PHYSICS

BOOKS - MHTCET PREVIOUS YEAR PAPERS AND PRACTICE PAPERS

KINETIC THEORY OF GASES ANDRADIATION

Example

1. During an experiment, an ideal gas is found to obey an additional law $VP^2 = cons\tan t,$ The gas is initially at a temperature T, and volume V. When it expands to a volume $2V,$ the temperature becomes.....

A. $\sqrt{3}T$

B. $\sqrt{1/2T}$

C. $T\sqrt{2}$

D. $\sqrt{3T}$

Answer: C

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2. The average speed of air molecules is 485ms^{-1} . At STP the number density is $2.7 \times 10^{25} m^{-3}$ and diameter of the air molecule is 2×10^{-10} m . The value of mean free path for the air molecule is

A. $2.5 \times 10^{-7} m$

B. $2.9 \times 10^{-7} m$

C. $3.5 \times 10^{-7} m$

D. $3.9 \times 10^{-7} m$

Answer: B

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3. Ten small planes are flying at a speed of $150km/h$ in total darkness in an air space that is $20 \times 20 \times 1.5km^3$ in volume. You are in one of the planes, flying at random within this space with no way of knowing where the other planes are, On the average about how long a time will elapse between near collision with your plane. Assume for this rough computation that a safety region around the plane can be approximately by a sphere of radius 10 m.

A. 250 h

B. 225 h

C. 330 h

D. 360 h

Answer: B

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4. A balloon has 5.0 mole of helium at $7^\circ C$. Calculate

(a) the number of atoms of helium in the balloon.

(b) the total internal energy of the system.

A. $1.64 \times 10^4 J$

B. $210 \times 10^4 J$

C. $1.74 \times 10^4 J$

D. $1.53 \times 10^4 J$

Answer: C

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5. A gas at $27^\circ C$ in a cylinder has a volume of 4 litre and pressure $100 Nm^{-2}$.

(i) Gas is first compressed at constant temperature so that the pressure is $150 Nm^{-2}$. Calculate the change in volume.

(ii) It is then heated at constant volume so that temperature becomes $127^\circ C$. Calculate the new pressure.

A. 1.22L

B. 1.33 L

C. 1.44 L

D. 1.55 L

Answer: B

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6. Air is filled in a container of $333K$. Calculate the tempeture upto which it should be heated so that `1//3 rd of air may escope out of th vessel.

A. 550 K

B. 400 K

C. 333 K

D. 444 K

Answer: D

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7. A vessel contains two non-reactive gases neon (monoatomic) and oxygen (diatomic). The ratio of their partial pressures is 3:2. Estimate the ratio of

(i) number of molecules, and

(ii) mass density of neon and oxygen in the vessel.

Atomic mass of neon = 20.2 u, and molecular mass of oxygen = 32.0 u.

A. $\frac{2}{3}$

B. $\frac{3}{2}$

C. $\frac{4}{3}$

D. $\frac{3}{4}$

Answer: B

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8. What is the rms speed of oxygen molecules at $225^{\circ}C$? Density of oxygen at NTP is $1.42kgm^{-3}$ and one atmosphere is $1.013 \times 10^{5}Nm^{-2}$.

A. $624.8ms^{-1}$

B. $618.6ms^{-1}$

C. $328.5ms^{-1}$

D. $320.7ms^{-1}$

Answer: A

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9. The total number of degrees of freedom possessed by the molecules in $1cm^{3}$ of H_2 gas at temperature 273 K and 1 atm pressure . Will be

A. 1.34375×10^{20}

B. 1.43753×10^{15}

C. 1.24365×10^{20}

D. 1.34375×10^{15}

Answer: A

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10. The molecular kinetic energy of 1 g of helium (molecular weight 4) at $127^{\circ} C$ is (Given , R $= 8.31 J \text{mol}^{-1} K^{-1}$)

A. 12.84 J

B. 12.465 J

C. 14.34

D. 14.384 J

Answer: B

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11. The molar specific heat at constant pressure of an ideal gas is $(7/2R)$. The ratio of specific heat at constant pressure to that at constant volume is

A. $7/5$

B. $8/7$

C. $5/7$

D. $9/7$

Answer: A

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12. At a constant pressure of $10^4 Nm^{-2}$, a gas expands by $0.25m^3$ work done by the gas is

A. 2500 J

B. 250 J

C. 25 J

D. 2.5 J

Answer: A

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13. When a system goes from state A to state B, it is supplied with 400 J of heat and it does 100 J of work.

(a) For this transition, what is the system's change in internal energy?

(b) If the system moves from B to A, what is the change in internal energy?

(c) If in moving from A to B along a different path in which $W'_{AB} = 400J$ of work is done on the system, how much heat does it absorb?

A. 250 J

B. 300 J

C. 350 J

D. 150 J

Answer: B

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14. In the above example , if the system moves from Bto A, what is the Change in internal energy ?

A. 300 J

B. $-300J$

C. 400 J

D. $-400J$

Answer: B

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15. A fixed mass of gas is taken through a process $A \to B \to C \to A$. Here , $A \to B$ is isoaric $B \to C$ is adiabatic and $C \to A$ is isothermal

The pressure at Cis given by $(\gamma = 1.5)$

A. $\frac{10^5}{64} Nm^{-2}$

B. $\frac{10^5}{32} Nm^{-2}$

C. Zero

D. $10^5 Nm^{-2}$

Answer: A

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16. A refrigerator transfers 250 J heat per second from $-23^\circ C$ to $-25^\circ C$. Find the power consumed , assuming no loss of energy.

A. $48 Js^{-1}$

B. $50Js^{-1}$

C. $52Js^{-1}$

D. $53Js^{-1}$

Answer: A

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17. The emissivity of tungsten is aproximately 0.35. A tungsten sphere 1 cm in radius is suspended within a large evacuated enclosure whose walls are at 300 K. What power input is required to maintain the sphere at a temperature of 3000 K if heat conduction along the support is neglected?$\sigma = 5.67 \times 10^{-8}$ SI units.

A. 2119.8W

B. 2019.8W

C. 2219.8 W

D. 1919.8 WS

Answer: B

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18. A hot body having the surface temperture $1127^{\circ}C$ Determine the wavelength at wchich it radiates maximum energy . Given , Wien' s constant $= 2.9 \times 10^{-3}$ mK .

A. 207.1Å

B. 220.1Å

C. 300.1Å

D. 250.1Å

Answer: A

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19. A body cools down from $60^\circ C$ to $55^\circ C$ in 30 s. Using newton's law of cooling calculate the time taken by same body to cool down from $55^\circ C$ to $50^\circ C$. Assume that the temperature of surrounding is $45^\circ C$.

A. 41.28 sS

B. 55.28 SS

C. 51.28 s

D. 60.28 S

Answer: C

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Exercise 1

1. The pressure p for a gas is plotted against its absolute temperature T for two different volumes V_1 and V_2. If p is plotted on $y-$ axis and T on $x-$ axis, then

A. the curve for V_1 has grater slope than that for V_2

B. the curve for V_2 has greater slope than that for V_1

C. Both curves have same slope

D. the curves intersect at some point other than T=O

Answer: A

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2. Air is pumped into an automobile tube upto a pressure of 200 kPa in the morning when the air temperture is $22^\circ C$ During the day , temperature ries to $42^\circ C$ and the tube expands by 2% a The pressure of the air in the tube at this temperature, will be approximately

A. 212 kPa

B. 209 kPa

C. 206 kPa

D. 200 kPa

Answer: B

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3. Simple behaviour under all conditions of real gas is governed by the equation

A. $pV = \mu RT$

B. $\left(p + \frac{a}{V^2}\right)(V - b) = \mu RT$

C. $pV = \text{constant}$

D. $pV^{\gamma} = \text{constant}$

Answer: B

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4. When a van der waals ' gas undergoes free expansion , then its temperature

A. decreases

B. increases

C. does not change

D. depends upon the nature of the gas

Answer: A

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5. At $10^\circ C$, the value of the density of a fixed mass of an ideal gas divided by its pressure is x. at $110^\circ C$, this ratio is

A. x

B. $\frac{383}{283}x$

C. $\frac{10}{110}x$

D. $\frac{283}{383}x$

Answer: D

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6. One litre of an ideal gas st $27^\circ C$ is heated at a constant pressure to the $297^\circ C$. Then, the final volume is the approximately

A. 1.2 L

B. 1.9 L

C. 19 L

D. 2.4 L

Answer: B

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7. Two ballons are filled, one with pure He gas and other by air, repectively. If the pressure and temperature of these ballons are same then the number of molecules per unit volume is:

A. more in the He filled balloon

B. same in both ballons

C. more in air filled balloon

D. in the ratio of 1:4

Answer: B

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8. Two moles of an ideal gas is contained in a cylinder fitted with a frictionless movalbe piston, exposed to the atmosphere, at an initial temperature T_0. The gas is slowly heated so that its volume becomes fout times the initial value. The work done by gas is

A. Zero

B. $2RT_0$

C. $4RT_0$

D. $6RT_0$

Answer: D

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9. During an experiment, an ideal gas is found to obey an additional law $VP^2 = cons\tan t,$ The gas is initially at a temperature T, and volume V. When it expands to a volume $2V,$ the temperature becomes.....

A. $\sqrt{3}T$

B. $\sqrt{1/2T}$

C. $\sqrt{2T}$

D. $\sqrt{3T}$

Answer: C

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10. The gas in a vessel is subjected to a pressure of 20 atmosphere at a temperature $27^\circ C$. The pressure of the gas in the vessel after one half of the gas is released from the vessel and the temperature of the remainder is raised by $50^\circ C$ is

A. 8.5 atm

B. 10.8 atm

C. 11.7 atm

D. 17 atm

Answer: C

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11. A real gas behaves like an ideal gas if its

A. Phase transition

B. temperature

C. pressure

D. None of these

Answer: C

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12. How much heat energy in joules must be supplied to 14gms of nitrogen at room temperature to rise its temperature by $40^\circ C$ at constant pressure? (Mol. Wt. of $N_2 = 28gm$, R=constant)

A. 50 R

B. 60 R

C. 70 R

D. 80 R

Answer: C

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13. A balloon contains $500m^3$ of He at $27^\circ C$ and 1 atm pressure. Then , the volume of He at $-3^\circ C$ and 0.5 atm pressure will be

A. $700m^3$

B. $900m^3$

C. $1000m^3$

D. $500m^3$

Answer: B

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14. The figure below shows the plot of $\frac{PV}{nT}$ versus P for oxygen gas at two different temperatures

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$\rightarrow theidealgasbehaviour(ii)$

T_(1)gtT_(2)$Thevalueof$(pV)/(nT)` at the point where the curves meet on the y-axis is the same for all gases Which of the above statements is true

?

A. (i) only

B. (i) and (ii) only

C. All of these

D. None of these

Answer: C

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15. Temperature remaining constant, the pressure of gas is decreased by 20%. The percentage change in volume

A. increases by 29 %

B. decreases by 20%

C. increases by 25%

D. deceases by 25%

Answer: C

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16. A closed container of volume $0.02m^3$ contains a mixture of neon and argon gases at a temperature $27^\circ C$ and pressure $1 \times 10^5 Nm^{-1}$ The total mass is 28 and the molar mass of and argon are 20 and 40 respectively find the masses of individual gases in the container assuming then to be ideal .

A. 24 g

B. 25 g

C. 26 g

D. 27 g

Answer: A

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17. The mean free path of collision of gas melecules varies with its diameter (d) of the molecules as

A. d^{-1}

B. d^{-2}

C. d^{-3}

D. d^{-4}

Answer: B

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18. At what temperature will be the oxygen molecules have the same root mean square root mean square speed as hydrogen molecules at 300 K ?

A. 1600 K

B. 2400 K

C. 3200 K

D. 4800 K

Answer: D

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19. The temperature of an ideal gas is increased from 120 K to 480 K. If at 120 K the root mean square velocity of the gas molecules is v, at 480 K it becomes

A. 4 v

B. 2 V

C. $\frac{v}{2}$

D. $\frac{v}{4}$

Answer: B

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20. The temperature at which the mean KE of the molecules of gas is one - third of the mean KE of its molecules at $180^\circ C$ is

A. $-122^\circ C$

B. $-90^\circ C$

C. $60^\circ C$

D. $-151^\circ C$

Answer: D

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21. if average velocity becomes 4 times, then what will be the effect on rms velocity at the temperature?

A. 1.4 times

B. 4 times

C. 2 times

D. $\frac{1}{4}$ times

Answer: B

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22. For real gases (van der waals ' gas)

A. Boyle temperature is a /2R

B. Critical temperature is 8a /27Rb

C. Triple temperture is a 2a/2b

D. Inversions temperature is a /2Rb

Answer: B

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23. The root mean square velocity of a gas molecule of mass m at a given temperature is proportional to

A. mT

B. $m^{1/2}T^{1/2}$

C. $m^{-1/2}T$

D. $m^{-1/2}T^{1/2}$

Answer: D

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24. When temperature of an ideal gas is increased from $27^\circ C$ to $227^\circ C$, its rms speed is changed from $400ms^{-1}$ to V_s. Then, the V_s is

A. $516ms^{-1}$

B. $450ms^{-1}$

C. $350ms^{-1}$

D. $746ms^{-1}$

Answer: A

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25. Root mean square velocity of gas molecules is $300m/\sec$. The $r.m.s$ velocity of molecules of gas with twice the molecular weight and half the absolute temperature is :

A. $300ms^{-1}$

B. $600ms^{-1}$

C. $75ms^{-1}$

D. $150ms^{-1}$

Answer: D

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26. N molecules , each of mass m, of gas A and 2 N molecules , each of mass 2m, of gas B are contained in the same vessel which is maintained at a temperature T. The mean square velocity of molecules of B type is denoted by V_2 and the mean square velocity of A type is denoted by V_1 then $\frac{V_1}{V_2}$ is

A. 2

B. 1

C. $1/3$

D. $2/3$

Answer: D

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27. At a certain temperature , the ratio of the rms velocity of H_2 molecules to O_2 molecule is

A. $1:1$

B. $1:4$

C. $4:1$

D. $16:1$

Answer: C

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28. If the molecular weight of two gases are M_1 and M_2 then at a temperature the ratio of rms velocity C_1 and C_2 will be

A. $\left(\frac{M_1}{M_2}\right)^{1/2}$

B. $\left(\frac{M_2}{M_1}\right)^{1/2}$

C. $\left(\frac{M_1 - M_2}{M_1 + M_2}\right)^{1/2}$

D. $\left(\frac{M_1 + M_2}{M_1 - M_2}\right)^{1/2}$

Answer: B

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29. The temperature at which the velocity of oxygen will be half of hydrogen at NTP is

A. $1092^\circ C$

B. $1492^\circ C$

C. $273^\circ C$

D. $819^\circ C$

Answer:

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30. 10 moles of an ideal monoatomic gas at $10^\circ C$ are mixed with 20 moles of another monoatomic gas at $20^\circ C$. Then the temp. of the mixture is

A. $15.5^\circ C$

B. $15^\circ C$

C. $16^\circ C$

D. $16.6^\circ C$

Answer: D

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31. The speed of sound in hydrogen is $1270 ms^{-1}$ at temperature T. the speed at the same T in a mixture of oxygen and hydrogen mixed in a volume ratio 1:4 will be ?

A. 317ms^{-1}

B. 635ms^{-1}

C. 830ms^{-1}

D. 950ms^{-1}

Answer: B

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32. The ratio of the velocity of sound in Hydrogen gas $\left(\gamma = \frac{7}{5}\right)$ to that in Helium gas $\left(\gamma = \frac{5}{3}\right)$ at the same temperature is $\sqrt{\frac{21}{3}}$.

A. $\sqrt{\frac{5}{42}}$

B. $\sqrt{\frac{5}{21}}$

C. $\frac{\sqrt{42}}{21}$

D. $\frac{\sqrt{21}}{5}$

Answer: C

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33. If at NTP, velocity of sound in a gas is 1150 m/s, then find out the rms velocity of gas molecules at NTP. (Given R=8.3J/mol/K, $C_P = 4.8$

cal/mol/k).

A. $1600 \mathrm{ms}^{-1}$

B. $1532.19 \mathrm{ms}^{-1}$

C. $160 \mathrm{ms}^{-1}$

D. Zero

Answer: B

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34. If c_s is the velocity of sound in air and c is rms velocity , then

A. $c_s < c$

B. $c_s = c$

C. $c_s = c\left(\frac{\gamma}{3}\right)^{1/2}$

D. None of these

Answer: C

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35. The root mean square velocity of the molecules in a sample of helium is $5/7th$ that of the molecules in a sample of hydrogen. If the temperature of hydrogen sample is $0^\circ C$, then the temperature of the helium sample is about

A. $0^\circ C$

B. 4 K

C. $273^\circ C$

D. $100^\circ C$

Answer: C

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36. Which one of the following is not an assumption in the kinetic theory of gases?

A. The volume occupied by the mplecules is negligible

B. The force of attraction between the melecules is negligible

C. The collision between molecules are elastic

D. All molecules have some speed

Answer: D

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37. Two vessels A and B having equal volume contain equal masses of hydrogen in A and helium in B at 300 K. Then, mark the correct statement?

A. The pressure exerted by hydrogen is half that exerted by helium

B. The pressure exerted by hydrogen is equal to that exerted by helium

C. Average KE of the molecule of hydrogen is half the average KE of the molecules of helium

D. The pressure exerted by hydrogen is twice that exerted by helium

Answer: D

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38. One mole of diatomic ideal gas undergoes a cyclic process ABC as show in figure . The process BC is adiabatic. The temperature at A,B and C are 400K, 800Kand 600 K, respectively . Choose the correct statement.

A. The Change in internal energy in whole cyclic process is 250R

B. The change in internal energy in the process CA is 700R

C. The change in internal energy in the process AB is $-350R$

D. The change in internal energy in the processBC is $-500R$

Answer: D

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39. One kg of a diatomic gas is at pressure of $8 \times 10^4 N/m^2$. The density of the gas is $4kg/m^3$. What is the energy of the gas due to its thermal motion?

A. $3 \times 10^4 J$

B. $5 \times 10^4 J$

C. $6 \times 10^4 J$

D. $7 \times 10^4 J$

Answer: B

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40. A sealed container with negiligible coefficient of volumetric expansion contains helium (a monatomic gas). When it is heated from 300 K to 600 K, the average KE of helium atoms is

A. halved

B. unchaged

C. doubled

D. increased by factor $\sqrt{2}$

Answer: C

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41. At what temperarture, the kinetic energy of a gas molecule is half of the value at $27^\circ C$. ?

A. $13.5^\circ C$

B. $150^\circ C$

C. $75K$

D. $-123^\circ C$

Answer: D

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42. Two perfect monoatomic gases at absolute temperature T_1 and T_2 are mixed. There is no loss of energy. Find the temperature of the mixture if the number of moles in the gases aren_1 and n_2.

A. $T_1 + T_2$

B. $\frac{n_1 T_1 + n_2 T_2}{n_1 + n_2}$

C. $\frac{n_1 T_2 + n_2 T_1}{n_1 + n_2}$

D. $\sqrt{T_1 T_2 / n_1 n_2}$

Answer: B

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43. The kinetic energy of one mole gas at 300 K temperature , is E. at 400 K temperature kinetic energy is E' . The value of E' / E is

A. 1.33

B. $\sqrt{\left(\frac{4}{3}\right)}$

C. $\frac{16}{9}$

D. 2

Answer: A

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44. How much should the pressure be increased in order to decrease the volume of a gas 5% at a constant temprature ?

A. $5\ \%$

B. $5.26\ \%$

C. $10\ \%$

D. $4.26\ \%$

Answer: B

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45. For a gas the differce between the two specific heat is $4150 J / kgK$. What is the specific heat at constant volume of gas if the ratio of sepcific heat is 1.4

A. $8475 Jkg^{-1}K^{-1}$

B. $5186 Jkg^{-1}K^{-1}$

C. $1660 Jkg^{-1}K^{-1}$

D. $10375 Jkg^{-1}K^{-1}$

Answer: D

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46. A molecule of a gas has six degrees of freedom Then , the molar specific heat of the gas at constant volume is

A. $\frac{R}{2}$

B. R

C. $\frac{3R}{2}$

D. 3R

Answer: D

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47. Which one of the following gases possesses the largest internal energy

A. 2 moles of helium occupying $1m^3$ at $300K$

B. 56 g of nitrogen at $107Nm^{-2}$ at $300K$

C. 8 g of oxygen at 8 atm at 300 K

D. 6×10^{26} molecules of argon occupying $40m^3$ at 900 K

Answer: D

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48. Value of two principal specific heats of a gas $(\text{in cal mol}K)^{-1}$ determined by different students are given . Which is most relible ?

A. 5,2

B. 6,5

C. 7,5

D. 7,4

Answer: C

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49. Caluculate Change in internal energy when 5 moles of hydrogen is heated to $20^{\circ}C$ from , Specific heat of hydrogen at constant pressure is 8 cal $(\text{mol}^{\circ}C)^{-1}$

A. 200 cal

B. 350 cal

C. 300 cal

D. 450 cal

Answer: C

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50. Each molecule of a gas has F degrees of freedom . The ratio $\frac{C_p}{C_V} = \gamma$ for the gas is

A. $\frac{2}{f} + 1$

B. $1 - \frac{2}{f}$

C. $1 + \frac{1}{f}$

D. $1 - \frac{1}{f}$

Answer: A

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51. The adiabatic elasticity of hydrogen gas $(\gamma = 1.4)$ at NTP

A. $1 \times 10^5 Nm^{-2}$

B. $1 \times 10^8 Nm^{-2}$

C. $1.4 Nm^{-2}$

D. $1.4 \times 10^5 Nm^{-2}$

Answer: D

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52. if quantity of heat 1163.4 J supplied to one mole of nitrogen gas , at room temperture at constant pressure , then the rise in temperature is

A. 54 K

B. 28 K

C. 65 K

D. 40 K

Answer: D

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53. using euipartion of energy, the specific heat $\left(\text{in} jkg^{-1}K^{-1}\right)$ of aluminium at room temperature can be estimated to be (atomic weigh of aluminium=27)

A. 410

B. 25

C. 1850

D. 925

Answer: D

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54. For a gas if ratio of specific heats at constant pressure and volume is g then value of degrees of freedom is

A. $\frac{3\gamma - 1}{2\gamma - 1}$

B. $\frac{2}{\gamma - 1}$

C. $\frac{9}{2}(\gamma - 1)$

D. $\frac{25}{2}(\gamma - 1)$

Answer: B

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55. One mole of an ideal monoatomic gas requires 207 J heat to raise the temperature by 10 K when heated at constant pressure. If the same gas is heated at constant volume to raise the temperature by the same 10 K, the heat required is [Given the gas constant R = 8.3 J/ mol. K]

A. 215.3 J

B. 198.7 J

C. 207 J

D. None of these

Answer: B

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56. Which of the given substances A B and C have more specific heat ?

A. A

B. B

C. C

D. Both (a) and (b)

Answer: C

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57. For the same rise in temperature of one mole of gas at constant volume , heat required for a non - linear tratomic gas is K times that required for monoatomic gas . The value of K is

A. 1

B. 0.5

C. 2

D. 2.5

Answer: C

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58. A gas expands with temperature according to the relation $V = KT^{\frac{2}{3}}$ .Work done when the temperature changes by 60K is.

A. 10 R

B. 30 R

C. 40 K

D. 20 K

Answer: C

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59. A system is taken through a cyclic proceses represented by a circle as shown in the figure. The heat absorbed by the system is

A. $\left(\pi \times 10^3\right) J$

B. $\left(\frac{\pi}{2}\right) J$

C. $\left(4\pi \times 10^2\right) J$

D. $(\pi) J$

Answer: B

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60. C_v for O_2 is $\frac{5}{2}R$ with increase in tempeature it becomes $\frac{7}{2}R$ due to a

A. translational motion

B. rotational motion

C. vibrational motion

D. None of these

Answer: C

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61. A given mass of a gas is compressed isothermally until its pressure is doubled. It is then allowed to expand adiabatically until its original voume is restored and its pressure is then found to be 0.75 of its initial pressure. The ratio of the specific heats of the gas is approximately.

A. 1.20

B. 1.41

C. 1.67

D. 1.83

Answer: B

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62. 310 J of heat is required to rise the temperature of 2 moles of an ideal gas at constant pressure from $25^\circ C$ to $35^\circ C$. The amount of heat required to raise the temperature of the gas through the same range at constant volume, is

A. 384 J

B. 144 J

C. 276 J

D. 452 J

Answer: B

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63. Two cylinders A and B fitted with pistons contain equal amounts of an ideal diatomic gas at 300K. The piston of A is free to move, while that B is held fixed. The same amount of heat is given to the gas in each cylinder. If the rise in temperature of the gas in A is 30K, then the rise in temperature of the gas in B is

A. 30 K

B. 18 K

C. 50 K

D. 42 K

Answer: D

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64. The ratio of the specific heats $\frac{C_p}{C_v} = \gamma$ in terms of degrees of freedom (n) is given by

A. $\left(1 + \frac{1}{n}\right)$

B. $\left(1 + \frac{n}{3}\right)$

C. $\left(1 + \frac{2}{n}\right)$

D. $\left(1 + \frac{n}{2}\right)$

Answer: C

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65. During an adiabatic process , the pressure p of a fixed mass of an ideal gas change by $\Delta p$and its volume V change by ΔV . If $\gamma = C_p / C_v$ then $\Delta V / V$ is given by

A. $-\frac{\Delta p}{p}$

B. $-\gamma\frac{\Delta p}{p}$

C. $-\frac{\Delta p}{\gamma p}$

D. $\frac{\Delta p}{\gamma^2 p}$

Answer: C

Watch Video Solution

66. A thermodynamic system is taken from state A to state B along ABC and is brought back to A along BDA as shown in figure . Net work done during one complete cycle is given by area

A. ACBDA

B. $ACB_{p_2p_1}A$

C. AV_1V_2BDA

D. $BDA_{P_1P_2}B$

Answer: A

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67. In a p-V diagram for an ideal gas (Where , p is along y-axis and V is along X- axis) , the value of the ratio "slope pof adiabatic curve/ Slope of the isothermal curve"at any point will be (Where symbols have their usual meanings).

A. 1

B. 2

C. C_p / C_v

D. C_v / C_p

Answer: C

Watch Video Solution

68. In the following p-v diagram figure two adiabates cut two isothermals at T_1 and T_2. The value V_b / V_c is

A. $= V_a / V_d$

B. $< V_a / V_d$

C. $> V_a / V_d$

D. Cannot say

Answer: A

View Text Solution

69. In the indicator diagram , T_a, T_b, T_c, T_d represents temperatures of gas at A,B,C,D respectively Which of the following is correct relation?

A. $T_a = T_b = T_c = T_d$

B. $T_a \neq T_b \neq T_c \neq T_d$

C. $T_a = T_b =$ and $T_c = T_d$

D. None of these

Answer: C

View Text Solution

70. During adiabatic expansion the increase in volume is associated with

A.	Pressure increase	Temperature increase
B.	Pressure decrease	Temperature decrease
C.	Pressure increase	Temperature decrease
D.	Pressure decrease	Temperature increase

Answer: B

Watch Video Solution

71. The change in the entropy of a 1 mole of an ideal gas which went through an isothermal process form an initial state (P_1, V_1, T) to the final state (P_2, V_2, T) is equal to

A. Zero

B. R In T

C. $R \ \ln\frac{V_1}{V_2}$

D. $R \ \ln\frac{V_2}{V_1}$

Answer: D

Watch Video Solution

72. At $27^\circ C$ a motor car tyre has pressure of 2 atmosphere. Find the temperautre. If the tyre suddenly bursts. (Given, $\gamma_{\text{air}} = 1.4$)

A. 246.1 K

B. 250 K

C. 290 K

D. 248 K

Answer: A

Watch Video Solution

73. A gas is compressed at a constant pressure of $50N/m^2$ from a volume $10m^3$ to a volume of $4m^3$. 100J of heat is added to the gas then its internal energy is

A. increased by 400 J

B. increased by 200 J

C. inceased by100 J

D. decreased by 200 J

Answer: A

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74. Figure shows four p-V diagrams . Which of these curves represent isothermal and adiabatic process?

A. D and C

B. A and C

C. A and B

D. B and D

Answer: A

View Text Solution

75. A gas at pressure P is abiabatically compressed so that its density becomes twice that of initial value. Given that $\gamma = C_p / C_v = (7/5)$, What will be the final pressure of the gas ?

A. $2p$

B. $\frac{7}{5}$

C. 2.63 p

D. p

Answer: C

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76. If an average jogs, he produces 14.5×10^3 cal/min. This is removed by the evaporation of sweat. The amount of sweat evaporated per minute (assuming 1 kg requires 580×10^3 cal for evaporation) is

A. 0.25 kg

B. 2.25 kg

C. 0.05 kg

D. 0.20 kg

Answer: A

Watch Video Solution

77. Figure shows a thermodynamic process on one mole of a gas . How does the work done in the process changes with time ?

A. decreases continuously

B. increases continuously

C. remains constant

D. first increases and then decreases

Answer: B

View Text Solution

78. A cyclic process is shown is shown in figure . Work done during isobaric expansion is

A. 1600 J

B. 100 J

C. 400 J

D. 600 J

Answer: C

View Text Solution

79. When $1kg$ of ice at $0^\circ C$ melts to water at $0^\circ C$, the resulting change in its entropy, taking latent heat of ice to be $80cal/g$ is

A. $8 \times 10^4 \text{cal} \quad K^{-1}$

B. $80 \quad \text{cal} \quad K^{-1}$

C. $293 \quad \text{cal} \quad K^{-1}$

D. $273 \quad \text{cal} \quad K^{-1}$

Answer: C

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80. Two temperature scales A and B are related by :

$$\frac{A-42}{110}=\frac{B-72}{220}$$

At which temperature two scales have the same reading ?

A. -42°

B. -72°

C. $+12^{\circ}$

D. -40°

Answer: C

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81. At ordinary temperatures, the molecules of an ideal gas have only translational and rotational kinetic energies. At high temperatures they

may also have vibrational energy.

As a result of this, at higher temperature

A. $C_v = \frac{3}{2}R$ for a monoatomic gas

B. $C_v > \frac{3}{2}R$ for a monoatomic gas

C. $C_v < \frac{3}{2}R$ for a diatomic gas

D. $C_v = \frac{5}{2}R$ for a diatomic gas

Answer: A

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82. In a certain process, 400 cal of heat are supplied to a system and the same time 105 J of mechanical work done on the system . The increase in its internal energy is

A. 20 cal

B. 303 cal

C. 404 cal

D. 425 cal

Answer: D

Watch Video Solution

83. A gas is expanded from volume V_0 to $2V_0$ three different processes shown in figure.

Process 1 is isobaric process, 2 is isothermal and process 3 is adiabatic . Let $\Delta U_1, \Delta U_2$ and ΔU_3 be the change in internal energy of the gas in these three 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. $\Delta U_2 < \Delta U_3 > \Delta U_1$

Answer: A

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84. What is the nature of change in internal energy in the following three thermodynamic processes shown in figure ?

A. ΔU is positive in all the three cases

B. ΔU is negative in all the three cases

C. ΔU is positive for (i),negative for (ii), Zero for (iii)

D. $\Delta U = 0$, in all the cases

Answer: D

View Text Solution

85. $1cm^3$ of water at its boiling point absorbs $540cal$ of heat to become steam with a volume of $1671cm^3$. If the atmospheic pressure is

$1.013 \times 10^5 N/m^2$ and the mechanical equivalent of heat $= 4.19 J/cal$, the energy spent in this process in overcoming intermolecular forces is

A. 540 cal

B. 40 cal

C. 500 cal

D. zero

Answer: C

Watch Video Solution

86. Five moles of hydrogen $(\gamma = 7/5)$, initially at STP, is compressed adiabatically so that its temperature becomes $400^\circ C$. The increase in the internal energy of the gas in kilojules is $(R = 8.30 J/mol - K)$

A. 21.55

B. 41.55

C. 65.55

D. 50.55

Answer: B

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87. Three copper blocks of masses M_1, M_2 and $M_3 kg$ respectively are brought into thermal contact till they reach equlibrium. Before contact, they were at $T_1, T_2, T)(3), (T_1 > T_2 > T_3)$. Assuming there is no heat loss to the surroundings, the equilibrium temperature T is $(sisspec \text{ if } icheatofcopper)$

A. $T = \frac{T_1 + T_2 + T_3}{3}$

B. $T = \frac{M_1T_1 + M_2T_2 + M_3T_3}{M_1 + M_2 + M_3}$

C. $T = \frac{M_1T_1 + M_2T_2 + M_3T_3}{3(M_1 + M_2 + M_3)}$

D. $T = \frac{M_1T_1s + M_2T_2s + M_3T_3s}{M_1 + M_2 + M_3}$

Answer: B

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88. A gas is suddenly compressed to $\frac{1}{4}th$ of its original volume. Caculate the rise in temperature when original temperature is $27^\circ C$. $\gamma = 1.5$.

A. $300^\circ C$

B. $350^\circ C$

C. $400^\circ C$

D. $450^\circ C$

Answer: A

Watch Video Solution

89. A cylinder of fixed capacity (of 44.8 L) contains 2 moles of helium gas at STP .What is the amount of heat needed to raise the temperature of the gas in the cylinder by $20^\circ C$? $\left(\text{Use} R = 8.31 J \text{mol}^{-1} K^{-1}\right)$

A. 996 J

B. 831 J

C. 498 J

D. 374 J

Answer: C

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90. The temperature of sink of Carnot engine is $27^\circ C$. Efficiency of engine is $25\ \%$. Then temeperature of source is

A. $227^\circ C$

B. $27^\circ C$

C. $327^\circ C$

D. $127^\circ C$

Answer: D

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91. Choose the incorrect statement from the following:

S1: The efficiency of a heat engine can be 1, but the coefficient of performance of a refrigerator can never be infinity

S2: The first law of thermodynamics is basically the principle of conservation of energy

S3: The second law of thermodynamics does not allow several phenomena consistent with the first law

S4: A process, whose sole result is the transfer of heat from a colder object to hotter object is impossible

A. S1

B. S3

C. S2

D. S4

Answer: A

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92. The temperature -entropy diagram of a reversible engine cycle is given in the figure.Its efficiency is

A. $1/2$

B. $1/4$

C. $1/3$

D. $2/3$

Answer: C

View Text Solution

93. A carnot's engine works between a source at a temperature of $27^\circ C$ and a sink at $-123^\circ C$. Its efficiency is

A. 0.5

B. 0.25

C. 0.75

D. 0.4

Answer: A

Watch Video Solution

94. A engine has an efficiency of $1/3$. The amount of work this engine can perform per kilocalorie of heat input is

A. 1400 cal

B. 700 cal

C. 700 J

D. 1400 J

Answer: D

Watch Video Solution

95. The coeffcient of performance of a refrigerator working between $10^{\circ} C$ and $20^{\circ} C$ is

A. 28.3

B. 29.3

C. 2

D. Cannot be calculated

Answer: A

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96. A Carnot engine used first ideal monoatomic gas and then an ideal diatomic gas , if the source and sink temperatures are $411^{\circ} C$ and $69^{\circ} C$,respectively and the engine extracts 1000 J of heat from the source in each cycle , then

A. area enclosed by the p-V diagram is 10 J

B. heat energy rejected by engine is 1 st case is 600 J while that in 2 nd case in 113 J

C. area enclosed by the p-V diagram is 500 J

D. efficiencies of the engine in both the cases are in the ratio 21 : 25

Answer: C

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97. A body having $110 \text{ and } 70^{\circ}C$ temperatures of surrounding and of itself repectively . What would be the value of coefficient of performance ?

A. 1.75

B. 2.3

C. 1.50

D. 2.55

Answer: A

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98. What is the source temperature of the carnot engine reuired to get 70 % efficiency ?

A. $1000^\circ C$

B. $90^\circ C$

C. $270^\circ C$

D. $727^\circ C$

Answer: D

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99. A carnot engine operates with source at $127^\circ C$ and sink at $27^\circ C$. If the source supplies $40kJ$ of heat energy. The work done by the engine is

A. 30 kJ

B. 10 kJ

C. 4 kJ

D. 1 kJ

Answer: B

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100. A carnot engine has efficiency $1/5$. Efficiency becomes $1/3$ when temperature of sink is decreased by 50 K What is the temperature of sink ?

A. 325 K

B. 375 K

C. 300 K

D. 350 K

Answer: C

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101. A Carnot engine, whose efficiency is $40\ \%$, takes in heat from a source maintained at a temperature of 500K. It is desired to have an engine of efficiency $60\ \%$. Then, the intake temperature for the same exhaust (sink) temperature must be:

A. 700 K

B. 900 K

C. 800 K

D. 600 K

Answer: D

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102. A Carnot engine, whose efficiency is $40\,\%$, takes in heat from a source maintained at a temperature of 500K. It is desired to have an engine of efficiency $60\,\%$. Then, the intake temperature for the same exhaust (sink) temperature must be:

A. efficiency of carnot engine cannot be made larger than 50 %

B. 1200 K

C. 750 K

D. 600 K

Answer: C

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103. A refrigerator works between temperature of melting ice and room temperatures $(17^{\circ}C)$. The amount of energy (in kWh) that must be supplied to freeze I kg of water at $0^{\circ}C$ is

A. 1.4

B. 1.8

C. 0.058

D. 2.5

Answer: C

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104. A Carnot engine whose source is at 400 K takes 200 cal of heat and reject 150 cal to the sink . What is the temperature of the sink ?

A. 800 K

B. 400 K

C. 300 K

D. Cannot say

Answer: A

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105. A Carnot's engine has an efficiency of 50 % at sink temperature $50^\circ C$ .Calculate the temperature of source.

A. $133^\circ C$

B. $143^\circ C$

C. $100^\circ C$

D. $373^\circ C$

Answer: D

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106. An ideal gas heat engine operates in a carnot cycle between $227^\circ C$ and $127^\circ C$ .It absorbs 6 kcal at the higher temperature. The amount of heat (in kcal converted into work is equal to

A. 1.6

B. 1.2

C. 4.8

D. 3.5

Answer: B

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107. A Carnot reversible engine converts $1/6$ of heat input into work . When the temperature of the sink is reduced by 62 K, the efficiency of carnot's cycle becomes $1/3$. The temperature of the source and sink will be

A. 372 K,310 K

B. 181 K,150 K

C. 472 K.410 K

D. None of these

Answer: A

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108. Consider the statement (A) and (B) and identify the carrect answers.

A . First law of thermodynamics specifics the consitions under which a body can use its heat energy to produce the work.

B. Second law of thermodynamics states that heat always flows from haot body to cold body the itself .

A. Both A and B are true

B. Both A and B are false

C. A is true but B is false

D. A is false B is true

Answer: A

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109. Solar radiation emitted by sun resembles that emitted by a body at a temperature of $6000K$ Maximum intensity is emitted at a wavelength of about $4800A^{\circ}$ If the sun was cooled down from $6000K$ to $3000K$ then the peak intensity would occure at a wavelenght of .

A. $4800Å$

B. $9600Å$

C. $2400Å$

D. $19200Å$

Answer: B

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110. The energy emitted per second by a black body at $27^{\circ}C$ is 10 J. If the temperature of the black body is increased to $327^{\circ}C$, the energy emitted per second will be

A. 20 J

B. 40 J

C. 80 J

D. 160 J

Answer: D

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111. The temperature of coffee in a cup with time is most likely given by then curve in the figure.

A. 

B. 

C. 

D. 

Answer: C

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112. A surface at temperature $T_0 K$ receives power P by radiation from a small sphere at temperature $T < T_0$ and at a distance d. If both T and d are doubled the power received by the surface will become .

A. P

B. $2P$

C. $4P$

D. $16P$

Answer: C

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113. Consider a black body radiation in a cubical box at absolute temperature T. If the lengh of each side of the box is doubled and the temperature of the walls of the box and that of the radiation is halved then the total energy

A. halves

B. doubles

C. quadruples

D. remains constant

Answer: D

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114. When a gas filled in a closed vessel is heated through $1^{\circ}C$, its pressure increases by 0.4%. What is the initial temperature of gas ?

A. 250 K

B. 2500 K

C. $250^{\circ}C$

D. $25^{\circ}C$

Answer: A

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115. An inflated rubber balloon contains one mole of an ideal gas has a pressure p, volume V and temperature T. if the temperature rises to 1.1 T, and the volume is increased to 1.05 V, the final pressure will be

A. 1.1 P

B. p

C. less than p

D. between p and 1.1 p

Answer: D

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116. The total radiant energy per unit area, normal to the direction of incidence, received at a distance R from the centre of a star of radius r whose outer surface radiates as a black body at a temperature TK is

given by

(where σ is Stefan's constant)

A. $\frac{\sigma r^2 T^4}{R^2}$

B. $\frac{\sigma r^2 T^4}{4\pi r^2}$

C. $\frac{\sigma r^4 T^4}{r^4}$

D. $\frac{4\pi\sigma r^2 T^4}{R^2}$

Answer: A

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117. At $273^\circ C$,the emissive power of a perfect black body is R . What is its value $0^\circ C$?

A. $\frac{R}{4}$

B. $\frac{R}{16}$

C. $\frac{R}{2}$

D. None of these

Answer: B

Watch Video Solution

118. A black body at $227^\circ C$ radiates heat at the rate of $7 cal cm^{-2} s^{-1}$. At a temperature of $727^\circ C$, the rate of heat radiated in the same unit will be

A. 60

B. 50

C. 112

D. 80

Answer: C

Watch Video Solution

119. The rate of emission of a black body at $0^\circ C$ is its rate of emission at $273^\circ C$ is

A. 4 R

B. 8 R

C. 16 R

D. 32 R

Answer: C

Watch Video Solution

120. Two spherical black bodies of radii R_1 and R_2 and with surface temperature T_1 and T_2 respectively radiate the same power. R_1 / R_2 must be equal to

A. $\left(\frac{T_2}{T_1}\right)^2$

B. $\left(\frac{T_2}{T_1}\right)^4$

C. $\left(\frac{T_1}{T_2}\right)^2$

D. $\left(\frac{T_1}{T_2}\right)^4$

Answer: A

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121. A solid cube and a solid sphere of the same material have equal surface area. Both are at the same temperature $120^\circ C$, then

A. Both of themwill cool down at the same rate

B. the cube will cool down faster than the sphere

C. the sphere will cool down faster than the cube

D. whichever of the two is heavier will cool down faster

Answer: A

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122. Two gases A and B having the same temperature T, same pressure P and same volume V are mixed. If the mixture is at the same temperature and occupies a volume V. The pressure of the mixture is

A. $2P$

B. p

C. $p/2$

D. $4p$

Answer: A

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123. The rectangular surface of area $8cm \times 4cm$ of a black body at temperature $127^\circ C$ emits energy E per section if length and breadth are reduced to half of the initial value and the temperature is raised to $327^\circ C$, the ratio of emission of energy becomes

A. $\frac{3}{81}E$

B. $\frac{81}{6}E$

C. $\frac{9}{16}E$

D. $\frac{81}{64}E$

Answer: B

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124. The air density at mount Everest is less than that at the sea level . It is found by mountainers that for one trip lasting few hours , the extra oxygen needed by them corresponds to 30000 cc at sea level (pressure 1 atm , temperature $27^\circ C$). Assuming that the temperature around Mount Everested is $-73^\circ C$ and that the pressure at which oxygen be filled (at site) in the cylinder is

A. 3.86 atm

B. 5.00 atm

C. 5.77atm

D. 1 atm

Answer: A

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125. The temperature of a black body is increased by 50% , then the percentage of increases of radiation is approximetaly

A. 100 %

B. 25 %

C. 400 %

D. 500 %A

Answer: C

Watch Video Solution

126. The frequency (v_m) corresponding to which energy emitted by a black body is maximum may very with temperature T of the body as shown in figure. With of the curves represents correct variation ?

A. A

B. B

C. C

D. D

Answer: A

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127. A kettle with 2 litre water at $27^\circ C$ is heated by operating coil heater of power 1 kW. The heat is lost to the atmosphere at constant rate $160 J/s$, when its lid is open. In how much time will water heated to $77^\circ C$ with the lid open ? (specific heat of water = $4.2 kJ/^\circ C.\, kg$)

A. 5 min 40 s

B. 10 min 20 s

C. 8 min 20 s

D. 16 min 10 s

Answer: C

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128. An object is cooled from $75^\circ C$ to $65^\circ C$ in 2 min in a room at $30^\circ C$. The time taken to cool the same object from $55^\circ C$ to $45^\circ C$ in the same room is

A. 4

B. 5

C. 6

D. 7

Answer: A

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129. A planet is at an average distance d from the sun and its average surface temeperature is T. Assume that the planet receives energy only from the sun and loses energy only through radiation from the surface. Neglect atmospheric effects. If $T \propto d^{-n}$, the value of n is

A. 2

B. 1

C. $1/2$

D. $1/4$

Answer: C

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130. The power of black body at temperature 200 K is 544 W .Its surface area is

$\left(\sigma = 5.67 \times 10^{-8} Wm^{-2} K^{-2}\right)$

A. $6 \times 10^{-2} m^2$

B. $6m^2$

C. $6 \times 10^{-6} m^2$

D. $6 \times 10^{2} m^2$

Answer: B

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131. The wavelength of maximum intensity of radiation emitted by a star is 289.8 nm . The radiation intensity for the star is : (Stefan's constant $5.67 \times 10^{-8} Wm^{-2} K^{-4}$, constant $b = 2898 \mu mK$)-

A. $5.67 \times 10^{8} Wm^{-2}$

B. $5.67 \times 10^{-12} Wm^{-2}$

C. $10.67 \times 10^{-7} Wm^{-2}$

D. $10.67 \times 10^{-14} Wm^{-2}$

Answer: A

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132. A body cools from $80^{\circ} C$ to $50^{\circ} C$ in 5 min-utes Calculate the time it takes to cool from $60^{\circ} C$ to $30^{\circ} C$ The temperature of the surroundings is $20^{\circ} C$.

A. 9 min

B. 7 min

C. 8 min

D. 10min

Answer: A

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Exercise 2

1. A monoatomic ideal gas, initially at temperature T_1, is enclosed in a cylinder fitted with a friction less piston. The gas is allowed to expand adiabatically to a temperature T_2 by releasing the piston suddenly. If L_1 and L_2 are the length of the gas column before expansion respectively, then $\frac{T_1}{T_2}$ is given by

A. $\left(\frac{L_1}{L_2}\right)^{2/3}$

B. $\left(\frac{L_1}{L_2}\right)$

C. $\left(\frac{L_2}{L_1}\right)$

D. $\left(\frac{L_2}{L_1}\right)^{2/3}$

Answer: D

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2. Consider p_V diagram for an ideal gas shown in figure

Out of the following diagrams which represents the T-p diagram ?

A. 

B. 

C. 

D. 

Answer: C

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3. Equal masses of two liquids A and B contained in vessels of negligible heat capacity are supplied heat at the same rate . The temperature-time graphs for the two liquids are shown in the figure . If s represents specofic heat and L represents latent heat of liquid, then

A. $S_A > S_B, L_A < L_B$

B. $S_A > S_B, L_A > L_B$

C. $S_A < S_B, L_A < L_B$

D. $S_A < S_B, L_A > L_B$

Answer: D

View Text Solution

4. The pressure inside a tyre is 4 atm at $27^\circ C$.If the tyre bursts suddenly, its final temperature will be

A. $300(4)^{7/2}$

B. $300(4)^{2/7}$

C. $300(2)^{7/2}$

D. $300(4)^{-2/7}$

Answer: D

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5. P-V diagram of a diatomic gas is a straight line passing through origin. The molar heat capacity of the gas in the process will be

A. 4 R

B. 3 R

C. $4R/3$

D. 2.5 R

Answer: B

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6. One mole of an ideal monoatomic gas is heated at a constant pressure of 1 atmosphere from 0° C to $100^{\circ 0}$C. Work done by the gas is

A. $8.31 \times 10^3 J$

B. $8.31 \times 10^{-3} J$

C. $8.31 \times 10^{-2} J$

D. $8.31 \times 10^{2} J$

Answer: D

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7. Diatomic molecules like hydrogen haven energy due to both translational as well as rotational motion. From the equation in kinetic theory $PV = \frac{2}{3}E$, E is

A. the total energy per uint volume

B. only the translation part of energy because rotational energy is very smaal compared to the trastinal energy

C. only the traslational part of the energy becouse during collisions with the well, pressure ralated to change in linear momentum

D. the translational part of the energy because rotational energies of molecules can be o feither sign and its average over all the molecules is zero

Answer: C

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8. Three designs are proposed for an engine which is to operate between 300 K and 500 K. design A is claimed to produced 3000 J of work per kcal of heat input, B is claimed to produced 2000 J and C , 1000 J. which design would you choose ? Given 1 kcal =4185 J

A. A only

B. B only

C. All

D. C only

Answer: D

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9. Two moles of helium are mixed with n moles of hydrogen. The root mean spure (rms) speed of the gas molecules in the mexture is $\sqrt{2}$ times the speed of sound in the mixture. Then value of n is

A. 1

B. $3/2$

C. 2

D. 3

Answer:

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10. An ideal gas is taken from the state A (pressure p, volume V) to the state B (pressure $\frac{p}{2}$, volume 2V) along a straight line path in the p-V diagram. Select the correct statement(s) from the following.

A. The work done by the gas in the process A to B , excceds the work that would be done by it if system were taken along the isothermal

B. In the T-V diagram , the path AB becomes a part of a hyperbola

C. IN the p-T diagram , the path AB becomes a part of a hyperbola

D. IN going from A to B , the temperature T of the gas first decreases to a minimum value and then increases

Answer: A

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11. A stream engine delivers $5.4 \times 10^8 J$ of work per minute and absorbs $3.6 \times 10^9 J$ of heat per minute from its boiler. What is the efficiency of

the engine? How much heat is wasted per minute?

A. $3.1 \times 10^9 \text{min}^{-1}$

B. $2 \times 10^9 \text{min}^{-1}$

C. $4 \times 10^9 \text{min}^{-1}$

D. $6 \times 10^9 \text{min}^{-1}$

Answer: B

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12. Which one of the following would reaise the temperature of 40 g of water at 20° C most when mixed with?

A. 40 g of water at $20^\circ C$

B. 30 g of water at $30^\circ C$

C. 10 g of water at $60^\circ C$

D. 4 g of water $100^\circ C$

Answer: C

Watch Video Solution

13. Two plates of same thickess with thermal conductivities k_1 and k_2 and area of cross - sections A_1 and A_2 are connected (as shown in figure) for heat conduction . The equivalent coefficient of thermal conductivity (k) will be

A. $k_1 + k_2$

B. $\frac{k_1 + A_2}{A_1} + \frac{k_2 + A_1}{A_2}$

C. $\frac{k_1 + A_1}{A_1 + A_2} + \frac{k_2 A_2}{A_2 + A_2}$

D. $\frac{k_1 + A_2}{A_1 + A_2} + \frac{k_2 A_1}{A_1 + A_2}$

Answer: C

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14. If temperature of black body increases from $300K$ to $900K$, then the rate of energy radiation increases by

A. 81

B. 3

C. 9

D. 2

Answer: A

Watch Video Solution

15. Hot water cools from $60^\circ C$ to $50^\circ C$ in the first 10 min and to $42^\circ C$ in the next 10 min. The temperature of the surrounding is

A. $10^\circ C$

B. $15^\circ C$

C. $20^\circ C$

D. $30^\circ C$

Answer: A

Watch Video Solution

16. One mole of a monoatomic ideal gas is mixed with one mole of a diatomic ideal gas . The molar specific heat of the mixture at constant volume is

A. $(3/2)R$

B. $(5/2)$

C. 2 R

D. 4 R

Answer: C

Watch Video Solution

17. At what temperature the molecule of nitrogen will have same rms velocity as the molecule of oxygen at $127^\circ C$?

A. $457^\circ C$

B. $273^\circ C$

C. $350^\circ C$

D. $77^\circ C$

Answer: D

Watch Video Solution

18. At what temperature the rms velocity of helium molecules will be equal to that of hydrogen molecules at NTP ?

A. 844 k

B. 64 k

C. $273^\circ c$

D. 273 k

Answer: C

Watch Video Solution

19. One mole of an ideal diatomic gas undergoes a transition from A to B along a path AB as shown in the figure .

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The change in internal energy of the gas during the transition is

A. 20kJ

B. $-20kJ$

C. 20 J

D. $-12kJ$

Answer: B

View Text Solution

20. The radiation emitted by a star A is 1000 times that of the sun. If the surface temperature of the sun and star A are $6000K$ and $2000K$ respectively. The ratio of the radii of the star A and the sun is:

A. $1200:1$

B. $900:1$

C. $600:1$

D. $300:1$

Answer: B

Watch Video Solution

21. Three objects coloured black, gray and white can withstand hostile conditions upto $2800^\circ C$. These objects are thrown into a furance where each of them attains a temperature of $2000^\circ C$. Which object will glow brightest?

A. White object

B. Black object

C. All glow with equal brightness

D. Grey object

Answer: B

Watch Video Solution

22. Temperature of two stars are in the ratio 3 : 2 . If wavelenghth for the maximum intensity of the first body is 4000Å , what is the corresponding wavelenghth of the second body ?

A. 9000Å

B. 6000Å

C. 2000Å

D. 8000Å

Answer: B

Watch Video Solution

23. Two slabs A and B of different materials but with the same thickness are joined as Shown in the figure. The thermal conductivites of A and B are k_1 and K_2 respectively . The thermal conductivity of the composite slab will be

A. $\frac{1}{2}(K_1 + K_2$

B. $\sqrt{K_1 K_2}$

C. $(K_1 + K_2)$

D. $\frac{2K_1 K_2}{(K_1 + K_2)}$

Answer: D

View Text Solution

24. A black body radiates heat at temperatures T_1 and $T_2(T_2 > T_1$ the frequency corresponding to maxium energy is

A. less at T_1

B. more at T_1

C. equal in the two cases

D. cannot say

Answer: A

Watch Video Solution

25. An ideal monotonic gas is taken round the cycle ABCDA as shown in following p-V diagram . The work done during the cycle is

A. pV

B. 2pV

C. 4pV

D. zero

Answer: C

View Text Solution

26. An ideal gas of mass m in a state A goes to another state B via three different processes as shown in figure. If Q_1, Q_2 and Q_3 denote the heat absorbed by the gas along the three paths , then

A. $Q_1 < Q_2 < Q_3$

B. $Q_1 < Q_2 = Q_3$

C. $Q_1 = Q_2 > Q_3$

D. $Q_1 > Q_2 > Q_3$

Answer: A

View Text Solution

27. The specific heat of hydrogen gas at constant pressure is $C_P = 3.4 \times 10^3 \text{cal}/kg^\circ C$ and at constant volume is $C_V = 2.4 \times 10^3 \text{cal}/kg^\circ C$. If one kilogram hydrogen gas is heated from $10^\circ C$ to $20^\circ C$ at constant pressure the external work done on the gas to maintain it at cosntant pressure is

A. 10^6cal

B. 10^4cal

C. 10^3cal

D. $5 \times 10^3 \text{cal}$

Answer: B

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28. In which mode of tranmission , the heat waves travel along straight line with the speed of light?

A. Thermal radiation

B. Forced convection

C. Natural convection

D. Thermal conduction

Answer: A

Watch Video Solution

29. A cane is taken out from a refrigerator at $0^\circ \mathrm{C}$. The atmospheric temperature is $25^\circ \mathrm{C}$. If t1 is the time taken to heat from $0^\circ \mathrm{C}$ to $5^\circ \mathrm{C}$ and t_2 is the time taken from $10^\circ \mathrm{C}$ to $15^\circ \mathrm{C}$, then the wrong statements are

(1) $t_1 > t_2$

(2)$t_1 = t_2$

(3) There is no relation

(4)$t_1 < t_2$

A. $t_1 > t_2$

B. $t_1 < t_2$

C. $t_1 = t_2$

D. there is no relation

Answer: B

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30. Three perfect gases at absolute temperature T_1, T_2 and T_3 are mixed. The masses f molecules are m_1, m_2 and m_3 and the number of molecules are n_1, n_2 and n_3 respectively. Assuming no loss of energy, the final temperature of the mixture is

A. $\frac{n_1T_1 + n_2T_2 + n_3T_3}{n_1 + n_2 + n_3}$

B. $\frac{n_1T_1^2 + n_2T_2^2 + n_3T_3^3}{n_1T_1 + n_2T_2 + n_3T_3}$

C. $\frac{n_1^2T_1^2 + n_2^2T_2^2 + n_3^2T_3^2}{n_1T_1 + n_2T_2 + n_3T_3}$

D. $\frac{T_1 + T_2 + T_3}{3}$

Answer: A

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31. Aperfect gas at $27^\circ C$ is heated at constant pressure soas to duuble its volume. The increase in temperature of the gas will be

A. $300^\circ C$

B. $54^\circ C$

C. $327^\circ C$

D. $600^\circ C$

Answer: A

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32. The pressure of a gas filled in a closed vessel increase by 0.4% when temperature is increased by $1^\circ C$. Find the initial temperature of the gas.

A. 100K

B. $273^\circ C$

C. $100^\circ C$

D. 200K

Answer: A

Watch Video Solution

33. One mole of gas occupies a volume of 200 mL at 100 mm pressure . What is the volume occupied by two mole of gas at 400 mm pressure and at same temperature ?

A. 50 mL

B. 100 mL

C. 200 mL

D. 400 mL

Answer: B

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34. For a real gas (van der Waal's gas)

A. Boyle temperature is a /Rb

B. Critical temperature is a /Rb

C. Triple temperture is a 2a/Rb

D. Inversions temperature is a /2Rb

Answer: A

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35. Six molecules speed 2 unit , 5 unit , 3unit, 6 unit, 3 unit , and 5unit , respectively . The rms speed is

A. 4 unit

B. 1.7 unit

C. 4.2 unit

D. 5 unit

Answer: C

Watch Video Solution

36. The root mean square velocity of gas molecules at $27^\circ C$ is $1365ms^{-1}$ .The gas is

A. O_2

B. He

C. N_2

D. CO_2

Answer: B

Watch Video Solution

37. If mass of He is 4 times that of hydrogen , then mean volocity of He is

A. 2 times of H-mean value

B. $\frac{1}{2}$times of H-mean value

C. 4 times of H- mean value

D. same as H-mean value

Answer: B

Watch Video Solution

38. By what factor the rms velocity will change, if the temperature s raised from $27^\circ C$ to $327^\circ C$?

A. $\sqrt{2}$ times

B. 2 times

C. $2\sqrt{2}$times

D. 4 times

Answer: A

Watch Video Solution

39. If one mole of a monatomic gas $\left(\gamma = \frac{5}{3}\right)$ is mixed with one mole of a diatomic gas $\left(\gamma = \frac{7}{5}\right)$, the value of gamma for mixture is

A. 1.40

B. 1.50

C. 1.53

D. 3.07

Answer: B

Watch Video Solution

40. A bubble of 8 moles of helium is submerged at a certain depth in water. The temperature of water increases by $30^{\circ}C$ How much heat is added approximately to helium during expansion ?

A. 4000 J

B. 3000 J

C. 3500 J

D. 4500 J

Answer: B

View Text Solution

41. Six moles of O_2 gas is heated from $20^\circ C$ to $35^\circ C$ at constant volume . If specific heat capacity at constant pressure is $8\ \text{cal mol}^{-1} - K^{-1}$ and $R = 8.31\text{J mol}^{-1} - K^{-1}$, what is change in internal energy of gas ?

A. 180 Cal

B. 300 cal

C. 360 cal

D. 540 cal

Answer: D

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42. A black body at a high temperature T radiates energy at the rate of U (in Wm^{-2}). When the temperature falls to half (I e . $\frac{T}{2}$) the radiated energy (in Wm^{-2}) will be

A. $\frac{U}{8}$

B. $\frac{U}{16}$

C. $\frac{U}{4}$

D. $\frac{U}{2}$

Answer: B

Watch Video Solution

43. An ideal Black-body at room temperature is thrown into a furnace. It is observed that

A. it is the darkest body at all times

B. it cannot be distinguished at all times

C. initially it is the darkest body and later it become brightest

D. initially it is the darkest body and later it cannot be distinguished

Answer: C

Watch Video Solution

44. A container with insulating walls is divided into two equal parts by a partition fitted with a valve. One part is filled with an ideal gas at a pressure P and temperature T, whereas the other part is completely evacuated . If the valve is suddenly opened, the pressure and temperature of the gas will be

A. $\frac{p}{2}, T$

B. $\frac{p}{2}, \frac{T}{2}$

C. p,T

D. $p, \frac{T}{2}$

Answer: A

Watch Video Solution

45. If universal gas constant is R, the essential heat to increase from K to 473 K at constant volume for ideal gas of 4 moles is

A. 200 R

B. 400 R

C. 800 R

D. 1200 R

Answer: D

Watch Video Solution

46. An ideal gas is expanding such that $PT^2 =$ constant. The coefficient of volume expansion of lthe gas is:

A. $\frac{1}{T}$

B. $\frac{2}{T}$

C. $\frac{3}{T}$

D. $\frac{4}{7}$

Answer: C

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47. If the rms velocity of gas is v , then

A. v^2T = constant

B. v^2/T = constant

C. vT^2=constant

D. v is independent of T

Answer: B

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48. A Carnot engine has the same efficiency between $800K$ to $500K$ and $xK \to 600K$. The value of x is

A. 100 K

B. 960 K

C. 846 K

D. 754 K%

Answer: B

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49. A constant temperature , the volume of a gas is to be decreased by 4 % The pressure must be increased by

A. 0.04

B. 0.0416

C. 0.08

D. 0.0386

Answer: B

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50. A mass of dry air at NTP is compressed to (1)/(20)th of its original volume suddenly . If $\gamma = 1.4$, the final pressure would be

A. 20 atm

B. 66.28 atm

C. 30 atm

D. 150 atm

Answer: B

Watch Video Solution

Mht Cet Corner

1. Assuming the expression for the pressure exerted by the gas on the walls of the container, it can be shown that pressure is

A. $\left[\frac{1}{3}\right]^{rd}$ kinetic energy per unit volume of a gas

B. $\left[\frac{2}{3}\right]^{rd}$ kinetic energy per unit volume of a gas

C. $\left[\frac{3}{4}\right]^{rd}$ kinetic energy per unit volume of a gas

D. $\frac{3}{2} \times$ kinetic energy per unit volume of a gas

Answer: B

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2. A black rectangular surface of area A emits energy E per second at $27^{\circ}C$. If length and breadth are reduced to one third of initial value and temperature is raised to $327^{\circ}C$, then energy emitted per second becomes

A. $\frac{4E}{9}$

B. $\frac{7E}{9}$

C. $\frac{10E}{9}$

D. $\frac{16E}{9}$

Answer: D

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3. For a gas $\frac{R}{C_V}$ = 0.4, where R is the universal gas constant and C, is molar specific heat at constant volume. The gas is made up of molecules which are

A. rigid diatomic

B. monoatomic

C. non-rigid diatomic

D. polyatomic

Answer: A

Watch Video Solution

4. A black body radiates heat at temperatures T_1 and $T_2(T_2 > T_1$ the frequency corresponding to maxium energy is

A. more at T_1

B. more ar T_2

C. equal for T_1 and T_2

D. independent of T_1 and T_2

Answer: B

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5. Gases excert pressure on the walls of the container , because the gas molecules

A. have finite volume

B. obey Boyle's law

C. possess momentum

D. collide with one another

Answer: C

Watch Video Solution

6. A gas is compressed isothermally . The rms velocity of its molecules

A. increases

B. decreases

C. first increases and then decreases

D. remains the same

Answer: D

Watch Video Solution

7. In the given (V-T) diagram , what is the relation between pressures P_1 and P_2 ?

A. $P_1 = P_2$

B. $P_1 > P_2$

C. $P_1 < P_2$

D. Cannot be predicted

Answer: C

View Text Solution

8. The molar specific heat of an ideal gas at constant pressure and constant volume is C_p and C_v respectively. If R is the universal gas constant and the ratio of C_p to C_v is γ, then C_v.

A. $\frac{1+\gamma}{1-\gamma}$

B. $\frac{R}{(\gamma-1)}$

C. $\frac{(\gamma-1)}{R}$

D. γR

Answer: B

Watch Video Solution

9. A piece of iron is heated in a flame. It first becomes dull red then becomes reddish yellow and finally turns to white hot. The correct explanation for the above observation is possible by using.

A. Setfan's law

B. Wien's displacement law

C. Kirchhoff's law

D. Newton 's law of cooling

Answer: B

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10. During an adiabatic process, the pressure of gas is found to be proportional to the cube of its absolute temperature. The ratio of $(C_{p,m}/C_{v,m})$ for gas is :

A. $\frac{4}{3}$

B. 2

C. $\frac{5}{3}$

D. $\frac{3}{2}$

Answer: D

Watch Video Solution

11. A black body at a temperature of $227^\circ C$ radiates heat energy at the rate of 5 cal/cm^2-sec. At a temperature of $727^\circ C$, the rate of heat radiated per unit area in cal/cm^2-sec will be

A. 80

B. 160

C. 250

D. 500

Answer: A

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12. A vessel is filled with an ideal gas at a pressure of 10 atmospheres and temp 27^0C. Half of the mass of the gas is removed from the vessel the temperature of the remaining gas is increased to 87^0C. Then the pressure of the gas in the vessel will be

A. 5 atm

B. 6 atm

C. 7 atm

D. 8 atm

Answer: B

Watch Video Solution

13. KE per unit volume is E. The pressure exerted by the gas is given by

A. $\frac{E}{3}$

B. $\frac{2E}{3}$

C. $\frac{3E}{2}$

D. $\frac{E}{2}$

Answer: B

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14. The velocity of 4 gas molecules are given by 1km/s , 3km/s , 5 km/s and 7km/s . Calculate the difference between average and RMS velocity .

A. 0.338

B. 0.438

C. 0.538

D. 0.638

Answer: C

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15. The sphere of radii 8 cm and 2 cm are cooling. Their temperatures are $127^\circ C$ and $527^\circ C$ respectively . Find the ratio of energy radiated by them in the same time

A. 0.06

B. 0.5

C. 1

D. 2

Answer: C

Watch Video Solution

16. At what temperature rms speed of air molecules is doubled of that at NTP ?

A. $819^\circ C$

B. $719^\circ C$

C. $909^\circ C$

D. None of these

Answer: A

Watch Video Solution

17. To what temperature should the hydrogen at $327^\circ C$ be cooled at constant pressure, so that the root mean square velocity of its molecules

become half of its previous value?

A. $-123^\circ C$

B. $123^\circ C$

C. $-100^\circ C$

D. $0^\circ C$

Answer: A

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18. If 150 J of energy is incident on area $2m^2$. If $Q_r = 15J$, coefficient of absorption is 0.6 , then amount of energy transmitted is

A. 50 J

B. 45 J

C. 40 J

D. 30 J

Answer: B

Watch Video Solution

19. The unit of Wien 's constant b is

A. $Wm^{-2}K^{-4}$

B. $m^{-1}K^{-1}$

C. Wm^2

D. m- K

Answer: D

Watch Video Solution

20. What is an ideal gas ? Explain its main characteristics.

A. One that consists of molecules

B. A gas satisfying the assumptions of kinetic theory

C. A gas having Maxwellian distribution of speed

D. A gas consisting of massless particles

Answer: B

Watch Video Solution

21. The gases carbon-monoxide (CO) and nitrogen at the same temperature have kinetic energies E_1 and E_2 respectively. Then

A. $E_1 = E_2$

B. $E_1 > E_2$

C. $E_1 < E_2$

D. E_1 and E_2 cannot be compared

Answer: A

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22. We consider a thermodynamic system. If ΔU represents the increase in its internal energy and W the work done by the system, which of the following statements is true?

A. $\Delta U = -W$ is an adiabatic process

B. $\Delta U = W$ in an isothermal process

C. $\Delta U = -W$ in an isothermal process

D. $\Delta U = W$ in an adiabatic process

Answer: A

Watch Video Solution

23. Newton's law of cooling holds good provided the temperature difference between the body and the surroundings is .

A. less than $10^{\circ} C$

B. more than $10^\circ C$

C. less than $100^\circ C$

D. more than $100^\circ C$

Answer: A

Watch Video Solution

24. At what temperature, pressure remaining unchanged, will the rms velocity of hydrogen be doubled its value at NTP ?

A. $819^\circ C$

B. $1092^\circ C$

C. $4368^\circ C$

D. $4095^\circ C$

Answer: D

Watch Video Solution

25. At constant pressure , which of the following is true ?

A. $c \propto \sqrt{\rho}$

B. $c \propto \frac{1}{\rho}$

C. $c \propto \rho$

D. $c \propto \frac{1}{\sqrt{\rho}}$

Answer: D

Watch Video Solution

26. In terms of mechanical unit , $C_p - C_v$ =.. Where , C_p and C_v are principal specific heats .

A. R

B. $\frac{R}{M}$

C. $\frac{R}{J}$

D. $\frac{R}{MJ}$

Answer: C

Watch Video Solution

27. The ratio of energy of emitted radiation of a black body at $27^\circ C$ and $927^\circ C$ is

A. $1:4$

B. $1:8$

C. $1:16$

D. $1:256$

Answer: D

Watch Video Solution

28. With same initial conditions , an ideal gas expands from volume V_1 to V_2 in three different ways . The work done by the gas is W_1 if the process is isothermal , W_2 if isobaric and W_3 if adiabatic , then

A. $W_2 > W_1 > W_3$

B. $W_2 > W_3 > W_1$

C. $W_1 > W_2 > W_3$

D. $W_1 > W_3 > W_2$

Answer: A

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29. A body takes 4 minutes to cool from $100^\circ C$ to $70^\circ C$. To cool from $70^\circ C$ to $40^\circ C$ it will take (room temperture os $15^\circ C$)

A. 14 s

B. 8 s

C. 10 s

D. 5 s

Answer: A

Watch Video Solution

30. A gas expands adiabatically at constant pressure such that its temperature $T \propto \frac{1}{\sqrt{V}}$, the value of C_P / C_V of gas is

A. 1.30

B. 1.50

C. 1.67

D. 2.00

Answer: B

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31. The state of a thermodynamic system is represented by

A. Pressure only

B. volume only

C. pressure , volume and temperature

D. number of moles

Answer: C

Watch Video Solution

32. A black body is at a temperature $300K$. It emits energy at a rate, which is proportional to

A. $(300)^4$

B. $(300)^3$

C. $(300)^2$

D. 300

Answer: A

Watch Video Solution

33. The root mean square speed of hydrogen molecule at 300 K is 1930m/s. Then the root mean square speed of oxygen molecules at 900K will be.....

A. $1930\sqrt{3}\text{ms}^{-1}$

B. 836ms^{-1}

C. 643ms^{-1}

D. $\frac{1930}{\sqrt{3}}\text{ms}^{-1}$

Answer: B

Watch Video Solution

34. The wavelength of maximum energy released during an atomic axplosion was $2.93 \times 10^{-10} m$. Given that Wien's constant is $2.93 \times 10^{-3} m - K$, the maximum temperature attained must be of the order of

A. $5.86 \times 10^{7} K$

B. 10^{-13}

C. $10^{-7} K$

D. $10^{7} K$

Answer: D

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35. A cup of tea cools from $80^{\circ} C$ to $60^{\circ} C$ in one minute. The ambient temperature is $30^{\circ} C$. In cooling from $60^{\circ} C$ to $50^{\circ} C$ it will take

A. 50 s

B. 90 s

C. 60 s

D. 30 s

Answer: A

Watch Video Solution

36. The rms velocity of a particle is v at pressure p. If the pressure increases by two times , then the rms velocity will be

A. 4 v

B. 2 v

C. v

D. 0.5v

Answer: C

View Text Solution

37. A measure of the degree of disorder of a system is known as

A. isobaric

B. isotropy

C. enthalpy

D. entropy

Answer: D

Watch Video Solution

38. The kinetic energy of 1 g molecule of a gas, at normal temperature and pressure, is

A. $3.4 \times 10^3 J$

B. $1.7 \times 10^3 J$

C. $2.4 \times 10^3 J$

D. None of these

Answer: A

Watch Video Solution

39. The temperature of two bodies A and B are respectively $727^\circ C$ and $327^\circ C$. The ratio $H_A : H_B$ of the rates of heat radiated by them is

A. $727 : 327$

B. $5 : 3$

C. $25 : 9$

D. $625 : 81$

Answer: D

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40. 110 J of heat is added to a gaseous system, whose internal energy change is 40 j. then the amount of external work done is

A. 140 J

B. 70 J

C. 110 J

D. 150 J

Answer: B

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