

MIZORAM PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF INSPECTOR OF LEGAL METROLOGY UNDER FOOD, CIVIL SUPPLIES & CONSUMER AFFAIRS DEPARTMENT, GOVERNMENT OF MIZORAM, DECEMBER, 2018

MECHANICAL ENGINEERING

PAPER - I

Time Allowed : 2 hours

Full Marks : 200

*All questions carry equal marks of two (2) each.
Attempt all questions.*

1. Stoichiometric air–fuel ratio of petrol is roughly
 - (a) 50 : 1
 - (b) 25 : 1
 - (c) 15 : 1
 - (d) 1 : 1
2. In a two-stroke engine, one power stroke is obtained in
 - (a) one revolution of the crank shaft
 - (b) two revolutions of the crank shaft
 - (c) four revolutions of the crank shaft
 - (d) none of these
3. In an ideal Brayton cycle, the heat is added at
 - (a) constant volume
 - (b) constant pressure
 - (c) constant temperature
 - (d) constant entropy
4. The function of an inter cooler in a gas turbine plant is
 - (a) to cool the exhaust gas from the turbine
 - (b) to cool compressed air from compressor
 - (c) to cool atmospheric air before inlet to compressor
 - (d) to cool the compressed air in between the stages
5. COP of a Carnot refrigeration cycle is greater than
 - (a) vapour compression cycle
 - (b) reversed Brayton cycle
 - (c) vapour absorption cycle
 - (d) all of these
6. Which of the variable controls the physical properties of a perfect gas?
 - (a) pressure
 - (b) temperature
 - (c) volume
 - (d) all of these
7. Boyle's law is applicable to gases under
 - (a) only Small range of pressure
 - (b) high range of pressure
 - (c) steady range of pressure
 - (d) all range of pressure
8. Which of the following can be regarded as gas so that gas laws could be applicable, within the commonly encountered temperature limits?
 - (a) O₂, N₂, steam, CO₂
 - (b) O₂, N₂, water vapour
 - (c) SO₂, NH₃, CO₂, moisture
 - (d) O₂, N₂, H₂, air
9. Temperature of a gas is produced due to
 - (a) Its heating value
 - (b) Kinetic energy of molecules
 - (c) Repulsion of molecules
 - (d) Attraction of molecules
10. 1 bar in SI units is
 - (a) 1x10⁵ Pa
 - (b) 100 kPa
 - (c) 0.987 atm
 - (d) All of these

11. Which of the following is an extensive property?
(a) Volume (b) Temperature
(c) Pressure (d) Density
12. When the rate of evaporation of water is zero, the relative humidity of the air is
(a) 0% (b) 100%
(c) 50% (d) Unpredictable
13. When H_1 =total heat of air entering the coil (heating or cooling), H_2 = total heat of the air leaving the coil (heating or cooling), H_3 = total heat of air at the end of the process (humidification or dehumidification), then the sensible heat factor $(H_2-H_1)/(H_3-H_1)$ represents the process of
(a) Cooling and humidification (b) Cooling and dehumidification
(c) Heating and humidification (d) Heating and dehumidification
14. The dew point temperature is less than the wet bulb temperature for
(a) Standard air (b) Unsaturated air
(c) Both saturated and unsaturated air (d) None of these
15. For charging a tank
(a) Enthalpy is converted to work done (b) Work done is converted to enthalpy
(c) Enthalpy is converted to internal energy (d) Internal energy is converted to work done
16. The first law of thermodynamics deals with
(a) heat and work (b) quality of energy
(c) balance of quantity of energy (d) measurement of energy transfer
17. The perpetual motion machine of the first kind is impossible according to the
(a) zeroth law of thermodynamics (b) first law of thermodynamics
(c) second law of thermodynamic (d) third law of thermodynamics
18. The latent heat of vaporization with increase in pressure of water
(a) increases (b) remains constant
(c) decreases (d) none of these
19. In an isothermal process
(a) temperature increases gradually (b) volume remains constant
(c) change in internal energy is zero (d) enthalpy change is maximum
20. In a reversible adiabatic process, the work transfer is equal to
(a) decrease in enthalpy (b) decrease in internal energy
(c) heat transfer (d) the product of pressure and change in volume
21. A control mass gives out 10 kJ of energy in the form of heat transfer at 500°C . Find the change in availability of the control mass
(a) -4.14 kJ (b) -5.14 kJ
(c) -6.14 kJ (d) -7.14 kJ
22. In turbofan engine, fan is used
(a) To compress the inlet air more efficiently (b) To increase the total thrust of the engine
(c) Both (a) & (b) (d) None of these
23. Gas turbines are suitable for aircraft propulsion because
(a) Gas turbines are light weight (b) Gas turbines are compact in size
(c) Gas turbines have a high power to weight ratio (d) All of these
24. The volatile petroleum fuels of high octane number, pre-ignition is reduced at _____ mixture
(a) Very rich (b) Very lean
(c) Equal (d) None of these

25. The pressure of supercharger used is
(a) 1 to 1.3 bar (b) 1.2 to 1.4 bar
(c) 1.3 to 1.5 bar (d) 1.5 to 1.8 bar
26. The following factors affect the process of carburetion
(a) Engine speed (b) The temperature of incoming air
(c) The volatility of fuel (d) All of these
27. The difference of fuel level of tip of main nozzle and fuel level in float chamber of a simple carburetor is called
(a) Nozzle lip (b) Nozzle dip
(c) Throttle lip (d) Throttle dip
28. Aero planes employ following type of compressors
(a) Radial flow (b) Axial flow
(c) Centrifugal (d) Combined of above
29. Internal energy of a perfect gas depends on
(a) temperature, specific heat and enthalpy (b) temperature, specific heat and entropy
(c) temperature, specific heat and pressure (d) temperature only
30. A refrigerator and heat pump operates between same temperature limits. If the COP of the refrigerator is 4, what is the COP of heat pump?
(a) 3 (b) 5
(c) 4 (d) 3.4
31. It is impossible to construct an engine which while operating in a cycle, produces no other effect except to extract the heat from a single-temperature reservoir and do equivalent amount of work.
(a) It refers to Clausius statement. (b) It refers to Kelvin–Planck’s statement.
(c) It refers to Carnot’s theorem. (d) It refers to Clausius’s theorem.
32. The degradation of energy is responsible for
(a) entropy generation within the system (b) decrease of entropy within the system
(c) maximum work done by the system (d) none of these
33. Bernoulli’s equation cannot be applied when the flow is
(a) rotational (b) turbulent
(c) unsteady (d) all of these
34. Streamline and equipotential lines in a flow field
(a) are parallel to each other (b) are identical to each other
(c) are perpendicular to each other (d) intersect at acute angles
35. A flow is called super-sonic if the
(a) velocity of flow is very high (b) discharge is difficult to measure
(c) Mach number is between 1 and 5 (d) Mach number is less than 1
36. The dynamic viscosity of a liquid is 1.2×10^{-4} Ns/m², whereas, the density is 600 kg/m³. The kinematic viscosity in m²/s is
(a) 72×10^{-3} (b) 20×10^{-8}
(c) 7.2×10^3 (d) 70×10^6
37. The anti-knock property of the fuel depends on its
(a) Self-ignition temperature (b) Molecular structure
(c) Chemical composition (d) All of these

38. Newton's law of viscosity states that
- (a) the shear stress applied to the fluid is directly proportional to the velocity gradient (du/dy)
 - (b) the shear stress applied to the fluid is inversely proportional to the velocity gradient (du/dy)
 - (c) the shear stress applied to the fluid is directly proportional to the specific weight of the fluid
 - (d) the shear stress applied to the fluid is inversely proportional to the specific weight of the fluid
39. The pressure that seawater exerts on a submerged submarine is called
- (a) underwater pressure.
 - (b) liquid pressure.
 - (c) submerged pressure.
 - (d) hydrostatic pressure
40. Which of the following is the correct relation between centroid (G) and the centre of pressure (P) of a plane submerged in a liquid?
- (a) G is always below P
 - (b) P is always below G
 - (c) G is either at P or below it.
 - (d) P is either at G or below it.
41. The value of the surface tension of an ideal fluid is
- (a) zero
 - (b) unity
 - (c) infinity
 - (d) more than that of a real fluid
42. The velocity of a fluid particle at the centre of the pipe section is
- (a) Maximum
 - (b) Minimum
 - (c) Average
 - (d) r.m.s
43. Viscous forces are not present in
- (a) rotational flow
 - (b) irrotational flow
 - (c) laminar flow
 - (d) none of the above
44. Property of fluid that describes its internal resistance is known as:
- (a) Viscosity
 - (b) Friction
 - (c) Resistance
 - (d) Internal energy
45. In a static fluid
- (a) resistance to shear stress is small
 - (b) fluid pressure is zero
 - (c) linear deformation is small
 - (d) only normal stresses can exist
46. Cavitation is caused by
- (a) high pressure
 - (b) high velocity
 - (c) low pressure
 - (d) weak material
47. The fluid forces considered in the Navier Stokes equation are
- (a) gravity, pressure and viscous
 - (b) gravity, pressure and turbulent
 - (c) pressure, viscous and turbulent
 - (d) gravity, viscous and turbulent
48. The region between the separation streamline and the boundary surface of the solid body is known as
- (a) wake
 - (b) drag
 - (c) lift
 - (d) boundary layer
49. In a free vortex motion, the radial component of velocity everywhere is
- (a) maximum
 - (b) minimum
 - (c) zero
 - (d) non-zero and finite
50. The flow in which the velocity vector is identical in magnitude and direction at every point, for any given instant, is known as
- (a) one dimensional flow
 - (b) uniform flow
 - (c) steady flow
 - (d) turbulent flow

51. The two important forces for a floating body are
(a) buoyancy, gravity (b) buoyancy, pressure
(c) buoyancy, inertial (d) inertial, gravity
52. Ratio of inertia force to elastic force is known as
(a) Mach number (b) Froude number
(c) Reynold's number (d) Weber's number
53. If fluid is incompressible and it is steady then its mass is
(a) increasing (b) decreasing
(c) same (d) conserved
54. According to the equation of continuity, when water falls its speed increases, while its cross-sectional area
(a) increases (b) decreases
(c) remain same (d) different
55. The highest point of syphon is called as
(a) syphon top (b) summit
(c) reservoir (d) none of these
56. As an incompressible fluid moves through a restriction,
(a) Velocity decreases and pressure increases
(b) Velocity increases and pressure increases
(c) Velocity increases and pressure remains the same
(d) Velocity decreases and pressure remains the same
57. For the measurement of flow rate of liquid, the method used is
(a) Conveyor-based methods (b) Bourdon tube
(c) Coriolis method (d) Thermal mass flow measurement
58. The pattern of flow in the boundary layer is judged by the
(a) Reynolds number (b) Fourier number
(c) Peclet number (d) Grashof number
59. The discharge in an open channel corresponding to critical depth is
(a) Zero (b) Minimum
(c) Maximum (d) None of these
60. Which type of nozzle is used in a steam turbine
(a) Convergent (b) Divergent
(c) Convergent-divergent (d) None
61. A body floats in stable equilibrium
(a) when the metacentre is above C.G.
(b) when its metacentric height is zero
(c) when its C.G. is below its center of buoyancy
(d) metacentre has nothing to do with position of C.G. for determining stability
62. Capillary action is due to the
(a) surface tension
(b) cohesion of the liquid
(c) adhesion of the liquid molecules and the molecules on the surface of a solid
(d) all of these
63. Heat transfer takes place as per -
(a) zeroth law of thermodynamics (b) first law of thermodynamic
(c) second law of the thermodynamics (d) Kirchoff's law

64. Metals are good conductors of heat because
- (a) their atoms collide frequently
 - (b) their atoms-are relatively far apart
 - (c) they contain free electrons
 - (d) they have high density
65. The flow on two sides of a normal shock wave is
- (a) subsonic
 - (b) sonic
 - (c) supersonic
 - (d) supersonic on one side and subsonic on the other side
66. Separation of flow occurs when pressure gradient
- (a) becomes negative
 - (b) changes abruptly
 - (c) tends to approach zero
 - (d) reduces to a value when vapor formation starts
67. The rate of energy transferred by convection to that by conduction is called
- (a) Stanton number
 - (b) Nusselt number
 - (c) Biot number
 - (d) Peclet number
68. Which statement is true regarding steady state condition?
- (a) There is a variation in temperature in the course of time
 - (b) Heat exchange is constant
 - (c) It is a function of space and time coordinates
 - (d) Internal energy of the system changes
69. Thermal conductivity of the same material varies with
- (a) the thickness of the material
 - (b) the temperature of the material
 - (c) both (a) & (b)
 - (d) thermal conductivity of the same material does not vary at all
70. In the process of heat transfer through extended surfaces or fins, the entire surface area is at
- (a) the same constant temperature
 - (b) different temperatures
 - (c) maximum base temperature
 - (d) minimum temperature
71. Thermal diffusivity is
- (a) a dimensionless parameter
 - (b) function of temperature
 - (c) used as mathematical model
 - (d) a physical property of the material
72. A non-dimensional number generally associated with natural convection heat transfer is
- (a) Grashoff number
 - (b) Nusselt number
 - (c) Weber number
 - (d) Prandtl number
73. LMTD in case of counter flow heat exchanger as compared-to parallel flow heat exchanger is
- (a) higher
 - (b) lower
 - (c) same
 - (d) depends on the area of heat exchanger
74. According to Stefan-Boltzmann law, ideal radiators emit radiant energy at a rate proportional to
- (a) absolute temperature
 - (b) square of temperature
 - (c) fourth power of absolute temperature
 - (d) fourth power of temperature
75. Which one is having highest value of overall heat transfer coefficient?
- (a) Feed water heaters
 - (b) Steam condensers
 - (c) Alcohol condensers
 - (d) Ammonia condensers

76. In free convection heat transfer transition from laminar to turbulent flow is governed by the critical value of the
- (a) Reynold's number
 - (b) Grashoff's number
 - (c) Reynold's number, Grashoff's number
 - (d) Prandtl number, Grashoff's number
77. Forced convection in a liquid bath is caused by
- (a) Intense stirring by an external agency
 - (b) Molecular energy interactions
 - (c) Density difference brought about by temperature gradients
 - (d) Flow of electrons in a random fashion
78. The mass transfer rate is independent of
- (a) Turbulence effect
 - (b) Physical properties
 - (c) Chemical properties
 - (d) none of these
79. Shape factor for plane wall is equal to
- (a) A/d
 - (b) $2A/d$
 - (c) $3A/d$
 - (d) $4A/d$
80. Which of the following is NOT a type of heat pump?
- (a) vapour compression type
 - (b) vapour absorption type
 - (c) both (a) & (b)
 - (d) none of these
81. During a refrigeration cycle, heat is rejected by the refrigerant in a
- (a) condenser
 - (b) compressor
 - (c) evaporator
 - (d) expansion valve
82. Which one of the following is a CFC refrigerant?
- (a) R 744
 - (b) R 290
 - (c) R 502
 - (d) R 718
83. In a dry evaporator, refrigerant at the outlet is
- (a) in the wet state
 - (b) saturated state
 - (c) super-heated state
 - (d) None
84. The presence of which of the following units in a vapor compression system is adversely affected by the presence of moisture?
- (a) Condenser
 - (b) Expansion valve
 - (c) Evaporator
 - (d) Compressor
85. On a psychrometric chart cooling and humidification process using spray can be shown by
- (a) horizontal line
 - (b) vertical line
 - (c) line parallel to dry bulb temperature lines
 - (d) line parallel to wet bulb temperature lines
86. During sensible heating of moist air, enthalpy
- (a) increases
 - (b) decreases
 - (c) remains constant
 - (d) none of these
87. Which of the following cycles uses air as the refrigerant
- (a) Ericsson
 - (b) Stirling
 - (c) Carnot
 - (d) Bell-coleman
88. The COP of a domestic refrigerator
- (a) is less than 1
 - (b) is more than 1
 - (c) is equal to 1
 - (d) depends upon the make

89. Which of the following refrigerants has lowest freezing point
(a) Freon-12 (b) NH_3
(c) CO_2 (d) Freon-22
90. In a bomb calorimeter, the fuel burns at constant
(a) volume (b) pressure
(c) temperature (d) entropy
91. Multistage centrifugal pumps are used to obtain
(a) high discharge (b) high head
(c) pumping of viscous fluids (d) high head and high discharge
92. Indicator diagram of a reciprocating pump is a graph between
(a) pressure in cylinder vs swept volume (b) flow vs swept volume
(c) flow vs speed (d) pressure vs speed
93. Francis, Kaplan and propeller turbines fall under the category of
(a) Impulse turbines (b) Reaction turbines
(c) Axial flow turbines (d) Mixed flow turbines
94. Comparing fire tube and water tube boilers, which boiler can produce comparatively higher pressure steam than another for the same capacity?
(a) fire tube boiler
(b) water tube boiler
(c) both can produce steam at same pressure for the same capacity
(d) none of these
95. For very high discharge at low pressure such as for flood control and irrigation applications, following type of pump is preferred
(a) centrifugal (b) axial flow
(c) reciprocating (d) mixed flow
96. Low specific speed of a pump implies it is
(a) centrifugal pump (b) mixed flow pump
(c) axial flow pump (d) any one of these
97. Equivalent evaporation is the amount of water evaporated in a boiler from and at
(a) 0°C (b) 100°C
(c) saturation temperature at given pressure (d) room temperature
98. The second law of thermodynamics deals with
(a) direction of process and quality of energy (b) energy balance
(c) balance of internal energy (d) system efficiency
99. Fourier law of heat conduction is based on the assumption that
(a) Heat flow through a solid is one dimensional (b) Heat flow is in steady state
(c) Both (a) and (b) (d) None of these
100. Work is a
(a) point function (b) path function
(c) depends on the state (d) none of these