Heat

PREVIOUS YEARS' QUESTIONS — EXERCISE-II

1. Heat given to a body which raises its temperature by 1°C is- **[AIEEE - 2002]**

(1) water equivalent

(2) thermal capacity

(3) specific heat

(4) temperature gradient

2. Cooking gas containers are kept in a lorry moving with uniform speed. The temperature of the gas molecules inside will- **[AIEEE - 2002]**

(1) increase

(2) decrease

(3) remains same

(4) decrease for some, while increase for others

3. At what temperature is the rms velocity of a hydrogen molecule equal to that of an oxygen molecules at 47° C ? **[AIEEE-2002]**

(1) 80 K (2) – 73 K

(3) 3 K (4) 20 K

4. 1 mole of a gas with $\gamma = 7/5$ is mixed with 1 mole of a gas with $\gamma = 5/3$, then the value of γ for the resulting mixture is- **[AIEEE-2002]**

(1) 7/5 (2) 2/5

(3) 24/16 (4) 12/7

5. Two spheres of the same material have radii 1 m and 4 m and temperatures 4000 K and 2000 K respectively. The ratio of the energy radiated per second by the first sphere to that by the second is- **[AIEEE - 2002]**

(1) 1 : 1 (2) 16 : 1

(3) 4 : 1 (4) 1 : 9

6. One mole of ideal monoatomic gas ($\gamma = 5/3$) is mixed with one mole of diatomic gas ($\gamma = 7/5$). What is γ for the mixture ? γ denotes the ratio of specific heat at constant pressure, to that at constant volume- **[AIEEE-2004]**

(1) 3/2 (2) 23/15

(3) 35/23 (4) 4/3

7. Two thermally insulated vessels 1 and 2 are filled with air at temperatures (T_1, T_2), volume (V_1, V_2) and pressure (P_1, P_2) respectively. If the valve joining the two vessels is opened, the temperature inside the vessel at equilibrium will be **[AIEEE - 2004]**

(1) $T_1 + T_2$

(2) $\dfrac{(T_1 + T_2)}{2}$

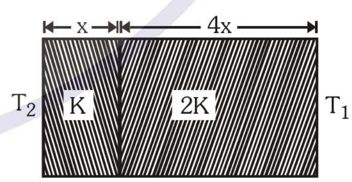
(3) $\dfrac{T_1T_2(P_1V_1 + P_2V_2)}{P_1V_1T_2 + P_2V_2T_1}$

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

8. If the temperature of the sun were to increase from 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- **[AIEEE - 2004]**

(1) 4 (2) 16 (3) 32 (4) 64

9. The temperature of the two outer surfaces of a composite slab, consisting of two materials having coefficients of thermal conductivity K and 2K and thickness x and 4x, respectively are T_2 and $T_1(T_2 > T_1)$. The rate of heat transfer through the slab, in a steady state is $\left(\dfrac{A(T_2 - T_1)K}{x}\right)f$, with f equals to- **[AIEEE - 2004]**



(1) 1

(2) 1/2

(3) 2/3

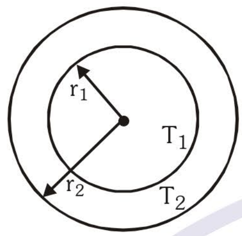
(4) 1/3

10. A gaseous mixture consists of 16 g of helium and 16 g of oxygen. The ratio $\dfrac{C_p}{C_v}$ of the mixture is- **[AIEEE-2005]**

(1) 1.59 (2) 1.62

(3) 1.4 (4) 1.54

11. The figure shows a system of two concentric spheres of radii r_1 and r_2 and kept at temperatures T_1 and T_2, respectively. The radial rate of flow of heat in a substance between the two concentric spheres, is proportional to- **[AIEEE - 2005]**



(1) $\frac{(r_2-r_1)}{(r_1r_2)}$ (2) $\ell n\left(\frac{r_2}{r_1}\right)$

(3) $\frac{r_1r_2}{(r_2-r_1)}$ (4) $(r_2 - r_1)$

12. 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 B contains one mole of helium at temperature (7/3) T_0. The boxes are then put into thermal contact with each other, and heat flows between them until the gases reach a common final temperature (Ignore the heat capacity of boxes). Then, the final temperature of gases, T_f, in terms of T_0 is - **[AIEEE - 2006]**

(1) $T_f = \frac{3}{7}T_0$ (2) $T_f = \frac{7}{3}T_0$

(3) $T_f = \frac{3}{2}T_0$ (4) $T_f = \frac{5}{2}T_0$

13. Assuming the sun to be a spherical body of radius R at a temperature of T K, evaluate the total radiant power, incident on earth, at a distance r from the sun- (r_0 is the radius of earth) **[AIEEE - 2006]**

(1) $4\pi r_0^2 R^2 \sigma T^4 / r^2$

(2) $\pi r_0^2 R^2 \sigma T^4 / r^2$

(3) $r_0^2 R^2 \sigma T^4 / 4\pi R^2$

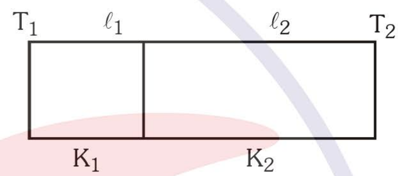
(4) $R^2 \sigma T^4 / r^2$

14. If C_P and C_V denote the specific heats of nitrogen per unit mass at constant pressure and constant volume respectively, then- **[AIEEE - 2007]**

(1) $C_P - C_V = R/28$ (2) $C_P - C_V = R/14$

(3) $C_P - C_V = R$ (4) $C_P - C_V = 28\,R$

15. One end of a thermally insulated rod is kept at a temperature T_1 and the other at T_2. The rod is composed of two sections of lengths ℓ_1 and ℓ_2 and thermal conductivities K_1 and K_2 respectively. The temperature at the interface of the two sections is- **[AIEEE - 2007]**



(1) $(K_2\ell_2T_1 + K_1\ell_1T_2)/(K_1\ell_1 + K_2\ell_2)$

(2) $(K_2\ell_1T_1 + K_1\ell_2T_2)/(K_2\ell_1 + K_1\ell_2)$

(3) $(K_1\ell_2T_1 + K_2\ell_1T_2)/(K_1\ell_2 + K_2\ell_1)$

(4) $(K_1\ell_1T_1 + K_2\ell_2T_2)/(K_1\ell_1 + K_2\ell_2)$

16. An insulated container of gas has two chambers separated by an insulating partition. One of the chambers has volume. V_1 and contains ideal gas at pressure P_1 and temperature T_1. The chamber has volume V_2 and contains ideal gas at pressure P_2 and temperature T_2. If the partition is removed without doing any work on the gas, the final equilibrium temperature of the gas in the container will be **[AIEEE - 2008]**

(1) $\frac{T_1T_2(P_1V_1+P_2V_2)}{P_1V_1T_2+P_2V_2T_1}$ (2) $\frac{P_1V_1T_1+P_2V_2T_2}{P_1V_1+P_2V_2}$

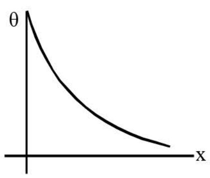
(3) $\frac{P_1V_1T_2+P_2V_2T_1}{P_1V_1+P_2V_2}$ (4) $\frac{T_1T_2(P_1V_1+P_2V_2)}{P_1V_1T_1+P_2V_2T_2}$

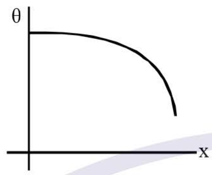
17. One kg of a diatomic gas is at a pressure of 8×10^4 N/m^2. The density of the gas is 4 kg/m^3. What is the energy of the gas due to its thermal motion ? **[AIEEE - 2009]**

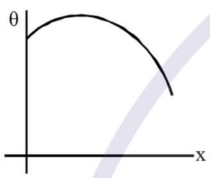
(1) 6×10^4 J (2) 7×10^4 J

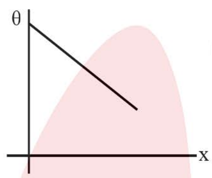
(3) 3×10^4 J (4) 5×10^4 J

18. A long metallic bar is carrying heat from one of its ends to the other end under steady-state. The variation of temperature θ along the length x of the bar from its hot end is best described by which of the following figures ? **[AIEEE - 2009]**

(1) 

(2) 

(3) 

(4) 

19. Three perfect gases at absolute temperatures T_1, T_2 and T_3 are mixed. The masses of molecules are m_1, m_2, and m_3 and the number of molecules are n_1, n_2 and n_3 respectively. Assuming no loss of energy, then final temperature of the mixture is :- **[AIEEE - 2011]**

(1) $\frac{n_1T_1^2+n_2T_2^2+n_3T_3^2}{n_1T_1+n_2T_2+n_3T_3}$

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

(3) $\frac{T_1+T_2+T_3}{3}$

(4) $\frac{n_1T_1+n_2T_2+n_3T_3}{n_1+n_2+n_3}$

20. An aluminium sphere of 20 cm diameter is heated from 0°C to 100°C. Its volume changes by (given that coefficient of linear expansion for aluminium $\alpha_{Al} = 23 \times 10^{-6}$/°C :- **[AIEEE - 2011]**

(1) 28.9 cc (2) 2.89 cc

(3) 9.28 cc (4) 49.8 cc

21. A wooden wheel of radius R is made of two semicircular parts (see figure). The two parts are held together by a ring made of a metal strip of cross sectional area S and Length L. L is slightly less than $2\pi R$. To fit the ring on the wheel, it is heated so that its temperature rises by ΔT and it just steps over the wheel. As it cools down to surrounding temperature, it presses the semicircular parts together. If the coefficient of linear expansion of the metal is α, and its Young's modulus is Y, the force that one part of the wheel applies on the other part is : **[AIEEE - 2012]**

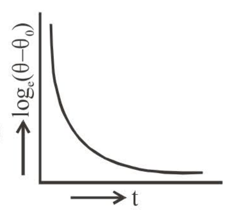
(1) $2SY\alpha\Delta T$

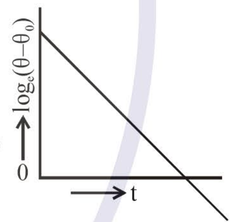
(2) $2\pi SY\alpha\Delta T$

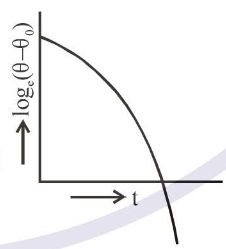
(3) $SY\alpha\Delta T$

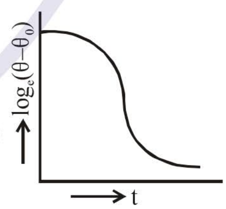
(4) $\pi SY\alpha\Delta T$

22. A liquid in a beaker has temperature θ(t) at time t and θ_0 is temperature of surroundings, then according to Newton's law of cooling the correct graph between $\log_e(\theta - \theta_0)$ and t is :- **[AIEEE - 2012]**

(1) 

(2) 

(3) 

(4) 

23. The pressure that has to be applied to the ends of a steel wire of length 10 cm to keep its length constant when its temperature is raised by 100°C is:

(For steel Young's modulus is 2×10^{11} N m^{-2} and coefficient of thermal expansion is 1.1×10^{-5} K^{-1}) **[JEE(Main)-2014]**

(1) 2.2×10^7 Pa (2) 2.2×10^6 Pa

(3) 2.2×10^8 Pa (4) 2.2×10^9 Pa

24. Three rods of Copper, Brass and Steel are welded together to form a Y-shaped structure. Area of cross-section of each rod = 4 cm^2. End of copper rod is maintained at 100°C where as ends of brass and steel are kept at 0°C. Lengths of the copper, brass and steel rods are 46, 13 and 12 cms respectively. The rods are thermally insulated from surroundings except at ends. Thermal conductivities of copper, brass and steel are 0.92, 0.26 and 0.12 CGS units respectively. Rate of heat flow through copper rod is : **[JEE(Main)-2014]**

(1) 4.8 cal/s (2) 6.0 cal/s

(3) 1.2 cal/s (4) 2.4 cal/s

25. A pendulum clock loses 12s a day if the temperature is 40°C and gains 4s a day if the temperature is 20°C. The temperature at which the clock will show correct time, and the co-effecient of linear expansion (α) of the metal of the pendulum shaft are respectively :- **[JEE(Main)-2016]**

(1) 55°C ; $\alpha = 1.85 \times 10^{-2}$ / °C

(2) 25°C ; $\alpha = 1.85 \times 10^{-5}$ / °C

(3) 60°C ; $\alpha = 1.85 \times 10^{-4}$ / °C

(4) 30°C ; $\alpha = 1.85 \times 10^{-3}$ / °C

26. The temperature of an open room of volume 30 m^3 increases from 17°C to 27°C due to sunshine. The atmospheric pressure in the room remains 1×10^5 Pa. If n_i and n_f are the number of molecules in the room before and after heating, then $n_f - n_i$ will be :- **[JEE(Main)-2017]**

(1) 2.5×10^{25} (2) -2.5×10^{25}

(3) -1.61×10^{23} (4) 1.38×10^{23}

27. C_p and C_v are specific heats at constant pressure and constant volume respectively. It is observed that

$C_p - C_v$ = a for hydrogen gas

$C_p - C_v$ = b for nitrogen gas

The correct relation between a and b is :

[JEE(Main)-2017]

(1) a = 14 b (2) a = 28 b

(3) $a = \frac{1}{14} b$ (4) a = b

28. A copper ball of mass 100 gm is at a temperature T. It is dropped in a copper calorimeter of mass 100 gm, filled with 170 gm of water at room temperature. Subsequently, the temperature of the system is found to be 75°C. T is given by : (Given : room temperature = 30° C, specific heat of copper = 0.1 cal/gm°C **[JEE(Main)-2017]**

(1) 1250°C (2) 825°C

(3) 800°C (4) 885° C

29. An external pressure P is applied on a cube at 0°C so that it is equally compressed from all sides. K is the bulk modulus of the material of the cube and α is its coefficient of linear expansion. Suppose we want to bring the cube to its original size by heating. The temperature should be raised by :

[JEE(Main)-2017]

(1) $\frac{3\alpha}{PK}$ (2) $3PK\alpha$

(3) $\frac{P}{3\alpha K}$ (4) $\frac{P}{\alpha K}$

PREVIOUS YEARS QUESTIONS				ANSWER KEY					Exercise-II
Que.	1	2	3	4	5	6	7	8	9	10
Ans.	**2**	**3**	**4**	**3**	**1**	**1**	**3**	**4**	**4**	**2**
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	**3**	**3**	**2**	**1**	**3**	**1**	**4**	**4**	**4**	**1**
Que.	21	22	23	24	25	26	27	28	29	
Ans.	**1**	**2**	**3**	**1**	**2**	**2**	**1**	**4**	**3**	