GMR Classes

JEE MAIN - MOT - 33 - DT 04-04-2020

Total Marks : 300
Duration : 3:00 hrs

Mathematics XI

SECTION 1 - (SCQ) (Maximum Marks : 80)

- This section contains **20** questions
- From given options **,ONLY ONE** of these option(s) is correct.
- For each question, select the alphabets corresponding to the correct option(s) provided below the questions

For each question, marks will be awarded in one of the following categories :

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Zero Marks : **0** If none of the options is chosen.(i.e the question is unanswered)

1.

$(1 + z + z^2)^8 = C_0 + C_1z + C_2z^2 + \ldots\ldots + C_{16}z^{16}$ Where z is real or complex then $C_0 - C_2 + C_4 - C_6 + \ldots\ldots + C_{16}$ is equa

(A) 0 (B) 1 (C) −1

(D) $\frac{1}{2}$

2. $x^{2n} - y^{2n}$ is divisible by

(A) x^2-y^2 (B) x − y (C) x+y

(D) All the above

3. If α , β are the roots of $x^2 - 2x + 4 = 0$ then $\alpha^n + \beta^n = 1$

(A) $2^{n+1}\cos\frac{n\pi}{3}$ (B) $2^n\cos\frac{n\pi}{2}$ (C) $2^{n-1}\cos\frac{n\pi}{3}$

(D) $2^{n+1}\sin\frac{n\pi}{3}$

4. $(n!)^2 > n^n$ is true for

(A) $\forall n \in N$ (B) $\forall n > 1, n \in N$ (C) $\forall n > 2, n \in N$

(D) $\forall n \in Z$

5. If $z = \sum_{r=1}^{8}\left(\sin\frac{2r\pi}{9} + i\cos\frac{2r\pi}{9}\right)$ then

i) $z + \bar{z} = 0$

ii) $z - \bar{z} = 0$

iii) $z\bar{z} = 1$

iv) $z^{2008} = 1$

(A) i, iii (B) iv, iii (C) iii, ii

(D) iii, iv

6. Given that the equation $Z^2 + (p + iq)z + ris = 0$ where p, q, r, s are non-zero has a real root. Then

(A) $pqr = r^2 + p^2s$ (B) $prs = q^2 + r^2p$ (C) $qrs = p^2 + s^2q$

(D) $pqs = s^2 + q^2r$

7. The least remainder when 17^{30} is divided by 5 is

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

(D) 4

8. $\left(\frac{1 + i}{1 - i}\right)^4 + \left(\frac{1 - i}{1 + i}\right)^4 =$

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

(D) 4

9. For a positive integer (n >1), Let $a(n) = 1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} \ldots\ldots + \frac{1}{(2^n) - 1}$. Then

(A) a (100)<100 (B) a (100)>100 (C) a (20)=100

(D) a (200) ≥ 100

10. $\forall\, n \in N, x \in R,\ \tan^{-1}\frac{x}{[1.2 + x^2]} + \tan^{-1}\frac{x}{[2.3 + x^2]} + \ldots. + \tan^{-1}\frac{x}{[n(n + 1) + x^2]} =$

(A) $\tan^{-1}\frac{x}{[n]} - \tan^{-1}\frac{x}{[n + 1]}$ (B) $\tan^{-1}[x] - \tan^{-1}\frac{x}{[n + 1]}$ (C) $\tan^{-1}[n + 1] - \tan^{-1}[x]$

(D) $\tan^{-1}[x]$

11. The maximum amplitude of z such that $|z - 1 - i\sqrt{3}| \le 1$ is

(A) 0° (B) $\frac{\pi^c}{2}$ (C) π^c

(D) $\frac{\pi^c}{4}$

12.

If z_1 and z_2 both satisfy $z + \bar{z} = 2|z - 1|$ and $\arg(z_1 - z_2) = \frac{\pi}{4}$, *then* $I_m(z_1 + z_2)$ *is*

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

(D) 4

13. Let z_1 and z_2 be the complex roots of the equation $3z^2 + 3z + b = 0$. If the origin, together with the points represented by z_1 and z_2 form an equilateral triangle, then the value of b

(A) –1 (B) 0 (C) 1

(D) can not be decided

14. $\sum_{k=1}^{2n+1} (-1)^{k-1} k^2 =$

(A) $(n + 1)(2n + 1)$ (B) $(n + 1)(2n - 1)$ (C) $(n - 1)(2n - 1)$

(D) $(n - 1)(2n + 1)$

15. If $S_1 = \{2\}$, $S_2 = \{3, 6\}$, $S_3 = \{4, 8, 16\}$, $S_4 = \{5, 10, 20, 40\}$, ... then the sum of numbers in the set S_{15} is

(A) $5(2^{15})$ (B) $16(2^{15} - 1)$ (C) $16(2^{16} - 1)$

(D) $15(2^{15} - 1)$

16. Consider the statement: "P(n) : $n^2 - n + 41$ is prime". Then which one of the following is true ?

(A) P(5) is false but P(3) is true (B) Both P(3) and P(5) are true (C) P(3) is false but P(5) is true

(D) Both P(3) and P(5) are false

17. If $\left(\frac{1 + \cos\theta + i\sin\theta}{i + \sin\theta + i\cos\theta}\right)^4 = \cos n\theta + i\sin n\theta$, then n is equal to

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

(D) 4

18. If $2^3 + 4^3 + 6^3 + \ldots + (2n)^3 = kn^2(n + 1)^2$ then k =

(A) 1/2 (B) 1 (C) 3/2

(D) 2

19. The value of the sum in the 50^{th} bracket of (1) + (2 + 3) + (4 + 5 + 6) + (7 + 8 + 9 + 10) + . . . *is*

(A) 62525 (B) 65225 (C) 56255

(D) 55625

20. The values of z for which |z + i| = |z − i| are

(A) Any real number (B) Any complex number (C) Any natural number

(D) None of these

SECTION 2 - (NUMERIC) (Maximum Marks : 20)

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21. Let $z_1, z_2, \ldots\ldots, z_n$ be equi - modular non-zero complex numbers such that $z_1+z_2+\ldots\ldots+ z_n= 0$. Then Re $\left(\sum_{j=1}^{n}\sum_{k=1}^{n}\frac{z_j}{z_k}\right)$ is equal to_____

22. Find the number of solutions of the equation $z^2 = \bar{z}$.

23. If the points 1+2i and -1+4i are reflections of each other in the line $z(1+i)+ \bar{z}(1-i) + K = 0$, then the value of *K* is

_____

24. z_1, z_2, z_3 are vertices of a triangle ABC having area D and satisfying

$(z_3 - z_1) = (1 - i\sqrt{3})(z_2 - z_1)$ *and* $\sqrt{3}|z_2 - z_3|^2 = k\Delta$ then value of k is

25. If the complex number z is such that |z - 1| ≤ 1 and |z - 2| = 1, then the maximum possible value $|z|^2$ is

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Physics XI

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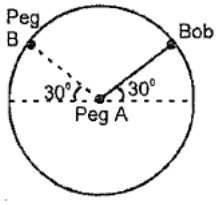
26. A body is placed at the middle of a plank of length 'l' coefficient of friction between the body and the plank is. If the body starts with an acceleration 'a', the time after which the body leaves the plank is

(A) $\sqrt{\frac{l}{(a-g)}}$ (B) $\sqrt{\frac{l}{(a+g)}}$ (C) $\sqrt{\frac{2l}{(a-g)}}$

(D) $\sqrt{\frac{2l}{(a+g)}}$

27. A bob is attached to one end of a string other end of which is fixed at peg A. The bob is taken to a position where string makes an angle of 30^o with the horizontal. On the circular path of the bob in vertical plane there is a peg "B" at a symmetrical position with respect to the position of release as shown in the figure. If v_c and v_a be the minimum speeds in clockwise and anticlockwise directions respectively, given to the bob in order to hit the peg "B" then ratio v_c : v_a is equal to :



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

(D) 1 : 4

28. A particle of mass m is revolving in a horizontal circle of radius r with constant angular speed ωthen a real velocity of particle is

(A) $r^2\omega$ (B) $r^2\theta$ (C) $\frac{r^2\omega}{2}$

(D) $\frac{r^2}{2}$

29. When a man starts to walk on rough horizontal surface, then nature and direction of force of friction on shoes due to ground :

(A) Static, forward (B) Static, backward (C) Dynamic, forward

(D) Dynamic, backward

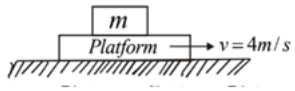
30. A horizontal force of 129.4 N is applied on a 10 kg block which rests on a horizontal surface. if the co-efficient of friction is 0.3 the acceleration should is:

(A) $9.8\,m/s^2$ (B) $10\,m/s^2$ (C) $12.6\,m/s^2$

(D) $19.6\,m/s^2$

31.

A stationary body of mass m is slowly lowered onto a rough massive plat form moving at a constant velocity $v_0 = 4m/s$ on smooth surface. The distance the body will slide with respect to the plat form ($\mu = 0.2$) is:



(A) 4 m (B) 6 m (C) 12 m

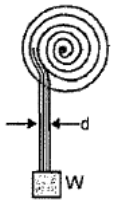
(D) 8 m

32.
An eraser weighing 2N is pressed against the black board with a force of 5N. If the co-efficient of friction is 0.4. How much force parallel to the black board is required to slide the eraser upwards?

(A) 2 N (B) 2.8 N (C) 4 N

(D) 4.8 N

33. A weight W attached to the end of a flexible rope of diameter d = 0.75cm is raised vertically by winding the rope on a reel as shown. If the reel is turned uniformly at the rate of 2 r.p.s. What is the tension in rope. The inertia of rope may be neglected.



(A) 1.019W (B) 0.51W (C) 2.04W

(D) W

34. A coin placed on a rotating turn table just slips it is placed at a distance of 20 cm from the centre. If the angular velocity of turn table is doubled, the coin will just slip at a distance of

(A) 40 cm (B) 20 cm (C) 10 cm

(D) 5 cm

35. A block of mass 5kg is lying on a rough horizontal surface. The coefficient of static and kinetic friction is 0.3 and 0.1 and g = 10 ms^{-2}. The frictional force on the block is

(A) 25 N (B) 15 N (C) 10 N

(D) zero

36. An engine pumps water continuously through earth a hose. Water leaves the hose with a velocity v and m is the mass per unit length of the Water jet. What is the rate at which kinetic energy is imparted to water?

(A) $\frac{1}{2}mv^3$ (B) mv^3 (C) $\frac{1}{2}mv^2$

(D) $\frac{1}{2}mv^2$

37.

A 1.5 kg box is initially at rest on a horizontal surface when at t = 0 a horizontal force $\vec{F}$ (1.8t) îN
(with t in seconds), is applied to the box. The acceleration of the box as a function of time t is given by:
$\vec{a} = 0$ for $0 \le t \le 2.85$
$\vec{a} = (1.2t - 2.4)$ î m/s² for $t > 2.85$
The coefficient of kinetic friction between the box and the surface is :

(A) 0.12 (B) 0.24 (C) 0.36

(D) 0.48

38. A ball suspended by a thread swing in a vertical plane so that its acceleration values in extreme and the lowest position is same. Find the thread deflection angle in extreme position?

(A) 53 ^{o} (B) 37 ^{o} (C) 60 ^{o}

(D) 15 ^{o}

39. A body of mass 2 kg is held at rest against a rough vertical wall by passing a horizontal (normal) force of 45 N. Coefficient of friction between wall and the block is equal to 0.5. Now a horizontal force of 15 N (tangential to wall) is also applied on the block. Then the block will:

(A) Move horizontally with acceleration of $5\,m/s^2$ (B) Start to move with an acceleration of magnitude $1.25\,m/s^2$

(C) Remain stationary (D) Start to move horizontally with acceleration greater than $5\,m/s^2$

40. If a particle moves in a circle, describing equal angles in equal intervals, the velocity vector

(A) Remains constant (B) Changes in magnitude (C) Changes in direction

(D) Changes both in magnitude and direction

41. A force of 150N produces an acceleration of $2ms^{-2}$ in a body and a force of 200 N produces an acceleration of $3ms^{-2}$. The mass of the body and the coefficient of kinetic friction are

(A) 50 kg, 0.1 (B) 25 kg, 0.2 (C) 50 kg, 0.5

(D) 50 kg, 0.2

42. A ball is suspended by a thread of length l from a point 'A'. At the lowest position it is given a velocity $\sqrt{\frac{7}{2}gl}$ in the horizontal direction. The string slackens after swinging through an angle with the vertical is

(A) 30 ^{0} (B) 60 ^{0} (C) 90 ^{0}

(D) 120 ^{0}

43. An electron is revolving around the nucleus of hydrogen atom. If F is centripetal force on an electron in 2nd orbit then the centripetal force on it in its 1st orbit is

(A) 1F (B) 4F (C) 16F

(D) 32F

44. A 4 kg stone tied at the end of a string 1 metre long is whirled in a vertical circle. At the instant when the string makes an angle θ with the vertical, the speed of the stone is 4 ms $^{-1}$ and the tension in the thread is 103.2 newton. Then θ is

(A) 0° (B) 30° (C) 60°

(D) 90°

45. 2 particles p & q located at distances r_p & r_q respectively from centre of a rotating disc such that $r_p > r_q$

(A) both p and q have same acceleration (B) both p and q do not have any acceleration

(C) p has greater acceleration (D) q has greater acceleration

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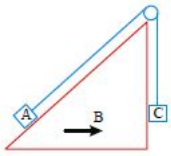
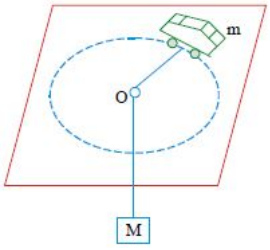
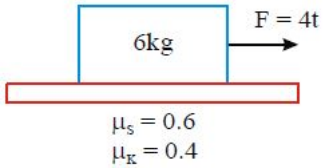
46. In the fig. as shown, mass of each block is same. The surface are rough with coefficient of friction μ . The block B moves with acceleration a. The frictional force on the block C is k × μ ma. Calculate the value of k



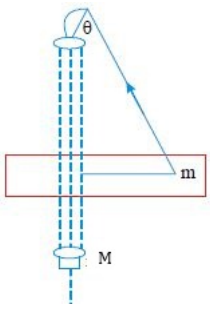
47. A toy car of mass m can travel at a fixed speed. It moves in a circle on a fixed horizontal table. A string is connected to the car and attached to a block of mass M that hangs as shown in figure (the portion of string below the table is always vertical). The coefficient of friction between the surface of table and tyres of the toy car is μ. F ind the ratio of the maximum radius to the minimum radius for which the toy car can move in a circular path with center O on table. (Given M = 3kg; m = 2kg; μ = 1/2)



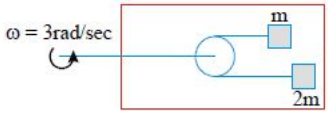
48. A 6 kg block is kept over a rough surface with coefficients of friction $\mu_s = 0.6$ and $\mu_k = 0.4$ as shown in figure. A time varying force F = 4t (F in newton and t in second) is applied on the block as shown. Find the acceleration of block at t = 5 sec. (Take g = 10 m/s^2)



49. A large mass M and a small mass m hang at the two ends of string that passes through a smooth tube as shown in fig. The mass m moves around in a circular path which lies in a horizontal plane. The length of the string from the mass m to the top of the tube is of length l and θ is the angle, this length makes with the vertical, what should be the frequency of rotation of the mass m so that M remains stationary if M=16kg, m=4kg, l = 1m and $g = \pi^2 m/s^2$.



50. A table with smooth horizontal surface is placed in a cabin which moves in a circle of a large radius R = 100 m, with ω = 3rad/s (see figure). A smooth pulley of small radius is fastened to the table. Two masses m and 2m placed on the table are connected through a string going over the pulley. Initially the masses are held by a person with the strings along the outward radius and then the system is released from rest (with respect to the cabin). Then the magnitude of the initial acceleration of the mass m as seen from the cabin is n × 100. Find n.



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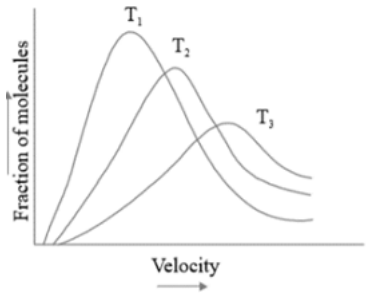
51. If the enthalpy change for the transition of liquid water to steam is 30 KJ mol^{-1} at 27°C, the entropy change for the process would be

(A) 100 J mol^{-1} K^{-1} (B) 10 J mol^{-1} K^{-1} (C) 1.0 J mol^{-1} K^{-1}

(D) 0.1 J mol^{-1} K^{-1}

52. In the following graph of Maxwell-Boltzmann distribution of molecular velocities



Which of the following is the correct order of temperature?

(A) $T_1 < T_2 < T_3$ (B) $T_3 < T_2 < T_1$ (C) $T_2 < T_1 < T_3$

(D) $T_1 > T_2 < T_3$

53. If a system absorb 1 kJ heat at 1 atm pressure the volume changes from 20 litre to 25 litre. The internal energy change will be

(A) 6 kJ (B) –4 kJ (C) 493 J

(D) 593 J

54. The root mean square velocity of an ideal gas to constant pressure varies with density (d) as

(A) d^2 (B) d (C) $\sqrt{d}$

(D) $\frac{1}{\sqrt{d}}$

55. At constant temperature if pressure increases by 1%, the percentage decrease of volume is

(A) 1% (B) $\frac{100}{101}$ % (C) $\frac{1}{101}$ %

(D) $\frac{1}{100}$%

56. For the reaction at 1240 K and 1 atm. decomposition of $CaCO_3$ has ΔH value 176 KJ/mol. The ΔU equals:

(A) 165.6 KJ (B) 160.0 KJ (C) 186.4 KJ

(D) 180.0 KJ

57.

The rms speed of hydrogen is $\sqrt{7}$ times the rms speed of nitrogen. If T is the temperature of the gas, then

(A) $T_{H_2} = T_{N_2}$ (B) $T_{H_2} > T_{N_2}$ (C) $T_{H_2} < T_{N_2}$

(D) $T_{H_2} \geq T_{N_2}$

58.

The work done in an open vessel at 300 K, when 112 gm iron (At. mass of Fe = 56) reacts with dilute HCl is

(A) 1.2 kcal (B) 0.6 kcal (C) 0.3 kcal

(D) 0.2 kcal

59. The density of a gas filled electric lamp is 0.75 kg/m ^{3}. After the lamp has been switched on, the pressure in it increases from 4×10^4 Pa to 9×10^4 pa. What is increases in U_{rms}?

(A) 100 (B) 300 (C) 200

(D) 400

60.

If the critical temperature of the gas be $T_c = \frac{8a}{27Rb}$ and TB is the Boyle's temperature, then which of the following, is the correct relation between T_C and T_B?

(A) $T_C = \frac{4}{27}T_B$ (B) $T_C = \frac{27}{4}T_B$ (C) $T_C = \frac{8}{27}T_B$

(D) $T_C = \frac{27}{8}T_B$

61. At which of the four conditions, the density of nitrogen will be the largest?

(A) STP (B) 273 K and 2 atm (C) 546 K and 1 atm

(D) 546 K and 2 atm

62. The standard molar enthalpies of formation of cyclohexane (l) & benzene (l) at 25°C are -156 & + 49 kJ/ mol^{-1} respectively. The standard enthalpy of hydrogenation of cyclohexene (l) at 25° is-119 kJ mol^{-1}. Use these data to estimate the magnitude of the resonance energy of benzene.

(A) -152 kJ/mol (B) -151 kJ/mol (C) -153 kJ/mol

(D) -154 kJ/mol

63. Three statements are given below

i)The enthalpy of any element is zero in their standard state

ii) The heat of neutralisation for any strong acid and strong base at 25º C is -13.7 kJ/mole

iii) $Q = \Delta E + W$ is a mathematical form of first law of thermodynamics if work is done by the system according IUPAC

(A) i only correct (B) ii and iii are correct (C) i and iii are correct

(D) all are correct

64. The term that is correct for the attractive forces present in a real gas in the vander Waals equation is

(A) nb (B) $\frac{an^2}{V^2}$ (C) $-\frac{an^2}{V^2}$

(D) -nb

65. Which of the following gases effuse at the same rate under similar conditions?

(A) Ethane and Ethene (B) Dioxygen and ozone (C) Carbon dioxide and sulphur dioxide

(D) Carbon monoxide and dinitrogen

$H_2 + \frac{1}{2}O_2 \rightarrow \Delta H_2O; \Delta H = -68.39$ kcal .....(i)

$K + aq\ KOH(aq) + \frac{1}{2}H_2; \Delta H = -48\ kcal$ .....(ii)

$KOH + aq \rightarrow KOH(aq); \Delta H = -14\ kcal$ ....(iii)

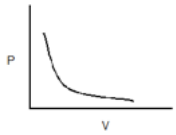
66. The heat of formation (in kcal) of KOH is:

(A) -68.39 + 48 - 14 (B) -68.39 - 48 - 14 (C) 68.39 - 48 + 4

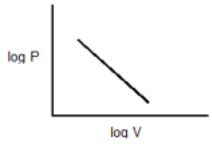
(D) 68.39 + 48 + 14

67. Which of the following curve does not represent Boyle's law?

(A)

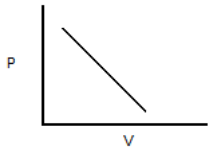


(B)



(C)

(D) 14



68. Two closed vessels of equal volume containing air at pressure P_1 and temperature T_1 are connected to each other through a narrow tube. If the temperature in one of the vessels in now maintained at T_1 and that in the other at T_2. What will be the pressure in the vessels?

(A) $\frac{2p_1T_1}{T_1 + T_2}$ (B) $\frac{T_1}{2p_1T_2}$ (C) $\frac{2p_1T_2}{T_1 + T_2}$

(D) $\frac{2p_1}{T_1 + T_2}$

69. 50 cm^{-3} of a certain gas A (mol. Mass = 64) diffuses through a porous plug in same time as 40 cm^{-3} of gas B (mol. mass = M) under similar conditions. The value of M is

(A) 200 (B) 160 (C) 40.96

(D) 100

70.

A sample of gas is at 0°C. The temperature at which its rms speed of the molecule will be doubled is

(A) 103°C

(B) 273°C

(C) 723°C

(D) 818°C

SECTION 2 - (NUMERIC) (Maximum Marks : 20)

- This section has **5** questions
- The answer to each question is a **NUMERICAL ANSWER**
- For each question, type the numerical value in the space provided below the question using provided keys.

For each question, marks will be awarded in one of the following categories :

Full Marks : **+4** If the correct numerical value is typed in the provided space.
Zero Marks : **0** If the question is unanswered

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71. What is the ratio of total kinetic energy of 8 g of Helium and 8 g of oxygen at 27°C.

72. 1 mol of a liquid of molar volume 100 mL is kept in adiabatic container under a pressure of 1 bar. The pressure is steeply increased to 100 bar. Under this constant pressure of 100 bar, the volume of the liquid decreases by 1 mL. Calculate Δ U and Δ H of the process.

73. What should be the percentage increase in pressure for a (100/21) % decrease in volume of gas at constant temperature ?

74.

Find the enthalpy of S – S bond from the following data.

(i) $C_2H_5 - S - C_2H_5$ (g) $\Delta H_f^o = -147.2$kJ/mol

(ii) $C_2H_5 - S - S - C_2H_5$(g) $\Delta H_f^o = -201.9$ kJ/mol

(ii) S (g) $\Delta H_f^o = 222.8$ kJ/mol

75. Calculate the enthalpy change when infinitely dilute solutions of $CaCl_2$ and 23 Na_2CO_3 are mixed. ΔH^0_f for Ca^{2+} (aq), CO^{2-}_3 (aq) and $CaCO_3$ (s) are -129.80, -161.65 and 1 -288.45 kcalmol^{-1} respectively.
