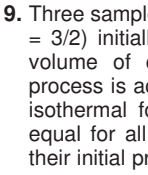
The rate of emission of energy..?

Thermal Physics



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1. The amount of heat energy (in joules) supplied to 14 grams of nitrogen at room temperature to raise its temperature by 40°C at constant pressure. (Molar mass of nitrogen = 28 and R is the gas constant)
1) 50 R 2) 60 R 3) 70 R 4) 80 R

2. A Carnot's engine working between 300 K and 600 K has a work out put of 800 J per cycle. How much heat energy is supplied to the engine from the source in each cycle?
1) 1400 J 2) 1500 J 3) 1600 J 4) 1700 J

3. Two cylindrical rods of lengths l_1 and l_2, radii r_1 and r_2 have thermal conductivities k_1 and k_2 respectively. The ends of the rods are maintained at the same temperature difference. If $l_1 = 2l_2$ and $r_1 = \frac{r_2}{2}$, the rate of heat flow in them will be the same if $\frac{k_1}{k_2}$ is
1) 1 2) 2 3) 4 4) 8

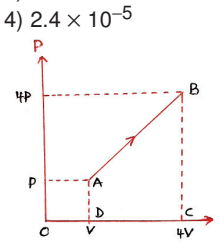
4. When an ideal gas at pressure P, temperature T and volume V is isothermally compressed to $\frac{V}{n}$, its pressure becomes P_i. If the gas is compressed adiabatically to $\frac{V}{n}$, its pressure becomes P_a. Then the ratio $\frac{P_i}{P_a}$ is .... $\left(\gamma = \frac{c_p}{c_v}\right)$
1) 1 2) n 3) n^γ 4) $n^{(1-\gamma)}$

5. A body cools from 80°C to 50°C in 6 minutes in a room where the temperature is 20°C. What is the temperature of the body at the end of next 6 minutes?
1) 20°C 2) 25°C 3) 30°C 4) 35°C

6. When the temperature of a rod increases from t to t + Δt, the moment of inertia increases from I to I + ΔI. The coefficient of linear expansion of the rod is α. The ratio of $\frac{\Delta I}{I}$ is ....
1) α. Δt 2) 2α. Δt 3) $\frac{\Delta t}{t}$ 4) $2\frac{\Delta t}{t}$

7. A pendulum clock having a metal rod keeps correct time at 20°C. When the temperature falls to 0°C, it gains 12 seconds per day. The coefficient of linear expansion of the metal (in/ °C) is.....
1) 1.8×10^{-5} 2) 1.4×10^{-5}
3) 2.8×10^{-5} 4) 2.4×10^{-5}

8. The figure shows the P – V diagram for 2 moles of a diatomic ideal gas under going a process A → B. Then the molar specific heat capacity of the gas is



1) R 2) $\frac{3R}{2}$ 3) 3R 4) $\frac{7R}{2}$

9. Three samples of the same gas A, B and C ($\gamma = 3/2$) initially have equal volume. Now the volume of each sample is doubled. The process is adiabatic for A, isobaric for B and isothermal for C. If the final pressures are equal for all the three samples, the ratio of their initial pressures is ...
1) 1 : 1 : 1 2) 1 : 2 : 3
3) 2 : 1 : $2\sqrt{2}$ 4) $2\sqrt{2}$: 1 : 2

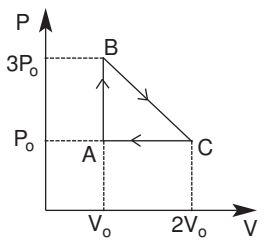
10. Two metallic spheres S_1 and S_2 are made of the same material and have identical surface finish. The mass of S_1 is 3 times that of S_2. Both the spheres are heated to the same high temperature and placed in the same room having lower temperature but are thermally insulated from each other. Then the ratio of the initial rate of cooling of S_1 to that of S_2 is .....
1) $\frac{1}{3}$ 2) $\sqrt{3}$ 3) $\left(\frac{1}{3}\right)^{1/3}$ 4) $\frac{1}{\sqrt{3}}$

11. 2 moles of a monatomic ideal gas occupy a volume V at 27°C. The gas is expanded adiabatically to a volume $2\sqrt{2}V$. Then the change in the internal energy of the gas in this process is ....
1) –3735J 2) 3735J 3) 0J 4) 1245J

12.

Three cylindrical rods A, B and C of equal lengths and equal diameters are joined in series as shown in the figure. Their thermal conductivities are 2k, k and 0.5 k respectively. In the steady state, the free ends of the rods are at 100°C and 0°C, respectively. Then the temperature of the junction between rods A and B is..... (neglect the loss of heat from curved surfaces of rods)
1) 85.7°C 2) 75.7°C 3) 95.7°C 4) 55.7°C

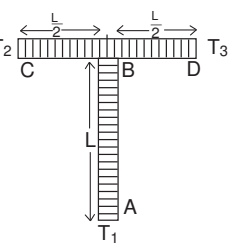
13. One mole of an ideal monatomic gas is taken round the cyclic process ABCA as shown in the figure. Then the heat energy rejected by the gas in the Process C → A is .....



1) $-P_oV_o$ 2) $-3P_oV_o$
3) $\frac{-5}{2}P_oV_o$ 4) $\frac{-3}{2}P_oV_o$

14. A copper block of mass 2 kg is heated to a temperature of 500°C and then placed in a large block of ice at 0°C. What is the maximum amount of ice that can melt? (Specific heat of copper = 400 J $kg^{-1}°C^{-1}$ and latent heat of fusion of water = 3.5×10^5 Jkg^{-1})
1) $\frac{5}{7}$ kg 2) $\frac{8}{7}$ kg 3) $\frac{9}{7}$ kg 4) $\frac{7}{9}$ kg

15. Two identical rods AB and CD each of length L, cross – sectional area A and thermal conductivity K are connected as shown in the figure. Ends A, C and D are maintained at temperatures T_1 = 20°C, T_2 = 30°C and T_3 = 40°C, respectively. Then the temperature at B is...



1) 30°C 2) 32°C 3) 40°C 4) 42°C

16. In an adiabatic process, the relation between internal energy U, volume V and pressure P of a real gas is, U = a + b PV where a and b are constants. If a = 3 J and b = 2.5, the ratio of the two specific heats of the gas is.....
1) $\frac{3}{5}$ 2) $\frac{5}{3}$ 3) $\frac{5}{7}$ 4) $\frac{7}{5}$

17. A vessel contains 1 mole of O_2 gas (molar mass 32) at a temperature T. The pressure of the gas is P. An identical vessel containing one mole of the gas (molar mass 4) at a temperature 2T has a pressure of.....
1) P 2) 2 P 3) 8 P 4) $\frac{P}{8}$

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Physics

18. An insulated box containing a diatomic gas of molar mass M is moving with a velocity V. The box is suddenly stopped. Then the resulting change in temperature is.....
1) $\frac{MV^2}{R}$ 2) $\frac{MV^2}{2R}$ 3) $\frac{MV^2}{3R}$ 4) $\frac{MV^2}{5R}$

19. A wire of length L_o is supplied heat to raise its temperature by T. If γ is the coefficient of volume expansion of the wire and Y is young's modulus of the wire, then the energy density stored in the wire is....
1) $\frac{1}{3}\gamma^2YT^2$ 2) γ^2YT^2
3) $\frac{1}{9}\gamma^2YT^2$ 4) $\frac{1}{18}\gamma^2YT^2$

20. A liquid of mass m and specific heat C is heated to a temperature 2 T. Another liquid of mass m/2 and specific heat 2 C is heated to a temperature T. If these two liquids are mixed, the resulting temperature of the mixture is .....
1) T 2) $\frac{3}{2}$ T 3) $\frac{2}{3}$ T 4) 2T

21. A heat flux of 4000 J/ S is to be passed through a copper rod of length 10 cm and area of cross section 100 cm^2. The thermal conductivity of copper is 400 W/m/°C. The two ends of this rod must be kept at a temperature difference of ....
1) 100°C 2) 1000°C 3) 10°C 4) 1°C

22. A rectangular surface of area 8 cm × 4 cm of a black body at a temperature of 127°C emits energy at the rate of E per second. If the length and breadth of the surface are each reduced to half the initial value and the temperature is raised to 327°C, the rate of emission of energy will become....
1) $\frac{3}{4}$ E 2) $\frac{9}{16}$ E 3) $\frac{64}{81}$ E 4) $\frac{81}{64}$ E

23. A sphere and a cube of same material and same volume are heated up to same temperature and allowed to cool in the same surroundings. The ratio of the amounts of radiations in equal time intervals will be
1) 1 : 1 2) π : 1 3) $\frac{\pi}{6}$: 1 4) $\left(\frac{\pi}{6}\right)^{1/3}$: 1

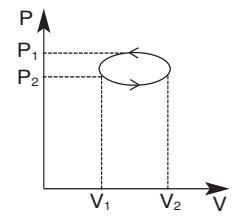
24. A rod of length *l* and cross sectional area A has a variable conductivity given by k = αT, where α is a positive constant and T is temperature in kelvin. Two ends of the rod are maintained at temperatures T_1 and T_2 ($T_1 > T_2$). Then the heat current flowing through the rod will be.....
1) $\frac{A\alpha(T_1^2 - T_2^2)}{2l}$ 2) $\frac{A\alpha(T_1 - T_2)}{2l}$
3) $\frac{A\alpha(T_1^2 - T_2^2)}{l}$ 4) $\frac{A\alpha(T_1^2 + T_2^2)}{2l}$

25. An incandescent lamp consuming P=54 W is immersed into a transparent calorimeter containing $V = 10^3$ cm^3 of water. In 420s the water is heated by 4°C. The percentage of the energy consumed by the lamp that passes out of the calorimeter in the form of radiant energy is...
1) 26% 2) 52% 3) 78% 4) 90%

26. The equation of state for a gas is given by, PV = nRT + αV, where n is the number of moles and α a positive constant. The initial pressure and temperature of 1 mole of the gas contained in a cylinder is P_o and T_o respectively. The workdone by the gas when its temperature doubles isobarically will be .....
1) $\frac{P_oT_oR}{\alpha}$ 2) $\frac{P_oT_oR}{(P_o + \alpha)}$
3) $\frac{P_oT_oR}{(P_o - \alpha)}$ 4) P_oT_oR

27. One mole of a diatomic gas undergoes a process $p = \frac{p_o}{\left[1 + \left(\frac{V}{V_o}\right)^3\right]}$ where P_o and V_o are constants. The translational kinetic energy of the gas when $v = v_o$ is .....
1) $\frac{3P_oV_o}{2}$ 2) $\frac{3P_oV_o}{4}$
3) $\frac{5P_oV_o}{2}$ 4) $\frac{5P_oV_o}{4}$

28. In the given elliptical P–V diagram the work done is



1) $-\left(\frac{\pi}{4}\right)^2 (P_2 - P_1)(V_2 - V_1)$
2) $\pi(V_2 - V_1)^2 - \pi(P_2 - P_1)^2$
3) $-\pi\left(\frac{V_2 - V_1}{2}\right)\left(\frac{P_2 - P_1}{2}\right)$
4) $\frac{\pi}{4}(P_2 - P_1)(V_2 - V_1)$

29. A certain ideal gas undergoes a polytropic process PV^n = constant such that the molar specific heat during the process is negative. It the ratios of the specific heats of gas is γ, then the range of values of n will be...
1) n = γ 2) n > γ
3) 1 < n < γ 4) o < n < γ

30. Two identical containers A and B have frictionless pistons. They contain the same volume of an ideal gas at the same temperature. 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 double the initial volume. The change in the pressure in A and B, respectively is ΔP and 1.5 ΔP then.....
1) 2 M_A = 3 M_B 2) 3 M_A = 2 M_B
3) 4 M_A = 9 M_B 4) 9 M_A = 4 M_B

ANSWERS

1-3; 2-3; 3-4; 4-4; 5-4; 6-2; 7-2; 8-4; 9-4; 10-3; 11-1; 12-1; 13-3; 14-2; 15-2; 16-4; 17-2; 18-4; 19-4; 20-2; 21-1; 22-4; 23-4; 24-1; 25-1; 26-3; 27-2; 28-3; 29-3; 30-2.