DPP No. 17

SYLLABUS : KTG & THERMODYNAMICS

1. When an ideal gas is compressed isothermally then its pressure increases because :

(A) its potential energy decreases

(B) its kinetic energy increases and molecules move apart

(C) its number of collisions per unit area with walls of container increases

(D) molecular energy increases

2. Which of the following is correct for the molecules of a gas in thermal equilibrium ?

(A) All have the same speed

(B) All have different speeds which remain constant

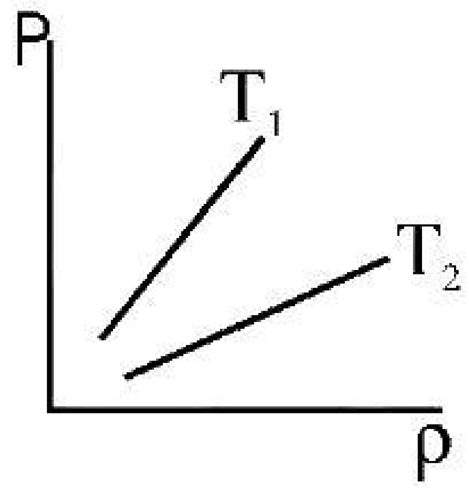
(C) They have a certain constant average speed

(D) They do not collide with one another.

3. The temperature at which the r.m.s velocity of oxygen molecules equal that of nitrogen molecules at 100ºC is nearly:

(A) 426.3 K (B) 456.3 K (C) 436.3 K (D) 446.3 K

4. Figure shows graphs of pressure vs density for an ideal gas at two temperatures T_1 and T_2.



(A) $T_1 > T_2$ (B) $T_1 = T_2$

(C) $T_1 < T_2$ (D) any of the three is possible

5. Suppose a container is evacuated to leave just one molecule of a gas in it. Let v_{mp} and v_{av} represent the most probable speed and the average speed of the gas, then

(A) $v_{mp} > v_{av}$ (B) $v_{mp} < v_{av}$ (C) $v_{mp} = v_{av}$ (D) none of these

6. The average speed of nitrogen molecules in a gas is v. If the temperature is doubled and the N_2 molecule dissociate into nitrogen atoms, then the average speed will be

(A) v (B) $v\sqrt{2}$ (C) 2 v (D) 4v

7. Four containers are filled with monoatomic ideal gases. For each container, the number of moles, the mass of an individual atom and the rms speed of the atoms are expressed in terms of n, m and v_{rms} respectively. If T_A, T_B, T_C and T_D are their temperatures respectively then which one of the options correctly represents the order ?

	A	B	C	D
Number of moles	n	3n	2n	n
Mass	4m	m	3m	2m
Rms speed	V_{rms}	$2V_{rms}$	V_{rms}	$2V_{rms}$
Temperature	T_A	T_B	T_C	T_D

(A) $T_B = T_C > T_A > T_D$ (B) $T_D > T_A > T_C > T_B$ (C) $T_D > T_A = T_B > T_C$ (D) $T_B > T_C > T_A > T_D$

8. For a gas sample with N_0 number of molecules, function N(V) is given by : $N(V) = \frac{dN}{dV} = \left(\frac{3}{V_0^3}\frac{N_0}{}\right)V^2$ for $0 < V < V_0$ and $N(V) = 0$ for $V > V_0$. Where dN is number of molecules in speed range V to V+ dV. The rms speed of the molecules is :

(A) $\sqrt{\frac{2}{5}}V_0$ (B) $\sqrt{\frac{3}{5}}V_0$ (C) $\sqrt{2}V_0$ (D) $\sqrt{3}V_0$

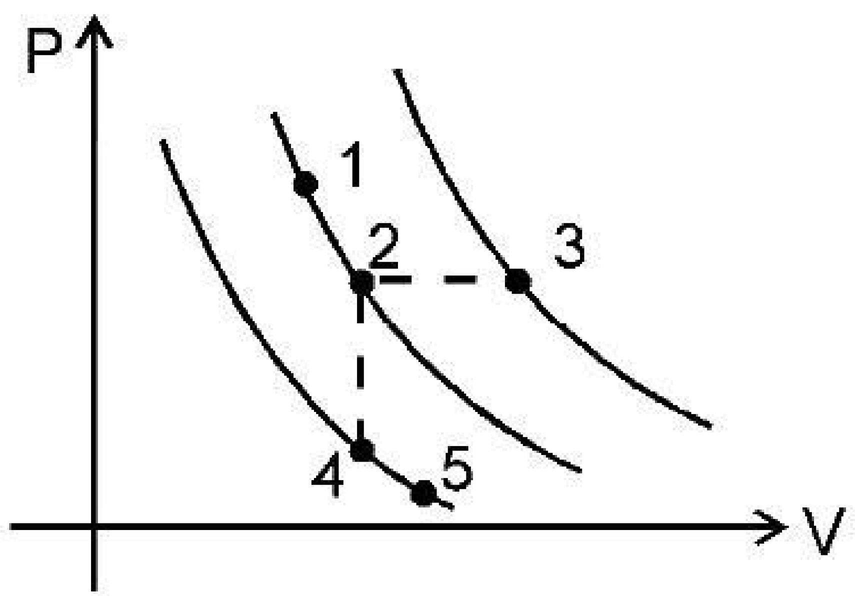
9. A gas is filled in a rigid container at pressure P_0. If the mass of each molecule is halved keeping the total number of molecules same and their r.m.s. speed is doubled then find the new pressure.

(A) $1P_0$ (B) $2P_0$ (C) $3P_0$ (D) $4P_0$

10. Three closed vessels A, B, and C are at the same temperature T and contain gases which obey the Maxwell distribution of speed . Vessel A contains only O_2, B only N_2 and C a mixture of equal quantities of O_2 and N_2. If the average speed of O_2 molecules in vessel A is V_1, that of the N_2 molecules in vessel B is V_2, the average speed of the O_2 molecules in vessel C will be :

(A) $(V_1 + V_2)/2$ (B) V_1 (C) $(V_1V_2)^{1/2}$ (D) $\frac{V_1}{2}$

11. A certain gas is taken to the five states represented by dots in the graph. The plotted lines are isotherms. Order of the most probable speed v_p of the molecules at these five states is :



(A) $V_{P\ at\ 3} > V_{P\ at\ 1} = V_{P\ at\ 2} > V_{P\ at\ 4} = V_{P\ at\ 5}$

(B) $V_{P\ at\ 1} > V_{P\ at\ 2} = V_{P\ at\ 3} > V_{P\ at\ 4} > V_{P\ at\ 5}$

(C) $V_{P\ at\ 3} > V_{P\ at\ 2} = V_{P\ at\ 4} > V_{P\ at\ 1} > V_{P\ at\ 5}$

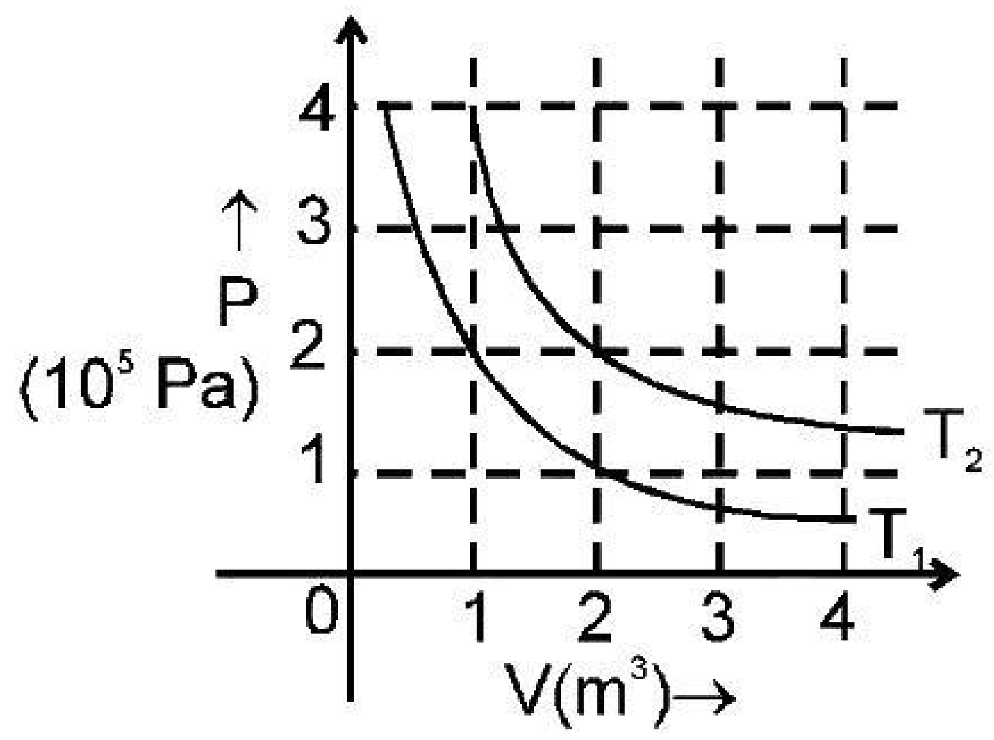
(D) Insufficient information to predict the result.

12. Find the average of magnitude of linear momentum of helium molecules in a sample of helium gas at temperature of 150 π K. Mass of a helium molecules = (166/3) × 10^{-27} kg and R = 25/3 J-mol^{-1} K^{-1}

(A) $\frac{53}{3\sqrt{10}} \times 10^{-23}$ kg-m/s (B) $\frac{83}{3\sqrt{5}} \times 10^{-23}$ kg-m/s

(C) $\frac{83}{3\sqrt{10}} \times 10^{-23}$ kg-m/s (D) $\frac{83}{2\sqrt{10}} \times 10^{-23}$ kg-m/s

13. The following graph shows two isotherms for a fixed mass of an ideal gas. Find the ratio of r.m.s. speed of the molecules at temperatures T_1 amd T_2 ?



(A) 1 : 2 (B) 1 : $\sqrt{2}$ (C) 1 : $\sqrt{3}$ (D) None of these

14. A gas has volume V and pressure P. The total translational kinetic energy of all the molecules of the gas is:–

(A) $\frac{3}{2}$PV only if the gas is monoatomic. (B) $\frac{3}{2}$PV only if the gas is diatomic.

(C) > $\frac{3}{2}$PV if the gas is diatomic. (D) $\frac{3}{2}$PV in all cases.

15. The pressure of an ideal gas is written as E = $\frac{3PV}{2}$. Here E stands for

(A) average translational kinetic energy (B) rotational kinetic energy

(C) total kinetic energy. (D) None of these

16. The quantities which remain same for all ideal gases at the same temperature is/are ?

(A) the kinetic energy of equal moles of gas

(B) the kinetic energy of equal mass of gas

(C) the number of molecules of equal moles of gas

(D) the number of molecules of equal mass of gas

17. The quantity $\frac{2U}{fkT}$ represents (where U = internal energy of gas)

(A) mass of the gas (B) kinetic energy of the gas

(C) number of moles of the gas (D) number of molecules in the gas

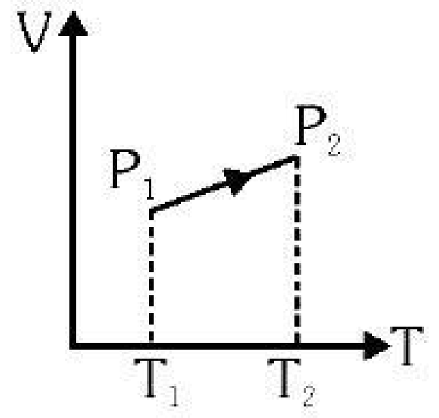
18. 16 g of oxygen at 37ºC is mixed with 14 g of nitrogen at 27ºC. Find the temperature of the mixture?

(A) 12ºC (B) 15ºC (C) 24ºC (D) 32ºC

19. 0.040 g of He is kept in a closed container initially at 100.0ºC. The container is now heated. Neglecting the expansion of the container, calculate the temperature at which the internal energy is increased by 12 J. $\left[R = \frac{25}{3} J - mol^{-1} - k^{-1}\right]$

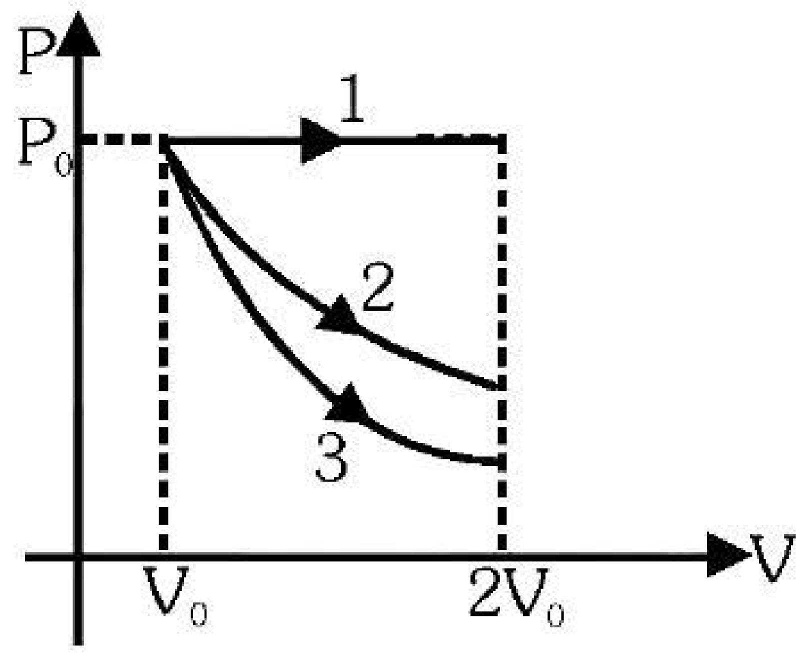
(A) 150ºC (B) 176ºC (C) 196ºC (D) 296ºC

20. From the following V–T diagram we can conclude:–



(A) $P_1 = P_2$ (B) $P_1 > P_2$ (C) $P_1 < P_2$ (D) Can't say anything

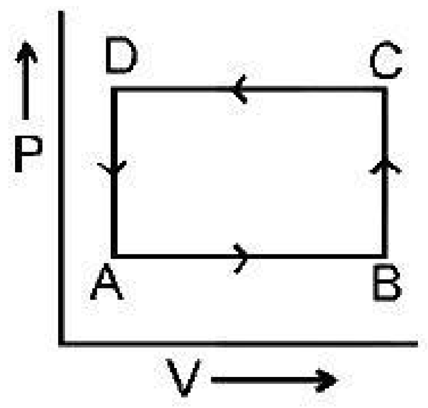
21. A gas is expanded from volume V_0 to $2V_0$ under three different processes. Process 1 is isobaric process, process 2 is isothermal and process 3 is adiabatic. Let ΔU_1, ΔU_2 and ΔU_3, be the change in internal energy of the gas is these processes. Then :–



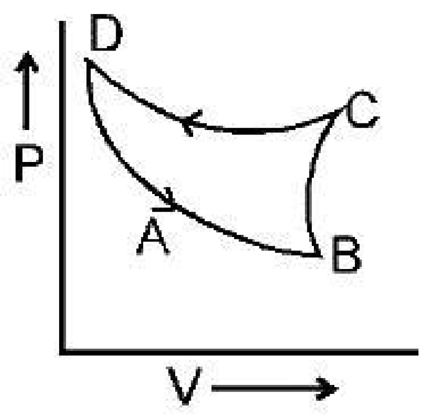
(A) $\Delta U_1 > \Delta U_2 > \Delta U_3$ (B) $\Delta U_1 < \Delta U_2 < \Delta U_3$ (C) $\Delta U_2 < \Delta U_1 < \Delta U_3$ (D) $\Delta U_2 < \Delta U_3 < \Delta U_1$

22. In the following figures (1) to (4), variation of volume by change of pressure is shown. A gas is taken along the path ABCDA. The change in internal energy of the gas will be:

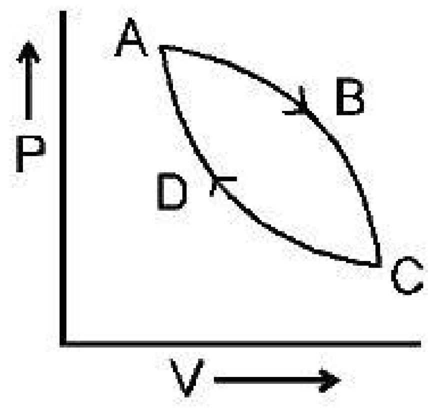
(1)



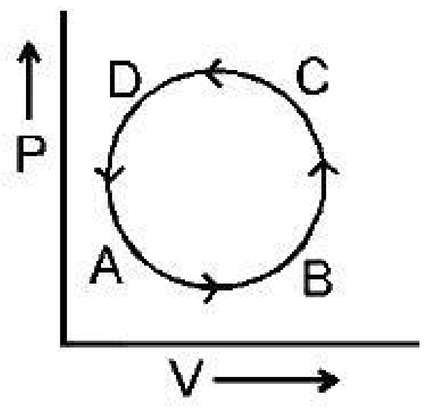
(2)



(3)



(4)



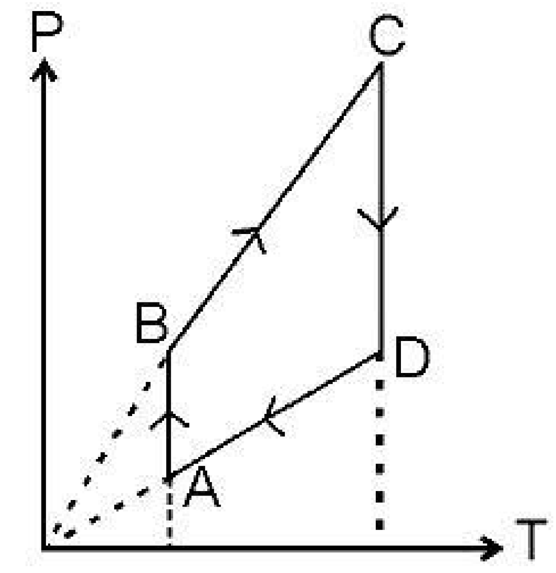
(A) positive in all cases from (1) to (4)

(B) positive in cases (1), (2) and (3) but zero in case (4)

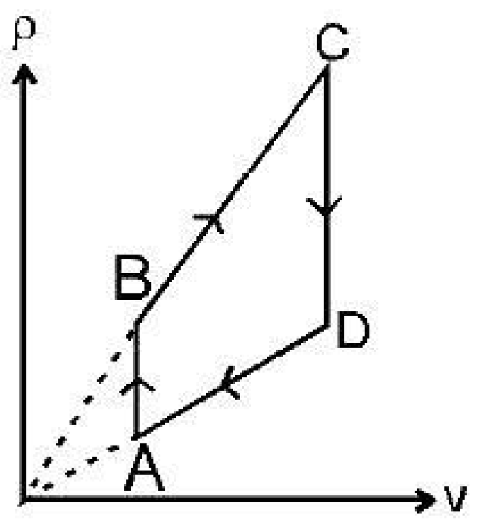
(C) negative in cases (1), (2) and (3) but zero in case (4)

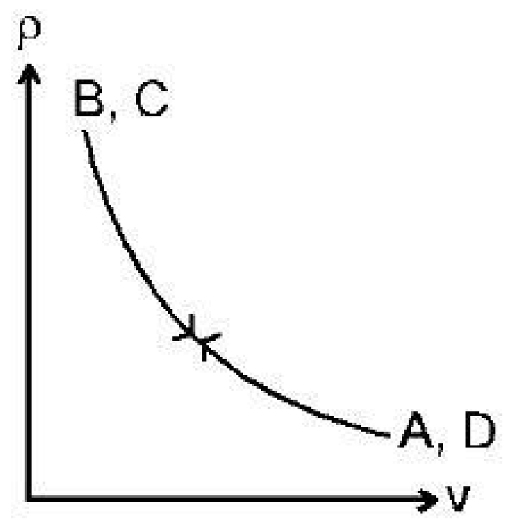
(D) zero in all the four cases.

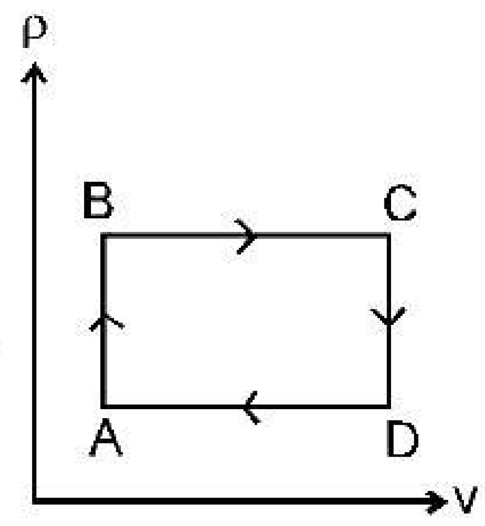
23. Pressure versus temperature graph of an ideal gas is as shown in figure.

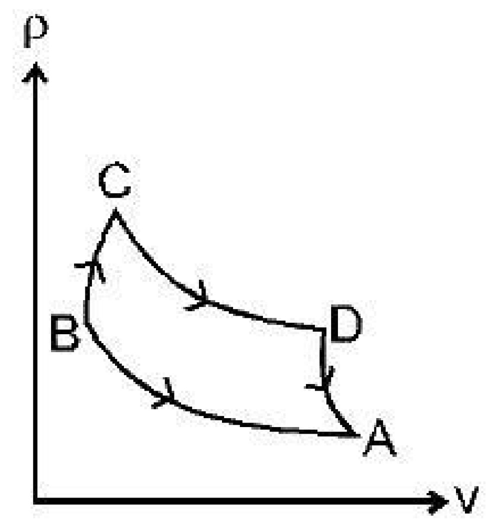


Corresponding density (ρ) versus volume (v) graph will be :

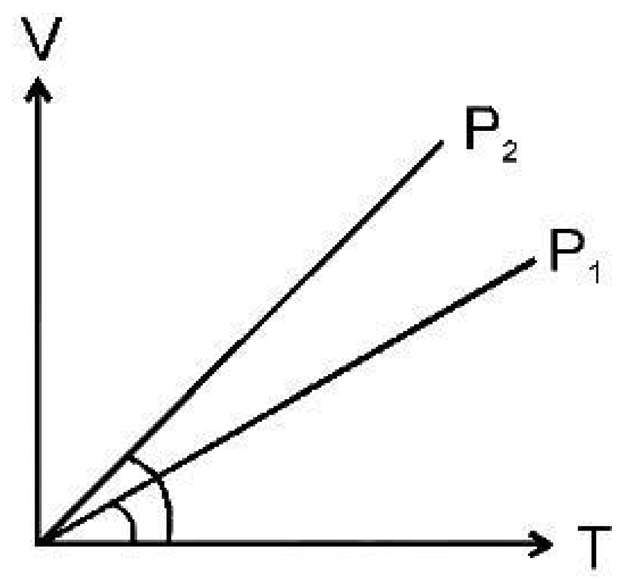
(A) 

(B) 

(C) 

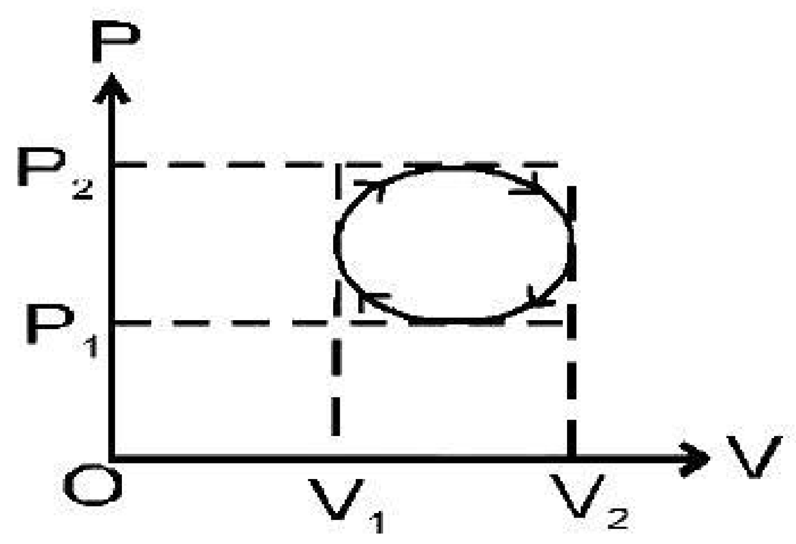
(D) 

24. In the following V-T diagram what is the relation between P_1 and P_2 :



(A) $P_2 = P_1$ (B) $P_2 > P_1$ (C) $P_2 < P_1$ (D) cannot be predicted

25. In a cyclic process shown on the P – V diagram the magnitude of the work done is :



(A) $\pi\left(\frac{P_2 - P_1}{2}\right)^2$ (B) $\pi\left(\frac{V_2 - V_1}{2}\right)^2$ (C) $\frac{\pi}{4}$ $(P_2 - P_1)$ $(V_2 - V_1)$ (D) π $(P_2V_2 - P_1V_1)$

ANSWER KEY

1.	(C)	**2.**	(C)	**3.**	(A)	**4.**	(A)	**5.**	(C)
6.	(C)	**7.**	(C)	**8.**	(B)	**9.**	(B)	**10.**	(B)
11.	(A)	**12.**	(C)	**13.**	(B)	**14.**	(D)	**15.**	(A)
16.	(C)	**17.**	(D)	**18.**	(D)	**19.**	(C)	**20.**	(C)
21.	(A)	**22.**	(D)	**23.**	(B)	**24.**	(C)	**25.**	(C)