

MIZORAM PUBLIC SERVICE COMMISSION
TECHNICAL COMPETITIVE EXAMINATIONS FOR
JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (AE/SDO)
UNDER PUBLIC HEALTH ENGINEERING DEPARTMENT,
GOVERNMENT OF MIZORAM, JANUARY-2024

MECHANICAL ENGINEERING
PAPER-I

Time Allowed : 3 hours

FM : 200

SECTION - A (Multiple Choice questions) (100 Marks)

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

This Section should be answered only on the OMR Response Sheet provided.

1. A condenser where circulating water flows through tubes which are surrounded by steam, is known as
 - (a) Surface condenser
 - (b) Jet condenser
 - (c) Barometric condenser
 - (d) Evaporative condenser
2. 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
3. During sensible heating of moist air, enthalpy
 - (a) increases
 - (b) decreases
 - (c) remains constant
 - (d) none of the above.
4. Solar radiation flux is usually measured with the help of a
 - (a) Anemometer
 - (b) Pyranometer
 - (c) Sunshine recorder
 - (d) All of the above
5. The two important forces for a floating body are
 - (a) Buoyancy, gravity
 - (b) Buoyancy, pressure
 - (c) Buoyancy, inertial
 - (d) Inertial, gravity
6. The highest point of syphon is called as
 - (a) Syphon top
 - (b) Summit
 - (c) Reservoir
 - (d) None of the above
7. 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) & (b)
 - (d) None of the options

8. Cyclic integral of a property is always
 - (a) zero
 - (b) one
 - (c) infinite value
 - (d) none of the mentioned
9. For laminar flow, Reynolds number must not be less than
 - (a) 1000
 - (b) 2000
 - (c) 20000
 - (d) 40000
10. 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
11. The zone or thin layer wherein the temperature field exists is called the
 - (a) Single boundary layer
 - (b) Multi boundary layer
 - (c) Hydrodynamic boundary layer
 - (d) Thermal boundary layer
12. The mass transfer rate is independent of
 - (a) Turbulence effect
 - (b) Physical properties
 - (c) Chemical properties
 - (d) none of the above.
13. The rate of increase of velocity with respect to change in the position of fluid particle in a flow field is called as
 - (a) local acceleration
 - (b) temporal acceleration
 - (c) convective acceleration
 - (d) all of the above
14. The velocity of a fluid particle at the centre of the pipe section is
 - (a) Maximum
 - (b) Minimum
 - (c) Average
 - (d) r.m.s
15. Viscous forces are not present in
 - (a) rotational flow
 - (b) irrotational flow
 - (c) laminar flow
 - (d) none of the above
16. If fluid is incompressible and it is steady then its mass is
 - (a) increasing
 - (b) decreasing
 - (c) same
 - (d) conserved
17. 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
18. 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
19. 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

20. 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 the above
21. 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 the above
22. 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
23. 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 the above
24. 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
25. In the phenomenon of cavitation, the characteristic fluid property involved is
- (a) surface tension
 - (b) viscosity
 - (c) bulk modulus of elasticity
 - (d) vapour pressure
26. State whether following flow field is physically possible?
 $u = 3xy^2 + 2x + y^2$ and $v = x^2 - 2y - y^3$
- (a) Possible for steady, incompressible flow
 - (b) Possible for unsteady, incompressible flow
 - (c) Possible for steady, compressible flow
 - (d) Not possible
27. The instrument preferred in the measurement of highly fluctuating velocities in air flows is
- (a) Pitot static tube
 - (b) propeller type anemometer
 - (c) three cup anemometer
 - (d) hot wire anemometer
28. A pipe is connected in series to another pipe whose diameter is twice and length is 32 times that of the first pipe. The ratio of frictional head losses for the first pipe to those for the second pipe is (both the pipes have the same frictional constant)
- (a) 8
 - (b) 4
 - (c) 2
 - (d) 1
29. The critical value of Reynolds number for transition from laminar to turbulent boundary layer in external flows is taken as
- (a) 2300
 - (b) 4000
 - (c) 5×10^5
 - (d) 3×10^6
30. For a given centrifugal pump
- (a) head varies inversely as square of speed
 - (b) discharge varies directly as speed
 - (c) discharge varies directly as square of speed
 - (d) power varies directly as fifth power of speed
31. In fluid machinery, the relationship between saturation temperature and pressure decides the process of
- (a) flow separation
 - (b) turbulent mixing
 - (c) cavitation
 - (d) water hammer

32. If a reciprocating pump having a mechanical efficiency of 80% delivers water at the rate of 80 kg/s with a head of 30 m, the brake power of the pump is
- (a) 29.4 kW (b) 20.8 kW
(c) 15.4 kW (d) 10.8 kW
33. A plane wall is 20 cm thick with an area of 1 m² and has a thermal conductivity of 0.5 W/mK. A temperature difference of 100°C is imposed across it. The heat flow is at:
- (a) 150 W (b) 180 W
(c) 220 W (d) 250 W
34. A cross-flow type air heater has an area of 50 m². The overall transfer coefficient is 100 W/m²K; and heat capacity of the stream, be it hot or cold, is 1000 W/K. What is the NTU?
- (a) 500 (b) 50
(c) 5 (d) 0.5
35. A reversible engine operates between temperatures T₁ and T₂. The energy rejected by this engine is received by a second reversible engine at temperature T₂ and rejected to a reservoir at temperature T₃. If the efficiencies of the engines are same then the relationship between T₁, T₂ and T₃ is given by
- (a) $T_2 = \frac{T_1 + T_3}{2}$ (b) $T_2 = \sqrt{T_1^2 + T_3^2}$
(c) $T_2 = \sqrt{T_1 T_3}$ (d) $T_2 = \frac{T_1 + 2T_3}{2}$
36. The working temperatures in the evaporator and condenser coils of a refrigerator are -30°C and 32°C respectively. If the actual refrigerator has a COP of 0.75 of the maximum, the required power input for a refrigerating effect of 5 kW is nearly,
- (a) 1.7 kW (b) 2.94 kW
(c) 3.92 kW (d) 4.0 kW
37. In aircraft, air refrigeration cycle is used because of
- (a) low unit weight per tonne of refrigeration (b) high heat transfer rate
(c) lower temperature at high-altitudes (d) higher coefficient of performance
38. The work given out during expansion process in a closed system will increase when the value of n (the index of compression)
- (a) increases (b) decreases
(c) remains same (d) first increases and then decreases
39. Carnot cycle efficiency depends upon
- (a) properties of the medium/substance used (b) condition of engine
(c) working condition (d) temperature range of operation
40. Which of the following has maximum value of thermal conductivity?
- (a) aluminium (b) steel
(c) brass (d) copper
41. When a body is placed over a liquid, it will float if
- (a) gravitational force is equal to the upthrust of the liquid
(b) gravitational force is less than the upthrust of the liquid
(c) gravitational force is more than the upthrust of the liquid
(d) None of the above

SECTION - B (Short answer type question) (100 Marks)

All questions carry equal marks of 5 each.

This Section should be answered only on the Answer Sheet provided.

1. Show that energy is a property of a thermodynamic system.
2. Write down the equations for stagnation pressure, stagnation density and stagnation temperature.
3. Describe the working of a single stage reciprocating air compressor.
4. What are natural refrigerants? Discuss their potentials and limitations.
5. Explain why priming is necessary to start pumping by centrifugal pump.
6. Define manometric head and manometric efficiency of a centrifugal pump.
7. What is cooling tower? Explain about natural draught and mechanical draught cooling towers.
8. What is the fundamental difference between the operation of impulse and reaction steam turbines?
9. Explain the need of compounding in steam turbines.
10. What are the essential properties of lubricants commonly used for engine lubrication.
11. Define a thermodynamic system. Differentiate between open system, closed system and an isolated system.
12. What is a quasi-static process?
13. Describe with a neat sketch a separating-throttling calorimeter for measuring the dryness fraction of steam.
14. Define heat engine, refrigerator and heat pump.
15. Describe briefly any two of the following processes:
 - (i) Sensible heating
 - (ii) Cooling and dehumidification
 - (iii) Heating and humidification
 - (iv) Heating and dehumidification
16. What do you mean by stoichiometric air-fuel (A/F) ratio?
17. Define the terms 'Volumetric efficiency' and 'Clearance volumetric efficiency'.
18. Define Bernoulli's theorem and explain what corrections are to be made in the equation for ideal fluid, if the fluid is a real fluid.
19. Explain the following: Newtonian and Non-Newtonian fluids, vapour pressure, and compressibility.
20. Define the terms meta-centre, centre of buoyancy, meta-centric height, gauge pressure and absolute pressure.

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