THINK IIT THINK

VMC Vidyamandir Classes SINCE 1986

SAMPLE PAPERS

NAT National Admission Test

JEE
(MAIN & ADVANCED)

For **Students**

Going to Class 12th

1 Year Program

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VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

Sample Paper – 1 Year JEE Program

NATIONAL ADMISSION TEST

Duration: 2.5 Hrs **Maximum Marks: 240**

PAPER SCHEME:

- The paper contains 60 Objective Type Questions divided into three sections: **Section - I (Chemistry), Section - II (Physics) and Section - III (Mathematics)**.
- Each section contains **25 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE is correct**.

MARKING SCHEME:

- For each question in Section-I, II and III, **4 marks** will be awarded for correct answer and **–1 negative marking** for incorrect answer.

GENERAL INSTRUCTIONS:

- For answering a question, an **ANSWER SHEET (OMR SHEET)** is provided separately. Please fill your **Name, Roll Number, Seat ID, Date of Birth** and the **PAPER CODE** properly in the space provided in the **ANSWER SHEET.** IT IS YOUR OWN RESPONSIBILITY TO FILL THE OMR SHEET CORRECTLY.
- The use of log tables, calculator and any other electronic device is strictly prohibited.
- Violating the examination room discipline will immediately lead to the cancellation of your paper and no excuses will be entertained.
- No one will be permitted to leave the examination hall before the end of the test.
- Please submit both the question paper and the answer sheet to the invigilator before leaving the examination hall.

SUGGESTIONS:

- *Before starting the paper, spend 2-2.5 minutes to check whether all the pages are in order and report any issue to the invigilator immediately.*
- Try to attempt the Sections in their respective order.
- Do not get stuck on a particular question for more than 2-2.5 minutes. Move on to a new question as there are 60 questions to solve.

SECTION - I [CHEMISTRY]

1. Which of the following gas will have molar volume greater than the molar volume of an ideal gas at 4 atm and 273 K ?

(A) H_2 **(B)** CH_4 **(C)** CO_2 **(D)** NH_3

2. Which of the following contains ionic bond, covalent bond and a co-ordinate bond ?

(A) Na_2O_2 **(B)** NH_4Cl **(C)** NaCl **(D)** CH_3COOH

3. The compressibility factor for a real gas at high pressure is :

(A) $1+\frac{RT}{Pb}$ **(B)** 1 **(C)** $1+\frac{Pb}{RT}$ **(D)** $1-\frac{Pb}{RT}$

4. Ionization energy of hydrogen like species Be^{3+} is :

(A) $16R_H \cdot hc$ **(B)** $9R_H \cdot hc$ **(C)** $4R_H \cdot hc$ **(D)** $2R_H \cdot hc$

5. The elements X (atomic mass = 75) and Y (atomic mass = 16) combine to give a compound having 75.75% of X. The formula of the compound is :

(A) XY **(B)** X_2Y **(C)** X_2Y_2 **(D)** X_2Y_3

6. Which of the following orbital is represented by quantum number $\ell = 2$ and m = 0 ?

(A) d_{xy} **(B)** $d_{x^2-y^2}$ **(C)** d_{z^2} **(D)** d_{zx}

7. Which of the following statements regarding kinetic theory of gases is INCORRECT ?

(A) All gas particles are in a state of continuous motion
(B) The molecular interactions are not present
(C) Intermolecular collisions are responsible for pressure
(D) Volume of gas particles is negligible

8. If a balloon filled with CO is pierced and kept in a tank filled with N_2 gas at same P and T, the volume of balloon will :

(A) Increase **(B)** Decrease **(C)** Remain same **(D)** Can't say

9. 0.1 M HCl and 0.2 M H_2SO_4 solutions are mixed in equal volume. This solution is diluted to double the volume. 20 ml of this diluted solution can neutralise *x* ml of 0.1 M NaOH solution. Find *x*.

(A) 20 ml **(B)** 40 ml **(C)** 50 ml **(D)** 25 ml

10. At Boyle's temperature:

(A) Ratio of molar volume of a real gas and an ideal gas is unity
(B) Intermolecular forces are negligible
(C) Gas can't be liquefied
(D) All of the above

11. O_2 is oxidised to $O_2^{\oplus}$. The change in bond order of $O-O$ bond is equal to :

(A) 2.5 **(B)** 0.5 **(C)** 1 **(D)** 2

12. Normality of 0.2M $Ca_3(PO_4)_2$ solution is :

(A) 0.2 N **(B)** 0.6 N **(C)** 0.8 N **(D)** 1.2 N

13. In which of the following case, would the probability of finding an electron residing in a d_{xy} orbital be zero ?

(A) xy and yz plane **(B)** xy and xz planes

(C) xz and yz planes **(D)** z-direction, yz and xz planes

14. Suppose 10^{-17} J of energy is needed by interior of human eye to see an object. How many photons of green light (λ = 550 nm) are needed to generate this minimum amount of energy ?

(A) 14 **(B)** 28 **(C)** 39 **(D)** 42

15. Of the following transition in hydrogen atom the one which gives an absorption line of lowest frequency is :

(A) n = 1 to n = 2 **(B)** n = 3 to n = 8 **(C)** n = 2 to n = 1 **(D)** n = 8 to n = 3

16. Orbital angular momentum for an electron in 2s orbital is :

(A) 0 **(B)** $\frac{h}{2\pi}$ **(C)** $\sqrt{6}\frac{h}{2\pi}$ **(D)** $\sqrt{2}\frac{h}{2\pi}$

17. Which set is expected to show the smallest difference in first ionisation energy ?

(A) He, Ne, Ar **(B)** B, N, O

(C) Mg, Mg^+, Mg^{2+} **(D)** Fe, Co, Ni

18. Alkali metals are powerful reducing agents because :

(A) These are metals **(B)** Their ionic radii are large

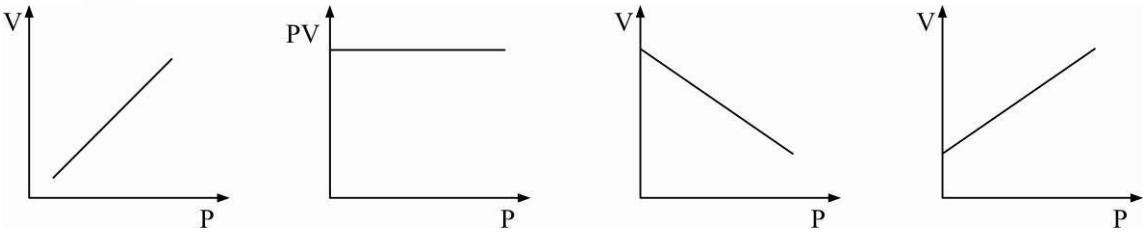
(C) These are monovalent **(D)** Their ionisation potential is low

19. The shape of $XeOF_2$ is :

(A) Trigonal planar **(B)** Trigonal pyramidal

(C) T-shaped **(D)** Square planar

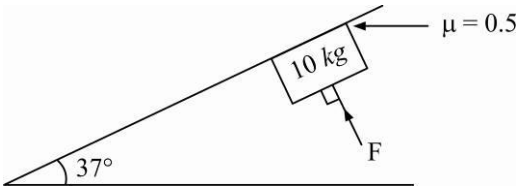
20. Which of the following graphs represent Boyle's law ?



(A) **(B)** **(C)** **(D)**

SECTION - II [PHYSICS]

21. In the figure shown, the minimum force F to be applied perpendicular to the incline so that the block does not slide is :



(A) 0 **(B)** 40 N
(C) 120 N **(D)** 200 N

22. $\vec{A}$ and $\vec{B}$ are two vectors such that their resultant is perpendicular to $\vec{A}$ and in magnitude equal to A. Find the magnitude of vector $\vec{B}$.

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

23. A particle is moving eastward with a velocity of $5\,ms^{-1}$. If in 10s the velocity changes to $5\,ms^{-1}$ northwards, what is the average acceleration in this time ?

(A) $1/\sqrt{2}ms^{-2}$ North - West **(B)** $1/2ms^{-2}$ East - North
(C) $\sqrt{2}ms^{-2}$ North - West **(D)** $2\sqrt{2}ms^{-2}$ North - West

24. A particle moves with a deceleration proportional to $\sqrt{v}$. Initial velocity is v_0. Find the time after which it will stop. [Given 'k' is constant of proportionality]

(A) $\frac{\sqrt{v_0}}{k}$ **(B)** $\frac{\sqrt{v_0}}{2k}$ **(C)** $\frac{2\sqrt{v_0}}{k}$ **(D)** $\frac{v_0}{k}$

25. A particle has an initial velocity of 9 m/s due east and a constant acceleration of $2m/s^2$ due west. The distance covered by the particle in the 5th second of its motion is :

(A) Zero **(B)** 0.5 m **(C)** 2 m **(D)** None

26. A particle is projected from a horizontal plane with speed u at some angle. At highest point its velocity is found to be $u/2$. The maximum height of the projectile will be:

(A) $\frac{u^2}{4g}$ **(B)** $\frac{3u^2}{4g}$ **(C)** $\frac{3u^2}{8g}$ **(D)** $\frac{u^2}{8g}$

27. If the angle of projection of a particle from the horizontal is doubled keeping the speed of projection same, the particle strikes the same target on the ground, then the ratio of time of flight in the two cases will be :

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

28. Two bodies of mass 10 kg and 5 kg moving in concentric orbits of radii R and r such that their periods are same. Then the ratio between their centripetal accelerations is :

(A) R/r **(B)** r/R **(C)** R^3/r^3 **(D)** r^3/R^3

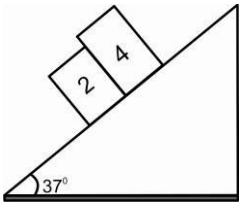
29. A bus is going south with a speed of 5 m/s. To a man sitting in the bus, a car appears to move towards west with a speed of $2\sqrt{6}\,m/s$. What is the actual speed of the car ?

(A) $4ms^{-1}$ **(B)** $3ms^{-1}$ **(C)** $7ms^{-1}$ **(D)** $6ms^{-1}$

30. Rain is falling vertically with a velocity of $25ms^{-1}$. A person rides a bicycle with a speed of $10ms^{-1}$ in the north to south direction. What is the direction (angle with vertical) in which he should hold his umbrella to save himself from the rain ?

(A) $tan^{-1}0.4$ **(B)** $tan^{-1}1$ **(C)** $tan^{-1}\sqrt{3}$ **(D)** $tan^{-1}2.6$

31. In the figure shown, the wedge is fixed and the masses are released from rest. The coefficient of friction between 4 *kg* and wedge is 0.8 and between 2 *kg* and wedge is 0.6. Which of the following statement is(are) correct ?



(A) $\vec{a}$ of blocks must be same

(B) Friction force on 4 *kg* is 24 *N*

(C) Friction force on 2 *kg* is 12 *N*

(D) Normal reactions between block is non-zero

32. Consider the following statement. When jumping from a height, you should bend your knees as you come to rest on ground, instead of keeping your legs stiff. Which of the following relations can be best used in explaining this statement?

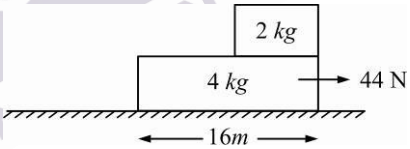
(A) $\Delta p_1 = -\Delta p_2$ **(B)** $\Delta E = -\Delta(PE + KE) = 0$

(C) $F\,\Delta t = m\Delta v$ **(D)** $\Delta x \propto \Delta F$

33. Natural length of a massless spring (of spring constant k) is x. It is slowly stretched by applying an external force. What is the work done in slowly stretching it from length $3x$ to $4x$?

(A) $1.5kx^2$ **(B)** $2.5kx^2$ **(C)** $3.5kx^2$ **(D)** $4.5kx^2$

34. A block of negligible size and mass 2kg is placed above a plank of mass 4kg and length 16m as shown in figure. A force of 44*N* is applied on the lower block as shown in the figure. The ground is smooth, coefficient of friction between upper and lower block is 0.2. Find the time after which the upper block will fall over.



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

35. Kinetic energy of a particle moving in a straight line varies with time t as $K = 4t^2$. The force acting on the particle:

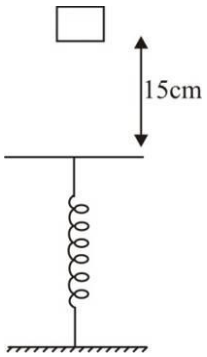
(A) is constant **(B)** is increasing

(C) is decreasing **(D)** first increases and then decreases

36. A block is placed in an elevator moving down with a constant speed. Work done by normal force on the block is:

(A) Zero **(B)** Positive **(C)** Negative **(D)** Cannot say

37. A block of mass 4kg at rest falls, on a spring from a height of 15cm. If spring constant is 2000 N/m, maximum compression in spring will be :



(A) 14cm

(B) 18.2cm

(C) 12.6cm

(D) 10cm

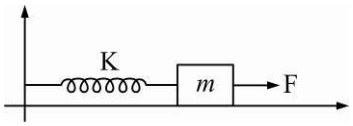
38. A bullet when fired at a target has its velocity decreased to 50% after penetrating 30cm into it. Additional thickness it will penetrate, before coming to rest is : (Assume target applies constant resistive force on bullet)

(A) 10cm **(B)** 30cm **(C)** 40cm **(D)** 60cm

39. A block of mass *m* is connected to a spring of force constant *K*. Initially the block is at rest and the spring is in its natural state. A constant force *F* is applied horizontally towards right. The maximum speed of the block will be : (All surfaces are frictionless)

(A) $\frac{F}{\sqrt{mK}}$ **(B)** $\frac{\sqrt{2}F}{\sqrt{mK}}$

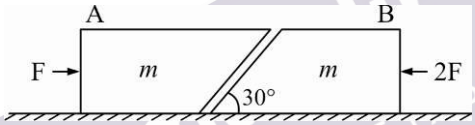
(C) $\frac{F}{\sqrt{2mK}}$ **(D)** $\frac{2F}{\sqrt{mK}}$



40. Two blocks *A* and *B* each of mass *m* are placed on a smooth horizontal surface. Two horizontal forces *F* and 2*F* are applied on the blocks *A* and *B* respectively as shown in figure. The block *A* does not slide on block *B*. Then the normal reaction acting between the two blocks is : (Assume no friction between the blocks)

(A) *F* **(B)** $\frac{F}{2}$

(C) $\frac{F}{\sqrt{3}}$ **(D)** 3*F*



SECTION - III [MATHEMATICS]

41. If $Z_1 \neq 0$ and Z_2 be two complex numbers such that $\frac{Z_2}{Z_1}$ is a purely imaginary number, then $\left|\frac{2Z_1+3Z_2}{2Z_1-3Z_2}\right|$ is equal to :

(A) 2 **(B)** 5 **(C)** 3 **(D)** 1

42. If $z_r = cos\frac{r\alpha}{n^2} + i\,sin\frac{r\alpha}{n^2}$, where $r = 1, 2, 3, \ldots, n$, then $\lim_{n\to\infty} z_1.z_2.\ldots\ldots z_n$ is equal to :

(A) $cos\,\alpha + i\,sin\,\alpha$ **(B)** $cos\left(\frac{\alpha}{2}\right) - i\,sin\left(\frac{\alpha}{2}\right)$

(C) $e^{i\alpha/2}$ **(D)** $3\sqrt{e^{i\alpha}}$

43. Given that, $(1+tan\,1°)(1+tan\,2°)\ldots\ldots(1+tan\,45°) = 2^{\lambda}$, then $(\lambda+1)$ is divisible by :

(A) 2 **(B)** 5 **(C)** 7 **(D)** 9

44. Let α, β be the roots of the quadratic equation $ax^2 + bx + c = 0$, then the roots of the equation $a(x+1)^2 + b(x+1)(x-2) + c(x-2)^2 = 0$ are :

(A) $\frac{2\alpha+1}{\alpha-1}, \frac{2\beta+1}{\beta-1}$ **(B)** $\frac{2\alpha-1}{\alpha+1}, \frac{2\beta-1}{\beta+1}$ **(C)** $\frac{\alpha+1}{\alpha-2}, \frac{\beta+1}{\beta-2}$ **(D)** $\frac{2\alpha+3}{\alpha-1}, \frac{2\beta+3}{\beta-1}$

45. The value of $x^{1/2}.x^{1/4}.x^{1/8}\ldots\ldots$ upto infinity is :

(A) x^3 **(B)** x^2 **(C)** x **(D)** x^{-1}

46. $\sum_{i=1}^{\infty}\sum_{j=1}^{\infty}\sum_{k=1}^{\infty}\frac{1}{a^{i+j+k}}$ is equal to, where $|a| > 1$:

(A) $(a-1)^{-3}$ **(B)** $\frac{3}{a-1}$ **(C)** $\frac{1}{a^3-1}$ **(D)** None of these

47. If A and G are arithmetic mean (AM) and geometric mean (GM) between two numbers a and b, then roots of the equation : $x^2 - 2Ax + G^2 = 0$ are :

(A) $a, 2b$ **(B)** $2a, b$ **(C)** a, b **(D)** $2a, 2b$

48. The sum of the series $\frac{1}{1.4} + \frac{1}{4.7} + \frac{1}{7.10} + \ldots\ldots$ to n terms is :

(A) $\frac{1}{3n-1}$ **(B)** $\frac{n}{3n+1}$ **(C)** $\frac{n}{3n-1}$ **(D)** $\frac{1}{3n+1}$

49. The number of solutions of $\cos x + \cos 2x + \cos 4x = 0$, where $0 \le x \le \pi$ are :

(A) 2 **(B)** 3 **(C)** 4 **(D)** 5

50. Let P be the relation defined on the set of all real numbers such that :

$P = \{(a, b) : \sec^2 a - \tan^2 b = 1\}$. Then P is :

(A) reflexive and symmetric but not transitive
(B) reflexive and transitive but not symmetric
(C) symmetric and transitive but not reflective
(D) an equivalence relation

51. A relation on the set $A = \{x : |x| < 3, x \in Z\}$, where Z is the set of integers is defined by $R = \{(x, y) : y = |x|, x \ne -1\}$. Then the number of elements in the power set of R is :

(A) 64 **(B)** 8 **(C)** 16 **(D)** 32

52. Let $A = \{1, 2, 3, 4\}$ and $R : A \to A$ be the relation defined by : $R = \{(1,1), (2,3), (3,4), (4,2)\}$. The correct statement is :

(A) R does not have an inverse **(B)** R is not a one to one function
(C) R is an onto function **(D)** R is not a function

53. Let $R = \{(3,3), (5,5), (9,9), (12,12), (5,12), (3,9), (3,12), (3,5)\}$ be a relation on the set $A = \{3, 5, 9, 12\}$. Then, R is :

(A) reflexive, symmetric but not transitive **(B)** symmetric, transitive but not reflexive
(C) an equivalence relation **(D)** reflexive, transitive but not symmetric

54. If $X = \{(4^n - 3n - 1 : n \in N)\}$ and $Y = \{9(n-1) : n \in N\}$, when N is the set of natural numbers, then $X \cup Y$ is equal to :

(A) $Y - X$ **(B)** X **(C)** Y **(D)** N

55. If sum of an infinite GP is S_1 and sum of the squares of the infinite terms of same G.P. is S_2 then common ratio is given by :

(A) $\frac{S_1 - S_2}{S_1 + S_2}$ **(B)** $\frac{S_1^2 + S_2}{S_1^2 - S_2}$ **(C)** $\frac{S_1^2 - S_2}{S_1^2 + S_2}$ **(D)** $\frac{S_1^2 - S_2^2}{S_1^2 + S_2^2}$

56. $2 + 5x + 10x^2 + 17x^3 + 26x^4 + \ldots\ldots$ upto infinite terms is $(-1 < x < 1, x \ne 0)$

(A) $\frac{1 - x + x^2}{(1-x)^3}$ **(B)** $\frac{2 + x + x^2}{(1-x)^3}$ **(C)** $\frac{2 - x - x^2}{(1-x)^3}$ **(D)** $\frac{2 - x + x^2}{(1-x)^3}$

57. If $\frac{\sin^4 x}{2}+\frac{\cos^4 x}{3}=\frac{1}{5}$ then which of the following is not true :

(A) $\tan^2 x=\frac{2}{3}$ **(B)** $\frac{\sin^8 x}{8}+\frac{\cos^8 x}{27}=\frac{1}{125}$

(C) $\cos 2x=\frac{5}{13}$ **(D)** $\sin^2 3x=\frac{98}{125}$

58. Let $f_k(x)=\frac{1}{k}\left(\sin^k x+\cos^k x\right)$ where $x\in R, k\geq 1$ then $f_4(x)-f_6(x)=$

(A) $\frac{1}{4}$ **(B)** $\frac{1}{12}$ **(C)** $\frac{1}{6}$ **(D)** $\frac{1}{3}$

59. Complete general solution of the equation $\sin(2x).\sec(3x)=1$ is :

(A) $\frac{2n\pi}{5}+\frac{\pi}{10}$ or $(4n-1)\frac{\pi}{2}, n\in I$ **(B)** $\frac{2n\pi}{5}+\frac{\pi}{10}, n\in I$

(C) $\frac{2n\pi}{5}+\frac{\pi}{10}, n\in I-\{5k+1: k\in I\}$ **(D)** $\frac{2n\pi}{5}+\frac{\pi}{10}$ or $2n\pi, n\in I$

60. Sum of values of p such that $3x^2-2x+p=0$ and $6x^2-17x+12=0$ have a common root is :

(A) $\frac{77}{12}$ **(B)** $-\frac{77}{12}$ **(C)** $\frac{13}{12}$ **(D)** $-\frac{13}{12}$

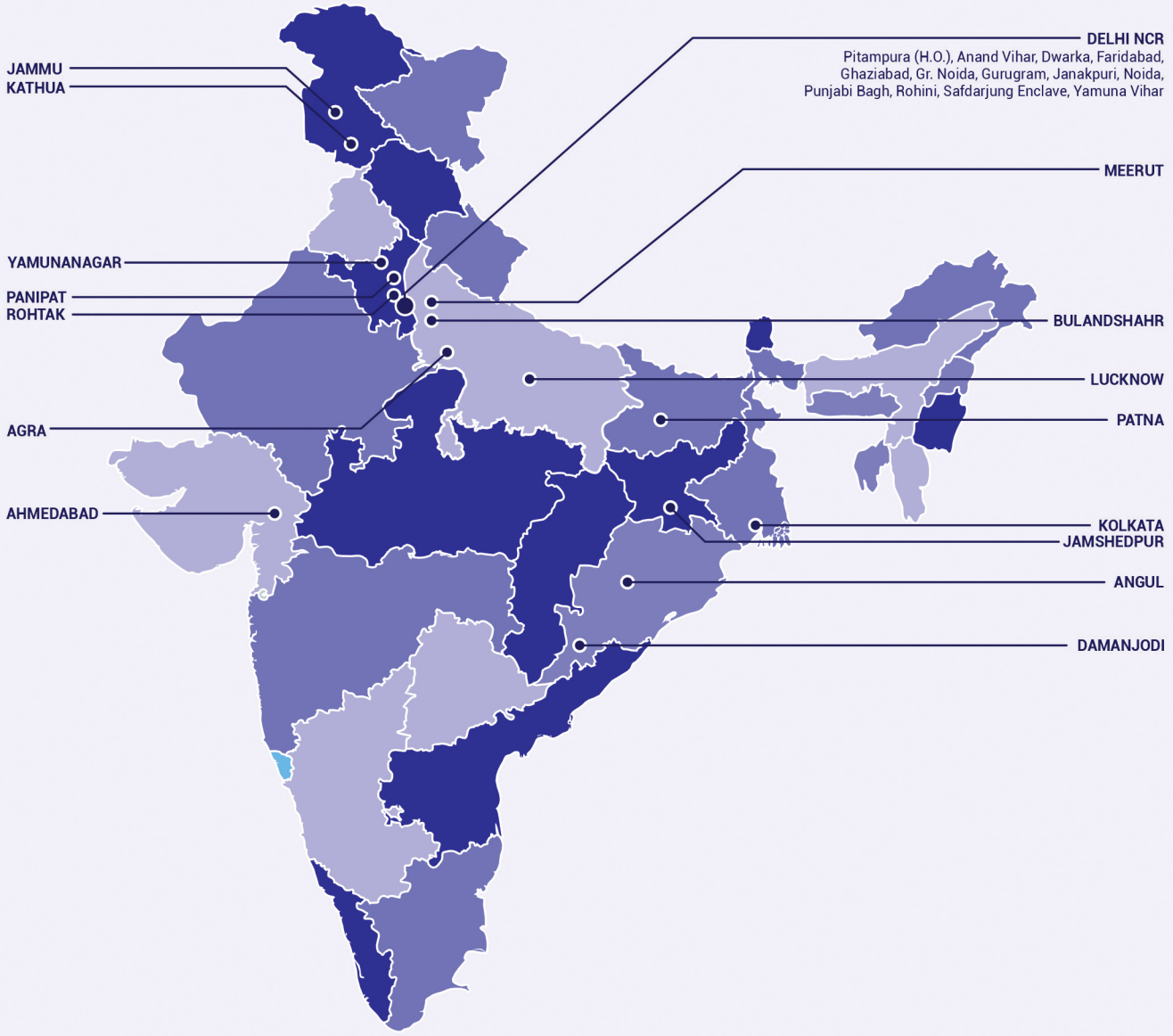
End of NAT Sample Paper | 1 Year JEE

1 Year JEE Sample Paper | Answer Key

Code - A	Code - A_Answer Key	Code A difficulty	Code-A subject	Code-A Topic	Code-A Skill	Code-A +ve marks	Code-A -ve marks
1	A	Medium	Chemistry	States of Matter	Conceptual	4	1
2	B	Easy	Chemistry	Chemical Bonding	Conceptual	4	1
3	C	Medium	Chemistry	States of Matter	Calculation	4	1
4	A	Medium	Chemistry	Atomic Structure	Calculation	4	1
5	D	Easy	Chemistry	Stoichiometry	Calculation	4	1
6	C	Easy	Chemistry	Atomic Structure	Memory	4	1
7	C	Easy	Chemistry	States of Matter	Memory	4	1
8	C	Easy	Chemistry	States of Matter	Conceptual	4	1
9	D	Easy	Chemistry	Stoichiometry	Calculation	4	1
10	D	Difficult	Chemistry	States of Matter	Conceptual	4	1
11	B	Easy	Chemistry	Chemical Bonding	Calculation	4	1
12	D	Easy	Chemistry	Stoichiometry	Calculation	4	1
13	C	Medium	Chemistry	Atomic Structure	Application	4	1
14	B	Medium	Chemistry	Atomic Structure	Calculation	4	1
15	B	Easy	Chemistry	Atomic Structure	Application	4	1
16	A	Easy	Chemistry	Atomic Structure	Calculation	4	1
17	D	Medium	Chemistry	Periodic Classification	Memory	4	1
18	D	Easy	Chemistry	Periodic Classification	Application	4	1
19	C	Easy	Chemistry	Chemical Bonding	Memory	4	1
20	B	Easy	Chemistry	States of Matter	Conceptual	4	1
21	D	Medium	Physics	Introduction to Vectors and Forces	Conceptual	4	1
22	C	Easy	Physics	Vectors	Application	4	1
23	A	Easy	Physics	Kinematics	Conceptual	4	1
24	C	Medium	Physics	Kinematics	Calculation	4	1
25	B	Easy	Physics	Kinematics	Calculation	4	1
26	C	Easy	Physics	Motion in 2D	Conceptual	4	1
27	D	Easy	Physics	Motion in 2D	Conceptual	4	1
28	A	Easy	Physics	Motion in 2D	Conceptual	4	1
29	C	Medium	Physics	Introduction to Vectors and Forces	Calculation	4	1
30	A	Difficult	Physics	Introduction to Vectors and Forces	Conceptual	4	1
31	B	Medium	Physics	Dynamics	Conceptual	4	1
32	C	Easy	Physics	Dynamics	Memory	4	1
33	C	Easy	Physics	Energy and Momentum	Conceptual	4	1
34	B	Medium	Physics	Dynamics	Calculation	4	1
35	A	Medium	Physics	Energy and Momentum	Conceptual	4	1
36	C	Easy	Physics	Energy and Momentum	Memory	4	1
37	D	Easy	Physics	Energy and Momentum	Conceptual	4	1
38	A	Easy	Physics	Energy and Momentum	Calculation	4	1
39	A	Difficult	Physics	Dynamics	Conceptual	4	1
40	D	Easy	Physics	Dynamics	Conceptual	4	1
41	D	Easy	Mathematics	Complex Number	Conceptual	4	1
42	C	Easy	Mathematics	Complex Number	Conceptual	4	1
43	A	Medium	Mathematics	Trigonometry	Application	4	1
44	A	Medium	Mathematics	Quadratic Equation	Application	4	1
45	C	Easy	Mathematics	Sequence and Series	Conceptual	4	1

46	A	Easy	Mathematics	Sequence and Series	Conceptual	4	1
47	C	Easy	Mathematics	Sequence and Series	Conceptual	4	1
48	B	Easy	Mathematics	Sequence and Series	Application	4	1
49	C	Easy	Mathematics	Trigonometry	Conceptual	4	1
50	D	Medium	Mathematics	Trigonometry	Application	4	1
51	C	Easy	Mathematics	Sets	Conceptual	4	1
52	C	Easy	Mathematics	Sets	Conceptual	4	1
53	D	Easy	Mathematics	Sets	Conceptual	4	1
54	C	Easy	Mathematics	Sets	Conceptual	4	1
55	C	Easy	Mathematics	Sequence and Series	Application	4	1
56	D	Medium	Mathematics	Sequence and Series	Application	4	1
57	C	Medium	Mathematics	Trigonometry	Application	4	1
58	B	Medium	Mathematics	Trigonometry	Application	4	1
59	C	Medium	Mathematics	Trigonometry	Application	4	1
60	B	Easy	Mathematics	Quadratic Equation	Application	4	1

VMC CENTRES ACROSS INDIA



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