheet will be processed by electronic device. Invalidation of answer sheet due to incomplete / incorrect filling of relevant circle of Roll No. and Question Booklet Series in the OMR answer sheet shall result in cancellation of candidature. Any deficiency in filling up OMR answer sheet will be the sole responsibility of the candidate.
4. An example is given below how to fill / mark (darken) Roll No. 41311706 and Question Booklet Series - B. Accordingly, you have to fill / mark (darken) the Roll No. and Question Booklet Series given to you in your OMR answer sheet.

EXAMPLE

Roll No.								Question Booklet Series
4	1	3	1	1	7	0	6	B
1	●	1	●	●	1	1	1	A ○
2	2	2	2	2	2	2	2	B ●
3	3	●	3	3	3	3	3	C ○
●	4	4	4	4	4	4	4	D ○
5	5	5	5	5	5	5	5	
6	6	6	6	6	6	6	●	
7	7	7	7	7	●	7	7	
8	8	8	8	8	8	8	8	
9	9	9	9	9	9	9	9	
0	0	0	0	0	0	●	0	



5. For marking the correct answer, darken one circle by **BLUE BALLPOINT PEN** only.
6. Please do not mark (darken) more than one circle. Darkening more than one circle against an answer will be treated as wrong answer.
7. Do not detach any leaf from this Question Booklet. After the examination, hand over the OMR answer sheet to the Room Invigilator. You are allowed to take the Question Booklet and carbon copy of the OMR answer sheet after examination is over.
8. Each question carries 2 marks. There is no negative marking for any wrong answer.
9. Possession and use of Calculator, Mobile Phone, Pager or any other electronic gadget is strictly prohibited in the Examination Hall.
10. Please abide by the instructions above and those given on the OMR answer sheet, failure to comply these instructions will be sole responsibility of the candidates.



04 - B

1. When the depth of immersion of a plane surface is increased the centre of pressure will
 - (A) Come closer to the centroid.
 - (B) Move further away from centroid.
 - (C) Will be at the same distance from centroid.
 - (D) Depends on the specific weight of liquid.
2. When a ship leaves a river and enters the sea
 - (A) It will rise a little.
 - (B) It will sink a little.
 - (C) There will be no change in draft.
 - (D) It will depend on the type of ship.
3. Bernoulli's equation is applicable for
 - (A) steady, rotational flow.
 - (B) steady, rotational, compressible flow.
 - (C) steady, irrotational, incompressible flow.
 - (D) All of the above.
4. In a static fluid with y as the vertical direction the pressure variation is given by
 - (A) $\frac{dp}{dy} = \rho$
 - (B) $\frac{dp}{dy} = -\rho$
 - (C) $\frac{dp}{dy} = \gamma$
 - (D) $\frac{dp}{dy} = -\gamma$
5. The entry length in the pipe flow will be higher for
 - (A) highly viscous fluids.
 - (B) highly velocity fluids.
 - (C) low viscosity fluids.
 - (D) small diameter.
6. Boundary layer thickness _____ along the direction.
 - (A) increases
 - (B) decreases
 - (C) remains constant
 - (D) first increases than decreases
7. V-notch is used to measure
 - (A) Velocity in pipe
 - (B) Wind velocity
 - (C) Discharge of liquid in an open channel
 - (D) Viscosity
8. The energy loss through hydraulic jump equals to the difference between the _____ at the upstream and downstream sections.
 - (A) relative energy
 - (B) pressure gradient
 - (C) temperature gradient
 - (D) specific energies
9. With constant flow rate if the diameter is double in laminar flow pipe, the frictional drop will change by a factor of
 - (A) 2
 - (B) 0.5
 - (C) 1/32
 - (D) 1/16

10. Overall efficiency (η) of hydraulic turbine is
 (A) $\eta_v/\eta_m \cdot \eta_n$
 (B) $\eta_n/\eta_m \cdot \eta_v$
 (C) $\eta_v \cdot \eta_m \cdot \eta_n$
 (D) $\eta_n \cdot \eta_v/\eta_m$
11. Specific speed of Kaplan turbine is about
 (A) 0.9
 (B) 9
 (C) 90
 (D) 900
12. The shut off speed of centrifugal pump is
 (A) $\frac{u_2^2 - u_1^2}{2q}$
 (B) $\frac{u_2^2 - u_1^2}{q}$
 (C) $\frac{u_2^2}{2q}$
 (D) $\frac{u_2 - Vu_2}{2q}$
13. A turbine is operating with a head of 400 m and speed of 500 rpm and flow rate of $5 \text{ m}^3/\text{s}$ producing power of 17.6 MW. The head available changed to 350 m. If no other corrective action was taken, what would be the speed and discharge? Assume efficiency is maintained.
 (A) 527 rpm, $4.677 \text{ m}^3/\text{s}$
 (B) 467.7 rpm, $14.45 \text{ m}^3/\text{s}$
 (C) 467.7 rpm, $4.677 \text{ m}^3/\text{s}$
 (D) 527 rpm, $14.45 \text{ m}^3/\text{s}$
14. Two horizontal plates are placed 1.25 cm apart the space between them being filled with oil of viscosity 14 poise. Calculate shear stress in oil if upper plate is moved with a velocity of 2.5 m/s.
 (A) 28 N/m^2
 (B) 280 N/m^2
 (C) 380 N/m^2
 (D) 38 N/m^2
15. The pressure intensity at a point in a fluid is given by 3.924 N/cm^2 . Find the corresponding height of the fluid when the fluid oil is of specific gravity 0.9.
 (A) 4 m of oil
 (B) 4.44 m of oil
 (C) 6.22 m of oil
 (D) 4.44 m of water
16. A ship 70 m long and 10 m broad has a displacement of 19620 kN. A weight of 343.35 kN is moved across the deck through a distance of 6 m. The ship is tilted through 6° , the moment of inertia of ship at water line about its fore and aft axis 75% of MOI of circums rectangle. Centre of buoyancy is 2.25 m below water line. Find metacentric height (specific weight of sea water is 10104 N/m^3)
 (A) 0.1 m
 (B) 1 cm
 (C) 10 m
 (D) 100 cm
17. Reciprocating pumps are suitable for _____ pressure.
 (A) low
 (B) low and high
 (C) high
 (D) None of the above

18. A pitot tube is used to measure the velocity of water in pipe. The stagnation pressure head is 6 m and static pressure head is 5 m. Calculate the velocity of flow assuming the coefficient of tube = 0.98.
- (A) 10.632 m/s
(B) 14.396 m/s
(C) 9.706 m/s
(D) 4.34 m/s
19. An orifice of diameter 150 mm is fitted at the bottom of a boiler drum of length 8 m and diameter 3m. The drum is horizontal and contains water upto a height of 2.4 m, find the time required to empty the boiler. $C_d = 0.6$
- (A) 1140 sec.
(B) 1998 sec.
(C) 1074 sec.
(D) 590 sec.
20. Find the discharge over a triangular notch of angle 60° when the head over the v-notch is 0.3 m. Assume $C_d = 0.6$.
- (A) $0.4 \text{ m}^3/\text{s}$
(B) $4 \text{ m}^3/\text{s}$
(C) $0.004 \text{ m}^3/\text{s}$
(D) $0.04 \text{ m}^3/\text{s}$
21. The velocity potential function is given by $\phi = 5(x^2 - y^2)$. Calculate the velocity component u, v at point (4, 5).
- (A) -40 units, 50 units
(B) 40 units, -50 units
(C) 40 units, 50 units
(D) -40 units, -50 units
22. Water at 15°C flows between two large parallel plates at a distance of 1.6 mm apart. What will be the pressure drop per unit length if the average velocity is 0.2 m/s and viscosity of water at 15°C is 0.01 poise.
- (A) 749.30 N/m^2
(B) 937.44 N/m^2
(C) 823.83 N/m^2
(D) 597.25 N/m^2
23. Find the displacement thickness for velocity distribution in boundary layer given by $\frac{v}{u} = \frac{y}{\delta}$. Where u is the velocity at a distance y from the plate and $u = U$ at $y = \delta$.
- $\delta \rightarrow$ boundary layer thickness.
- (A) $\delta/6$
(B) $\delta/2$
(C) $\delta/4$
(D) $\delta/3$
24. Water is flowing through pipe of diameter 200 mm with a velocity of 3 m/s. Find head loss due to friction for a length of 5 m, if the coefficient of friction is given by
- $$f = 0.002 + \frac{0.09}{Re^{0.3}}$$
- Re-Reynolds number
Kinematic viscosity of water = 0.01 stoke.
- (A) 0.346 m of water
(B) 0.576 m of water
(C) 0.993 m of water
(D) 0.877 m of water

25. A water jet of diameter 75 mm moving with a velocity of 25 m/s strikes a fixed plate in a way that angle between jet and plate is 60° . Find the force extracted by the jet on the plate in the direction normal to the plate.
- (A) 1380.31 N
(B) 2390.7 N
(C) 1857.23 N
(D) 1625.11 N
26. Find the number of pump requires to take water from a deep well under a total head of 89 m. All the pump are identical and running at 800 rpm. The specific speed of each pump is given as 25. while rated capacity of each pump is $0.16 \text{ m}^3/\text{s}$.
- (A) 5
(B) 4
(C) 2
(D) 3
27. The diameter of fixed ram and fixed cylinder of an intensifier are 8 cm and 20 cm respectively. If the pressure of water supplied to the fixed cylinder is 300 N/cm^2 . Find the pressure of water flowing through fixed ram.
- (A) 937.5 N/cm^2
(B) 3750 N/cm^2
(C) 1875 N/cm^2
(D) 1250 N/cm^2
28. Calculate Mach number at a point on jet propelled aircraft which is flying at 1100 km/hr at sea level where air temperature is 20°C . Take $k = 1.4$ and $R = 287 \text{ J/kg K}$.
- (A) 2.32
(B) 0.56
(C) 0.89
(D) 1.32
29. Consider an actual regenerative rankine cycle with one open feed water heater for each kg steam entering the turbine, if 'm' kg steam with a specific enthalpy 'h', is bled from the turbine and specific enthalpy of liquid water entering is 'h', then 'h₃', specific enthalpy of saturated liquid leaving the heater is equals to
- (A) $mh_1 - (h_2 - h_1)$
(B) $h_1 - m(h_2 - h_1)$
(C) $h_2 - m(h_2 - h_1)$
(D) $mh_2 - (h_2 - h_1)$
30. For a given set of operating pressure limit of rankine cycle, the highest efficiency occurs for
- (A) Saturated cycle
(B) Superheated cycle
(C) Reheat cycle
(D) Regenerative cycle
31. A plant has boiler efficiency of 92%, turbine efficiency of 94%, generator efficiency of 44%, if 6% of generated power is used to run auxiliaries, the overall efficiency of the plant is
- (A) 34%
(B) 39%
(C) 45%
(D) 30%
32. The efficiency of superheat rankine cycle is higher than that of simple rankine cycle because
- (A) the enthalpy of main steam is higher for superheat cycle.
(B) The mean temperature of heat addition is higher for superheat cycle.
(C) The temperature of steam in condenser is high.
(D) The quality of steam in low condenser is low.

33. Blade erosion in steam turbine takes place due to
 (A) high temperature of steam.
 (B) due to droplet in steam.
 (C) due to high rotational speed.
 (D) due to high flow rate.
34. The main advantages of a reheat rankine cycle is
 (A) reduced moisture content in LP side of turbine.
 (B) increased efficiency.
 (C) reduced load on condenser.
 (D) reduced load on pump.
35. In an ideal steam power cycle with same inlet pressure the low dryness fraction of steam in the last stage of expansion process can be
 (A) Providing regeneration.
 (B) Providing reheating
 (C) Reduce superheat
 (D) Lowering condenser pressure
36. The equivalent evaporation (kg/hr) of a boiler providing 2000 kg/hr of steam with enthalpy content of 2426 kJ/kg from feed water at temperature 40 °C (liquid enthalpy = 168 kJ/kg of vaporization of water at 100 °C = 2258 kJ/kg) is
 (A) 2000
 (B) 2149
 (C) 1682
 (D) 1650
37. During which of the following process does the heat rejection takes place in Carnot vapour cycle ?
 (A) Constant volume
 (B) Constant pressure
 (C) Constant temperature
 (D) Constant entropy

AERTM (04)

38. Which one of the following is a fire tube boiler ?
 (A) Bobcock and Wilcox boiler
 (B) Locomotive boiler
 (C) Stirling boiler
 (D) Benson boiler
39. There is no steam drum in
 (A) La Mont boiler
 (B) Loffler boiler
 (C) Benson boiler
 (D) Velox boiler
40. A Curtis stage; Rateau stage and a 50% reaction stage in a steam turbine are the example of
 (A) Different type of impulse turbine.
 (B) Different type of reaction turbine.
 (C) A simple impulse stage, a velocity compounded impulse stage and reaction stage.
 (D) A velocity compounded impulse stage, a simple stage and a reaction stage.
41. Boiler rating is usually defined in terms of
 (A) Maximum temperature of steam in Kelvin
 (B) Heat transfer area in m²
 (C) Heat transfer rate in kJ/hr
 (D) Steam output in kJ/hr

42. A single stage impulse turbine with a diameter of 120 cm runs at 300 rpm. If the blade speed ratio is 0.42 then, the inlet velocity of steam will be
 (A) 79 m/s
 (B) 188 m/s
 (C) 450 m/s
 (D) 900 m/s
43. The net result of the pressure velocity compounding of steam turbine is
 (A) Less number of stages.
 (B) Large turbine for a given pressure drop.
 (C) Shorter turbine for a given pressure drop.
 (D) Lower friction loss.
44. If the enthalpy drop in the moving blades and fixed blades of a steam turbine is 10 kJ/kg and 15 kJ/kg respectively then the degree of reaction will be
 (A) 67%
 (B) 60%
 (C) 40%
 (D) 33%
45. The efficiency of impulse turbine is maximum when
 Nozzle angle = α
 Blade angle = V_b
 Absolute velocity of steam entering in blade = V
 (A) $V_b = 0.5 V \cos \alpha$
 (B) $V_b = V \cos \alpha$
 (C) $V_b = 0.5 V^2 \cos \alpha$
 (D) $V_b = V^2 \cos \alpha$
46. Which one of the following sets of conditions clearly apply to an ideal fluid ?
 (A) Viscous and Compressible
 (B) Non Viscous and Incompressible
 (C) Non Viscous and Compressible
 (D) Viscous and Incompressible
47. The vertical component of the hydrostatic force on a submerged curved surface is the
 (A) mass of liquid vertically above it.
 (B) weight of liquid vertically above it.
 (C) force on a vertical projection of the surface.
 (D) product of pressure at the centroid and the surface area.
48. Circulation is defined as line integral of tangential component of velocity about a _____
 (A) closed Contour (Path) in a fluid flow.
 (B) open contour (Path) in a fluid flow.
 (C) closed or open Contour (Path) in a fluid flow.
 (D) None.
49. Symmetrical blading is used in a turbine when its degree of reaction is
 (A) 25%
 (B) 50%
 (C) 75%
 (D) 100%

50. One kg of ice at 0°C is completely melted into water at 0°C at 1 bar pressure. The latent heat of fusion of water is 333 kJ/kg and the densities of water and ice at 0°C are 999.0 kg/m^3 and 916.0 kg/m^3 , respectively. What are the approximate values of the work done and energy transferred as heat for the process, respectively.
- (A) -9.4 J and 333.0 kJ
 (B) 9.4 J and 333.0 kJ
 (C) -333.0 kJ and -9.4 J
 (D) None of these
51. A system undergoes a process during which the heat transfer to the system per degree increase in temperature is given by the equation : $\frac{dQ}{dT} = 2\text{ kJ/}^\circ\text{C}$. The work done by the system per degree increase in temperature is given by the equation $\frac{dW}{dT} = 2 - 0.1T$, where T is in $^\circ\text{C}$. 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
52. A frictionless piston-cylinder device contains 0.015 m^3 gas initially at 0.8 MPa . It expands quasi-statically at constant temperature to a final volume of 0.030 m^3 . The work output (in kJ/kg) during this process will be
- (A) 8.32
 (B) 12.00
 (C) 554.67
 (D) 8320.00
53. One reversible heat engine operates between 1600 K and $T_2\text{ K}$, and another reversible heat engine operates between $T_2\text{ K}$ and 400 K . If both the engines have the same heat input and output then the temperature T_2 must be equal to
- (A) 1000 K
 (B) 1200 K
 (C) 1400 K
 (D) 800 K
54. A system of 100 kg mass undergoes a process in which its specific entropy increases from 0.3 kJ/kg K to 0.4 kJ/kg K . At the same time the entropy of the surrounding 80 kJ/K to 75 kJ/K . The process is
- (A) Reversible and isothermal
 (B) Irreversible
 (C) Reversible
 (D) Impossible
55. An inventor says that his new concept of an engine, while working between temperature limit of 27°C and 327°C rejects 45% of heat absorbed from the source. His engine is then equivalent to which one of the following engines ?
- (A) Carnot engine
 (B) Diesel engine
 (C) An impossible engine
 (D) Ericsson engine

56. 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
57. The thermodynamic parameters are :
I : Temperature, II : Specific Volume,
III : Pressure, IV : Enthalpy, V : Entropy. The Clapeyron equation of state provides relationship between
- (A) I and II
(B) II, III and V
(C) III, IV and V
(D) I, II, III and IV
58. Constant pressure lines in the super heated region of the Mollier diagram have what type of slope ?
- (A) A positive slope
(B) A negative slope
(C) Zero slope
(D) May have either positive or negative slope
59. Heat flows between two reservoirs having temperature 1000 K and 500 K respectively. If the entropy change of the cold reservoir is 10 kJ/K, then what is the entropy change for the hot reservoir ?
- (A) -10 kJ/K
(B) -5 kJ/K
(C) 5 kJ/K
(D) 10 kJ/K

60. Consider the following statements :
A real gas obeys perfect gas law at a very
- I. High temperature
II. High pressure
III. Low pressure
- Which of the following statements are/is correct ?
- (A) I alone
(B) I and III
(C) II alone
(D) III alone
61. A Stirling cycle and a Carnot cycle operate between 50 °C and 350 °C. Their efficiencies are η_s and η_c respectively. In this case, which of the following statement is true ?
- (A) $\eta_s > \eta_c$
(B) $\eta_s = \eta_c$
(C) $\eta_s < \eta_c$
(D) the sign of $(\eta_s - \eta_c)$ depends on the working fluids used
62. One kilomole of an ideal gas is throttled from an initial pressure of 0.5 MPa to 0.1 MPa. The initial temperature is 300 K. The entropy change of the universe is
- (A) 13.38 kJ/K
(B) 401.3 kJ/K
(C) 0.0446 kJ/K
(D) -0.0446 kJ/K

63. In the case of a Diesel cycle, increasing the cut off ratio will increase _____.
 (A) efficiency
 (B) mean effective pressure
 (C) the maximum weight
 (D) the engine weight
64. Consider the following statements for a carburettor.
 I. Acceleration jet is located just behind the throttle valve.
 II. Idle jet is located close to choke.
 III. Main jet alone supplies petrol at normal engine speeds.
 Which of the statements given below are correct ?
 (A) I, II and III
 (B) I and II
 (C) II and III
 (D) I and III
65. An air breathing air craft is flying where the air density is half the value at ground level. With reference to the ground level, the air fuel ratio at this altitude will be
 (A) 3
 (B) 5
 (C) 2
 (D) 4
66. A heat engine using lake water at 12°C as source and the surrounding atmosphere at 2°C as sink, executes 1080 cycles/min. If the amount of heat drawn per cycle is 57 Joule, then the output of the engine will be
 (A) 66 W
 (B) 56 W
 (C) 46 W
 (D) 36 W

67. Which one of the following set of materials is most commonly used in Catalytic converters for CI engine ?
 (A) Platinum, Palladium and Rhodium.
 (B) Palladium, Rhodium and Ruthenium.
 (C) Rhodium, Ruthenium and Platinum.
 (D) Ruthenium, Platinum and Palladium.
68. Considering the weight percentage, which of the following is determined by the proximate analysis of coal ?
 (A) Fixed carbon, Volatile matter, Moisture and Ash.
 (B) All solid and gaseous components.
 (C) All solid and gaseous components except volatile matter.
 (D) Fixed carbon and volatile matter.
69. In the Orsat flue gas analyser, ammoniacal cuprous chloride is used to absorb.
 (A) CO_2
 (B) CO
 (C) O_2
 (D) N_2
70. A turbo prop is preferred to turbojet because
 (A) it has high propulsive efficiency at high speeds.
 (B) it can fly at supersonic speeds.
 (C) it can fly at high elevations.
 (D) it has high power for take off.

71. When solid flames are burned, the Nitrogen content of the flue gas by volume is about
 (A) 60%
 (B) 70%
 (C) 80%
 (D) 90%
72. Which one of the following fuels is used to determine the water equivalent of a bomb Calorimeter ?
 (A) Benzoic acid
 (B) Octane
 (C) Coke
 (D) Cetane
73. The use of regenerator in a gas turbine cycle
 (A) Increases efficiency but has no effect on output.
 (B) Increases output but has no effect on efficiency.
 (C) Increases both efficiency and output.
 (D) Increases efficiency but decreases output.
74. A nuclear unit becoming critical means
 (A) it is generating power to rated capacity.
 (B) it is capable of generating power much more than the rated capacity.
 (C) there is danger of nuclear spread.
 (D) chain reaction that causes automatic splitting of the fuel nuclei has been established.
75. A composite wall is made of two layers of thickness σ_1 and σ_2 having thermal conductivities 'K and '2K' and equal surface areas normal to the direction of heat flow. The outer surface of the composite wall are 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, $\sigma_1 : \sigma_2$?
 (A) 1 : 1
 (B) 2 : 1
 (C) 1 : 2
 (D) 2 : 3
76. A large concrete slab 1 m thick has one dimensional temperature distribution : $T = 4 - 10x + 20x^2 + 10x^3$, where T is temperature and x is distance from one face towards other face of wall. If the slab material has thermal diffusivity of $2 \times 10^{-3} \text{ m}^2/\text{hr}$, what is the rate of change of temperature at the other face of the wall ?
 (A) 0.1 °C/h
 (B) 0.2 °C/h
 (C) 0.3 °C/h
 (D) 0.4 °C/h

77. A spherical thermocouple junction of diameter 0.706 mm is to be used for the measurement of temperature of a gas stream. The convective heat transfer coefficient of the bead surface is $400 \text{ W/m}^2 \text{ K}$. Thermo physical properties of thermocouple material are :

$$K = 20 \text{ W/mK}$$

$$C = 400 \text{ J/kg K}$$

$\rho = 8500 \text{ kg/m}^3$. If thermo couple initially at 30°C is placed in a hot stream of 300°C , then time taken by the bead to reach 298°C is

- (A) 2.35 s
- (B) 4.9 s
- (C) 14.7 s
- (D) 29.4 s

78. The temperature distribution in a stainless fin (Thermal conductivity $0.17 \text{ W/cm } ^\circ \text{C}$) of constant cross-sectional area of 2 cm^2 and length of 1 cm , exposed to ambient at 40°C (with a surface heat transfer co-efficient of $0.0025 \text{ W/cm } ^\circ \text{C}$) is given by $(T - T_\infty) = 3x^2 - 5x + 6$, where T is in $^\circ \text{C}$ and x is in cm . If the base temperature is 100°C , then the heat dissipated by the fin surface will be

- (A) 6.8 W
- (B) 3.4 W
- (C) 1.7 W
- (D) 0.17 W

79. For laminar flow over a flat plate, the local heat transfer coefficient ' h_x ' varies as $x^{-1/2}$, where x is the distance from the leading edge ($x = 0$) of the plate. The ratio of the average coefficient ' h_a ' between the leading edge and some location ' A ' at $x = x$ on the plate to the local heat transfer coefficient ' h_x ' at A is

- (A) 1
- (B) 2
- (C) 4
- (D) 8

80. The properties of Hg at 300 K are : density = 13529 kg/m^3 , specific heat at constant pressure = 0.1393 kJ/kg K , dynamic viscosity = $0.1523 \times 10^{-2} \text{ N.s/m}^2$ and thermal conductivity = 8.540 W/mK . The Prandtl number of Hg at 300 K is

- (A) 0.0248
- (B) 2.48
- (C) 24.8
- (D) 2480

81. A sphere, a cube and a thin circular plate, all made of same material and having same mass are initially heated to a temperature of 250°C and then left in air at room temperature for cooling. Then, which one of the following is correct ?

- (A) All will be cooled at the same rate.
- (B) Circular plate will be cooled at lowest rate.
- (C) Sphere will be cooled faster.
- (D) Cube will be cooled faster than sphere but slower than circular plate.

82. In a heat exchanger, the hot liquid enters with a temperature of 180°C and leaves at 160°C . The cooling fluid enters at 30°C and leaves at 110°C . The capacity ratio of the heat exchanger is
- (A) 0.25
(B) 0.40
(C) 0.50
(D) 0.55
83. Assertion (A) : A counter flow heat exchanger is thermodynamically more efficient than parallel flow type :
Reason (R) : A counter flow heat exchanger has a lower LMTD for the same temperature conditions.
- (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.
84. Nu for a pipe flow heat transfer coefficient is given by the equation $\text{Nu} \cdot D = 4.36$. Which one of the following combinations of conditions does exactly apply for the 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.
85. What is the value of view factor for two inclined flat having common edge of equal width and with an angle of 20° degree ?
- (A) 1.17
(B) 0.66
(C) 0.83
(D) 1.34
86. For an 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
87. A heat exchanger with heat transfer surface area 'A' and overall heat transfer coefficient 'u' handles two fluids of heat capacity C_1 and C_2 such that $C_1 > C_2$. The NTU of the heat exchanger is given by
- (A) $\frac{AU}{C_2}$
(B) e^{Au/C_2}
(C) e^{Au/C_1}
(D) $\frac{AU}{C_1}$

88. A refrigerating machine working on reverse Carnot cycle takes out 2 kW of heat from the system at 200 K while working between temperature limits of 300 K and 200 K. COP and power consumed by the cycle will, respectively be
- 1 and 1 kW
 - 1 and 2 kW
 - 2 and 1 kW
 - 2 and 2 kW
89. In an ideal vapour compression cycle, the enthalpy of the refrigerant at exit from the condenser, compressor and evaporator is 80 kJ/kg, 200 kJ/kg and 180 kJ/kg respectively, the coefficient of performance of the cycle is
- 6
 - 5
 - 3.5
 - 2.5
90. In milk chilling plant, the usual secondary refrigerant is
- Ammonia solution
 - Sodium silicate
 - Propylene glycol
 - Brine
91. A building in cold climate is to be heated by a Carnot heat pump. The minimum outside temperature is -23°C if the building is to be kept at 27°C and heat requirement is @ 30 kW, what is the minimum power required for the heat pump?
- 180 kW
 - 30 kW
 - 6 kW
 - 5 kW
92. When a refrigeration plant is started the evaporator temperature decreases from room temperature to the required value. During this period how does the compressor power requirement vary?
- It increases continuously.
 - It increases, reaches a peak and then decreases.
 - It decreases and then becomes constant.
 - It remains constant.
93. An expansion valve is NOT used for reducing pressure in the
- Vapour compression refrigeration cycle.
 - Vapour absorption refrigeration cycle.
 - Steam-jet refrigeration cycle.
 - Gas refrigeration cycle.
94. A condenser of a refrigeration system rejects heat at the rate of 120 kW, while its compressor consumes a power of 30 kW. The coefficient of performance of the system would be
- 1/4
 - 1/3
 - 3
 - 4

95. Which of the statements given below is/are correct ?

1. Sensible heating is a process in which moisture content remains unchanged.
2. In the dehumidification process the dew point temperature remains same.
3. The process of adding moisture at constant dry bulb temperature is known as pure humidification process.

- (A) 1 and 2
(B) 1 and 3
(C) 2 and 3
(D) 1 only

96. In order to have a low bypass factor of a cooling coil, the fin spacing and the number of tube rows should be

- (A) Wide apart and high respectively.
(B) Wide apart and low respectively.
(C) Close and high respectively.
(D) Close and low respectively.

97. When wet and dry bulb temperatures are identical, which of the following statements is/are true ?

1. Air is fully saturated.
2. Dew point temperature is reached.
3. Humidity ratio is unity.
4. A partial pressure of vapours equals total pressure.

Select the correct answer from the codes given below :

- (A) 1 only
(B) 1 and 2
(C) 3 and 4
(D) 1, 2, 3 and 4

98. Which one of the following statements is true for effective temperature ET ?

- (A) ET increases with increase in level of activity and it decreases with increase in air velocity.
(B) ET decreases with increase in level of activity and it increases with increase in air velocity.
(C) ET increases with increase in level of activity and it increases with increase in air velocity.
(D) ET decreases with increase in level of activity and decreases with increase in air velocity.

99. In a forced vortex

- (A) The fluid velocity is inversely proportional to the radius.
(B) The fluid rotates without any relative velocity.
(C) The rise depends on the specific weight.
(D) The rise is proportional to the cube of angular velocity.

100. A solar collector receiving solar radiation at the rate of 0.6 kW/m^2 transform it to the internal energy of a fluid at an overall efficiency of 50%. The fluid heated to 350 K is used to run a heat engine which rejects heat at 313 K . If the heat engine is to deliver 2.5 kW power, then minimum area of the solar collector required would be

- (A) 8.33 m^2
(B) 16.66 m^2
(C) 39.68 m^2
(D) 79.36 m^2