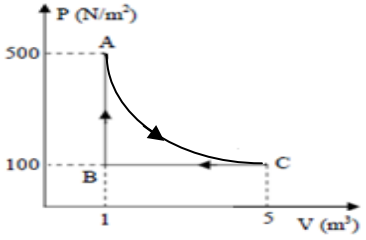
PHYS102 – Chapter 19 (Instructor: Dr. Al–Shukri)

1. Three moles of an ideal monatomic gas is compressed from 600 cm^3 to 200 cm^3 at a constant pressure of 400 kPa. How much heat energy is exchanged during this process?

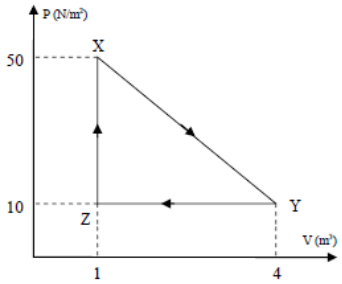
a. –400 J b. 160 J c. 400 J
d. –160 J e. –240 J

2. Helium gas within a closed chamber undergoes the cycle shown in the **Figure**. Process AC is isothermal. Calculate the net heat added to the system in a complete cycle.



a. 405 J b. 600 J
c. 805 J d. 400 J e. -400 J

3. A system of one mole of an ideal monatomic gas undergoes the cyclic process shown in the **Figure**. Calculate the change in the internal energy of the system along the path XY.



a. –15 J b. 15 J c. 60 J
d. –60 J e. zero

4. Which of the following statement is **INCORRECT**:

a. If the internal energy of the gas is decreased, the volume remains constant in an adiabatic process.
b. In an adiabatic process, transfer of energy as heat is zero.
c. The internal energy of the system increases if energy is added as heat Q for isochoric (constant volume) process
d. In a cyclic process, the change in internal energy of the system is zero.
e. Heat energy can transfer only between bodies having different temperatures.

5. A gas initially at a temperature of 0 °C and a pressure of 100 kPa is compressed isothermally from 30 L to 20 L. What is the work required?

a. 1.2 kJ b. 4.2 kJ c. 0
d. 4.5 kJ e. 3.0 kJ

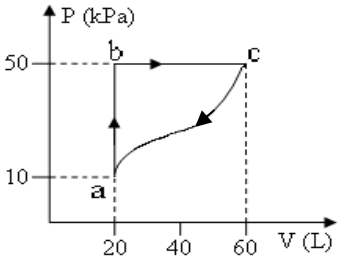
6. Specify the **WRONG** statement:

a. Work is a path-independent quantity.
b. One mole is the number of atoms in a 12 g of carbon 12.
c. The internal energy of an ideal gas is a function of gas temperature only.
d. The internal energy is a state function.
e. Kinetic theory of gasses relates the macroscopic properties of gasses to the microscopic properties of gas molecules.

7. An ideal monatomic gas, undergoes an adiabatic expansion to one-third of its initial pressure. Find the ratio of the final volume to the initial volume.

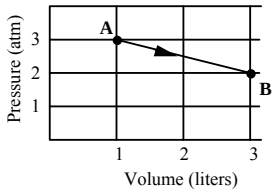
a. 1.9 b. 1.5 c. 2.5 d. 1 e. 3.0

8. A gas undergoes the cyclic process shown in the **Figure**. The net heat absorbed during the complete cycle is 1000 J. Find the work done by the gas for the process c to a.



a. –1000 J b. 1000 J
c. –1500 J d. 1500 J
e. –1200 J

9. An ideal monatomic gas expands from state A to state B along the straight line path shown in the **Figure**. Calculate the heat absorbed by the gas in the process.

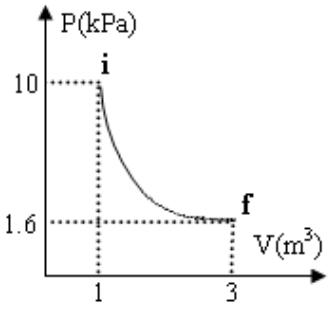


a. +962 J b. – 56 J
c. + 864 J d. + 575 J
e. – 575 J

10. An ideal gas is initially at a pressure of 1.40 atm and has a volume of 3.50 L. It expands isothermally to a final pressure of 0.600 atm. What is the work done in the process?

a. + 420 J b. – 420 J c. + 300 J
d. – 300 J e. Zero

11. One mole of an ideal monatomic gas is taken through an adiabatic process, as shown in the **Figure**. Calculate the work done in this process.



a. 7.8 kJ b. 5.5 kJ
c. 4.5 kJ d. 6.2 kJ
e. 4.2 kJ

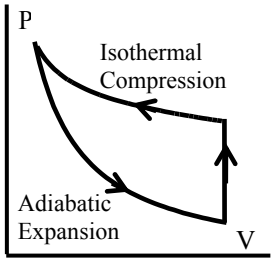
12. 500 cm^3 of an ideal gas at 40 °C and 200 kPa is compressed to 250 cm^3 and cooled to 20 °C. What is the final pressure?

a. 374 kPa b. 748 kPa c. 200 kPa
d. 100 kPa e. 512 kPa

13. An ideal gas that initially occupies 0.140 m^3 at a pressure of 204.0 kPa is expanded isothermally to a pressure of 202.3 kPa. The work done by the gas is

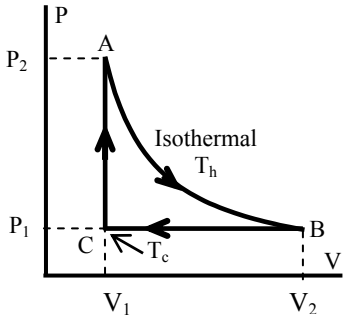
a. 239 J b. 140 J c. – 140 J
d. 533 J e. Zero.

14. For the cyclic process shown in the **Figure**,



a. the net thermal energy is transferred from the gas to the surroundings.
b. the net work done by the gas on the surroundings is positive.
c. the net work done by the gas on the surroundings is zero.
d. the internal energy of the gas increases.
e. the internal energy of the gas decreases.

15. Suppose one mole of an ideal gas undergoes the reversible cycle ABCA as shown in the **Figure**, where AB is an isotherm and the temperature at point C is T_c. The net heat added to the gas during the cycle is equal to



a. $RT_h \ln V_2/V_1 - R(T_h - T_c)$
b. $-C_p(T_h - T_c)$.
c. $-C_v(T_h - T_c)$
d. $RT_h \ln V_2/V_1 - C_p(T_h - T_c)$
e. RT_hV_2/V_1.

16. Two moles of nitrogen gas are in a 3-liter container at a pressure of 5.0×10^6 Pa. Find the average translational kinetic energy of a molecule.

a. 1.9×10^{-20} J b. 7.1×10^{-22} J c. 3.6×10^{-20} J
d. 1.1×10^{-23} J e. 1.0×10^{-24} J

17. Two moles of helium (monatomic) gas are heated from 100 ºC to 250 ºC. How much heat is transferred to the gas if the process is done at constant pressure?

a. 6.23 kJ b. 2.63 kJ c. 3.11 kJ
d. 1.51 kJ e. 8.52 kJ

18. An ideal diatomic gas, initially at a pressure $P_i = 1.0$ atm and volume V_i, is allowed to expand isothermally until it's volume doubles. The gas is then compressed adiabatically until it reaches its original volume. The final pressure of the gas will be:

a. 1.3 atm b. 0.5 atm c. 2.0 atm
d. 0.4 atm e. 1.7 atm

19. Five moles, of an ideal monatomic gas, expand at constant pressure of 100 Pa from a volume of 1.0 m^3 to to a volume of 3.0 m^3. What is the change in the internal energy of the system?

a. 300 J b. 500 J c. 600 J
d. 100 J e. 1000 J

20. For an ideal gas, Which of the following statements are CORRECT:

1. $C_p - C_v = R/2$.
2. In an isothermal process, the internal energy of the system does not change.
3. In an adiabatic process, no heat enters or leaves the system.
4. In a constant volume process, the work done by the system is positive.

a. 2 and 3 b. 1 and 3 c. 1, 2 and 4
d. 2 and 4 e. 3 and 4

21. One mole of oxygen molecule (M = 32 g/mol) occupies a cubic vessel of side length 10 cm at a temperature of 27 ºC. Calculate the pressure of the gas on the walls.

a. 2.49×10^6 Pa b. 5.01×10^6 Pa
c. 7.52×10^6 Pa d. 1.14×10^4 Pa
e. 3.33×10^4 Pa

22. The equation of state of a certain gas is given as $P\times V^2 = K$, where P is the pressure, V is the volume and K is a constant. Find the work done by the gas if its volume increases from $V_i = 2.0$ m^3 to a final volume $V_f = 4.0$ m^3.

a. K/4 b. 4×K c. K/2 d. K^2 e. $2\times K^2$

23. Which one of the following statements is correct?

a. Two different ideal gas molecules of different mass will have the same average translational kinetic energy if they are at the same temperature.
b. In an isothermal process, the work done on the gas is always positive.
c. All real gases approach the ideal gas state at low temperatures.
d. In an isobaric process, the energy is always constant.
e. In an adiabatic process, the work is always zero.

24. A diatomic ideal gas undergoes a constant pressure process in which its internal energy increases by 540 J. Find the heat added to the gas and the work done by the gas.

a. Q = 756 J, W = 216 J. b. Q = 540 J, W = 0.
c. Q = 0, W = 540 J. d. Q = 900 J, W = 360 J.
e. Q = 230 J, W = 313 J.

25. The air in an automobile engine at 20 ºC is compressed adiabatically from an initial pressure of 1 atm and a volume of 200 cm^3 to a final volume of 20 cm^3. Find the final temperature if the air behaves like an ideal gas. [Take $\gamma = 1.4$]

a. 463 ºC b. 526 ºC c. 10 ºC
d. 50 ºC e. 20 ºC