FIITJEE (JEE-Advanced)

BATCHES – NWCM721O1S, NWCM921X1W, NWCM921A1W & PANINI921-XIIG1

PHYSICS, CHEMISTRY & MATHEMATICS

QP Code: **Test - 12**

Time Allotted: 3 Hours **Maximum Marks: 180**

- 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. In Each Section is **One Part:** Part-A.
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 Three Sections.

(i) **Part-A (01-15)** contains Six (15) Numerical based questions, the answer of which maybe positive or negative numbers or decimals (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

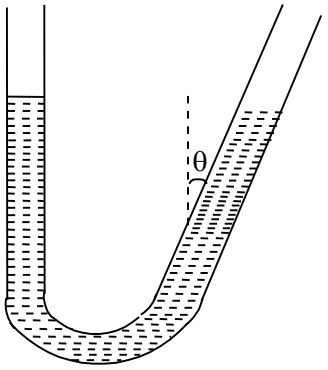
(Numerical based)

This section contains **15 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals).

1. A toy train in a children amusement park runs on a elliptical orbit having major and minor axis in the ratio of 4 : 3. The length of the train is exactly equal to half the perimeter of the elliptical track. The train is travelling at a constant speed of 20 ms^{-1}. The engine sound a whistle when its acceleration is minimum. The whistle has a frequency of f_0 = 3460 Hz and speed of sound in air is V = 330 ms^{-1}. What frequency of whistle is received by a passenger sitting in the central compartment of the train (in Hz)?

1. **3420**

2. Determine the period of oscillation of a mass of 200 *g* of mercury poured into a bent tube whose right arm forms an angle of $\theta = 30°$ with the vertical. Cross-sectional area of tube = 0.5 cm^2 (in sec).

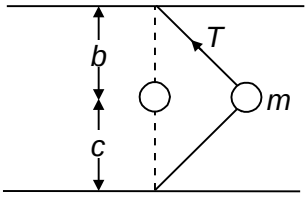


2. **0.8**

3. A horizontal board is made to perform simple harmonic motion horizontally moving to and fro through a distance of 20 cm and making 15 complete oscillations per minute. Find the least value of the coefficient of friction in order that a heavy body placed on the shelf may not slip.

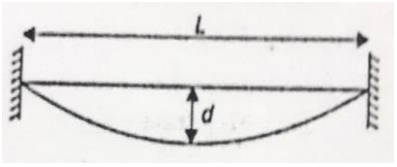
3. **0.02**
Range: 0.02 to 0.03

4. A small mass *m* is fastened to a vertical wire, which is under tension T. What will be the natural angular frequency (in rad/sec) of vibration of the mass if it is displaced laterally a slight distance and then released? Take b = 3 m, c = 6 m, T = 200 N & m = 0.16 kg.



4. **250**

5. A wire having mass per unit length μ and length L is fixed between two fixed vertical walls at a separation L. Due to its own weight the wire sags. The sag in the middle is d (<< L). Assume that tension is practically constant along the wire, owing to its small mass. Calculate the speed (in m/s) of the transverse wave on the wire. Take: d = 20 cm, L = 10 m.



5. **25**

6. A particle is hanging at one end of a light inextensible string and the upper end of the string is made to move vertically up and down with a simple harmonic motion of amplitude 3 inches. Find the least period for which the string will never become slack.

6. **0.55**
Range: 0.50 to 0.60

7. Two sound waves, travelling in same direction can be represented as

$$y_1 = (0.02\,\text{mm})\sin\left[(400\,\pi\,\text{rads}^{-1})\left(\frac{x}{330\,\text{ms}^{-1}} - t\right)\right]$$

And

$$y_2 = (0.02\,\text{mm})\sin\left[(400\,\pi\,\text{rads}^{-1})\left(\frac{x}{330\,\text{ms}^{-1}} - t\right)\right]$$

The waves superimpose.

Find the time gap (in sec) between two successive intensity maxima at a given point.

7. **0.50**

8. The vertical motion of a ship at sea is described by the equation $\ddot{x} = -4x$, where x (meter) is the vertical height of the ship above its mean position. If it oscillates through a total distance of 1 m, find the greatest vertical speed (in m/s).

8. 1 m/s

9. The average speed over a complete oscillation of a particle performing rectilinear simple harmonic motion is 2 cm/s. If the particle attains this speed when it is at a point P whose distance from the centre O is 4 cm, determine the amplitude (in cm), expressing your answers in terms of π.

9. **5.18**
Range: 5.10 to 5.20

10. One end of an elastic string of natural length a and force constant $\frac{\lambda}{a}$ is fixed to a point on a smooth horizontal surface and the other end is attached to a particle of mass m lying on the surface. The particle is pulled from the fixed point to a distance 2a and released. Find the time for a complete oscillation of the particle. Take a = 2 m, m = 25 kg and λ = 8 cm.

10. **257.07**
Range: 255 to 260

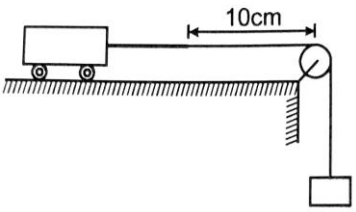
11. An elastic string of natural length a and force constant $\frac{mg}{a}$ is attached by one end to a fixed point X on a smooth horizontal table. It passes through a small smooth ring Y fixed to the table so that XY = a and the other end is attached to a bead of mass m/2 which slides on a smooth rail on the table, the rail being perpendicular to XY at a distance 2a from X. If the bead is displaced along the rail, show that it will execute SHM and find its period. Take a = 8 m, g = 10 m/s^2

11. **4.01**
Range: 3.90 to 4.10

12. A string of natural length 2*a* and force constant *k* is stretched between two fixed points *A* and *B* on a smooth horizontal table such that *AB* = 3*a*. A mass *m* attached to the midpoint of the string makes small oscillations in a horizontal line perpendicular to *AB*. Find the frequency of these oscillations. Take k = 750 N/m and m = 0.01 kg.

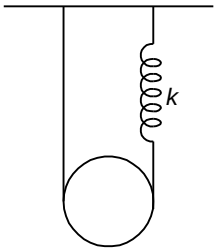
12. **50**

13. A heavy string is tied at one end to a movable support and to a light thread at the other end as shown in figure. The thread goes over a fixed pulley and supports a weight to produce a tension. The lowest frequency with which the heavy string resonates is 120 Hz. If the movable support is pushed to the right by 10 cm so that the joint is placed on the pulley, what will be the minimum frequency (in Hz) at which the heavy string can resonate?



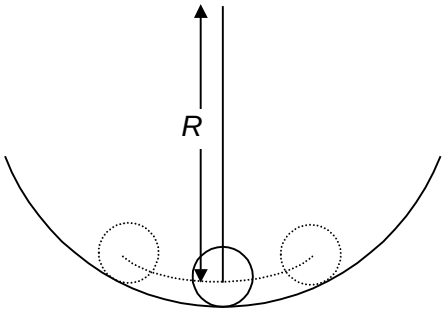
13. **240**

14. The pulley of radius *r* shown in Figure has a moment of inertia *I* about its axis and mass *m*. Find the time period (in sec) of vertical oscillations of its centre of mass. The spring has spring constant k and the string does not slip over pulley. Take I = 25 kg m^2, r = 50 cm, m = 44 kg and k = π^2 N/m.



14. **12**

15. A spherical ball of mass *m* and radius *r* rolls without slipping in a rough concave surface of large radius *R*. It makes small oscillations about the lowest point. Find the time period (in sec). Take R = 72 cm, r = 2 cm



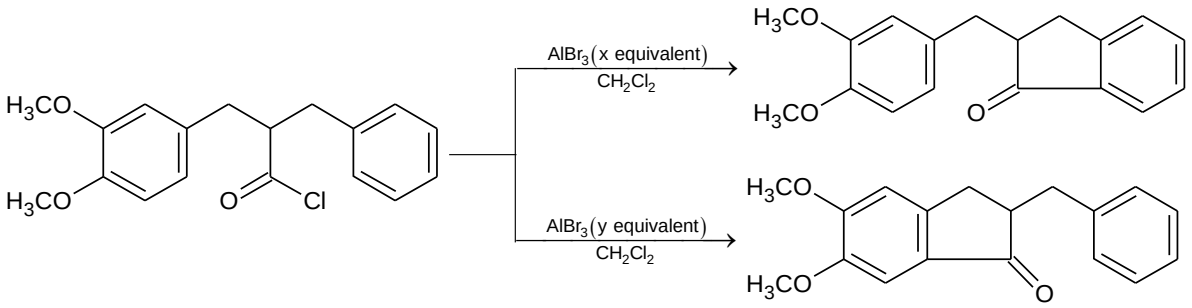
15. **1.97**
Range: 1.90 to 2.00

SECTION-2 : CHEMISTRY

PART – A

(Numerical based)

This section contains **15 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals).

1. 

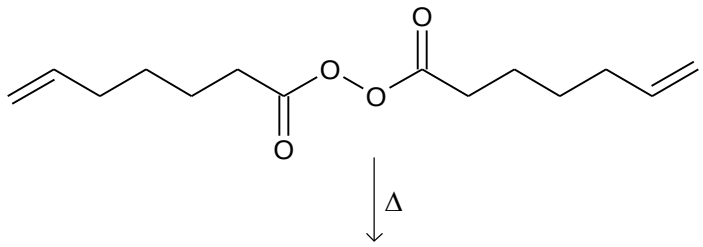
What is the value of (x + y)?

1. 4

2. $1,5-\text{Cyclootadiene} + Cl-\ddot{\underset{\cdot\cdot}{S}}-Cl \longrightarrow [X]$

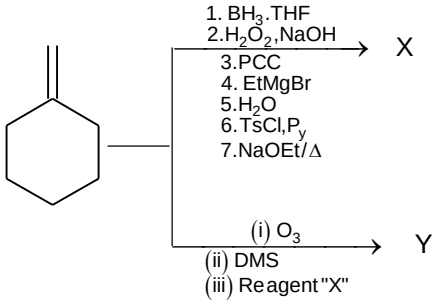
[X] is bicyclic compound. If the ring size of one ring is 'a' and other is 'b' and number of hetero atoms in [X] is "d", then what is the value of $\left(\frac{a \times b}{d}\right)$?

2. 12

3. 

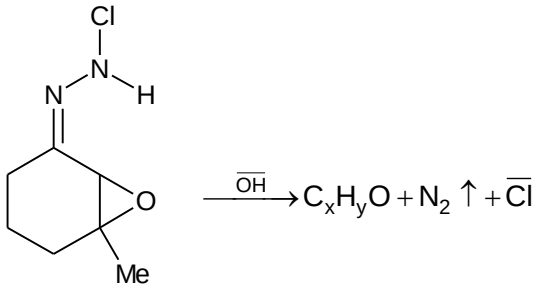
Mixture of hydrocarbons

3. 4

4. 

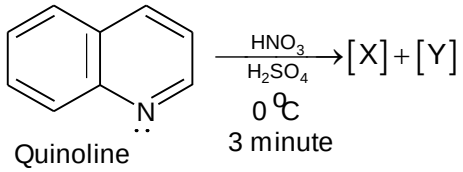
What is sum of π-bonds in reagent "X" and hydrocarbon "Y"

4. 11

5. 

What is the value of (x + y).

5. 17

6. 

[X] and [Y] are nitroquinoline. The algebric sum of the position of nitro group in the compound [X] and [Y] is Z. What is value of Z?

6. 13

7. $(a)\ Ph-\overset{\overset{O}{\|}}{C}-OH+NaHCO_3 \longrightarrow A(gas)$

$(b)\ Ph-OH+NaNH_2 \longrightarrow B(gas)$

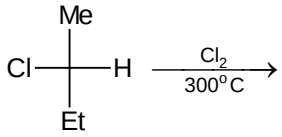
$(c)\ Ph-OH+NaH \longrightarrow C(gas)$

$(d)\ Ph-OH+Na \longrightarrow D(gas)$

What is the sum of mol. wt of (A + B + C + D)

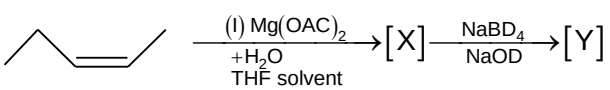
7. 65

8. For the monochlorination of R – secbutylchloride



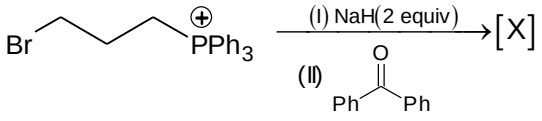
There are (x) possible products,(y) are optically active and (z) are optically inactive. What is value of (x + y + z)?

8. 10

9. 

What is the value of (x + y)?

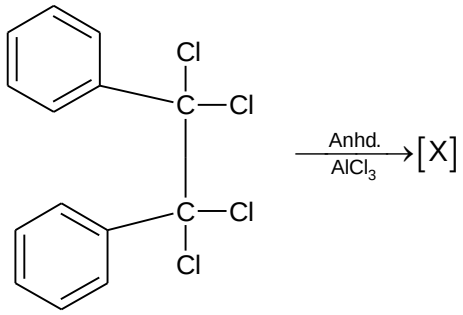
9. 12

10. 

The formula of hydrocarbon[X] is C_xH_y. What is the value of (x + y)/8?

10. 5

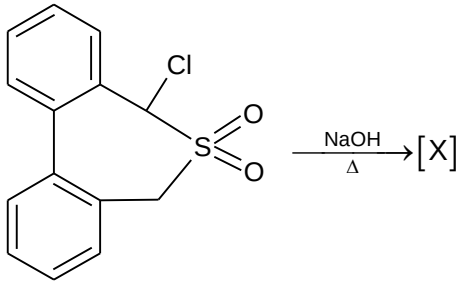
11.



The algebric sum of π-bonds and the number of chlorine atom in the compound[X] is [Y]. What is the vale of Y?

11. 9

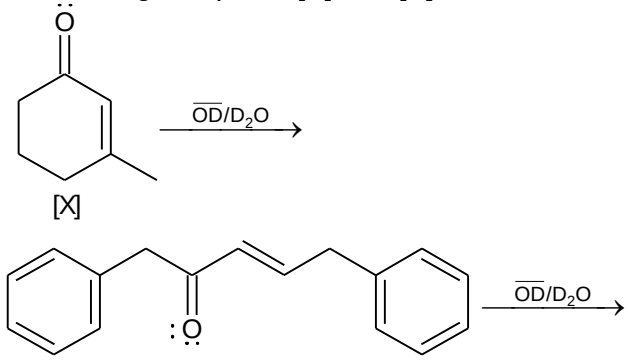
12.



How many π-bonds are present in compound[X]?

12. 7

13. The following compound[X] and [Y] are treated with $D_2O/\overline{OD}$.



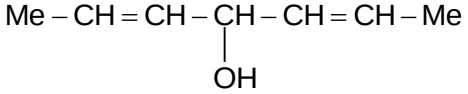
The total number of H that may be replaced by D in both compounds [X] and [Y] are Z. What is the value of Z?

13. 13

14. The minimum mol. wt. of acyclic alkane that is optically active is [X] and the minimum mol. wt of acyclic hydrocarbon that is optically active is [Y]. (Isotopes are not permitted). What is the value of {[X] – [Y]}?

14. 20

15. What is the total number of stereoisomers of the following compound?



15. 4

SECTION-3 : MATHEMATICS

PART – A

(Numerical based)

This section contains **15 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals).

1. If sum of all the solutions of the equation $\cot x + \operatorname{cosec} x + \sec x = \tan x$ in $[0, 2\pi]$ is $\frac{k\pi}{2}$, then find the value of k.

1. 5

2. Find the number of common solutions(s) of the trigonometric equations $\cos 2x + \left(1+\sqrt{3}\right) = \left(2-\sqrt{3}\right)\cos x$ and $\sin 3x = 2\sin x$ which satisfy the inequality $\sqrt{3}\tan x - 1 \geq 0$ in $[0, 5\pi]$

2. 2

3. If $|x| + y = 3$ and $\left|\sin\frac{\pi x^2}{2}\right| = 1$, then number of ordered pairs(x, y), is (where y is a non negative integer)

3. 4

4. In ΔABC, let $2r_1 = r_2 = r_3$ and $b = 3$. If area of the triangle is Δ then find the value of Δ^2. [Note : All symbols used have usual meaning in ΔABC.]

4. 8

5. The sides a, b and c of triangle ABC satisfy $(a+1)bc = 12, (b+1)ca = 4$ and $(c+1)ab = 4$. If area of triangle equals $\frac{\sqrt{4n^2-1}}{4n}$ where $n \in N$, then find the value of n.

5. 9

6. Let altitude AD of acute angled triangle (ΔABC) be produced which meets its circumcircle at P such that AP = 4. If circumradius of the triangle is $2\sqrt{2}$ then find the value of $\sec^2(B-C)$

6. 2

7. A flag staff 20 m high standing on the top of a house subtends an angle whose tangent is $\frac{1}{6}$ at a distance 70 m from the foot of the house. The height of the house (in meter) is

7. 50

8. If $\left(x+\frac{1}{x}+1\right)^6 = a_0 + \left(a_1x + \frac{b_1}{x}\right) + \left(a_2x^2 + \frac{b_2}{x^2}\right) + ... + \left(a_6x^6 + \frac{b_6}{x^6}\right)$, then find the value of a_0.

8. 141

9. When $(3x+5)^{100}$ is expanded, find the largest power of 2 dividing the coefficient of x^{39}.

9. 6

10. Let $\sum_{r=0}^{100}\sum_{s=0}^{100}\left(C_r^2 + C_s^2 + C_rC_s\right) = m\left({}^{2n}C_n\right) + 2^p$ where m, n and p are even natural numbers and C_r represents the coefficient of x^r in the expansion of $(1+x)^{100}$. Find the value of $(m+n+p)$.

10. 502

11. Let $\omega = e^{\frac{2i\pi}{3}}$ and a, b, c, x, y, z be non – zero complex number such that

$a+b+c=x$

$a+b\omega+c\omega^2=y$

$a+b\omega^2+c\omega=z$

Then the value of $\frac{|x|^2+|y|^2+|z|^2}{|a|^2+|b|^2+|c|^2}$, is equal to

11. 3

12. Let $P(z) = z^3 + az^2 + bz + c$, where a, b, c are real. There exist a complex number w such that the three roots of $P(z)$ are $w+3i, w+9i$ and $2w-4$, where $i^2=-1$. Then the value of $|a+b+c|$ is equal to

12. 136

13. If least positive argument of z satisfying $z^{12}+9z^6-400=0$ is θ, then value of $4\cos^2\theta$ is

13. 3

14. Let (x, y) be a pair of real number satisfying $56x+33y = -\frac{y}{x^2+y^2}$ and $33x-56y = \frac{x}{x^2+y^2}$. If $|x|+|y| = \frac{p}{q}$ (where p and q are relatively prime), then $(6p-q)$ is

14. 1

15. For any integer k, let $\alpha_k = \cos\left(\frac{k\pi}{7}\right) + i\sin\left(\frac{k\pi}{7}\right)$, where $i = \sqrt{-1}$. The value of the expression $\frac{\sum_{k=1}^{12}|\alpha_{k+1} - \alpha_k|}{\sum_{k=1}^{3}|\alpha_{4k-1} - \alpha_{4k-2}|}$ is

15. 4

ANSWERS

SECTION-1 : PHYSICS

PART – A

SECTION – 2 : CHEMISTRY

PART – A

SECTION – 3 : MATHEMATICS

PART – A