1. Hailstone of $0°C$ falls from a height of **1 km** on an insulating surface converting whole of its kinetic energy into heat. What part of it will melt ? ($g = 10\ m\ s^{-2}$)

(a) 1/33 (b) $\frac{1}{8}$

(c) $(1/33) \times 10^{-4}$ (d) all of it. **[2000]**

2. Surface temperatures of stars A and B are **727° C** and **327° C** respectively. What is the ratio $\mathbf{H_A : H_B}$ for the heat radiated per second by the two stars ?

(a) 5 : 3 (b) 25 : 9

(c) 625 : 81 (d) 125 : 27 **[2000]**

3. A black body at a high temperature TK radiates energy at the rate of E Wm^{-2}. When the temperature falls to $\frac{T}{2}$ K, the radiated energy will be

(a) $\frac{E}{4}$ (b) $\frac{E}{2}$

(c) 2E (d) $\frac{E}{16}$ **[2000]**

4. The **sun** emits a light with maximum wavelength of **510 nm** while the another **star X** emits a light with maximum wave length of **350 nm**. What is the ratio of surface temperature of the **sun** and **star X** ?

(a) 1·45 (b) 0·68

(c) 0·46 (d) 2·1 **[2000]**

5. A black body is heated from **27°C** to **127°C**. The ratio of their energies of radiations emitted will be

(a) 3 : 4 (b) 9 : 16

(c) 81 : 256 (d) 27 : 64 **[2001]**

6. One mole of an ideal gas at an initial temperature of **T K** does **6R** joules 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) $(T + 2{\cdot}4)\,K$ (b) $(T - 2{\cdot}4)\,K$

(c) $(T + 4)\,K$ (d) $(T - 4)\,K$. **[AIPMT–2004]**

7. Starting 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 purely isothermal ; W_2 if the process is purely isobaric and W_3, if the process is purely adiabatic, then

(a) $W_1 > W_2 > W_3$ (b) $W_2 > W_3 > W_1$

(c) $W_3 > W_2 > W_1$ (d) $W_2 > W_1 > W_3$.

[AFMC–2004]

8. An ideal gas heat engine operates in Carnot cycle between 227° C and 127° C. It absorbs 6×10^4 **cal** of heat at higher temperature. Amount of heat converted to work is

(a) $2 \cdot 4 \times 10^4$ cal (b) 6×10^4 cal

(c) $1 \cdot 2 \times 10^4$ cal (d) $4 \cdot 8 \times 10^4$ cal.

[AIPMT–2005]

9. Air is expanded from **50 litres** to **150 litres** at 2 **atmospheric** pressure. The external work done is (1 atmosphere = 1×10^5 N/m^2)

(a) 2×10^{-8} J (b) 2×10^4 J

(c) 200 J (d) 2000 J. [VMMC–2005]

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

(a) 380 K (b) 275 K

(c) 325 K (d) 250 K. [AIMPT–2006]

11. A gas is found to obey the law $P^2 V$ = constant. The initial temperature and volume are T_0 and V_0. If the gas expands to a volume $2 V_0$, its final temperature becomes.

(a) $\sqrt{2}\, T_0$ (b) $2 T_0$

(c) $T_0/2$ (d) $T_0/\sqrt{2}$.

[JIPMER–2006]

12. A monoatomic gas is suddenly compressed to $(1/8)^{th}$ of its initial volume adiabatically. The ratio of its final pressure to initial pressure is (given the ratio of the specific heats of the given gas to be **5/3**)

(a) 32 (b) $\frac{40}{3}$

(c) $\frac{24}{5}$ (d) 8.

[AFMC–2008 ; CET Karnataka–2006]

13. 1 g mole of an ideal gas at **STP** is subjected to a reversible adiabatic expansion to double its volume. Find the change in internal energy **(γ = 1·4)**

(a) 1169·5 J (b) 769·5 J

(c) 1369·5 J (d) 969·5 J. [DPMT–2006]

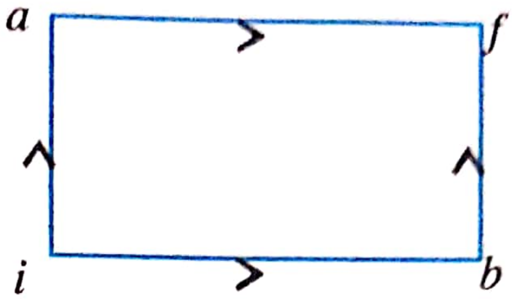
14. The **molar specific** heat at **constant pressure** of an ideal gas is **(7/2) R**. The ratio of specific heat at constant pressure to that at constant volume is

(a) 7/5 (b) 8/7

(c) 5/7 (d) 9/7. [AIMPT–2006]

15. When an ...

15. When a system is taken from the initial state i to final state f along the path iaf, it is found that



$Q = 50$ cal and **$W = 20$ cal**. If **along the** ibf, **$Q = 36$ cal, then W along the path ibf is**

(a) 6 cal *(b)* 16 cal

(c) 66 cal *(d)* 14 cal [AIEEE–2007]

16. If c_P and c_V denote the specific heats of nitrogen per unit mass at constant pressure and constant volume respectively, then

(a) $c_P - c_V = \frac{R}{28}$ *(b)* $c_P - c_V = \frac{R}{14}$

(c) $c_P - c_V = R$ *(d)* $c_P - c_V = 28\,R$

[AIEEE–2007]

[Karnataka (CET)–2010]

17. If c_P and c_V denote specific heats of nitrogen per unit mass at constant pressure and constant volume respectively, then

(a) $c_P - c_V = 28/R$ (b) $c_P - c_V = R/28$

(c) $c_P - c_V = R/14$ (d) $c_P - c_V = R$

[AFMC–2010]

18. If c_P and c_v denote specific heats per unit mass of an ideal gas of molecular weight M, then

(a) $c_P - c_V = R/M^2$ (b) $c_P - c_V = R$

(c) $c_P - c_V = R/M$ (d) $c_P - c_V = MR$

where R is molar gas constant. [AIPMT (Mains)–2010]

19. The respective speeds of five molecules are, 2, 1·5, 1·6, 1·6, and **1·2 km s^{-1}**, the **most probable speed in km s^{-1}** will be

(a) 2 (b) 1·58

(c) 1·6 (d) 1·31 [JIPMER–2011]

20. For nitrogen $C_P - C_V = x$ and for **argon**, $C_P - C_V = y$. The relation between x and y is given by

(a) $x = y$ (b) $x = 7y$

(c) $y = 7x$ (d) $x = \frac{1}{2}y$ [BHU–2011]

21. For a gas, the difference between the two principal specific heats is **4150 J kg^{-1} K^{-1}**. What is the specific heat of the gas at constant volume if the ratio of specific heats is 1·4?

(a) 5186 J kg^{-1} K^{-1} (b) 10375 J kg^{-1} K^{-1}

(c) 1660 J kg^{-1} K^{-1} (d) 8475 J kg^{-1} K^{-1}

[AFMC–2011]

22. A **5g** droplet of liquid nitrogen is enclosed in a **50 mL** tube which is sealed at very low pressure. When the tube is warmed to **35°C** the nitrogen pressure in the tube is (molecular weight of nitrogen = **28** and **R = 8·3 J/mol K**)

(a) $1·01 \times 10^5$ N/m^2 (b) $9·13 \times 10^4$ N/m^2

(c) $9·13 \times 10^3$ N/m^2 (d) 18·26 N/m^2

[VMMC–2011]

(e) [illegible]

23. Three perfect gases at absolute temperatures $\mathbf{T_1}$, $\mathbf{T_2}$ and $\mathbf{T_3}$ are mixed. The masses of their molecules are $\boldsymbol{m_1}$, $\boldsymbol{m_2}$ and $\boldsymbol{m_3}$ and the number of molecules are $\boldsymbol{n_1}$, $\boldsymbol{n_2}$ and $\boldsymbol{n_3}$ respectively. Assuming no loss of energy, the final temperature of the mixture is

(a) $\dfrac{T_1 + T_2 + T_3}{3}$ (b) $\dfrac{n_1 T_1 + n_2 T_2 + n_3 T_3}{n_1 + n_2 + n_3}$

(c) $\dfrac{n_1 T_1^2 + n_2 T_2^2 + n_3 T_3^2}{n_1 T_1 + n_2 T_2 + n_3 T_3}$ (d) $\dfrac{n_1^2 T_1^2 + n_2^2 T_2^2 + n_3^2 T_3^2}{n_1 T_1 + n_2 T_2 + n_3 T_3}$

[AIEEE–2011]

24. A thermally insulated vessel contains an ideal gas of molecular mass M and ratio of specific heats γ. It is moving with speed υ and is suddenly brought to rest. Assuming no heat is lost to the surroundings, its temperature increases by

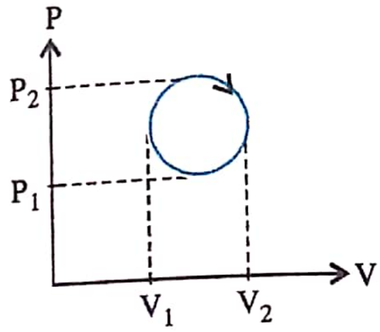
(a) $\dfrac{(\gamma - 1)}{2\gamma R} M\upsilon^2 \, K$ (b) $\dfrac{\gamma M\upsilon^2}{2R} K$

(c) $\dfrac{(\gamma - 1)M\upsilon^2}{2R} K$ (d) $\dfrac{(\gamma - 1)M\upsilon^2}{2(\gamma + 1)R} K$

[AIEEE–2011]

(c) 0·75 2010)

25. In the cyclic process shown in the diagram, calculate the work done



(a) $\pi\left(\frac{V_2 - V_1}{2}\right)^2$ (b) $\pi\left(\frac{P_2 - P_1}{2}\right)^2$

(c) $\frac{\pi}{4}(P_2-P_1)(V_2-V_1)$ (d) $\pi(P_2V_2-P_1V_1)$

[AMU(Engg)–2010]

26. **100 g** of water is heated from **30°C** to **50°C**. Ignoring the slight expansion of the water, the change in internal energy is (specific heat of water is **4184 J kg^{-1}**)

(a) 4·2 kJ (b) 8·4 kJ

(c) 84 kJ (c) 2·1 kJ **[AIEEE–2011]**

27. A Carnot engine operating between temperature T_1 and T_2 has efficiency $\frac{1}{6}$, when T_2 is lowered by **62 K**, its efficiency 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

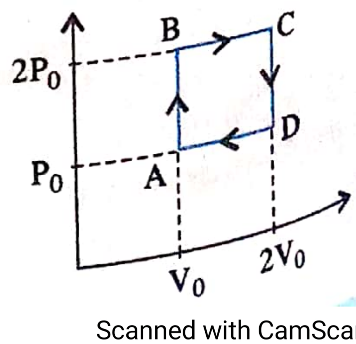
[AIEEE–2011]

28. A sample of gas from an initial pressure and volume **10 Pa** and **1·0 m^3** to a final volume of 2·0 m^3. During the expansion, the pressure and volume are related by the equation, $P = aV^2$. where $a = 10\ N/m^8$. Find the work done by gas during the expansion.

(a) 23 J (b) 18 J

(c) 9 J (d) 43 J **[AMU (Engg)–2011]**

29. Helium gas goes through a cycle **ABCDA** (consisting of two isochoric and two isobaric lines) as shown in figure. Efficiency of this cycle is nearly (Assume the gas close to ideal gas).

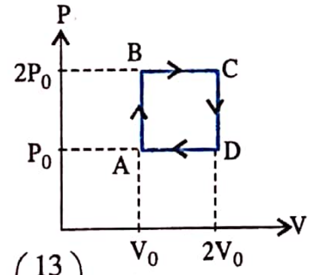


(a) 9·1 % (b) 10·5 %
(c) 12·5 % (d) 15·4 % **[AIEEE–2012]**

30. A Carnot engine, whose efficiency is **40 %** takes in heat from a source maintained at a temperature of **500 K**. It is desired to have an efficiency of **60%**. Then 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 greater than 50 % **[AIEEE–2012]**

31. Which of the following **laws of thermodynamics forms the basis of temperature**
(a) First law (b) Zeroth law
(c) Second law (d) Third law

32. The P – V diagram below represents the thermodynamic cycle of an engine, operating with an ideal monoatomic gas. **The amount of heat extracted from the source in the single cycle is**

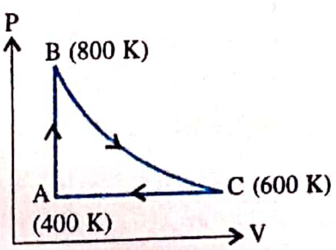


(a) P_0V_0 (b) $\left(\frac{13}{2}\right)P_0V_0$
(c) $\left(\frac{11}{2}\right)P_0V_0$ (d) $4P_0V_0$ **[JEE (Main)–2013]**

33. An ideal monoatomic gas of given mass is heated at constant pressure. In this process, the fraction of supplied heat energy used for the **increase of the internal energy** of the gas is
(a) $\frac{3}{8}$ (b) $\frac{3}{6}$
(c) $\frac{3}{4}$ (d) $\frac{3}{5}$ **[WBJEE–2013]**

34. For which combination of working temperatures of **source** and **sink**, the **efficiency** of **Carnot's heat engine** is **maximum**?
(a) 600 K, 400 K (b) 400 K, 200 K
(c) 500 K, 300 K (d) 300 K, 100 K
[Karanataka (CET)–2013]

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

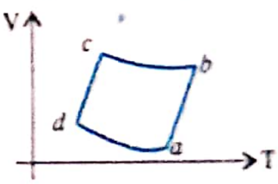


(a) The change in internal energy in the process AB is – 350 R.
(b) The change in internal energy in the process BC is – 500 R.
(c) The change in internal energy in the whole cyclic process is 250 R.
(d) The change in internal energy in the process CA is 700 R. **[JEE (Main)–2014]**

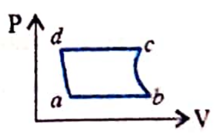
36. Consider a spherical shell of radius **R** at temperature **T**. The black body radiation inside it can be considered as an ideal gas of photons with internal energy per unit volume, $u = \frac{U}{V} \propto T^4$ and pressure, $p = \frac{1}{3}\left(\frac{U}{V}\right)$. If the shell undergoes **adiabatic expansion** the relation between **T** and **R** is
(a) $T \propto e^{-R}$ (b) $T \propto e^{-3R}$
(c) $T \propto \frac{1}{R}$ (d) $T \propto \frac{1}{R^3}$ **[AIEEE–2015]**

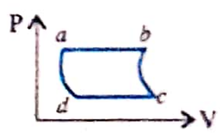
37. A solid body of constant heat capacity **1 J/°C** is being heated by keeping it in contact with reservoirs in two ways :
(i) Sequentially keeping in contact with **2 reservoirs** such that each reservoir supplies same amount of heat.
(ii) Sequentially keeping in contact with **8 reservoirs** such that each reservoir supplies same amount of heat.
In both the cases, the body is brought from initial temperature **100°C** to final temperature **200°C**. Entropy change of the body in the two cases respectively is
(a) *ln* 2, 4 *ln* 2 (b) *ln* 2, *ln* 2
(c) *ln* 2, 2 *ln* 2 (d) 2 *ln* 2, 8 *ln* 2
[JEE (Main)–2015]

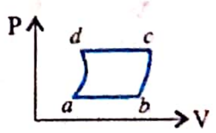
38. An ideal gas goes through a reversible cycle **a → b → c → d** has V – T diagram shown below. Processes ***d* → *a*** and ***b* → *c*** are adiabatic

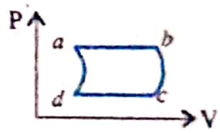


The corresponding **P – V diagram for the process is** (all figures schematic and not drawn to scale)

(a)


(b)


(c)


(d)


[Online, JEE (Main)–2015]

39. The pressure *p*, volume **V** and temperature **T** for a certain gas are related by, $p = \frac{AT - BT^2}{V}$, where **A** and **B** are

constants. The **work done** by the gas when the temperature changes from T_1 and T_2 while pressure remains constant is given by

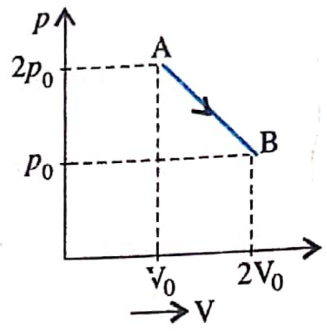
(a) $A(T_2 - T_1) + B(T_2^2 - T_1^2)$

(b) $\dfrac{A(T_2 - T_1)}{V_2 - V_1} - \dfrac{B(T_2^2 - T_1^2)}{V_2 - V_1}$

(c) $A(T_2 - T_1) - B(T_2^2 - T_1^2)$

(d) $\dfrac{A(T_2 - T_2^2)}{V_2 - V_1}$

[WB JEE–2015]



40. 'n' **moles** of an ideal gas undergoes a process $A \rightarrow B$ as shown in figure. The maximum temperature of the gas during the process will be

(a) $\dfrac{9}{4}\dfrac{p_0 V_0}{nR}$

(b) $\dfrac{3}{2}\dfrac{p_0 V_0}{nR}$

(c) $\dfrac{9}{2}\dfrac{p_0 V_0}{nR}$

(d) $\dfrac{9 p_0 V_0}{nR}$

[JEE (Main)–2016]

41. An ideal gas undergoes quasistatic reversible process in which its molar heat capacity C remains constant. If during this process relation of pressure p and volume V is given by pV^n = constant, then n is given by (here C_p and C_V are molar specific heat at constant pressure and constant volume respectively)

(a) $n = \dfrac{C_P}{C_V}$

(b) $n = \dfrac{C - C_P}{C - C_V}$

(c) $n = \dfrac{C_P - C}{C - C_V}$

(d) $n = \dfrac{C - C_V}{C - C_P}$

[JEE (Main)–2016]

42. A Carnot freezer takes heat from water at **0°C** inside it and rejects it to the room at temperature of **27°C**. The latent heat of ice is $\mathbf{336 \times 10^3\ J\ kg^{-1}}$. If 5 kg of water at **0°C** is converted into ice at **0°C** by the freezer, then the energy consumed by the freezer is close to

(a) $1{\cdot}51 \times 10^5$ J

(b) $1{\cdot}68 \times 10^6$ J

(c) $1{\cdot}71 \times 10^7$ J

(d) $1{\cdot}67 \times 10^5$ J

[Online JEE ...

43. Two rods **A** and **B** of different materials are welded together as shown in figure. Their thermal conductivities are K_1 and K_2. The thermal conductivity of the composite rod will be

(a) $\frac{3(K_1 + K_2)}{2}$ (b) $K_1 + K_2$

(c) $2(K_1 + K_2)$ (d) $\frac{K_1 + K_2}{2}$

[NEET 2017]

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

(a) 450 (b) 1000

(c) 1800 (d) 225 **[NEET 2017]**

45. Two spherical black bodies have radii r_1 and r_2. Their surface temperature are T_1 and T_2. If they radiate same power, then $\frac{r_2}{r_1}$ is

(a) $\frac{T_1}{T_2}$ (b) $\frac{T_2}{T_1}$

(c) $\left(\frac{T_1}{T_2}\right)^2$ (d) $\left(\frac{T_2}{T_1}\right)^2$

[MH (CET) 2017]

46. A black body radiates heat energy at the rate of 2×10^5 **J/s m²** at the temperature of **127°C**. The temperature of the black body at which rate of heat radiation 32×10^5 **J/s m²** is

(a) 400 K (b) 600 K

(c) 800 K (d) 200 K.

[JIPMER–2017]

47. The power radiated by a black body is **P** and it radiates maximum energy at wave length, λ_0. If the temperature of the black body is now changed so that it radiates maximum energy at $3\lambda_0$, the power radiated by it becomes n**P**. The value of n is

(a) $\frac{3}{4}$ (b) 4/3

(c) $\frac{256}{81}$ (d) $\frac{81}{256}$ **[NEET 2018]**

48. A deep rectangular pond of surface **area A**, containing water (density = ρ, specific heat capacity capacity = s), is located in a region where the outside air temperature is at a steady value of **–26°C**. The thickness of the **frozen ice layer** in this pond, at a certain instant is x. Taking the thermal conductivity of ice as K, and its specific latent heat of fusion as L, the rate of increase of the thickness of ice layer, at this instant, would be given by

(a) $26\ K/\rho x\ (L + 4s)$ (b) $26\ K/\rho x\ (L - 4s)$

(c) $26\ K/(\rho x^2\ L)$ (d) $26\ K/(\rho x L)$

[Odisha (NEET)–2019]

49. **A copper rod** of **88 cm** and and **an aluminium rod** of unknown length have their increase in length independent of increase in temperature. The length of aluminium rod is

$(\alpha_{Cu} = 1{\cdot}7 \times 10^{-5}\ K^{-1},\ \alpha_{Al} = 2{\cdot}2 \times 10^{-5}\ K^{-1})$

(a) 68 cm (b) 6·8 cm

(c) 113·9 cm (d) 88 cm

[NEET-2019]

50. In Fig. 12.16, the amount of heat supplied to one mole of an ideal gas is plotted on the horizontal axis, and the amount of work performed by the gas is plotted on vertical axis. The experiment is done on two gases. The initial states for both the gases are same. Two of the straight lines are isobars. Then (Given $\theta_3 = 45°$, $\theta_2 = 30°$, $\theta_1 = 25°$)

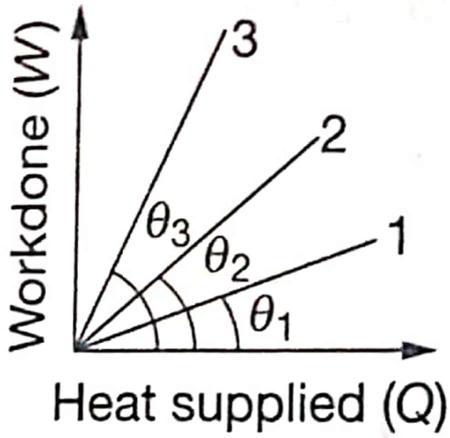


Fig. 12.16

(A) Curve 3 corresponds to isothermal process.
(B) Curves 1 and 2 corresponds to isobaric process.
(C) Curves 3 and 2 corresponds to isobaric process.
(D) Curves 1 and 3 corresponds to isobaric process.