

CHEMISTRY, MATHEMATICS & PHYSICS RANK IMPROVEMENT TEST – V

Pattern-5

Time Allotted : 3 Hours

Maximum Marks: 183

INSTRUCTIONS

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

- ✓ Attempt ALL the questions. Answers have to be marked on the OMR sheets.
- ✓ This question paper contains **Three Sections**.
- ✓ **Section – I** is “Chemistry”, **Section – II** is “Mathematics” and **Section – III** is “Physics”.
- ✓ Each Section is further divided into two Parts: **Part – A & Part – C**.
- ✓ Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
- ✓ Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

- (i) **PART-A (01 – 07)** contains 7 Multiple Choice Questions which have **One or More Correct** answer. For each question in the group **Q. 1 – 7** of **PART – A** you will be awarded
Full Marks: +4 if only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
Partial Marks: +1 For darkening a bubble corresponding to **each correct option**, provided NO incorrect option is darkened.
Zero Marks: 0 if none of the bubbles is darkened.
Negative Marks: –1 In all other cases.
- For example, if **(A), (C) and (D)** are all the correct options for a question, darkening all these three will result in **+4 marks**; darkening only **(A) and (D)** will result in **+2 marks**; and darkening **(A) and (B)** will result in **–1** marks, as a wrong option is also darkened.
- PART-A (08 - 13)** contains 2 Tables with 3 Columns and 4 Rows has three questions. Column 1 will be with 4 rows designated (I), (II), (III) and (IV). Column 2 will be with 4 rows designated (i), (ii), (iii) and (iv). Column 3 will be with 4 rows designated (P), (Q), (R) and (S). Each question has four options with **only one correct**.
Full Marks : +3 if only the bubble corresponding to the correct answer is darkened
Zero Marks : 0 if none of the bubbles is darkened
Negative Marks : –1 In all other cases
- (ii) **PART-B** valid for this paper as matrix match is not there.
- (iii) **PART-C (01 – 05)** contains 5 Numerical Based questions with Single Digit Integer as answer, ranging from 0 to 9 and each question carries **+3 marks** for correct answer. No negative marks will be awarded in this section.

Name of Candidate :

Batch ID : Date of Examination : / / 2 0 1

Enrolment Number :

Batches:

SECTION-I : CHEMISTRY

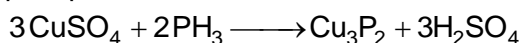
PART – A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. Out of the following which statement is correct?

- (A) Phosphine is prepared by reaction of calcium phosphide with H_2O or dil.HCl.
 (B) It is non-inflammable when pure & becomes inflammable owing to the presence of P_2H_4 or P_4 vapours.
 (C) It is brown in colour & non poisonous gas.
 (D) When absorbed in copper sulphate or mercuric chloride solution, the corresponding phosphides are obtained.



1. ABD

2. Out of the following which statement is correct about PCl_3 ?

- (A) PCl_3 is obtained by passing dry chlorine over heated white phosphorous
 (B) PCl_3 is obtained by action of thionyl chloride with white phosphorous
 $(\text{P}_4 + 8\text{SOCl}_2 \longrightarrow 4\text{PCl}_3 + 4\text{SO}_2 + 2\text{S}_2\text{Cl}_2)$
 (C) PCl_3 is colourless oily liquid & hydrolysis in presence of moisture & give orthophosphorus acid.
 (D) PCl_3 is yellowish white powder and in moist air it hydrolysis to give orthophosphoric acid

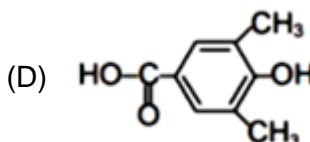
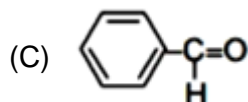
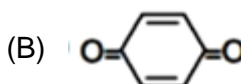
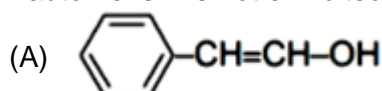
2. ABC

3. Which of the following is the correct statement?

- (A) $\text{B}_2\text{H}_6 \cdot 2\text{NH}_3$ is known as 'inorganic benzene'
 (B) Boric acid is protonic acid
 (C) Beryllium exhibits coordination number of six
 (D) Chlorides of both beryllium and aluminium have bridged chloride structure in solid phase

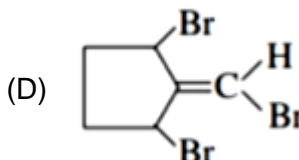
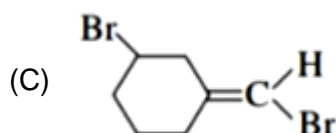
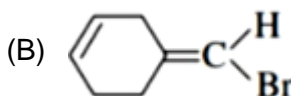
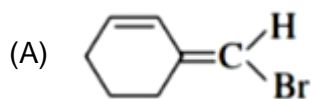
3. D

4. Tautomerism is not exhibited by



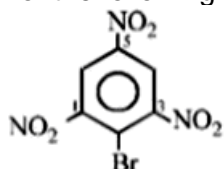
4. BC

5. Which of the compounds will show geometrical isomerism?



5. ABCD

6. Which of the following statements would be false about this compound:



- (A) All three C – N bonds are of same length
 (B) C1 – N and C3 – N bonds are of same length but shorter than C5 - N bond
 (C) C1 – N and C3 – N bonds are of same length but longer than C5 - N bond
 (D) C1 – N and C3 – N bonds are of different length but both are longer than C5 - N bond
6. ABD
7. Which of the following statement is/are correct?
 (A) Contributing structures contributes to the resonance hybrid in proportion of their energies
 (B) Equivalent contributing structure make the resonance very important.
 (C) Contributing structures represent hypothetical molecules having no real existence.
 (D) Contributing structures are less stable than the resonance hybrid.
7. BCD

(Single Option Correct)

PART-A (08 - 13)

contains 2 Tables with 3 Columns and 4 Rows has three questions. Column 1 will be with 4 rows designated (I), (II), (III) and (IV). Column 2 will be with 4 rows designated (i), (ii), (iii) and (iv). Column 3 will be with 4 rows designated (P), (Q), (R) and (S). Each question has four options with **only one correct**.

| | Column – 1 Acids | | Column – 2 Reagent | | Column – 3 PK _a values of acids |
|-------|---------------------|-------|-----------------------------------|-----|---|
| (I) | | (i) | NaHCO ₃ will react | (P) | PK _a = -6.5 |
| (II) | | (ii) | Na will react | (Q) | PK _a = 10 |
| (III) | | (iii) | NaOH will react | (R) | PK _a = 4.20 |
| (IV) | | (iv) | NaHCO ₃ will not react | (S) | PK _a = 1.5 |

8. The only CORRECT combination is
 (A) (I) (iv) (Q) (B) (I) (i) (S)
 (C) (I) (ii) (P) (D) (I) (i) (Q)
8. B

9. The only CORRECT combination for benzoic acid is
 (A) (III) (i) (P) (B) (III) (i) (S)
 (C) (III) (ii) (R) (D) (III) (iv) (R)
9. C
10. The only INCORRECT combination is
 (A) (IV) (i) (P) (B) (I) (ii) (S)
 (C) (III) (i) (R) (D) (IV) (iv) (Q)
10. D

(Single Option Correct)

Answer Q. 11, Q.12 and Q.13 by appropriately matching the information given in the three column of the following table:

| Columns 1, 2 and 3 contain starting materials, reaction conditions, and type of reactions, respectively. | | |
|--|---|-------------------|
| Column 1 | Column 2 | Column 3 |
| (I) Toluene | (i) NaOH/ Br ₂ | (P) Condensation |
| (II) Acetophenone | (ii) Br ₂ / hν | (Q) Carboxylation |
| (III) Benzaldehyde | (iii) (CH ₃ CO) ₂ O/ CH ₃ COOK | (R) Substitution |
| (IV) Phenol | (iv) NaOH/ CO ₂ | (S) Haloform |

11. The only CORRECT combination that gives two different carboxylic acids is
 (A) (III) (iii) (P) (B) (I) (i) (S)
 (C) (II) (iv) (R) (D) (IV) (iii) (Q)
11. A
12. The only CORRECT combination in which the reaction proceeds through radical mechanism is
 (A) (III) (ii) (P) (B) (IV) (i) (Q)
 (C) (II) (iii) (R) (D) (I) (ii) (R)
12. D
13. For the synthesis of benzoic acid, the only CORRECT combination is
 (A) (I) (iv) (Q) (B) (III) (iv) (R)
 (C) (IV) (iii) (P) (D) (II) (i) (S)
13. D

PART – C
(Integer Type)

This section contains 5 questions. The answer to each question is a **single-digit integer**, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

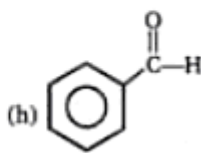
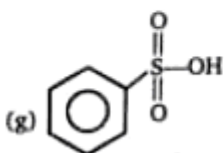
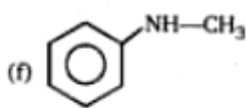
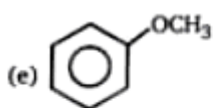
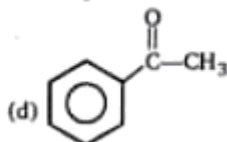
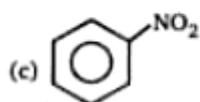
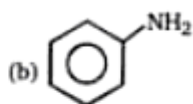
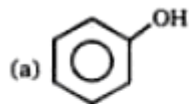
1. Find the value of x in the tremolite asbestos:
 $\text{Ca}_2\text{Mg}_x(\text{Si}_4\text{O}_{11})_2(\text{OH})_2$
1. 5
2. Consider the following four compounds
 (i) C_xO_y (ii) C_xO_{y+1} (iii) C_{x+2}O_{y+1} (iv) C_{x+11}O_{y+8}
 If "x = y = 1", then calculate the value of |p - q|, where p and q are total number of sp² and sp-hybridized carbon atoms respectively in given four compounds.
2. 7

3. When B_2H_6 is allowed to react with following lewis bases, then how many given lewis bases form adduct through symmetrical cleavage of B_2H_6 ?

NH_3 , $MeNH_2$, Pyridine, CO , $T.H.F$, PH_3 , PF_3 , Me_3N , Me_2NH

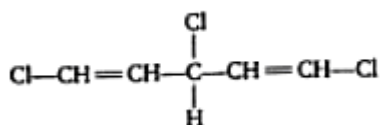
3. 6

4. x = number of (+M) group attached with phenyl ring, so the value of x is



4. 4

5. Find out the total number of stereoisomers of the given following compound.



5. 4

Space for rough work

SECTION-II : MATHEMATICS

PART – A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. If the equation $ax^2 + bx + c = 0$ ($a > 0$) has two roots α and β such that $\alpha < -2$ and $\beta > 2$, then
- (A) $b^2 - 4ac > 0$ (B) $c < 0$
 (C) $a + |b| + c < 0$ (D) $4a + 2|b| + c < 0$

1. **ABCD**

2. The real values of λ for which the equation $3x^3 + x^2 - 7x + \lambda = 0$ has two distinct real roots in $[0, 1]$ lies in the interval (s):
- (A) $(-2, 0)$ (B) $[0, 1]$
 (C) $[1, 2]$ (D) $(-\infty, \infty)$

2. **ABCD**

3. The three roots of equation $x^4 - px^3 + qx^2 - rx + s = 0$, where $p, q, r, s \in \mathbb{R}$ and $s < 0$, are $\tan A$, $\tan B$ and $\tan C$ where A, B, C are angles of a triangle. Then the fourth root of the equation can be equal to:
- (A) $\frac{p + \sqrt{p^2 - 4s}}{2}$ (B) $\frac{p - \sqrt{p^2 - 4s}}{2}$
 (C) $\frac{p+r}{1-q+s}$ (D) $\frac{p-r}{1-q+s}$

3. **ABD**

4. The complete set of values of real parameter 'm' for which the equation $m \sin^2 x + (m-1) \sin x + (m-2) = 0$ has
- (A) No real roots is $(-\infty, 1) \cup \left(1 + \frac{2}{\sqrt{3}}, \infty\right)$ (B) 5 roots in $[0, 2\pi]$ is $\{2\}$
 (C) 4 roots in $[0, 2\pi]$ is $(1, 2) \cup \left(2, \frac{\sqrt{3}+2}{\sqrt{3}}\right)$ (D) 2 roots in $[0, 2\pi]$ is $\left\{-1, 1, \frac{\sqrt{3}+2}{\sqrt{3}}\right\}$

4. **ABCD**

5. If a, b, c, d are four unequal positive numbers which are in A.P., then:
- (A) $\frac{1}{a} + \frac{1}{d} = \frac{1}{b} + \frac{1}{c}$ (B) $\frac{1}{a} + \frac{1}{d} < \frac{1}{b} + \frac{1}{c}$
 (C) $\frac{1}{a} + \frac{1}{d} > \frac{1}{b} + \frac{1}{c}$ (D) $\frac{1}{b} + \frac{1}{c} > \frac{4}{a+d}$

5. **CD**

6. 3 married couples are to be seated around a circular table. Let x denote the number of ways where at most two couples sit together and let y denote the number of ways where only two particular couples sit together, then identify the correct option(s)
- (A) $x - 8y = 60$ (B) $x + y = 112$
 (C) $x = 13y$ (D) None of these

6. **BC**

7. Ten persons numbered 1, 2, ..., 10 play a chess tournament, each player playing against every other player exactly one game. It is known that no game ends in a draw. If w_1, w_2, \dots, w_{10} are the number of games won by players 1, 2, 3, ..., 10, respectively, and l_1, l_2, \dots, l_{10} are the number of games lost by the players 1, 2, ..., 10, respectively, then
- (A) $\sum w_i = \sum l_i = 45$ (B) $\sum (w_i + l_i) = 90$
 (C) $\sum w_i^2 = \sum l_i^2$ (D) none of these

7. **ABC**

(Single Option Correct)

Answer Q. 8, Q. 9 and Q. 10 by appropriately matching the information given in the three columns of the following table.

| Columns I, II and III contains statement, number of ways/solutions and statement respectively. | | |
|--|-----------|--|
| Column I | Column II | Column III |
| (I) The number of triplets (a, b, c) such that all three terms a, b, c are in HP in which $a = 20$ and b divides c (where a, b, c are strictly increasing positive integers) | (i) 66 | (P) N is the number of 6 digit numbers whose digits are selected from set {5, 6, 7, 8, 9} such that any digit that appears in the number appears at least twice then $\left(\frac{N-5}{28}\right)$ |
| (II) The number of solutions of $m+n+p=10$, (m, n, p are non negative integers) | (ii) 2 | (Q) Real value of $(\sqrt{108+10})^{1/3} - (\sqrt{108-10})^{1/3}$ is |
| (III) The number of ordered pair (a, b) satisfying the equation $ab+b-a+1=0$ are where $a, b \in I$ | (iii) 4 | (R) Real value of x which satisfies $(\sqrt{x^2-5x+6} + \sqrt{x^2-5x+4})^{x/2} + (\sqrt{x^2-5x+6} - \sqrt{x^2-5x+4})^{x/2} = 2^{\frac{x+4}{4}}$ |
| (IV) If a, b, c are in G.P. and x, y are the arithmetic means between a, b and b, c respectively, then $\frac{a}{x} + \frac{c}{y}$ | (iv) 5 | (S) If 64, 27, 36 are the P^{th} , Q^{th} and R^{th} terms of a G.P. then $\frac{(22 \times (P + 2Q))}{R}$ |

8. Which of the following option is the only **CORRECT** combination?
- (A) (I) (ii) (P) (B) (II) (ii) (R)
 (C) (I) (iv) (P) (D) (III) (ii) (S)

8. **C**

9. Which of the following option is the only **CORRECT** combination?

- (A) (II) (i) (Q) (B) (I) (iv) (S)
(C) (I) (ii) (P) (D) (III) (iii) (R)

9. **D**

10. Which of the following options is the only **CORRECT** combination?

- (A) (I) (iv) (P) (B) (III) (ii) (P)
(C) (IV) (ii) (P) (D) (I) (ii) (Q)

10. **A**

(Single Option Correct)

Answer Q. 11, Q. 12 and Q. 13 by appropriately matching the information given in the three columns of the following table.

| Columns I, II and III contains conics, equations of tangents to the conics and points of contact, respectively | | |
|--|-----------------|---------------|
| Column I | Column II | Column III |
| (I) $x^3 = x^2 + 1$ has roots α, β and γ , then the equations whose roots are $\alpha^2 + \beta^3 + \gamma^4$, $\alpha^4 + \beta^2 + \gamma^3$ and $\gamma^2 + \alpha^3 + \beta^4$ is given by $x^3 + ax^2 + 33x + b = 0$ | (i) $a = 1$ | (P) $b = 7$ |
| (II) The largest real root of the equation $x^4 - 4x^3 + 5x^2 - 4x + 1 = 0$ can be expressed as $\frac{a + \sqrt{b}}{2}$ (where 'b' does not contain any perfect square) | (ii) $a = 2$ | (Q) $b = 5$ |
| (III) If $(2a - b)x^2 + (a - 1)x + 5 = 0$ has both roots ∞ , then | (iii) $a = -10$ | (R) $b = 2$ |
| (IV) The number of 15 letter arrangements of 5A's, 5B's and 5C's having no A's in the first 5 letters, no B's in the next 5 letters and no C's in the last 5 letters are $a2b2$ (where a and b represent digits) | (iv) $a = 3$ | (S) $b = -37$ |

11. Which of the following option is the only **CORRECT** combination?

- (A) (II) (ii) (R) (B) (II) (iii) (P)
(C) (IV) (ii) (P) (D) (III) (i) (R)

11. **D**

12. Which of the following represents **INCORRECT** combination?

- (A) (IV) (ii) (Q) (B) (III) (i) (R)
(C) (IV) (ii) (R) (D) (I) (iii) (S)

12. **C**

13. Which of the following represents **INCORRECT** combination?
 (A) (III) (i) (R) (B) (I) (iii) (S)
 (C) (IV) (ii) (P) (D) (II) (iv) (Q)

13. **C**

PART – C
(Integer Type)

This section contains 5 **questions**. The answer to each question is a **single-digit integer**, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

14. Let $f(x) = ax^4 + bx^2 + 3x + 7$ and $f(-4) = 2286$ and $f(4) = N$. If K be the number of ways in which the number N can be resolved as a product of two divisors which are relatively prime then $K - 7$

14. **9**

15. $\left(\sum_{r=1}^{30} \frac{r^2}{(r^2 - 30r + 450)} \right) - 25$ is _____

15. **6**

16. If a, b, c are non – zero real numbers, then the minimum value of the expression $\frac{(a^8 + 4a^4 + 1)(b^4 + 3b^2 + 1)(c^2 + 2c + 2)}{5a^4b^2}$ equals

16. **6**

17. Let α, β are the roots of the equation $x^2 + x - 3 = 0$. Then the value of $\alpha^3 - 4\beta^2 + 19$ is equal to

17. **0**

18. Given that a, b are integers and the two real roots α, β of the equation $3x^2 + 3(a+b)x + 4ab = 0$ satisfy the relation $\alpha(\alpha+1) + \beta(\beta+1) = (\alpha+1)(\beta+1)$. Then the number of ordered pairs (a, b) is equal to

18. **4**

Space for rough work

SECTION-III : PHYSICS

PART – A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. Two objects of masses m and $4m$ are at rest at an infinite separation. They move towards each other under mutual gravitational force of attraction. If G is the universal gravitational constant. Then at separation r

(A) the total energy of the two objects is zero.

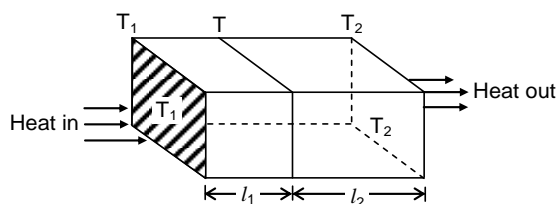
(B) their relative velocity of approach is $\left(\frac{10Gm}{r}\right)^{\frac{1}{2}}$ in magnitude.

(C) the total kinetic energy of the objects is $\frac{4Gm^2}{r}$.

(D) net angular momentum of both the particles is zero about any point.

1. **ACD**

2. Two plates thickness l_1 and l_2 with thermal conductivities K_1 and K_2 respectively are kept in thermal contact as shown in the figure. If A is area of each face, then mark the correct options.



(A) Thermal resistance of combination is $R = \frac{l_1}{AK_1} + \frac{l_2}{AK_2}$

(B) Heat flow rate through the combination is $H = \frac{A(T_1 - T_2)}{\left(\frac{l_1}{K_1} + \frac{l_2}{K_2}\right)}$

(C) Temperature of joint of slabs is $T = \frac{T_1 \frac{l_2}{K_2} + T_2 \frac{l_1}{K_1}}{\left(\frac{l_1}{K_1} + \frac{l_2}{K_2}\right)}$

(D) Equivalent thermal conductivity; of combination will be $K_{eq} = \frac{l_1 + l_2}{\left(\frac{l_1}{K_1} + \frac{l_2}{K_2}\right)}$

2. **ABCD**

3. The temperature drop through a two layers furnace wall is 900°C . Each layer is of equal area of cross-section. Which of the following actions will result in lowering the temperature θ of the interface?

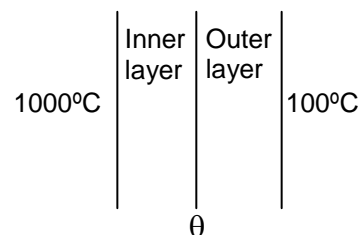
(A) by increasing the thermal conductivity of outer layer.

(B) by increasing the thermal conductivity of inner layer.

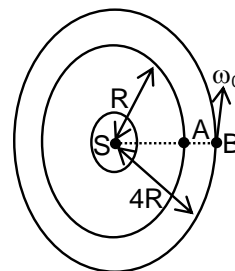
(C) by increasing thickness of outer layer.

(D) by increasing thickness of inner layer.

3. **AD**



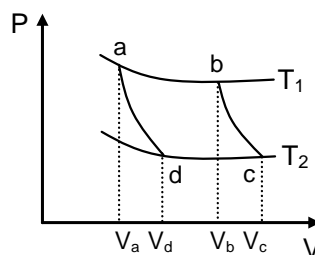
4. Two planets A and B, having orbital radius R and $4R$ are initially at the closest position, and rotating in the same direction. If angular velocity of planet B is ω_0 , then after how much time, will both the planets be again in the closest position?



- (A) $\frac{2\pi}{7\omega_0}$ (B) $\frac{2\pi}{9\omega_0}$
 (C) $\frac{2\pi}{\omega_0}$ (D) $\frac{10\pi}{\omega_0}$

4. **ACD**

5. Two adiabatic processes bc and ad for the same gas are given to intersect two isotherms at T_1 and T_2 (as shown). Then



- (A) $\frac{V_a}{V_b} = \frac{T_2}{T_1}$ (B) $\frac{V_a}{V_b} = \frac{T_1}{T_2}$
 (C) $\frac{V_b}{V_c} = \left(\frac{T_2}{T_1}\right)^{\frac{1}{\gamma-1}}$ (D) $V_a V_c = V_b V_d$

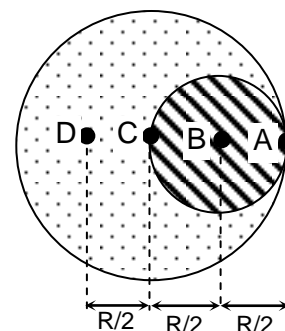
5. **CD**

6. A satellite moves in a circular orbit around earth with speed V_0 . Suddenly, it's direction of motion is changed by angle $\theta = \cos^{-1}(3/5)$ away from earth keeping it's speed same. Due to this, satellite's orbit changes to an elliptical one. In new orbit:

- (A) Ratio of maximum to minimum distance of satellite from earth is 3 : 1.
 (B) Ratio of maximum to minimum distance of satellite from earth is 9 : 1.
 (C) Ratio of maximum to minimum K.E. of satellite in orbit is 9 : 1.
 (D) Ratio of maximum to minimum K.E. of satellite in orbit is 81 : 1.

6. **BD**

7. Gravitational potential on the surface of an isolated uniform solid sphere of mass M and radius R is found to be V_0 . A spherical cavity having radius $R/2$ is created inside the sphere which is touching the surface of original sphere. The cavity is then filled with material having density 16 times that of original sphere. A, B, C and D are consecutive points as shown in the figure each $R/2$ apart. V_A, V_B, V_C and V_D are gravitational potentials found at points A, B, C and D respectively.



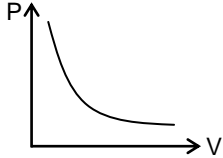
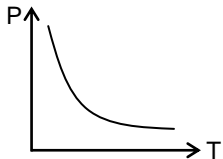
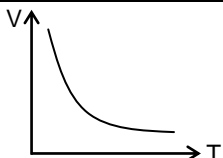
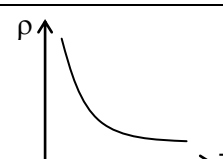
- (A) the value of V_A is $19/4 V_0$ (B) the value of V_B is $7V_0$
 (C) the value of V_C is $21/4 V_0$ (D) the value of V_D is $13/4 V_0$

7. **ABCD**

(Single Option Correct)

The following table has 3 columns and 4 rows. Based on table, there are TWO questions. Each question has FOUR option (A), (B), (C) and (D). ONLY ONE of these four options is correct.

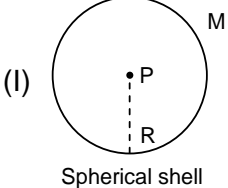
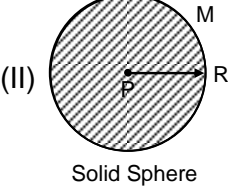
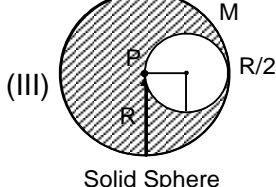
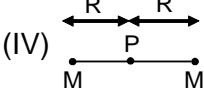
Column I shows rectangular hyperbola graphs, Column II shows molar heat capacities for monoatomic gases and column III shows work done when process goes from initial state 1 to final state 2.

| Column 1 | Column 2 | Column 3 |
|---|--------------------------|--|
| (I)  | (i) $C = \frac{7R}{2}$ | (P) $\Delta W = nR(T_2 - T_1)$ |
| (II)  | (ii) $C = \frac{R}{2}$ | (Q) $\Delta W = -nR(T_2 - T_1)$ |
| (III)  | (iii) $C = \frac{5R}{2}$ | (R) $\Delta W = 2nR(T_2 - T_1)$ |
| (IV)  | (iv) $C = \infty$ | (S) $\Delta W = nRT \ln \frac{V_2}{V_1}$ |

8. Which option matches the data for an isobaric process?
 (A) (IV) (iv) (P) (B) (III) (iii) (P)
 (C) (IV) (iii) (P) (D) (III) (i) (Q)
8. **C**
9. Which of the following options is a correct combination?
 (A) (II) (iii) (R) (B) (III) (ii) (Q)
 (C) (III) (iii) (Q) (D) (II) (ii) (Q)
9. **B**
10. Which option matches the data for a process whose $\Delta U = 0$?
 (A) (IV) (ii) (S) (B) (II) (iv) (S)
 (C) (I) (ii) (Q) (D) (I) (iv) (S)
10. **D**

(Single Option Correct)

Let V & E denote the gravitational potential and gravitational field respectively at a point due to certain mass distribution. Column-1 shows the mass distribution. Column-2 shows gravitational field. Column-3 represents the gravitational potential. (r is horizontal distance from centre P).

| Column 1 | Column 2 | Column 3 |
|---|--|---|
| (I)  Spherical shell | (i) $E = \frac{GM}{R^2}$ When $r = R$ | (P) $V = -\frac{3GM}{2R}$ When $r = 0$ |
| (II)  Solid Sphere | (ii) $E = 0$ When $r = 0$ | (Q) $V = -\frac{GM}{R}$ When $0 \leq r \leq R$ |
| (III)  Solid Sphere | (iii) $E = \frac{GM}{4R^2}$ When $r = 2R$ | (R) $V = -\frac{2GM}{R}$ When $r = 0$ |
| (IV)  | (iv) $E = \frac{GM}{2R^2}$ When $r = \frac{R}{2}$ | (S) $V = 0$ When $r = \frac{4R}{7}$ |

11. In which of the following cases corresponds with zero gravitational field ?

(A) (III) (ii) (Q)

(B) (IV) (ii) (R)

(C) (II) (ii) (R)

(D) (I) (ii) (P)

11. **B**

12. Which of the following is correct combination ?

(A) (I) (iv) (R)

(B) (II) (ii) (Q)

(C) (I) (i) (Q)

(D) (III) (i) (P)

12. **C**

13. Which of the following is correct combination ?

(A) (III) (iv) (P)

(B) (III) (ii) (P)

(C) (IV) (iii) (P)

(D) (II) (iv) (P)

13. **D**

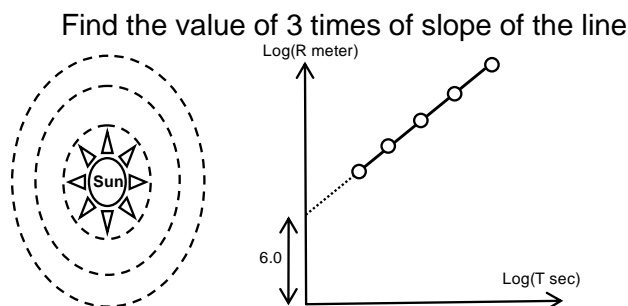
PART – C
(Integer Type)

This section contains 5 questions. The answer to each question is a **single-digit integer**, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

14. Many particles are revolving around a fixed sun, in circular orbits of different radius (R) and different time period (T). To estimate the mass of the sun, the orbital radius (R) and time period (T) of planets were noted. Then $\log_{10}T$ v/s $\log_{10}R$ curve was plotted.

The curve was found to be approximately straight line (as shown in figure) having y intercept = 6.0 (neglect the gravitational interaction among the planets)

[Take $G = \frac{20}{3} \times 10^{-11}$ in MKS, $\pi^2 = 10$]

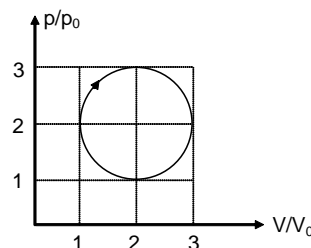


14. **2**

15. A spacecraft is moving in a circular orbit around the Earth (Radius 6400 Km), at a height of 300 km from the surface. To place the spacecraft in an elliptical orbit, the mechanical energy of the spacecraft– Earth system is increased by 10.0%. If the spacecraft-earth system had initial energy ($-E_0$) and the total mechanical energy of the system after firing the rocket will be $-xE_0/10$, then find the value of x

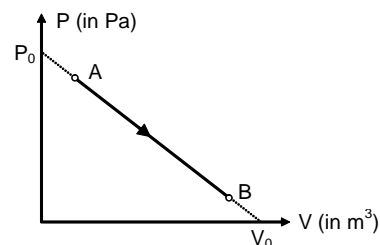
15. **9**

16. An ideal gas undergoes a cyclic process that is shown by a circle in a p-V indicator diagram of the process. If the ratio of the highest temperature to the lowest temperature attained by the gas during the process is $\frac{a + b\sqrt{2}}{a - b\sqrt{2}}$, then find the value of 'a - b'.



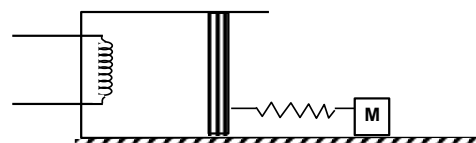
16. **5**

17. One mole of an ideal mono-atomic gas undergoes a process A \rightarrow B that is a straight line on a p-V indicator diagram of the process as shown in the figure. If volume of the gas when the process turns from an endothermic to an exothermic one is $\frac{xV_0}{8}$ then find the value of 'x'.



17. **5**

18. An adiabatic cylinder has 8 gm of helium. A light smooth adiabatic piston is connected to a light spring of force constant 30 N/m. The other end of the spring is connected with a block of mass 1 kg kept on a rough horizontal surface of coefficient of friction $\mu = 0.3$. Area of cross section of cylinder is $a = 25 \text{ cm}^2$.



Initially the spring is in a relaxed position and the temperature of the gas is 400 K. The gas is heated slowly from some time by means of an electric heater so as the block M just starts moving. Find the value of b if work done by the gas is $0.113b$

18. 1

Space for rough work

FIITJEE INTERNAL TEST

Batches:

RANK IMPROVEMENT TEST – V

IIT - JEE 2021

ANSWERS

QP CODE:

Answers

Chemistry

Part – A

Part – C

Mathematics

Part – A

Part – C

Physics

Part – A

Part – C