

BRC INSTITUTE

JEE MAINS / ADVANCE ENTRANCE EXAM.S

TEST - 2

M.M. 300

TIME - 3HRS

PHYSICS - FULL SYLLABUS

CHEMISTRY - FULL SYLLABUS

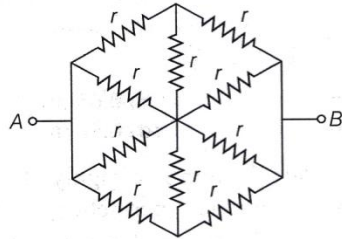
MATHEMATICS - FULL SYLLABUS

PHYSICS

1. A radio wave with frequency 150 MHz propagates through free space in the positive z -direction. At a certain instant and position, the electric field is measured as $\mathbf{E} = 12.0\hat{y}$ V/m. What is the magnetic field vector \mathbf{B} at this same instant and position?

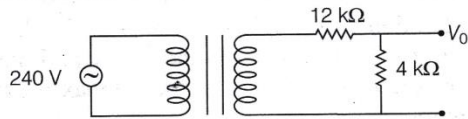
- (a) $-4.0 \times 10^{-8} \hat{x}$ T (b) $4.0 \times 10^{-7} \hat{x}$ T
(c) $-12.0 \times 10^{-8} \hat{x}$ T (d) $2.0 \times 10^{-7} \hat{x}$ T

2. The resistance of hexagon circuit between A and B represented in figure is (Take, resistance of each resistor 1Ω)



- (a) 1Ω (b) 0.5Ω (c) 2Ω (d) 3Ω

3. A step-down transformer is connected to a 240 V AC supply. The number of turns in the primary coil is 120 and the secondary coil has 30 turns. The output from the secondary coil is passed through two resistors connected in series one of $12\text{ k}\Omega$ and the other of $4\text{ k}\Omega$. What will be the voltage across the $4\text{ k}\Omega$ resistor?



- (a) 15 V (b) 20 V (c) 17 V (d) 22 V

4. In a micrometer screw gauge, rotating the thimble through 8 complete revolutions causes it to advance 2 mm along the main scale. If the circular scale contains 50 equal divisions, what is the least count

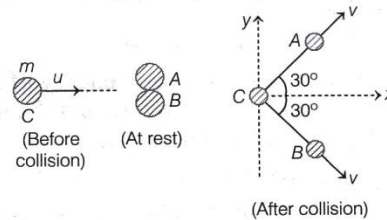
of this instrument?

- (a) 0.005 mm (b) 0.0025 cm
(c) 0.0005 cm (d) 0.05 mm

5. In the Bohr model of a hydrogen-like atom (atomic number Z), the kinetic energy of the electron depends on the principal quantum number n as

- (a) $K \propto n^2$ (b) $K \propto 1/n^2$
(c) $K \propto 1/n^4$ (d) $K \propto Z^2/n$

6. A billiard ball C of mass m moving with velocity u collides two identical balls A and B in contact and at rest. After the collision, ball C is stopped dead and balls A and B move along directions shown in figure with the same speed v . Then,



- (a) $v = \frac{u}{\sqrt{3}}$ (b) $v = \frac{u}{\sqrt{2}}$
(c) loss in KE = $\frac{1}{3}mu^2$ (d) loss in KE = $\frac{1}{8}mu^2$

7. A spherical droplet of water has a radius R . It is divided into 8 identical smaller droplets. The total work required for this process is 6 J. What will be the total work done to divide the same original droplet into 27 equal-sized smaller droplets?

- (a) 9 J (b) 10 J (c) 12 J (d) 13.5 J

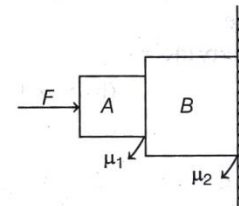
8. Two blocks A and B of masses 1 kg and 2 kg are being pressed against a wall by a force F as shown in the figure below. If the coefficient of friction between the blocks is 0.15 and the wall is 0.2, then the frictional force applied by the wall on the block B is

- (a) 20 N

- (b) 30 N

- (c) 50 N

- (d) 40 N



9. Given below are two statements.

Statement I The most probable speed of gas molecules is always less than the root mean square speed of the same gas at a given temperature.

Statement II The total kinetic energy of an ideal gas depends only on its temperature and the number of molecules, not on the type of gas.

In the light of the above statements, choose the correct answer from the options given below.

- (a) Statement I is true but Statement II is false.
(b) Statement I is false but Statement II is true.
(c) Both Statement I and Statement II are true.
(d) Both Statement I and Statement II are false.

10. A subatomic particle moves with a speed that is p times the speed of an electron. The ratio of the de-Broglie wavelength of this particle to that of the electron is q . If the mass of the electron is given as m , what is the mass of the particle in terms of p , q , and m ?

- (a) m/pq (b) q/pm (c) p/qm (d) qm/p

11. An ideal gas is enclosed in a rigid, thermally insulated container. Initially, the gas occupies a volume of 250 cm^3 at a temperature of 400 K. If the gas undergoes an adiabatic expansion to a new volume of 2000 cm^3 , what is the final temperature of the gas? (Assume, $\gamma = \frac{5}{3}$)

- (a) 100 K

- (b) 150 K

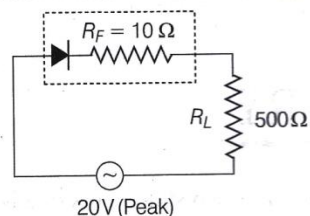
- (c) 200 K

- (d) 250 K

12. Two bodies X and Y , with masses in the ratio 5:2, are placed 1.2 meter apart in vacuum. A third particle Z is positioned between X and Y such that the gravitational force on Z due to X is twice the force due to Y . What is the distance of Z from X ? (Given, $\sqrt{115.2} \approx 10.7$)
 (a) 0.48 m (b) 0.65 m (c) 0.72 m (d) 0.96 m
13. A comet orbits the Sun in a highly elliptical path. At its closest approach (perihelion), the comet is 5×10^9 m from the Sun and moves with a speed of 1.2×10^5 m/s. At its farthest point (aphelion), the comet is 2×10^{11} m from the Sun. What is the comet's speed at aphelion?
 (a) 3.0×10^3 m/s (b) 4.8×10^3 m/s
 (c) 6.0×10^3 m/s (d) 7.2×10^3 m/s
14. A particle moves in a straight line in simple harmonic motion. The ratio of its highest acceleration to its highest speed is 5 s^{-1} . At the start ($t=0$) it is 2 m away from the centre and the initial angle is $\pi/6$. What is the particle's maximum acceleration?
 (a) 100 m/s^2 (b) 25 m/s^2
 (c) 50 m/s^2 (d) 40 m/s^2
15. A positively charged proton (mass = 1.67×10^{-27} kg, charge = 1.6×10^{-19} C) travels at a speed of 2.0×10^6 m/s moving exactly perpendicular to a constant magnetic field of strength 0.05 T directed along the Y -axis. What path does the proton follow and what are the radius and time period of this motion?
 (a) Circular path of radius 0.42 m and time period 1.3×10^{-6} s.
 (b) Spiral path of radius 0.25 m and time period 0.9×10^{-6} s.
 (c) Spiral path of radius 0.60 m and time period 2.5×10^{-6} s.

(d) Spiral path of radius 0.10 m and time period 5.0×10^{-7} s.

16. In the circuit shown below, the barrier voltage of diode is 0.7 V. Match the physical quantities given in Column I to the results given in Column II and select the correct answer from the codes.

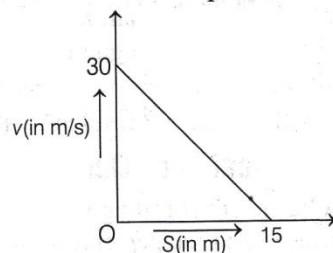


Column I	Column II
A. Peak current (in mA) in diode	1. 37.8
B. Peak voltage (in V) across the ends of load	2. 40.0
C. Peak current (in mA), if diode is ideal	3. 20.0
D. Peak voltage (in V) across the ends of load, if diode is ideal	4. 18.9

Codes

	A	B	C	D		A	B	C	D
(a)	1	4	3	2	(b)	4	3	1	2
(c)	1	4	2	3	(d)	3	1	2	4

17. A body moves in a straight path such that its velocity v (in m/s) decreases linearly from 30 m/s to 0 m/s as its displacement s increases from 0 m to 15 m. What is the acceleration of the particle when it is at $s = 7.5$ m?



- (a) -60 m/s^2
 (b) 60 m/s^2
 (c) -30 m/s^2
 (d) 30 m/s^2

18. Given below are two statements. One is labelled as

Assertion (A) and other is labelled as Reason (R).

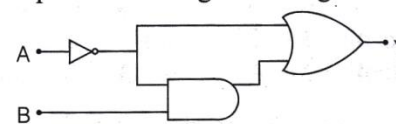
Assertion (A) No net energy is required to shift a test charge from one point to another inside a hollow conducting sphere carrying a uniform surface charge.

Reason (R) The electrostatic potential stays uniform throughout the interior of a uniformly charged conducting shell.

In the light of the above statements, choose the most appropriate answer from the options given below.

- (a) Both A and R are true and R is the correct explanation of A.
 (b) Both A and R are true but R is not the correct explanation of A.
 (c) A is true, but R is false.
 (d) A is false, but R is true.

19. The output Y of the logic circuit given below is,



- (a) \bar{A} (b) $\bar{A} + B$
 (c) $(\bar{A} + B) \cdot A$ (d) $(\bar{A} + B) \cdot \bar{A}$

20. A parallel plate capacitor of capacitance 120 pF is connected to a battery of emf 30 V. If a dielectric material of dielectric constant $K = 3/2$ is inserted between the plates, then magnitude of induced charge will be
 (a) 1.5 nC (b) 1.6 nC (c) 1.8 nC (d) 2.4 nC

NUMERICAL VALUE BASED QUESTIONS

21. When a solid sphere is rolling without slipping along a level surface, then the percentage of its translational kinetic energy is $x\%$. The value of x is
22. A parallel plate capacitor with a capacitance of 20 pF is charged to 9.0 V and then disconnected from the battery. A dielectric ($\epsilon_r = 4$) is inserted. The change in stored energy $|U_2 - U_1|$ is $x \times 10^{-13}$ J.

The value of x is.....

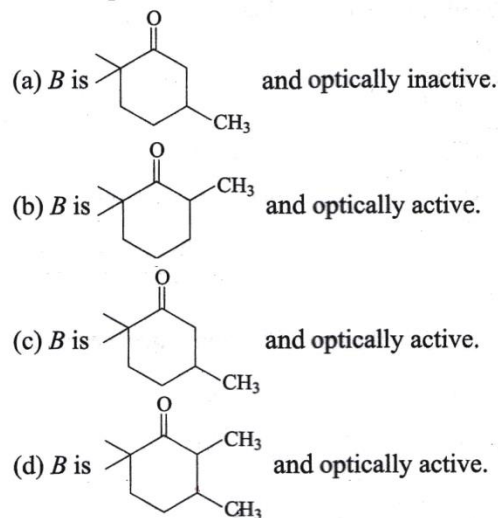
- 23.** In a Young's double slit experiment using coherent light of wavelength λ , the intensity recorded at a point on the screen where the path difference between the two waves is λ is 100 units. What is the intensity at a point where the path difference is one-third of the wavelength, that is, $\lambda / 3$? [Provide your answer as an integer.]
- 24.** A convex lens of focal length 15 cm is placed coaxially on an optical bench in front of a convex mirror at a distance of 5 cm from it. It is found that an object and its image coincide when the object is placed at a distance of 20 cm from the lens. If the focal length of the convex mirror is $x/2$ cm then the value of x is
- 25.** Stretching a wire by 1 mm requires 4 J of work. Find the work necessary to stretch another wire of the same material by the same extension (1 mm), if its radius is doubled and its length is reduced to one-fourth of the first wire.

CHEMISTRY

- 26.** Select the incorrect statement from the following.
- During test for nitrogen, sodium cyanide first reacts with iron (II) sulphate and forms sodium hexacyano ferrate (II).
 - On treating sodium fusion extract with sodium nitroprusside, appearance of a violet colour indicates the presence of sulphur.
 - Carbon and hydrogen are detected by heating the compound with copper (II) oxide.
 - For test of phosphorus, the compound is heated with a reducing agent.
- 27.** Given below are two statements one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A) Interhalogen compounds are more reactive than halogens (except fluorine).
Reason (R) $X-X'$ bond in interhalogen is weaker than $X-X$ bond in halogens except $F-F$ bond.
 In the light of the above statements, choose the

correct answer from the options given below.

- Both A and R are true and R is the correct explanation of A.
 - Both A and R are true but R is not the correct explanation of A.
 - A is true but R is false.
 - A is false but R is true.
- 28.** Order of covalent bond
- $NaF > NaI; NaCl < NaI$
 - $NaF < NaI; LiF > NaF$
 - $PbCl_2 < PbCl_4; CuCl > KCl$
 - $KF < KCl; MgCl_2 > NaCl$
 - $LiF > KF; NaCl > MgCl_2$
- Choose the correct answer from the options given below.
- A, C and D
 - B and C
 - B, C and D
 - A, C and E
- 29.** When 6,6-dimethyl cyclohex-2-en-1-ol react with MnO_2 , it produces *A*. What will be the product *B* when *A* is treated with CH_3Li in presence of $CuCl$ and its optical activity? Choose the correct option.



- 30.** Select the correct statement from the following according to MOT.

- O_2^+ is paramagnetic and bond order is greater than O_2 .
- O_2^+ is paramagnetic and bond order is less than O_2 .
- O_2^+ is diamagnetic and bond order is less than O_2 .
- O_2^+ is diamagnetic and bond order is more than O_2 .

- 31.** Given below are two statements.

Statement I The boiling points of alcohols and phenols increase with decrease in the number of C-atoms.

Statement II The boiling points of alcohols and phenols are higher in comparison to other class of compounds such as ethers and haloalkanes of comparable molecular masses.

In the light of the above statements, choose the correct answer from the options given below.

- Both statement I and statement II are true.
 - Both statement I and statement II are false.
 - Statement I is true but statement II is false.
 - Statement I is false but statement II is true.
- 32.** Number of molecules from below which can give iodoform reaction?
 ethanol, isopropyl alcohol, bromoacetone, 2-butanol, 2-butanone, butanol, 2-pentanone, 3-pentanone, pentanal and 3-pentanol
- (a) 4 (b) 6 (c) 5 (d) 3
- 33.** Correct statements for an element with atomic number 9 are
- Total number of p electrons is 6.
 - The quantum number for valence electrons is $n = 3, l = 1, m_l = 0, m_s = +\frac{1}{2}$
 - The last electron goes to orbital with $n = 2$ and $l = 1$.
 - Angular node for s -orbital is 0 while for each p -orbital is 1.
- Choose the correct answer from the options given below.
- A and B only
 - C and D only
 - A, C and D only
 - B and D only
- 34.** Given that, an ideal gas is expanded adiabatically

there is no depression in freezing point.

In the light of the above statement choose the correct answer from the options given below.

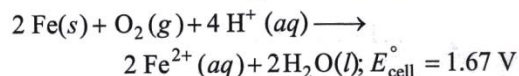
- (a) Both statement I and statement II are false.
- (b) Both statement I and statement II are true.
- (c) Statement I is true but statement II is false.
- (d) Statement I is false but statement II is true.

45. The molarity of a solution of oxalic acid $[(\text{COOH})_2 \cdot 2\text{H}_2\text{O}]$ containing 12.6 g of the acid in 500 mL of the solution is

- (a) 0.2 M (b) 0.1 M (c) 0.4 M (d) 0.3 M

NUMERICAL VALUE BASED QUESTIONS

46. Consider the following cell reaction,



At $[\text{Fe}^{2+}] = 10^{-3}\text{ M}$, $p_{(\text{O}_2)} = 0.1\text{ atm}$ and $\text{pH} = 3$,

the cell potential at 25°C is $\dots \times 10^{-1}\text{ V}$. (Nearest integer)

47. The rate constant of a zero order reaction is $2.0 \times 10^{-2}\text{ mol L}^{-1}\text{s}^{-1}$. If the concentration of the reactant after 25s is 0.5 M, the initial concentration is $\dots\text{ M}$.

48. If 5 mol of an ideal gas expands reversibly from a volume of 8 dm^3 to 80 dm^3 at a temperature of 27°C . Then the change in entropy is $\dots\text{ J/K}$ (Nearest integer)

49. The vapour pressure of a pure liquid A is 40 mm Hg at 310 K. The vapour pressure of this liquid in a solution with liquid B is 32 mm Hg.

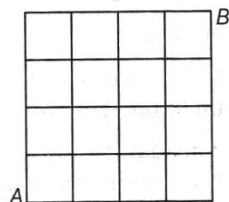
Then the mole fraction of A in the solution, if it obey's Raoult's law is $x \times 10^{-1}$. The value of x is

50. During the estimation of sulphur, 0.314 g of an organic compound gave 0.9626 g of barium sulphate. Then the percentage of sulphur in the compound is $\dots\dots\dots$ (Nearest integer)

MATHEMATICS

51. In given figure, person can move towards right or in

upward direction only, how many ways are there to reach the point B from point A ?



- (a) 70 (b) 90 (c) 8 (d) 16

52. The value of λ for which the lines

$$\frac{X-2}{1} = \frac{Y-9}{2} = \frac{Z-13}{3} \text{ and } \frac{X-\lambda}{-1} = \frac{Y-7}{2} = \frac{Z+2}{-3}$$

intersect, is

- (a) -2 (b) -5 (c) -3 (d) 5

53. Let $z_1 = 10 + 6i$ and $z_2 = 4 + 6i$. If z is any complex number such that amplitude of $\frac{z-z_1}{z-z_2}$ is $\frac{\pi}{4}$ such that

$|z - 7 - 9i| = \alpha$, then α is equal to

- (a) $3\sqrt{2}$ (b) $2\sqrt{3}$
- (c) $\sqrt{2}$ (d) $3\sqrt{3}$

54. Let $p, q, r \in \mathbb{R}$, such that $pqr = 5$, if

$$A = \begin{bmatrix} 3p & q & r \\ q & 3r & p \\ r & p & 3q \end{bmatrix} \text{ and } AA^T = 4I \text{ and } |A| \text{ is a}$$

positive real number, then $3(p^3 + q^3 + r^3)$ is equal to

- (a) 125 (b) 137
- (c) 64 (d) 16

55. If $\left(\frac{1}{a}\right)^b = \lim_{x \rightarrow 0} \frac{8}{x^8}$

$$\left(1 - \cos \frac{x^2}{2} - \cos \frac{x^2}{4} + \cos \frac{x^2}{2} \cos \frac{x^2}{4}\right),$$

where a is a prime number, then ab is

- (a) is greater than $2b$
- (b) is less than $2b$
- (c) is equal to $2b$
- (d) is equal to $5b$

56. Let P be the foot of the perpendicular from the point $Q(5, 7, -6)$ on the line $\frac{x-1}{4} = \frac{y+2}{-2} = \frac{z-3}{3}$.

Then, the area of the right-angled triangle ΔPQR , where R is the point $(1, 0, 4)$, is

- (a) $3\sqrt{21}$ (b) $14\sqrt{6}$
- (c) $2\sqrt{66}$ (d) $5\sqrt{13}$

57. For the given two data sets

	Variance	Mean	Number of observation
X	4	2	5
Y	5	4	5

Then, the variance of the combined data set is

- (a) $\frac{5}{2}$ (b) $\frac{7}{2}$ (c) $\frac{11}{2}$ (d) $\frac{13}{2}$

58. For any 3×3 matrix M , let $|M|$ denote the determinant of M . Let

$$E = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \\ 8 & 13 & 18 \end{bmatrix}, P = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} \text{ and } F = \begin{bmatrix} 1 & 3 & 2 \\ 8 & 18 & 13 \\ 2 & 4 & 3 \end{bmatrix}$$

If Q is a non-singular matrix of order 3×3 , then which of the following statements is (are) true?

- (a) $F = PEP$ and $P^2 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$
- (b) $|EQ + PFQ^{-1}| = |EQ| + |PFQ^{-1}|$
- (c) $|(EF)^3| > |EF|^2$
- (d) Sum of the diagonal entries of $P^{-1}EP + F$ is equal to the sum of diagonal entries of $E + P^{-1}FP$

59. For $f(x) = \int_x^{x^2} \frac{du}{(\log u)^2}$, $x \neq 0, 1$, then consider the

following statements for $f(x)$.

Statement I $f(x)$ is monotonically increasing in the interval $(2, \infty)$.

Statement II $f(x)$ is monotonically decreasing in the interval $(0, 1)$.

- (a) Statement I is true and Statement II is false
- (b) Statement I is false and Statement II is true
- (c) Both Statement I and Statement II are true
- (d) Both Statement I and Statement II are false

60. The contents of 3 bags with respect to green and red marbles is as given in the table below.

Bag	A	B	C
Green	3	2	1
Red	1	2	3

A person randomly select one of the bags and draws a marble from it and retains it. If the marble is green, the persons draws the second marbles randomly from one of the two remaining bags.

If the first marble drawn is red the person draws one more marble from the same bag. The probability that the second drawn marble is green, is

- (a) $\frac{73}{144}$
- (b) $\frac{79}{140}$
- (c) $\frac{63}{134}$
- (d) $\frac{56}{137}$

61. Let $f(x) = x + \frac{a}{\pi^2 - 4} \sin x + \frac{b}{\pi^2 - 4} \cos x, x \in R$ be a

function which satisfies

$$f(x) = x + \int_0^{x/2} \sin(x+y)f(y)dy. \text{ Then, } (a+b) \text{ is}$$

equal to

- (a) $-\pi(\pi+2)$
- (b) $-2\pi(\pi+2)$
- (c) $-2\pi(\pi-2)$
- (d) $-\pi(\pi-2)$

62. Consider the function

$$f(x) = \begin{cases} [x], & -2 \leq x \leq -1 \\ |x|+1, & -1 < x \leq 2 \end{cases}$$

$$g(x) = \begin{cases} [x], & -\pi \leq x < 0 \\ \sin x, & 0 < x \leq \pi \end{cases}$$

(where, $[\cdot]$ denotes the greatest integer function), then the range of $g[f(x)]$ is

- (a) $[\sin 3, \sin 1]$
- (b) $[\sin 3, 1] \cup \{-2, 0\}$
- (c) $[\sin 3, 1] \cup \{-2, -1\}$
- (d) $[\sin 1, 1]$

63. Let $P = \begin{bmatrix} 1 & 0 & 0 \\ 4 & 1 & 0 \\ 16 & 4 & 1 \end{bmatrix}$ and I be the identity matrix of order 3.

If $Q = [q_{ij}]$ is a matrix such that $P^{50} - Q = I$, then

- (a) 52
- (b) 103
- (c) 201
- (d) 205

64. Let $g(x) = \int_0^{x^2} \frac{t^2 - 8t + 15}{e^t} dt, x \in R$.

Then, the number of local maximum and local minimum points of g , respectively are

- (a) 2 and 3
- (b) 3 and 2
- (c) 2 and 2
- (d) 3 and 3

65. The area (in sq units) enclosed by the curve $y = \ln(x+e), x = \ln(1/y)$ and X -axis is

- (a) 4
- (b) 2
- (c) -3
- (d) -6

66. If the solution $y = y(x)$ of the differential equation $(x^4 + 4x^3 + 6x^2 + 4x + 1)dy - (2x^2 + 4x + 2)dx = 0$,

satisfies $y(0) = \frac{\pi}{6}$, then $y(1)$ is equal to

- (a) $1 - \frac{\pi}{2}$
- (b) $1 + \frac{\pi}{6}$
- (c) $\frac{\pi}{4} + 1$
- (d) $2 + \frac{\pi}{3}$

67. Let \mathbf{a} and \mathbf{b} be two unit vectors such that $|\mathbf{a} + \mathbf{b}| = \sqrt{2}$. If $\mathbf{c} = \mathbf{a} + 2\mathbf{b} + 3(\mathbf{a} \times \mathbf{b})$ and $2|\mathbf{c}|$ is equal to K , then $\sqrt{14}K$ is

- (a) 14
- (b) 28
- (c) 42
- (d) 56

68. Let $f(x)$ be a real differentiable function such that $f(0) = 1$ and $f(x+y) = f(x)f'(y) + f'(x)f(y)$

$\forall x, y \in R$. Then, $\sum_{n=1}^{100} \log_e f(n)$ is equal to

- (a) 2384
- (b) 5440
- (c) 2306
- (d) 2525

69. The streets of a city are arranged like the lines of a

chess board. There are m streets running North to South and n streets are running East to West. The number of ways in which a man can travel from North-West to South-East corner going to the shortest possible distance, is

- (a) $\sqrt{m^2 + n^2}$
- (b) $\sqrt{(m-1)^2 (n-1)^2}$
- (c) $\frac{(m+n)!}{m! \cdot n!}$
- (d) $\frac{(m+n-2)!}{(m-1)!(n-1)!}$

70. If one of the diameters of the circle $x^2 + y^2 - 2x - 6y + 6 = 0$ is a chord of another circle c , whose centre is at $(2, 1)$, then its radius is

- (a) 3
- (b) -3
- (c) 2
- (d) 4

NUMERICAL VALUE BASED QUESTIONS

71. The product of all the rational roots of the equation $(x^2 - 2x + 1)^2 - (x - 1)^2 = 0$ is equal to

72. From 6 different novels and 3 different dictionaries, 4 novels and 1 dictionary are to be selected and arranged in a row on a shelf so that the dictionary is always in the middle.

Then, the number of such arrangements is equal to

73. Number of integral terms in the expansion of $(\sqrt{3} + \sqrt[3]{5})^{256}$ is

74. Let α and β be real numbers such that

$$-\frac{\pi}{4} < \beta < 0 < \alpha < \frac{\pi}{4}. \text{ If } \sin(\alpha + \beta) = \frac{1}{3} \text{ and}$$

$\cos(\alpha - \beta) = \frac{2}{3}$, then the greatest integer less than or

equal to $\left(\frac{\sin \alpha}{\cos \beta} + \frac{\cos \beta}{\sin \alpha} + \frac{\cos \alpha}{\sin \beta} + \frac{\sin \beta}{\cos \alpha} \right)^2$ is equal to

75. Let $AP(a; d)$ denote the set of all the terms of an infinite arithmetic progression with first term a and common difference $d > 0$. If $AP(1; 3) \cap AP(2; 5) \cap AP(3; 7) = AP(a; d)$, then $a + d$ equals