PHYSICS

BOOKS - MARVEL PHYSICS (HINGLISH)

KINETIC THEORY OF GASES ,THERMODYNAMICS AND RADIATION

MULTIPLE CHOICE QUESTIONS

1. A vessel contains 60,000 molecules of a gas. Due to a very fine hole in the wall, 10,000 molecules escape from the vessel. Then the mean free path of the molecules of the gas

A. is increased

B. is decreased

C. is not changed

D. may increase of decrease

Answer: A

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2. There are N molecules of a gas in a containter. If this number is increased to 2N, what will be (i) pressure (ii) total energy (iii) rms speed of the gas ?

A. increase

B. decrease

C. not change

D. be halved

Answer: C

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3. At constant volume, temperature is increased. Then

A. the collisions on the walls will be less

B. the number of collisions will not change

C. collisions will be in straight lines

D. number of collisions per unit time will increase

Answer: D

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4. For a planet, the escape velocity is V_e. The presence of atmosphere on the planet shows that the

A. $V_{\text{rms}} = V_e$

B. $V_{\text{rms}} = 0$

C. $V_{\text{rms}} < V_e$

D. $V_{\text{rms}} > V_e$

Answer: C

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5. The root mean square velocity of the molecules of a gas is $200m/s$. What will be the rms velocity of the molecules if the atomic weight is doubled and the absolute temperature is halved?

A. $50m/s$

B. $100m/s$

C. $200m/s$

D. $300m/s$

Answer: B

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6. Molecular weight of oxygen is 32 and that of hydrogen is 2. The ratio of the rms velocity of hydrogen molecule at 400K to rms velocity of oxygen molecule at 900 K is given by

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

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

C. $\frac{8}{3}$

D. $\frac{10}{3}$

Answer: C

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7. The absolute temperature of the gas is increased 3 times. What will be the increases in root mean square velocity of the gas molecules?

A. 3 times

B. 9 times

C. $\sqrt{3}$ times

D. $\frac{1}{\sqrt{3}}$ times

Answer: C

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8. The temperature of the gas is raised from $27^\circ C$ to $927^\circ C$, the root mean square velocity is

A. twice

B. half

C. four times

D. one third

Answer: A

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9. The velocities of 5 molecules are $2m/s, 3m/s, 4m/s, 5m/s$ and $6m/s$ respectively. What is their mean velocity?

A. $2m / s$

B. $3m / s$

C. $4m / s$

D. $7m / s$

Answer: C

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10. The velocities of 4 molecules are $2m / s, 4m / s, 5m / s$ and $6m / s$ respectively. What is their mean square velocity?

A. $\frac{51}{4}m^2/s^2$

B. $\frac{61}{4}m^2/s^2$

C. $\frac{71}{4}m^2/s^2$

D. $\frac{81}{4}m^2/s^2$

Answer: D

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11. The translational K.E. of the molecules of a gas at absolute temperature (T) can be doubled

A. by increasing T to 4T

B. by increasing T to $\sqrt{2}T$

C. by decreasing T to $\frac{T}{2}$

D. by increasing T to 2T

Answer: D

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12. 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. $643m/s$

B. $836m/s$

C. $\frac{1930}{\sqrt{3}}m/s$

D. $1930\sqrt{3}m/s$

Answer: B

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13. A vessel contains one mole of oxygen and one mole of hydrogen at N.T.P. What is the ratio of the values of rms velocities of hydrogen and oxygen molecules?

A. $1:16$

B. $16:1$

C. $4:1$

D. $1:4$

Answer: C

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14. The rms speed of the molecules of a gas in a vessel at $80^{\circ}C$ is $200m/s$. If 40% of the gas is taken out of the vessel, what is the rms speed of the remaining molecules if their temperature is not changed?

A. $120m/s$

B. $280m/s$

C. $200m/s$

D. $200\sqrt{3}m/s$

Answer: C

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15. The mean free path of a gas molecule at $27^{\circ}C$ is 2 cm. If the rms velocity of the gas at that temperature is $10m/s$, what is the time interval between two successive collisions?

A. $\frac{1}{5}s$

B. $\frac{1}{50}s$

C. $\frac{1}{500}s$

D. $\frac{1}{250}s$

Answer: C

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16. Which of the following gases has maximum rms speed at a given temperature?

A. Oxygen

B. Hydrogen

C. Carbon dioxide

D. Nitrogen

Answer: B

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17. The phenomenon of Brownian motion is taken as an evidence of

A. particle nature of matter

B. kinetic theory of matter

C. wave nature of matter

D. relativistic variation of mass of matter

Answer: B

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18. The molecules of an ideal gas possesses

A. only P.E.

B. only K.E.

C. both P.E. and K.E.

D. only gravitational energy

Answer: B

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19. The number of molecules in a gram-mole of molecule of a gas is called

A. Universal gas constant

B. Planck's constant

C. Avogadro's number

D. Boltzmann constant

Answer: C

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20. When a gas is compressed as constant temperature:

A. is decreased

B. is increased

C. remains unchanged

D. becomes half

Answer: B

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21. The temperature of the gas is raised from $27^\circ C$ to $927^\circ C$, the root mean square velocity is

A. double

B. three times

C. one half

D. one fourth

Answer: C

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22. At a certain temperature, hydrogen molecules have r.m.s. velocity of $3km/s$. What is the r.m.s. velocity of the oxygen molecules at the same temperature ?

A. $0.25km/s$

B. $0.5km/s$

C. $0.75km/s$

D. $6km / s$

Answer: C

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23. At what temperature, the r.m.s. speed of the molecules of a gas is half its value at NTP?

A. 0 K

B. 273 K

C. 150 K

D. 68.25 K

Answer: D

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24. The r.m.s. velocity of the molecules of an ideal gas is C at a temperature of 100 K. At what temperature its r.m.s. velocity will be doubled ?

A. 200 K

B. 400 K

C. 300 K

D. 50 K

Answer: B

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25. The temperature of a gas is - $68^\circ C$. To what temperature should it be heated, so that the r.m.s. velocity of the molecules be doubled ?

A. $357^{\circ} C$

B. $457^{\circ} C$

C. 547°

D. 820°

Answer: C

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26. The velocities of 4 molecules are 4m/s, 5m/s, 6m/s and 2m/s respectively. What is their rms velocity?

A. $0.15m/s$

B. $0.25m/s$

C. $0.20m/s$

D. $0.30m/s$

Answer: B

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27. The molecular weights of H_2 and O_2 are 2 and 32 respectively. The rms velocity of H_2

molecule at N.T.P. is $2000 m / s$. What is the rms

velocity of Oxygen molecules at N.T.P. ?

A. $400 m / s$

B. $500 m / s$

C. $1000 m / s$

D. $3000 m / s$

Answer: B

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28. A sample of gas is at $0^{\circ}C$. The temperature at which its rms speed of the molecule will be doubled is

A. $273^{\circ}C$

B. $623^{\circ}C$

C. $819^{\circ}C$

D. $1092^{\circ}C$

Answer: C

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29. If the absolute temperature of a gas is increased 5 times, the r.m.s. velocity of the molecules will be

A. 5 times

B. 10 times

C. $\sqrt{5}$ times

D. 25 times

Answer: C

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

A. $300 m / s$

B. $600 m / s$

C. $150 m / s$

D. $75 m / s$

Answer: C

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31. The temperature of an ideal gas is increased from $27^{\circ} C$ to $327^{\circ} C$. If the r.m.s. speed of its molecules at $27^{\circ} C$ is $200 m / s$, then the new r.m.s. speed at $600^{\circ} K$ will be

A. $200 m / s$

B. $200 \sqrt{5} m / s$

C. $200 \sqrt{2} m / s$

D. $400 m / s$

Answer: C

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32. The root mean square velocity of the molecules of a gas is $200m/s$. What will be the rms velocity of the molecules if the atomic weight is doubled and the absolute temperature is halved?

A. $150m/s$

B. $100m/s$

C. $300m / s$

D. $400m / s$

Answer: B

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33. Find the wrong statement from the following :

According to kinetic theory 0 K is that temperature at which

A. pressure of an ideal gas is zero

B. volume of an ideal gas is zero

C. internal energy of an ideal gas is zero

D. mass of an ideal gas is zero

Answer: D

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34. There is no atomosphere on moon because

A. it is far away from the surface of the earth

B. its surface temperature is - $10^\circ C$

C. the r.m.s. velocity of all the gas molecules is more than the escape velocity of the moon's surface

D. the escape velocity of the moon's surface is more than the r.m.s. velocity of all gas molecules

Answer: C

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35. In the equation $PV = nRT$, the value of 'R' will not depend on:

A. nature of the gas

B. pressure of the gas

C. temperature of the gas

D. units of measurement

Answer: D

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36. The rms speed of the molecules of a gas in a vessel is $400ms^{-1}$. If half of the gas leaks out at constant temperature, the rms speed of the ramaining molecules will be..............

A. $200\sqrt{2}m/s$

B. $200m/s$

C. $400m/s$

D. $400\sqrt{2}m/s$

Answer: C

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37. At what temperature will the r.m.s. speed of the hydrogen molecules be half of its value at $327^\circ C$?

A. $-123^\circ C$

B. $81.75^\circ C$

C. $127^\circ C$

D. $150^\circ C$

Answer: A

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38. 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. $0.583 km / s$

B. $0.438 km / s$

C. $0.358 km / s$

D. $0.683km / s$

Answer: A

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

A. remains the same

B. increases

C. decreases

D. first increases and then decreases

Answer: A

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40. The temperature at which the rms velocity of oxygen molecules equals to that of nitrogen molecules at $0^\circ C$ is

A. $312^\circ C$

B. $292^\circ C$

C. $195^\circ C$

D. $39^\circ C$

Answer: D

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41. A perfect gas of volume 10 litre is compressed isothermally to a volume of 1 litre, the rms speed of the molecules will

A. increase by 5 times

B. decrease by 5 times

C. increase by 10 times

D. not change

Answer: D

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42. A vessel X contains 1 mole of O_2 gas (molar mass 32) at a temperature T and pressure p. Another ideantical vessel Y contains one mole of Ge gas (molar mass 4) at temperature 2T, then

A. P

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

C. 2P

D. 4P

Answer: C

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43. Cooking gas container are kept in a lorry moving with uniform speed. The temperature of the gas molecules inside will

A. remain the same

B. decrease for some, while increase for others

C. increase

D. decrease

Answer: A

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44. At what temperature is the rms velocity of a hydrogen molecule equal to that of an oxygen molecule at $47^{\circ} C$?

A. 3K

B. 20K

C. 80K

D. $-73K$

Answer: B

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45. 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 the above

Answer: C

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46. The mean free path of molecules of a gas (radius r) is inversely proportional to

A. r

B. $\sqrt{r}$

C. r^3

D. r^2

Answer: D

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47. Root mean square velocity of a particle is v at pressure P. If pressure is increased two times, then the r.m.s. velocity becomes

A. v

B. 2v

C. 0.5v

D. 4v

Answer: A

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48. The dimensions of universal gas constant is

A. $\left[M^{1}L^{1}T^{-2}K^{-1}mol^{-1}\right]$

B. $\left[M^{2}L^{2}T^{-2}K^{-1}mol^{-1}\right]$

C. $\left[M^{1}L^{2}T^{-2}K^{-1}mol^{-1}\right]$

D. $\left[M^{2}L^{1}T^{-2}K^{-1}mol^{-1}\right]$

Answer: C

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49. Air in a cylinder is suddenly compressed by a piston, which is then maintained at the same position. With the passage of time

A. the pressure may increase or decrease depending upon the nature of the gas

B. the pressure remains the same

C. the pressure decreases

D. the pressure increases

Answer: C

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50. What will be the r.m.s. speed of a gas at $800^{\circ} K$?

A. Four times the value of 200 K

B. Half the value at 200 K

C. Twice the value at 200 K

D. Same as at 200 K

Answer: C

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51. The temperature of a ideal gas is increased for 100 k to 400k. If at 100 K the root mea square velocity of the gas molecules is v, at 400K it becomes

A. 4x

B. $\frac{x}{4}$

C. 2x

D. 3x

Answer: C

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52. The rms velocity of a gas kept at a temperature of $27^{\circ}C$ in a vessel is $61 m / s$. The vessel is filled with

[R = 8.31$J / mol K$]

A. O_2

B. N_2

C. CO_2

D. H_2

Answer: D

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53. At room temperature the rms speed of the molecules of a certain diatomic gas is formed to be $1930m/\sec$ The gas is .

A. H_2

B. O_2

C. Cl_2

D. F_2

Answer: A

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54. If we travel from the troposphere to the thermosphere, the mean free path of the ait molecules

A. is considerably decreased

B. is considerably increased

C. does not change

D. becomes zero

Answer: B

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55. The speed of sound in oxygen (O_2) at a certain temperature is $460ms^{-1}$. The speed of sound in helium (He) at the same temperature will be (assume both gases to be ideal)

A. $330m/s$

B. $460m/s$

C. $1420m/s$

D. $920m/s$

Answer: C

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56. Three closed vessels A, B and C are at the same temperature T and contain gases which obey the Maxwellian distribution of velocities. 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 the 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 is (where M is the mass of an oxygen molecules)

A. $\sqrt{v_1 v_2}$

B. $\sqrt{\frac{3KT}{M}}$

C. $\frac{1}{2}(v_1 + v_2)$

D. v_1

Answer: D

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57. Two identical containers A and B with frictionless pistons contain the same ideal gas at the same temperature and the same velocity V. The mass of the gas in A is m_A, and that in B is m_B. The gas in each cylinder is now allowed to expand isothermally to the same final volume 2V. The changes in the pressure in A and B are found to be ΔP and $1.5\Delta P$ respectively. Then

A. $4m_A = 9m_A$

B. $9m_A = 4m_B$

C. $2m_A = 3m_B$

D. $3m_A = 2m_B$

Answer: D

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58. 1 mole of H_2 gas in contained in a box of volume V 1.00 m^3 at T =300 K. The gas is heated to a temperature of T= 3000K and the gas gets converted to a gas of hydrogen atoms. The final pressure would be (considering all gases to be ideal)

A. same as the initial pressure

B. 2 times the initial pressure

C. 10 times the initial pressure

D. 20 times the initial pressure

Answer: D

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59. What is the density of a gas at N.T.P. if the rms velocity of the gas molecules is $400 m / s$? (Take atmospheric pressure $P = 1 \times 10^5 N / m^2$)

A. $\frac{5}{8} kg / m^3$

B. $\frac{11}{8} kg / m^3$

C. $\frac{15}{8} kg / m^3$

D. $\frac{25}{8} kg / m^2$

Answer: C

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60. n balls each of mass m impinge elastically each second on a surface with velocity u. The average force experienced by the surface will be

A. μn

B. $\frac{\text{mun}}{2}$

C. 2mun

D. $\frac{\text{mnu}^2}{2}$

Answer: A

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61. n balls each of mass m impinge elastically each second on a surface with velocity u. The average force experienced by the surface will be

A. mnu^2

B. $2mnu^2$

C. $2mnu$

D. $\frac{1}{2}mnu^2$

Answer: C

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62. A molecule of mass m moving with a velocity v makes 5 elastic collisions with a wall of the container per second. The change in its momentum per second will be

A. mv

B. 5 mv

C. $\frac{mv}{10}$

D. 10 mv

Answer: D

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63. The root mean square speed of the molecules of an enclosed gas is 'v'. What will be the root mean square speed if the pressure is doubled, the temperature remaining the same?

A. x

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

C. 2x

D. $\sqrt{x}$

Answer: A

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64. Equal volumes of two gases, having their densities in the ratio $1:16$ exert equal pressures on the walls of two containers. The ratio of their rms velocities $\left(\frac{C_1}{C_2}\right)$ is

A. $1:8$

B. $8:1$

C. $1:4$

D. $4:1$

Answer: D

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65. If the pressures exerted by two ideal gases are in the ratio $3:2$ and their densities are in the ratio $2:1$, then the ratio of their r.m.s. velocities is

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

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

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

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

Answer: D

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66. At a constant temperature, what is the relation between pressure P and density ρ of gas?

A. $C \propto \frac{1}{\rho}$

B. $C \propto \rho$

C. $C \propto \frac{1}{\sqrt{\rho}}$

D. $C \propto \sqrt{\rho}$

Answer: C

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67. 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

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68. If masses of all molecules of a gas are halved and the speed doubled. Then the ratio of initial and final pressure is :

A. $2:1$

B. $1:2$

C. $1:4$

D. $4:1$

Answer: B

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69. Gas at a pressure P_0 in contained as a vessel. If the masses of all the molecules are halved and their speeds are doubles. The resulting pressure P will be equal to

A. $4P_0$

B. $2P_0$

C. P_0

D. $\frac{P_0}{2}$

Answer: B

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70. Consider a gas with density $'\rho'$ and $\bar{c}$ as the root mean square velocity of its molecules contained in a volume. If the system moves as whole with velocity 'v' , then the pressure exerted by the gas is

A. $P = \frac{1}{3}\rho[C + V]^2$

B. $P = \frac{1}{3}\rho C^2$

C. $P = \frac{1}{3}\rho[C - V]^2$

D. $P = \frac{1}{3}\rho\left[C^2 - V^2\right]$

Answer: B

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71. 10^{23} molecules of a gas, each having a mass of 3×10^{-27} kg strike per second per sq. cm. of a rigid will at an angle of 60° with the normal and rebound with a velocity of

$500 m / s$. What is the pressure exerted by the gas molecules on the wall?

A. $500 N / m^2$

B. $1000 N / m^2$

C. $1500 N / m^2$

D. $2000 N / m^2$

Answer: C

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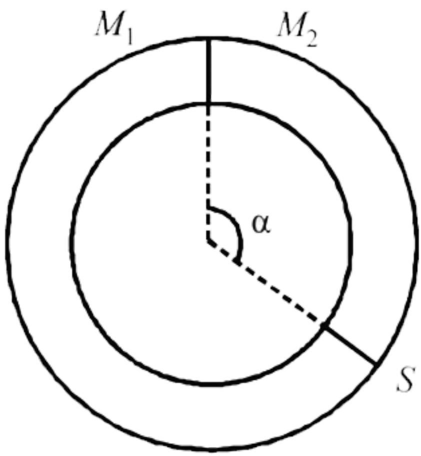
72. A ring shaped tube contain two ideal gases with equal masses and relative molar masses $M_1 = 32$ and $M_2 = 28$.

The gases are separated by one fixed partiotin and another movable stopper S which can move freely without friction inside the ring. The angle α as shown in the figure is ......

degrees.



A. 150°

B. 172°

C. 192°

D. 82°

Answer: C

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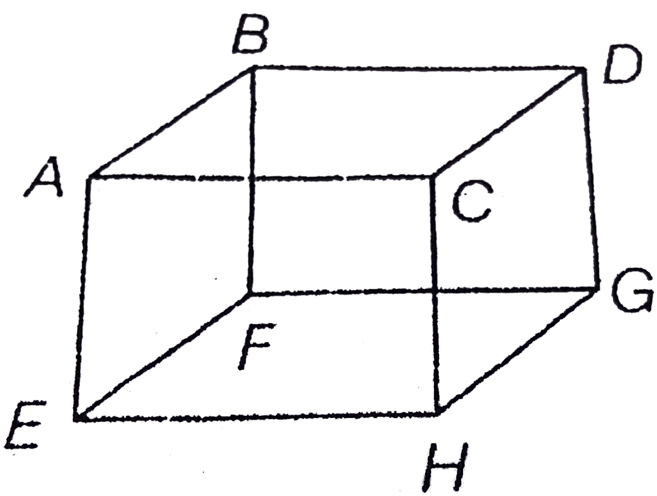
73. Mole of an ideal gas is contained in a cubical volume V, ABCDEFGH at 300 K (figure). One face of the cube (EFGH) is made up of a material which totally absorbs any gas molecule incident on it .At any given time.



A. the pressure on EFGH would be zero

B. the pressure on all the faces will be equal

C. the pressure on EFGH would be double the pressure on ABCD

D. the pressure on EFGH would be half that on ABCD

Answer: D

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74. At the same temperature, the mean kinetic energies of the molecules of hydrogen and oxygen are in the ratio

A. $1:16$

B. $8:1$

C. $16:1$

D. $1:1$

Answer: D

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75. The kinetic energy per cubic metre of a perfect gas at N.T.P. is (Take atmospheric pressure $= 1 \times 10^5 N / m^2$)

A. $1.5 \times 10^5 J / m^3$

B. $2 \times 10^5 J / m^3$

C. $0.75 \times 10^5 J / m^3$

D. $2.5 \times 10^5 J / m^3$

Answer: A

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76. The kinetic energy of one gram molecule of a gas at normal temperature and pressure is $(R = 8.31 J / mol - K)$

A. $3.4 \times 10^3 J$

B. $1.3 \times 10^2 J$

C. $0.56 \times 10^4 J$

D. $3.74 \times 10^{-3} J$

Answer: A

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77. In case of Boyle's law, if the pressure is increased by 1% the percentage decrease in volume is

A. 1%

B. $\frac{1}{100}\%$

C. $\frac{1}{101}\%$

D. $\frac{100}{101}\%$

Answer: D

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78. If the universal gas constant is $8.3 J / \text{mole} / K$ and the Avogadro's number is 6×10^{23}, then the mean K.E. of the oxygen molecules at $327^\circ C$ will be

A. $2.49 \times 10^{20} J$

B. $4.10 \times 10^{-21} J$

C. $8.5 \times 10^{20} J$

D. $1.245 \times 10^{-20} J$

Answer: D

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79. The kinetic energy of a gas at $27^{\circ}C$ is E. What will be its K.E., if the temperature is increased to 500 K ?

A. E

B. 2E

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

D. $\sqrt{\frac{5}{3}E}$

Answer: C

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80. A monoatomic gas of n -moles is heated from temperature T to T under two different conditions (i) at constant volume and (ii) at constant pressure. The change in internal energy of the gas is

A. is more in (ii)

B. is more in (i)

C. is the same in both cases

D. is $C_p - C_v$

Answer: C

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81. The average kinetic energy of the molecules of a gas at 27° is $9 \times 10^{-20} J$. What is its average K.E. at $227^\circ C$?

A. $5 \times 10^{-20} J$

B. $10 \times 10^{-20} J$

C. $15 \times 10^{-20} J$

D. $20 \times 10^{-20} J$

Answer: C

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82. If the pressure of an ideal gas is decreased by 10% isothermally, then its volume will

A. increase by 10%

B. increase by 11.1%

C. decrease by 10%

D. decrease by 9%

Answer: B

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83. If E is the kinetic energy per mole of a gas, and T is the absolute temperature, then the universal gas constant is given by

A. $R = \frac{3T}{2E}$

B. $R = \frac{2E}{3T}$

C. $R = \frac{3E}{2T}$

D. $R = \frac{2T}{3E}$

Answer: B

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84. A gas has volume V and pressure P. The total translational kinetic energy of all the molecules of the gas is equal to $\frac{3}{2}PV$

A. if the gas is monoatomic

B. if the gas is diatomic

C. if the gas is triatomic

D. in all cases

Answer: D

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85. At what temperature will the average K.E. of the hydrogen molecules be half of its value at N.T.P. ?

A. 136.5 K

B. 273 K

C. 1052 K

D. 546 K

Answer: A

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86. In the Boyle's law experiment, if the volume of the enclosed air is to be decreased from 20 cc to 18 cc, then its pressure should be increased by about

A. 0.2

B. 0.15

C. 0.05

D. 0.11

Answer: D

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87. In the expression for boyle 's law the product pV has dimensions of

A. Force

B. Impulse

C. Energy

D. Momentum

Answer: C

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

A. $\frac{1}{3}E$

B. $\frac{1}{2}E$

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

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

Answer: D

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89. The kinetic energy of translation of 20gm of oxygen at $47^\circ C$ is (molecular wt. of oxygen is 32 gm/mol and R=8.3 J/mol/K)

A. 2490 ergs

B. 2490 J

C. 249 J

D. 960 J

Answer: B

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90. The average translational K.E. of O_2 molecules (Molecular weight = 32) at a particular temperature is 0.035 eV. What is the average translational K.E. of N_2 molecules

(Molecular weight = 28) at the same temperature ?

A. 0.028 eV

B. 0.055 eV

C. 0.035 eV

D. 0.075 eV

Answer: C

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91. The average translational K.E. of the molecules in a sample of oxygen at 300K is $6 \times 10^{-20} J$. What is the average translational energy at 750 K?

A. $2 \times 10^{-19} J$

B. $1.5 \times 10^{-19} J$

C. $3 \times 10^{-18} J$

D. $3.5 \times 10^{-21} J$

Answer: B

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

A. 0.05

B. 0.1

C. 0.0526

D. 0.04

Answer: C

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93. The average translational energy and the rms speed of molecules in a sample of oxygen gas at $300K$ are $6.21 \times 10^{-21}J$ and $484m/s$, respectively. The corresponding values at $600K$ are nearly (assuming ideal gas behaviour)

A. $8.78 \times 10^{-21}J, 684m/s$

B. $0.21 \times 10^{-21}J, 989m/s$

C. $12.42 \times 10^{-21}J, 684m/s$

D. $12.42 \times 10^{-21} J, 968 m / s$

Answer: C

Watch Video Solution

94. A mixture of 2 moles of helium gas ($(a \rightarrow micmass) = 4 a.m.u)$ and 1 mole of argon gas $((a \rightarrow micmass) = 40 a.m.u)$ is kept at 300K in a container. The ratio of the rms speeds $\left(\frac{v_{rms}(helium)}{(v_{rms}(argon))}\right)$ is

A. 0.32

B. 0.45

C. 2.24

D. 3.16

Answer: D

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95. Two thermally insulated vessel 1 and 2 are filled with air at temperature $(T_1T_2), volume(V_1V_2)$ and pressure (P_1P_2) respectively. If the valve joining the two vessels is opened, the temperature inside the vessel at equilibrium will be

A. $\dfrac{T_1T_2(P_1V_1+P_2V_2)}{P_1V_1T_2+P_2V_2T_1}$

B. $\dfrac{T_1T_2(P_1V_1+P_2V_2)}{P_1V_1T_1+P_2V_2T_2}$

C. $\dfrac{T_1+T_2}{2}$

D. T_1+T_2

Answer: B

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96. At what temperature does the average translational K.E. of a molecule in a gas becomes equal to K.E. of an electron accelerated from rest through potential difference of V volt ? All symbols have their usual meaning.

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

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

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

D. $\frac{2NeV}{R}$

Answer: A

Watch Video Solution

97. T_1 is the temperature of oxygen enclosed in a cylinder. The temperature is increased to T_2 and Maxwellian distribution curves for O_2 at temperatures T_1 and T_2 are plotted. If A_1 and A_2 are the areas under the curves and the speed axis, in both cases, then

A. $A_1 > A_2$

B. $A_1 < A_2$

C. $A_1 = A_2$

D. $A_1 = \sqrt{A_2}$

Answer: C

Watch Video Solution

98. Calculate the total number of degree of freedom for a mole of diatomic gas at STP.

A. 6.02×10^{23}

B. 18.06×10^{23}

C. 30.1×10^{23}

D. 36.12×10^{23}

Answer: C

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99. The value of $\gamma = \frac{C_P}{C_V}$ for a gas is given by $\gamma = 1 + \frac{2}{f}$ where f is the number of degrees of freedom of a molecule of a gas

What is the ratio of $\frac{\gamma_{\text{monoatomic}}}{\gamma_{\text{diatomic}}}$?

A. $\frac{25}{21}$

B. $\frac{21}{25}$

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

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

Answer: A

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100. 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

Watch Video Solution

101. Each atom of mass m of a monoatomic gas has three degrees of freedom. The r.m.s.

velocity of these atom is given by $\sqrt{\frac{3KT}{2m}}$.

What is the r.m.s. velocity of a diatomic molecule of mass m which has got five degrees os freedom ?

A. sqrt((KT)/(m))`

B. sqrt((KT)/(2m))`

C. sqrt((3KT)/(2m))`

D. sqrt((5KT)/(2m))`

Answer: C

Watch Video Solution

102. Which one of the following molecules does not possess vibrational energy ?

A. Oxygen

B. Nitrogen

C. Argon

D. CO_2

Answer: C

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

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

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

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

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

Answer: B

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104. For a gas, $R = \frac{2}{3} C_V$. This suggests that the gas consists of molecules, which are

A. Polyatomic

B. Diatomic

C. Monoatomic

D. A mixture of diatomic and polyatomic molecules

Answer: C

Watch Video Solution

105. A diatomic gas undergoes adiabatic changes. What is its bulk modulus at 2 atmospheric pressure ?

[Atmospheric pressure $= 10^5 N/m^2$]

A. $1N/m^2$

B. $1.4 \times 10^5 N/m^2$

C. $2.8 \times 10^5 N/m^2$

D. $2 \times 10^5 N/m^2$

Answer: C

Watch Video Solution

106. When an ideal diatomic gas is heated at constant pressure, the fraction of the heat energy supplied, which increases the internal energy of the gas, is

A. $\frac{2}{5}$

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

C. $\frac{3}{7}$

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

Answer: B

Watch Video Solution

107. A vessel contains a mixture of one of oxygen and two moles of nitrogen at $300K$ The ratio of the average rotational kinetic energy per O_2 molecule to N_2 molecule is .

A. $1:2$

B. $2:1$

C. $1:1$

D. depends upon the moment of inertia of the two molecules

Answer: C

Watch Video Solution

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

A. $5 \times 10^4 J$

B. $6 \times 10^4 J$

C. $7 \times 10^4 J$

D. $3 \times 10^4 J$

Answer: A

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109. How many degrees of freedom have the gas molecules, if under standard conditions the gas density is $1.3 kgm^{-3}$ and the velocity of sound propagation in it is $C = 330 ms^{-1}$.

A. 2

B. 3

C. 4

D. 5

Answer: D

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110. A polyatomic gas with (n) degress of freedom has a mean energy per molecule given by.

A. $\frac{nKT}{N}$

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

C. $\frac{nKT}{2N}$

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

Answer: D

Watch Video Solution

111. The molar specific heat at constant pressure of an ideal gas is $\frac{7}{2}R$. The gas is made up of molecules which are

A. Monoatomic

B. Diatomic

C. Triatomic

D. Polyatomic

Answer: B

Watch Video Solution

112. Equal amounts of heat are supplied to equal masses of helium and oxygen, kept at the same initial temperature. If T_{He} and T_O denote the increase in temperatures of helium and oxygen, then

A. $T_{He} = T_O$

B. $T_{He} > T_O$

C. $T_{He} < T_O$

D. $T_{He} = \frac{1}{16} T_O$

Answer: B

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113. The heat required to raise the temperature of 1g of O_2 through $1^\circ C$ at constant volume is Q. What is the heat required to raise the temperature of 1 g of O_2 through $1^\circ C$ at constant pressure ?

A. Q + R

B. $Q + \frac{R}{32}$

C. $Q + \frac{R}{16}$

D. $Q + \frac{R}{8}$

Answer: B

Watch Video Solution

114. Find $\frac{C_p}{C_v}$ for monatomic ideal gas.

A. > 1

B. < 1

C. $= 1$

D. ≥ 1

Answer: B

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115. A gas mixture consists of 2 moles of oxygen and 4 of Argon at temperature T. Neglecting all vibrational modes, the total internal energy of the system is

A. 5RT

B. 9RT

C. 11RT

D. 15RT

Answer: C

Watch Video Solution

116. Three moles of oxygen ar mixed with two moles of helium. What will be the ratio of specific heats at constant pressure and constant volume for the mixture ?

A. 1.2

B. 1.5

C. 2

D. 1.8

Answer: B

Watch Video Solution

117. 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. 1.25

B. 1.40

C. 1.50

D. 1.60

Answer: C

Watch Video Solution

118. A gaseous mixture consists of 16g of helium and 16 g of oxygen. The ratio $\frac{C_p}{C_v}$ of the mixture is

A. 1.62

B. 1.55

C. 1.81

D. 1.45

Answer: A

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119. For argon, $c_v = 0.075 Kcal / kg / K$. What is its atomic weight? [R = 2cal/mol/k]

A. 20

B. 30

C. 40

D. 50

Answer: C

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120. If one mole of a monoatomic gas $(\gamma = 5/3)$ is mixed with one mole of a diatomic gas $(\gamma = 7/5)$ the value of γ for the mixture is .

A. $\frac{15}{23}$

B. $\frac{23}{15}$

C. $\frac{7}{3}$

D. $\frac{3}{7}$

Answer: B

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121. X and Y are two cylinders, fitted with frictionless pistons. Both of them contain equal amounts of oxygen at 200K. Equal amount of heat is given to the gas in each cylinder. However, the piston of A is fixed while that of B is movable. What is the rise in temperature of the gas in B, if the rise in temperature of A is 42 K ?

A. 50 K

B. 40 K

C. 30 K

D. 25 K

Answer: C

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122. A mixture of n_1 moles of monoatomic gas and n_2 moles of diatomic gas has $\frac{C_p}{C_V} = \gamma = 1.5$

A. $n_1 = 2n_2$

B. $n_1 = n_2$

C. $n_2 = 2n_1$

D. $n_1 = \frac{3}{2}n_2$

Answer: B

Watch Video Solution

123. Heat is supplied to a diatomic gas at constant pressure.

The ratio of $\Delta Q : \Delta U : \Delta W$ is

A. $2:3:5$

B. $5:3:2$

C. $2:5:7$

D. $7:5:2$

Answer: D

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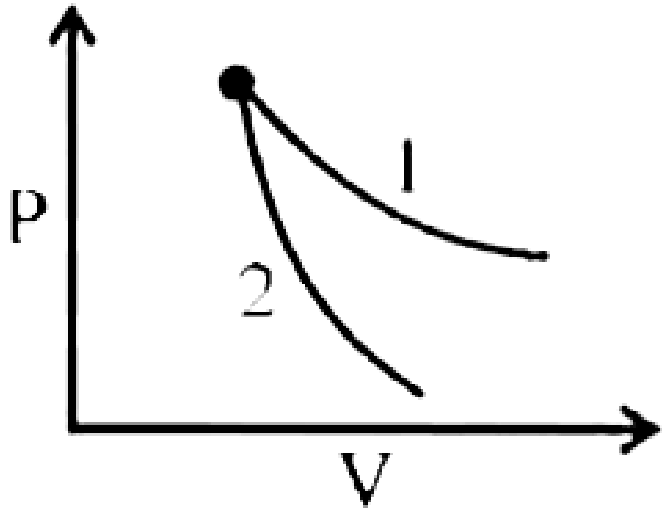
124. P - V plots for two gases, undergoing adiabatic processes are as shown in the figure.



Plots 1 and 2 should correspond respectively to

A. He and O_2

B. He and Ar

C. O_2 and He

D. O_2 and N_2

Answer: C

Watch Video Solution

125. A gaseous mixture enclosed in a vessel consists of one gram mole of a gas A with $\gamma = \left(\frac{5}{3}\right)$ and some amount of gas B with $\gamma = \frac{7}{5}$ at a temperature T.

The gases A and B do not react with each other and are assumed to be ideal. Find the number of gram moles of the gas B if γ for the gaseous mixture is $\left(\frac{19}{13}\right)$.

A. 3

B. 4

C. 2

D. 5

Answer: C

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126. Two rigid boxes containing different ideal gases are placed on a table. Box A contains one mole of nitrogen at temperature T_0, while

Box contains one mole of helium at temperature $\left(\frac{7}{3}\right)T_0$. The boxes are then put into thermal contact with each other, and heat flows between them until the gasses reach a common final temperature (ignore the heat capacity of boxes). Then, the final temperature of the gasses, T_f in terms of T_0 is

A. $T_f = \frac{3}{7}T_0$

B. $T_f = \frac{7}{3}T_0$

C. $T_f = \frac{3}{2}T_0$

D. $T_f = \frac{5}{2}T_0$

Answer: C

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127. 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. 2.00

B. 1.50

C. 1.67

D. 1.30

Answer: B

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128. 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. ΔU = dW is an isothermal process

B. ΔU = -dW is an adiabatic process

C. ΔU = -dW is an isothermal process

D. ΔU = dW is an adiabatic process

Answer: B

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129. If the specific heat of a gas at constant volume is $\frac{3}{2}R$, then the value of γ will be

A. $\frac{5}{2}$

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

C. $\frac{5}{4}$

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

Answer: B

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130. Which of the following statements is correct for any thermodynamic system?

A. The work done in an adiabatic process is always zero

B. The change in entropy can never be zero

C. The internal energy changes in all processes

D. Internal energy and entropy are state functions

Answer: D

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131. An ideal gas A and a real gas B have their volumes increases from $V \rightarrow 2V$ under isothermal condtitions. The increase in internal energy

A. will be same in both A and B

B. will be zero in both the gases

C. of B will be more than that of A

D. of A will be more than that of B

Answer: B

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132. A sample of gas expands from volume V_1 to V_2. The amount of work done by the gas is greatest when the expansion is

A. adiabatic

B. isobaric

C. isothermal

D. equal in all above cases

Answer: B

Watch Video Solution

133. Which of the following processes is reversible?

A. Transfer of heat by radiation

B. Electrical heating of nichrome wire

C. Transfer of heat by conduction

D. Isothermal compression

Answer: D

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

B. $\frac{8}{7}$

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

D. $\frac{9}{7}$

Answer: A

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135. The specific heat at constant pressure and at constant volume for an ideal gas are C_p and $C_v$and its adiabatic and isothermal eleasticities are E_ϕ and E_θ respectively. The ratio of E_ϕ to E_θ is

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

B. C_pC_v

C. $\frac{C_v}{C_p}$

D. $\frac{C_p}{C_v}$

Answer: D

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136. A gas is being compressed adiabatically. The specific heat of the gas during compression is

A. undefined

B. infinite

C. zero

D. finite but non-zero

Answer: C

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137. A polyatomic gas $\left(\lambda=\frac{4}{3}\right)$ is compressed to $\frac{1}{8}$ of its voulme Adiabatically. If initial pressure is P_0, Its mew perssure will be

A. $6P_0$

B. $2P_0$

C. $8P_0$

D. $16P_0$

Answer: D

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138. For a gas undergoing an adiabatic change, the relation between temperature and volume is found to be $TV^{0.4}$ = constant. This gas must be

A. Helium

B. Carbon dioxide

C. Argon

D. Hydrogen

Answer: D

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139. Which of the following parameters does not characterize the thermodynamic state of matter?

A. Work

B. Volume

C. Pressure

D. Temperature

Answer: A

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140. In an adiabatic change, the pressure p and temperature T of a diatomic gas are related by the relation $p \propto T^{\alpha}$, where α equals

A. 2.5

B. 3.5

C. 1.4

D. 2.25

Answer: B

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

C. $\sqrt{\frac{L_2}{L_1}}$

D. $\sqrt{\frac{L_1}{L_2}}$

Answer: A

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142. In an adiabatic change, the pressure and temperature of a monoatomic gas are related with relation as $P \propto T^C$, Where C is equal to:

A. $\frac{5}{2}$

B. $\frac{2}{5}$

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

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

Answer: A

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143. If mass-energy equivalence is taken into account , when water is cooled to form ice, the mass of water should :-(Note: The mass energy of an object is the energy equivalent of its mass , as given by $E = mc^2$, where m= mass of object & c = speed of light)

A. first increase then decrease

B. decrease

C. remain unchanged

D. increase

Answer: B

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144. A gas for which $\lambda = 4/3$, is heated at constant pressure. What percentage of the total heat supplied is used up for external work?

A. 0.3

B. 0.4

C. 0.5

D. 0.6

Answer: B

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145. An ideal gas under goes a quasi static, reversible process in which its molar heat capacity C remains constant. If during this process the relation of pressure P and volume V is given by $PV^n = \text{constant}$, then n is given by (Here C_P and C_V are molar specific heat at constant pressure and constant volume, respectively):

A. $n = \gamma - 1$

B. $n = \gamma$

C. $n = \gamma + 1$

D. $n = 1 - \gamma$

Answer: B

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146. The work of 146 kJ is performed in order to compress one kilo mole of a gas adiabatically and in this process the temperature of the gas increases by $7^\circ C$. The gas is $(R = 8.3ml^{-1} Jmol^{-1} K^{-1})$

A. mixture of monoatomic and diatomic

B. monoatomic

C. diatomic

D. triatomic

Answer: C

Watch Video Solution

147. An insulated box containing a monoatomic gas of molar mass (M) moving with a speed v_0 is suddenly stopped. Find the increment is gas temperature as a result of stopping the box.

A. $\frac{Mv^2}{3R}$

B. $\frac{Mv^2}{5R}$

C. $\frac{2Mv^2}{5R}$

D. $\frac{Mv^2}{5R}$

Answer: B

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148. An ideal gas at pressure P and temperature T is enclosed in a vessel of volume V. Some gas leaks through a hole from the vessel and the pressure of the enclosed gas falls to P'. Assume that the temperature of the gas remains constant during the leakage. What is the number of moles of the gas that have leaked ?

A. $\frac{V}{RT}(P + P')$

B. $\frac{2V}{RT}(P + P')$

C. $\frac{V}{RT}(P - P')$

D. $\frac{V}{2RT}(P - P')$

Answer: C

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149. 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. $W_1 > W_2 > W_3$

B. $W_2 > W_3 > W_1$

C. $W_1 > W_3 > W_2$

D. $W_2 > W_1 > W_3$

Answer: D

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150. During an experiment, an ideal gas is found to obey an additional law $VP^2 = \text{constant}$, The gas is initially at a temperature T, and volume V. When it expands to a volume $2V$, the temperature becomes.......

A. 2T

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

C. $\sqrt{2}T$

D. $\frac{T}{\sqrt{2}}$

Answer: C

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151. An ideal gas with pressure P, volume V and temperature T is expanded isothermally to a volume 2V and a final pressure P_i, If the same gas is expanded adiabatically to a volume 2V, the final pressure P_a. The ratio of the specific heats of the gas is 1.67. The ratio $\frac{P_a}{P_1}$ is ....

A. 0.43

B. 0.53

C. 0.63

D. 0.73

Answer: C

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152. A diatomic ideal gas is compressed adiabatically to 1/32 of its initial volume. If the initial temperature of the gas is T_i (in Kelvin) and the final temperature is a T_i, the value of a is

A. 3

B. 4

C. 5

D. 6

Answer: B

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153. Two moles of ideal helium gas are in a rubber balloon at $30^{\circ} C$. The balloon is fully expandable and can be assumed to require no energy in its expansion. The temperature of the gas in the balloon is slowly changed to

$35^{\circ}C$. The amount of heat required in raising the temperature is nearly (take R $= 8.31 J / mol. K$)

A. 62 J

B. 104 J

C. 124 J

D. 208 J

Answer: D

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154. One mole of an ideal gas at an initial temperature true of TK does $6R$ joule of work adiabatically. If the ratio of specific heats of this gas at constant pressure and at constant volume is $5/3$, the final temperature of the gas will be

A. $(T+2.4)K$

B. $(T-2.4)K$

C. $(T+4)K$

D. $(T-4)K$

Answer: D

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155. A monoatomic gas at a pressure p, having a volume 2V and then adiabatically to a volume 16 V. The final pressure of the gas is (take $\gamma = \frac{5}{3}$)

A. P/64

B. 16P

C. 64P

D. 32P

Answer: A

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156. One mole of an ideal monoatomic gas requires 200 J heat to increase its temperature by 10 K, when heated at constant pressure. The same gas is then heated at constant volume to increase its temperature by 10 K. What is the heat required ?

A. 200 J

B. 300 J

C. 120 J

D. 80 J

Answer: C

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157. Certain perfect gas is found to obey the law $PV^{3/2}$= constant, during adiabatic process. If such a gas at initial temprerature T

is adiabatically compressed to half of the initial volume, its final temperature will be

A. 4 T

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

C. 2 T

D. $2\sqrt{2}T$

Answer: B

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158. Suppose that A, B, C, D represent the energies of 1 erg, 1 Joule, 1 calorie, 1 Kcalorie. What is the correct order of magnitudes of their energies ?

A. $A > C > B > D$

B. $A < B < C < D$

C. $A > B > C > D$

D. $A < B > C < D$

Answer: B

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159. If R = universal gas constant, the amount of heat needed to raise the temperature of 2 mole of an ideal monoatomic gas from 273 K to 373 K when no work is done

A. 500 R

B. 300 R

C. 150 R

D. 100 R

Answer: B

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160. When an ideal monoatomic gas is heated at constant pressure, fraction of heat energy supplied which increases the internal energy of gas , is

A. $\frac{3}{7}$

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

C. $\frac{2}{5}$

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

Answer: B

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161. 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 200 J

B. increased by 400 J

C. decreased by 200 J

D. increased by 100 J

Answer: B

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162. The temperature of 10 moles of a gas is increased from $30^{\circ} C$ to $80^{\circ} C$ at constant pressure. If R = 8.2 J/mole K, then the external work done in this process is

A. 410 J

B. 820 J

C. 4100 J

D. 2050 J

Answer: C

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163. Which of the following is incorrect regarding the first law of thermodynamics?

A. It is a restatement of the principle of conservation of energy

B. It is applicable to any cyclic process

C. It introduces the concept of entropy

D. It introduces the concept of the internal energy

Answer: C

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164. If Q, E and W denote respectively the heat added, change in internal energy and the work done in a closed cycle process, then

A. $W = 0$

B. $Q = W = 0$

C. $E = 0$

D. $Q = 0$

Answer: C

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165. In a thermodynamic system working substance is ideal gas, its internal energy is in the form of

A. potential energy only

B. neither kinetic nor potential energy

C. kinetic energy only

D. kinetic and potential energy

Answer: C

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166. In a given process on an ideal gas, $dW = 0$ and dQ is negative, then for the gas:

A. T will increase

B. T will decrease

C. V will increase

D. P may increase or decrease

Answer: B

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167. "Heat cannot by itself flow from a body at lower temperature to a body at higher temperature" is a statement or consequence of

A. first law of thermodynamics

B. conservation of mass

C. conservation of momentum

D. second law of thermodynamics

Answer: D

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168. A monatomic gas expands at constant pressure on heating. The percentage of heat supplied that increases the internal energy of the gas and that is involed in the expansion is

A. 0.3

B. 0.4

C. 0.5

D. 0.6

Answer: D

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169. The work done during expansion of a gas in vacuum is zero, because there is

A. no change in volume (ΔV = 0)

B. no change in temperature

C. no change in internal energy

D. no opposing pressure (noatmospheric pressure)

Answer: D

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170. An ideal gas is filled in a closed rigid and thermally insulated container. A coil of 100Ω resistor carrying current 1 A for 5 minutes supplies heat to the gas. The change in internal energy of the gas is

A. 10 KJ

B. 15 KJ

C. 20 KJ

D. 30 KJ

Answer: D

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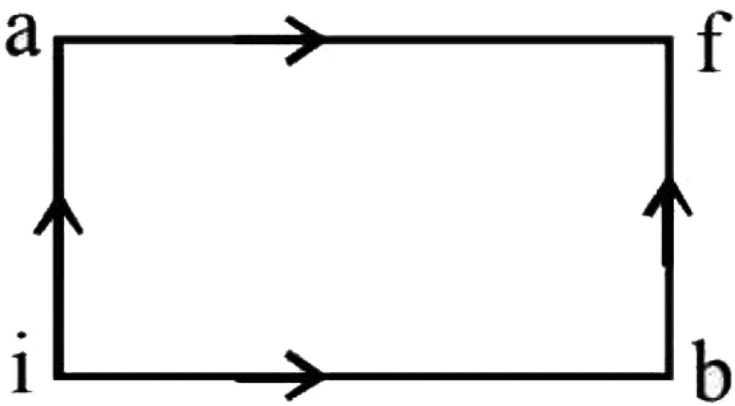
171. When a system is taken from state i to state f along the path iaf, it is found that $Q = 50 cal$ and $W = 20 cal$. Along the path ibf $Q = 36cal$. W along the path ibf is



A. 66 cal

B. 16 cal

C. 14 cal

D. 6 cal

Answer: D

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172. A thermally insulated vessel contains an ideal gas of molecular mass M and ratio of specific heats γ. It is moving with speed v and it's suddenly brought to rest. Assuming no heat is lost to the surroundings, Its temperature increases by:

A. $\frac{(\gamma-1)}{2(\gamma+1)}Mv^2$

B. $\frac{(\gamma-1)}{2\gamma R}Mv^2$

C. $\frac{\gamma Mv^2}{2R}$

D. $\frac{(\gamma - 1)}{2R} Mv^2$

Answer: D

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173. One mole of a monoatomic ideal gas is contained in an insulated and rigid container. It is heated by passing a current of 2A for 10 minutes through a filament of resistance 100Ω. What is change in the internal energy of the gas ?

A. 240 KJ

B. 30 KJ

C. 60 KJ

D. 120 KJ

Answer: A

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174. Two moles of a monoatomic ideal gas occupy a volume V at $27^{\circ} C$. The gas is expanded adiabatically to a volume $2\sqrt{2}V$. The final temperature is 150 K. What is the work done by the gas ? [R = 8.3J/K/mol]

A. 1660 J

B. 3735 J

C. 2490 J

D. 1240 J

Answer: B

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175. A container of volume $1m^3$ is divided into two equal parts by a partition. One part has an ideal gas at 300K and the other part is vacuum. The whole system is thermally isolated from the surroundings. When the partition is removed, the gas expands to occupy the whole volume. Its temperature will now be ....

A. 600 K

B. 150 K

C. 300 K

D. 450 K

Answer: C

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176. The source tempreature of a Carnot engine is $127^\circ C$. It takes 500 cal of heat from the source and rejects 400 cal to the sink during each cycle. What is the temperature of the sink ?

A. $37^\circ C$

B. $47^{\circ} C$

C. $20^{\circ} C$

D. $27^{\circ} C$

Answer: B

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177. A carnot engine working between 450 K and 600 K has a work output of 300 J/cycle. What is the amount of heat energy supplied to the engine from the source in each cycle ?

A. 400 J

B. 800 J

C. 1200 J

D. 1600 J

Answer: C

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178. For which combination of working temperatures the efficiency of Carnot's engine is highest

A. 40 K and 20 K

B. 50 K and 30 K

C. 70 K and 50 K

D. 90 K and 60 K

Answer: A

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179. A carnot engine has the same efficiency between 800 K and 500 K and x K to 400 K. What is the value of x ?

A. 900 K

B. 750 K

C. 640 K

D. 550 K

Answer: C

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180. A cornot engine has the same efficiency between (i) 100 K and 500 K and (ii) T and 900 K. Find T.

A. 130 K

B. 160 K

C. 180 K

D. 200 K

Answer: C

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181. A carnot engine first works between $100^\circ C$ and $0^\circ C$ and then between

$0^\circ C$ and $-100^\circ C$. What is the ratio of its efficiency in these two cases ?

A. 0.51

B. 0.63

C. 0.73

D. 0.85

Answer: C

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182. A Carnot engine takes in heat from a reservoir of heat at $427^\circ C$. How many calories of heat must it take from the reservoir in order to procuce useful mechanical work at the rate of $357wa$?

A. 150 cal/s

B. 160 cal/s

C. 170 cal/s

D. 180 cal/s

Answer: C

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183. In a Carnot engine, the temperature of the reservoir is $927^{\circ} C$ and that of the skin is $27^{\circ} C$. The work done by the engine when it transfers heat from the reservoir to the sink is $12.6 \times 10^{6} J$. What is the quantity of heat absorbed by the engine from the reservoir ?

A. $16.8 \times 16^{6} J$

B. $4 \times 16^{6} J$

C. $4.2 \times 16^{6} J$

D. $7.6 \times 16^6 J$

Answer: A

Watch Video Solution

184. An ideal gas heat engine operates in Carnot cycle between $227^\circ C$ and $127^\circ C$. It absorbs $6.0 \times 10^4 cal$ of heat at high temperature. Amount of heat converted to work is :

A. 2.4×10^4cal

B. 6×10^4cal

C. 1.2×10^4cal

D. 4.8×10^4cal

Answer: C

Watch Video Solution

185. The temperature inside and outside a refrigerator are 273 K and 300 K respectively. Assuming that the refrigerator cycle is reversible. For every joule of work done heat delivered to the surrounding will be nearly :-

A. 5 J

B. 7 J

C. 9 J

D. 12 J

Answer: C

Watch Video Solution

186. The temperature of a refrigeratoe is kept at $7^\circ C$ to keep the food articles kept in it in good condition. What is its coefficient of performance, if the room temperature is $37^\circ C$

A. 7.5

B. 8.3

C. 9.33

D. 10.5

Answer: C

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187. A Carnot engine, having an efficiency of $\eta = \frac{1}{10}$ as heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is

A. 99 J

B. 90 J

C. 1 J

D. 100 J

Answer: B

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188. An ideal refrigerator has a freezer at a temperature of $-13^\circ C$. The coefficient of performance of the engine is 5. The temperature of the air (to which heat is rejected) will be

A. 320 K

B. $39^\circ C$

C. 39 K

D. $325^\circ C$

Answer: B

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189. A Carnot engine takes 3×10^6 cal of heat from a reservoir at $627^\circ C$ and gives it to a sink at $27^\circ C$. The work done by the engine is:

A. zero

B. $16.8 \times 10^6 J$

C. $8.4 \times 10^6 J$

D. $4.2 \times 10^6 J$

Answer: C

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190. Which statement is incorrect ?

A. Carnot cycle has the maximum efficiency in all cycles

B. Carnot cycle is a reversible one

C. Reversible cycle has more efficiency than an irreversible one

D. All reversible cycles have the same efficiency

Answer: D

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191. Even Carnot engine cannot give 100% efficiency because we cannot

A. reach absolute zero temperature

B. find ideal sources

C. eliminate friction

D. prevent radiation

Answer: A

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192. An ideal Carnot's engine whose efficiency 40% receives heat of 500K. If the efficiency is to be 50% then the temperature of sink will be

A. 900 K

B. 800 K

C. 700 K

D. 600 K

Answer: D

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193. The temperature of the source and the sink of a heat engine are $127^\circ C$ and $27^\circ C$ respectively, An inventor claims its efficiency to be 30%, then

A. it is impossible

B. it is possible with high probability

C. it is possible with low probability

D. data is insufficient

Answer: A

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194. A carnot engine has an efficiency of 20%. The energy is supplied to the engine at the rateof $2kW$. What is the output power of the engine?

A. 300 W

B. 400 W

C. 500 W

D. 600 W

Answer: B

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195. For a carnot engine the source and the sink temperatures are $527^\circ C$ and $47^\circ C$ respectively and the engine extracts 800 J of heat in each cycle. What is the area enclosed by the P-V diagram in terms of energy units ?

A. 480 J

B. 600 J

C. 350 J

D. 280 J

Answer: A

Watch Video Solution

196. A carnot engine operates between $227^{\circ}C$ and $127^{\circ}C$. It absorbs 80 kilocalories of heat from the source. What is the work done in joule ?

A. $4.5 \times 10^{4} J$

B. $5.3 \times 10^4 J$

C. $6.72 \times 10^4 J$

D. $7.32 \times 10^4 J$

Answer: C

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197. The efficiency of carnot engine is 50% and temperature of sink is 500K. If temperature of source is kept constant and its efficiency raised to 60%, then the required temperature of the sink will be : -

A. 600 K

B. 500 K

C. 400 K

D. 300 K

Answer: C

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198. A Carnot engine whose sinl is at $300K$ has an efficiency of $40\,\%$. By how much should the temperature of source be increased so as to increase its efficiency by $50\,\%$ of original efficiency.

A. 225 K

B. 250 K

C. 275 K

D. 350 K

Answer: B

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199. A carnot engine operating between temperatures T_1 and T_2 has efficiency $\frac{1}{6}$. When T_2 is lowered by 62K, its efficience increases to $\frac{1}{3}$. Then T_1 and T_2 are respectively:

A. 372 K and 310 K

B. 372 K and 330 K

C. 330 K and 268 K

D. 310 K and 248 K

Answer: A

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200. 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. 1200 K

B. 750 K

C. 600 K

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

Answer: B

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201. The efficiency of a carnot heat engine is 0.6 when the absolute temperatures of the source and sink are T_1 and T_2 respectively. The efficiency of another carnot engine is also 0.6 but the source and sink temperatures are different. What are the temperatures of the source and the sink of the other engine ?

A. $T_1 + 5, T_2 + 5$

B. $T_1 + 10, T_2 - 10$

C. $2T_1, 2T_2$

D. $2T_1$ and $\frac{T_2}{2}$

Answer: C

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202. A Carnot engine whose sinl is at $300K$ has an efficiency of 40%. By how much should the temperature of source be increased so as to increase its efficiency by 50% of original efficiency.

A. 275 K

B. 325 K

C. 250 K

D. 380 K

Answer: C

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203. An engine has an efficiency of $\frac{1}{6}$. When the temperature of sink is reduced by $62^{\circ}C$, its efficiency is doubled. Temperature of the source is

A. $124^\circ C$

B. $37^\circ C$

C. $62^\circ C$

D. $99^\circ C$

Answer: D

Watch Video Solution

204. A diatomic ideal gas is used in a Carnot engine as the working substance. If during the adiabatic expansion part of the cycle the volume of the gas increase from V to 32V, the efficiency of the engine is

A. 0.25

B. 0.5

C. 0.75

D. 0.99

Answer: C

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205. Calculate the least amount of work that must be done to freeze one gram of wate at $0^\circ C$ by means of a refrigerator. Temperature of surroundings is $27^\circ C$. How much heat is passed on the surroundings in this process? Latent heat of fusion $L = 80 cal / g$.

A. 70 cal

B. 50 cal

C. 79 cal

D. 63 cal

Answer: C

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206. Find relation between efficiency (η) of carnot engine and coefficient of performance $(\eta$))` of refrigerator.

A. $\eta = \frac{1}{\beta}$

B. $\eta = \frac{1}{\beta + 1}$

C. $\eta\beta = \frac{1}{2}$

D. $\eta = \frac{1}{\beta - 1}$

Answer: B

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207. A Carnot engine, having an efficiency of $\eta = 1/10$ as heat engine, is used as a refrigerator. If the work done on the system is 10J, the amount of energy absorbed from the reservoir at lower temperature is

A. 100 J

B. 99 J

C. 90 J

D. 10 J

Answer: C

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208. Four copper plates of the same dimensions are painted with red, green, white and black colours. All of them are heated upto a temperature of $300^\circ C$ and then allowed to cool in the surrounding, which is at room temperature. Which plate would cool at the earliest?

A. Green

B. White

C. Black

D. Red

Answer: C

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209. A black body emits which type of wavelength?

A. Infrared wavelengths

B. Ultraviolet wavelengths

C. All wavelengths

D. A particular wavelengths

Answer: C

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210. In which of the following process, convection does not take place primarily

A. Heating of air around a furnace

B. Boiling of water

C. Heating of the glass cover of a bulb due to hot filament

D. Land and sea breezes

Answer: C

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211. Which is not a true statement about black body radiation ?

A. intensity is same for all wavelengths

B. intensity is less for longer wavelengths

C. intensity is more for shorter wavelengths

D. a black body emits all wavelengths

Answer: A

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212. Which of the following is more close to a black body?

A. Black holes

B. Red roses

C. Blackboard paint

D. Green leaves

Answer: C

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213. For an opaque body, coefficient of reflection is 0.3. If 200 J of heat energy is incident on it then the heat absorbed by the body will be

A. 140 J

B. 70 J

C. zero

D. 60 J

Answer: A

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214. Assuming the sun to have a spherical outer surface of radius r radiating like a black body at temperature $t^{\circ} C$. The power received by a unit surface (normal to the incident rays) at a distance R from the centre of the sun is where σ is the Stefan's constant.

A. $\frac{4\pi r^2 t^4}{R^2}$

B. $\frac{r^2 \sigma (t+273)^4}{4\pi R^2}$

C. $\frac{r^2 \sigma (t+273)^4}{R^2}$

D. $\frac{16\pi^2 r^2 \sigma t^4}{R^2}$

Answer: C

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215. You are given a disc, a cube and a sphere, All of them have the same material, volume and nature of the surface. They are heated to $400^\circ C$ and are left in air. Which one of these will have the lowest rate of cooling?

A. Cube

B. Disc

C. Sphere

D. All will have the same rate of cooling

Answer: C

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216. A block of metal is heated to a temperature of $200^\circ C$ which is much higher than the room temperature. It is allowed to cool up to room temperature, in a room which is free from air currents. Its cooling curve (graph of temperature against time) is based on

A. only Stefan's law

B. only Newton's law of cooling

C. both Stefan's law and Newton's law of cooling

D. neither Stefan's law nor Newton's law but by Kirchoffs law

Answer: C

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217. 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. $80 cal / cm^2 s$

B. $500 cal / cm^2 s$

C. $100 cal / cm^2 s$

D. $250 cal / cm^2 s$

Answer: A

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218. A perfectly black body emits radiation at temperature T_1K. If is to radiate at 16 times this power, its temperature T_2K should be

A. $T_2 = 4T_1$

B. $T_2 = 8T_1$

C. $T_2 = 2T_1$

D. $T_2 = 16T_1$

Answer: C

Watch Video Solution

219. 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. 0.5

B. 0.06

C. 2

D. 1

Answer: D

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220. The temperature of a piece of iron is $27^\circ C$ and it is radiating energy at the rate of $QkWm^{-2}$. If its temperature is raised to

$151^{\circ}C$, the rate of radiation of energy will become approximately

A. 2Q kw/m^2

B. 4Q kw/m^2

C. 6Q kw/m^2

D. 8Q kw/m^2

Answer: B

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221. If the temperature of the sun (black body) is doubled, the rate of energy received on earth will be increase by a factor of

A. 2

B. 4

C. 16

D. 8

Answer: C

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222. If the temperature of a black body becomes half of its original temperature, then the amount of radiation emitted by the body per second will be reduced to

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

B. $\frac{1}{4}$

C. $\frac{1}{16}$

D. $\frac{1}{8}$

Answer: C

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223. A black body at high temperature $T\ K$ radiates energy at the rate of EW/m^2. When the temperature falls to $(T/2)K$, the radiated energy will be

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

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

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

D. 2E

Answer: B

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224. The temperature of a black body is increased from $7^{\circ} C$ to $567^{\circ} C$, then the rate of energy radiation becomes

A. 3 times

B. 27 times

C. 9 times

D. 81 times

Answer: D

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225. A blackbody of surface area $10cm^2$ is heated to $127^\circ C$ and is suspended in a room at temperature $27^\circ C$. Calculate the initial rate of loss of heat from the body to the room.

A. 0.5 W

B. 1 W

C. 1.5 W

D. 2 W

Answer: B

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226. A black body A at a temperature of $527^\circ C$, emits radiant energy at the rate of 16 watt. Another black body B at temperature $127^\circ C$, emits radiant energy at the rate 8 watt in the same surrounding. Compare the surface areas of A and B.

A. $1:4$

B. $1:8$

C. $2:1$

D. $4:1$

Answer: B

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227. A black body of surface area$5cm^2$, is kept at $127^\circ C$. The rate of energy radiated by it is E. If its temperature is increased to $527^\circ C$, then the increase in the rate of energy radiation will be

A. 2 E

B. 8 E

C. 15 E

D. 20 E

Answer: C

Watch Video Solution

228. Two spheres P and Q of the same colour and having radii 4 cm and 2 cm are kept at $127^\circ C$ and $527^\circ C$ respectively. The ratio of the energies radiated by P and Q

A. $1:2$

B. $1:4$

C. $3:1$

D. $4:1$

Answer: B

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229. If the temperature of a hot-black body is increased by 10%, the heat energy radiated by it would increase by

A. 1

B. 1.26

C. 1.46

D. 1.76

Answer: C

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230. A black body of $127^\circ C$ radiates heat at the rate of $5cal / cm^2$-second. At $527^\circ C$, the rate of heat radiated in the same units will be

A. 32

B. 48

C. 64

D. 80

Answer: D

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231. A sphere, a cube and a thin circular plate all made of the same material and having the same mass are initially heated to a temperature of $300^\circ C$. Which one of these cools faster ?

A. Circular plate

B. Sphere

C. Cube

D. All will cool at the same rate

Answer: A

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

A. $1:4$

B. $1:16$

C. $1:256$

D. $1:64$

Answer: C

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233. A body radiates heat at the rate of $4cal/m^2/s$, when its temperature is $227^\circ C$. What is the heat radiated by the same body when its temperature is $727^\circ C$?

A. $8cal/m^2/s$

B. $16cal / m^2 / s$

C. $64cal / m^2 / s$

D. $32cal / m^2 / s$

Answer: C

Watch Video Solution

234. A sphere II A cube III A thin circular plate All made of the same material having the same mass are initially heated to $200^\circ C$ Identify the order in which the objects cool faster when left in air room temperature ? .

A. sphere

B. thin circular plate

C. cube

D. all at the same rate

Answer: B

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235. The velocity of thermal radiations (V) is related to the velocity of light (C) as

A. $V > C$

B. $V < C$

C. $V = \frac{C}{2}$

D. $V = C$

Answer: D

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236. The dimensional formula for Boltzmann's constant is

A. $M^0L^0T^{-2}K^{-4}$

B. $M^1L^1T^{-2}K^{-2}$

C. $M^1L^0T^{-3}K^{-4}$

D. $M^0L^2T^{-3}K^{-3}$

Answer: C

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237. Energy is being emitted from the surface of a black body at $127^{\circ} C$ temperature at the rate of $1.0 \times 10^{6} J / \sec - m^{2}$. Temperature of the black at which the rate of energy emission is $16.0 \times 10^{6} J / \sec - m^{2}$ will be

A. $254^{\circ} C$

B. $381^{\circ} C$

C. $527^{\circ} C$

D. $80^{\circ} C$

Answer: C

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238. Suppose that the sun expands, so that its diameter becomes 10 times its present diameter and its surface temperature becomes half of its present value. Then the total energy emitted by the sun per unit time, will increase by a factor of

A. 4.25

B. 5.25

C. 6.25

D. 7.25

Answer: C

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239. A body with surface area (A), temperature (T) and emissivity (e) = 0.6 is kept inside a spherical black body. What will be the maximum energy radiated ?

[σ is Stefan's constant]

A. $0.2\sigma AT^4$

B. $0.4\sigma AT^4$

C. $0.6\sigma AT^4$

D. $0.8\sigma AT^4$

Answer: C

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240. At what temperature, a perfectly black body would radiate energy at a rate of $90.72 \times 10^4 W / m^2$?

A. 1500 K

B. 1800 K

C. 2000 K

D. 2500 K

Answer: C

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241. The temperature of the sun is 6000 K and is treated as a black body. The solar heat energy radiated by the sun is $10^9 W / m^2$.

What is the temperature of a black body if it radiated heat energy of $10^5 W / m^2$?

A. $227^\circ C$

B. $27^\circ C$

C. $327^\circ C$

D. $400^\circ C$

Answer: C

Watch Video Solution

242. Two sphere made of the same material have their radii in the ratio of $2:1$. What is the ratio of the radiant energy emitted per second by them if both of them are at the same temperature ?

A. $4:1$

B. $1:4$

C. $2:1$

D. $1:2$

Answer: A

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243. The quantity of heat radiated per unit time by a perfectly black body at 300 K is $81kJ/s$. What is the power radiated by a body of emissivity 0.8 and having the same area as that of the black at 500 K ?

A. $250k\frac{J}{s}$

B. $400k\frac{J}{s}$

C. $500k\frac{J}{s}$

D. $625k\frac{J}{s}$

Answer: C

Watch Video Solution

244. 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. 1

B. 2

C. 3

D. 0.5

Answer: A

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245. The radiant energy from the Sun incident normally at the surface of earth is $20 kcal / m^2$ min What would have been the radiant energy incident normally on the earth if the sun had a temperature twice of the present one ? .

A. $160 Kcal / m^2 \min$.

B. $40 Kcal / m^2 \min$.

C. $320 Kcal / m^2 \min$.

D. $80 Kcal / m^2 \min$.

Answer: C

Watch Video Solution

246. If temperature of a black body increases from $7^{\circ}C$ to $287^{\circ}C$, then the rate of energy radiation increases by

A. $\left(\frac{287}{7}\right)^4$ times

B. 15 times

C. 4 times

D. $(287-7)^4$ times

Answer: B

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247. A spherical body of emissivity e, placed inside a perfectly black body (emissivity = 1) is maintained at absolute temperature T. The energy radiated by a unit area of the body per second will be (σ is Stefan's constant)

A. $(1 - e)\sigma T^4$

B. $e\sigma T^4$

C. σT^4

D. $(1 + e)\sigma T^4$

Answer: B

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248. A spherical black body with a radius of 12 cm radiates 450 W power at 500 K. If the radius were halved and the temperature doubled, the power radiated in watt would be

(a)225 (b)450

(c) 900 (d)1800

A. 450

B. 900

C. 1800

D. 225

Answer: C

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249. If the temperature of the sun were to increase form T to 2T and its radius from R to 2R, then the ratio of the radiant energy received on earth to what it was previously will be

A. 16

B. 4

C. 64

D. 82

Answer: C

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250. The unit of Stefan's constant σ is

A. Watt$m^{-2}K^{-1}$

B. Watt$m^{-2}K^{-4}$

C. N$m^{-2}K^{-4}$

D. Watt$m^{-2}S^{-1}K^{-4}$

Answer: B

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251. A star behaves like a perfectly black body emitting radiant energy The ratio of radiant energy per second by this star to that emitted by another star having 8 times the radius of former, but having temperature, one-fourth that of the former in Kelvin is .

A. $4:1$

B. $1:4$

C. $1:8$

D. $8:1$

Answer: A

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

A. 1

B. 1.5

C. 2.5

D. 4

Answer: D

Watch Video Solution

253. Two spheres of the same material have radii $1m$ and $4m$ and temperature $4000K$ and $2000K$ respectively . How The energy radiated per second by the first sphere is related to second sphere? .

A. greater than that of B

B. less than that of B

C. equal to that of B

D. double that of B

Answer: C

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254. Two bodies A and B at temperatures $T_1 K$ and $T_2 K$ respectively have the same dimensions. Their emissivities are in the ratio of $1:3$. If they radiate the same amount of heat per unit area per unit time, then the relation between their temperatures is given by

A. $\frac{T_1}{T_2} = \frac{1}{3}$

B. $\frac{T_1}{T_2} = \frac{81}{1}$

C. $\frac{T_1}{T_2} = 3^{1/4} : 1$

D. $\frac{T_1}{T_2} = 9^{1/4} : 1$

Answer: C

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255. The solar constant for the earth is about $1.8 J / m^2 / s$. What is the solar constant for a black body situated on a planet which is situated at a distance of 0.3 times the distance of the earth from the sun ?

A. $9J/m^2/s$

B. $12J/m^2/s$

C. $15J/m^2/s$

D. $20J/m^2/s$

Answer: D

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

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

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

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

Answer: C

Watch Video Solution

257. The rectangular surface area 12cm $\times$ 6cm of a black body at a temperature of $127^{\circ}C$, emits heat energy at the rate of Q units per second. If the length and breadth of the surface area are each reduced to half of its initial value and the temperature is increased to $327^{\circ}C$, then the rate of emission of heat energy will be

A. $\frac{81}{16}Q$

B. $\frac{81}{32}Q$

C. $\frac{81}{64}Q$

D. $\frac{9}{4} \times Q$

Answer: C

Watch Video Solution

258. The temperature of the sun is T. If it becomes 2T, then

A. the rate of emission of energy will become four times

B. the rate of emission of energy will be doubled

C. there will be considerable increase in the emission of infrared radiations

D. there will be considerable increase in the emission of ultraviolet radiations

Answer: D

Watch Video Solution

259. Three discs, A, B and C having radii 2m, 4m and6m respectively are coated with carbon black on their outer surfaces. The wavelengths corresponding to maximum intensity are $300nm$, $400nm$ and $500nm$, respectively. The power radiated by them are Q_A, Q_B and Q_C respectively

(a) Q_A is maximum (b) Q_B is maximum (c) Q_C is maximum (d) $Q_A = Q_B = Q_C$

A. $Q_A = Q_B = Q_C$

B. Q_A is maximum

C. Q_B is maximum

D. Q_C is maximum

Answer: C

Watch Video Solution

260. Assuming the Sun to be a spherical body of radius R at a temperature of TK, evaluate the total radiant powered incident of Earth at a distance r from the sun where r_0 is the radius of the Earth and σ is Stefan's constant.

A. $\frac{r_0^2 R^2 \sigma T^4}{4\pi r^2}$

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

C. $\frac{4\pi r_0^2 R^2 \sigma T^4}{r^2}$

D. $\frac{\pi r_0^2 R^2 \sigma T^4}{r^2}$

Answer: C

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261. A spherical black body with a radius of 12 cm radiates 450 W power at 500 K. What would be the power of radiation if radius were to be halved and the temperature is doubled ?

A. 1800 W

B. 2000 W

C. 1500 W

D. 1200 W

Answer: A

Watch Video Solution

262. Suppose the sun expands so that its radius becomes 100 times its present radius and its surface temperature becomes half of its present value. The total energy emited by it then will increase by a factor of :

A. 625

B. 1000

C. 256

D. 16

Answer: A

Watch Video Solution

263. A hot liquid takes 10 minute to cool from $70^\circ C \rightarrow 60^\circ C$. The time taken by the liquid to cool from $60^\circ C \rightarrow 50^\circ C$ is

A. 10 minute

B. less than 10 minute

C. more than 10 minute

D. more or less than 10 minute depending

upon the liquid and the surrounding

Answer: C

Watch Video Solution

264. If a sphere, a cube and a thin plate are heated and are left in air. Then the one which cools first is

A. the sphere

B. the thin plate

C. the cube

D. cannot decide as their material, volume and nature of the surface is not given

Answer: D

Watch Video Solution

265. Newton's law of cooling leads us to the following expression.

A. $(\theta - \theta_0) = Kt + C$

B. $\log(\theta - \theta_0) = Kt + C$

C. $\log \theta = Kt + C$

D. $\theta = K\theta_0 + C$

Answer: B

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266. Water is filled in a vessel which is kept in a room at a temperature of $20^{\circ} C$. The temperature of the water is slowly increased.

When the temperature of water is $40^{\circ} C$, it loses heat at the rate of 10cal/s. What will be the rate of loss of heat when the temperature of water is $80^{\circ} C$?

A. 20cal/s

B. 30cal/s

C. 40cal/s

D. 60cal/s

Answer: B

Watch Video Solution

267. The rate of cooling of a body is $0.5^\circ C/\text{minute}$, when the body is $50^\circ C$ above the surrounding. What is the rate of cooling if the body is $30^\circ C$ above the surrounding ?

A. $24^\circ C/\text{hour}$

B. $18^\circ C/\text{hour}$

C. $30^\circ C/\text{hour}$

D. $12^\circ C/\text{hour}$

Answer: B

Watch Video Solution

268. A body cools from 60°C to 50°C in 10 min. Find its temperature at the end of next 10 min if the room temperature is $25^{\circ}C$. Assume Newton's law of cooling holds.

A. $\left(\frac{200}{7}\right)^{\circ}C$

B. $\left(\frac{300}{7}\right)^{\circ}C$

C. $\left(\frac{100}{7}\right)^{\circ}C$

D. $\left(\frac{400}{7}\right)^{\circ}C$

Answer: B

Watch Video Solution

269. A vessel full of hot water is kept in a room and it cools from $80^\circ C$ to $75^\circ C$ in T_1 minutes, from $75^\circ C$ to $70^\circ C$ in T_2 minutes and from $70^\circ C$ to $65^\circ C$ in T_3 minutes Then .

A. $t_1 > t_2 > t_3$

B. $t_1 < t_2 = t_3$

C. $t_1 = t_2 = t_3$

D. $t_1 < t_2 < t_3$

Answer: D

Watch Video Solution

270. Liquid is filled in a vessel which is kept in a room with temperature 20°C. When the temperature of the liquid is 80°C, then it loses heat at the rate of 60 cal/sec. What will be the rate of loss of heat when the temperature of the liquid is 40°C ?

A. 180 cal/s

B. 40 cal/s

C. 30 cal/s

D. 20 cal/s

Answer: D

Watch Video Solution

271. According to Newton's law of cooling, the rate of cooling of a body is proportional to $(\Delta\theta)^n$, where $\Delta\theta$ is the difference of the temperature of the body and the surroundings, and n is equal to

A. n = 0.5

B. n = 1

C. $n = 3/2$

D. n = 2

Answer: B

Watch Video Solution

272. A body cools from $100^{\circ} C$ to $70^{\circ} C$ in 8 second. If the room temperature is $15^{\circ} C$, and assuming that Newton's law of cooling holds good, then time required for the body to cool from $70^{\circ} C$ to $40^{\circ} C$ is

A. 7 s

B. 14 s

C. 10 s

D. 20 s

Answer: B

Watch Video Solution

273. A body cools from $50.0^\circ C$ to $49.9^\circ C$ in 10s. How long will it take to cool from $40.0^\circ C$ to $39.9^\circ C$? Assume the temperature of the surrounding to be $30.0^\circ C$ and Newton's law of cooling to be valid.

A. 10 s

B. 20 s

C. 2.5 s

D. 5 s

Answer: B

Watch Video Solution

274. The ratio of the wavelengths of emission corresponding to the maximum emission in the spectrum of a black body heated to temperatures 1000K and 2000K respectively is

A. $\frac{1}{4}$

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

C. $4:1$

D. $2:1$

Answer: D

Watch Video Solution

275. The temperature corresponding to maximum intensity of emission of wavelength 4800Å is

[Given b = 0.002898 mK]

A. 2037 K

B. 4037 K

C. 6037 K

D. 8037 K

Answer: C

Watch Video Solution

276. The light emitted by the sun has maximum wavelength of 570 nm. The light emitted by another star has the maximum wavelength of 380 nm. What is the ratio of the surface temperatures of the star and the sun ?

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

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

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

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

Answer: B

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277. The wavelengths corresponding to maximum energy density of radiation, emitted by the moon and the sun are $10^{-4} m$ and $4 \times 10^{-7} m$ respectively. What is the ratio of their temperatures ?

A. $\frac{1}{100}$

B. $\frac{1}{150}$

C. $\frac{1}{200}$

D. $\frac{1}{250}$

Answer: D

Watch Video Solution

278. If the temperature of a black body is doubled, the frequency at which the spectral intensity becomes maximum will be

A. doubled

B. halved

C. unchanged

D. quadrupled

Answer: A

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279. 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 at T_2

C. equal in two cases

D. can not find, because the dimensions of the body are not given

Answer: B

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280. The phenomenon of black body radiation was explained satisfactorily by

A. kinetic theory

B. classical theory

C. quantum theory

D. theory of relativity

Answer: C

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281. Solar radiation emitted by the sun resembles the radiations emitted by a black body at the temprature of 6000 K. Maximum intensity is emitted at a wavelength of 4800 Å. If the temperature of the sun decreases from 6000 K to 4000 K , then the peak intensity would occur at a wavelength of

A. 3200Å

B. 5200Å

C. 7200Å

D. 9600Å

Answer: C

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282. The maximum wavelength of radiation emitted at 1500 K is $5\mu m$. The maximum wavelength of radiation emitted at 2500 K will be

A. $2\mu m$

B. $3\mu m$

C. $4\mu m$

D. $10\mu m$

Answer: B

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283. If wavelengths of maximum intensity of radiations emitted by the sun and the moon are $0.5 \times 10^{-6} m$ and 10^{-4}m respectively, the ratio of their temperature is ....

A. 200

B. 100

C. $\frac{1}{200}$

D. $\frac{1}{100}$

Answer: C

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284. The temperature of a furnace is $2327^{\circ} C$ and the intensity is maximum in its radiation spectrum at 12000Å. If the intensity in the spectrum of a star is maximum at 4800Å, then the surface temperature of the star is

A. 6500 K

B. 6000 K

C. 4800 K

D. 7500 K

Answer: A

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285. The maximum wavelength of radiation emitted by a black body at $1227^{\circ} C$ is λm. What is its maximum wavelength at $2227^{\circ} C$?

A. $\frac{\lambda m}{2}$

B. $\frac{\lambda m}{3}$

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

D. $\frac{9}{25}\lambda m$

Answer: C

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286. The sun emits light with a maximum wavelength of 510 nm while another star X emits light of maximum wavelength of 350 nm. What is the ratio of the surface temperatures of the sun and the star ?

A. 0.35

B. 1.5

C. 1.1

D. 0.69

Answer: D

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287. Two stars X and Y emit blue and yellow lights respectively. What is the relation between their temperatures (T_x and T_y) ?

A. $T_x > T_y$

B. $T_x < T_y$

C. $T_x = T_y$

D. $T_x = \frac{1}{2}T_y$

Answer: A

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288. The surface temperature of a black body is 1200 K. What is the wavelength corresponding to maximum intensity of emission of radiation if Wien's constant b = $2.892 \times 10^{-3} mK$?

A. $2.41 \times 10^{-4} m$

B. 2.41Å

C. $2.41 \mu m$

D. 2.41 cm

Answer: C

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289. At what temperature a body will appear blue if Wiens constant b = 0.3 cm-K and the wavelength of maximum emission for blue collour is 5000Å ?

A. 5000 K

B. 5500 K

C. 6000 K

D. 6500 K

Answer: C

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290. Two stars A and B radiate maximum energy 5200Å and 6500Å respectively. Then the ratio of absolute temperatures of A and B is

A. $25:16$

B. $5:4$

C. $4:5$

D. $16:25$

Answer: B

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291. What is the temperature of a star having maximum emission at $\lambda_{\max} = 4800\text{Å}$, if for the sun, the surface temperature is 6000 K and the maximum emission is at $\lambda_m = 5000\text{Å}$.

A. 5500 K

B. 5800 K

C. 6100 K

D. 6250 K

Answer: D

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292. The surface temperature of a particular star which is assumed to behave like a black body is about 5×10^4K. What is the wavelength in nanometre at which its intensity of radiation becomes maximum ? [b = 2.9×10^{-3}mK]

A. 48

B. 58

C. 38

D. 38

Answer: B

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293. If the temperature of a black body be increased from $27^{\circ} C$ to $327^{\circ} C$ the radiation emitted increases by a fraction of

A. doubled

B. unchanged

C. halved

D. tripled

Answer: C

Watch Video Solution

294. The earth radiates in the infra-red region of the spectrum. The spectrum is correctly given by

A. Stefan's law of radiation

B. Wien's law

C. Rayleigh Jeans law

D. Planck's law of radiation

Answer: B

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295. The SI unit of Wien's constant in Wien's displacement law is

A. mK

B. m / K

C. K / m

D. $1 / Mk$

Answer: A

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296. The colour of a star indicates its

A. size

B. temperature

C. mass

D. distance from the earth

Answer: B

Watch Video Solution

297. The surface temperature of the sun is about 6000K. If the temperature of the sun becomes twice the present temperature, then [b = $2.9 \times 10^{-3} mK$]

A. the output of radiant energy will be doubled

B. it will radiate predominantly in the infrared region

C. the frequency spectrum of the radiated energy will not change

D. it will radiate predominantly in the ultraviolet region

Answer: D

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298. A black body radiates power P and maximum energy is radiated by it at a wavelength λ_0. The temperature of the black body is now so changed that it radiates maximum energy at the wavelength $\frac{3\lambda_0}{4}$. What is the power radiated by it at the new temperature ?

A. $\frac{16}{9}P$

B. $\frac{256}{81}P$

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

D. $\frac{64}{27}P$

Answer: B

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299. Two black bodies A and B at temperatures 5802 K and 1934 K emits total radiations at the same rate. The wavelength λ_B corresponding to maximum spectral radiancy from B is shifted from the wavelength corresponding to maximum spectral radiancy in the radiation from A by $1.00\mu m$. Then

A. $\lambda_A = \frac{3}{2}\mu m$

B. $\lambda_B = 0.5\mu m$

C. $\lambda_B = \frac{3}{2}\mu m$

D. $\lambda_B = 3\mu m$

Answer: C

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300. In an atomic bomb, the temperature of 10million degrees is developed at the moment of explosion In what region of the spectrum of explosion In what region of the spectrum do the wavelength corresponding to maximum energy density lie ?

$(b = 0.28 \times 10^{-2} S.\, I unit)$.

A. visible region

B. X - ray region

C. infrared region

D. microwaves regions

Answer: B

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301. The absolute temperature of a body X is 4 times that of body Y. For X and Y, the difference in wavelength at which enrgy radiated is maximum is $3\mu m$. What is the wavelength (in μm) at which the body Y radiates maximum energy ?

A. $2\mu m$

B. $3\mu m$

C. $4\mu m$

D. $5\mu m$

Answer: C

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302. Two spheres A and B having radii 3 cm and 5 cm respectively are coated with carbon black on their outer surfaces. The wavelengths of maximum intensity of emitted radiation are 300 nm and 500 nm respectively. If the powers radiated are Q_A and Q_B respectively, then $\frac{Q_A}{Q_B}$ is

A. $\left(\frac{5}{3}\right)^2$

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

C. $\left(\frac{5}{3}\right)^4$

D. $\sqrt{\frac{5}{3}}$

Answer: A

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303. Two spherical bodies A (radius 6cm) and B (radius 18cm) are at temperature T_1 and T_2 respectively The maximum intensity in the emission spectrum of A is at $500nm$ and in that of B is at $1500nm$ considering them to be black bodies, what will be the ratio of the rate of total energy radiated by A to that of B . ?

A. 8

B. 9

C. 10

D. 12

Answer: B

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304. On observing light from three different stars P, Q and R, it was found that intensity of violet colour is maximum in the spectrum of P, the intensity of green colour is maximum in the spectrum of R and the intensity of red colour is maximum in the spectrum of Q. if T_P, T_Q and T_R are respective absolute temperature of P, Q and R. then it can be concluded from the above observation that

A. $T_P > T_R > T_Q$

B. $T_P < T_R < T_Q$

C. $T_P < T_Q < T_R$

D. $T_P > T_Q > T_R$

Answer: A

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305. Which one of the following is a green house gas ?

A. Oxygen

B. Nitrogen

C. Carbon dioxide

D. Hydrogen

Answer: C

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306. Which one of the following in not a green house gas ?

A. Nitrous oxide (N_2O)

B. Oxygen (O_2)

C. Methane (CH_4)

D. Carbon dioxide (CO_2)

Answer: B

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307. In the absence of gree house effect, the temperature of the earth would have been

A. absolute zero

B. 155 K

C. 255 K

D. 355 K

Answer: C

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308. The phenomenon of global warming is due to

A. rotation of the earth

B. ultraviolet radiations

C. green house effect

D. land and sea freezes

Answer: C

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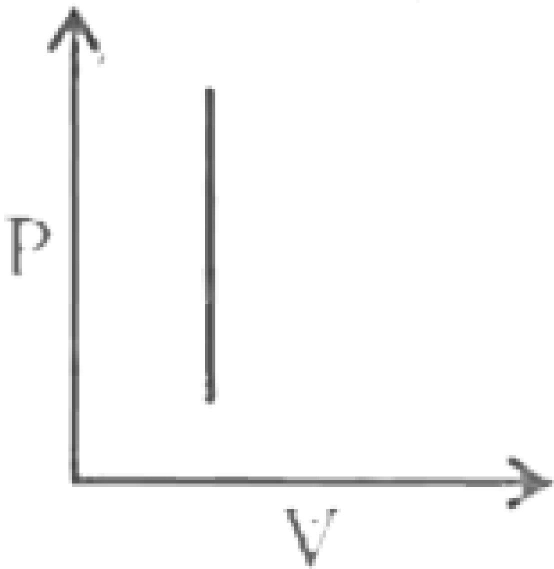
309. The graph of a thermodynamic process is a straight line parallel to pressure axis in P - V diagram. What is the work done in that process ?



A. zero

B. infinity

C. 2PV

D. $\sqrt{PV}$

Answer: A

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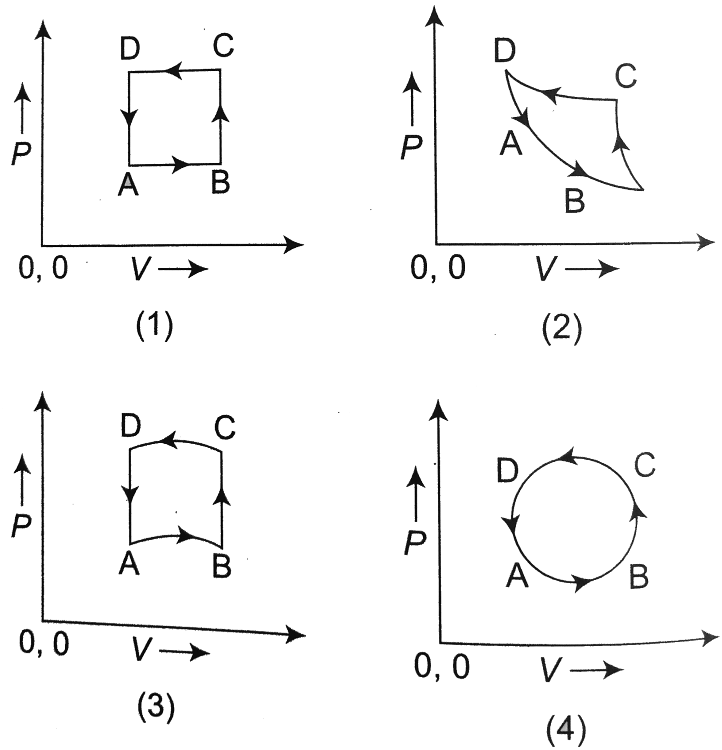
310. In following figs. Variation of volume by change of pressure is shown in Fig. A gas is taken along the path $ABCDA$. The change in internal energy of the tgas will be:



A. zero in all the four cases

B. positive in cases (i), (ii) and (iii) but zero in case (iv)

C. positive in all the cases (i) to (iv)

D. negative in cases (i), (ii) and (iii) but zero in case (iv)

Answer: A

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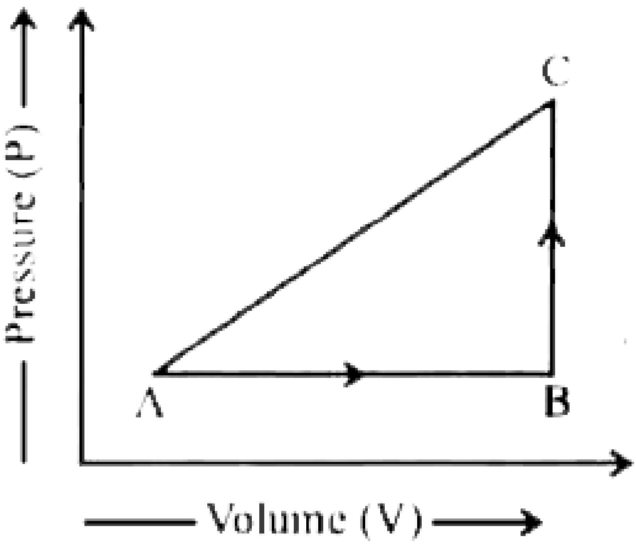
311. The P - V diagram of a system undergoing thermodynamic changes is as shown in the figure. The work done by the system in going from $A \rightarrow B \rightarrow C$ is 30 J. If 68 J of heat is given to the system, then the change in the internal energy of the system between A and C

is



A. 34 J

B. 38 J

C. 50 J

D. 55 J

Answer: B

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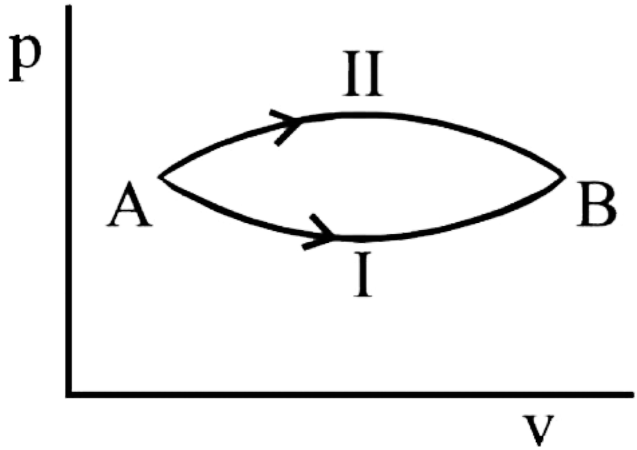
312. A system goes from A and B via two processes. I and II as shown in figure. If ΔU_1 and ΔU_2 are the changes in internal energies in the processes I and II respectively, then



A. $\Delta U_2 < \Delta U_1$

B. $\Delta U_2 > \Delta U_1$

C. relation between ΔU_1 and ΔU_2 cannot be determined

D. $\Delta U_1 = \Delta U_2$

Answer: D

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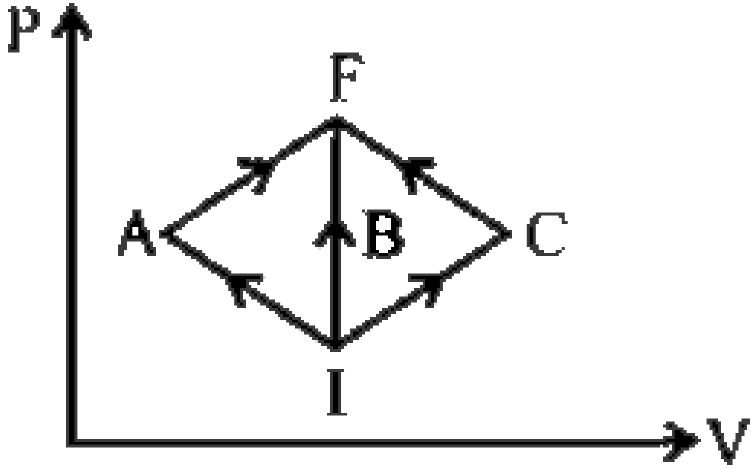
313. In the P - V diagram, I is the initial state and F is the final state. The gas goes from I to F by

(i) IAF, (ii) IBF and (iii) ICF.



The heat absorbed by the gas is

A. the same in all the three processes

B. the same in (i) and (ii)

C. more in (i) than in (ii)

D. the same in (ii) and (iii)

Answer: C

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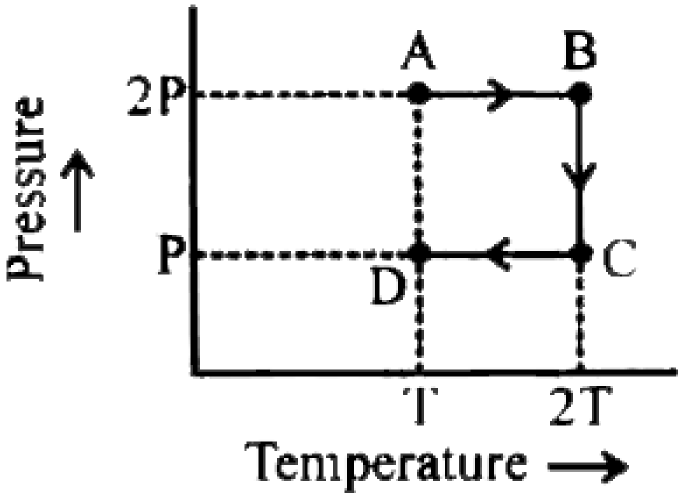
314. An ideal monoatomic gas is taken through the thermodynamic states $A \rightarrow B \rightarrow C \rightarrow D$ via the paths shown in the figure. U_A, U_B, U_C and U_D represent the internal energies of the gas in the states A, B, C and D respectively. Which is the wrong statement from the following ?



A. $U_C > U_D$

B. $U_B = U_C$

C. $U_B < U_A$

D. $U_A = U_D$

Answer: C

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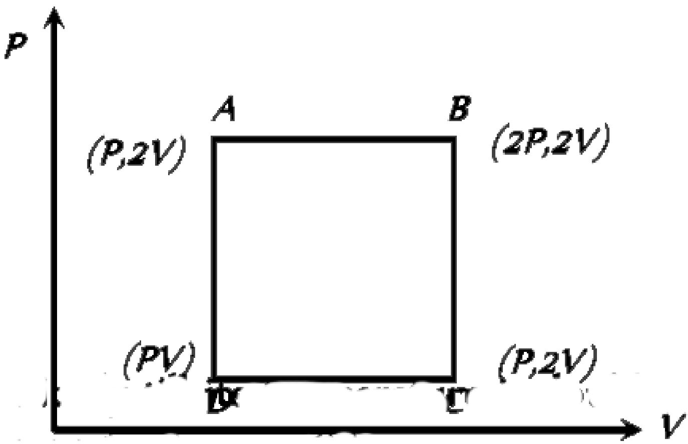
315. An ideal monoatomic gas is taken round the cycle ABCD A shown in the PV diagram in the given fig. The work done the cycle is



A. $2P_1V_1$

B. $\frac{1}{2}P_1V_1$

C. zero

D. P_1V_1

Answer: D

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316. In Newton's law of cooling experiment, we plot a graph of $\left(\frac{d\theta}{dt}\right)$ against the temperature difference $(\theta - \theta_0)$. The graph is

A. a curve passing through the origin

B. a straight line passing through the origin

C. a straight line having an intercept on the y axis

D. a straight line having an intercept on the temperature axis

Answer: B

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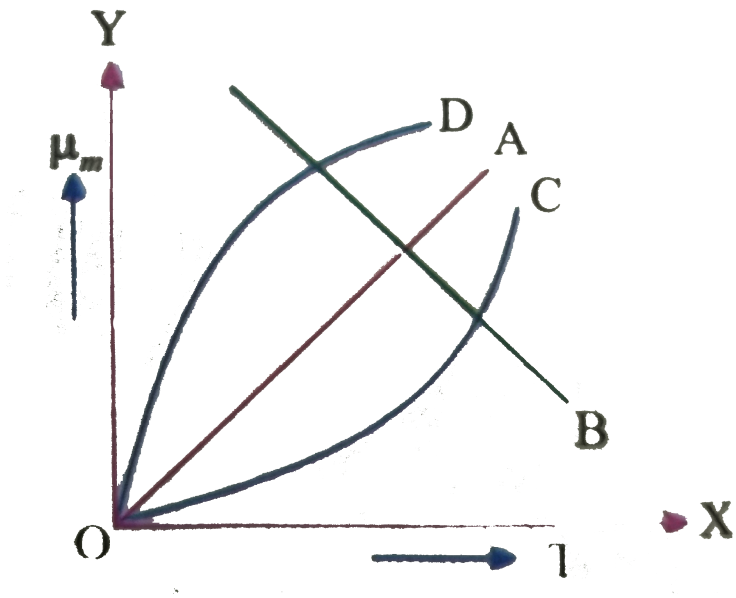
317. The frequency (v_m) corresponding to which energy emitted by a black body is maximum may vary with temperature T of the body as shown in Which of the curves repersents correct variation ?



A. curve D

B. curve C

C. curve B

D. curve A

Answer: C

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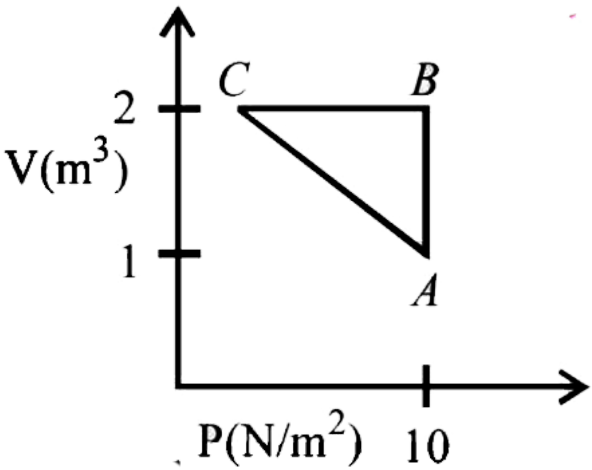
318. An ideal gas is taken through the cycle $A \to B \to C \to A,$ as shown in the figure, If the net heat supplied to the gas in the cycle is 5J, the work done by the gas in the process

CtoA is



A. $-20J$

B. $-5J$

C. $-10J$

D. $-15J$

Answer: B

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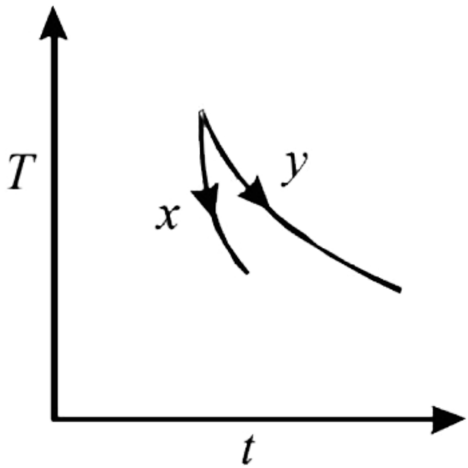
319. The graph, shown in the adjacent diagram, represents the variation of temperature (T) of two bodies, x and y having same surface area, with time (t) due to the emission of radiation. Find the correct relation between the emissivity and absorptivity power of the two bodies



A. $E_x < E_y, a_x < a_y$

B. $E_x > E_y, a_x < a_y$

C. $E_x < E_y, a_x > a_y$

D. $E_x > E_y, a_x > a_y$

Answer: D

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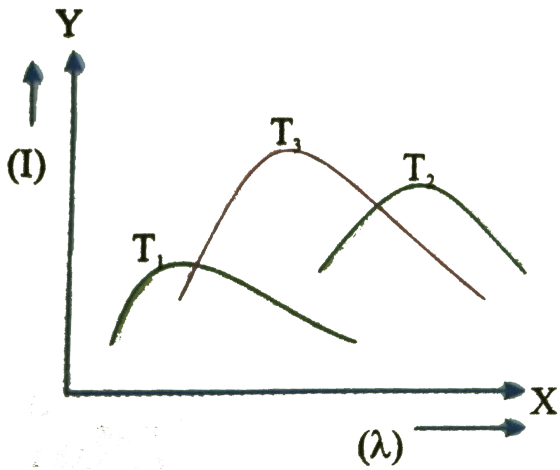
320. The plots of intensity versus wavelength for three black bodies at temperatures T_1, T_2 and T_3 respectively are shown in Their temperatures are shown in How their temperatures are related ?



.

A. $T_2 > T_3 > T_1$

B. $T_3 > T_2 > T_1$

C. $T_1 > T_2 > T_3$

D. $T_1 > T_3 > T_2$

Answer: D

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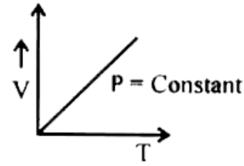
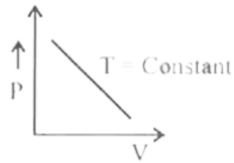
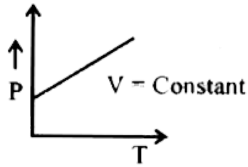
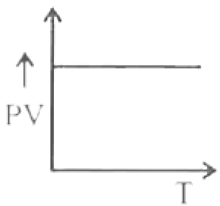
321. Which one of the following graphs correctly gives the ideal gas behaviour ?

A. 

B. 

C. 

D. 

Answer: A

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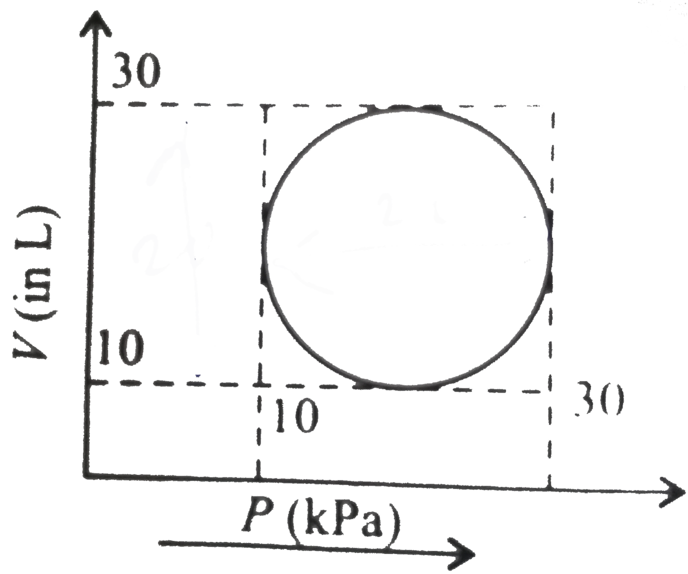
322. Heat energy absorbed by a system in going through a cyclic process shown in figure is



A. $10^{-3}\pi J$

B. $10^{2}\pi J$

C. $10^3 \pi J$

D. $10^4 \pi J$

Answer: B

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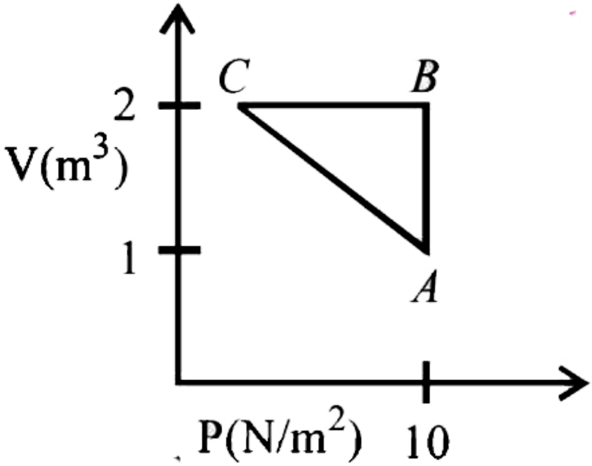
323. An ideal gas is taken through the cycle $A \rightarrow B \rightarrow C \rightarrow A$, as shown in the figure, If the net heat supplied to the gas in the cycle is 5J, the work done by the gas in the process

CtoA is



A. $-10J$

B. $-15J$

C. $-5J$

D. $-20J$

Answer: C

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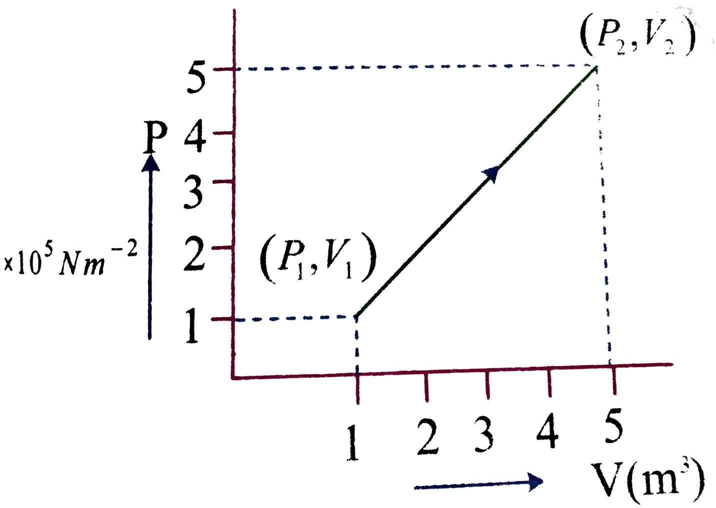
324. A system changes from the state (P_1, V_1) to $(P_2 V_2)$ as shwon in the diagram. The workdone by the system is



A. 7×10^5 Joule

B. 12×10^5 Joule

C. 25×10^5 Joule

D. 6×10^5 Joule

Answer: B

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325. The number of degrees of freedom for a rigid diatomic molecule is

A. 3

B. 5

C. 6

D. 7

Answer: B

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326. The wavelength range of thermal radiation is

A. from 4000Å to 7000Å

B. from 7700Å to 4×10^{16} Å

C. from 10^{6} Å to 10^{8} Å

D. from 4×10^{-12} Å to 4×10^{8} Å

Answer: B

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327. The substance which allows heat radiations to pass through it is

A. Iron

B. Water vapour

C. Wood

D. Dry air

Answer: D

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328. The coefficient of reflection of an opaque body is 0.16. Its coefficient of emission is

A. 0.94

B. 0.84

C. 0.74

D. 0.64

Answer: B

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329. A metal ball cools from $64^{\circ}C$ to $50^{\circ}C$ in 10 minutes and to $42^{\circ}C$ in the next 10 minutes. The ratio of the rates of fall of temperature during the two intervals is

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

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

C. 2

D. 2.5

Answer: B

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330. The light from th sun is found to have a maximum intensity near the wavelength of $470nm$. Assuming that the surface of the sun emits as a blackbody, calculate the temperature of the surface of the sun.

A. 5800 K

B. 6050 K

C. 6166 K

D. 6500 K

Answer: C

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331. Two copper spheres of radii 6 cm and 12 cm respectively are suspended in an evacuated. Each of them is at a temperature $15^{\circ} C$ above the surroundings. The ratio of their of loss of heat is

A. $2:1$

B. $1:4$

C. $1:8$

D. $8:1$

Answer: B

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332. For polyatomic molecules having 'f' vibrational modes, the ratio of two specific heats, $\frac{C_P}{C_V}$ is

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

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

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

D. $\frac{5+f}{4+f}$

Answer: C

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333. 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

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334. 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 the gas

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

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

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

Answer: B

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335. 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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336. 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. $\frac{T_1}{T_2}$

B. $\frac{T_2}{T_1}$

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

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

Answer: C

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337. For a rigid diatomic molecule, univerisal gas constant $R = mc_p$, where $'C_p'$ is the molar specific heat at constant pressure and 'n' is a number. Hence n is equal to

A. 0.2257

B. 0.4

C. 0.2857

D. 0.3557

Answer: C

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338. A ideal gas has pressure 'p', volume 'V' and absolute temperature 'T'. It 'm' is the mass of each molecules and 'K' is the Boltzmann constant , the density of the gas is

A. $\frac{Pm}{KT}$

B. $\frac{KT}{Pm}$

C. $\frac{Km}{PT}$

D. $\frac{PK}{Tm}$

Answer: A

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TEST YOUR GRASP - 9

1. The velocities of 4 molecules are 4m/s, 5m/s, 6m/s and 2m/s respectively. What is their rms velocity?

A. $\frac{5}{2}m/s$

B. $\frac{7}{2}m/s$

C. $\frac{9}{2}m/s$

D. $\frac{3}{2}m/s$

Answer: C

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2. Oxygen and hydrogen gas are at same temperature and pressure. And the oxygen molecule has 16 times the mass of hydrogen molecule. Then the ratio of their rms speed is

A. 2

B. 4

C. $\frac{1}{4}$

D. $\frac{1}{2}$

Answer: C

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3. The mean free path of nitrogen molecules at $27^{\circ} C$ is $3 \times 10^{-7} m / s$. If the average speed of nitrogen molecules at the same temperature is 600 m/s then the collision frequency will be

A. $10^{9} / \mathrm{sec}$

B. $1.5 \times 10^{9} / \mathrm{sec}$

C. $2 \times 10^{9} / \mathrm{sec}$

D. $3 \times 10^{9} / \mathrm{sec}$

Answer: C

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4. The equation of state for 15 gram of oxygen at pressure P, volume V and temperature T is given by

A. PV = 15 RT

B. $PV = \frac{15RT}{2}$

C. $PV = \frac{15}{32}RT$

D. PV = RT

Answer: C

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5. The rms velocity of the molecules of a gas at temperature T is 1200 m/s. If the atmospheric pressure is $10^5 N/m^2$, then the density of the gas at that temperature is approximately equal to

A. $0.1 kg/m^3$

B. $0.2 kg/m^3$

C. $0.02 kg/m^3$

D. $0.03 kg / m^3$

Answer: B

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6. If atmospheric pressure $P = 1 \times 10^5 N / m^2$ and $R = 8 J / \text{mole} / {}^\circ K$, then the kinetic energy per mole of a gas at N.T.P. is

A. 1638 joule/mole

B. 819 joule/mole

C. 3276 joule/mole

D. 4000 joule/mole

Answer: C

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7. At what temperature is the $K.E.$ Of a gas molecules half that of its value at $27^\circ C$

A. $135^\circ C$

B. $150^{\circ} C$

C. `150K

D. 300K

Answer: C

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

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

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

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

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

Answer: A

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9. Argon gas is heated at constant volume through $1^{\circ}C$. The heat supplied to a gas is used to increase the translational and rotational kinetic energies of the gas molecules. What is the percentage share of translational and rotational kinetic energies of the molecules of Argon ?

A. 60% and 40%

B. 40% and 60%

C. 50% and 50%

D. 100% and 0%

Answer: D

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10. C_v denotes the molar specific heat of a gas at constant volume and γ is the adiabatic constant, then the universal gas constant R is given by

A. $C_v[\gamma - 1]$

B. $C_v = \left[\frac{1}{\gamma} - 1\right]$

C. $C_v[1 - \gamma]$

D. $C_v = \left[1 - \frac{1}{\gamma}\right]$

Answer: A

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11. 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. 1.5R

B. 2R

C. 2.5R

D. 3R

Answer: B

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12. Which one of the following is not true about the following thermodynamic processes ?

A. For isobaric process $\Delta P = 0$

B. For adiabatic process $\Delta Q = 0$

C. For isothermal process $\Delta T = 0$

D. For isochoric process $\Delta E = 0$

Answer: D

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13. 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. 2

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

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

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

Answer: B

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14. The difference between the principal specific heats of a gas is 300J/kg K and the ratio of its specific heats $\left(\frac{C_p}{C_v}\right)$ is 1.4. Then the value of C_p expressed in J/kg K is

A. 750

B. 1250

C. 1050

D. 500

Answer: C

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15. When the temperature of 4 moles of a gas was increased from $80^\circ C$ to $100^\circ C$, at constant volume, the change in internal energy was 60J. What is the total heat capacity of the gas at constant volume ?

A. 2 J/K

B. 4 J/K

C. 0.5 J/K

D. 3 J/K

Answer: D

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16. 100g of water is heated from $30^{\circ}C \rightarrow 50^{\circ}C$. Ignoring the slight expansion of the water, the change in its internal energy is (specific heat of water is $4184 J/kg/K$):

A. 4.2 KJ

B. 8.4 kJ

C. 84 kJ

D. 2.1 kJ

Answer: B

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

A. $127^{\circ} C$

B. $227^{\circ} C$

C. $327^{\circ} C$

D. $27^{\circ} C$

Answer: A

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18. In an ideal refrigerator, heat from inside at 280 K is transferred to a room at 300 K. What is the amount of heat (in joule) which will be transferred to the room for each joule of electrical energy consumed in the process ?

A. 12 J

B. 13 J

C. 15 J

D. 18 J

Answer: C

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19. Which one of the following statements is true in the case of radiation emitted by a human body ?

A. It is emitted only during the day

B. It lies in the infrared region

C. It lies in the ultraviolet region and hence it is invisible

D. It is emitted during the summer and absorbed during the winter

Answer: B

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20. A perfectly black sphere of diameter 0.2 m is in thermal equilibrium with the surrounding. What is the temperature of the surrounding, if its rate of absorption of heat energy from the surrounding is $5.67 \times 4\pi \times 10^2$ watt?

$[\sigma = 5.67 \times 10^{-8}$ S.I. units]

A. 10 KJ

B. 100 K

C. 1000 K

D. 10000 K

Answer: C

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21. The radiation emitted by a star A is 100 times that of the sun. If the surface temperatures of the sun and the star are 6000

K and 2000 K respectively, then the ratio of the radii of the star and the sun is

A. $30 : 1$

B. $90 : 1$

C. $60 : 1$

D. $100 : 1$

Answer: B

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22. Three black bodies A, B and C in the form of cubes of sides in the ratio $3:4:5$ are kept at the same high temperature. The ratio of the quantity of heat lost per second by A, B and C will be

A. $27:64:125$

B. $5:4:3$

C. $9:16:25$

D. $25:16:9$

Answer: C

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23. The rate of dissipation of heat by a black body at temperature T is Q. What will be the the rate of dissipation of heat by another body at temperature $2T$ and emissivity 0.25?

A. 8Q

B. 4Q

C. 16Q

D. 32Q

Answer: B

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24. A body is heated to a temperature of $75^\circ C$ and is allowed to cool. If the temperature of the surrounding is $35^\circ C$, then the temperature at which the rate of cooling will be exactly half of that initially will be

A. $37.5^\circ C$

B. $50^\circ C$

C. $55^{\circ} C$

D. $30^{\circ} C$

Answer: C

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25. A body cools from $50^{\circ} C$ to $46^{\circ} C$ in 5 minutes and to $40^{\circ} C$ in the next 10 minutes. The surrounding temperature is :

A. $36^{\circ} C$

B. $32^\circ C$

C. $30^\circ C$

D. $28^\circ C$

Answer: D

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26. The maximum wavelength of radiation emitted from the sun at 6000 K is about 550 nm. What would be the wavelength of maximum radiation emitted from the earth at $27^{\circ}C$?

A. $22\mu m$

B. $33\mu m$

C. $11\mu m$

D. $44\mu m$

Answer: C

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27. The temperature of a black body is gradually increased. The colour of the body will change from

A. White - green - red

B. Red - yellow - blue

C. Red - violet - yellow

D. Yellow - green - red

Answer: B

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28. 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. 10^3K

B. 10^5K

C. 10^7K

D. 10^{-10}K

Answer: C

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29. Which rays are responsible for green house effect ?

A. Ultraviolet rays

B. Infrared rays

C. X-rays

D. Cosmic rays

Answer: B

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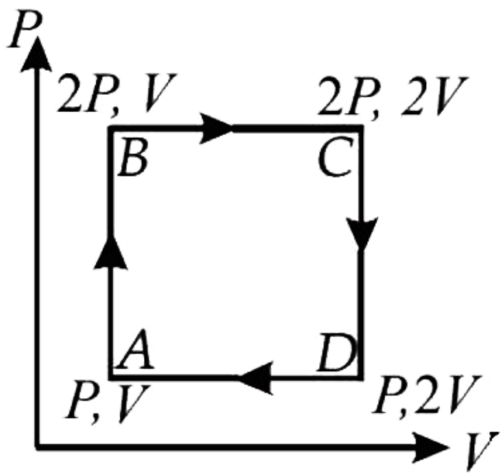
30. An ideal monoatomic gas is taken round the cycle ABCDA as shown in the P-V diagram. The work done during the cycle is



A. zero

B. PV

C. 2 PV

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

Answer: C

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