



Sri Chaitanya IIT Academy, India

A.P, TELANGANA, KARNATAKA, TAMILNADU, MAHARASHTRA, DELHI, RANCHI

A right Choice for the Real Aspirant

ICON CENTRAL OFFICE, MADHAPUR-HYD

Sec: Sr.IPLCO
Time: 3 Hours

JEE-ADVANCE
2011-P1-Model

Date: 20-12-15
Max Marks: 240

PAPER-I KEY & SOLUTIONS

CHEMISTRY

1	B	2	A	3	D	4	A	5	A	6	B
7	D	8	ACD	9	BC	10	BC	11	ABC	12	B
13	C	14	A	15	B	16	C	17	4	18	7
19	5	20	9	21	2	22	0	23	6		

PHYSICS

24	B	25	A	26	B	27	C	28	B	29	D
30	D	31	B	32	CD	33	C	34	AD	35	B
36	A	37	A	38	A	39	C	40	0	41	0
42	1	43	2	44	2	45	6	46	3		

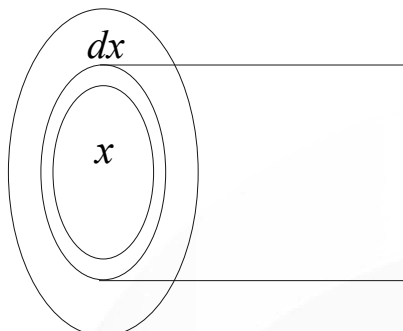
MATHS

47	A	48	D	49	D	50	A	51	B	52	D
53	A	54	ABC	55	AC	56	ABCD	57	ABC	58	B
59	C	60	A	61	B	62	A	63	1	64	2
65	5	66	2	67	9	68	5	69	5		

PHYSICS

24. Divide the entire cylinder into parallel co-axial cylindrical shells and write

$$k_{\text{eff}} = \frac{\int k dA}{\int dA}$$



as ' l ' is same for all of them.

25. Inside barometer, ρgh remains constant.

26. b. At $x = \infty$, $C = \frac{3}{2}R$

From $PV^x = \text{constant}$

$\Rightarrow P^{1/x}V = \text{another constant}$

So at $x = \infty$, $V = \text{constant}$

Hence $C = C_v = \frac{3}{2}R$

And then $C_p = C_v + R = \frac{5}{2}R$

At $x = 0$, $P = \text{constant}$ and $C = C'$

Hence $C' = C_p = \frac{5}{2}R$

At $x = x'$, $C = 0$, so the process is adiabatic, hence $x' = \frac{C_p}{C_v} = \frac{5}{3}$

28. c. $PV = \frac{m}{M}RT$ (for ideal gas)

$$\therefore MV = \frac{mRT}{P}$$

In the position of equilibrium of stopper S,

$$P_1 = P_2, \quad T_1 = T_2, \quad m_1 = m_2$$

$\therefore MV = \text{constant}$

$$M_1V_1 = M_2V_2$$

$$\Rightarrow A \times 32(360 - \alpha) = 40\alpha \times A$$

$$\alpha = 160^\circ$$

29. d. BC is isochoric. $V_B > V_A$, $V_B = V_C$, $V_D \Rightarrow V_C$

30. d. Under steady state condition, heat released to the room = heat dissipated out of the room. Let θ be the temperature of heater. Then
- $$\theta - 20 = \alpha [20 - (-20)] \quad (i)$$
- and
- $$\theta - 10 = \alpha [10 - (-40)] \quad (ii)$$
- solving Eqs. (i) and (ii), we get
31. To decide which variable is extensive and which intensive, think of a relevant system in equilibrium and imagine that it is divided into two equal parts. The variables that remain unchanged for each part are intensive. The variables whose values get halved in each part are extensive.
32. The product $N(v) dv$ gives the number of molecules having speeds in the range v to $v + dv$. Graphically, this product for $v = 600 \text{ m/s}$ is represented in figure, as the shaded area of the narrow vertical strip located at that speed.
- Avoid the temptation to interpret $N(v)$ as “the number of molecules having a speed v ”. This interpretation is meaningless because, although the number of molecules may be large, it cannot be infinite but the number of available speeds is infinite; they cannot be matched up on a one-to-one basis. The probability that a molecule has a precisely stated speed, such as $600.34326759 \dots \text{ m/s}$, is exactly zero. However, the number of molecules whose speeds lie in a narrow range such as 600 m/s to 602 m/s has a definite nonzero value.
- If we add up (integrate) the numbers of molecules in each differential speed range dv from $v = 0$ to $v \rightarrow \infty$, we must obtain N , the total number in the system. That is, it must be true that
- $$N = \int_0^{\infty} N(v) dv.$$
- Note that the integral in equation can be interpreted as the total areal under the speed distribution curve of figure. The number of molecules whose speeds lie between any given values, such as v_1 and v_2 , is equal to the area under the speed distribution curve between those limits.
33. First law only checks the conservation of energy and doesn't check the plausibility of the occurrence of the process.
34. $n_1 + n_2 = n_{\text{mix}}$
- $$\frac{P_1 V}{T_1} + \frac{P_2 V}{T_2} = \frac{P(2V)}{T}$$
- $$\Rightarrow \frac{P}{T} = \frac{1}{2} \left(\frac{P_1}{T_1} + \frac{P_2}{T_2} \right)$$
- Also $U_1 + U_2 = U_{\text{mix}}$

$$\Rightarrow \frac{5}{2}P_1V + \frac{5}{2}P_2V = \frac{5}{2}P(2V)$$

$$\Rightarrow P = \frac{P_1 + P_2}{2}$$

- 35,36. This question has a distraction: it asks about the heat flow through the window, but what you need to find first is the heat flow through the air hear the window. We are given the temperature gradient both inside and outside the window. Inside,

$$\frac{\Delta T}{\Delta x} = \frac{(20^\circ\text{C}) - (5^\circ\text{C})}{(0.08\text{m})} = 190^\circ\text{C} / \text{m};$$

a similar expression exists for outside.

From equation. 23-1 we find the heat flow through the air;

$$H = kA \frac{\Delta T}{\Delta x} = (0.026\text{W} / \text{m.K})(0.6\text{m})^2 (190^\circ\text{C} / \text{m}) = 1.8\text{W}$$

The value that we arrived at is the rate that heat flows through the air cross an area the size of the window on either side of the window. This heat flow had to occur through the window as well, so

$$H = 1.8\text{W}$$

Answers the window question.

(b) Now that we know the rate that heat flows through the window, we are in a position to find the temperature difference across the window. Rearranging equation. 32-1,

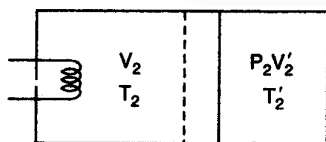
$$\Delta T = \frac{H \Delta x}{kA} = \frac{(1.8\text{W})(0.005\text{m})}{(1.0\text{W} / \text{m.K})(0.6\text{m})^2} = 0.025^\circ\text{C},$$

So we were well justified in our approximation that the temperature drop across the glass is very small.

37. For the RHS chambers,

$$P_2 V_2'^{\gamma} = P_0 V_0^{\gamma}$$

$$V_2' = \left(\frac{P_0}{P_2} \right)^{\frac{1}{\gamma}} V_0$$



$$= \left(\frac{32}{243} \right)^{\frac{1}{(5/3)}} V_0 = \frac{8}{27} V_0$$

For the left part chamber, the final volume is

$$V_2 = V_0 + V_0 - V_2'$$

$$= V_0 + V_0 - 8/27V_0$$

$$= \frac{46}{27}V_0$$

Then, $V_2 / V_2' = (46/27V_0) / (8/27V_0)$

$$= 23/4$$

38. $\frac{P_0V_0}{T_0} = \frac{P_2V_2}{T_2}$

$$T_2 = \frac{P_2}{P_0} \left(\frac{V_2}{V_0} \right) T_0$$

$$= \left(\frac{243}{32} \right) \left(\frac{46}{27} \right) T_0$$

$$= \frac{207}{16} T_0$$

Applying general gas law for RHS chamber,

$$T_2' = (P_2V_2' / P_0V_0) T_0$$

$$= 9/4 T_0$$

Then,

$$T_2 / T_2' = \left(\frac{207}{16} T_0 \right) / \left(\frac{9}{4} T_0 \right) = \frac{23}{4}$$

39. For RHS chamber, the process is adiabatic,

$$\Delta Q = -\Delta U + W, \quad \text{where } \Delta Q = 0$$

$$W = -\Delta U = nC_v \Delta T$$

$$= -2 \times \frac{3R}{2} \left(\frac{9}{4} T_0 - T_0 \right)$$

$$= -\frac{15}{4} RT_0$$

40. $\frac{\text{watt}}{m^2} = [MT^{-3}]$ power of L is 0.

41. Strain energy is zero for rod freely allowed to expand.

42. Since $\theta = \text{constant}$

$$\sin \theta = \frac{l_2/2}{l_1}$$

or $l_2 = 2l_1 \sin \theta$

or $\delta l_2 = 2\delta l_1 \sin \theta$

or $l_2 \alpha_2 \Delta T = 2l_1 \alpha_1 \Delta T \sin \theta$ putting $l_1 \sin \theta = \frac{l_2}{2}$, we have

$$\alpha_2 = \alpha_1$$

43. By using Newton's law of cooling

$$\frac{d\theta}{dt} = -k(\theta - \theta_s)$$

Solving this differential eqn, we have

$$\int_{\theta_0}^{\theta} \frac{d\theta}{\theta - \theta_s} = -k \int_0^t dt$$

This gives, $kt = \ln \frac{\theta_0 - \theta_s}{\theta - \theta_s}$

Putting $t = t_1$, $\theta_0 = \theta_1$, $\theta = \theta_2$, we have

$$kt_1 = \ln \frac{\theta_1 - \theta_s}{\theta_2 - \theta_s}$$

Putting $t = t_2$, $\theta_0 = \theta_2$, $\theta = \theta_3$, we have

$$kt_2 = \ln \frac{\theta_2 - \theta_s}{\theta_3 - \theta_s}$$

By using eqns. (i) and (ii),

$$\frac{t_1}{t_2} = \frac{\ln \left[(\theta_1 - \theta_s) / (\theta_2 - \theta_s) \right]}{\ln \left[(\theta_2 - \theta_s) / (\theta_3 - \theta_s) \right]}$$

44. $V_{rms} = \sqrt{\frac{3RT}{M}} \quad V_{rms}^1 = \sqrt{\frac{3RT'}{M'}}$

$$M' = \frac{M}{2}; T' = 2T \Rightarrow V_{rms}^1 = 2V_{rms}$$

45. Area under $I - \lambda$ curve is proportional to total energy radiated per unit time & it is proportional to fourth power of absolute temperature of body.

46. $5(0.2)(40 - 22) = mS(22 - 20)$

$$5S(40 - 23) = mS(23 - 20)$$

$$\frac{S(17)}{0.2 \times 18} = \frac{3}{2} \quad S = \frac{27}{85}$$