

## PHYSICS, CHEMISTRY & MATHEMATICS

QP Code: 100171

Common  
Test- V

Time Allotted: 3 Hours

Maximum Marks: 198

- 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.

### INSTRUCTIONS

**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

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains **Three Sections**.
3. **Section-I** is Physics, **Section-II** is Chemistry and **Section-III** is Mathematics.
4. Each **Section** is further divided into **Two Parts: Part-A & B** in the OMR.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. 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 Two Parts.

- (i) **Part-A (01-06)** – Contains seven (06) multiple choice questions which have **One or More** correct answer.  
*Full Marks: +4* If only the bubble(s) corresponding to all the correct options(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.
- (ii) **Part-B (01-06)** contains Six (06) Numerical based questions with single digit integer as answer, ranging from 0 to 9 (both inclusive) and each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer.
- (iii) **Part-B (07-12)** contains Six (06) Numerical based questions, the answer of which maybe positive or negative numbers or decimals to **Two decimal places** (e.g. 6.25, 7.00, -0.33, -30, 30.27, -127.30) and each question carries **+4 marks** for correct answer and **there will be no negative marking**.

Name of the Candidate : \_\_\_\_\_

Batch : \_\_\_\_\_ Date of Examination : \_\_\_\_\_

Enrolment Number : \_\_\_\_\_

# SECTION-1 : PHYSICS

## PART – A

### (Multi Correct Choice Type)

This section contains 6 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

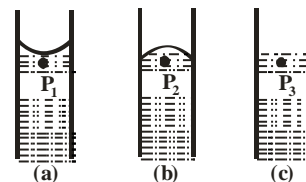
1. Compare the pressure at the point P in the three tubes shown in the figure:

(A)  $P_2 > P_1 > P_3$

(B)  $P_3 > P_1 > P_2$

(C)  $P_1 > P_3 > P_2$

(D)  $P_2 > P_3 > P_1$



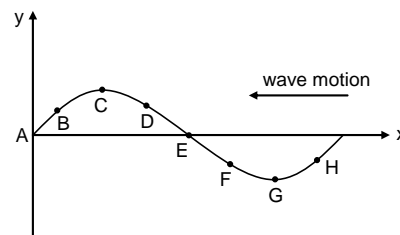
2. A transverse wave is travelling along a stretched string from right to left. The figure shown represents the shape of the string (snap shot) at a given instant:

(A) the particles at A, B and H have upward velocity.

(B) the particles at D, E and F have downward velocity.

(C) the particles at C, E and G have zero velocity.

(D) the particles at A and E have maximum velocity.



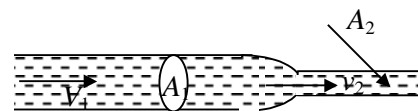
3. A liquid flows in a tube from left to right as shown in figure  $A_1$  and  $A_2$  are the cross-sections of the portions of the tube as shown. Then the ratio of speeds  $v_1/v_2$  will be

(A)  $A_1/A_2$

(B)  $A_2/A_1$

(C)  $\sqrt{A_2} / \sqrt{A_1}$

(D)  $\sqrt{A_1} / \sqrt{A_2}$



4. A vibrating string produces 2 beats per seconds when sounded with a tuning fork of frequency 256 Hz. increasing the tension in the string produces 3 beats per second. The initial frequency of the string may have been

(A) 253 Hz

(B) 254 Hz

(C) 258 Hz

(D) 259 Hz

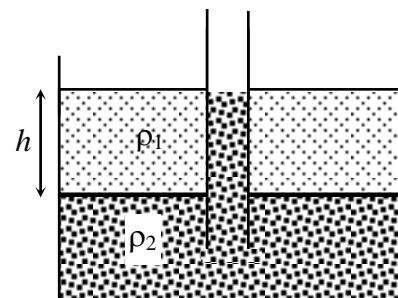
5. A container has two immiscible liquids of densities  $\rho_1$  and  $\rho_2$  ( $\rho_2 > \rho_1$ ). A capillary tube of radius  $r$  is inserted in the liquid so that its bottom reaches upto the denser liquid. The denser liquid rises in the capillary and attains a height  $h$  from the interface of the liquids, which is equal to the column length of the lighter liquid. Assuming angle of contact to be zero, the surface tension of heavier liquid is

(A)  $2\pi r \rho_2 g h$

(B)  $\frac{\rho_2 r g h}{2}$

(C)  $\frac{r}{2}(\rho_2 - \rho_1) g h$

(D)  $2\pi r (\rho_2 - \rho_1) g h$



*Space For Rough Work*

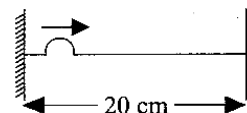
6.  $Y(x, t) = \frac{0.8}{\left[(4x + 5t)^2 + 5\right]}$  represents a moving pulse where  $x$  and  $y$  are in metres and  $t$  in second. Then
- (A) pulse is moving in positive  $x$ -direction (B) in 2 s, it will travel a distance of 2.5 m  
 (C) its maximum displacement is 0.16 m (D) its maximum displacement is 0.10 m

## PART – B

### Integer Answer Type

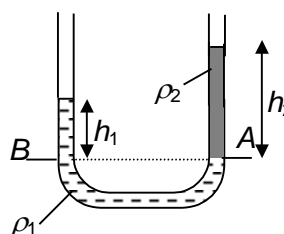
This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

1. Two soap bubbles of radii 2mm and 4mm are brought in contact. If the surface tension of liquid is  $7 \times 10^{-2} \text{ Nm}^{-1}$ . Then the radius of the common surface is  $n \times 10^{-3} \text{ m}$  find  $n$ .
2. A large tank is filled with water to a height  $H$ . A small hole is made at the base of the tank. It takes  $T_1$  time to decrease the height of water to  $H/9$  and it takes  $T_2$  time to take out the rest of water. Find  $T_1 / T_2$ .
3. A bus is moving towards a huge wall with a velocity of 5 m/s. the driver sounds a horn of frequency 200 Hz. What is the frequency of beats heard by a passenger of the bus, if the speed of sound in air is 330 m/s.
4. A string of length 20 cm and linear mass density 0.40 g/cm is fixed at both ends and is kept under a tension of 16 N. A wave pulse is produced at  $t = 0$  near an end as shown in figure which travels towards the other end. When will the string have the shape shown in the figure again? (in  $\times 10^{-2} \text{ s}$ )



5. An organ pipe  $P_1$  closed at one end vibrating in its first overtone and another pipe  $P_2$  open at the both ends vibrating in its third overtone are in resonance with a given tuning fork. The ratio of the length of  $P_1$  to that of  $P_2$  is  $\frac{3}{n}$  then  $n = ?$

6. Two immiscible liquids are placed on a U-tube having densities  $\rho_1$  and  $\rho_2$ . Find the ratio  $\frac{h_1 \rho_1}{h_2 \rho_2}$ .



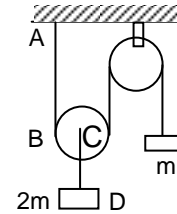
*Space For Rough Work*

## PART – B (Numerical based)

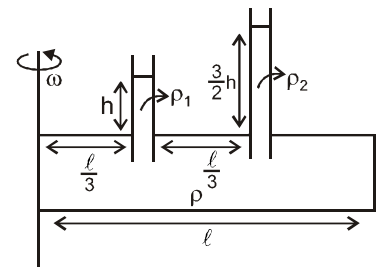
This section contains **6 questions**, numerical based questions, (answer of which may be positive or negative numbers or decimals).

7. A ball of mass  $m$  and density  $\rho$  is immersed in a liquid of density  $2.5 \rho$  at a depth  $h$  and released. If the height will the ball jump up above the surface of liquid is  $H$  then find the value of  $H/h$  (neglect the resistance of water and air).

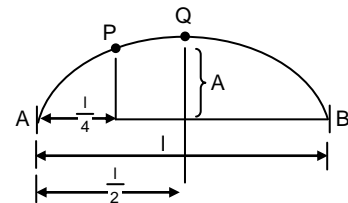
8. Both the string shown in figure are made of same material and have same cross – sectional area. The pulleys are light. The wave speed of a transverse wave in the string AB is  $v_1$  and in string CD, it is  $v_2$ . Then  $v_1/v_2$  (upto two decimal places) is



9. The manometers inserted in a rotating liquid tube have different liquid columns of heights  $h$  and  $\frac{3h}{2}$  find the value of  $\frac{\rho_1}{\rho_2} \times 10$  (tube is open at axis of rotation and filled with liquid of density  $\rho$ ).



10. A string vibrates with one loop between the fixed points A and B. The ratio of maximum velocities of Q to P is

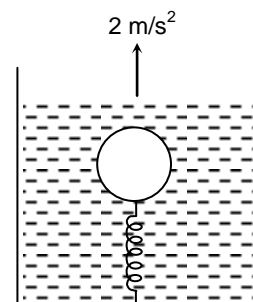


11. Two waves get superposed on a string,

$$Y_1 = 3\sin 2\pi(x - 10t) \text{ and } Y_2 = 3\sin 2\pi(x + 10t)$$

Where  $x$ ,  $y_1$  and  $y_2$  are in metre and  $t$  in second. Then, the distance between two adjacent nodes on the string in centimetre is:

12. A ball of mass  $10 \text{ kg}$  and density  $1 \text{ gm/cm}^3$  is attached to the base of a container having a liquid of density  $1.1 \text{ gm/cm}^3$ , with the help of a spring as shown in the figure. The container is going up with an acceleration  $2 \text{ m/s}^2$ . If the spring constant of the spring is  $800 \text{ N/m}$ , then find the elongation (in cm) in the spring



*Space For Rough Work*

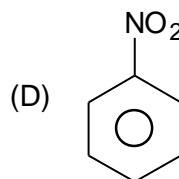
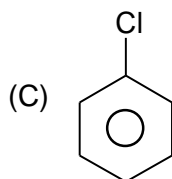
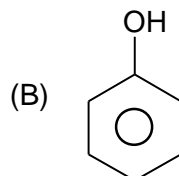
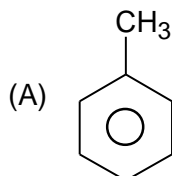
## **SECTION-2 : CHEMISTRY**

### **PART – A**

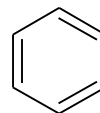
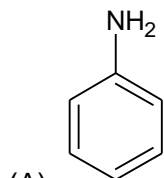
#### **(Multi Correct Choice Type)**

This section contains 6 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. In which of the following electron density of phenyl ring is more than benzene?

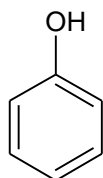


2. Which of the following statement is/are incorrect?

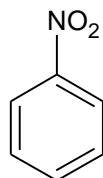


- (A) show better rate of Friedel-craft alkylation than  
 (B)  $C_6D_6$  show faster sulphonation than  $C_6H_6$   
 (C)  $C_6H_6$  shows faster nitration than  $C_6D_6$   
 (D)  $CH_2 = CH - Cl$  in anhydrous  $AlCl_3$  reacted with benzene gives vinyl benzene easily

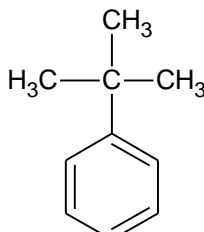
- 3.



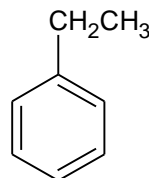
(a)



(b)



(c)



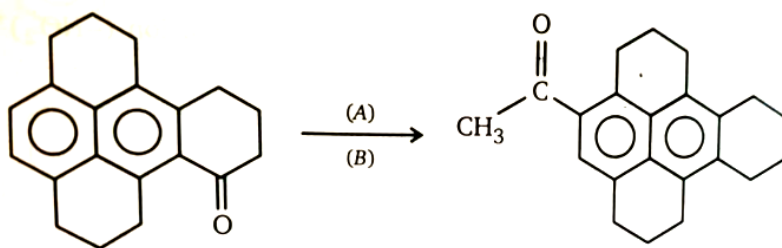
(d)

Which of the following statement is/are incorrect for give compounds?

- (A) (a) shows tribromination if reacted with  $Br_2/H_2O$   
 (B) (b) form para methyl nitrobenzene on reaction with  $CH_3 - Cl$  in anhydrous  $AlCl_3$   
 (C) (c) shows faster rate of electrophilic aromatic substitution than (d)  
 (D) (d) shows faster rate of electrophilic aromatic substitution than (c)

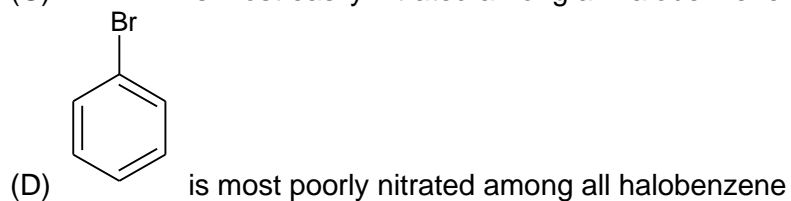
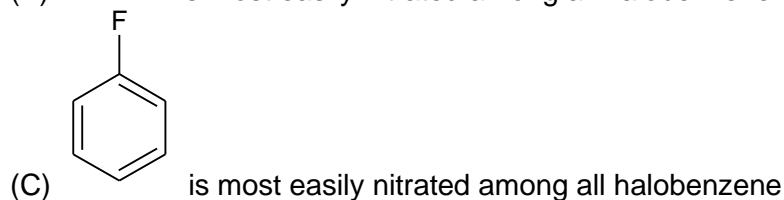
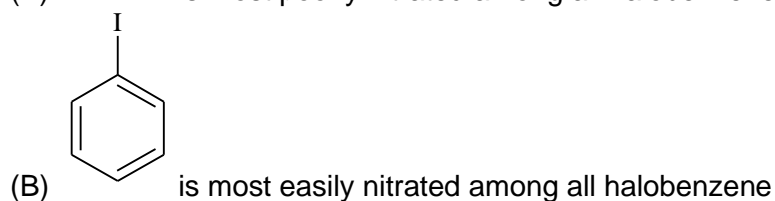
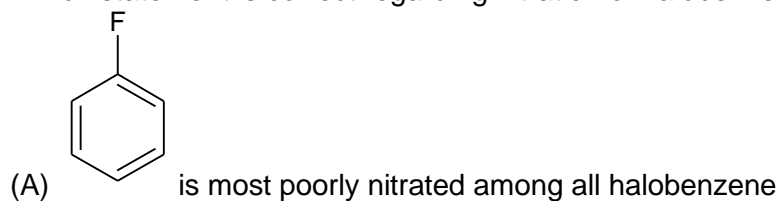
*Space For Rough Work*

4. In the given conversion best yield will be obtained with



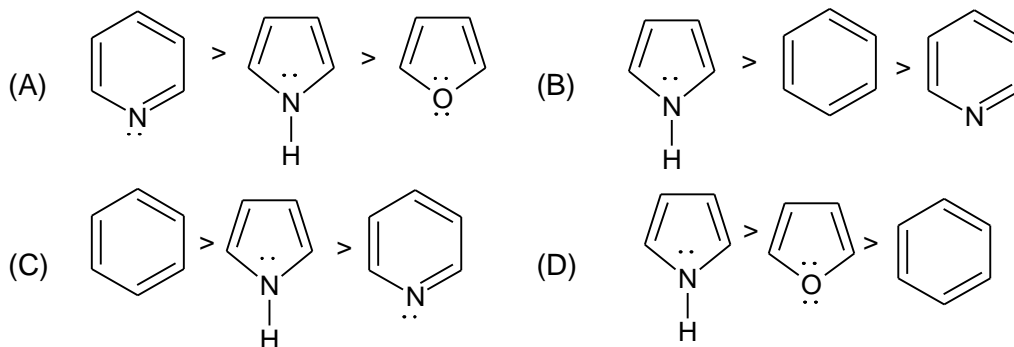
- (A)  $A = \text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{Cl}, \text{AlCl}_3$   $B = \text{Zn(Hg)}, \text{HCl}$
- (B)  $A = \text{Zn(Hg)}, \text{HCl}$   $B = \text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{Cl}, \text{AlCl}_3$
- (C)  $A = \text{CH}_3 - \text{CH}_2 - \text{Cl}, \text{AlCl}_3$   $B = \text{Zn(Hg)}, \text{HCl}$
- (D)  $A = \text{NH}_2 - \text{NH}_2/\text{OH}^-, \text{B} = \text{CH}_3 - \text{CH}_2 - \text{Cl}, \text{AlCl}_3$

5. Which statement is correct regarding nitration of halobenzene?



*Space For Rough Work*

6. Out of the following which order is correct for EAS?

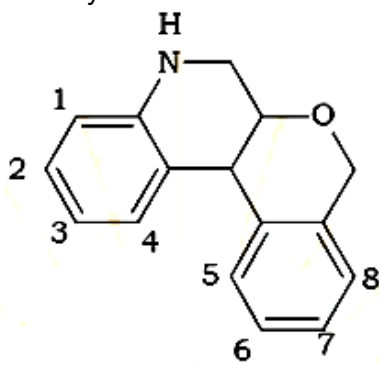


## PART – B

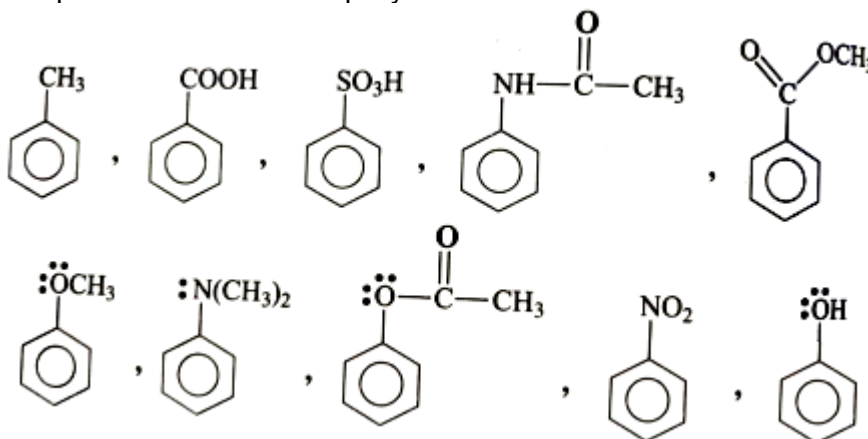
### Integer Answer Type

This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

1. From which position does  $\text{NO}_2^+$  replace a hydrogen from the following compound predominately?

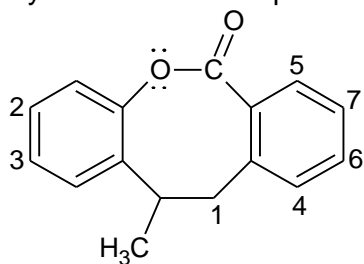


2. Examine the structural formulas shown below and find out how many compounds undergo electrophilic nitration more rapidly than fluorobenzene.

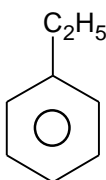
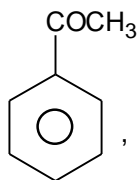
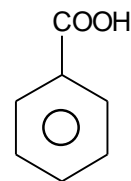
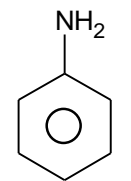
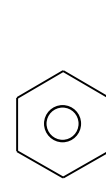
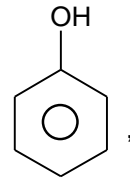
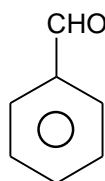
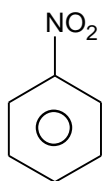
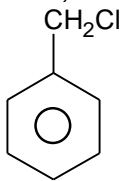
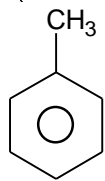
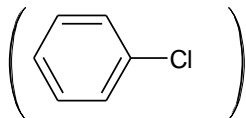


Space For Rough Work

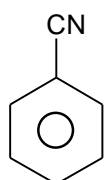
3. Identify the site of electrophilic attack for the formation of major product?



4. How many of the following compound(s) is/are more reactive than chlorobenzene towards  $\text{NO}_2\text{BF}_4$  (Electrophilic substitution reaction)?



and



5. When 2 litre of ideal gas expands isothermally into vacuum to a total volume of 6 litre, the change in internal energy is \_\_\_\_\_ J.
6. The standard entropy change for the reaction:  
 $4\text{Fe}(\text{s}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{Fe}_2\text{O}_3(\text{s})$  is  $-550 \text{ J K}^{-1}$  at 298 K.  
 [Given: The standard enthalpy change for the reaction is  $-165 \text{ kJ mol}^{-1}$ ] The temperature in K at which the reaction attains equilibrium is  $x \times 10^2$ . What is the value of x?

*Space For Rough Work*

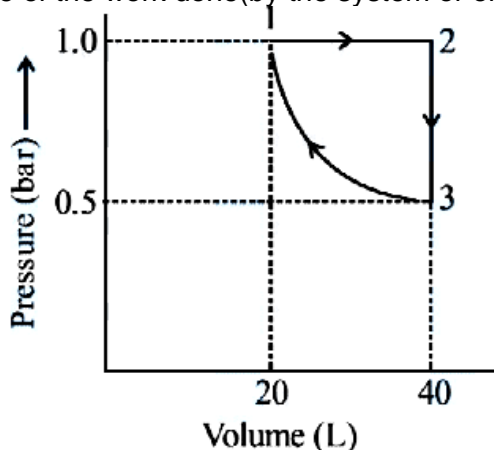


## PART – B

### (Numerical based)

This section contains **6 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals).

7. One mole of an ideal monoatomic gas is subjected to changes as shown in the graph. The magnitude of the work done (by the system or on the system) is \_\_\_\_\_ J



Given:  $\log 2 = 0.3$ ,  $\ln 10 = 2.3$

8. 17.0 g of  $\text{NH}_3$  completely vapourises at  $-33.42^\circ\text{C}$  and 1 bar pressure and the enthalpy change in the process is  $23.4 \text{ kJ mol}^{-1}$ . The enthalpy change for the vapourisation of 85 g of  $\text{NH}_3$  under the same conditions is \_\_\_\_\_ kJ.
9. Enthalpies of formation of  $\text{CCl}_4(\text{g})$ ,  $\text{H}_2\text{O}(\text{g})$ ,  $\text{CO}_2(\text{g})$  and  $\text{HCl}(\text{g})$  are  $-105$ ,  $-242$ ,  $-394$  and  $-92 \text{ kJ mol}^{-1}$  respectively. The magnitude of enthalpy of the reaction given below is \_\_\_\_\_  $\text{kJ mol}^{-1}$ .
- $$\text{CCl}_4(\text{g}) + 2\text{H}_2\text{O}(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 4\text{HCl}(\text{g})$$
10. For combustion of one mole of magnesium in an open container at 300 K and 1 bar pressure,  $\Delta_c H^\ominus = -601.70 \text{ kJ mol}^{-1}$ , the magnitude of change in internal energy in  $\text{kJ mol}^{-1}$  is \_\_\_\_\_
- (Given :  $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$ )
11. For complete combustion of methanol
- $$\text{CH}_3\text{OH}(\ell) + \frac{3}{2}\text{O}_2(\text{g}) \longrightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\ell)$$
- the amount of heat produced as measured by bomb calorimeter is  $726 \text{ kJ mol}^{-1}$  at  $27^\circ\text{C}$ . The enthalpy of combustion for the reaction is  $-x \text{ kJ mol}^{-1}$ , where x is \_\_\_\_\_ (Given:  $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$ )
12. 40% of HI undergoes decomposition of  $\text{H}_2$  and  $\text{I}_2$  at 300 K. If  $\Delta G^\ominus$  for this decomposition reaction at one atmosphere pressure is expressed by  $100x \text{ J mol}^{-1}$ , what is x? (Use  $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$ ;  $\log 2 = 0.3010$ ,  $\ln 10 = 2.3$ ,  $\log 3 = 0.477$ )

*Space For Rough Work*

## **SECTION-3 : MATHEMATICS**

### **PART – A**

#### **(Multi Correct Choice Type)**

This section contains 6 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

---

1. The number of ways in which 10 candidates  $A_1, A_2, \dots, A_{10}$  can be ranked, so that  $A_1$  is always above  $A_2$  is  
 (A)  $\frac{10!}{2}$  (B)  $8! \times {}^{10}C_2$   
 (C)  ${}^{10}P_2$  (D)  ${}^{10}C_2$
2. The co – ordinates of a focus of the hyperbola  $9x^2 - 16y^2 + 18x + 32y - 151 = 0$  is  
 (A)  $(-1, 1)$  (B)  $(6, 1)$   
 (C)  $(4, 1)$  (D)  $(-6, 1)$
3. For the hyperbola  $\frac{x^2}{3} - y^2 = 3$  which of the following statements is / are correct :  
 (A) its eccentricity is  $\frac{2}{\sqrt{3}}$ .  
 (B) angle between its asymptotes is  $\frac{\pi}{3}$ .  
 (C) length of its latus rectum is 2 units.  
 (D) product of distances of any point on the curve from its asymptotes is less than 2 units.
4. The sum of all five digit numbers that can be formed using the digit 1, 2, 3, 4 and 5 (repetition of digits not allowed)  
 (A)  $24 \times 15 \times 1111$  (B)  $5! \times 15 \times 1111$   
 (C)  $6!$  (D)  $3999960$
5. Number of integers between 1 and 1000000 have the sum of the digits equal to 18  
 (A) 25927 (B) 33649  
 (C) 7722 (D)  ${}^{23}C_5 - 6 \times {}^{13}C_5$
6. Triangles can be formed by joining the vertices of a decagon  
 (A)  ${}^{10}C_3$  (B)  ${}^{10}C_2$   
 (C) 120 (D) 90

---

*Space For Rough Work*

**PART – B**  
**Integer Answer Type**

This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

1. If the eccentricity of the ellipse  $\frac{x^2}{25} + \frac{y^2}{9} = 1$  is  $e$  then the value of  $5e$  is
2. The number of integral values of  $r$  for which the equation  $\frac{x^2}{2-r} + \frac{y^2}{r-5} + 1 = 0$  represents an ellipse is
3. An ellipse and a hyperbola have the same centre origin, the same foci and the minor – axis of the one is the same as the conjugate axis of the other. If  $e_1, e_2$  be their eccentricities respectively, then  $\frac{1}{e_1^2} + \frac{1}{e_2^2} =$
4. The number of possible tangents which can be drawn to the curve  $4x^2 - 9y^2 = 36$ , which are perpendicular to the straight line  $5x + 2y - 10 = 0$  is:
5. If the hyperbolas,  $x^2 + 3xy + 2y^2 + 2x + 3y + 2 = 0$  and  $x^2 + 3xy + 2y^2 + 2x + 3y + c = 0$  are conjugate of each other, then the value of 'c' is equal to:
6. The number of ways 5 identical balls can be distributed into 3 different boxes so that no box remains empty

**PART – B**  
**(Numerical based)**

This section contains **6 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals).

7. The eccentricity of the conic represented by  $x^2 - y^2 - 4x + 4y + 16 = 0$  is
8. There are 12 points in a plane of which 5 are collinear. The number of distinct quadrilaterals which can be formed with vertices at these points is:
9. If distance between the directrices be thrice the distance between the foci, then eccentricity of ellipse is
10. If the line  $3x - 4y + k = 0$  touches the ellipse  $\frac{x^2}{16} + \frac{y^2}{9} = 1$  then the value of  $k$  can be
11. Minimum area of the triangle formed by any tangent to the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  with the coordinate axes is  $\lambda ab$ , then  $\lambda$  will be
12. If all the words formed by letters of the word 'RACHIT' are arranged in the order as they are in the dictionary, then rank of the word 'RACHIT' is

*Space For Rough Work*

**BATCHES – All 22-24 Batches****Common Test – V****Code : 100171****ANSWERS****SECTION-1 : PHYSICS****PART – A**

- |      |        |      |       |
|------|--------|------|-------|
| 1. D | 2. ABD | 3. B | 4. BC |
| 5. C | 6. BC  |      |       |

**PART – B**

- |                                |         |          |      |
|--------------------------------|---------|----------|------|
| 1. 4                           | 2. 2    | 3. 6     | 4. 2 |
| 5. 8                           | 6. 1    | 7. 1.5   |      |
| 8. 0.71 (range: 0.70 to 0.74)  | 9. 3.75 |          |      |
| 10. 1.41 (range: 1.40 to 1.44) | 11. 50  | 12. 1.50 |      |

**SECTION – 2 : CHEMISTRY****PART – A**

- |       |         |       |      |
|-------|---------|-------|------|
| 1. AB | 2. ABCD | 3. BC | 4. B |
| 5. CD | 6. BD   |       |      |

**PART – B**

- |                                   |                            |                                   |      |
|-----------------------------------|----------------------------|-----------------------------------|------|
| 1. 3                              | 2. 6                       | 3. 3                              | 4. 6 |
| 5. 0                              | 6. 3                       | 7. 628.06 (range:628.00 to 628.5) |      |
| 8. 117                            | 9. 173                     | 10. 600.45 (range 600.1 to 600.9) |      |
| 11. 727.24 (range 727.1 to 727.8) | 12. 27.38 (range 27 to 28) |                                   |      |

**SECTION – 3 : MATHEMATICS****PART – A**

- |       |       |        |      |
|-------|-------|--------|------|
| 1. AB | 2. CD | 3. ABC | 4. D |
| 5. AD | 6. AC |        |      |

**PART – B**

- |         |                                  |         |        |
|---------|----------------------------------|---------|--------|
| 1. 4    | 2. 2                             | 3. 2    | 4. 0   |
| 5. 0    | 6. 6                             | 7. 1.41 | 8. 420 |
| 9. 0.58 | 10. 16.96 (range 16.90 to 17.01) |         |        |
| 11. 1   | 12. 481                          |         |        |