



# CLASSROOM CONTACT PROGRAMME

(Academic Session : 2022 - 2023)

JEE(Main)

UNIT TEST

18-07-2022

**JEE(Main + Advanced) : NURTURE COURSE [PHASE : TEPS,TTES,TOPS,TNPS,I(A),I(B),I(C),LIVE-I(B)]**

Time : 3 Hours

## PAPER-2

Maximum Marks : 300

**READ THE INSTRUCTIONS CAREFULLY**

### Important Instructions :

1. Immediately fill in the form number on this page of the Test Booklet with Blue/Black Ball Point Pen. Use of pencil is strictly prohibited.
2. The candidates should not write their Form Number anywhere else (except in the specified space) on the Test Booklet/Answer Sheet.
3. The Test Booklet consists of **90** questions.
4. There are **three** parts in the question paper 1,2,3 consisting of **Physics, Chemistry and Mathematics** having **30 questions** in each subject and each subject having **Two sections**.
  - (i) Section-I contains 20 multiple choice questions with **only one correct** option.  
**Marking scheme** : +4 for correct answer, 0 if not attempted and –1 in all other cases.
  - (ii) Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions. First 5 attempted questions will be considered for marking.  
**Marking scheme** : +4 for correct answer, 0 if not attempted and –1 in all other cases.
5. Use **Blue/Black Ball Point Pen only** for writing particulars/markings responses on **Side-1** and **Side-2** of the Answer Sheet. **Use of pencil is strictly prohibited.**
6. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electronic device etc, except the Identity Card inside the examination hall/room.
7. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
8. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Room/Hall. **However, the candidate are allowed to take away this Test Booklet with them.**
9. **Do not fold or make any stray marks on the Answer Sheet.**
10. Take  $g = 10 \text{ m/s}^2$  unless otherwise stated.

DO NOT BREAK THESE SEALS WITHOUT BEING INSTRUCTED TO DO SO BY THE INVIGILATOR

Name of the Candidate (in Capitals)\_\_\_\_\_

Form Number : in figures\_\_\_\_\_

: in words\_\_\_\_\_

Centre of Examination (in Capitals) : \_\_\_\_\_

Candidate's Signature : \_\_\_\_\_ Invigilator's Signature : \_\_\_\_\_

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PART-1 : PHYSICS

SECTION-I : (Maximum Marks: 80)

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

**Full Marks** : +4 If correct answer is selected.

**Zero Marks** : 0 If none of the option is selected.

**Negative Marks** : -1 If wrong option is selected.

1. If  $y$  represents mass and  $x$  represents velocity, then dimensional formula for  $\frac{d^3y}{dx^3}$  will be :

(A)  $[M^0L^0T^0]$  (B)  $[ML^{-3}T^3]$   
(C)  $[M^3L^{-3}T^3]$  (D)  $[M^3L^3T^{-3}]$

2. If the number of particles crossing per unit volume perpendicular to  $x$ -axis per unit time is given by  $N = D(N_2 - N_1)(x_2 - x_1)$  where  $N_2$  and  $N_1$  are number of particles per unit area at  $x_2$  and  $x_1$  respectively, then dimensional formula for  $\frac{Dx}{t}$  is, (where  $t$  is time):

(A)  $[M^0L^2T^{-1}]$  (B)  $[M^0L^{-2}T^1]$   
(C)  $[M^0L^{-1}T^{-2}]$  (D)  $[M^0L^{-1}T^0]$

3. A suitable unit for gravitational constant/force is :

(A)  $\text{kg metre sec}^{-1}$   
(B)  $\text{Newton metre}^{-1} \text{ sec}$   
(C)  $\text{Metre}^2 \text{ kg}^{-2}$   
(D)  $\text{kg metre hr}^{-1}$

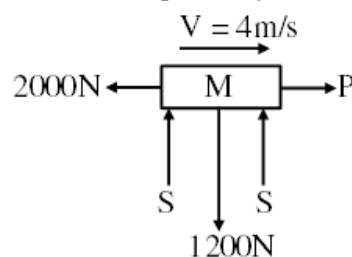
4. Two vectors  $P = 4\hat{i} + b\hat{j} + 2\hat{k}$  and  $Q = \hat{i} + \hat{j} + c\hat{k}$  will be parallel if :

(A)  $b = 4$  (B)  $b = 1$   
(C)  $b = 2$  (D)  $b = -4$

5. The  $x$  and  $y$  components of vectors  $\vec{A}$  are 4 and 6. The  $x$  and  $y$  components of  $\vec{A} + \vec{B}$  are 10 and 9. Then find the angle between  $\vec{B}$  and  $x$ -axis.

(A)  $\sin^{-1}\left(\frac{1}{3}\right)$  (B)  $\cos^{-1}(1)$   
(C)  $\tan^{-1}\left(\frac{1}{2}\right)$  (D)  $\tan^{-1}(3)$

6. The forces acting on an object are shown in the figure. If the body moves horizontally at a constant speed of 4 m/s, then the values of the forces  $P$  and  $S$  are, respectively :



(A) 0 N, 0 N (B) 300 N, 200 N  
(C) 300 N, 1000 N (D) 2000 N, 600 N

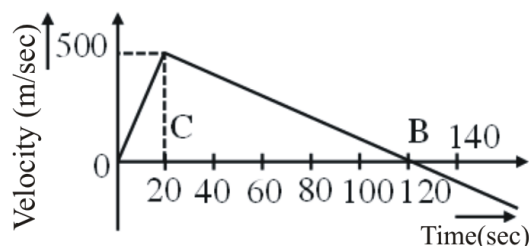
7. A car travels a distance of 2000 m. If the first half distance is covered at 30 km/hour and the second half with speed  $v$  and the average speed is 48 km/hour, then the value of  $v$  is:

(A) 56 km/hour (B) 60 km/hour  
(C) 120 km/hour (D) 48 km/hour

8. The displacement of a body is given to be proportional to the square of time elapsed. The magnitude of the acceleration of the body is:

(A) Increasing with time  
(B) Decreasing with time  
(C) Constant but not zero  
(D) Zero

9. A rocket is projected vertically upwards, whose velocity-time graph is shown in figure. The maximum height reached by the rocket is :



- (A) 1 km (B) 10 km  
(C) 20 km (D) 30 km
10. A body falling from a high Minaret travels 40 meters in the last 1 seconds of its fall to ground. Height of Minaret in meters is (take  $g = 10 \text{ m/s}^2$ )
- (A) 60 (B) 101.25  
(C) 80 (D) 51.75
11. From the top of a tower 19.6 m high, a ball is thrown horizontally. If the line joining the point of projection to the point where it hits the ground makes an angle of  $53^\circ$  with the horizontal, then the initial velocity of the ball is ( $g = 9.8 \text{ m/s}^2$ )
- (A)  $9.8 \text{ m/s}^{-1}$  (B)  $4.9 \text{ m/s}^{-1}$   
(C)  $14.7 \text{ m/s}^{-1}$  (D)  $7.35 \text{ m/s}^{-1}$

12. Three identical balls are thrown with same speed at angles of  $30^\circ$ ,  $45^\circ$  and  $60^\circ$  with the horizontal respectively. The ratio of their distances from the point of projection to the where they hit the ground will be :

(A)  $1 : \sqrt{2} : 1$  (B)  $1 : 2 : 1$   
(C)  $2 : 4 : 3$  (D)  $\sqrt{3} : 2 : \sqrt{3}$

13. A body is projected with a speed  $u$  in such a direction that the maximum height obtained is equal to twice its horizontal range. The horizontal range is :

(A)  $\frac{8u^2}{17g}$  (B)  $\frac{5u^2}{65g}$   
(C)  $\frac{16u^2}{65g}$  (D)  $\frac{u^2}{2g}$

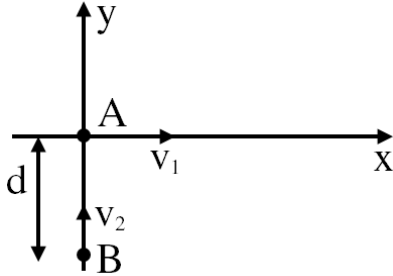
14. A person aiming to reach the exactly opposite point on the bank of a stream is swimming with a speed of 0.5 m/s at an angle of  $150^\circ$  with the direction of flow of water. The speed of water in the stream is :

(A) 1 m/s (B) 0.5 m/s  
(C) 0.25 m/s (D) 0.433 m/s

15. When a person walks on a straight road with speed 10 km/h, rain appears to fall vertically downward. As he stops, the appears to fall at an angle  $30^\circ$  with vertical. The speed of rain with respect to ground.

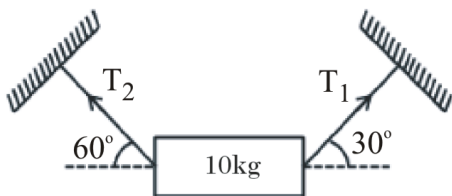
(A) 20 km/hr  
(B)  $10\sqrt{3}$  km/hr  
(C) 10 km/hr  
(D)  $20\sqrt{3}$  km/hr

16. Two particles A and B move with velocities  $v_1$  and  $v_2$  respectively along the x & y axis. The initial separation between them is 'd' as shown in the figure. Find the least distance between them during their motion.



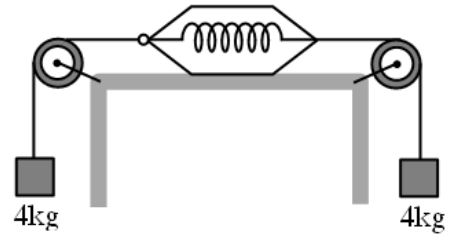
- (A)  $\frac{d \cdot v_1^2}{v_1^2 + v_2^2}$   
 (B)  $\frac{d \cdot v_2^2}{v_1^2 + v_2^2}$   
 (C)  $\frac{d \cdot v_1}{\sqrt{v_1^2 + v_2^2}}$   
 (D)  $\frac{d \cdot v_2}{\sqrt{v_1^2 + v_2^2}}$

17. A body of mass 10 kg is suspended by the strings making angles  $60^\circ$  and  $30^\circ$  with the horizontal :

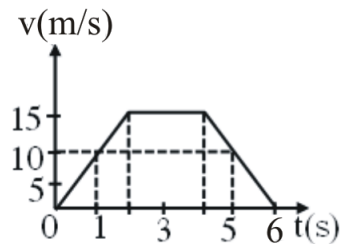


- (a)  $T_1 = 50 \text{ N}$       (b)  $T_2 = 25 \text{ N}$   
 (c)  $T_1 = 25\sqrt{3} \text{ N}$       (d)  $T_2 = 50\sqrt{3} \text{ N}$   
 (A) a, b      (B) a, d  
 (C) c, d      (D) b, c

18. As shown in the figure, two equal masses each of 4kg are suspended from a spring balance. The reading of the spring balance will be :



- (A) Zero  
 (B) 8kg  
 (C) 4kg  
 (D) Between zero and 4kg
19. A particle of mass 100 gram moves on a straight line. The variation of speed with time is shown in figure. Find the force acting on the particle at  $t = 1, 3$  and 5 seconds.



- (A) 2 N, 0 N, -1 N      (B) 2 N, 0 N, -2 N  
 (C) 1 N, 0 N, -1 N      (D) None of these
20. A flexible chain of weight W hangs between two fixed points A & B which are at the same horizontal level. The inclination of the chain with the horizontal at both the points of support is  $\theta$ . What is the tension of the chain at the mid point?

- (A)  $\frac{W}{2} \cdot \operatorname{cosec} \theta$       (B)  $\frac{W}{2} \cdot \tan \theta$   
 (C)  $\frac{W}{2} \cdot \cot \theta$       (D) None

SECTION-II : (Maximum Marks: 20)

This section contains 10 questions. Candidates have to attempt any 5 questions out of 10. If more than 5 questions are attempted, then only first 5 attempted questions will be evaluated.

The answer to each question is a Numerical Value Type questions.

For each question, enter the correct integer value (in decimal notation, the answer should be rounded off to the nearest Integer).

Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

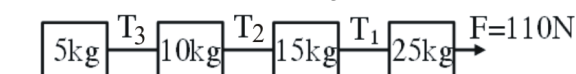
Negative Marks : -1 If wrong option is selected.

- The vector  $\vec{P}$  whose magnitude is 4 units make  $120^\circ$  with the x-axis and the vector  $\vec{Q}$  whose magnitude is 3 makes  $30^\circ$  with the y-axis. What is the magnitude of their resultant?
- A body at rest starts from the origin with an acceleration of  $6 \text{ m/s}^2$  along the x-axis and  $8 \text{ m/s}^2$  along the y-axis. Its distance from the origin (in m) after 4 seconds will be :
- To find the distance  $d$  over which a signal can be seen clearly in foggy conditions, a railways engineer uses dimensional analysis and assumes that the distance depends on the mass-density  $\rho$  of the fog, intensity (power/area)  $S$  of the light from the signal and its frequency  $f$ . The engineer finds that  $d$  is proportional to  $S^{1/n}$ . The value of  $n$  is :
- A ship is travelling due east at  $10 \text{ km/h}$ . A ship heading  $30^\circ$  east of north is always due north from the first ship. The speed of the second ship in  $\text{km/h}$  is :
- A bird flies for  $4 \text{ s}$  with a velocity of  $|t - 3| \text{ m/s}$  in a straight line, where  $t = \text{time it seconds}$ . It covers a distance of  $x$  meter. Find  $x$ .

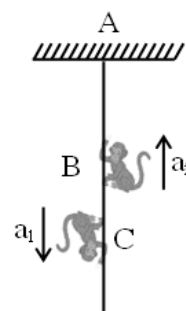
- A bullet of  $5 \text{ g}$ , travelling at a speed of  $200 \text{ m/s}$  penetrates a wooden block up to  $6.0 \text{ cm}$ . Then the average force applied (in newton) by the bullet on the block :

- The velocity of a body of mass  $2 \text{ kg}$  changes from  $V_1 = (2\hat{i} + 3\hat{j} - \hat{k}) \text{ m/s}$  to  $V_2 = (-3\hat{i} + 2\hat{j} + 3\hat{k}) \text{ m/s}$  in  $3 \text{ sec}$ , then the magnitude of the force applied: (in N)

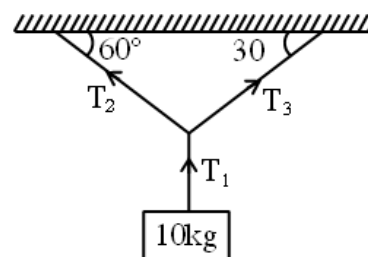
- $T_1, T_2, T_3$  are the tensions in different strings as shown in figure. A force of  $110 \text{ N}$  is given to the  $25 \text{ kg}$  block towards right then value of  $T_1, T_2$  &  $T_3$  respectively are? (Strings are massless & stretched & all the surface are smooth). Find  $(T_1 + T_2 + T_3)$  in newton.



- Two monkeys each of mass  $m$  move with acceleration  $a_1 = a_2 = \frac{g}{2}$  relative to the light inextensible string as shown in the figure. The ratio of tensions in the portions AB and BC of the string is :



- A block of mass  $10 \text{ kg}$  is suspended by three strings as shown in the figure. The tension  $T_2$  (in N) Is:



SECTION-I : (Maximum Marks: 80)

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

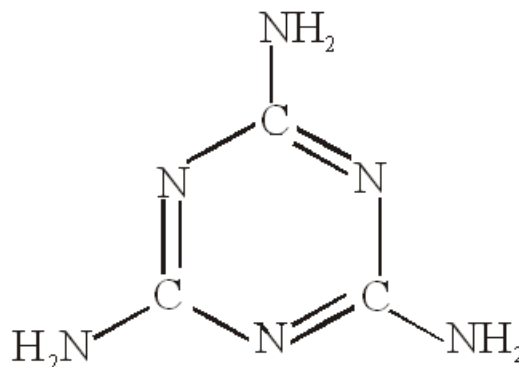
**Full Marks** : +4 If correct answer is selected.

**Zero Marks** : 0 If none of the option is selected.

**Negative Marks** : -1 If wrong option is selected.

- Which of the following species does not obey octet rule?  
(A)  $\text{SiF}_4$  (B)  $\text{PCl}_5$   
(C)  $\text{ICl}$  (D)  $\text{BF}_4^-$
- Which of the following is the correct order of lattice energy  
(A)  $\text{Na}_2\text{O} < \text{Al}_2\text{O}_3 < \text{MgO}$   
(B)  $\text{MgO} < \text{Al}_2\text{O}_3 < \text{Na}_2\text{O}$   
(C)  $\text{Al}_2\text{O}_3 < \text{MgO} < \text{Na}_2\text{O}$   
(D)  $\text{Na}_2\text{O} < \text{MgO} < \text{Al}_2\text{O}_3$
- Which of the following atomic orbitals form  $\pi$ -bond along given axis.  
(A)  $p_x + p_y$  : x-axis  
(B)  $p_x + d_{xy}$  : y-axis  
(C)  $p_y + d_{xz}$  : y-axis  
(D)  $p_z + p_z$  : z-axis
- Which of the following molecule has see-saw shape  
(A)  $\text{CH}_4$  (B)  $\text{SF}_4$   
(C)  $\text{XeF}_4$  (D)  $\text{CCl}_4$

- Find the number of sigma bond present in melamine (given as)



- (A) 9 (B) 12  
(C) 15 (D) 18
- In which of the following pairs the two species are not isostructural ?  
(A)  $\text{AlF}_6^{3-}$  and  $\text{SF}_6$   
(B)  $\text{CO}_3^{2-}$  and  $\text{NO}_3^-$   
(C)  $\text{PCl}_4^+$  and  $\text{SiCl}_4$   
(D)  $\text{PF}_5$  and  $\text{BrF}_5$
  - $\text{XeO}_4$  molecule is having : -  
(A)  $\text{sp}^3$  hybridisation, Tetrahedral , two  $\pi$  bonds only  
(B)  $\text{sp}^3$  hybridisation, Tetrahedral , four  $\pi$  bonds  
(C)  $\text{sp}^3\text{d}^2$  hybridisation, Octahedral , four  $\pi$  bonds  
(D)  $\text{sp}^3$  hybridisation, square planar, four  $\pi$  bonds

8. Which ordering of compounds is according to the decreasing order of the oxidation state of nitrogen :-  
 (A)  $\text{HNO}_3$ ,  $\text{NO}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{N}_2$   
 (B)  $\text{HNO}_3$ ,  $\text{NO}$ ,  $\text{N}_2$ ,  $\text{NH}_4\text{Cl}$   
 (C)  $\text{HNO}_3$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{NO}$ ,  $\text{N}_2$   
 (D)  $\text{NO}$ ,  $\text{HNO}_3$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{N}_2$
9. Consider the electronic configuration of 2 elements-  
 (I)  $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$   
 (II)  $1s^2, 2s^2, 2p^6, 3s^2, 3p^4$   
 Choose the INCORRECT option:  
 (A) (I) has more IE than II  
 (B) (I) has more EA than II  
 (C) Electron addition would be easier in II than I  
 (D) Removal of electron would be easier in II than I
10. The species among the following that has maximum difference of number of BONDS of central atom between Lewis octet structure and structure according to extended covalency is.  
 (A)  $\text{SO}_4^{2-}$  (B)  $\text{POF}_3$   
 (C)  $\text{CO}_3^{2-}$  (D)  $\text{ClO}_4^-$
11. Specify hybridisation of N & B atoms in a 1 : 1 complex  $\text{BF}_3$  &  $\text{NH}_3$ .  
 (A) N : tetrahedral,  $sp^3$ ; B: tetrahedral,  $sp^3$   
 (B) N : pyramidal,  $sp^2$ ; B: pyramidal,  $sp^3$   
 (C) N : pyramidal,  $sp^3$ ; B: planar,  $sp^2$   
 (D) N : pyramidal,  $sp^3$ ; B: tetrahedral,  $sp^2$
12. Which of the following is correct about  $Z_{\text{eff}}$  for an element (as per Slater's rule)?  
 (A)  $Z_{\text{eff}}$  is same for (ns, np) electron  
 (B)  $Z_{\text{eff}}$  is same for (nd, nf) electron  
 (C)  $\sigma$  is not same for (ns, np) electron  
 (D)  $\sigma$  is same for (ns, np & (n-1)s, (n-1)p)
13. Which of the following is not an isodiapher of  ${}_6\text{C}^{12}$ ?  
 (A)  ${}_7\text{N}^{14}$   
 (B)  ${}_8\text{O}^{16}$   
 (C)  ${}_{20}\text{Ca}^{40}$   
 (D)  ${}_9\text{F}^{19}$
14. The third ionization energy is maximum for :  
 (A) Magnesium  
 (B) Chlorine  
 (C) Aluminium  
 (D) Sulphur
15. Choose the incorrect statement(s).  
 (A)  $\text{Cl}^- > \text{K}^+ > \text{Ca}^{2+}$  : Ionic radius  
 (B)  $\text{Rb} > \text{Zn} > \text{S}$  : Atomic radius  
 (C)  $\text{Se} < \text{As} < \text{Br}$  : Ionization energy  
 (D)  $\text{Sr}^{+2} > \text{Ca}^{+2} > \text{Rb}^+$  : Hydration energy



16. Correct statement(s) among the following is/are  
 (i)  $IE_1$  of Tl is less than that of In due to its larger atomic size  
 (ii)  $4d_{yz}$  and  $4p_z$  have at least one common nodal plane  
 (iii) Cl has highest electron affinity in periodic stable  
 (iv)  $I.P_1$  of Ga >  $I.P_1$  of Al  
 (A) (ii), (iii), (iv) only  
 (B) (i), (iii), (iv) only  
 (C) (iii), (iv) only  
 (D) All are correct

17. Molecular shapes of  $SF_4$ ,  $CF_4$  and  $XeF_4$  are respectively :  
 (A) The same with 2, 0 and 1 lone pair of electrons on central atoms respectively  
 (B) the same with 1, 1 and 1 lone pair of electrons on central atoms respectively  
 (C) different with 0, 1 and 2 lone pair of electrons on central atoms respectively  
 (D) different with 1, 0 and 2 lone pair of electrons on central atoms respectively

18. Which of the following species are hypervalent?  
 (1)  $PCl_5$ , (2)  $BF_3$ , (3)  $XeF_2$ , (4)  $CO_3^{2-}$   
 (A) 1, 2, 3  
 (B) 1, 3  
 (C) 3, 4  
 (D) 1, 2

19. Carbon atoms in  $C_2(CN)_4$  are :  
 (A) sp-hybridized  
 (B)  $sp^2$ -hybridized  
 (C) sp-and  $sp^2$  hybridized  
 (D) sp,  $sp^2$  and  $sp^3$ - hybridized
20. On hybridization of one s-orbital and one p-orbital, we get :  
 (A) two mutually perpendicular orbitals  
 (B) two orbital at  $180^\circ$   
 (C) four orbital directed tetrahedrally  
 (D) three orbital in the plane

**SECTION-II : (Maximum Marks: 20)**

**This section contains 10 questions Candidates have to attempt any 5 questions out of 10. If more than 5 questions are attempted, then only first 5 attempted questions will be evaluated.**

The answer to each question is a Numerical Value Type questions.

For each question, enter the correct integer value (in decimal notation, the answer should be rounded off to the nearest Integer).

Answer to each question will be evaluated according to the following marking scheme:

*Full Marks* : +4 If correct answer is selected.

*Zero Marks* : 0 If none of the option is selected.

*Negative Marks* : -1 If wrong option is selected.

1. Find out number of transformation among following which involves the change of hybridisation of underlined atom.  
 (a)  $H_2\underline{O} + H^+ \rightarrow H_3\underline{O}^+$   
 (b)  $NH_3 + \underline{B}F_3 \rightarrow NH_3 \cdot \underline{B}F_3$   
 (c)  $\underline{X}eF_6 \rightarrow \underline{X}eF_5^+ + F^-$   
 (d)  $2\underline{P}Cl_5 \rightarrow \underline{P}Cl_4^+ + \underline{P}Cl_6^-$   
 (e)  $\underline{C}H_3 - CH_3 \rightarrow \underline{C}H_3^- + CH_3^+$

2. Out of molecules  $\text{CH}_2\text{Cl}_2$ ,  $\text{XeO}_4$ ,  $\text{BeCl}_2$ ,  $\text{XeO}_2\text{F}_2$ ,  $\text{BF}_3$ ,  $\text{NO}_2^+$  find total number of species which have similar hybridisation of the central atom as that of  $\text{CO}_2$ .
3. Find the number of acidic oxides :  $\text{Na}_2\text{O}$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{MgO}$ ,  $\text{ZnO}$ ,  $\text{SnO}$ ,  $\text{BeO}$ ,  $\text{CO}_2$ ,  $\text{NO}$ ,  $\text{Cl}_2\text{O}_7$ ,  $\text{N}_2\text{O}_5$
4. Number of incorrect statements in following are
  - (i)  $\text{SF}_2$  and  $\text{H}_2\text{O}$  have same hybridisation but different molecular shapes
  - (ii)  $\text{SF}_6$  and  $\text{PCl}_6^-$  are isostructural.
  - (iii) Four atomic orbitals participates in hybridisation of each carbon atom in  $\text{C}_2\text{H}_6$  molecule
  - (iv) Hybridized orbitals are directional orbitals
  - (v)  $2p_\pi - 3p_\pi$  overlapping is more stronger than  $2p_\pi - 3d_\pi$  overlapping
5. How many of the following are Ionic Compounds :
 

|                             |                               |
|-----------------------------|-------------------------------|
| (i) $\text{Na}_2\text{S}$   | (ii) $\text{SiCl}_4$          |
| (iii) $\text{KBr}$          | (iv) $\text{Na}_2\text{SO}_4$ |
| (v) $\text{NaH}$            | (vi) $\text{C}_2\text{H}_4$   |
| (vii) $\text{CaCl}_2$       | (viii) $\text{HCl}$ gas       |
| (ix) $\text{NH}_4\text{Cl}$ |                               |

6. Consider the following species :  
 $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{SO}_3$ ,  $\text{PO}_4^{3-}$   
 then calculate the value of  $X + Y = ?$   
 Where  
 $X$  = Total number of species which used all three p-orbitals of valence shell in hybridisation of central atom  
 $Y$  = Total number of species which used d-orbital for bonding
7. Maximum value of  $(n + \ell + m_\ell)$  for the electron of  $\text{He}^+$  in 3<sup>rd</sup> excited state?
8. Find the number of paramagnetic atom/ions from the following.  
 $\text{Na}^+$ ,  $\text{Ne}$ ,  $\text{Fe}^{+2}$ ,  $\text{Cu}^{+2}$ ,  $\text{Cu}$ ,  $\text{Cl}^\ominus$ ,  $\text{He}^+$ ,  $\text{Ni}^{+2}$
9. If all quantum numbers remain same, but spin quantum number can have three values, then maximum number of elements possible in 7<sup>th</sup> period ?
10. Number of lone pairs in a molecule of  $\text{I}(\text{CN})_2^-$  are \_\_\_\_\_.

**PART-3 : MATHEMATICS**

**SECTION-I : (Maximum Marks: 80)**

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

**Full Marks** : +4 If correct answer is selected.

**Zero Marks** : 0 If none of the option is selected.

**Negative Marks** : -1 If wrong option is selected.

1. If  $\frac{5+9+13+\dots \text{ to } n \text{ terms}}{7+9+11+\dots \text{ to } 12 \text{ terms}} = \frac{5}{12}$ , then  $n$  is

(A) 12 (B) 18  
(C) 10 (D) 6

2. For the equation  $k^2x^2 + |x| + 12 = 0$ ,  $k \neq 0$

(A) there can be at least one real root  
(B) there can be exactly one real root  
(C) there can be exactly two roots  
(D) no real roots

3. The sum of non real roots of equation  $(x^2 + x - 2)(x^2 + x - 3) = 12$  is

(A) 1 (B) -1  
(C) -6 (D) 6

4. Let  $k_1, k_2, k_3, \dots, k_{12}$  be a G.P. If  $\frac{k_5}{k_2} = 27$ ,

then sum of digits of  $\frac{k_{10}}{k_5}$  is -

(A) 7 (B) 8  
(C) 9 (D) 10

5. Consider the sequence 1,2,2,3,3,3,... where  $n$  occurs  $n$  times. The number that occurs as 2007<sup>th</sup> term is-

(A) 61 (B) 62  
(C) 63 (D) 64

6. If the graph of  $y = 16x^2 + 8(a+5)x - 7a - 5$  is strictly above the  $x$ -axis then-

(A)  $a \in (-15, -2)$  (B)  $a \in (-2, -1)$   
(C)  $a \in (-1, 1)$  (D)  $a \in (5, 7)$

7. If  $\alpha$  and  $\beta$  are positive integers such that  $\alpha\beta + \alpha + \beta = 71$ ,  $\alpha^2\beta + \alpha\beta^2 = 880$ , then the value of  $\alpha^2 + \beta^2 =$

(A) 125 (B) 137  
(C) 146 (D) 152

8. The number of solutions of  $\log_2 3 \cdot \log_x 2 = \log_3 x$  is

(A) 0 (B) 1  
(C) 2 (D) 3

9. Let the harmonic mean and geometric mean of two positive numbers be in ratio 4 : 5, then the two numbers are in the ratio

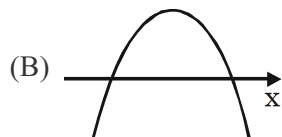
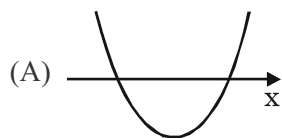
(A) 1 : 2 (B) 1 : 3  
(C) 1 : 4 (D) 1 : 5

10. The number of integers in the range of

$$f(x) = \frac{x^2 + x + 2}{x^2 + x + 1}, x \in \mathbb{R} \text{ is}$$

(A) 1 (B) 2  
(C) 3 (D) 4

11. If roots of quadratic equation  $ax^2 + bx + c = 0$  are non real and  $4a + c < 2b$ , then which of the following is the graph of  $f(x) = ax^2 + bx + c$



12. If one root of quadratic equation  $ax^2 + bx + c = 0$  is 7 times the other, then the value of  $\frac{7b^2}{2ac}$  is -

- (A) 64 (B) 32  
(C) 16 (D) 2

13. If one root of the following equations  $ax^2 + bx + 2 = 0$  and  $5x^2 + x + 3 = 0$  is common, then the value of 'a + b' is

- (A)  $\frac{10}{3}$  (B)  $\frac{7}{3}$   
(C) 3 (D) 4

14. If roots  $x^2 - 8x + a^2 - 6a = 0$  lie on either side of unity, then the maximum integral value of 'a' is -

- (A) -1 (B) 7  
(C) 0 (D) 6

15. The number of non negative integral values of the expression  $y = x^2 - 3x - 10$  in  $x \in [-2, 6]$

- (A) 10 (B) 18  
(C) 8 (D) 9

16. The number of solution(s) of  $\log_4(x-1) = \log_2(x-3)$  is-

- (A) 0 (B) 1  
(C) 2 (D) 3

17. The number of value(s) of x satisfying

$$\frac{(x-1)^2(3-x)^3(x^2-2x+5)}{x^6(2x-5)^4} \leq 0 \text{ and}$$

$$9 - x^2 \geq 0 \text{ is}$$

- (A) 1 (B) 2  
(C) 3 (D) infinite

18. If  $x_1, x_2$  are roots of the equation  $\log_{x^2} 9 + \log_{3x} 27 = 3$ , then the value of  $x_1 x_2$  is

- (A)  $(3)^{1/3}$  (B) 3  
(C)  $-\frac{1}{3}$  (D)  $\frac{1}{3}$

19.  $\log_{\sqrt{7}} \left( \frac{49}{\sqrt{2} + \sqrt{3}} \right) + \log_{\frac{1}{7}} \left( \frac{1}{5 + 2\sqrt{6}} \right)$  is -

- (A) 0 (B)  $\frac{1}{2}$   
(C) 4 (D) 2

20. Which of the following is negative

- (A)  $\left( \log_{\frac{1}{5}} 7 \right)^{10}$   
(B)  $\frac{\log_{1/5} 7}{\log_{1/3} (3 + \cos^2 x)}$   
(C)  $\log_3 (\log_5 (\log_4 22))$   
(D)  $\log_9 (\log_4 5)$

SECTION-II : (Maximum Marks: 20)

This section contains 10 questions. Candidates have to attempt any 5 questions out of 10. If more than 5 questions are attempted, then only first 5 attempted questions will be evaluated.

The answer to each question is a Numerical Value Type questions.

For each question, enter the correct integer value (in decimal notation, the answer should be rounded off to the nearest Integer).

Answer to each question will be evaluated according to the following marking scheme:

*Full Marks* : +4 If correct answer is selected.

*Zero Marks* : 0 If none of the option is selected.

*Negative Marks* : -1 If wrong option is selected.

1. Given that  $\log_{a^2} (a^2 + 1) = 13$ , then the value of  $130 \log_{a^{26}} \left( a + \frac{1}{a} \right)$  is equal to -
2. If  $x^3 + y^3 + 15xy = 125$  where  $x \neq y$ , then the value of  $x + y$  is equal to -
3. If  $a, b, c$  are positive numbers where  $a + 2b = 4$  and  $b + 2c = 5$ , then the maximum value of  $ab^3$  is  $\lambda$ , then the value of  $\frac{27}{\lambda}$  is -
4. If  $\alpha, \beta$  and  $\gamma$  are the roots of the equation  $x^3 + 4x + 1 = 0$ , then  $(\alpha + \beta)^{-1} + (\beta + \gamma)^{-1} + (\gamma + \alpha)^{-1}$  is equal to
5. Find the sum of all integral values of 'a' for which the equation  $x^2 + ax + 1 = 0$ , has only integral roots

6. Let  $a_1, a_2, \dots, a_{30}$  be an A.P.,  $S = \sum_{i=1}^{30} a_i$  and  $T = \sum_{i=1}^{15} a_{(2i-1)}$ . If  $a_5 = 27$  and  $S - 2T = 75$ , then  $a_{10}$  is equal to :
7. The number of common integers in two arithmetic progression 1, 3, 5, 7, ... 157 and 2, 5, 8, 11 ... 161 is
8. If  $a$  and  $b$  are roots of  $11x^2 - 4x - 2 = 0$ , then the value of  $10(1 + a + a^2 + \dots \infty)(1 + b + b^2 + \dots \infty)$  is
9. Let  $x_1, x_2$  are the values of  $x$  satisfying  $\log_3 (2^{(2+x)} - 6^x) = 1 + x \log_3 \left( \frac{2}{3} \right)$ , then the value  $|x_1| + x_1^2 + x_1^3 + |x_2| + x_2^2 + x_2^3$  is
10. Let non-integral value of  $x$  satisfying the equation  $x^{(2+\log_{10} x)} = 10^8$  is  $\lambda$  then the value of  $\frac{1}{4\lambda}$  is -

## Space for Rough Work

