MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (COMBINED) UNDER VARIOUS DEPARTMENT, GOVERNMENT OF MIZORAM, JULY-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. Which of the following is an intensive property of a thermodynamic system?
   (a) Volume (b) Temperature
   (c) Mass (d) Energy
2. The specific volume of water when heated at 0°C
   (a) first increases and then decreases (b) first decreases and then increases
   (c) increases steadily (d) decreases steadily
3. High-speed diesel engine works on
   (a) Carnot cycle (b) Diesel cycle
   (c) Dual combustion cycle (d) None of these
4. Which of the following thermodynamic law gives the concept of enthalpy?
   (a) Zeroth law of thermodynamics (b) First law of thermodynamics
   (c) Second law of thermodynamics (d) Third law of thermodynamics
5. A cylinder/piston contains 1kg methane gas at 100 kPa, 20°C. The gas is compressed reversibly to a pressure of 800 kPa. What is the work required if the process is isothermal?
   (a) -416 kJ (b) -316 kJ
   (c) -216 kJ (d) -116 kJ
6. To increase work capacity of energy transferred by heat transfer from high temperature to low temperature
   (a) lower temperature should be lowered keeping temperature difference same
   (b) higher temperature should be increased keeping temperature difference same
   (c) temperature difference should be increased
   (d) temperature difference should be decreased
7. Which of the following properties describe entropy?
   (a) Point function, intensive property (b) Point function, extensive property
   (c) Path function, intensive property (d) Path function, extensive property

8. If a process can be stopped at any stage and reversed so that the system and surroundings are exactly restored to their initial states, it is known as
   (a) adiabatic process
   (b) isothermal process
   (c) ideal process
   (d) frictionless process

9. In a two stage gas turbine plant, with intercooling and reheating
   (a) both work ratio and thermal efficiency improve
   (b) work ratio improves but thermal efficiency decreases
   (c) thermal efficiency improves but work ratio decreases
   (d) both work ratio and thermal efficiency decrease

10. The difference in the amount of work done on a system and the amount of heat supplied from a system to bring back the system to its initial state is
   (a) less than zero
   (b) greater than zero
   (c) zero
   (d) maximum

11. The specific heat of an ideal gas depends on its
   (a) density
   (b) molecular weight
   (c) pressure
   (d) temperature

12. Which of the following is not a component of the Bell- Coleman cycle?
   (a) Condenser
   (b) Compressor
   (c) Cooler
   (d) Expander

13. Air refrigeration cycle is used in which of the following?
   (a) Commercial refrigerators
   (b) Deep freezers
   (c) Gas liquefaction
   (d) None of these

14. During throttling process
   (a) enthalpy does not change
   (b) pressure does not change
   (c) entropy does not change
   (d) internal energy does not change

15. The degree of disorder of a mixture of two gases
   (a) is always less than the degrees of disorder of individual gases
   (b) is always equals the degrees of disorder of individual gases
   (c) is always greater than the degrees of disorder of individual gases
   (d) none of the above

16. The temperature at which the air cannot hold all the water vapour mixed in it and some vapour starts condensing is called as
   (a) humidification temperature
   (b) dehumidification temperature
   (c) dew point temperature
   (d) none of these

17. When the dew point temperature is equal to the air temperature then the relative humidity is
   (a) 0%
   (b) 50%
   (c) 100%
   (d) unpredictable

18. If the temperature of intake air in internal combustion engine increases, then its efficiency will
   (a) remain same
   (b) decrease
   (c) increase
   (d) none of these

19. If petrol is used in a diesel engine, then
(a) efficiency will be low
(b) higher knocking occur
(c) black smoke will be produced
(d) low power produced

20. In nuclear power station, moderator is used to
(a) absorb neutrons
(b) reduce the speed of neutrons
(c) accelerate the speed of neutrons
(d) stop chain reactions

21. Which of the following is the unit of coefficient of radiant heat transfer?
(a) W/m^2
(b) W/mK
(c) W/m^2K
(d) W/K

22. What is the purpose of using fins in a particular heat transfer system?
(a) To decrease rate of heat transfer
(b) To increase rate of heat transfer
(c) To maintain constant rate of heat transfer
(d) None of these

23. Which refrigerant is widely used in refrigeration facilities of food as cooling of fresh vegetables, dairy products, meat and fish and similar process industries?
(a) Sulphur dioxide
(b) Ethyl chloride
(c) Propane
(d) Ammonia

24. When the depth of immersion of a plane surface is increased, the centre of pressure will
(a) come closer to the centroid
(b) move farther away from centroid
(c) will be at the same distance from centroid
(d) depend on the specific weight of the liquid

25. Two cubes of equal volume but of specific weights of 0.8 and 1.2 are connected by a weightless string and placed in water
(a) one cube will completely submerged and the other will be completely outside the surface.
(b) heavier cube will go down completely and the lighter one to 0.25 times its volume.
(c) will float in neutral equilibrium.
(d) heavier cube will submerge completely and the lighter one will submerge to 0.8 times its volume.

26. The stream function is
(a) constant along an equipotential line
(b) along a stream line
(c) defined only in irrotational flow
(d) defined only for incompressible flow

27. In steady flow, in a varying section pipe if the diameter is doubled, the kinetic energy will
(a) be doubled
(b) increase 4 times
(c) increase 8 times
(d) decrease to one sixteenth

28. The forced convection heat transfer coefficient of a plate depends on which of the following-
(a) gravity
(b) velocity of fluid
(c) conductivity of fluid
(d) conductivity of plate material

29. The velocity profile of the hydrodynamic boundary layer is dependent upon
(a) time
(b) viscosity
(c) temperature
(d) mass

30. "Good absorber of heat is good radiator of heat also" is
(a) Stefan's law
(b) Plank's law
(c) Kirchhof's law
(d) Wien's law

31. The velocity profile in turbulent flow is
(a) parabolic
(b) logarithmic
(c) 2nd degree polynomial
(d) 4th degree polynomial

32. Rotameter is used to measure
(a) Viscosity
(b) Flow
(c) Density
(d) Pressure

33. In a reaction turbine the function of a draft tube is to
(a) provide safety to turbine
(b) prevent air from entering
(c) reconvert the kinetic energy to flow energy
(d) increase the rate of flow

34. A surge tank is used to
(a) prevent occurrence of hydraulic jump
(b) smoothen the flow
(c) relieve the pipeline of excessive pressure transients
(d) avoid reversal of flow

35. The concept of stream function which is based on the principle of continuity is applicable to
(a) irrotational flow only
(b) two-dimensional flow only
(c) three-dimensional flow
(d) uniform flow only

36. Which device maintains a body at a temperature higher than the temperature of the surroundings?
(a) Perpetual Motion Machine 1
(b) Perpetual Motion Machine 2
(c) Refrigerator
(d) Heat pump

37. What prevents the leakage of oil inside an unbalanced vane pump?
(a) Vanes
(b) Cylindrical rotor
(c) Screw
(d) Pressure difference between inlet and outlet

38. Which of the following is not a type of steam turbine?
(a) Impulse turbine
(b) Reaction turbine
(c) Pelton wheel turbine
(d) Axial flow type turbine

39. Which of the following is not a water tube boiler?
(a) Stirling boiler
(b) Cornish boiler
(c) Loeffler boiler
(d) Lamont boiler

40. Centrifugal compressors are also known as
(a) turbo compressors
(b) radial compressors
(c) turbo and radial compressors
(d) none of these

41. What is the mach number of aircraft flying in air where the pressure ratio is 1.893?
(a) 1
(b) 2
(c) 3
(d) 4

42. The dimension whose unit does not depend on any other dimension's unit is known as
(a) fundamental dimension
(b) dependent dimension
(c) independent dimension
(d) absolute dimension

43. Nusselt number is
(a) ratio of viscous to inertia forces
(b) dimensionless heat transfer coefficient
(c) ratio of conduction to convection resistance
(d) signifies the velocity gradient at the surface

44. The decreasing order of effectiveness for a given situation among types of heat exchangers is

(a) parallel flow, cross flow, shell and tube, counter flow

(b) cross flow, counter flow, shell and tube, parallel flow

(c) counter flow, shell and tube, cross flow, parallel flow

(d) counter flow, cross flow, shell and tube, parallel flow

45. For solar collectors the required surface characteristics combination is

(a) high emissivity and low absorptivity

(b) high emissivity and high reflectivity

(c) high reflectivity and high absorptivity

(d) low emissivity and high absorptivity

46. A gray surface is one for which

(a) reflectivity equals emissivity

(b) emissivity equals transmissivity

(c) emissivity is constant

(d) Absorptivity equals reflectivity

47. What helps the pipe line to branch off at 90°?

(a) Elbows

(b) Tee branch

(c) Plug

(d) Coupling

48. Which of the following method of steam turbine governing is ideal for reaction turbines?

(a) Throttle governing

(b) Nozzle governing

(c) By-pass governing

(d) Combination of throttle and by-pass governing

49. In gas cycle refrigeration system, the throttle valve of a vapour compression refrigerant system is replaced by

(a) capillary tube

(b) expander

(c) reverse throttle valve

(d) none of these

50. Diffuser increases the pressure of a fluid at the expense of its

(a) kinetic energy

(b) impact energy

(c) potential energy

(d) rotational energy

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. Prove that entropy is a property of a system.
2. What is the difference between the analytical and experimental approaches to heat transfer in terms of the advantages and disadvantages of each approach? How does the science of heat transfer differ from the science of thermodynamics?
3. The two modes of energy transfer are work and heat. Does the mode of energy transfer depend on the choice of a system? Support your answer with the help of an example.
4. Define the following terms: (a) Dry bulb temperature (b) Relative humidity (c) Specific humidity.
5. Explain the Carnot and Rankine cycles. Why does the efficiency of a Rankine cycle increase with decreasing condenser pressure?
6. A gas initially at a supersonic velocity enters an adiabatic converging duct. Discuss how this affects (a) the velocity (b) the temperature (c) the pressure and (d) the density of the fluid.
7. Differentiate the function of centrifugal pump and reciprocating pump. What is cavitation? Where does it occur in centrifugal pumps?
8. An engine has a heat input of 500 kJ at 437°C. It rejects 200 kJ at 82°C. The engine develops 250 kJ of work. Check whether such an engine is possible.
9. What do you understand by the degree of superheat and the degree of subcooling?
10. Define the first and second laws of thermodynamics. Describe imaginary processes that satisfy the first law but violate the second law of thermodynamics and vice versa.
11. In an engine working on ideal Otto cycle, the temperatures at the beginning and end of compression are 50°C and 373°C. Find the compression ratio and the air-standard efficiency of the engine.
12. Explain briefly the following heads: (a) Potential head (b) Velocity head (c) Datum head. List the assumptions which are made while deriving Bernoulli's equation.
13. What is the physical significance of the Nusselt Number, Prandtl number and Reynold's number? Do these numbers depend on the pressure, temperature, types of flow and types of flow geometry?
14. What do you understand by the terms 'convective heat transfer co-efficient' and 'overall heat transfer co-efficient'?
15. Classify the heat exchangers according to the flow directions of fluid and give few examples of each in actual field of application.
16. What fluid property is responsible for the development of the velocity boundary layer? For what kinds of fluids will there be no velocity boundary layer in a pipe?
17. What are the primary differences between fans, blowers, and compressors? Discuss in terms of pressure rise and volume flow rate. List at least two common examples of fans, of blowers, and of compressors.
18. Explain the hydraulic pump and turbine working principal. Differentiate hydraulic efficiency, mechanical efficiency and volumetric efficiency for the turbine.
19. Differentiate centrifugal and axial flow compressors. Draw the velocity diagram of axial flow compressors. What do you mean by multi-stage compression and state its advantage?
20. Why does the viscosity of a gas increases with the increase in temperature while that of a liquid decreases with increase in temperature?

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