socrative by MasteryConnect

Name: Solutions Date: _____

Quiz name: Chapter 12 Review - Thermodynamics Pt. 1

1. What is the mass, in u, of a molecule of carbon dioxide, CO_2?

- A 12
- B 24
- C 32
- D 36
- E 44

2. Which contains more atoms, a mole of hydrogen gas (H_2) or a mole of neon gas (Ne)?

- A The hydogen — each molecule has 2 hydrogens
- B The neon
- C They each contain the same number of molecules.
- D Can't tell without knowing their temperatures.

3. A rigid container holds both Helium gas (He) and Oxygen gas (O_2) at 273 K. Which statement described their rms speeds?

- A v_{rms} of He < v_{rms} of O_2
- B v_{rms} of He = v_{rms} of O_2
- C v_{rms} of He > v_{rms} of O_2

4. An object moving faster than the earth's escape velocity (about 11 km/s) has enough energy to escape the pull of the earth's gravity. Which of the following gas molecules would be most likely to be moving at a speed high enough to escape the earth's atmosphere assuming each molecule has the same temperature?

- A Carbon dioxide
- B Oxygen
- C Nitrogen
- D Water vapor
- E Hydrogen — smallest mass

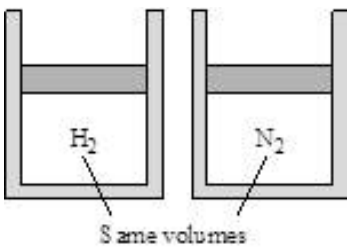
$$v_{rms} = \sqrt{\frac{3k_B T}{m}}$$

5. The two identical cylinders each have lightweight pistons on top that are free to move, so the pressure inside each cylinder is equal to atmospheric pressure. One cylinder contains hydrogen, the other nitrogen. Both gases are at the same temperature. The number of moles of hydrogen is

- A Greater than the number of moles of nitrogen.
- B Equal to the number of moles of nitrogen.
- C Less than the number of moles of nitrogen.

So this must be the same too!

$PV = nRT$ (same, same, same)

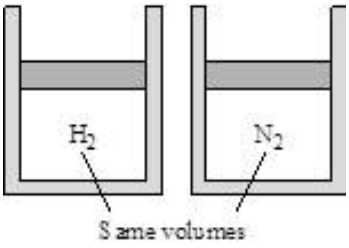


6. The two identical cylinders each have lightweight pistons on top that are free to move, so the pressure inside each cylinder is equal to atmospheric pressure. One cylinder contains hydrogen, the other nitrogen. The mass of gas in each cylinder is the same. The temperature of the hydrogen gas is

A Greater than the temperature of the nitrogen.

B Equal to the temperature of the nitrogen.

C Less than the temperature of the nitrogen.



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7. Two identical cylinders, A and B, contain the same type of gas at the same pressure. Cylinder A has twice as much gas as cylinder B. Which is true?

A $T_A < T_B$

B $T_A = T_B$

C $T_A > T_B$

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8. The temperature of a rigid (i.e., constant-volume), sealed container of gas increases from 100 C to 200 C. The gas pressure increases by a factor of

A 2

B 1.3

C 1

D 0.8

E 0.5

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9. An ideal gas is made up of N diatomic molecules, each of mass M. All of the following statements about this gas are true EXCEPT:

A The temperature of the gas is proportional to the average translational kinetic energy of the molecules.

B All of the molecules have the same speed.

C The molecules make elastic collisions with each other and with the walls of the container.

D The average number of collisions per unit time that the molecules make with the walls of the container depends on the temperature of the gas.

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10. An ideal gas in a closed container initially has volume V, pressure P. and Kelvin temperature T. If the temperature is changed to 3T, which of the following pairs of pressure and volume values is possible?

A 3P and V

B 3P and 3V

C P and V/3

D P/3 and V

$\frac{P_1V_1}{T_1}$ → If we triple T P or V must also be tripled but not both.

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11. An ideal gas confined in a box initially has pressure p. If the absolute temperature of the gas is doubled and the volume of the box is quadrupled, the pressure is

A p/8

B p/4

C p/2

D 2p

$\frac{PV}{T}$ → If T doubles, $P\times 2$
If V is quadrupled, $P\times\frac{1}{4}$
$P\times 2\times\frac{1}{4} = \frac{1}{2}P$

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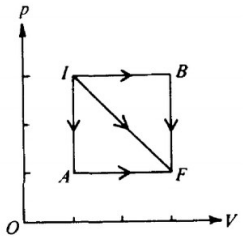
12. If three identical samples of an ideal gas are taken from initial state I to final state F along the paths IAF, IF, and IBF as shown in the pV-diagram above, which of the following must be true?

A The heat absorbed by the gas is the same for all three paths.

B The change in internal energy of the gas is the same for all three paths. $\Delta E \propto \Delta T$

C The expansion along path IF is adiabatic.

D The expansion along path IF is isothermal.



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13. If the average kinetic energy of the molecules in an ideal gas at a temperature of 300 K is E, the average kinetic energy at a temperature of 600 K is

A E

B E*sqrt(2)

C 2E

D 4E

$\Delta E \propto \Delta T$

An ideal gas undergoes a cyclic process as shown on the graph above of pressure p versus volume V.

14. During which process is no work done on or by the gas?

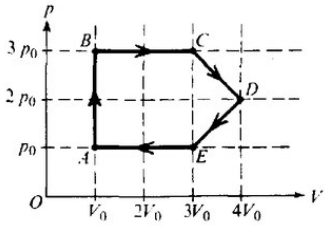
A AB

B BC

C CD

D EA

Work = Area



An ideal gas undergoes a cyclic process as shown on the graph above of pressure p versus volume V.

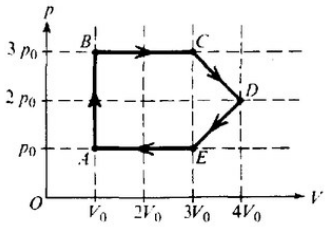
15. At which point is the gas at its highest temperature?

A A

B B

C C

D D



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16. If the gas in a container absorbs 275 joules of heat, has 125 joules of work done on it, and then does 50 joules of work, what is the increase in the internal energy of the gas?

A 450 J

B 400 J

C 350 J

D 200 J

$275 + 125 - 50$

A certain quantity of an ideal gas initially at temperature T0, pressure p0, and volume V0 is compressed to one-half its initial volume. As shown above, the process may be adiabatic (process 1), isothermal (process 2), or isobaric (process 3).

17. Which of the following is true of the mechanical work done on the gas?

Work = area

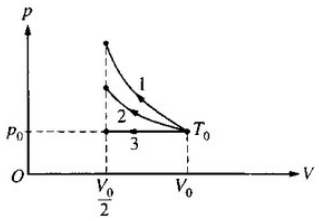
area under path 1 is largest

(A) It is greatest for process 1.

(B) It is greatest for process 2.

(C) It is greatest for process 3.

(D) It is the same for all three processes.



A certain quantity of an ideal gas initially at temperature T0, pressure p0, and volume V0 is compressed to one-half its initial volume. As shown above, the process may be adiabatic (process 1), isothermal (process 2), or isobaric (process 3).

18. Which of the following is true of the final temperature of this gas?

PV ∝ T

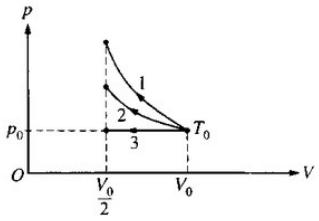
so higher P·V means higher T

(A) It is greatest for process 1.

(B) It is greatest for process 2.

(C) It is greatest for process 3.

(D) It is the same for all three processes.



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19. In a certain process, 400 J of heat is transferred to a system and the system simultaneously does 100 J of work. The change in internal energy of the system is

400 − 100

(A) 400 J

(B) 300 J

(C) -100 J

(D) -300 J

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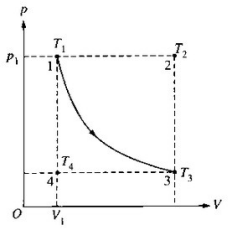
20. Multiple Correct: An ideal gas is initially in a state that corresponds to point 1 on the graph above, where it has pressure p1, volume V1, and temperature T1. The gas undergoes an isothermal process represented by the curve shown, which takes it to a final state 3 at temperature T3. If T2 and T4 are the temperatures the gas would have at points 2 and 4, respectively, which of the following relationships is true? Select two answers:

(A) $T_1 < T_3$

(B) $T_1 < T_2$ $P_1V_1 < P_2V_2$

(C) $T_1 = T_3$ isothermal

(D) $T_1 = T_4$



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21. The absolute temperature of a sample of monatomic ideal gas is doubled at constant volume. What effect, if any, does this have on the pressure and density of the sample of gas?

(A) Pressure remains the same
Density remains the same

(B) Pressure remains the same
Density doubles

(C) Pressure doubles
Density remains the same

(D) Pressure doubles
Density doubles

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22. Which of the following statements is NOT a correct assumption of the classical model of an ideal gas?

(A) The molecules are in random motion.

(B) The volume of the molecules is negligible compared with the volume occupied by the gas.

(C) The molecules obey Newton's laws of motion.

(D) The collisions between molecules are inelastic.

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23. A sample of an ideal gas is in a tank of constant volume. The sample absorbs heat energy so that its temperature changes from 300 K to 600 K. If v_1 is the average speed of the gas molecules before the absorption of heat and v_2 is their average speed after the absorption of heat, what is the ratio v_2/v_1?

(A) 4

(B) 2

(D) sqrt(2)

(D) 1/2

$v_{rms} = \sqrt{\frac{3kT}{m}}$

$v_{rms} \propto \sqrt{T}$

If T×2, then $v \times \sqrt{2}$

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24. Two blocks of steel, the first of mass 1 kg and the second of mass 2 kg, are in thermal equilibrium with a third block of aluminum of mass 2 kg that has a temperature of 400 K. What are the respective temperatures of the first and second steel blocks?

(A) 400 K and 200 K

(B) 200 K and 400 K

(D) 400 K and 400 K

(D) 800 K and 400 K

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25. Which of the following will occur if the average speed of the gas molecules in a closed rigid container is increased?

isochoric

(A) The density of the gas will decrease.

(B) The density of the gas will increase.

(D) The pressure of the gas will increase.

(D) The pressure of the gas will decrease.

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26. A gas with a fixed number of molecules does 32 J of work on its surroundings, and 16 J of heat are transferred from the gas to the surroundings. What happens to the internal energy of the gas?

(A) It decreases by 48 J.

(B) It decreases by 16 J.

(C) It increases by 16 J.

(D) It increases by 48 J.

lost 32 J

then lost 16 J

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27. A mass m of helium gas is in a container of constant volume V. It is initially at pressure p and absolute (Kelvin) temperature T. Additional helium is added, bringing the total mass of helium gas to 3m. After this addition, the temperature is found to be 2T. What is the gas pressure?

(A) 2/3 p

(B) 3/2 p

(C) 3 p

(D) 6 p

$PV = nRT$

$n \times 3$

$T \times 2 \Rightarrow P \times 6$

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28. When an ideal gas is isothermally compressed:

(A) thermal energy flows from the gas to the surroundings.

(B) thermal energy flows from the surroundings to the gas.

(C) no thermal energy enters or leaves the gas.

(D) the temperature of the gas increases.

A gas is enclosed in a cylindrical piston. When the gas is heated from 0°C to 100°C, the piston is allowed to move to maintain a constant pressure.

29. Which statement is true?

- (A) the molecules continue to strike the sides of the container with the same energy
- (B) the number of molecules of gas must increase
- (C) the size of the individual molecules has increased
- (D) the average speed of the molecules has increased

$v_{rms} = \sqrt{\frac{3K_BT}{m}}$

Two containers are filled with gases at the same temperature. In the container on the left is a gas of molar mass 2M, volume 2V, and number of moles 2n. In the container on the right is a gas of molar mass M, volume V, and moles n. Which is most nearly the ratio of the pressure of the gas on the left to the pressure of the gas on the

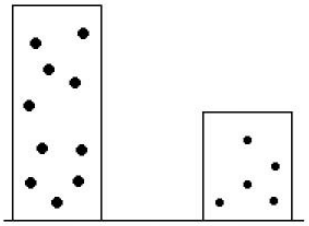
30. right?

$PV = nRT$

$P(2V) = (2n)RT$

$PV = nRT$

- (A) 1:1
- (B) 2:1
- (C) 4:1
- (D) 8:1



The volume of an ideal gas changes as the gas undergoes an isobaric (constant pressure) process starting from temperature 273 OC and ending at 546OC. What is the ratio of the new volume of the

31. gas to the old volume (V_{new}/V_{old})?

$273°C = 546K$

$546°C = 819K$

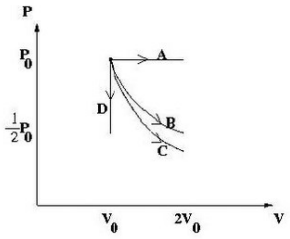
$\frac{819K}{546K} = \frac{3}{2}$

- (A) 1/2
- (B) 2/3
- (C) 3/2
- (D) 2

Multiple Correct. The PV diagram shows four different possible reversible processes performed on a monatomic ideal gas. Process A is isobaric (constant pressure). Process B is isothermal (constant temperature). Process C is adiabatic. Process D is isochoric (constant volume). For which processes

32. does the temperature of the gas decrease? Select two answers:

- (A) Process A
- (B) Process B
- (C) Process C
- (D) Process D



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33. Absolute zero is best described as that temperature at which

- (A) water freezes at standard pressure.
- (B) the molecules of a substance have a maximum kinetic energy.
- (C) the molecules of a substance have a maximum heat energy.
- (D) the molecules of a substance have minimum kinetic energy.

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34. A sample of gas is caused to go through the cycle shown in the pV diagram shown above. What is the net work done by the gas during the cycle?

net work = Area of parallelogram

= (3)(200)

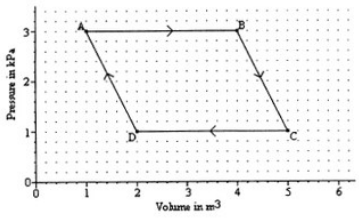
= 600 J

(A) 4,000 J

(B) 6,000 J

(C) 8,000 J

(D) 12,000 J



35. Hydrogen gas (H_2) and oxygen gas (O_2) are in thermal equilibrium. How does the average speed of the hydrogen molecules compare to the average speed of oxygen molecules?

(A) equal

(B) 4 times greater

(C) 8 times greater

(D) 16 times greater

$v_{rms} = \sqrt{\frac{3 k_B T}{m}}$

$m_{O_2} = 16\, m_{H_2}$

$m_{H_2} = \frac{1}{16} m_{O_2}$

becomes $\sqrt{\frac{\approx}{1/16}}$

$\Rightarrow \sqrt{16} \Rightarrow 4$ times greater