PHYSICS

BOOKS - BHARATI BHAWAN PHYSICS (HINGLISH)

ISOTHERMAL AND ADIABATIC PROCESS

Others

1. A motor car tyre is pumped up to pressure of two atmosheres at $15^{\circ} C$ when it suddenly bursts. Calculate the resulting drop in temperature of the escaping air $(\gamma = 14)$.

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2. A certain volume of dry air at $20^{\circ} C$ is expanded to there times its volume (i) slowly, (ii) suddenly. Calculate the final pressure and temperature in eachh case. Atmospheric pressure $= 10^5 Nm^{-2}$, γ of air $= 1.4$

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3. A certain volume of a gas (diatomic) expandds isothermally at $20^\circ C$ until its volume is doubled and then adiabatically until its volume is again doubled. Find the final temperature of the gas, given $\gamma = 1.4$ and that there is 0.1 mole of the gas. Also calculate the work done in the two cases.

$R = 8.3 J \text{mole}^{-1} K^{-1}$

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4. The volume of one mode of an ideal gas with adiabatic exponent γ is varied according to the law $V = a/T$, where a is constant . Find the amount of heat obtained by the gas in this process, if the temperature is increased by ΔT.

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5. In a polytropic process an ideal gas (y= 1.40) was compressed from volume $V_1 = 10 litres \rightarrow v_2 = 5 litres$. The pressure increased from $p_1 = 10^5 Pa \rightarrow p_2 = 5 \times 10^5$ Pa.Determine: (a) the polytropic expoment n, (b) the molar heat capacity of the gas for the process.

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6. An ideal gas expands according to the law $pV^2 =$ constant (a) Is it heated or cooled ? (b) What is the molar heat capacity in this process?

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7. A quantity of air at normal temperature is compressed (a) slowly (b) suddenly to one third of its volume. Find the rise in temperature, if any in each case, $\gamma = 1.4$.

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8. A volume of gas at atmospheric pressure is compressed adiabatically to half its original volume, Calculated the resulting pressure $(\gamma = 1.4)$. $(1 atmoshpere = 0.76 m of mercury)$

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9. A gas of $\gamma = 1.4$ and initial temperature $0^\circ C$ is suddenly compressed to $1/5th$ its original volume. Calculate the rise in temperature.

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10. A volume of gas at $15^{\circ}C$ expands adiabatically until its volume is doubled. Find the resultant temperture given that the ratio of specific heat capacity of the gas $= 1.4.$

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11. A gass of given mass at a pressure of $10^5 Nm^{-2}$ expands isothermally until its volume is doubled and then adiabatically until volume is again double. Find the final pressure of the gas. $(\gamma = 1.4)$

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12. A gram molecule of gas at $27^\circ C$ expands isothermally untill its volume is doubled. Find

the amount of work done and heat absorbed.

Take $R = 8.31 Jmole^{-1} K^{-1}$.

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13. The tube of a motor car cotaining air at $27^{\circ} C$ and 2 atmospheric pressure bursts suddenly. Find the temperature of the air immediately after the tube bursts. $(\gamma = 1.4)$

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14. A certain mass of a gas is taken at $0^{\circ} C$ in a cylinder whose walls are perfect insulators. The gas is compressed (a) slowly, (b) suddenly till its pressure is increased to 20 times the initial pressure $(\gamma = 1.4)$. Calculate the final temperature in each case.

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15. One cubic metre of argon at $27^{\circ} C$ is adiabatically compressed so that the final temperature is $127^\circ C$. Calculate the new volume of the gas $(\gamma = 5/3)$.

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16. A gas at constant pressure $P_1, volume V_1$ and temperture T_1 is suddenly compressed to $\frac{V_1}{2}$ and then slowly expanded to V_1 again.Find the final temperature and pressure.

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17. A cubic metre of dry air at NTP is allowed to expand to 5 cubic metres (i) isothermally, (ii) adiabatically. Calculate in each cae, the pressure, temperature and work done. ($\gamma = 1.4$ and $1 atm = 1.013 \times 10^5 Nm^{-2}$)

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18. A mole of a monatimic perfect gas is adiabatically comporessed when its temperature rises from 27° to $127^\circ C$.

Calculate the work done.

[Hint: Work done $= R\frac{T - T'}{\gamma} - 1$, for monatomic gas $= \frac{5}{3}$]

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19. A piston can freely move inside a horizontal cylinder closed from both ends. Initially, the piston separates the inside space of the cylinder into two equal parts each of volmek V_0 in which an ideal gas is contained under the same pressure p_0 and at the same temperature. What work has to be performed in order to increase isothermally the volume of one part of gas η times compared to that of the other by slowly moving the piston ?

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20. A certain mass of nitrogen was compressed $\eta = 5.0$ times (in terms of volume), first adiabatically, and then isothermally. In both cases the initial state of the gas was the same. Find the ratio of the respective works expended in each compression.

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21. Demonstrate that the process in which the work performed by an ideal gas is alphaortional to that corresponding increment of its internal energy is decribed by the equation $pV^{n} - const$, where n is a constant.

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22. In a certain polytropic process the volume of argon was increased $\alpha = 4.0$ times. Simultaneously, the pressure decreased $\beta = 8.0$ times. Find the molar heat capacity of argon in this process. Assuming the gas to be ideal.

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23. On mole of argon expands polytropically, the polytropic constant being 1.5, that is, the process proceeds according to the law $pV^{1.5}$ = constant. In the process, its temperature change by $\Delta T = -26K$. Find

a. the amount of heat obatined by the gas.

b. the work performed by the gas.

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24. An ideal gas has an adiabatic exponent γ. In some process its molar heat capacity varies as $C = \alpha / T$,where α is a constant Find :

(a) the work performed by one mole of the gas during its heating from the temperature T_0 to the temperature η times higher ,

(b) the equation of the process in the variables p, V.

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25. (a) A polytropic process for an ideal gas is represented by $PV^x =$ constant, where $x \neq 1$. Show that molar specific heat capacity for such a process is given by $C = C_v + \dfrac{R}{1-x}$.

(b) An amount Q of heat is added to a mono atomic ideal gas in a process in which the gas performs a work $\frac{Q}{2}$ on its surrounding. Show that the process is polytropic and find the molar heat capacity of the gas in the process.

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26. If a gas of a volume V_1 at pressure p_1 is compressed adiabatically to volume V_2 and pressure p_2, calculate the work done by the gas.

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27. The relation between internal energy U, pressure P and volume V of a gas in an adiabatic process is

$U = a + bPV$ where a and b are constants. What is the effective value of adiabatic constant γ ?

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28. Molar heat capacity of an ideal gas varies as $C = C_v + \alpha T, C = C_v + \beta V$ and $C = C_v + ap$, where α, β and a are constant. For an ideal gas in terms of the variables T and V.

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29. One mole of an ideal gas at temperature T expands slowly according to the law $\frac{p}{V} =$ constant.

Its final temperature is T_2. The work done by the gas is

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30. A diatomic ideal gas is heated at constant volume until its pressure becomes three times. It is again heated at constant pressure until its volume is doubled. Find the molar heat capacity for the whole process.

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