IIT-JEE-2013-P2-Model

Time:2:00 PM to 5:00 PM **IMPORTANT INSTRUCTIONS** **Max Marks: 180**

PHYSICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 8)	Questions with Multiple Correct Choice	3	-1	8	24
Sec – II(Q.N : 9 – 16)	Questions with Comprehension Type (4 Comprehensions – 2 +2+2+2 = 8Q)	3	-1	8	24
Sec – III(Q.N : 17 – 20)	Matrix Matching Type	3	-1	4	12
Total				**20**	**60**

CHEMISTRY:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 21 –28)	Questions with Multiple Correct Choice	3	-1	8	24
Sec – II(Q.N : 29 – 36)	Questions with Comprehension Type (4 Comprehensions – 2 +2+2+2 = 8Q)	3	-1	8	24
Sec – III(Q.N : 37 – 40)	Matrix Matching Type	3	-1	4	12
Total				**20**	**60**

MATHEMATICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 41 – 48)	Questions with Multiple Correct Choice	3	-1	8	24
Sec – II(Q.N : 49 – 56)	Questions with Comprehension Type (4 Comprehensions – 2 +2+2+2 = 8Q)	3	-1	8	24
Sec – III(Q.N : 57 – 60)	Matrix Matching Type	3	-1	4	12
Total				**20**	**60**

PHYSICS: **Max. Marks : 60**

SECTION – I

(MULTIPLE CORRECT CHOICE TYPE)

This section contains **8 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**

1. A vessel of volume 30l is separated into three equal parts by partitions. The left, middle and right parts are filled with 30g of H_2, 160g of O_2 and 70g of nitrogen. The left partition lets through only hydrogen. The right partition allows hydrogen and nitrogen. The vessel is maintained at 300K. On reaching the steady state
   A) The pressures in all the compartments are same
   B) The pressure in the left compartment is least
   C) The pressure in the middle compartment is highest
   D) The pressure in the right compartment is $1.56\times10^5\,Pa$
2. A metal cylinder of mass 0.5 kg is heated electrically by a 12 W heater in a room at 15^0C. The cylinder temperature rises uniformly to 25^0C in 5 min and finally becomes constant at 45^0C. Assuming that the rate of heat loss is proportional to excess temperature over the surrounding.
   A) The rate of less of heat of the cylinder to surroundings at 20^0C is 2W.
   B) The rate of less of heat of the cylinder to surrounding at 45^0C is 12 W
   C) specific heat capacity of metal is $\frac{240}{ln(3/2)}J/kg^0C$
   D) specific heat capacity of metal is $\frac{120}{ln(3/2)}J/kg/^0C$

3. An ideal gas undergoes a process A at constant pressure P_A between temperatures T_1 and T_2. The gas under goes another process at constant pressure P_B between the same temperatures. If W_A and W_B are the works done during the two processes then

A) $|W_B| = |W_A|$ for $P_B = P_A$ B) $|W_B| = |W_A|$ for $P_B > P_A$

C) $|W_B| = |W_A|$ for $P_B < P_A$ D) data is insufficient to conclude

4. An ideal gas is taken from state A(pressure P, volume V) to state B (pressure $\frac{P}{2}$, volume 2V) along a straight line path in the P-V diagram. Selected the correct statements from the following:

A) The work done by the gas in the process A to B exceeds the work done that would be done by it if the system were taken from A to B along an isotherm

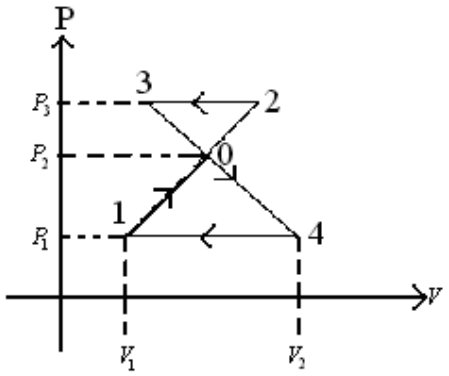
B) In the T-V diagram, the path AB becomes a part of a parabola

C) In the P-T diagram, the path AB become part of hyperbola

D) In going from A to B, the temperature T of the gas first increases to a maximum value and then decrease

5. An ideal gas undergoes a cyclic process $1 \to 2 \to 3 \to 4 \to 1$ as shown in the figure.

Choose the incorrect option



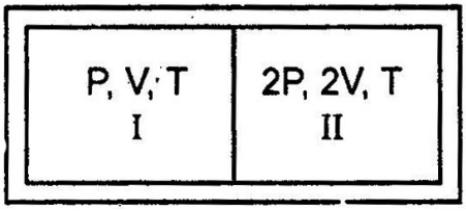
A) Work done by the goes in closed process $1 \to 0 \to 4 \to 1$ is positive.

B) Work done by the gas is closed process $0 \to 2 \to 3 \to 0$ is negative.

C) Work done by gas in closed process $1 \to 0 \to 4 \to 1$ is $\frac{1}{2}(P_2 - P_1)(V_2 - V_1)$

D) Work done by the gas in the closed process $0 \to 2 \to 3 \to 0$ is $\frac{1}{4}(P_2 - P_1)(V_2 - V_1)$

6. A partition divides a container having insulated walls into two compartments I and II. The same gas fills the two compartments whose initial parameters are given. The partition is a conducting wall which can move freely without friction. Which of the following statements is/are correct, with reference to the final equilibrium position?



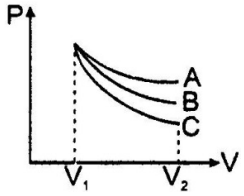
A) The Pressure in the two compartments are equal.

B) Volume of compartment I is $\frac{3V}{5}$

C) Volume of compartment II is $\frac{12V}{5}$

D) Final pressure in compartment I is $\frac{5V}{3}$

7. An ideal gas undergoes an expansion from a state with temperature T_1 and volume V_1 to V_2 through three different polytropic processes A.B and C as shown in the P-V diagram If $|\Delta E_A^{1}|, |\Delta^2 E_B|$ and $|\Delta E_C|$ be the magnitude of changes in internal energy along the three paths respectively, then:



A) $|\Delta E_A| < |\Delta E_B| < |\Delta E_C|$ if temperature in every process decreases

B) $|\Delta E_A| > |\Delta E_B| > |\Delta E_C|$ if temperature in every process decreases

C) $|\Delta E_A| < |\Delta E_B| < |\Delta E_C|$ if temperature in every process increases

D) $|\Delta E_A| > |\Delta E_B| > |\Delta E_C|$ if temperature in every process increases

8. An ideal gas can be expanded from an initial state to a certain volume through two different processes (i) PV^2 = constant and (ii) $P = KV^2$ where K is a positive constant. Then.

A) Final temperature in (i) will be greater than in (ii)

B) Final temperature in (ii) will be greater than in (i)

C) Total heat given to the gas in (i) case is greater than in (ii)

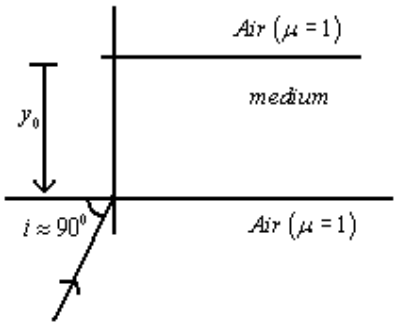
D) Total heat given to the gas in (ii) case is greater than in (i)

SECTION - II
(COMPREHENSION TYPE)

This section contains **4 groups of questions.** Each group has 2 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 9 and 10

A ray of light traveling in air is incident at an angle of incidence $i \approx 90^0$ on a long rectangular slab of a transparent medium of thickness y_0 . The medium has a variable index of $\mu(x) = \sqrt{1+e^{2x/a}}\ \forall\, x \geq 0$, where a is a positive constant.



9. In the above situation, if $y_0 = a/2$, the co-ordinates of the point where the ray intersects the upper surface of the slab – air boundary are

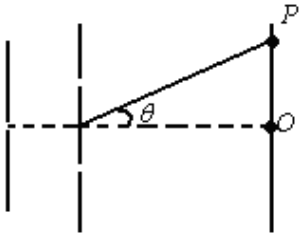
A) $\left[ae^2, \frac{a}{2}\right]$ B) $\left[a\,ln2, \frac{a}{2}\right]$ C) $\left[\frac{a}{2}ln2, \frac{a}{2}\right]$ D) $\left[\sqrt{2}a, \frac{a}{2}\right]$

10. In the previous questions, the angle made by light ray with +ve x-axis at the upper surface of slab air boundary, inside the medium is

A) $\pi/4$ B) $\pi/3$ C) $\tan^{-1}(2)$ D) $\tan^{-1}(1/2)$

Paragraph for Questions 11 and 12

In Youngs double slit experiment we have two coherent cylindrical wave fronts interfering and the pattern is observed on a screen which is a placed a large distance away compared to the distance between the slits. The interference pattern has a constant fringe width only over a small region at the centre of screen, (small value of θ) and would increase we go to points of greater θ. We can have constant fringe width over the screen if two plane wave fronts propagating with a small angle of divergence interfere on the screen.



11. Two coherent plane light waves propagating with a divergence angle $\psi << 1^0$ fall almost normally on a screen. The amplitudes of the waves are equal. If the wavelength of light is λ the distance between two neighboring maxima on the screen is

A) $\frac{2\lambda}{\psi}$ B) $\frac{\lambda}{\psi}$ C) $\frac{\lambda}{2\psi}$ D) $\frac{\lambda}{4\psi}$

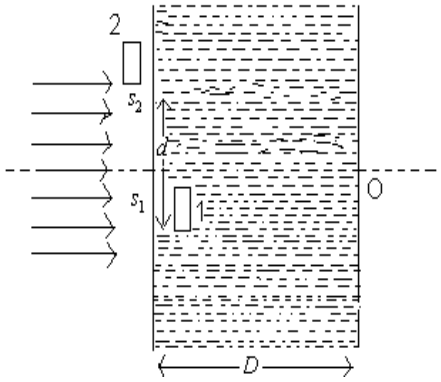
12. A lens of diameter 5.0 cm and focal length f = 25.0 cm was cut along the diameter into two identical halves. In the process, the layer of the lens a=1.00 mm in thickness was lost. Then the halves were put together to form a composite lens. In this focal plane a narrow slit is placed, emitting monochromatic light with wavelength $\lambda = 0.60\ \mu$m. Behind the lens a screen is placed at a distance b = 50 cm form it.

The number of maxima observed on the screen are

A) 11 B) 12 C) 13 D) 14

Paragraph for Questions 13 and 14

A young double slit apparatus is immersed in a liquid of refractive index (μ_1). The slit plane touches the liquid surface. A parallel beam of monochromatic light of wavelength 5000^o A travelling through air is incident normally on the slits. Initially no transparent plate (1&2) is introduced.



13. If one of the slits (s_2) is covered by a transparent slab 2 of refractive index μ_2 and thickness t as shown, the shift in the position of central maxima is.

A) $\frac{D(\mu_2-1)t}{d}$ B) $\frac{D(\mu_2+1)t}{d}$ C) $\frac{d}{D(\mu_2-1)t}$ D) $\frac{d}{D(\mu_2+1)t}$

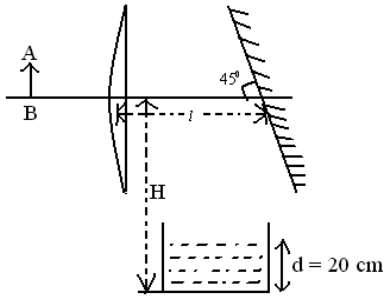
14. Now the other slit S_1 is also covered by a slab of same thickness and refractive index μ_3 as shown in the figure due to which the central maxima recovers its position. Find the value of μ_3

A) $\mu_1\mu_2$ B) μ_1/μ_2 C) $\mu_1^2\mu_2$ D) none of these

Paragraph for Questions 15 and 16

A linear object AB is at a distance of 36 cm from a equi-convex lens of focal length 30 cm. In front of lens there is a plane mirror which is inclined at an angle 45^0 with the principal axis of the lens at a distance of 1 m from the lens, as shown in the figure.

A container with water layer d is placed as shown in the figure. Take the refractive index of water as $\frac{4}{3}$.



Answer the following questions.

15. After reflection from the mirror the image of AB will be

A) Parallel to principal axis of lens

B) Perpendicular to Principal axis of lens

C) Inclined at an angle 45^0 with the Principal axis of lens.

D) a cross(x)

16. After reflection from the mirror the image of AB from the Principal axis will be formed at a distance of

A) 80 cm B) 100 cm C) 180 cm D) 90 cm

SECTION – III

(MATRIX MATCH TYPE)

This section contains **4 multiple choice questions.** Each question has matching lists. The codes for the lists have choices (A), (B), (C), and (D) out of which **ONLY ONE** is correct.

17. F_1= First principal focus

F_2 = Second principal focus

Lens is conversing and ray is incident from left

List-I	**List-II**
P) Object is to left of F_1	1) Image is definitely diminished
Q) Object is to right of F_1	2) Image is definitely virtual
R) Object is between F_1 and optic center	3) Image is to right of F_2
S) Object is virtual	4) Image is to left of F_2

A) $P-3; Q-4; R-2; S-1$ B) $P-4; Q-4; R-2; S-2$

C) $P-3; Q-2; R-4; S-1$ D) $P-3; Q-4; R-4; S-4$

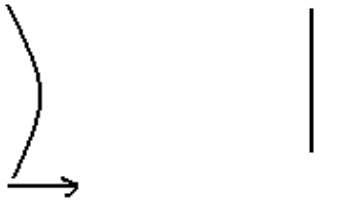
18.

LIST-I

Incident wave front / Reflected / Refracted wave front

P) 

Q) 

R) 

S) 

LIST-II

Possible optical entity used

1) 

2) 

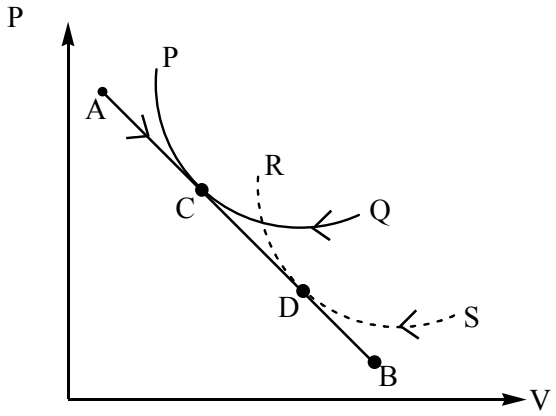
3) 

4) 

A) $P-1; Q-3; R-4; S-2$ B) $P-1,3; Q-2,4; R-2,3; S-1,4$

C) $P-1,4; Q-2,4; R-2,3; S-2,4$ D) $P-2,3; Q-2,4; R-2,3; S-1,4$

19.



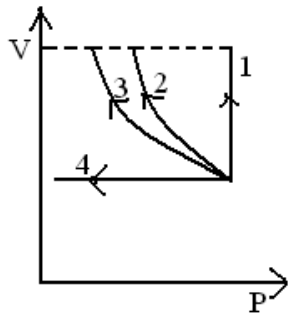
PQ represents an isotherm Q, RS an adiabatic and AB a thermodynamic process for same sample of an ideal gas. AB is tangential to both PQ & RS at points C & D resp.

Column – I	**Column – II**
P) AD	1) Internal energy continuously increases
Q) CB	2) Internal energy continuous increases
R) QC	3) Heat is continuously absorbed
S) DR	4) Heat is continuously released

A) $P-3; Q-4; R-2; S-3$ B) $P-3; Q-2; R-4; S-1$

C) $P-3; Q-2; R-2; S-1$ D) $P-2; Q-4; R-3; S-1$

20. Volume versus pressure curves are given for 4 processes as shown in the figure. Match the entries of column – I with those of column II (ΔQ is heat gained by the system)



LIST – I	**LIST – II**
P) For process 1	1) work done is maximum
Q) For process 2	2) work done is minimum
R) For process 3	3) Temperature may increase
S) For process 4	4) $\Delta Q > 0$

A) $P-1,3;\ Q-2,4;\ R-1,3;\ S-2,4$ B) $P-1,4;\ Q-3;\ R-3;\ S-2$

C) $P-3;\ Q-2,4;\ R-2,4;\ S-2$ D) $P-3;\ Q-2;\ R-1;\ S-4$