MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF

INSPECTOR OF LEGAL METROLOGY

UNDER FOOD, CIVIL SUPPLIES & CONSUMER AFFAIRS, GOVT. OF MIZORAM

NOVEMBER, 2023

MECHANICAL ENGINEERING PAPER-I

Time Allowed : 2 hours | Full Marks : 200

All questions carry equal marks of 2 each.
Attempt all questions.

1. Pseud-plastic is a fluid for which
(a) dynamic viscosity decreases as the rate of shear increase
(b) newton's law of viscosity holds good
(c) dynamic viscosity increases as the rate of shear increases
(d) dynamic viscosity increases with the time for which the shearing forces are applied

2. The viscosity of water with respect to air is about
(a) 50 times
(b) 55 times
(c) 60 times
(d) 65 times

3. What are the dimensions of kinematic viscosity of a fluid?
(a) LT^{-2}
(b) L^2T^{-1}
(c) $ML^{-1}T^{-1}$
(d) $ML^{-2}T^{-2}$

4. A unit cubic metre of water is subjected to a pressure of 10 bar. Then a change in the volume of water amounts to _____ m^3 when bulk modulus $K = 2 \times 10^9$ Pa.
(a) 1/20
(b) 1/200
(c) 1/2000
(d) 1/ 3000

5. All liquid surfaces tend to stretch. This phenomenon is called
(a) Cohesion
(b) adhesion
(c) surface tension
(d) cavitation

6. To avoid a correction for the effect of capillary in manometers, the minimum diameter of tube (in mm) should be
(a) 2.5
(b) 6
(c) 10
(d) 15

7. The pressure inside a soap bubble of 50 mm diameter is 25 N/m^2 above the outside atmospheric pressure. The surface tension in sop film would be _____ N/m.
(a) 0.156
(b) 0.312
(c) 0.624
(d) 0.078

8. Which of the following forces act on a fluid at rest?

(i) gravity force (ii) hydrostatic force

(iii) surface tension (iv) viscous force

Select the correct answer using the code given below:

(a) i, ii, iii and iv (b) i, ii and iii

(c) ii and iv (d) i, iii, iv

9. The height of water column (in meters) corresponding to a pressure equivalent of 75 cm of mercury column is

(a) 1.0 (b) 1.02

(c) 1.04 (d) 1.06

10. Resultant pressure of the liquid in case of an immersed body acts through

(a) centre of gravity (b) centre of pressure

(c) metacentre (d) centre of buoyancy

11. A metallic piece weighs 80 N in air and 60 N in water. The relative density of the metal would be

(a) 8 (b) 6

(c) 4 (d) 3

12. For warships, metacentric height of ship should vary between

(a) 0-1 m (b) 1-2 m

(c) 5-10 m (d) more than 10 m

13. The fluid forces considered in the Navier Stokes equation are

(a) gravity, pressure and viscous (b) gravity, pressure and turbulent

(c) viscous, pressure and laminar (d) gravity, turbulent and viscous

14. The property of stream function ψ is :

(a) ψ is constant everywhere on any stream line

(b) the flow around any path in the fluid is zero for continuous flow

(c) the velocity vector may be found by differentiating the stream function

(d) all of the above

15. A fluid is said to be ideal, if it is

(a) incompressible (b) inviscous

(c) inviscous and incompressible (d) viscous and compressible

16. Low-torque high-speed motors are used in

(a) cranes (b) winches

(c) fans (d) all of the above

17. The efficiency of pelton wheel shall be maximum if the ratio of jet velocity to tangential velocity of the wheel is

(a) ½ (b) 1

(c) 2 (d) 4

18. An impulse turbine

(a) is most suited for low head installations (b) always operates submerged

(c) makes use of draft tube (d) is not expose to atmosphere

19. A jet of water impinges normally on a fixed plate. The forced exerted on the plate will be

(a) $\frac{wAV}{g}$ (b) $\frac{wAV^2}{g}$

(c) $\frac{wAV^2}{2g}$ (d) $\frac{wAV}{2g}$

20. The force of impingment of a jet on a vane increases if

(a) the vane angle is increased (b) the vane angle is decreased

(c) the pressure is reduced (d) the vane is moved against the jet

21. The value of speed ratio for a Kaplan turbine is about

(a) 0.5 (b) 0.9

(c) 1.5 (d) 2.0

22. Which of the following water turbine does not require a draft tube?

(a) Propeller turbine (b) Pelton turbine

(c) Kaplan turbine (d) Francis turbine

23. If n is the number of jets in a Pelton turbine, then its specific speed is proportional to

(a) n (b) $\sqrt{n}$

(c) n^2 (d) independent of n

24. The unit power P_u of a turbine developing a power P under a head H is

(a) $P/\sqrt{H}$ (b) $P / H^{3/2}$

(c) $P/ H^{5/2}$ (d) $P / H^{4/5}$

25. Operating characteristic curves of turbine means curves drawn at constant

(a) head (b) discharge

(c) speed (d) efficiency

26. Reciprocating compressors have maximum capacity of _____ m^3/min

(a) 50 (b) 100

(c) 200 (d) 300

27. Standard air is air at

(a) 1 bar pressure and 0°C temperature

(b) 1 bar pressure and 15°C temperature

(c) 1 bar pressure, 20°C temperature and 36% relative humidity

(d) atmospheric conditions of pressure and temperature at any specific location

28. Which of the following types of impeller vanes are most commonly used in centrifugal type impeller?

(a) forward curved (b) radial

(c) backward (d) tangential

29. Maximum delivery pressure for rotary bladed compressor is usually restricted to _____ bar.

(a) 5 (b) 10

(c) 20 (d) 50

30. During peak load periods, the best method for compressor control is

(a) relief valve (b) variable speed

(c) start-stop motor (d) constant speed unloading

31. In axial compressor, exit flow angle deviation from the blade angle is a function of
(a) blade camber
(b) both blade camber and space-chord ratio
(c) space-chord ratio
(d) blade camber and incidence angle

32. For the same tip diameter, axial flow compressor compared to centrifugal compressor offers higher
(a) pressure ratio
(b) mass flow
(c) temperature ratio
(d) speed of rotation

33. An object having 10 kg mass weighs 9.81 kg on a spring balance. The value of 'g' at this place is
(a) 10 m/sec^2
(b) 9.81 m/sec^2
(c) 10.2 m/sec^2
(d) 9 m/sec^2

34. A balloon lifting in air follows the following principle
(a) Law of gravitation
(b) Archimedes Principle
(c) Principle of buoyancy
(d) All of the above

35. If mercury in a barometer is replaced by water, the height of 3.75 cm of mercury will be following cm of water
(a) 51 cm
(b) 50 cm
(c) 52 cm
(d) 52.2 cm

36. For a hypersonic flow, the mach number is
(a) unity
(b) greater than unity
(c) greater than 2
(d) greater than 4

37. the use of gas turbine in electric power stations serves
(a) to meet base load
(b) to meet the peak loads
(c) to start thermal power plants
(d) to generate power when other power sources fail

38. A jet air-craft is powered by
(a) piston engine
(b) screw propeller
(c) gas turbine
(d) free piston engine

39. Bernoulli equation deals with the law of conservation of
(a) mass
(b) momentum
(c) energy
(d) work

40. Increasing the number of reheating stages in a gas turbine to infinity makes the expansion tending
(a) reversible adiabatic
(b) isothermal
(c) isobaric
(d) adiabatic

41. For incompressible flow diverging section acts as diffuser in the down-stream for
(a) sonic state only
(b) subsonic state only
(c) supersonic state
(d) both sonic and supersonic

42. Nozzle used in rocket engine is
(a) convergent nozzle
(b) divergent nozzle
(c) convergent-divergent nozzle
(d) none of the above

43. The rate of heat transfer in drop-wise condensation is _____ than firm condensation.
(a) larger
(b) smaller
(c) equal
(d) none

44. Which of the following statements are true?

i) piston pumps are self-priming
ii) piston pumps require high maintenance
iii) piston pumps have low cost of production
iv) piston pumps have low volumetric efficiency

(a) i and ii
(b) iii and iv
(c) i and iii
(d) all of the above

45. What causes suction of fluid into the gear pump?

(a) when pressure drops during disengagement of teeth at the suction side
(b) when pressure increases during disengagement of teeth at the suction side
(c) when pressure drops during engagement of teeth at the suction side
(d) when pressure increases during engagement of teeth at the suction side

46. The total energy developed by the hydraulic oil in a system is given as

(a) Total energy = (Potential energy + Pressure energy)
(b) Total energy = (Potential energy + Kinetic energy)
(c) Total energy = (Potential energy – Kinetic energy)
(d) None of the above

47. When is a pressure reducing valve used?

(a) it is used when higher pressure than system pressure is required
(b) it is used when lower pressure than system pressure is required
(c) when absolutely zero pressure is required
(d) all of the above

48. Which factor is considered while selecting the diameter of piston rod in hydraulic cylinder?

(a) bore diameter
(b) length of stroke
(c) load
(d) all of the above

49. Which of the following is not an accessory of the boiler

(a) condenser
(b) economiser
(c) air-preheater
(d) feed water pump

50. If R_e is the Renold's number, the coefficient of friction for laminar flow is

(a) $\frac{4}{R_e}$
(b) $\frac{8}{R_e}$
(c) $\frac{12}{R_e}$
(d) $\frac{16}{R_e}$

51. 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

52. Most unsteady heat flow occurs

(a) through the walls of a refrigerator
(b) during annealing of castings
(c) through the walls of a furnace
(d) through insulated pipe carrying steam

53. All of the followings are unit of thermal conductivity except

(a) kcal/m.hr.°C
(b) kJ/m.hr.K
(c) W/m.s.K
(d) cal/cm.s.°C

54. Molecular transmission of heat is smallest in case of

(a) gases (b) liquids

(c) solids (d) alloys

55. Heat is conducted through a 10 cm thick wall at the rate of 30 W/m^2 when the temperature difference across the wall is 10 °C. What is the thermal conductivity (Wm/K) of the wall material?

(a) 0.03 (b) 0.3

(c) 3.0 (d) 30

56. Two walls of same thickness and cross-sectional area have thermal conductivities in the ratio 1:2. If the same temperature difference is maintained across the wall faces, the ratio of heat flow Q_1/Q_2 will be

(a) ½ (b) 1

(c) 2 (d) 4

57. Fins are made as thin as possible to

(a) reduce the total weight (b) accommodate more number of fins

(c) increase the width for the same profile area (d) improve the flow of coolant around the fin

58. An increase in convective coefficient over a fin

(a) increases effectiveness (b) decreases effectiveness

(c) does not influence effectiveness (d) influences only the fin efficiency

59. In transient heat conduction, the two significant dimensionless parameters are

(a) Reynolds and Prandtl number (b) Biot and Fourier number

(c) Reynolds and Biot number (d) Reynolds and Fourier number

60. Thermal radiations occur in the portion of electromagnetic spectrum between the wavelengths

(a) 10^{-2} to 10^{-4} micron (b) 10^{-1} to 10^{-2} micron

(c) 0.1 to 10^2 micron (d) 10^2 micron onwards

61. Heat transfer by radiation is encountered least in

(a) boiler furnace (b) insulated steam pipe

(c) electric bulb (d) nuclear reactor

62. The intensity of solar radiation (kW/m^2) on earth is

(a) 1 (b) 2

(c) 5 (d) 10

63. Free convection heat flows depends on all of the followings, except

(a) density (b) coefficient of viscosity

(c) gravitational force (d) velocity

64. Which dimensionless number has significant role in forced convection?

(a) Prandtl number (b) Reynolds number

(c) Mach number (d) Peclet number

65. Heat is lost from a 100 mm diameter steam pipe placed horizontally in ambient air at 30 °C. If the Nusselt number is 25 W/m^2K and thermal conductivity of air is 0.03 W/mK, then the heat transfer coefficient will be _____ W/m^2K

(a) 7.5 (b) 16.5

(c) 25 (d) 30

66. For the same operating temperature limits, the coefficient of performance (COP) of heat pump equals
(a) COP of refrigerators
(b) 1+ COP of refrigerators
(c) COP of refrigerator -1
(d) $\frac{1}{COP\ of\ refrigerator}$

67. Thermoelectric refrigeration system is based on
(a) Peltier effect
(b) Joule effect
(c) Joule-Thomson throttling
(d) adiabatic magnetisation

68. The refrigerating system of passenger aircraft works on reversed
(a) Brayton cycle
(b) Atkinson cycle
(c) Ericsson cycle
(d) Carnot cycle

69. Which is usually the costliest item in a refrigeration system?
(a) condenser
(b) capillary tube
(c) compressor
(d) evaporator

70. The chemical formula of Freon-12 is
(a) $CCl\ F_2$
(b) $CCl_2\ F_3$
(c) $CCl_2\ F_2$
(d) $CCl\ F$

71. In conventional refrigerants, what is the element responsible for ozone depletion?
(a) Chlorine
(b) Fluorine
(c) Carbon
(d) Hydrogen

72. If m_a = mass of dry air and m_w = mass of water vapour in the air-water vapour mixture, then the humidity ratio is given by
(a) $\frac{m_w}{m_a}$
(b) $\frac{m_a}{m_w}$
(c) $\frac{m_w}{m_a + m_w}$
(d) $\frac{m_a}{m_a + m_w}$

73. The comfort air-conditioning and industrial air conditioning differ in relation to
(a) process adopted
(b) equipment used
(c) indoor requirement
(d) environmental condition

74. Dew point is the temperature at which the condensation begins when the air is cooled at constant:
(a) volume
(b) entropy
(c) pressure
(d) enthalpy

75. Which of the following parameters remain constant during a sensible cooling or heating process?
(a) humidity ratio
(b) relative humidity
(c) enthalpy
(d) wet bulb temperature

76. The vapour compression refrigeration employs the following cycle
(a) Reverse carnot
(b) Carnot
(c) Rankine
(d) Brayton

77. The air standard efficiency of an I.C. engine is given by (where r = Compression ratio, and γ = Ratio of specific heats)
(a) $1-r^{\gamma-1}$
(b) $1+r^{\gamma-1}$
(c) $1-(1/r^{\gamma-1})$
(d) None of these

78. Which of the following is the lightest and most volatile liquid fuel?

(a) Diesel (b) Kerosene

(c) Fuel oil (d) Gasoline

79. Which law of thermodynamics is known as law of nature?

(a) Zeroth law (b) First Law

(c) Second Law (d) Third law

80. What is the use of reheat cycle in steam turbines?

(a) To remove the moisture from the steam (b) To increase the steam temperature

(c) To increase steam pressure (d) None of the these

81. Clausius inequality is applied at

(a) reversible isothermal heat addition (b) reversible adiabatic expansion

(c) reversible isothermal compression (d) reversible isothermal heat rejection

82. An ideal gas with an internal energy U initially at 0°C is heated to 273°C. What is the new internal energy in terms of U?

(a) U (b) (1/2)U

(c) (1/4)U (d) 2U

83. Choose the open thermodynamic sytem

(a) manual ice cream freezer (b) centrifugal pump

(c) pressure cooker (d) battery

84. Which of the following is the extensive property of a thermodynamic system?

(a) viscosity (b) specific enthalpy

(c) density (d) potential energy

85. Which one of the following quantities presents the property of a system?

(a) $\int p\,dv$ (b) $\int v\,dp$

(c) $\int (p\,dv + v\,dp)$ (d) none of these

86. A quasi static process is one in which all the states through which a system passes are very close to

(a) equilibrium state (b) original state

(c) same temperature (d) each other

87. Which parameter remains constant during a reversible isothermal process?

(a) internal energy (b) rate of heat exchange

(c) enthalpy (d) entropy

88. Neglecting changes in potential and kinetic energies, the shaft work during a steady flow process is given by

(a) $\int p\,dv$ (b) $\int v\,dp$

(c) pv (d) $-\Delta h$

89. An engine operates between temperatures limits of 900 K and T_2, another engine operates between T_2 and 400 K. For both engines to be equally efficient, T_2 should be equal to

(a) 600 K (b) 625 K

(c) 650 K (d) 700 K

90. A carnot cycle is having an efficiency of 0.75. If the temperature of the high temperature reservoir is 727 °C, what is the temperature of the low temperature reservoir?

(a) 23 °C (b) -23 °C

(c) 0 °C (d) 250 °C

91. Zeroth law: temperature; Second law: _____

(a) entropy (b) enthalpy

(c) internal energy (d) efficiency

92. A heat pump working on reversed carnot cycle has a COP of 5. If it works as a refrigerator taking 1kW of work input, the refrigeration effect in kW will be

(a) 1 (b) 2

(c) 3 (d) 4

93. In counter flow heat exchangers

(a) both the fluids at inlet (of heat exchanger where hot fluid enters) are in their coldest state

(b) both the fluids at inlet are in their hottest state

(c) both the fluids at exit are in their hottest state

(d) one fluid is in hottest state and other in coldest state at inlet

94. Consider the following statements pertaining to heat transfer through fins:

(i) Fins are equally effective irrespective of whether they are on the hot side or cold side of the fluid.

(ii) the temperature along the fin is variable and hence the rate of heat transfer varies along the fin.

(iii) The fins may be made of materials that have a higher thermal conductive than the material of the wall.

(iv) Fins must be arranged at right angles to the direction of fluid flow.

Of the above statement;

(a) i and ii are correct (b) ii and iv are correct

(c) i and iii are correct (d) ii and iii are correct

95. For the same compression ratio, the efficiency of dual combustion cycle is

(a) greater than Diesel cycle and less than Otto cycle

(b) less than Diesel cycle and greater than Otto cycle

(c) greater than Otto cycle

(d) less than Diesel cycle

96. Which of the following cycles uses air as the refrigerant

(a) Ericsson (b) Stirling

(c) Carnot (d) Bell-coleman

97. Depending on the radiating properties, a body will be opaque when

(a) $p = 0$, $x = 0$ and $a = 1$ (b) $p = 1$, $x = 0$ and $a = 0$

(c) $p = 0$, $x = 1$ and $a = 0$ (d) $x - 0$, $a + p = 1$

where a = absorptivity, p = reflectivity, X = transmissivity

98. The phenomenon of pre ignition

(a) always occur in diesel engines (b) never occur in diesel engines

(c) always occur in petrol engines (d) increases the power ouput of engines

99. Which of the following automobile exhaust gas pollutants is a major cause of photochemical smog?

(a) CO
(b) HC
(c) NO_x
(d) SO_x

100. The part of the engine is directly driven by the starting motor?

(a) camshaft
(b) crankshaft
(c) flywheel
(d) none of these

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