

PDH Academy

Final Exam

What Every Energy Engineer Needs to Know about Thermodynamics and Liquefaction Systems (Part 1 of 3)

- 200 years ago, the source of obtaining ice was?
 - a. Vapor Compression of a refrigeration
 - b. Cutting it out of frozen rivers during the winter
 - c. Blowing dry air over water until it froze
 - d. All of the above
- The refrigerants used in the 1800s were?
 - a. Called Freons
 - b. Toxic
 - c. Water-based solvents
 - d. Oil-based solvents
- The refrigerants of the mid-1900s were found to be?
 - a. Extremely toxic
 - b. Harmful to the environment and are being phased out
 - c. Too expensive to produce
 - d. Too inefficient to provide refrigeration
- To get down to very cold temperatures to liquefy natural gas, refrigerants today may use a mixture containing?
 - a. Nitrogen and propane
 - b. Methane and ethane
 - c. Iso-pentane
 - d. All of the above
- Methane is a?
 - a. Hydrocarbon
 - b. Molecule
 - c. Compound
 - d. All of the above
- Air is?
 - a. An element
 - b. A mixture
 - c. A pure substance
 - d. Molecule
- Natural gas is?
 - a. An element
 - b. A mixture

- c. A pure substance
 - d. Molecule
8. Enthalpy is a term used to define?
- a. The irreversibility of a process
 - b. The thermodynamic energy of a substance
 - c. Mass to volume ratio of a substance
 - d. Force exerted on the outside world by a substance.
9. What is the difference between psig and psia?
- a. Psia is psig plus the barometric pressure
 - b. Psig is psia plus the barometric pressure
 - c. Psig does not change as the barometer changes
 - d. Psia does not change as the barometer changes
10. What changes as we leave the earth's gravitational field?
- a. The mass of our body decreases
 - b. The weight of our body decreases
 - c. Mass and weight are the same, so neither decreases
 - d. Mass and weight are reduced in proportion to the distance from the earth's gravitational field.
11. Density is?
- a. The ratio of mass divided by volume
 - b. The ratio of volume divided by mass
 - c. The sum of the mass and the volume
 - d. The product of the mass times the volume
12. The relationship of specific volume to density is?
- a. Specific volume = 1/density
 - b. Density = 1/specific volume
 - c. Each term is equal to the other term and divided into the number 1
 - d. All of the above
13. All that is needed to define the state of a fluid is?
- a. Two intensive properties
 - b. Two extensive properties
 - c. One intensive and one extensive property
 - d. The volume and mass of a fluid
14. A steady-state process is one that?
- a. The state of the fluid at every point in the analyzed flow remains unchanged with time.
 - b. The mass flow rate of the fluid at every point remains unchanged with time
 - c. The volumetric flow rate of the fluid at every point remains unchanged with time
 - d. All of the above
15. A steady-flow process is?
- a. A process whereby the inlet flow is constant, and inventory in the control volume increases because the outlet flow is less than the inlet flow.
 - b. One that does not have changes in flow rates or changes in fluid inventory over the period when the process is studied

- c. One where the observer can steadily track the changes in flow rates to perform the analysis.
- d. All of the above

16. 3 Molecules of Methanol CH₄O contains?

- a. 18 atoms
- b. Three carbon atoms
- c. 12 hydrogen atoms
- d. All of the above

17. Sensible heat?

- a. Raises the temperature of a phase of a fluid without changing the phase
- b. Changes the phase of a fluid
- c. Changes the temperature and the phase of a fluid
- d. All of the above.

18. Latent heat?

- a. Raises the temperature of a phase of a fluid without changing the phase
- b. Changes the phase of a fluid
- c. Changes the temperature and the phase of a fluid
- d. All of the above.

19. Intensive properties?

- a. Change as the volume of the sample is cut in half
- b. Do not change as the volume of the sample is cut in half
- c. Are a function of the mass of the fluid
- d. Are a function of the volume of the fluid

20. A Pressure Enthalpy Chart?

- a. Can display many different intensive properties on the chart
- b. Always displays only pressure and enthalpy
- c. Display density and specific gravity as identical properties
- d. Are used to show the pressure and enthalpy only at a single point within a flowing stream.

21. On a Pressure Enthalpy Chart?

- a. The saturated liquid line refers to the points where only liquid exists in equilibrium with saturated vapor
- b. The saturated vapor line refers to the points where only vapor exists in equilibrium with saturated liquid
- c. The constant pressure line is horizontal
- d. All of the above.

22. On a Pressure Enthalpy Chart the critical point?

- a. Occurs at the very top of the dome, where the saturated liquid and saturated vapor lines meet
- b. Is identical to the triple point of the fluid
- c. Occurs where the constant temperature line intersects with the constant pressure line
- d. Is located at the critical reference point, which is selected as the reference point from which enthalpy and entropy are measured.

23. On a Pressure Enthalpy Chart?

- a. Constant enthalpy lines are vertical
- b. Constant temperature lines are nearly vertical on the lower right side of the table but then curve towards the critical point the closer they are to the critical point

- c. The constant entropy lines are curved, sloping upward from the lower left to the upper right
- d. All of the above.

24. The conservation of mass?

- a. For this learning in a Steady-State-Steady-Flow process, the mass into the control volume is equal to the mass out of the control volume
- b. For this learning in a Steady-State-Steady-Flow process, the enthalpy into the control volume is equal to the enthalpy out of the control volume
- c. For this learning in a Steady-State-Steady-Flow process, the entropy into the control volume is equal to the entropy out of the control volume
- d. For this learning, in a Steady-State-Steady-Flow process, the density into the control volume is equal to the mass out of the control volume

25. What is a control volume?

- a. The specific volume of a fluid times the mass of the fluid
- b. An imaginary box that defines the limits of what we are studying
- c. The total volume of the fluid passed through a process each hour
- d. The specific volume of a fluid expressed in ft³/lbm

26. For a Steady-State-Steady-Flow process the first law of thermodynamics can be written as?

- a. Fluid energy in + work in + heat in = fluid energy out + work out + heat out
- b. Fluid energy in = Enthalpy times the component efficiency
- c. Mass into a process = mass out of a process
- d. All of the above

27. A Steady-State-Steady-Flow of a fluid through a valve restriction without heat transfer results in?

- a. The outlet fluid being the same temperature as the inlet fluid
- b. The outlet fluid enthalpy being the same enthalpy as the inlet fluid
- c. The outlet density being the same density as the inlet fluid
- d. The outlet entropy being the same entropy as the inlet entropy

28. A Steady-State-Steady-Flow of a fluid through a heat exchanger that rejects heat to the environment results in?

- a. The density of the fluid decreasing and the enthalpy of the fluid increasing
- b. The entropy and the enthalpy of the fluid remaining constant
- c. The enthalpy of the fluid decreasing
- d. The outlet fluid enthalpy being the same enthalpy as the inlet fluid

29. A Steady-State-Steady-Flow of a fluid through a heat exchanger that adds heat to the fluid results in?

- a. The density of the fluid increasing and the enthalpy of the fluid decreasing
- b. The entropy and the enthalpy of the fluid remaining constant
- c. The enthalpy of the fluid increasing
- d. The outlet fluid enthalpy being the same enthalpy as the inlet fluid

30. A Steady-State-Steady-Flow of a fluid through a compressor results in?

- a. The density and the enthalpy of the fluid decreasing
- b. The entropy and the enthalpy of the fluid remaining constant
- c. The enthalpy of the fluid increasing
- d. The outlet fluid enthalpy being the same enthalpy as the inlet fluid

31. A Steady-State-Steady-Flow of a fluid through a turbine, sometimes called an expander, results in?

- a. The density and the enthalpy of the fluid increasing
 - b. The entropy and the enthalpy of the fluid remaining constant
 - c. The enthalpy of the fluid decreasing
 - d. The outlet fluid enthalpy being the same enthalpy as the inlet fluid
32. In a Steady-State-Steady-Flow heat exchanger with multiple streams what is true?
- a. The sum of all the energy into the control volume must equal the sum of all the energy out of the control volume
 - b. Because it is Steady-Flow, the density of each of the streams remains constant inlet to outlet
 - c. Because it is Steady-State the state of each stream remains constant from inlet to outlet
 - d. Because it is SSSF no energy is transferred between any of the streams
33. A pressure enthalpy (PH) diagram can be set up to show many properties of a fluid provided?
- a. The specific volume and the temperature are known
 - b. The temperature and the pressure are known
 - c. The entropy per lbm and the enthalpy per pound are known
 - d. All of the above.
34. What does the term adiabatic mean?
- a. Without any enthalpy change
 - b. Without any pressure change
 - c. Without any temperature change
 - d. Without any heat transfer
35. What does isentropic mean?
- a. Without any enthalpy change
 - b. Without any pressure change
 - c. Without any temperature change
 - d. Without any entropy change
36. In the real-world, there is no such thing as a?
- a. Constant entropy expander
 - b. Constant entropy compressor
 - c. A turbine driving the compressor with no net change in the fluid entropies
 - d. All of the above
37. The percent efficiency of a real-world compressor is equal to?
- a. $100 (\text{actual work} / \text{ideal work})$
 - b. $100 (\text{ideal work} / \text{actual work})$
 - c. $100 (\text{inlet fluid density} / \text{outlet fluid density})$
 - d. None of the above
38. The percent efficiency of a real-world turbine is equal to?
- a. $100 (\text{actual work} / \text{ideal work})$
 - b. $100 (\text{ideal work} / \text{actual work})$
 - c. $100 (\text{inlet fluid density} / \text{outlet fluid density})$
 - d. None of the above
39. When a subcooled liquid is dropped in pressure across a Joules Thompson valve to within the dome of the PH diagram?
- a. The resulting fluid consists of a liquid and a vapor at a lower temperature
 - b. The temperature increases due to viscous dissipation within the valve as velocity energy is converted to heat

energy

- c. The entropy remains constant
 - d. The density of the fluid remains constant
40. When a subcooled liquid is dropped in pressure across a Joules-Thompson valve what is true?
- a. The entropy of the inlet fluid is equal to the sum of the entropies of the outlet fluids
 - b. The density of the inlet fluid is equal to the sum of the densities of the outlet fluids
 - c. The enthalpy of the inlet fluid is equal to the sum of the enthalpies of the outlet fluids
 - d. The temperature of the outlet fluids is greater than that of the inlet fluid
41. When a point on the PH diagram lands within the dome in between the saturated liquid line and the saturated vapor line, the resulting fluid?
- a. Consists of a homogenous fluid with an enthalpy found by drawing a straight line down to the x-axis
 - b. Consists of a homogenous fluid with an enthalpy found by drawing a straight line across to the y axis
 - c. Consists of both a vapor and a liquid, whereby the vapor and liquid have the properties that correspond to that pressure line intersected with the saturated liquid and saturated vapor lines.
 - d. Is at the same property as the critical point.
42. When the outlet of a JT valve is sent to a knock-out drum, what is true?
- a. The sum of the mass in is equal to the sum of the mass out
 - b. The total enthalpy in is equal to the sum of the total enthalpy out
 - c. The liquid is separated from the vapor
 - d. All of the above.
43. After analyzing a complex system, what can be done to help prove the findings as correct?
- a. A summation of the entropy changes for each of the analyses can be made, and if the value is very close to zero, this confirms the individual calculations as likely correct
 - b. A summation of the density changes for each of the analyses can be made, and if the value is very close to zero, this confirms the individual calculations as likely correct
 - c. A control volume can be placed around the entire plant, and the conservation of mass and 1st law of thermodynamics can be applied to the control volume to confirm that the whole plant does not violate the conservation of mass or the 1st law of thermodynamics.
 - d. All of the above
44. As a hot cup of coffee cools, what is true?
- a. Heat is transferred to the surroundings
 - b. The enthalpy of the coffee is dropping
 - c. The temperature of the coffee is dropping
 - d. All of the above
45. When you turn on a methanol or LNG pump?
- a. The fluid being pumped is increasing in enthalpy
 - b. Work energy is added to the fluid being pumped
 - c. As that fluid then flows through the plant and gains or loses heat, its enthalpy is changing
 - d. All of the above