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Continuing Education Course #280
Introduction to Thermodynamic Cycles - Part 1
1st Law of Thermodynamics and Gas Power Cycles

1. Which of the following statements is true about an open system?
 - a. They are also known as a control mass
 - b. Mass cannot cross the boundary
 - c. Mass and energy can cross the boundary
 - d. None of the above

2. Which law of thermodynamics is a statement of conservation of energy with the inclusion of internal energy?
 - a. Zeroth law of thermodynamics
 - b. First law of thermodynamics
 - c. Second law of thermodynamics
 - d. None of the above

3. A vapor that is about to condense is known as which of the following?
 - a. saturated liquid
 - b. saturated vapor
 - c. superheated vapor
 - d. subcooled liquid

4. Using the Ideal Gas Properties of Air table provided in Section 7.0, what is the enthalpy for a temperature of 825 degrees Kelvin?
 - a. 612.9 kJ/kg
 - b. 905.2 kJ/kg
 - c. 654.0 kJ/kg
 - d. 849.7 kJ/kg

5. A constant pressure process is known as which of the following?
 - a. isobaric
 - b. isochoric
 - c. isentropic
 - d. isothermal

6. What does the area under the process curve on a P-v diagram represent?
 - a. work
 - b. change in temperature
 - c. power
 - d. mass flow rate

7. Consider a gas in a closed container. Adding heat to the system will result in which of the following?

- a. only an increase in internal energy
 - b. an increase in internal energy and negative work
 - c. only a decrease in internal energy
 - d. none of the above
8. An adiabatic process is one in which
- a. pressure is constant
 - b. no heat transfer occurs
 - c. the entropy is constant
 - d. temperature remains constant
9. A _____ is a device that increases the velocity of a fluid by decreasing the cross-sectional area
- a. diffuser
 - b. nozzle
 - c. compressor
 - d. none of the above
10. A gas power cycle is a thermodynamic cycle used for power generation where the working fluid always remains a gas.
- a. True
 - b. False
11. What is the maximum theoretical efficiency of a power cycle that has a high-temperature reservoir at 475°C and a low-temperature reservoir at 60°C?
- a. 55.5%
 - b. 44.5%
 - c. 87.4%
 - d. 12.6%
12. Which of the following assumption is NOT part of the air-standard assumptions used for gas power cycles?
- a. The combustion process is replaced with a heat addition process
 - b. The exhaust process is replaced with a heat rejection process
 - c. All processes are irreversible processes
 - d. The working fluid is air and is considered an ideal gas
13. In an Otto cycle, the ratio of the volume at bottom dead center and the volume at top dead center is known as which of the following?
- a. expansion ratio
 - b. compression ratio
 - c. cutoff ratio
 - d. Carnot ratio
14. An ideal Otto cycle has a compression ratio of 9. Air is at 290°K at the beginning of the compression process. What is the temperature at state 2?
- a. 460.2°K
 - b. 681.4°K
 - c. 716.9°K
 - d. 824.3°K
15. During the isentropic expansion process of an ideal Otto cycle, the temperature drops from 1560°K to 800°K. What is the approximate compression ratio?

- a. 6.1
- b. 8.9
- c. 7.6
- d. 9.3

16. An ideal Otto cycle has a compression ratio of 8. The heat addition process increases the temperature of the air from 350°C to 1300°C. If the pressure at the beginning of heat addition process is 1665 kPa, what is the pressure at the end of the heat addition process?

- a. 4.2 MPa
- b. 6.2 MPa
- c. 7.8 MPa
- d. None of the above

17. An ideal Otto cycle has a compression ratio of 8.5. Air is at 25°C and 108 kPa at the beginning of the compression process. During the heat addition process 785 kJ/kg of heat is transferred to the air. What is the approximate maximum pressure during the cycle?

- a. 2100 kPa
- b. 3150 kPa
- c. 3760 kPa
- d. 4877 kPa

18. The heat addition process for a diesel cycle is which of the following?

- a. isobaric
- b. isochoric
- c. isentropic
- d. isothermal

19. In a diesel cycle, the _____ is the ratio of the volumes after and before the combustion process.

- a. compression ratio
- b. combustion ratio
- c. heat ratio
- d. cutoff ratio

20. The constant pressure heat addition process of an air-standard diesel cycle increases the temperature from 840 degrees Kelvin to 2016 degrees Kelvin. What is the approximate cutoff ratio?

- a. 1.8
- b. 2.4
- c. 3.0
- d. 3.7

21. In an air-standard diesel cycle, the temperature at the end of the isentropic expansion process is 800 degrees Kelvin. During the constant volume heat rejection process, the heat removed is approximately 385.4 kJ/kg. What is the approximate temperature after the heat rejection process?

- a. 460°K
- b. 100°K
- c. 340°K
- d. 290°K

22. An air-standard diesel cycle has a compression ratio of 16 and a cutoff ratio of 2. At the beginning of the compression process air is at 100 kPa and 30°C. Determine the thermal efficiency.

- a. 47%
- b. 56%

- c. 63%
- d. 71%

23. An Otto cycle is plotted on a P-v diagram. The area contained within the process curves of the cycle represents which of the following?

- a. Heat output per unit mass
- b. Heat input per unit mass
- c. Net work per unit mass
- d. Work input per unit mass

24. The thermal efficiency of an Otto cycle can be increased by decreasing the compression ratio.

- a. True
- b. False

25. For air, the specific heat ratio is approximately $k = 1.4$. Using the idea that the cutoff ratio is always greater than one, which of the following statements is true?

- a. For the same compression ratio, the diesel cycle is more efficient than the Otto cycle
- b. For the same compression ratio, the Otto cycle is more efficient than the diesel cycle
- c. For the same compression ratio, the Otto cycle and diesel cycle will always have the same efficiency

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