

## PHYSICS, CHEMISTRY & MATHEMATICS

CPT3 - 1

CODE:

PAPER - 1

Time Allotted: 3 Hours

Maximum Marks: 186

- 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. All the section can be filled in **PART-A** of 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 **Blue/Black Ball Point Pen** 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 Only One Part.

- (i) **Part-A (01-06)** – Contains Six (06) multiple choice questions which have ONLY ONE CORRECT answer. Each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer.
- (ii) **PART-A (07-14)** contains 8 Multiple Choice Questions which have **One or More Correct** answer. For each question in the group **Q. 07 – 14** 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.
- (iii) **Part-A (15-18)** - This section contains Two paragraphs. Based on each paragraph, there are Two multiple choice questions. Each question has only one correct answer and carries **+3 marks** for the correct answer. **There is no negative marking.**

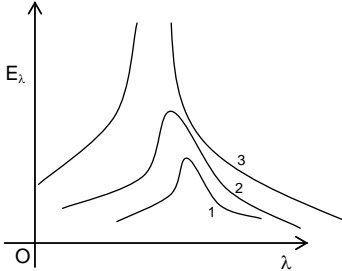
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Batch : \_\_\_\_\_ Date of Examination : \_\_\_\_\_

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

**SECTION - I : PHYSICS****Part - A****(Only One Correct Answer Type)**

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

1. A particle executing simple harmonic motion is having velocities  $v_1$  and  $v_2$  at distances  $x_1$  and  $x_2$  from the equilibrium position. The amplitude of the motion is  
 (A)  $\sqrt{\frac{v_1^2 x_2 - v_2^2 x_1}{v_1^2 + v_2^2}}$  (B)  $\sqrt{\frac{v_1^2 x_1^2 - v_2^2 x_2^2}{v_1^2 + v_2^2}}$  (C)  $\sqrt{\frac{v_1^2 x_2^2 - v_2^2 x_1^2}{v_1^2 - v_2^2}}$  (D)  $\sqrt{\frac{v_1^2 x_2^2 + v_2^2 x_1^2}{v_1^2 + v_2^2}}$
2. A disc is suspended at a point  $R/2$  above its centre. Find its period of small oscillation.  
 (A)  $2\pi\sqrt{\frac{2R}{3g}}$  (B)  $2\pi\sqrt{\frac{3R}{2g}}$  (C)  $2\pi\sqrt{2\frac{R}{g}}$  (D)  $2\pi\sqrt{\frac{3R}{g}}$
3. The graph shown in the figure represents energy density  $E_\lambda$  versus  $\lambda$  for three sources sun, welding arc, tungsten filament.  
 (A) 1–Tungsten, 2–Welding arc, 3–Sun  
 (B) 1–Sun, 2– Tungsten, 3–Welding arc  
 (C) 1–Sun, 2–Welding arc, 3– Tungsten  
 (D) 1– Welding arc, 2– Sun, 3– Tungsten
- 
4. A train moves towards a stationary observer with speed  $34 \text{ ms}^{-1}$ . The train sounds a whistle and its frequency registered by the observer is  $f_1$ . If the train's speed is reduced to  $17 \text{ ms}^{-1}$  the frequency registered is  $f_2$ . If the speed of sound is  $340 \text{ ms}^{-1}$ , then the ratio  $f_1 / f_2$  is  
 (A)  $\frac{18}{19}$  (B)  $\frac{1}{2}$  (C) 2 (D)  $\frac{19}{18}$
5. A gas for which  $\gamma = 1.5$  is suddenly compressed to  $\frac{1}{4}$  the of the initial volume adiabatically. Then the ratio of the final to the initial pressure is  
 (A) 1:16 (B) 1:8  
 (C) 1:4 (D) 8:1
6. A uniform ring of mass  $m$  and radius  $r$  is placed directly above a uniform sphere of mass  $M$  and of equal radius. The centre of the ring is at a distance  $\sqrt{3}r$  from the centre of the sphere. The gravitational force exerted by the sphere on the ring will be :  
 (A)  $\frac{\sqrt{3}GMm}{8r^2}$  (B)  $\frac{GMm}{6r^2}$  (C)  $\frac{GMm}{8r^2}$  (D)  $\frac{GMm}{4r^2}$

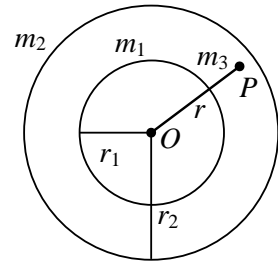
## PART-A

## (One or More than One Correct Type)

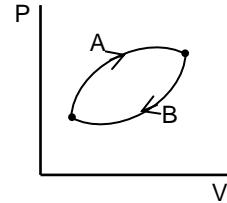
This section contains 8 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

7. If  $\alpha$ ,  $\beta$  and  $\gamma$  are coefficients of linear superficial and volume expansion respectively, then  
 (A)  $\frac{\beta}{\alpha} = \frac{1}{2}$                       (B)  $\frac{\beta}{\gamma} = \frac{2}{3}$                       (C)  $\frac{\gamma}{\alpha} = \frac{3}{1}$                       (D)  $\frac{\beta}{\alpha} = \frac{\gamma}{\beta}$
8.  $C_V$  and  $C_P$  denote the molar specific heat capacities of a gas at constant volume and constant pressure respectively. Then  
 (A)  $C_P - C_V$  is larger for a diatomic ideal gas than for a monatomic ideal gas  
 (B)  $C_P + C_V$  is larger for a diatomic ideal gas than for a monatomic ideal gas  
 (C)  $C_P / C_V$  is larger for a diatomic ideal gas than for a monatomic ideal gas  
 (D)  $C_P \cdot C_V$  is larger for a diatomic ideal gas than for a monatomic ideal gas
9. One mole of an ideal monoatomic gas is taken from A to C along the path ABC. The temperature of the gas at A is  $T_0$ . For the process ABC (where R is gas constant)  
 (A) Heat absorbed by the gas is  $\frac{11}{12}RT_0$   
 (B) Heat absorbed by the gas is  $\frac{11}{2}RT_0$   
 (C) Work done by the gas =  $RT_0$   
 (D) Change in internal energy of gas is  $\frac{9}{2}RT_0$
- 
10. A wave is represented by the equation  
 $y = A \sin(10\pi x + 15\pi t + \pi/3)$   
 where x is in metres and t is in seconds. The expression represents  
 (A) a wave traveling in the positive x direction with a velocity of 1.5 m/s  
 (B) a wave traveling in the negative x direction with a velocity of 1.5 m/s  
 (C) a wave traveling in the negative x - direction with a wavelength of 0.2 m  
 (D) a wave traveling in the positive x - direction with a wavelength of 0.2 m
11. Two moles of a monatomic ideal gas undergoes a thermodynamic process  $\frac{V^3}{T^2} = \text{constant}$ ,  
 if the temperature is raised by 300K then  
 (A) work done by the gas is 400 R  
 (B) change in internal energy is 900 R  
 (C) molar heat capacity of the gas for the process is  $13/6 R$   
 (D) molar heat capacity of the gas for the process is  $3/2 R$
12. In the isothermal expansion of an ideal gas:  
 (A) there is no change in the temperature of the gas  
 (B) there is no change in the internal energy of the gas  
 (C) the work done by the gas is equal to the heat supplied to the gas  
 (D) the work done by the gas is equal to the change in its internal energy.

13. Two concentric spherical shells masses  $m_1$  and  $m_2$  and radii  $r_1$  and  $r_2$ . Then  
 (A) outer shell will have no contribution in gravitational field at point P  
 (B) force on P is directed towards O  
 (C) force on P is  $\frac{Gm_1m_2}{r^2}$   
 (D) force on P is  $\frac{Gm_1m_3}{r^2}$



14. Refer to figure. Let  $\Delta U_1$  and  $\Delta U_2$  be the change in internal energy in processes A and B respectively,  $\Delta Q$  be the net heat given to the system in process A + B and  $\Delta W$  be the net work done by the system in the process A + B.  
 (A)  $\Delta Q - \Delta W = 0$  (B)  $\Delta Q + \Delta W = 0$   
 (C)  $\Delta U_1 - \Delta U_2 = 0$  (D)  $\Delta U_1 + \Delta U_2 = 0$



### Paragraph Type

This section contains 2 paragraphs. Based upon each paragraph, 2 multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE is correct**.

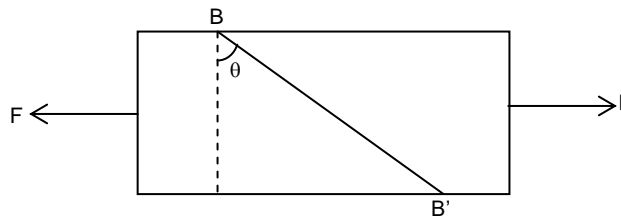
#### Comprehension Type (15-16)

According to Stefan's Law, heat energy emitted/sec/area by a perfectly black body varies directly as the fourth power of its absolute temperature. The wavelength corresponding to which energy emitted is maximum varies inversely as the temperature of black body (Wien's Law). However, the rate of loss of heat of a liquid varies directly as the difference in temperatures of the liquid and the surroundings, provided this difference is small ( $\approx 30^\circ\text{C}$ ). This is Newton's laws of cooling.

15. Temperature of a black body is made three times. The power radiated becomes  
 (A) 3 times (B) 9 times  
 (C) 27 times (D) 81 times
16. The wavelength corresponding to which energy radiated is maximum in the above case becomes n times, where n is  
 (A)  $\frac{1}{3}$  (B)  $\frac{1}{9}$  (C)  $\frac{1}{27}$  (D)  $\frac{1}{81}$

#### Comprehension Type (17-18)

A bar of cross section A is subjected to two equal and opposite tensile forces F at its ends as shown in Figure. Suppose there is a plane BB' through the bar making an angle  $\theta$  with a plane at right angle to the bar.



17. What is the tensile stress on the plane BB'?
- (A)  $\frac{F}{A}$  (B)  $\frac{F \cos \theta}{A}$  (C)  $\frac{F}{A} \sin \theta$  (D)  $\frac{F \cos^2 \theta}{A}$

18. What is the shearing stress on the plane BB'?

(A)  $\frac{F}{A}$

(B)  $\frac{F \cos \theta}{A}$

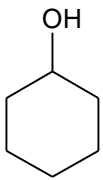
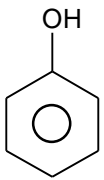
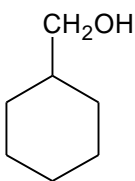
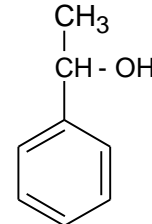
(C)  $\frac{F}{A} \sin \theta$

(D)  $\frac{F \sin 2\theta}{2A}$

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*Space for rough work*

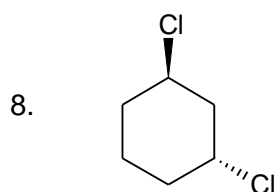


5. Which of the following reaction intermediate(s) can undergo rearrangement through hydride or alkyl shift?
- (A)  $\text{CH}_3\text{CH}(\text{C}_2\text{H}_5)\text{CH}_2\text{CH}_2^{\oplus}$
- (B)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2^{\ominus}$
- (C)  $\text{CH}_3\text{C}(\text{CH}_3)\text{CH}_2\text{CH}_2^{\ominus}$
- (D)  $\text{C}(\text{CH}_3)(\text{CH}_2\text{CH}_3)^{\ominus}$
6. Which of the following substance(s) is/are more acidic than benzyl alcohol?
- (A) 
- (B) 
- (C) 
- (D) 

**PART-A**
**(One or More than One Correct Type)**

This section contains 8 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

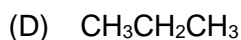
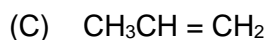
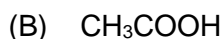
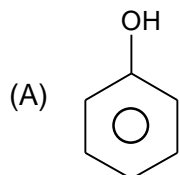
7. Which of the following reaction(s) take(s) place through formation of carbonium ion intermediate?
- (A)  $\text{CH}_3\text{CH}=\text{CH}_2 \xrightarrow{\text{H}_2\text{O}/\text{H}^+}$
- (B)  $\text{CH}_3\text{CH}=\text{CH}_2 \xrightarrow{\text{HCl}}$
- (C)  $\text{CH}_3\text{CH}=\text{CH}_2 \xrightarrow[\text{CCl}_4]{\text{Br}_2}$
- (D)  $\text{CH}_3\text{CH}=\text{CH}_2 \xrightarrow{\text{H}_2/\text{Ni}}$



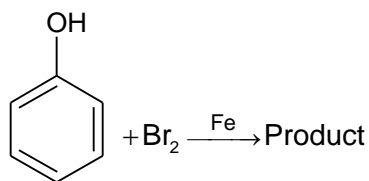
The isomerism(s) exhibited by the above compound is/are:

- (A) chain isomerism
- (B) position isomerism
- (C) geometrical isomerism
- (D) optical isomerism

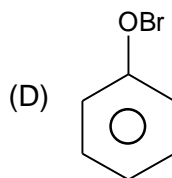
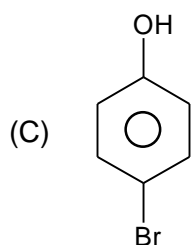
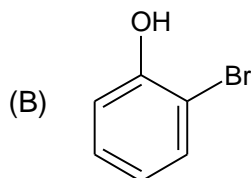
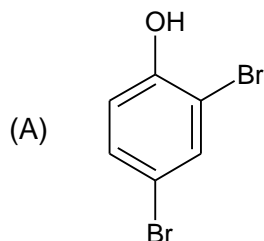
9. Which of the following substance(s) is/are more acidic than  $\text{CH}_3\text{CH}_2\text{OH}$ ?



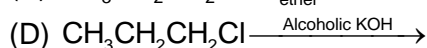
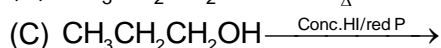
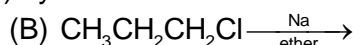
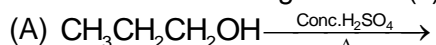
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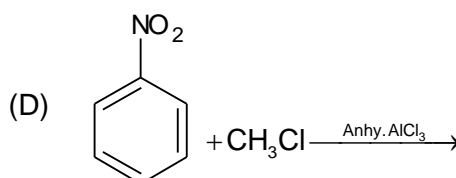
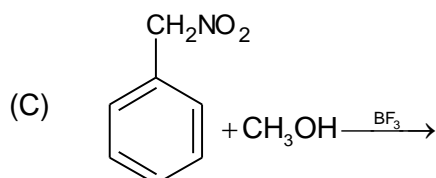
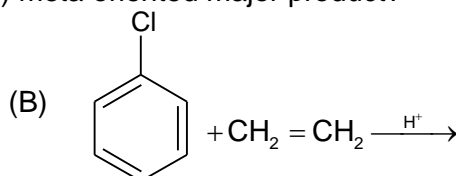
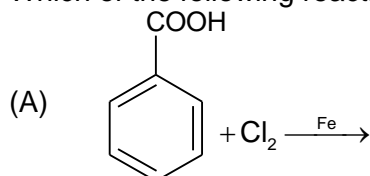
The product(s) of above reaction is/are:



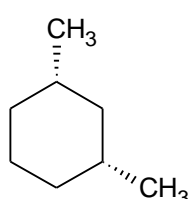
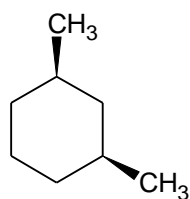
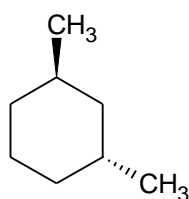
11. Which of the following reaction(s) produce(s) hydrocarbons?



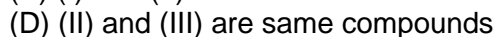
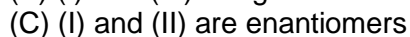
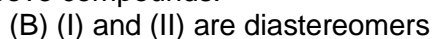
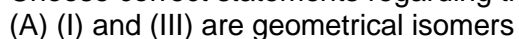
12. Which of the following reaction(s) produce(s) meta oriented major product?



13.



Choose correct statements regarding the above compounds.



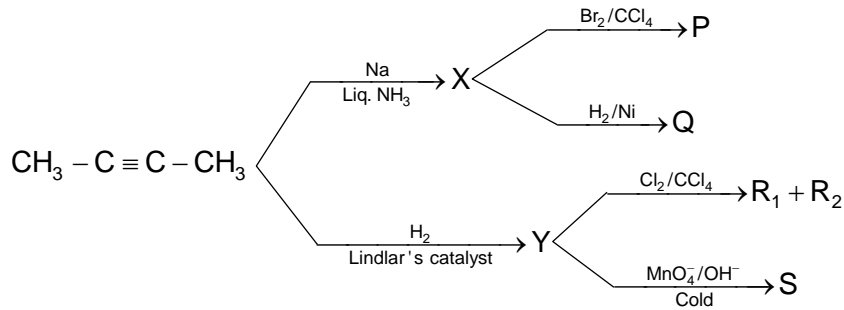


14. Which of the following substance(s) can form at least one optically active product, when treated with  $\text{Cl}_2$  in presence of sun light? [Product may be mono or poly substituted]
- (A)  $\text{CH}_3\text{CH}_2\text{CH}_3$  (B)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$   
 (C)  $\text{CH}_3\text{CH}_3$  (D)  $\text{CH}_4$

### Paragraph Type

This section contains 2 paragraphs. Based upon each paragraph, 2 multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE is correct**.

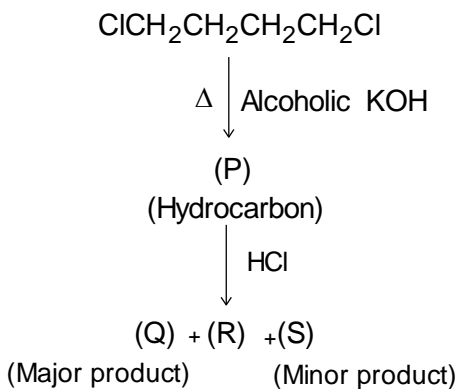
### Comprehension Type (15-16)



Answer the following questions on the basis of above reactions.

15. Which of the following compounds are geometrical isomers?  
 (A) X and Y (B)  $\text{R}_1$  and  $\text{R}_2$   
 (C)  $\text{R}_2$  and S (D)  $\text{R}_1$  and S
16. Which of the following is 'Q'?  
 (A)  $\text{CH}_3\text{CH}_2\text{C}\equiv\text{CH}$  (B)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$   
 (C)  $\text{CH}_3\text{CH}=\text{CHCH}_3$  (D)  $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$

### Comprehension Type (17-18)



Answer the following questions on the basis of above reaction.

17. Which of the following is (P)?  
 (A)  $\text{CH}_3\text{CH}=\text{CHCH}_3$  (B)  $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$   
 (C)  $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$  (D)  $\text{CH}_3-\text{CH}=\text{C}=\text{CH}_2$
18. Which of the following is not the end product of the reaction?  
 (A)  $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_2\text{Cl}$  (B)  $\text{CH}_2=\text{CH}-\underset{\text{Cl}}{\text{CH}}-\text{CH}_3$   
 (C)  $\text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_2\text{Cl}$  (D)  $\text{ClCH}_2\text{CH}=\underset{\text{Cl}}{\text{CH}}\text{CH}_2\text{Cl}$

Space for rough work

**SECTION – III : MATHEMATICS****Part – A****(Only One Correct Answer Type)**

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

- In  $\triangle ABC$ ,  $BC = 1$ ,  $AC = 2$  then maximum value of  $\angle A$  equal to  
 (A)  $\frac{\pi}{6}$  (B)  $\frac{\pi}{4}$   
 (C)  $\frac{\pi}{3}$  (D)  $\frac{\pi}{2}$
- If  $z_1, z_2$  lies on  $|z| = r$  and  $\arg\left(\frac{z_1}{z_2}\right) = \frac{\pi}{3}$  then  $\frac{(z_1 + z_2)^2}{z_1 z_2}$  is equal to  
 (A) 1 (B) 2  
 (C) 3 (D) None
- If  $(23)^{23}$  is divided by 53 then remainder is  
 (A) 0 (B) 23  
 (C) 30 (D) 1
- Number of 5 digit natural numbers made with 1, 2, 3 each of which can be used at most thrice is  
 (A) 60 (B) 90  
 (C) 150 (D) 210
- The coefficient of  $x^{32}$  in the expansion of  $((1+x)(2+x)(3+x))^{10} (2+x)(3+x)^2$  is  
 (A) 60 (B) 64  
 (C) 68 (D) none of these
- In a triangle  $ABC$ ,  $b + c = 2a$  and  $\angle A = 60^\circ$ . Let  $O$  be an interior point and its distance from three sides 3,4,5 units, then circum radius of triangle  $ABC$  is  
 (A) 2 (B) 4  
 (C) 8 (D) 16

**PART-A****(One or More than One Correct Type)**

This section contains 8 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

- If  $(4 + \sqrt{15})^n = I + f$ , where  $n$  is an odd natural number,  $I$  is an integer and  $0 < f < 1$ , then  
 (A)  $I$  is a natural number (B)  $I$  is an even integer  
 (C)  $(I + f)(I - f) = 1$  (D)  $I - f = (4 - \sqrt{15})^n$
- Let  $n = 3^{100}$ , then for  $n$ :  
 (A) unit's digit is 1 (B) ten's digit is 0  
 (C) unit's digit is 7 (D) ten's digit is 2

9. The solution of the equation  $\cos^{103} x - \sin^{103} x = 1$  is:  
 (A)  $-\frac{\pi}{2}$  (B) 0  
 (C)  $\frac{\pi}{2}$  (D)  $\pi$
10. If  $\sin^2 x - 2\sin x - 1 = 0$  has exactly four different solutions in  $x \in [0, n\pi]$ , then value/values of  $n$  are ( $n \in \mathbb{I}$ ):  
 (A) 5 (B) 3  
 (C) 4 (D) 6
11. Which of the following is a rational number  
 (A)  $\sin\left(\tan^{-1} 3 + \tan^{-1} \frac{1}{3}\right)$  (B)  $\cos\left(\frac{\pi}{2} - \sin^{-1} \frac{3}{4}\right)$   
 (C)  $\log_2\left(\sin\left(\frac{1}{4} \sin^{-1} \frac{\sqrt{63}}{8}\right)\right)$  (D)  $\tan\left(\frac{1}{2} \cos^{-1} \frac{\sqrt{5}}{3}\right)$
12. The value of  $x$  in  $(0, \pi/2)$  satisfying  $\frac{\sqrt{3}-1}{\sin x} + \frac{\sqrt{3}+1}{\cos x} = 4\sqrt{2}$  is  
 (A)  $\frac{\pi}{12}$  (B)  $\frac{5\pi}{12}$   
 (C)  $\frac{7\pi}{24}$  (D)  $\frac{11\pi}{36}$
13. Let us consider all complex numbers satisfying  $|z - 25i| \leq 15$ . Among all these complex numbers:  
 (A) complex number with least argument is  $\tan^{-1}\left(\frac{4}{3}\right)$   
 (B) complex number with maximum argument is  $\pi - \tan^{-1}\left(\frac{4}{3}\right)$   
 (C) complex number with at least magnitude is 10  
 (D) complex number with maximum magnitude is 40
14. The number of ways of arranging seven persons (having A, B, C and D among them) in a row so that A, B, C and D are always in order A-B-C-D (not necessarily together) is:  
 (A) 210 (B) 5040  
 (C)  $6 \times {}^7C_4$  (D)  ${}^7P_3$

### Paragraph Type

This section contains 2 **paragraphs**. Based upon each paragraph, 2 multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE is correct**.

### Comprehension Type (15-16)

Different words are being formed by arranging the letters of the word 'SUCCESS'. All of the words obtained are written in the form of a dictionary.

15. The number of words in which the two C are together but no two S are together is:  
 (A) 120 (B) 96  
 (C) 24 (D) 420

16. The number of words in which no two C and no two S are together is:  
 (A) 120 (B) 96  
 (C) 24 (D) 420

**Comprehension Type (17-18)**

Consider the identity  $(1+x)^{6m} = \sum_{r=0}^{6m} {}^{6m}C_r \cdot x^r$ . By putting different values of  $x$  on both sides, we can get summation of several series involving binomial coefficients. For example, by putting  $x = \frac{1}{2}$  we get  $\sum_{r=0}^{6m} {}^{6m}C_r \frac{1}{2^r} = \left(\frac{3}{2}\right)^{6m}$

17. The value of  $\sum_{r=0}^{6m} {}^{6m}C_r 2^{r/2}$  is equal to  
 (A)  $\frac{3^{6m}}{2}$  (B)  $(1+\sqrt{2})^{3m}$   
 (C)  $(3+2\sqrt{2})^{3m}$  (D) None of these
18. The value of  $\sum_{r=0}^{3m} (-1)^r {}^{6m}C_{2r}$  is  
 (A)  $2^{3m}$  (B) 0 if  $m$  is odd  
 (C)  $-2^{3m}$  if  $m$  is even (D) None of these

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*Space for rough work*

# FIITJEE INTERNAL TEST

BATCH: CTY 1921 Batches  
 PHASE TEST-III (PAPER-1)  
 ANSWER KEY

Paper Code

SECTION – I (PHYSICS)	SECTION – II (CHEMISTRY)	SECTION – III (MATHS)
<b>PART-A</b>	<b>PART-A</b>	<b>PART-A</b>
1. C	1. C	1. A
2. B	2. C	2. C
3. A	3. B	3. C
4. D	4. B	4. D
5. D	5. A	5. C
6. A	6. B	6. C
7. B,C	7. AB	7. A,C,D
8. B,D	8. BCD	8. A,B
9. B,C,D	9. AB	9. A,B
10. B,C	10. ABC	10. A,C
11. A,B,C	11. ABCD	11. A,B,C
12. A,B,C	12. ACD	12. A,D
13. A,B,D	13. ABD	13. A,B,C,D
14. A,D	14. AB	14. A,C,D
15. D	15. A	15. C
16. A	16. B	16. B
17. D	17. C	17. C
18. D	18. D	18. B