JEE-ADVANCED-2011-P1-Model

Time: 3:00 Hrs. **IMPORTANT INSTRUCTIONS** **Max Marks: 240**

CHEMISTRY

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I (Q.N : 1 – 7)	Questions with Single Correct Choice	3	-1	7	21
Sec – II(Q.N : 8 – 11)	Questions with Multiple Correct Choice	4	0	4	16
Sec – III(Q.N : 12 – 16)	Questions with Comprehension Type (2 Comprehensions – 2 + 3 = 5Q)	3	-1	5	15
Sec – IV(Q.N : 17 – 23)	Questions with Integer Answer Type	4	0	7	28
Total				**23**	**80**

PHYSICS

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 24 – 30)	Questions with Single Correct Choice	3	-1	7	21
Sec – II(Q.N : 31 – 34)	Questions with Multiple Correct Choice	4	0	4	16
Sec – III(Q.N : 35 – 39)	Questions with Comprehension Type (2 Comprehensions – 2 + 3 = 5Q)	3	-1	5	15
Sec – IV(Q.N : 40 – 46)	Questions with Integer Answer Type	4	0	7	28
Total				**23**	**80**

MATHEMATICS

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 47 – 53)	Questions with Single Correct Choice	3	-1	7	21
Sec – II(Q.N : 54 – 57)	Questions with Multiple Correct Choice	4	0	4	16
Sec – III(Q.N : 58 – 62)	Questions with Comprehension Type (2 Comprehensions – 2 + 3 = 5Q)	3	-1	5	15
Sec – IV(Q.N : 63 – 69)	Questions with Integer Answer Type	4	0	7	28
Total				**23**	**80**

PHYSICS **Max Marks: 80**

SECTION – I
(SINGLE CORRECT CHOICE TYPE)

This section contains **7 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct

24. A cylinder of radius R and length l is made up of a material whose thermal conductivity k varies with distance x from the axis as $k = k_1 x + k_2$, where k_1 and k_2 are positive constants. The effective thermal conductivity between the flat faces of the cylinder in steady state conduction is

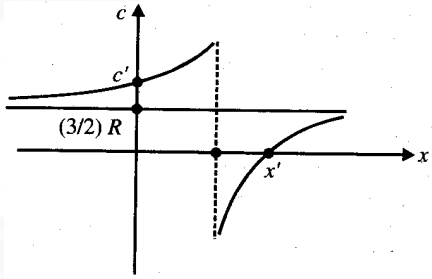
A) $\frac{2}{3}k_1 l + k_2$ B) $\frac{2}{3}k_1 R + k_2$ C) $\frac{k_1 R}{2} + k_2$ D) $\frac{k_1 R}{2} l + k_2$

25. The temperature of a liquid in a Toricelli-barometer with large base vessel slightly changes by ΔT and the atmosphere pressure remains constant at that place. The height 'h' of the liquid column in the barometer changes by Δh. If the coefficient of volume expansion of the liquid is γ and we don't neglect the expansion of the glass tube then $\Delta h =$

A) $\gamma h \Delta T$ B) $\frac{\gamma}{3} h \Delta T$

C) $\frac{2\gamma}{3} h \Delta T$ D) a value depending on α of glass

26. One mole of an ideal gas is taken along the process in which $PV^x = \text{constant}$. The graph shown represents the variation of molar heat capacity of such a gas with respect to 'x'. The values of c' and x', respectively, are given by (dotted line in the diagram is asymptote to the graph on both sides. The horizontal solid line is not part of the graph and is an asymptote to the graph)

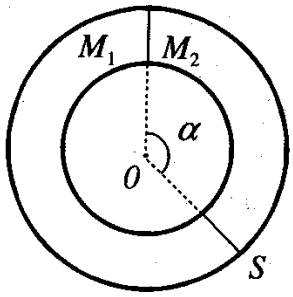


A) $\frac{5}{2}R, \frac{5}{2}$ B) $\frac{5}{2}R, \frac{5}{3}$ C) $\frac{7}{2}R, \frac{7}{2}$ D) $\frac{5}{2}R, \frac{7}{5}$

27. When the temperature of black body increases it is observed that the wavelength corresponding to maximum intensity of emitted radiation changes from $0.26\,\mu m$ to $0.13\,\mu m$. The ratio of spectral emissive powers of the body corresponding to its dominant wavelength at the respective temperatures (initial: final) is

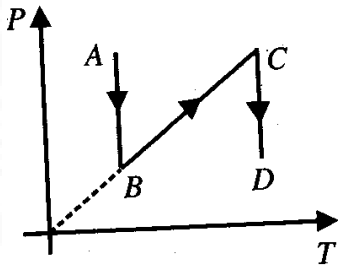
A) $\frac{16}{1}$ B) $\frac{1}{16}$ C) $\frac{1}{32}$ D) $\frac{1}{4}$

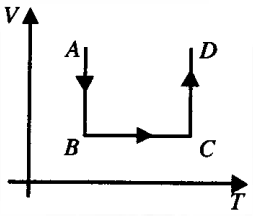
28. A torroid shaped tube contains two ideal gases with equal masses and molar masses $M_1 = 32$ and $M_2 = 40$. The gases are separated by one fixed partition and another movable conducting stopper S which can move freely without friction inside the torroid. The angle α is

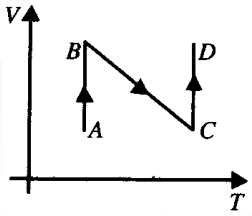


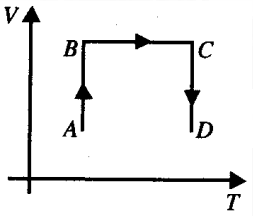
A) 182° B) 160° C) 192° D) 180°

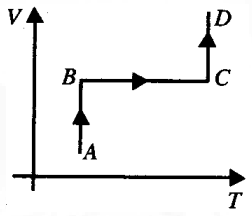
29. P – T indicator diagram for a reversible process under gone by an ideal gas is shown in Figure. Choose the corresponding V – T indicator diagram.



A) 

B) 

C) 

D) 

30. The temperature of a room heated by a heater is $20°C$ when outside temperature is $-20°C$ and it is $10°C$ when the outside temperature is $-40°C$. The temperature of the heater is (Assume steady state conduction for walls of the room to outside and Newton's law for heater-room interaction)

A) $80°C$ B) $100°C$ C) $40°C$ D) $60°C$

SECTION – II

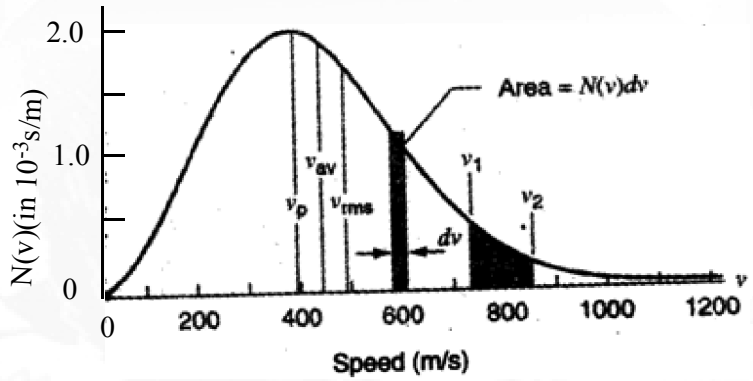
(MULTIPLE CORRECT CHOICE TYPE)

This section contains **4 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE** is/ are correct

31. The thermo dynamic variables are of two kinds : extensive and intensive. Extensive variables indicate the 'size' of the system. In an enclosed ideal gas chamber, which of the following is/are extensive? (All symbols have usual meaning)

A) P B) V C) ρ (density) D) T

32. Which of the following is true with regards to the below graph of the Maxwell speed distribution for the molecules of an ideal monatomic gas at 300K $\left(N(v)=\frac{dN}{dv}\right)$



A) $N(v)$ represents the number of molecules having speed v

B) The probability that a molecule has a precisely stated speed such as 600.34326759 m/s is finite

C) The number of molecules whose speeds lie in a narrow range such as 600 m/s to 10000 m/s has a definite non-zero value

D) Area under the graph given by $\int_0^\infty N(v)dv$ represents the total number of molecules in the system

33. Which of the following processes is/are forbidden by the first law of thermodynamics?

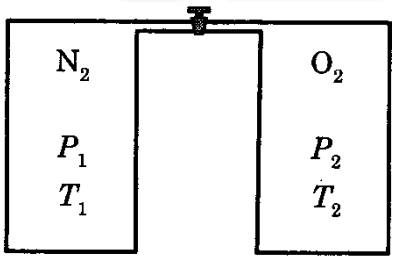
A) An ice cube is placed in hot coffee; the ice gets colder and the coffee gets hotter

B) Solid wax is placed in a hot metal pan; the wax melts and the metal pan cools

C) Cold water is placed in a cold glass insulated from surroundings; the glass gets colder and the water gets colder

D) A student builds an automobile engine that converts into work the heat energy released when water changes to ice

34. Two identical vessels are connected by a tube. Volume of the tube is vanishingly small and it is equipped with a valve. One of the vessels contains nitrogen at pressure P_1 and temperature T_1 and the other vessel contains oxygen at pressure P_2 and temperature T_2. The system is well insulated from the surroundings. Now the valve is opened. The final pressure P and temperature T are attained by mixture of both the gases. Then (Assuming gases to be ideal and non-interactive)



A) $P = \frac{P_1 + P_2}{2}$

B) $P = P_1 + P_2$

C) $T = \frac{(P_1 + P_2)T_1T_2}{2(P_1T_2 + P_2T_1)}$

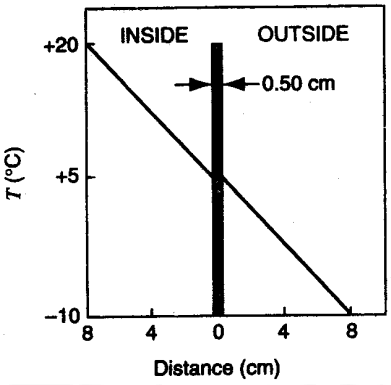
D) $T = \frac{(P_1 + P_2)T_1T_2}{P_1T_2 + P_2T_1}$

SECTION – III
(COMPREHENSION TYPE)

This section contains 2 groups of questions. Each group has 2&3 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

Paragraph for Questions Nos. 35 to 36

An idealized representation of the air temperature as a function of distance from a single-pane window having same areal dimensions as wall of the room on a calm, winter day is shown in figure. The window dimensions are $60\,cm \times 60\,cm \times 0.50\,cm$. (Thermal conductivity of air and glass are 0.026 and 1 respectively is SI units)



35. At what rate does heat approximately flow out through the window? (Assume the temperature drop across the glass is very small.)

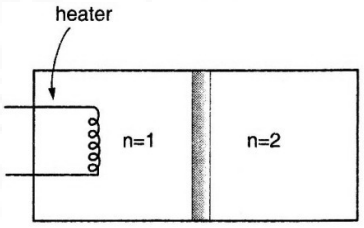
A) 1.2 W B) 1.8 W C) 2.2 W D) 2.4 W

36. What is the approximate difference in temperature between the inner and outer glass surfaces?

A) $0.025C°$ B) $0.050C°$ C) $0.075C°$ D) $0.010C°$

Paragraph for Questions Nos. 37 to 39

A thermally insulated smooth piston divides the gas cylinder into two equal parts, each of volume V_0 and pressure P_0. The gas cylinder is also thermally insulated. However, heat is given to the LHS (Left hand side) chamber by an electric heater. The LHS chamber contains 1 mole of an ideal diatomic gas and the RHS (Right hand side) chamber has 2 moles of an ideal monoatomic gas. Assuming ideal conditions, if the LHS chamber is slowly heated the movable piston shifts towards right till the pressures in both chamber will be equal to $243\ P_0/32$. (Initial temperature of gas in RHS chamber is T_0)



37. The ratio of final volumes of LHS and RHS chambers, is:

A) 23: 4 B) 25 : 8 C) 23 : 2 D) 23 : 8

38. The ratio of final temperatures of RHS and LHS chambers is:

A) 4 : 23 B) 23 : 4 C) 4: 27 D) 25 : 4

39. The work done by the gas in RHS chamber is:

A) $-\frac{15}{8}RT_0$ B) $\frac{15}{8}RT_0$ C) $\frac{-15}{4}RT_0$ D) $\frac{5}{6}RT_0$

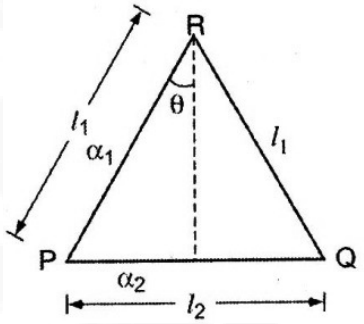
SECTION –IV
(INTEGER ANSWER TYPE)

This section contains 7 questions . The answer to each of the questions is a single digit integer, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the ORS have to be darkened.

40. The number of dimensions of length (L) in the dimensional formula of emissive power of a black body is _____

41. A uniform rod of length *l*, cross sectional area A $\left(\sqrt{A} << l\right)$ density ρ, Young's modulus Y, coefficient of linear expansion α lying on a smooth horizontal floor is heated uniformly through a temperature rise ΔT. The elastic strain energy stored in the rod is $\frac{n}{4}YAl(\alpha\Delta T)^2$. The value of *n* is _____

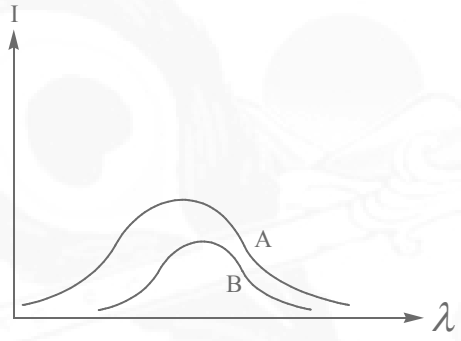
42. The rods of length l_1 *and* l_2 comprise an isosceles triangle. If they are heated, the angle $\theta(=37^\circ)$ remains constant. The value of ratio of coefficients of linear expansion of the two rods $\frac{\alpha_1}{\alpha_2}$ = _____ . (Assume rods are pivoted with frictionless hinges to each other at P,Q,R)



43. A body cools down from temperature $9\theta_0$ to $3\theta_0$ in time t_1, $3\theta_0$ to $2\theta_0$ in time t_2 in a surrounding ambience of constant temperature θ_0. Following Newton's law of cooling, the value of t_1 / t_2=_____ (nearest integer value)

44. Assuming ideal gas theory, the rms speed of oxygen molecule at temperature T is v. If the temperature is doubled and oxygen gas dissociates into atomic oxygen, the rms speed of the atomic oxygen is nv where n=_____

45. The graph shows the spectral intensity (I) versus wave length (λ) of emission spectrum of a black body at two different temperatures. The temperature of body corresponding to curve B is 27^0C. The temperature of body corresponding to curve A is $n \times 100$K..... where $n =$ ..... . (Given that the ratio of area under two curves of graphs is 16 : 1)



46. Two identical calorimeters A and B contain equal quantity of water at $20°C$. A 5gm piece of metal X of specific heat $0.2 cal/gC°$ is dropped into A and a 5gm piece of metal Y into B. The equilibrium temperature in A is $22°C$ and in B is $23°C$. The initial temperature of both the metals is $40°C$. The specific heat of metal y in $cal/gC°$ is $\frac{9K}{85}$ where $K =$ _____