

# FIITJEE RET – 9

(2018 – 2020)(1<sup>ST</sup> YEAR\_REGULAR)

IIT-2017 (P1)\_SET-A

DATE: 03.09.2018

Time: 3 hours

Maximum Marks: 183

## INSTRUCTIONS:

### A. General

1. This booklet is your Question Paper containing 54 questions.
2. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are not allowed to be carried inside the examination hall.
3. Fill in the boxes provided for Name and Enrolment No.
4. The answer sheet, a machine-readable Objective Response (ORS), is provided separately.
5. DO NOT TAMPER WITH / MULTILATE THE ORS OR THE BOOKLET.

### B. Filling in the OMR:

6. The instructions for the OMR sheet are given on the OMR itself.

### C. Question paper format & Marking Scheme

7. Each part has three sections as detailed in the following table:

Section	Question Type	Number of Questions	Category wise Marks Each Question				Maximum marks of the section
			Full Marks	Partial Marks	Zero Marks	Negative Marks	
1	One or more correct option (s)	7	<b>+4</b> If only the bubble(s) corresponding to all the correct option(s) is(are) darkened	<b>+1</b> For darkening a bubble corresponding to each correct option, provided <b>NO</b> incorrect option is darkened	<b>0</b> If none of the bubbles is darkened	<b>-2</b> In all other cases	<b>28</b>
2	Single digit integer (0-9)	5	<b>+3</b> If only the bubble corresponding to the correct answer is darkened.	---	<b>0</b> In all other cases	---	<b>15</b>
3	Single correct option	6	<b>+3</b> If only the bubble corresponding to the correct option is darkened	---	<b>0</b> If none of the bubbles is darkened	<b>-1</b> In all other cases	<b>18</b>

**Don't write / mark your answers in this question booklet.**

**If you mark the answers in question booklet, you will not be allowed to continue the exam.**

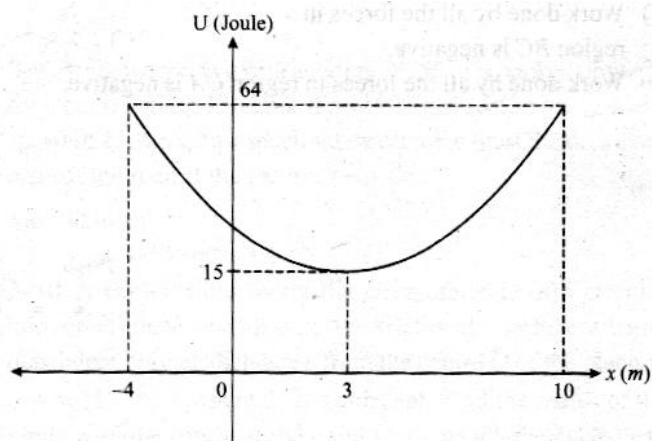
NAME:

ENROLLMENT NO.:

**PAPER-I**  
**PART I: PHYSICS**  
**SECTION 1 (Maximum Marks: 28)**

- \* This section contains **SEVEN** questions.
- \* Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.
- \* For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- \* For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will get +4 marks; darkening only (A) and (D) will get +2 marks; and darkening (A) and (B) will get -2 marks, as a wrong option is also darkened.

1. A single conservative force  $F(x)$  acts on a particle that moves along the  $x$  – axis. The graph of the potential energy with  $x$  is given. At  $x = 5\text{m}$ , the particle has a kinetic energy of  $50\text{ J}$  and its potential energy is related to position ' $x$ ' as  $U = 15 + (x - 3)^2$  Joule, where  $x$  is in meter. Then
- (A) The mechanical energy of system is  $69\text{ J}$   
 (B) The mechanical energy of system is  $19\text{ J}$   
 (C) At  $x = 3$ , the kinetic energy of particle is minimum  
 (D) The maximum value of kinetic energy is  $54\text{ J}$

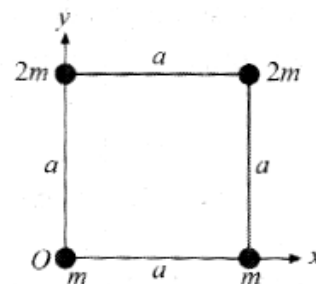


2. A block of mass  $2\text{ kg}$  is hanging over a smooth and light pulley through a light string. The other end of the string is pulled by a constant force  $F = 40\text{ N}$ . The kinetic energy of the particle increases  $40\text{ J}$  in a given interval of time. Then (Take  $g = 10\text{ m/s}^2$ ).
- (A) Tension in the string is  $40\text{ N}$   
 (B) Displacement of the block in the given interval of time is  $2\text{m}$   
 (C) Power developed by this force varies linearly with displacement  
 (D) Power developed by this force varies parabolically with displacement.
3. A ball of mass  $m$  is attached to the lower end of a light vertical spring of force constant  $k$ . The upper end of the spring is fixed. The ball is released from rest with the spring at its natural length, and comes to momentarily rest after descending through a distance  $x$ . Then
- (A)  $x = mg/k$   
 (B)  $x = 2 mg /k$   
 (C) The ball will have no acceleration at the position where it has descended through  $x /2$   
 (D) The ball will have an upward acceleration equal to  $g$  at its lowermost position

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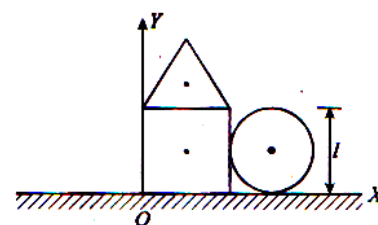
4. Four particles of masses  $m$ ,  $m$ ,  $2m$  and  $2m$  are placed at the four corners of a square of side  $a$  as shown in figure. The  $(x, y)$  coordinates of the centre of mass are.

(A)  $\left(\frac{a}{2}, 2a\right)$                       (B)  $\left(\frac{a}{2}, a\right)$   
 (C)  $\left(\frac{a}{2}, \frac{2a}{3}\right)$                       (D)  $\left(a, \frac{a}{3}\right)$



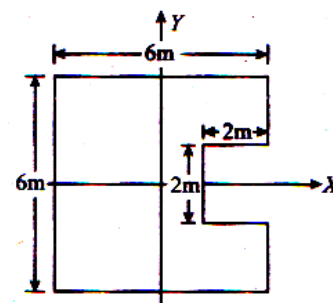
5. Three laminar objects of uniform density a square, a disc and an equilateral triangle are placed as shown in the figure. If centre of mass of the system of three objects is given by  $(x_{cm}, y_{cm})$  then

(A)  $x_{cm} = \frac{(3\pi + \sqrt{3} + 4)\ell}{2(4 + \pi + \sqrt{3})}$                       (B)  $x_{cm} = \frac{(2\pi + \sqrt{3} + 4)\ell}{2(2 + \pi + \sqrt{3})}$   
 (C)  $y_{cm} = \frac{(\pi + 2\sqrt{3} + 5)\ell}{2(4 + \pi + \sqrt{3})}$                       (D)  $y_{cm} = \frac{(2\pi + \sqrt{3} + 4)\ell}{2(2 + \pi + \sqrt{3})}$



6. X and Y-coordinates of the centre of mass of the plate shown in the figure from which a square of side  $2m$  is cut out are .....

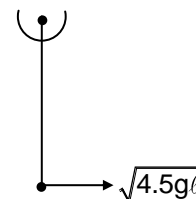
(A)  $X_{cm} = -0.25m$                       (B)  $X_{cm} = -0.50m$   
 (C)  $Y_{cm} = 0$                               (D)  $Y_{cm} = 0.50m$



**Space for rough work**

7. A particle of mass  $m$  is attached with a light string of length  $\ell$ . It is free to rotate in a vertical plane (as shown). At the lowermost tip, a velocity of  $\sqrt{4.5g\ell}$  is given. Choose correct options:

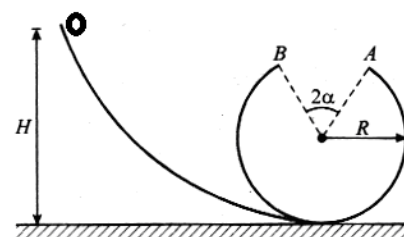
- (A) The string will slack at  $\theta = \cos^{-1}\left(\frac{5}{6}\right)$ , ( $\theta$  is the angle made by the string with vertical axis)  
 (B) The maximum tension in the string will be  $5.5 mg$   
 (C) The maximum tension in the string will be  $4.5 mg$   
 (D) The string will slack at  $\theta = \cos^{-1}\left(\frac{1}{2}\right)$  ( $\theta$  is the angle made by the string with vertical axis)



### SECTION 2 (Maximum Marks: 15)

- \* This section contains **FIVE** questions.
- \* The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- \* For each question, darken the bubble corresponding to the correct integer the ORS.

8. A small object slides without friction from the height  $H = 50$  cm shown in figure and then loops the vertical loop of radius  $20$  cm from which a symmetrical section of angle  $2\alpha$  has been removed. If the angle  $\alpha = \frac{\pi}{n}$  is such that after losing contact at A and flying the air, the object will reach at point B, value of  $n$  is \_\_\_\_\_



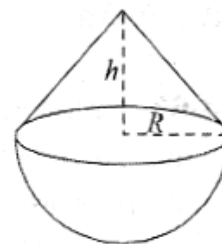
9. A smooth rubber cord of length  $\ell$  whose coefficient of elasticity is  $k$  is suspended by one end from the end O as shown in figure. The other end is fitted with a catch B. A small sleeve of mass  $m$  starts from the point O. Neglect the masses of the thread and the catch. All the surface are frictionless. If the maximum elongation of the cord is  $x_{\max} = \frac{mg}{k} \left( 1 + \sqrt{a + \frac{bk\ell}{mg}} \right)$  then value of  $(a + 2b)$  is \_\_\_\_\_



*Space for rough work*

10. Force acting on a particle is  $(2\hat{i} + 3\hat{j})\text{N}$ . Work done by this force is zero, when a particle is moved on the line  $3y+kx=5$ . Then value of  $k$  is \_\_\_\_\_

11. A uniform solid right circular cone of base radius  $R$  is joined to a uniform solid hemisphere of radius  $R$  and of the same density, so as to have a common face. The centre of mass of the composite solid lies on the common face. If the height of the cone is given by  $\sqrt{K_0} R$  then value of  $K_0$  is \_\_\_\_\_.



12. If the centre of mass of a non uniform rod of length  $L$  whose mass per unit length  $\rho$  varies as  $\rho = \frac{kx^2}{L}$  where  $k$  is a positive constant and  $x$  is the distance of any point from one end, is given by  $\frac{aL}{8}$  then value of  $a$  is \_\_\_\_\_ (take rod to be placed between  $x = 0$  to  $x = L$ )

### SECTION 3 (Maximum Marks: 18)

- \* This section contains **SIX** questions of matching type.
- \* This section contains **TWO** tables (each having 3 columns and 4 rows)
- \* Based on the table, there are **THREE** questions
- \* Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- \* For each question, darken the bubble corresponding to the correct option in the ORS.

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*Space for rough work*

Quarter rings are arranged in different orientations in Column 1. Their linear mass density (in kg/m) has been labeled in each case. Each quarter ring is a part of circle of radius  $R$ . Origin (O) of the system of quarter rings has been shown. Column 2 gives x-coordinate of centre of mass ( $X_{cm}$ ) and Column 3 gives y-coordinate of centre of mass ( $Y_{cm}$ ) respectively of these arrangements.

Column 1		Column 2 $X_{cm}$		Column 3 $Y_{cm}$	
(I)		(i)	0	(P)	0
(II)		(ii)	$-\frac{R}{\pi}$	(Q)	$-\frac{3R}{\pi}$
(III)		(iii)	$-\frac{4R}{5\pi}$	(R)	$-\frac{4R}{5\pi}$
(IV)		(iv)	$-\frac{2R}{5\pi}$	(S)	$-\frac{2R}{5\pi}$

13. Which of the following matching is correct?

(A) I → ii → R

(B) I → i → S

(C) I → i → R

(D) I → iii → S

14. Which of the following matching is correct?

(A) II → iv → P

(B) II → i → S

(C) IV → iii → R

(D) IV → iv → S

**Space for rough work**

15. Which of the following matching is correct?

(A) III  $\rightarrow$  ii  $\rightarrow$  S

(B) III  $\rightarrow$  iv  $\rightarrow$  P

(C) III  $\rightarrow$  iii  $\rightarrow$  S

(D) III  $\rightarrow$  ii  $\rightarrow$  P

Two blocks I and II are attached with a mass less spring as shown in **Column - 1**. After striking the ground, the speed of Block - II becomes zero instantly. Let  $h$  is the minimum height from where the system must be released, so that Block - II just gets lifted up.

Answer the below questions based on the situations given in **Column - 1**

	<b>Column - 1</b>	<b>Column - 2</b> Height ( $h$ ) (in SI units)	<b>Column - 3</b> Speed of <b>Block I</b> corresponding to $h$ , when Block-II just reaches the ground (in SI units)
(I)		(i) $\frac{3mg}{2K}$	(P) $2g\sqrt{\frac{m}{K}}$
(II)		(ii) $\frac{mg}{K}$	(Q) $2g\sqrt{\frac{2m}{K}}$
(III)		(iii) $\frac{4mg}{K}$	(R) $g\sqrt{\frac{2m}{K}}$
(IV)		(iv) $\frac{2mg}{K}$	(S) $g\sqrt{\frac{3m}{K}}$

**Space for rough work**

16. Pick the correct option  
 (A) II  $\rightarrow$  iv  $\rightarrow$  Q      (B) II  $\rightarrow$  iv  $\rightarrow$  P      (C) II  $\rightarrow$  iii  $\rightarrow$  R      (D) none of these
17. Pick the option for maximum work done by the external agent.  
 (A) III  $\rightarrow$  i  $\rightarrow$  P      (B) III  $\rightarrow$  ii  $\rightarrow$  R      (C) III  $\rightarrow$  iv  $\rightarrow$  P      (D) none of these
18. Pick the option for minimum potential energy in the final configuration.  
 (A) IV  $\rightarrow$  i  $\rightarrow$  S      (B) I  $\rightarrow$  i  $\rightarrow$  S      (C) III  $\rightarrow$  iv  $\rightarrow$  P      (D) none of these

## PART II: CHEMISTRY

### SECTION 1 (Maximum Marks: 28)

- \* This section contains **SEVEN** questions.
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- \* For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will get +4 marks; darkening only (A) and (D) will get +2 marks; and darkening (A) and (B) will get -2 marks, as a wrong option is also darkened.

19. Which is correct statement  
 As the s-character of a hybrid orbitals decreases  
 (A) the bond angle decreases      (B) the bond strength decreases  
 (C) the bond length increases      (D) no change in bond length
20. Which is correct  
 (A) during  $N_2^+$  formation, one electron is removed from the bonding molecule orbital of  $N_2$ .  
 (B) during  $O_2^+$  formation, one electron is removed from the antibonding molecular orbital of  $O_2$ .  
 (C) during  $O_2^-$  formation one electron is added the bonding molecule orbital of  $O_2$ .  
 (D) during  $CN^-$  formation, one  $e^-$  is added to bonding molecular orbital of CN
21. Which of the following is/are correct relation ?  
 (A) bond energy  $\propto$  (polarity of the bond)<sup>1</sup>      (B) bond energy  $\propto$  (s-character of hybrid orbital)<sup>-1</sup>  
 (C) bond energy  $\propto$  (atomic radius)<sup>-1</sup>      (D) bond energy  $\propto$  (bond order)<sup>1</sup>

*Space for rough work*



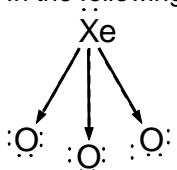
22. Which of the following is/ are correct statements.  
 (A) In ortho nitro phenol intra molecular H-bonding takes place.  
 (B) Lower alcohols are soluble in water  
 (C) Hydrogen bond is generally formed by polar covalent compounds.  
 (D) Hydrogen bond is not formed by non-polar covalent compounds.
23. The compound / species in which d – orbital is not involved in central atom hybridization  
 (A)  $\text{POCl}_3$  (B)  $\text{SOF}_4$  (C)  $\text{XeOF}_2$  (D)  $\text{IF}_2^+$
24. Sodium sulphate is soluble in water whereas barium sulphate is sparingly soluble because  
 (A) the hydration energy of sodium sulphate is more than its lattice energy  
 (B) the lattice energy of barium sulphate is more than its hydration energy  
 (C) the lattice energy has no role to play in solubility  
 (D) the hydration energy of sodium sulphate is less than its lattice energy
25. A  $\pi$ - bond can be formed between two  $p_x$  orbitals each having an unpaired electron, if they approach each other along:  
 (A) X-axis (B) Y-axis (C) Z-axis (D) Any direction

### SECTION 2 (Maximum Marks: 15)

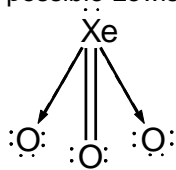
- \* This section contains **FIVE** questions.
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26. Out of  $\text{I}_3^-$ ,  $\text{ICl}_2^-$ ,  $\text{BeCl}_2$ ,  $\text{XeF}_2$ ,  $\text{XeF}_6$ ,  $\text{BrF}_5$ ,  $\text{HC} \equiv \text{CH}$  .How many will have linear shape?

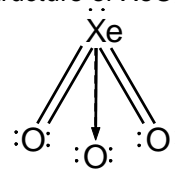
**Space for rough work**

27. How many of the following is correct regarding bond angle ?
- (i)  $\text{NH}_3 < \text{H}_2\text{O}$  (ii)  $\text{F}_2\text{O} < \text{H}_2\text{O}$
- (iii)  $\text{SCl}_2 < \text{OCl}_2$  (iv)  $\text{H}_2\text{S} < \text{H}_2\text{O}$
- (v)  $\text{Cl}_2\text{O} < \text{F}_2\text{O}$  (vi)  $\overset{(-)}{\text{C}}\text{H}_3 < \overset{\oplus}{\text{C}}\text{H}_3$
- (vii)  $\text{NH}_3 < \text{CH}_4$  (viii)  $\overset{(-)}{\text{B}}\text{F}_4 < \text{BF}_3$
- (ix)  $\text{SnCl}_2 < \text{HgCl}_2$
28. The maximum number of hydrogen bonds that a molecule of water can have is
29. The experimental value of dipole moment of the HCl is 1.03 D. The length of the H-Cl bond is 1.275 Å. The percentage of ionic character in HCl is x then the value of (x - 10) approximately is
30. In the following four possible Lewis structure of  $\text{XeO}_3$ , the sum of formal charge present on Xe is?
- 

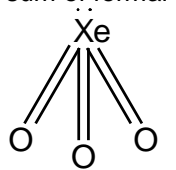
(I)



(II)



(III)



(IV)

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**Space for rough work**

**SECTION 3 (Maximum Marks: 18)**

- \* This section contains **SIX** questions of matching type.
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- \* Based on the table, there are **THREE** questions
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Column 1 (species)		Column 2 (Bond order)		Column 3 (characteristics)	
(I)	$C_2$	(i)	2	(P)	Paramagnetic
(II)	$N_2^+$	(ii)	3	(Q)	Diamagnetic
(III)	$O_2^{2-}$	(iii)	2.5	(R)	Does not exist
(IV)	$N_2$	(iv)	1	(S)	Triple bond and diamagnetic

31. The only CORRECT combination for  $N_2$  is  
 (A) IV, iii, S                      (B) IV, ii, P                      (C) IV, i, S                      (D) IV, ii, S
32. The only CORRECT combination for  $O_2^{2-}$  is  
 (A) III, i, R                      (B) III, iv, Q                      (C) III, iii, P                      (D) III, iv, P
33. The only CORRECT combination for  $C_2$  is  
 (A) I, i, S                      (B) I, iv, P                      (C) I, i, Q                      (D) I, iii, Q

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**Space for rough work**

Column 1 (Ionic species)		Column 2 (Shape)		Column 3 (Hybridisation)	
(I)	$\text{XeF}_5^+$	(i)	Tetrahedral	(P)	$\text{Sp}^2$
(II)	$\text{SiF}_5^-$	(ii)	Square planar	(Q)	$\text{Sp}^3\text{d}^2$
(III)	$\text{AsF}_4^+$	(iii)	Trigonal bipyramidal	(R)	$\text{Sp}^3\text{d}$
(IV)	$\text{CH}_4$	(iv)	Square pyramidal	(S)	$\text{Sp}^3$

34. The only CORRECT combination for  $\text{XeF}_5^+$  is  
 (A) I, ii, Q                      (B) I, iv, Q                      (C) I, iii, Q                      (D) I, iv, R
35. The only CORRECT combination for  $\text{SiF}_5^-$  is  
 (A) II, iii, Q                      (B) II, iii, P                      (C) II, iii, R                      (D) II, iv, R
36. The only CORRECT combination for  $\text{AsF}_4^+$  is  
 (A) III, i, P                      (B) III, ii, S                      (C) III, iv, P                      (D) III, i, S

### PART III: MATHEMATICS

#### SECTION 1 (Maximum Marks: 28)

- \* This section contains **SEVEN** questions.
- \* Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.
- \* For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- \* For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will get +4 marks; darkening only (A) and (D) will get +2 marks; and darkening (A) and (B) will get -2 marks, as a wrong option is also darkened.

37. The system of equation  $x - y \cos \theta + z \cos 2\theta = 0$ ;  $-x \cos \theta + y - z \cos \theta = 0$ ;  $x \cos 2\theta - y \cos \theta + z = 0$  has a non-trivial solution, for  $\theta$  is equal to
- (A)  $\frac{\pi}{3}$                       (B)  $\frac{\pi}{6}$                       (C)  $\frac{2\pi}{3}$                       (D)  $\frac{\pi}{12}$

*Space for rough work*

38. If the system of equations  $x = cy + bz$ ,  $y = az + cx$  and  $z = bx + ay$  have a non-trivial solution, then the value of  $a^2 + b^2 + c^2 + 2abc$  is  
 (A) 1 (B) 0 (C) -1 (D) independent of a, b, c

39. The value of determinant  $\begin{vmatrix} \cos(\theta + \phi) & -\sin(\theta + \phi) & \cos 2\phi \\ \sin \theta & \cos \theta & \sin \phi \\ -\cos \theta & \sin \theta & \cos \phi \end{vmatrix}$  is  
 (A) positive (B) independent of  $\theta$  (C) independent of  $\phi$  (D) none of these

40. If  $\begin{vmatrix} yz - x^2 & zx - y^2 & xy - z^2 \\ xz - y^2 & xy - z^2 & yz - x^2 \\ xy - z^2 & yz - x^2 & zx - y^2 \end{vmatrix} = \begin{vmatrix} r^2 & u^2 & u^2 \\ u^2 & r^2 & u^2 \\ u^2 & u^2 & r^2 \end{vmatrix}$ , then  
 (A)  $r^2 = x + y + z$  (B)  $r^2 = x^2 + y^2 + z^2$  (C)  $u^2 = yz + zx + xy$  (D)  $u^2 = xyz$

41. Let  $\Delta = \begin{vmatrix} \frac{1}{\sin \theta \cos \phi} & \frac{1}{\sin \theta \sin \phi} & \frac{1}{\cos \theta} \\ -\cos \theta & -\cos \theta & \frac{\sin \theta}{\cos^2 \theta} \\ \frac{\sin \phi}{\sin \theta \cos^2 \phi} & \frac{-\cos \phi}{\sin \theta \sin^2 \phi} & 0 \end{vmatrix}$ , then  
 (A)  $\Delta$  is dependent on  $\theta$  (B)  $\Delta$  is dependent on  $\phi$   
 (C)  $\Delta$  is a constant (D) none of these

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**Space for rough work**

42. If  $\begin{vmatrix} x^2 + x & x + 1 & x - 2 \\ 2x^2 + 3x - 1 & 3x & 3x - 3 \\ x^2 + 2x + 3 & 2x - 1 & 2x - 1 \end{vmatrix} = Ax + B$ , where A and B are constants, then  
 (A)  $A + B = 12$  (B)  $A - B = 36$  (C)  $A^2 + B^2 = 720$  (D)  $A + 2B = 0$
43. The determinant  $\Delta = \begin{vmatrix} b & c & b\lambda + c \\ c & d & c\lambda + d \\ b\lambda + c & c\lambda + d & a\lambda^3 + 3c\lambda \end{vmatrix}$  is equal to zero, if  
 (A) b, c, d are in AP (B) b, c, d are in GP  
 (C) b, c, d are in H.P (D)  $\lambda$  is a root of  $ax^3 - bx + cx - d = 0$

### SECTION 2 (Maximum Marks: 15)

- \* This section contains **FIVE** questions.  
 \* The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.  
 \* For each question, darken the bubble corresponding to the correct integer the ORS.

44. If  $x \neq y \neq z$  and  $\begin{vmatrix} x & x^2 & 1 + x^3 \\ y & y^2 & 1 + y^3 \\ z & z^2 & 1 + z^3 \end{vmatrix} = 0$ , then  $3xyz + 4 =$
45. If  $a + b + c = 2s$ , then  $\begin{vmatrix} a^2 & (s-a)^2 & (s-a)^2 \\ (s-b)^2 & b^2 & (s-b)^2 \\ (s-c)^2 & (s-c)^2 & c^2 \end{vmatrix} = \frac{2ks^3(s-a)(s-b)(s-c)}{3}$ , then k is
46. If  $\Delta_r = \begin{vmatrix} x & y & z \\ 2^r & 2 \cdot 3^r & 3 \cdot 4^r \\ 2 \cdot (2^n - 1) & 3 \cdot (3^n - 1) & 4 \cdot (4^n - 1) \end{vmatrix}$ , then the value of  $\frac{1}{2} \left( 3 \sum_{r=1}^n \Delta_r + 8 \right)$  is

*Space for rough work*

47. If  $2ax - 2y + 3z = 0$ ,  $x + ay + 2z = 0$  and  $2x + az = 0$  have a non-trivial solution, then  $a$  is

48. The value of determinant  $\begin{vmatrix} a_1x_1 + b_1y_1 & a_1x_2 + b_1y_2 & a_1x_3 + b_1y_3 \\ a_2x_1 + b_2y_1 & a_2x_2 + b_2y_2 & a_2x_3 + b_2y_3 \\ a_3x_1 + b_3y_1 & a_3x_2 + b_3y_2 & a_3x_3 + b_3y_3 \end{vmatrix}$  is

### SECTION 3 (Maximum Marks: 18)

- \* This section contains **SIX** questions of matching type.
- \* This section contains **TWO** tables (each having 3 columns and 4 rows)
- \* Based on the table, there are **THREE** questions
- \* Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- \* For each question, darken the bubble corresponding to the correct option in the ORS.

49 – 51: By appropriately matching the information given in the three columns of the following table.

Column 1	Column 2	Column 3
(I) $\begin{vmatrix} 1 & a & b+c \\ 1 & b & c+a \\ 1 & c & a+b \end{vmatrix}$	(i) $2abc(a + b + c)^3$	(P) $\begin{vmatrix} 1 & 1 & 1 \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix}$
(II) $\begin{vmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ bc & ca & ab \end{vmatrix}$	(ii) 0	(Q) $\begin{vmatrix} b-c & c-a & a-b \\ c-a & a-b & b-c \\ a-b & b-c & c-a \end{vmatrix}$
(III) $\begin{vmatrix} a+b+c & a & a^2 \\ a+b+c & b & b^2 \\ a+b+c & c & c^2 \end{vmatrix}$	(iii) $(a - b)(b - c)(c - a)(ab + bc + ca)$	(R) $\begin{vmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ b+c & a+c & a+b \end{vmatrix}$
(IV) $\begin{vmatrix} (b+c)^2 & bc & ac \\ ab & (a+c)^2 & bc \\ ac & bc & (a+b)^2 \end{vmatrix}$	(iv) $(a - b)(b - c)(c - a)(a + b + c)$	(S) $\begin{vmatrix} (b+c)^2 & a^2 & a^2 \\ b^2 & (c+a)^2 & b^2 \\ c^2 & c^2 & (a+b)^2 \end{vmatrix}$

49. Which of the following is the **CORRECT** combination ?  
 (A) (III) (iii) (P)      (B) (III) (iv) (S)      (C) (II) (iv) (P)      (D) (II) (iii) (S)
50. Which of the following options is the **CORRECT** combination ?  
 (A) (I) (iii) (Q)      (B) (I) (i) (R)      (C) (II) (iii) (P)      (D) (II) (iv) (P)
51. Which of the following options is the **INCORRECT** combination ?  
 (A) (III) (iii) (P)      (B) (III) (iv) (S)      (C) (I) (ii) (Q)      (D) (IV) (i) (R)

**Space for rough work**

52 – 54: By observing column 1, column 2, column 3 establish the relation and answer to the questions below:

Column 1	Column 2	Column 3
(I) If B is odd ordered matrix such that $BB^T = I$ and $ B  = -1$ , then	(i) $\det(B - I) = -\det(B + I)$	(P) $B - I$ is null matrix
(II) If B is skew symmetric matrix of even order then	(ii) $\det(B - I) = 0$	(Q) $B - I$ has no inverse
(III) If B is skew symmetric matrix of odd order then	(iii) $\det(B - I) = \det(B + I)$	(R) $B - I$ has an inverse only if $B + I$ has inverse
(IV) If A is a non-singular matrix satisfying $AB - BA = A$ , then	(iv) $\det(B - I) = 1$	(S) $B - I$ has no inverse if $B + I$ has no inverse

52. Which of the following is the only **CORRECT** combination ?  
 (A) (I) (ii) (P)      (B) (I) (ii) (Q)      (C) (II) (iii) (Q)      (D) (IV) (i) (P)
53. Which of the following is the only **INCORRECT** combination ?  
 (A) (II) (iii) (R)      (B) (II) (iii) (S)      (C) (III) (i) (R)      (D) none of these
54. Which of the following options is the **INCORRECT** combination ?  
 (A) (III) (i) (S)      (B) (IV) (iii) (R)      (C) (IV) (iii) (S)      (D) none of these

---

**Space for rough work**



# FITJEE RET – 9

(2018 – 2020)(1<sup>ST</sup> YEAR\_REGULAR)

IIT-2017 (P1)\_SET-A

DATE: 03.09.2018

## ANSWERS

### PHYSICS

- |           |            |            |       |
|-----------|------------|------------|-------|
| 1. A, D   | 2. A, B, D | 3. B, C, D | 4. C  |
| 5. A, C   | 6. A, C    | 7. A, B    | 8. 3  |
| 9. 5      | 10. 2      | 11. 3      | 12. 6 |
| 13. C     | 14. B      | 15. D      | 16. D |
| 17. Bonus | 18. Bonus  |            |       |

### CHEMISTRY

- |             |             |             |                |
|-------------|-------------|-------------|----------------|
| 19. A, B, C | 20. A, B, D | 21. A, C, D | 22. A, B, C, D |
| 23. A, D    | 24. A, B    | 25. B, C    | 26. 5          |
| 27. 7       | 28. 4       | 29. 7       | 30. 6          |
| 31. D       | 32. B       | 33. C       | 34. B          |
| 35. C       | 36. D       |             |                |

### MATHEMATICS

- |           |           |                 |        |
|-----------|-----------|-----------------|--------|
| 37. ABCD  | 38. AD    | 39. B           | 40. BC |
| 41. AB    | 42. ABCD  | 43. B           | 44. 1  |
| 45. 3     | 46. Bonus | 47. 2           | 48. 0  |
| 49. Bonus | 50. C     | 51. A or B or D | 52. B  |
| 53. D     | 54. D     |                 |        |

# FIITJEE RET – 9

(2018 – 2020)(1<sup>ST</sup> YEAR\_REGULAR)

IIT-2017 (P1)\_SET-B

DATE: 03.09.2018

Time: 3 hours

Maximum Marks: 183

## INSTRUCTIONS:

### A. General

1. This booklet is your Question Paper containing 54 questions.
6. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are not allowed to be carried inside the examination hall.
7. Fill in the boxes provided for Name and Enrolment No.
8. The answer sheet, a machine-readable Objective Response (ORS), is provided separately.
9. DO NOT TAMPER WITH / MULTILATE THE ORS OR THE BOOKLET.

### B. Filling in the OMR:

6. The instructions for the OMR sheet are given on the OMR itself.

### C. Question paper format & Marking Scheme

7. Each part has three sections as detailed in the following table:

Section	Question Type	Number of Questions	Category wise Marks Each Question				Maximum marks of the section
			Full Marks	Partial Marks	Zero Marks	Negative Marks	
1	One or more correct option (s)	7	<b>+4</b> If only the bubble(s) corresponding to all the correct option(s) is(are) darkened	<b>+1</b> For darkening a bubble corresponding to each correct option, provided <b>NO</b> incorrect option is darkened	<b>0</b> If none of the bubbles is darkened	<b>-2</b> In all other cases	<b>28</b>
2	Single digit integer (0-9)	5	<b>+3</b> If only the bubble corresponding to the correct answer is darkened.	---	<b>0</b> In all other cases	---	<b>15</b>
3	Single correct option	6	<b>+3</b> If only the bubble corresponding to the correct option is darkened	---	<b>0</b> If none of the bubbles is darkened	<b>-1</b> In all other cases	<b>18</b>

**Don't write / mark your answers in this question booklet.**

**If you mark the answers in question booklet, you will not be allowed to continue the exam.**

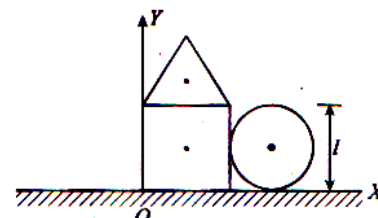
NAME:

ENROLLMENT NO.:

**PAPER-I**  
**PART I: PHYSICS**  
**SECTION 1 (Maximum Marks: 28)**

- \* This section contains **SEVEN** questions.
- \* Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.
- \* For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- \* For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will get +4 marks; darkening only (A) and (D) will get +2 marks; and darkening (A) and (B) will get -2 marks, as a wrong option is also darkened.

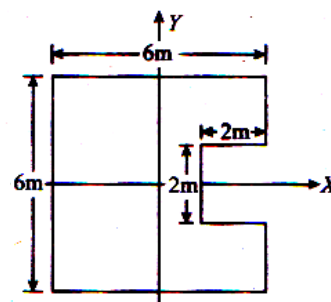
1. Three laminar objects of uniform density a square, a disc and an equilateral triangle are placed as shown in the figure. If centre of mass of the system of three objects is given by  $(x_{cm}, y_{cm})$  then



- (A)  $x_{cm} = \frac{(3\pi + \sqrt{3} + 4)\ell}{2(4 + \pi + \sqrt{3})}$       (B)  $x_{cm} = \frac{(2\pi + \sqrt{3} + 4)\ell}{2(2 + \pi + \sqrt{3})}$
- (C)  $y_{cm} = \frac{(\pi + 2\sqrt{3} + 5)\ell}{2(4 + \pi + \sqrt{3})}$       (D)  $y_{cm} = \frac{(2\pi + \sqrt{3} + 4)\ell}{2(2 + \pi + \sqrt{3})}$

2. X and Y-coordinates of the centre of mass of the plate shown in the figure from which a square of side 2 m is cut out are .....

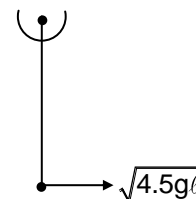
- (A)  $X_{cm} = -0.25$  m      (B)  $X_{cm} = -0.50$  m
- (C)  $Y_{cm} = 0$       (D)  $Y_{cm} = 0.50$  m



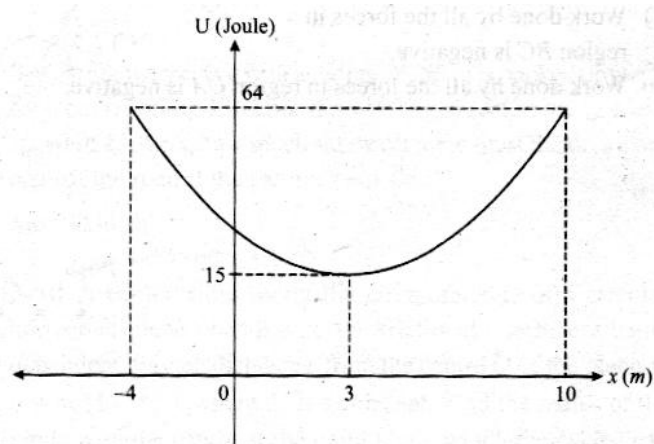
*Space for rough work*

3. A particle of mass  $m$  is attached with a light string of length  $\ell$ . It is free to rotate in a vertical plane (as shown). At the lowermost tip, a velocity of  $\sqrt{4.5g\ell}$  is given. Choose correct options:

- (A) The string will slack at  $\theta = \cos^{-1}\left(\frac{5}{6}\right)$ , ( $\theta$  is the angle made by the string with vertical axis)  
 (B) The maximum tension in the string will be  $5.5 mg$   
 (C) The maximum tension in the string will be  $4.5 mg$   
 (D) The string will slack at  $\theta = \cos^{-1}\left(\frac{1}{2}\right)$  ( $\theta$  is the angle made by the string with vertical axis)



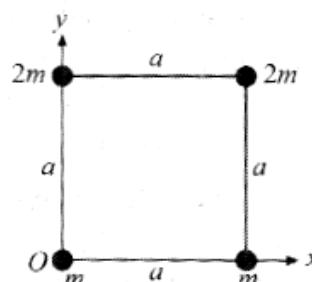
4. A single conservative force  $F(x)$  acts on a particle that moves along the  $x$  - axis. The graph of the potential energy with  $x$  is given. At  $x = 5m$ , the particle has a kinetic energy of  $50 J$  and its potential energy is related to position ' $x$ ' as  $U = 15 + (x - 3)^2$  Joule, where  $x$  is in meter. Then  
 (A) The mechanical energy of system is  $69 J$   
 (B) The mechanical energy of system is  $19 J$   
 (C) At  $x = 3$ , the kinetic energy of particle is minimum  
 (D) The maximum value of kinetic energy is  $54 J$



5. A block of mass  $2 kg$  is hanging over a smooth and light pulley through a light string. The other end of the string is pulled by a constant force  $F = 40 N$ . The kinetic energy of the particle increases  $40 J$  in a given interval of time. Then (Take  $g = 10 m/s^2$ ).  
 (A) Tension in the string is  $40 N$   
 (B) Displacement of the block in the given interval of time is  $2m$   
 (C) Power developed by this force varies linearly with displacement  
 (D) Power developed by this force varies parabolically with displacement.

**Space for rough work**

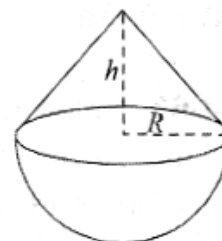
6. A ball of mass  $m$  is attached to the lower end of a light vertical spring of force constant  $k$ . The upper end of the spring is fixed. The ball is released from rest with the spring at its natural length, and comes to momentarily rest after descending through a distance  $x$ . Then  
 (A)  $x = mg/k$   
 (B)  $x = 2 mg /k$   
 (C) The ball will have no acceleration at the position where it has descended through  $x/2$   
 (D) The ball will have an upward acceleration equal to  $g$  at its lowermost position
7. Four particles of masses  $m, m, 2m$  and  $2m$  are placed at the four corners of a square of side  $a$  as shown in figure. The  $(x, y)$  coordinates of the centre of mass are.  
 (A)  $\left(\frac{a}{2}, 2a\right)$                       (B)  $\left(\frac{a}{2}, a\right)$   
 (C)  $\left(\frac{a}{2}, \frac{2a}{3}\right)$                       (D)  $\left(a, \frac{a}{3}\right)$



### SECTION 2 (Maximum Marks: 15)

- \* This section contains **FIVE** questions.
- \* The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- \* For each question, darken the bubble corresponding to the correct integer the ORS.

8. A uniform solid right circular cone of base radius  $R$  is joined to a uniform solid hemisphere of radius  $R$  and of the same density, so as to have a common face. The centre of mass of the composite solid lies on the common face. If the height of the cone is given by  $\sqrt{K_0} R$  then value of  $K_0$  is \_\_\_\_\_.



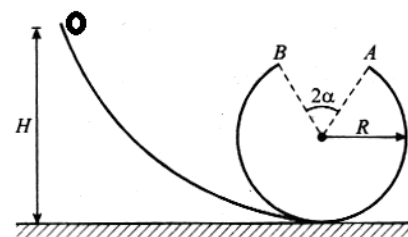
9. If the centre of mass of a non uniform rod of length  $L$  whose mass per unit length  $\rho$  varies as  $\rho = \frac{kx^2}{L}$  where  $k$  is a positive constant and  $x$  is the distance of any point from one end, is given by  $\frac{aL}{8}$  then value of  $a$  is \_\_\_\_\_ (take rod to be placed between  $x = 0$  to  $x = L$ )

**Space for rough work**

10. A small object slides without friction from the height  $H = 50$  cm shown in figure and then loops the vertical loop of radius  $20$  cm from which a symmetrical section of angle  $2\alpha$  has been

removed. If the angle  $\alpha = \frac{\pi}{n}$  is such that after losing contact at

A and flying the air, the object will reach at point B, value of  $n$  is \_\_\_\_\_



11. A smooth rubber cord of length  $\ell$  whose coefficient of elasticity is  $k$  is suspended by one end from the end O as shown in figure. The other end is fitted with a catch B. A small sleeve of mass  $m$  starts from the point O. Neglect the masses of the thread and the catch. All the surface are frictionless. If the maximum

elongation of the cord is  $x_{\max} = \frac{mg}{k} \left( 1 + \sqrt{a + \frac{bk\ell}{mg}} \right)$  then value of

$(a + 2b)$  is \_\_\_\_\_



12. Force acting on a particle is  $(2\hat{i} + 3\hat{j})$  N. Work done by this force is zero, when a particle is moved on the line  $3y + kx = 5$ . Then value of  $k$  is \_\_\_\_\_

**Space for rough work**

## SECTION 3 (Maximum Marks: 18)

- \* This section contains **SIX** questions of matching type.
- \* This section contains **TWO** tables (each having 3 columns and 4 rows)
- \* Based on the table, there are **THREE** questions
- \* Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- \* For each question, darken the bubble corresponding to the correct option in the ORS.

Two blocks I and II are attached with a mass less spring as shown in **Column - 1**. After striking the ground, the speed of Block - II becomes zero instantly. Let  $h$  is the minimum height from where the system must be released, so that Block - II just gets lifted up.

Answer the below questions based on the situations given in **Column - 1**

	Column - 1	Column - 2 Height ( $h$ ) (in SI units)	Column - 3 Speed of <b>Block I</b> corresponding to $h$ , when Block-II just reaches the ground (in SI units)
(I)		(i) $\frac{3mg}{2K}$	(P) $2g\sqrt{\frac{m}{K}}$
(II)		(ii) $\frac{mg}{K}$	(Q) $2g\sqrt{\frac{2m}{K}}$
(III)		(iii) $\frac{4mg}{K}$	(R) $g\sqrt{\frac{2m}{K}}$
(IV)		(iv) $\frac{2mg}{K}$	(S) $g\sqrt{\frac{3m}{K}}$

*Space for rough work*

13. Pick the correct option  
 (A) II → iv → Q      (B) II → iv → P      (C) II → iii → R      (D) none of these
14. Pick the option for maximum work done by the external agent.  
 (A) III → i → P      (B) III → ii → R      (C) III → iv → P      (D) none of these
15. Pick the option for minimum potential energy in the final configuration.  
 (A) IV → i → S      (B) I → i → S      (C) III → iv → P      (D) none of these

Quarter rings are arranged in different orientations in Column 1. Their linear mass density (in kg/m) has been labeled in each case. Each quarter ring is a part of circle of radius R. Origin (O) of the system of quarter rings has been shown. Column 2 gives x-coordinate of centre of mass ( $X_{cm}$ ) and Column 3 gives y-coordinate of centre of mass ( $Y_{cm}$ ) respectively of these arrangements.

Column 1		Column 2 $X_{cm}$		Column 3 $Y_{cm}$	
(I)		(i)	0	(P)	0
(II)		(ii)	$-\frac{R}{\pi}$	(Q)	$-\frac{3R}{\pi}$
(III)		(iii)	$-\frac{4R}{5\pi}$	(R)	$-\frac{4R}{5\pi}$
(IV)	<p>Each arc is a quarter circle having radius R</p>	(iv)	$-\frac{2R}{5\pi}$	(S)	$-\frac{2R}{5\pi}$

*Space for rough work*



16. Which of the following matching is correct?  
 (A) I → ii → R      (B) I → i → S      (C) I → i → R      (D) I → iii → S
17. Which of the following matching is correct?  
 (A) II → iv → P      (B) II → i → S      (C) IV → iii → R      (D) IV → iv → S
18. Which of the following matching is correct?  
 (A) III → ii → S      (B) III → iv → P      (C) III → iii → S      (D) III → ii → P

## PART II: CHEMISTRY

### SECTION 1 (Maximum Marks: 28)

- \* This section contains **SEVEN** questions.
- \* Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.
- \* For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- \* For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will get +4 marks; darkening only (A) and (D) will get +2 marks; and darkening (A) and (B) will get -2 marks, as a wrong option is also darkened.

19. The compound / species in which d – orbital is not involved in central atom hybridization  
 (A)  $\text{POCl}_3$       (B)  $\text{SOF}_4$       (C)  $\text{XeOF}_2$       (D)  $\text{IF}_2^+$
20. Sodium sulphate is soluble in water whereas barium sulphate is sparingly soluble because  
 (A) the hydration energy of sodium sulphate is more than its lattice energy  
 (B) the lattice energy of barium sulphate is more than its hydration energy  
 (C) the lattice energy has no role to play in solubility  
 (D) the hydration energy of sodium sulphate is less than its lattice energy
21. A  $\pi$  - bond can be formed between two  $p_x$  orbitals each having an unpaired electron, if they approach each other along:  
 (A) X-axis      (B) Y-axis      (C) Z-axis      (D) Any direction

***Space for rough work***

22. Which is correct statement  
As the s-character of a hybrid orbitals decreases  
(A) the bond angle decreases (B) the bond strength decreases  
(C) the bond length increases (D) no change in bond length
23. Which is correct  
(A) during  $N_2^+$  formation, one electron is removed from the bonding molecule orbital of  $N_2$ .  
(B) during  $O_2^+$  formation, one electron is removed from the antibonding molecular orbital of  $O_2$ .  
(C) during  $O_2^-$  formation one electron is added the bonding molecule orbital of  $O_2$ .  
(D) during  $CN^-$  formation , one  $e^-$  is added to bonding molecular orbital of CN
24. Which of the following is/are correct relation ?  
(A) bond energy  $\propto$  (polarity of the bond )<sup>1</sup> (B) bond energy  $\propto$  (s-character of hybrid orbital)<sup>-1</sup>  
(C) bond energy  $\propto$  (atomic radius)<sup>-1</sup> (D) bond energy  $\propto$  (bond order)<sup>1</sup>
25. Which of the following is/ are correct statements.  
(A) In ortho nitro phenol intra molecular H-bonding takes place.  
(B) Lower alcohols are soluble in water  
(C) Hydrogen bond is generally formed by polar covalent compounds.  
(D) Hydrogen bond is not formed by non-polar covalent compounds.

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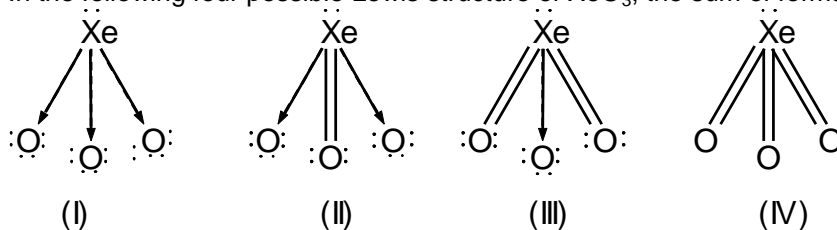
**Space for rough work**

## SECTION 2 (Maximum Marks: 15)

- \* This section contains **FIVE** questions.  
 \* The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.  
 \* For each question, darken the bubble corresponding to the correct integer the ORS.

26. The experimental value of dipole moment of the HCl is 1.03 D. The length of the H-Cl bond is 1.275 Å. The percentage of ionic character in HCl is x then the value of (x - 10) approximately is

27. In the following four possible Lewis structure of XeO<sub>3</sub>, the sum of formal charge present on Xe is?



28. Out of  $\overset{\ominus}{\text{I}}_3, \overset{\ominus}{\text{ICl}}_2, \text{BeCl}_2, \text{XeF}_2, \text{XeF}_6, \text{BrF}_5, \text{HC} \equiv \text{CH}$ . How many will have linear shape?

29. How many of the following is correct regarding bond angle ?

- |  |   |
|--|---|
| (i) $\text{NH}_3 < \text{H}_2\text{O}$         | (ii) $\text{F}_2\text{O} < \text{H}_2\text{O}$                                  |
| (iii) $\text{SCl}_2 < \text{OCl}_2$            | (iv) $\text{H}_2\text{S} < \text{H}_2\text{O}$                                  |
| (v) $\text{Cl}_2\text{O} < \text{F}_2\text{O}$ | (vi) $\overset{(-)}{\text{C}}\text{H}_3 < \overset{\oplus}{\text{C}}\text{H}_3$ |
| (vii) $\text{NH}_3 < \text{CH}_4$              | (viii) $\overset{(-)}{\text{B}}\text{F}_4 < \text{BF}_3$                        |
| (ix) $\text{SnCl}_2 < \text{HgCl}_2$           |   |

30. The maximum number of hydrogen bonds that a molecule of water can have is

**Space for rough work**

**SECTION 3 (Maximum Marks: 18)**

- \* This section contains **SIX** questions of matching type.
- \* This section contains **TWO** tables (each having 3 columns and 4 rows)
- \* Based on the table, there are **THREE** questions
- \* Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- \* For each question, darken the bubble corresponding to the correct option in the ORS.

Column 1 (Ionic species)		Column 2 (Shape)		Column 3 (Hybridisation)	
(I)	$\text{XeF}_5^+$	(i)	Tetrahedral	(P)	$\text{Sp}^2$
(II)	$\text{SiF}_5^-$	(ii)	Square planar	(Q)	$\text{Sp}^3\text{d}^2$
(III)	$\text{AsF}_4^+$	(iii)	Trigonal bipyramidal	(R)	$\text{Sp}^3\text{d}$
(IV)	$\text{CH}_4$	(iv)	Square pyramidal	(S)	$\text{Sp}^3$

31. The only CORRECT combination for  $\text{XeF}_5^+$  is  
 (A) I, ii, Q                      (B) I, iv, Q                      (C) I, iii, Q                      (D) I, iv, R
32. The only CORRECT combination for  $\text{SiF}_5^-$  is  
 (A) II, iii, Q                      (B) II, iii, P                      (C) II, iii, R                      (D) II, iv, R
33. The only CORRECT combination for  $\text{AsF}_4^+$  is  
 (A) III, i, P                      (B) III, ii, S                      (C) III, iv, P                      (D) III, i, S

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**Space for rough work**

Column 1 (species)		Column 2 (Bond order)		Column 3 (characteristics)	
(I)	$C_2$	(i)	2	(P)	Paramagnetic
(II)	$N_2^+$	(ii)	3	(Q)	Diamagnetic
(III)	$O_2^{2-}$	(iii)	2.5	(R)	Does not exist
(IV)	$N_2$	(iv)	1	(S)	Triple bond and diamagnetic

34. The only CORRECT combination for  $N_2$  is  
 (A) IV, iii, S                      (B) IV, ii, P                      (C) IV, i, S                      (D) IV, ii, S
35. The only CORRECT combination for  $O_2^{2-}$  is  
 (A) III, i, R                      (B) III, iv, Q                      (C) III, iii, P                      (D) III, iv, P
36. The only CORRECT combination for  $C_2$  is  
 (A) I, i, S                      (B) I, iv, P                      (C) I, i, Q                      (D) I, iii, Q

## PART III: MATHEMATICS

### SECTION 1 (Maximum Marks: 28)

- \* This section contains **SEVEN** questions.
- \* Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.
- \* For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- \* For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will get +4 marks; darkening only (A) and (D) will get +2 marks; and darkening (A) and (B) will get -2 marks, as a wrong option is also darkened.

37. Let  $\Delta = \begin{vmatrix} \frac{1}{\sin \theta \cos \phi} & \frac{1}{\sin \theta \sin \phi} & \frac{1}{\cos \theta} \\ -\cos \theta & -\cos \theta & \sin \theta \\ \frac{1}{\sin^2 \theta \cos \phi} & \frac{1}{\sin^2 \theta \sin \phi} & \frac{1}{\cos^2 \theta} \\ \frac{\sin \phi}{\sin \theta \cos^2 \phi} & \frac{-\cos \phi}{\sin \theta \sin^2 \phi} & 0 \end{vmatrix}$ , then

- (A)  $\Delta$  is dependent on  $\theta$                       (B)  $\Delta$  is dependent on  $\phi$   
 (C)  $\Delta$  is a constant                      (D) none of these

*Space for rough work*

38. If  $\begin{vmatrix} x^2 + x & x + 1 & x - 2 \\ 2x^2 + 3x - 1 & 3x & 3x - 3 \\ x^2 + 2x + 3 & 2x - 1 & 2x - 1 \end{vmatrix} = Ax + B$ , where A and B are constants, then  
 (A)  $A + B = 12$  (B)  $A - B = 36$  (C)  $A^2 + B^2 = 720$  (D)  $A + 2B = 0$
39. The determinant  $\Delta = \begin{vmatrix} b & c & b\lambda + c \\ c & d & c\lambda + d \\ b\lambda + c & c\lambda + d & a\lambda^3 + 3c\lambda \end{vmatrix}$  is equal to zero, if  
 (A) b, c, d are in AP (B) b, c, d are in GP  
 (C) b, c, d are in H.P (D)  $\lambda$  is a root of  $ax^3 - bx + cx - d = 0$
40. The system of equation  $x - y \cos \theta + z \cos 2\theta = 0$ ;  $-x \cos \theta + y - z \cos \theta = 0$ ;  $x \cos 2\theta - y \cos \theta + z = 0$  has a non-trivial solution, for  $\theta$  is equal to  
 (A)  $\frac{\pi}{3}$  (B)  $\frac{\pi}{6}$  (C)  $\frac{2\pi}{3}$  (D)  $\frac{\pi}{12}$
41. If the system of equations  $x = cy + bz$ ,  $y = az + cx$  and  $z = bx + ay$  have a non-trivial solution, then the value of  $a^2 + b^2 + c^2 + 2abc$  is  
 (A) 1 (B) 0 (C) -1 (D) independent of a, b, c
42. The value of determinant  $\begin{vmatrix} \cos(\theta + \phi) & -\sin(\theta + \phi) & \cos 2\phi \\ \sin \theta & \cos \theta & \sin \phi \\ -\cos \theta & \sin \theta & \cos \phi \end{vmatrix}$  is  
 (A) positive (B) independent of  $\theta$  (C) independent of  $\phi$  (D) none of these
43. If  $\begin{vmatrix} yz - x^2 & zx - y^2 & xy - z^2 \\ xz - y^2 & xy - z^2 & yz - x^2 \\ xy - z^2 & yz - x^2 & zx - y^2 \end{vmatrix} = \begin{vmatrix} r^2 & u^2 & u^2 \\ u^2 & r^2 & u^2 \\ u^2 & u^2 & r^2 \end{vmatrix}$ , then  
 (A)  $r^2 = x + y + z$  (B)  $r^2 = x^2 + y^2 + z^2$  (C)  $u^2 = yz + zx + xy$  (D)  $u^2 = xyz$

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**Space for rough work**

## SECTION 2 (Maximum Marks: 15)

\* This section contains **FIVE** questions.

\* The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.

\* For each question, darken the bubble corresponding to the correct integer the ORS.

44. If  $2ax - 2y + 3z = 0$ ,  $x + ay + 2z = 0$  and  $2x + az = 0$  have a non-trivial solution, then  $a$  is

45. The value of determinant  $\begin{vmatrix} a_1x_1 + b_1y_1 & a_1x_2 + b_1y_2 & a_1x_3 + b_1y_3 \\ a_2x_1 + b_2y_1 & a_2x_2 + b_2y_2 & a_2x_3 + b_2y_3 \\ a_3x_1 + b_3y_1 & a_3x_2 + b_3y_2 & a_3x_3 + b_3y_3 \end{vmatrix}$  is

46. If  $x \neq y \neq z$  and  $\begin{vmatrix} x & x^2 & 1+x^3 \\ y & y^2 & 1+y^3 \\ z & z^2 & 1+z^3 \end{vmatrix} = 0$ , then  $3xyz + 4 =$

47. If  $a + b + c = 2s$ , then  $\begin{vmatrix} a^2 & (s-a)^2 & (s-a)^2 \\ (s-b)^2 & b^2 & (s-b)^2 \\ (s-c)^2 & (s-c)^2 & c^2 \end{vmatrix} = \frac{2ks^3(s-a)(s-b)(s-c)}{3}$ , then  $k$  is

48. If  $\Delta_r = \begin{vmatrix} x & y & z \\ 2^r & 2 \cdot 3^r & 3 \cdot 4^r \\ 2 \cdot (2^n - 1) & 3 \cdot (3^n - 1) & 4 \cdot (4^n - 1) \end{vmatrix}$ , then the value of  $\frac{1}{2} \left( 3 \sum_{r=1}^n \Delta_r + 8 \right)$  is

**Space for rough work**

**SECTION 3 (Maximum Marks: 18)**

- \* This section contains **SIX** questions of matching type.
- \* This section contains **TWO** tables (each having 3 columns and 4 rows)
- \* Based on the table, there are **THREE** questions
- \* Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- \* For each question, darken the bubble corresponding to the correct option in the ORS.

**49 – 51:** By observing column 1, column 2, column 3 establish the relation and answer to the questions below:

Column 1	Column 2	Column 3
(I) If B is odd ordered matrix such that $BB^T = I$ and $ B  = -1$ , then	(i) $\det(B - I) = -\det(B + I)$	(P) $B - I$ is null matrix
(II) If B is skew symmetric matrix of even order then	(ii) $\det(B - I) = 0$	(Q) $B - I$ has no inverse
(III) If B is skew symmetric matrix of odd order then	(iii) $\det(B - I) = \det(B + I)$	(R) $B - I$ has an inverse only if $B + I$ has inverse
(IV) If A is a non-singular matrix satisfying $AB - BA = A$ , then	(iv) $\det(B - I) = 1$	(S) $B - I$ has no inverse if $B + I$ has no inverse

49. Which of the following is the only **CORRECT** combination ?  
 (A) (I) (ii) (P)                      (B) (I) (ii) (Q)                      (C) (II) (iii) (Q)                      (D) (IV) (i) (P)
50. Which of the following is the only **INCORRECT** combination ?  
 (A) (II) (iii) (R)                      (B) (II) (iii) (S)                      (C) (III) (i) (R)                      (D) none of these
51. Which of the following options is the **INCORRECT** combination ?  
 (A) (III) (i) (S)                      (B) (IV) (iii) (R)                      (C) (IV) (iii) (S)                      (D) none of these

**Space for rough work**



52 – 54: By appropriately matching the information given in the three columns of the following table.

Column 1	Column 2	Column 3
(I) $\begin{vmatrix} 1 & a & b+c \\ 1 & b & c+a \\ 1 & c & a+b \end{vmatrix}$	(i) $2abc(a+b+c)^3$	(P) $\begin{vmatrix} 1 & 1 & 1 \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix}$
(II) $\begin{vmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ bc & ca & ab \end{vmatrix}$	(ii) 0	(Q) $\begin{vmatrix} b-c & c-a & a-b \\ c-a & a-b & b-c \\ a-b & b-c & c-a \end{vmatrix}$
(III) $\begin{vmatrix} a+b+c & a & a^2 \\ a+b+c & b & b^2 \\ a+b+c & c & c^2 \end{vmatrix}$	(iii) $(a-b)(b-c)(c-a)(ab+bc+ca)$	(R) $\begin{vmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ b+c & a+c & a+b \end{vmatrix}$
(IV) $\begin{vmatrix} (b+c)^2 & bc & ac \\ ab & (a+c)^2 & bc \\ ac & bc & (a+b)^2 \end{vmatrix}$	(iv) $(a-b)(b-c)(c-a)(a+b+c)$	(S) $\begin{vmatrix} (b+c)^2 & a^2 & a^2 \\ b^2 & (c+a)^2 & b^2 \\ c^2 & c^2 & (a+b)^2 \end{vmatrix}$

52. Which of the following is the **CORRECT** combination ?  
 (A) (III) (iii) (P)      (B) (III) (iv) (S)      (C) (II) (iv) (P)      (D) (II) (iii) (S)
53. Which of the following options is the **CORRECT** combination ?  
 (A) (I) (iii) (Q)      (B) (I) (i) (R)      (C) (II) (iii) (P)      (D) (II) (iv) (P)
54. Which of the following options is the **INCORRECT** combination ?  
 (A) (III) (iii) (P)      (B) (III) (iv) (S)      (C) (I) (ii) (Q)      (D) (IV) (i) (R)

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**Space for rough work**

# FITJEE RET – 9

(2018 – 2020)(1<sup>ST</sup> YEAR\_REGULAR)

IIT-2017 (P1)\_SET-B

DATE: 03.09.2018

## ANSWERS

### PHYSICS

- |            |            |           |         |
|------------|------------|-----------|---------|
| 1. A, C    | 2. A, C    | 3. A, B   | 4. A, D |
| 5. A, B, D | 6. B, C, D | 7. C      | 8. 3    |
| 9. 6       | 10. 3      | 11. 5     | 12. 2   |
| 13. D      | 14. Bonus  | 15. Bonus | 16. C   |
| 17. B      | 18. D      |           |         |

### CHEMISTRY

- |             |             |                |             |
|-------------|-------------|----------------|-------------|
| 19. A, D    | 20. A, B    | 21. B, C       | 22. A, B, C |
| 23. A, B, D | 24. A, C, D | 25. A, B, C, D | 26. 7       |
| 27. 6       | 28. 5       | 29. 7          | 30. 4       |
| 31. B       | 32. C       | 33. D          | 34. D       |
| 35. B       | 36. C       |                |             |

### MATHEMATICS

- |        |                 |        |           |
|--------|-----------------|--------|-----------|
| 37. AB | 38. ABCD        | 39. B  | 40. ABCD  |
| 41. AD | 42. B           | 43. BC | 44. 2     |
| 45. 0  | 46. 1           | 47. 3  | 48. Bonus |
| 49. B  | 50. D           | 51. D  | 52. Bonus |
| 53. C  | 54. A or B or D |        |           |