



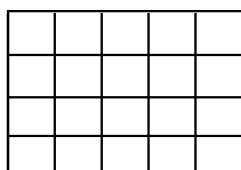
## Exercise-1

✎ Marked questions are recommended for Revision.

### PART - I : SUBJECTIVE QUESTIONS

#### Section (A) : Problems based on Classical definition of Probability (PRCD)

- A-1.** Write the sample space of the following experiment  
 (i) 'Three coins are tossed'.  
 (ii) 'Selection of two children from a group of 3 boys and 2 girls without replacement'.
- A-2.** There are three events A, B, C, one of which must, and only one can, happen; the odds are 8 to 3 against A, 5 to 2 against B : find the odds against C.
- A-3.** If the letters of the word BANANA are arranged randomly, then find the probability that the word thus formed does not contain the pattern BAN.
- A-4.** Nine cards are labelled 0, 1, 2, 3, 4, 5, 6, 7, 8. Two cards are drawn at random and put on a table in a successive order, and then the resulting number is read say 07(seven), 42(fourty two) and so on. Find the probability that the number is even.
- A-5.** Three persons A, B and C speak at a function along with 5 other persons. If the persons speak at random, find the probability that A speaks before B and B speaks before C
- A-6.** (i) A rectangle is randomly selected from the grid of equally spaced squares as shown.



- Find the probability that the rectangle is a square.
- (ii) Three of the six vertices of a regular hexagon are chosen at random. Then the probability that the triangle with three vertices is equilateral is 'p' then 100p equals
- A-7.** In throwing a pair of dice, find whether the two events  
 (i)  $E_1$  : 'coming up of an odd number on first dice' and  $E_2$  : 'coming up of a total of 8'.  
 (ii)  $E_1$  : 'coming up of 4 on first dice' and  $E_2$  : 'coming up of 5 on the second dice'.  
 are mutually exclusive or not
- A-8.** In throwing of a pair of dice, find the probability of the event : total is 'not 8' and 'not 11'.
- A-9.** ✎ Before a race the chance of three runners, A, B, C were estimated to be proportional to 5, 3, 2, but during the race A meets with an accident which reduces his chance to  $\frac{1}{3}$ . What are the respective chance of B and C now?
- A-10.** Tickets are numbered from 1 to 100. One ticket is picked up at random. Then find the probability that the ticket picked up has a number which is divisible by 5 or 8.
- A-11.** Three cards are drawn at random from a pack of well shuffled 52 cards. Find the probability that  
 (i) all the three cards are of the same suit;  
 (ii) one is a king, the other is a queen and the third a jack.



- A-12.** In a throw of a pair of dice, then find the probability of 'A total of 8 but not 11'.
- A-13.** Six boys and six girls sit in a row at random. Find the probability that boys and girls sit alternately
- A-14.** Four persons draw 4 cards from an ordinary pack find the chance  
 (1) that a card is of each suit  
 (2) that no two cards are of equal value.

### Section (B) : Problems based on venn diagram & set theory (PRVD)

- B-1.** Prove that  

$$P(A - B) = P(A) - P(A \cap B) = P(A \cup B) - P(B) = P(A \cap \bar{B}) = 1 - P(\bar{A} \cup B)$$
- B-2** If  $P(A) = 0.7$  and  $P(A \cap B) = 0.5$  find  
 (i)  $P(A - \bar{B})$  (ii)  $P(\bar{A} \cup B)$
- B-3.** If  $P(A) = 0.4$ ,  $P(B) = 0.48$  and  $P(A \cap B) = 0.16$ , then find the value of each of the following :  
 (i)  $P(A \cup B)$  (ii)  $P(A' \cap B)$   
 (iii)  $P(A' \cap B')$  (iv)  $P((A \cap B') \cup (A' \cap B))$
- B-4.** There are three clubs A, B, C in a town with 40, 50, 60 members respectively 10 people are members of all the three clubs, 70 members belong to only one club. A member is randomly selected. Find the probability that he has membership of exactly two clubs

### Section (C) : Problems based on Conditional Probability/ Total probability & Bayes' theorem

- C-1.** (i) In a two child family, one child is a boy. What is the probability that the other child is a girl?  
 (ii) If the older child is a boy, then probability that the second child is a girl is
- C-2.** A fair dice is thrown untill a score of less than 5 points is obtained. Find the probability of obtaining not less than 2 points on the last throw.
- C-3.** A card is drawn from a well shuffled ordinary deck of 52 playing cards. Find the probability that the card drawn is :  
 (i) A king or a queen (ii) A king or a spade
- C-4.** The odds against a certain event are 5 to 2, and the odds in favor of another event independent of the former are 6 to 5 : find the chance that one at least of the events will happen.
- C-5.** A, B, C in order draws a card from a pack of cards, replacing them after each draw, on condition that the first who draws a spade shall win a prize : find their respective chances.
- C-6.** 6 persons A,B,C,D,E,F are arranged in row. Find the conditional probability that C & D are separated given that A & B are together.
- C-7.** There are 5 brilliant students in class XI and 8 brilliant students in class XII. Each class has 50 students. The odds in favour of choosing the class XI are 2 : 3. One of the classes is chosen randomly and then a student is randomly selected. Find the probability of selecting a brilliant student.
- C-8.** Box – I contains 5 red and 2 blue balls while box – II contains 2 red and 6 blue balls. A fair coin is tossed. If it turns up head, a ball is drawn from box–I, else a ball is drawn from box–II. Find the probability of each of the following :  
 (i) A red ball is drawn (ii) Ball drawn is from box–I if it is blue



- C-9.** Two cards are drawn successively from a well-shuffled ordinary deck of 52-playing cards without replacement and is noted that the second card is a king. Find the probability of the event 'first card is also a king'.
- C-10.** 12 cards, numbered 1 to 12, are placed in a box, mixed up thoroughly and then a card is drawn at random from the box. If it is known that the number on the drawn card is more than 3, find the probability that it is an even number.
- C-11.** In a building programme the event that all the materials will be delivered at the correct time is M, and the event that the building programme will be completed on time is F. Given that  $P(M) = 0.8$  &  $P(M \cap F) = 0.65$ . If  $P(F) = 0.7$ , find the probability that the building programme will be completed on time if all the materials are not delivered at the correct time.

### Section (D) : Problem based on Binomial Distribution / Expectation / mean & Variance

- D-1.** South African cricket captain lost the toss of a coin 13 times out of 14. Then find the chance of this happening.
- D-2.** In an examination of 10 multiple choice questions (1 or more can be correct out of 4 options). A student decides to mark the answers at random. Find the probability that he gets exactly two questions correct. (Assume he attempts all the questions)
- D-3.** Three cards are drawn successively with replacement from a well shuffled deck of 52 playing cards. If getting a card of spade is considered a success, find the probability distribution of the number of successes.
- D-4.** A had in his pocket a 100 Rupee and four 10 rupee notes; taking out two notes at random he promises to give them to B and C. What is the worth of C's expectation?
- D-5.** A box contains 2 red and 3 blue balls. Two balls are drawn successively with replacement. If getting 'a red ball on first draw and a blue ball on second draw' is considered a success, then write the probability distribution of successes. It is given that the above experiment is performed 3-times,
- D-6.** A coin is tossed 5-times. Find the mean and variance of the probability distribution of appearance of heads on the tosses.

## PART - II : ONLY ONE OPTION CORRECT TYPE

### Section (A) : Problems based on Classical definition of Probability (PRCD)

- A-1.** In drawing of a card from a well shuffled ordinary deck of playing cards the events 'card drawn is spade' and 'card drawn is an ace' are  
 (A) mutually exclusive (B) equally likely  
 (C) forming an exhaustive system (D) none of these
- A-2.** A 9 digit number using the digits 1, 2, 3, 4, 5, 6, 7, 8 & 9 is written randomly without repetition. The probability that the number will be divisible by 9 is:  
 (A)  $\frac{1}{9}$  (B)  $\frac{1}{2}$  (C) 1 (D)  $\frac{9!}{9^9}$
- A-3.** Entries of a  $2 \times 2$  determinant are chosen from the set  $\{-1, 1\}$ . The probability that determinant has zero value is  
 (A)  $\frac{1}{4}$  (B)  $\frac{1}{3}$  (C)  $\frac{1}{2}$  (D) none of these





- A-4.** A dice is thrown a fixed number of times. If probability of getting even number 3 times is same as the probability of getting even number 4 times, then probability of getting even number exactly once is  
 (A)  $\frac{1}{4}$  (B)  $\frac{3}{128}$  (C)  $\frac{5}{64}$  (D)  $\frac{7}{128}$
- A-5.** A and B throw with two dice ; if A throws 9, then B's chance of throwing a higher number equals  
 (A)  $\frac{1}{6}$  (B)  $\frac{1}{3}$  (C)  $\frac{1}{2}$  (D)  $\frac{2}{3}$
- A-6.** If an integer  $q$  is chosen at random in the interval  $-10 \leq q \leq 10$ , then the probability that the roots of the equation  $x^2 + qx + \frac{3q}{4} + 1 = 0$  are real is  
 (A)  $\frac{16}{21}$  (B)  $\frac{15}{21}$  (C)  $\frac{14}{21}$  (D)  $\frac{17}{21}$
- A-7.** The chance that a 13 card combination from a pack of 52 playing cards is dealt to a player in a game of bridge, in which 9 cards are of the same suit, is  
 (A)  $\frac{4 \cdot {}^{13}C_9 \cdot {}^{39}C_4}{{}^{52}C_{13}}$  (B)  $\frac{4! \cdot {}^{13}C_9 \cdot {}^{39}C_4}{{}^{52}C_{13}}$  (C)  $\frac{{}^{13}C_9 \cdot {}^{39}C_4}{{}^{52}C_{13}}$  (D)  $2 \cdot \frac{{}^{13}C_9 \cdot {}^{39}C_4}{{}^{52}C_{13}}$
- A-8.** A bag contains 7 tickets marked with the numbers 0, 1, 2, 3, 4, 5, 6 respectively. A ticket is drawn & replaced. Then the chance that after 4 drawings the sum of the numbers drawn is 8 is:  
 (A) 165/2401 (B) 149/2401 (C) 3/49 (D) 1/49
- A-9.** A & B having equal skill, are playing a game of best of 5 points. After A has won two points & B has won one point, the probability that A will win the game is:  
 (A) 1/2 (B) 2/3 (C) 3/4 (D) 2/5

### Section (B) : Problems based on venn diagram & set theory (PRVD)

- B-1.** If two subsets A and B of set S containing  $n$  elements are selected at random, then the probability that  $A \cap B = \phi$  and  $A \cup B = S$  is  
 (A)  $\frac{1}{2}$  (B)  $\frac{1}{2^n}$  (C)  $\left(\frac{3}{4}\right)^n$  (D)  $\frac{1}{3^n}$
- B-2.** If  $P(A) = \frac{3}{5}$  and  $P(B) = \frac{2}{3}$  then –  
 (i) The range of values of  $P(A \cap B)$  is  
 (A)  $\left[\frac{2}{5}, \frac{9}{10}\right]$  (B)  $\left[\frac{2}{3}, 1\right]$  (C)  $\left[0, \frac{1}{3}\right]$  (D)  $\left[\frac{4}{15}, \frac{3}{5}\right]$   
 (ii) The range of values of  $P(A \cup B)$  is  
 (A)  $\left[\frac{2}{5}, \frac{9}{10}\right]$  (B)  $\left[\frac{2}{3}, 1\right]$  (C)  $\left[0, \frac{1}{3}\right]$  (D)  $\left[\frac{4}{15}, \frac{3}{5}\right]$   
 (iii) The range of values of  $P(A \cap B')$  is  
 (A)  $\left[\frac{2}{5}, \frac{9}{10}\right]$  (B)  $\left[\frac{2}{3}, 1\right]$  (C)  $\left[0, \frac{1}{3}\right]$  (D)  $\left[\frac{4}{15}, \frac{3}{5}\right]$
- B-3.** Let  $X = \{1, 2, \dots, 10\}$ , if set A and B are formed from elements of X the probability that  $n(A \cap B) = 2$ , is  
 (A)  $\frac{{}^{10}C_2}{4^{10}}$  (B)  $5 \cdot \left(\frac{3}{4}\right)^{10}$  (C)  $\left(\frac{3}{4}\right)^{10}$  (D)  $\frac{3^8}{4^{10}}$
- B-4.** If probability that exactly one of events A, B, C occurs, is 0.6 and probability that none of A, B, C occur is 0.2, then probability that atleast two of A, B, C occur is  
 (A) 0.6 (B) 0.4 (C) 0.8 (D) 0.2



### Section (C) : Problems based on Conditional Probability/ Total probability & Bayes' theorem

- C-1.** The odds that a book will be favourably reviewed by three independent critics are 5 to 2, 4 to 3, and 3 to 4 respectively. Then the probability that of the three reviews a majority will be favourable.  
 (A)  $\frac{163}{343}$  (B)  $\frac{209}{343}$  (C)  $\frac{209}{387}$  (D)  $\frac{208}{387}$
- C-2.** In throwing a pair of dice, the events 'coming up of 6 on 1<sup>st</sup> dice' and 'a total of 7 on both the dice' are  
 (A) mutually exclusive (B) forming an exhaustive system  
 (C) independent (D) dependent
- C-3.** A dice is thrown twice and the sum of the numbers appearing is observed to be 8. The conditional probability that the number 5 has appeared at least once is  
 (A)  $\frac{1}{6}$  (B)  $\frac{2}{5}$  (C)  $\frac{3}{5}$  (D)  $\frac{1}{2}$
- C-4.** An instrument consists of two units. Each unit must function for the instrument to operate. The reliability of the first unit is 0.9 and that of the second unit is 0.8. The instrument is tested & fails. The probability that "only the first unit failed & the second unit is sound" is "  
 (A)  $\frac{1}{7}$  (B)  $\frac{2}{7}$  (C)  $\frac{3}{7}$  (D)  $\frac{4}{7}$
- C-5.** A pack of cards is counted with face downwards. It is found that one card is missing. One card is drawn and is found to be red. Then the probability that the missing card is red.  
 (A)  $\frac{25}{51}$  (B)  $\frac{26}{51}$  (C)  $\frac{1}{2}$  (D)  $\frac{25}{52}$
- C-6.** Pal's gardner is not dependable, the probability that he will forgot to water the rose bush is  $\frac{2}{3}$ . The rose bush is in questionable condition. Any how if watered, the probability of its withering is  $\frac{1}{2}$  & if not watered then the probability of its withering is  $\frac{3}{4}$ . Pal went out of station & after returning he finds that rose bush has withered. Then the probability that the gardner did not water the rose bush is.  
 (A)  $\frac{3}{4}$  (B)  $\frac{2}{5}$  (C)  $\frac{1}{4}$  (D)  $\frac{1}{2}$
- C-7.** A dice is weighted so that the probability of different faces to turn up is as given

Number	1	2	3	4	5	6
Probability	0.2	0.1	0.1	0.3	0.1	0.2

If  $P(A/B) = p_1$  and  $P(B/C) = p_2$  and  $P(C/A) = p_3$  then the values of  $p_1, p_2, p_3$  respectively are -

Take the events A, B & C as  $A = \{1, 2, 3\}$ ,  $B = \{2, 3, 5\}$  and  $C = \{2, 4, 6\}$

- (A)  $\frac{2}{3}, \frac{1}{3}, \frac{1}{4}$  (B)  $\frac{1}{3}, \frac{1}{3}, \frac{1}{6}$  (C)  $\frac{1}{4}, \frac{1}{3}, \frac{1}{6}$  (D)  $\frac{2}{3}, \frac{1}{6}, \frac{1}{4}$

### Section (D) : Problem based on Binomial Distribution / Expectation / mean & Variance

- D-1.** A bag contains 2 white & 4 black balls. A ball is drawn 5 times, each being replaced before another is drawn. The probability that atleast 4 of the balls drawn are white is:  
 (A)  $\frac{4}{81}$  (B)  $\frac{10}{243}$  (C)  $\frac{11}{243}$  (D)  $\frac{8}{243}$
- D-2.** In a series of 3 independent trials the probability of exactly 2 success is 12 times as large as the probability of 3 successes. The probability of a success in each trial is:  
 (A)  $\frac{1}{5}$  (B)  $\frac{2}{5}$  (C)  $\frac{3}{5}$  (D)  $\frac{4}{5}$



- D-3.** A coin is tossed  $n$  times, what is the chance that the head will present itself an odd number of times.  
 (A)  $\frac{1}{2}$  (B)  $\frac{2}{3}$  (C)  $\frac{1}{4}$  (D)  $\frac{2}{5}$
- D-4.** From a bag containing 2 one rupee and 3 two rupee coins a person is allowed to draw 2 coins randomly then the value of his expectation.  
 (A) Rs. 5.10 (B) Rs. 2.30 (C) Rs. 4.30 (D) Rs. 3.20
- D-5.** A & B throw with one dice for a stake of Rs. 99/- which is to be won by the player who first throws 4. If A has the first throw then their respective expectations of rupees are:  
 (A) 50 & 49 (B) 54 & 45 (C) 45 & 54 (D) 33 & 66
- D-6.** A fair coin is tossed 99 times. If  $X$  is the number of times heads occur, if  $P(X = r)$  is maximum then sum of possible values of  $r$  is  
 (A) 98 (B) 99 (C) 101 (D) 104

### PART - III : MATCH THE COLUMN

- 1. Column – I**
- (A) If the probability that units digit in square of an even integer is 4 is  $p$ , then the value of  $5p$  is
- (B) If A and B are independent events and  $P(A \cap B) = \frac{1}{6}$ ,  $P(A) = \frac{1}{3}$ , then  $6P\left(\frac{B}{A}\right) =$
- (C) One mapping is selected at random from all mappings of the set  $S = \{1, 2, 3, \dots, n\}$  into itself. If the probability that the mapping is one-one is  $\frac{3}{32}$ , then the value of  $n$  is
- (D) A boy has 20% chance of hitting at a target. Let  $p$  denote the probability of hitting the target for the first time at the  $n^{\text{th}}$  trial. If  $p$  satisfies the inequality  $625p^2 - 175p + 12 < 0$ , then value of  $n$  is
- Column – II**
- (p) 1
- (q) 2
- (r) 3
- (s) 4
- 2. Column – I**
- (A) A pair of dice is thrown. If total of numbers turned up on both the dice is 8, then the probability that the number turn up on the second dice is 5' is
- (B) A box contains 4 white and 3 black balls. Two balls are drawn successively and is found that second ball is white, then the probability that 1st ball is also white is
- (C) A biased coin with probability  $p$ ,  $0 < p < 1$  of heads is tossed until a head appears for the first time. If the probability that the number of tosses required is even is  $\frac{2}{5}$ , then  $p$  equals
- (D) A coin whose faces are marked 3 and 5 is tossed 4 times : what is the probability that the sum of the numbers thrown being less, than 15?
- Column – II**
- (p)  $\frac{5}{16}$
- (q)  $\frac{1}{3}$
- (r)  $\frac{1}{2}$
- (s)  $\frac{1}{5}$



## Exercise-2

Marked questions are recommended for Revision.

### PART - I : ONLY ONE OPTION CORRECT TYPE

- A local post office is to send  $M$  telegrams which are distributed at random over  $N$  communication channels, ( $N > M$ ). Each telegram is sent over any channel with equal probability. Chance that not more than one telegram will be sent over each channel is:

(A)  $\frac{{}^N C_M \cdot M!}{N^M}$  (B)  $\frac{{}^N C_M \cdot N!}{M^N}$  (C)  $1 - \frac{{}^N C_M \cdot M!}{M^N}$  (D)  $1 - \frac{{}^N C_M \cdot N!}{N^M}$
- A cube painted red on all sides, is cut into 125 equal small cubes. A small cube when picked up is found to show red colour on one of its faces. Then the probability that two more faces also show red colour.

(A)  $\frac{4}{49}$  (B)  $\frac{4}{120}$  (C)  $\frac{8}{49}$  (D)  $\frac{3}{49}$
- A car is parked by an owner in a parking lot of 25 cars in a row, including his car not at either end. On his return he finds that exactly 15 places are still occupied. The probability that both the neighboring places are empty is

(A)  $\frac{91}{276}$  (B)  $\frac{15}{184}$  (C)  $\frac{15}{92}$  (D)  $\frac{17}{92}$
- A has 3 tickets in a lottery containing 3 prizes and 9 blanks; B has 2 tickets in a lottery containing 2 prizes and 6 blanks. Compare their chances of success

(A) 952 / 715 (B) 950 / 952 (C) 952 / 710 (D) 425/952
- A  $2n$  digit number starts with 2 and all its digits are prime, then the probability that the sum of all 2 consecutive digits of the number is prime, is

(A)  $4 \times 2^{3n}$  (B)  $4 \times 2^{-3n}$  (C)  $2^{3n}$  (D)  $2^{2n}$
- A fair coin is tossed eight times, then find the probability that resulting sequence of heads and tails looks the same when viewed from the beginning or from the end.

(A) 1/8 (B) 1/16 (C) 1/4 (D) 1/2
- An urn contains ' $m$ ' green and ' $n$ ' red balls.  $K$  ( $< m, n$ ) balls are drawn and laid aside, their colour being ignored. Then one more ball is drawn. Then the probability that it is green.

(A)  $\frac{m}{m+n}$  (B)  $\frac{n}{m+n}$  (C)  $\frac{2n}{m+n}$  (D)  $\frac{3n}{m+n}$
- In a regular decagon find the probability that the two diagonal chosen at random will intersect inside the polygon.

(A)  $\frac{6}{17}$  (B)  $\frac{12}{17}$  (C)  $\frac{5}{17}$  (D)  $\frac{3}{17}$
- An urn contains  $m$  white and  $n$  black balls. A ball is drawn at random and is put back into the urn along with  $k$  additional balls of the same colour as that of the ball drawn. A ball is again drawn at random. Then the probability that the ball drawn now is white.

(A)  $\frac{m}{m+n}$  (B)  $\frac{n}{m+n}$  (C)  $\frac{2n}{m+n}$  (D)  $\frac{2m}{m+n}$





10. There are two urns. There are  $m$  white &  $n$  black balls in the first urn and  $p$  white &  $q$  black balls in the second urn. One ball is taken from the first urn & placed into the second. The probability of drawing a white ball from the second urn is -  
 (A)  $\frac{(p+1)n+pm}{(m+n)(p+q+1)}$  (B)  $\frac{(p+1)m+pn}{(m+n)(p-q+1)}$  (C)  $\frac{(p+1)m+2pn}{(m+n)(p+q+1)}$  (D)  $\frac{(p+1)m+pn}{(m+n)(p+q+1)}$
11. The chance that the top card in the deck is a diamond given that the fourth card from the top is a eight in well shuffled deck.  
 (A)  $\frac{1}{4}$  (B)  $\frac{2}{3}$  (C)  $\frac{1}{2}$  (D)  $\frac{2}{5}$
12. A fair coin is tossed 9 times the probability that at least 5 consecutive heads occurs is  
 (A)  $\frac{5}{64}$  (B)  $\frac{3}{32}$  (C)  ${}^9C_5 \left(\frac{1}{2}\right)^9$  (D)  $\frac{5}{2^9}$
13. A man has 10 coins and one of them is known to have two heads. He takes one at random and tosses it 5 times and it always falls head. Then the chance that it is the coins with two heads.  
 (A)  $\frac{32}{41}$  (B)  $\frac{32}{51}$  (C)  $\frac{23}{32}$  (D)  $\frac{19}{32}$
14. 2 hunters A & B shot at a bear simultaneously. The bear was shot dead with only one hole in its hide. Probability of A shooting the bear 0.8 & that of B shooting the bear is 0.4. The hide was sold for Rs. 280/-. If this sum of money is divided between A & B in a fair way, then find the share of A  
 (A) 130 (B) 240 (C) 200 (D) 190
15. A number is chosen at random from the numbers 10 to 99. A number whose product of digits is 12 will be called a good number. If he choose three numbers with replacement then the probability that he will choose a good number at least once is  
 (A) 0.872 (B) 0.127 (C) 0.562 (D) 0.461

## PART - II : SINGLE AND DOUBLE VALUE INTEGER TYPE

1. Seven digits from the number 1, 2, 3, 4, 5, 6, 7, 8 & 9 are written in random order. The probability that this seven digit number is divisible by 9 is  $\frac{p}{q}$  then value of  $p^2 + q^2$  is.  
 (Where  $p$  &  $q$  are co-prime natural numbers)
2. Three numbers are chosen at random without replacement from  $\{1, 2, 3, \dots, 10\}$ . The probability that the minimum of the chosen numbers is 3 or their maximum is
3. In a multiple choice question there are 4 alternative answers of which 1, 2, 3 or all may be correct. A candidate will get marks in the question only if he ticks all the correct answer. The candidate decides to tick answers at random. If he is allowed upto 5 chances to answer the question, If the probability that he will get the marks in the question is  $p$  then  $40p$  equals
4. 3 firemen X, Y and Z shoot at a common target. The probabilities that X and Y can hit the target are  $\frac{2}{3}$  and  $\frac{3}{4}$  respectively. If the probability that exactly two bullets are found on the target is  $\frac{11}{24}$ , then the probability of Z to hit the target is
5. A mapping is selected at random from all the mappings defined on the set A consisting of three distinct elements. Probability that the mapping selected is one to one is





6. A card is drawn from a pack, the card is replaced & the pack shuffled. If this is done 6 times, the probability that the cards drawn are 2 hearts, 2 diamonds & 2 black cards is  $\frac{p}{q}$  then total number of proper divisors of  $\frac{pq}{2}$ . (Where p & q are co-prime natural numbers):
7. There is a three volume dictionary among 40 books arranged on a shelf in random order. Then the reciprocal of probability of these volumes standing in increasing order from left to right (the volumes are not necessarily kept side by side) is
8. There are 4 urns. The first urn contains 1 white & 1 black ball, the second urn contains 2 white & 3 black balls, the third urn contains 3 white & 5 black balls & the fourth urn contains 4 white & 7 black balls. The selection of each urn is not equally likely. The probability of selecting  $i^{\text{th}}$  urn is  $\frac{i^2 + 1}{34}$  ( $i = 1, 2, 3, 4$ ). If we randomly select one of the urns & draw a ball, then the probability of ball being white is  $\frac{p}{q}$  then sum of digits of p is. (Where p & q are co-prime natural numbers) :
9. In a Nigerian hotel, among the english speaking people 40% are English & 60% Americans. The English & American spellings are "RIGOUR" & "RIGOR" respectively. An English speaking person in the hotel writes this word. A letter from this word is chosen at random & found to be a vowel. If the probability that the writer is an Englishman is  $\frac{a}{b}$ , then  $\frac{1}{4} (5a + b + 23)$  equals. (Where a & b are co-prime natural numbers)
10. Mr. Modi is a professional tea taster. When given a high grade tea, he will identify it with probability 0.9 correctly as high grade and will mistake it for a low grade tea with probability 0.1. When given a low grade tea, he will identify it with probability 0.8 correctly as low grade tea and will mistake it for a high grade tea with probability 0.2. Suppose that Mr. Modi is given ten unlabelled cups of tea, three with high grade and seven with low grade tea. He randomly picks a cup, tries the tea and solemnly says "high grade tea". Then the probability that the tea he tasted was low grade tea is
11. A gambler has one rupee in his pocket. He tosses an unbiased normal coin unless either he is ruined or unless the coin has been tossed for a maximum of five times. If for each head he wins a rupee and for each tail he loses a rupee, then if the probability that the gambler is ruined is
12. 3 cards are given, one of them is red on both sides, one is blue on both sides & one is blue on one side and red on the other side. One of them is chosen randomly & put on the table. It shows red colour on the upper side. If probability of the other side of the card being red is  $\frac{p}{q}$  (where p and q are co-prime natural numbers) then  $\frac{10p + 15q}{4}$  is
13. In a purse there are 10 coins, all 5 paise except one which is a rupee. In another purse there are 10 coins all 5 paise. 9 coins are taken out from the former purse & put into the latter & then 9 coins are taken out from the latter & put into the former. Then the chance that the rupee is still in the first purse is
14. A Teacher wrote either of words "PARALLELOGRAM" or "PARALLELOPIPED" on board but due to malfunction of marker words is not properly written and only two consecutive letters "RA" are visible then the chance that the written word is "PARALLELOGRAM" is
15. The numbers 'a and b' are randomly selected from the set of natural numbers. Probability that the number  $3^a + 7^b$  has a digit equal to 8 at the units place, is



16. Suppose that of all used cars of a particular year, 30% have bad brakes. You are considering buying a used car of that year. You take the car to a mechanic to have the brakes checked. The chance that the mechanic will give you wrong report is 20%. Assuming that the car you take to the mechanic is selected "at random" from the population of cars of that year. The odds in favor of chance that the car's brakes are good given that the mechanic says its brakes are good is
17. A bag contains  $(n + 1)$  coins. It is known that one of these coins has a head on both sides, whereas the other coins are normal. One of these coins is selected at random & tossed. If the probability that the toss results in head, is  $\frac{7}{12}$ , then the value of  $n$  is.
18. In a certain factory machines A, B and C produce bolts. of their production A, B and C produce 2%, 1% and 3% defective bolts respectively. Machine A produces 35% of the total output of bolts machine B produces 25% and machine C produces 40%. A bolts is chosen at random from the factory's production and its found to be defective. The odds in favor that it was produced on machine C is
19. In each of a set of games it is 2 to 1 in favor of the winner of the previous game. If the probability that the player who wins the first game shall win three at least of the next four is  $\frac{p}{q}$  then  $pq$  equals : (Where  $p$  &  $q$  are co-prime natural numbers)
20. A couple has one or two or three children with probability  $\frac{1}{4}$ ,  $\frac{1}{2}$  and  $\frac{1}{4}$  respectively. Probability of a couple having exactly four grandchildren in such a type of society is  $\frac{p}{q}$  then sum of digit of  $q$  equals. (Where  $p$  &  $q$  are co-prime natural numbers)

### PART - III : ONE OR MORE THAN ONE OPTIONS CORRECT TYPE

1. In throwing a dice let A be the event 'coming up of an odd number', B be the event 'coming up of an even number', C be the event 'coming up of a number  $\geq 4$ ' and D be the event 'coming up of a number  $< 3$ ', then  
 (A) A and B are mutually exclusive and exhaustive  
 (B) A and C are mutually exclusive and exhaustive  
 (C) A, C and D form an exhaustive system  
 (D) B, C and D form an exhaustive system
2. If M & N are any two events, then which one of the following represents the probability of the occurrence of exactly one of them ?  
 (A)  $P(M) + P(N) - 2P(M \cap N)$   
 (B)  $P(M) + P(N) - P(M \cap N)$   
 (C)  $P(\bar{M}) + P(\bar{N}) - 2P(\bar{M} \cap \bar{N})$   
 (D)  $P(M \cap \bar{N}) + P(\bar{M} \cap N)$
3. Let  $0 < P(A) < 1$ ,  $0 < P(B) < 1$  &  $P(A \cup B) = P(A) + P(B) - P(A) \cdot P(B)$ , then:  
 (A)  $P(B/A) = P(B) - P(A)$   
 (B)  $P(A^c \cup B^c) = P(A^c) + P(B^c)$   
 (C)  $P((A \cup B)^c) = P(A^c) \cdot P(B^c)$   
 (D)  $P(A/B) = P(A)$
4. A box contains 11 tickets numbered from 1 to 11. Two tickets are drawn simultaneously at random. Let  $E_1$  denotes the event that the sum of the numbers on the tickets drawn is even and  $E_2$  denotes the event that the sum of the numbers on the tickets drawn is odd. Which of the following hold good ?  
 (A)  $P(E_1/E_2) = P(E_2/E_1)$   
 (B)  $E_1$  and  $E_2$  are exhaustive  
 (C)  $P(E_2) > P(E_1)$   
 (D)  $E_1$  and  $E_2$  are equally likely



5. The probabilities of events,  $A \cap B$ ,  $A, B$  &  $A \cup B$  are respectively in A.P. with second term equal to the common difference. Therefore  $A$  &  $B$  are :
- (A) mutually exclusive  
(B) independent  
(C) such that one of them must occur  
(D) such that one is twice as likely as the other
6. A bag contains four tickets marked with numbers 112, 121, 211, 222. One ticket is drawn at random from the bag. Let  $E_i (i = 1, 2, 3)$  denote the event that  $i$ th digit on the ticket is 2. Then
- (A)  $E_1$  and  $E_2$  are independent  
(B)  $E_2$  and  $E_3$  are independent  
(C)  $E_3$  and  $E_1$  are independent  
(D)  $E_1, E_2, E_3$  are independent
7. In an experimental performance of a single throw of a pair of unbiased normal dice, three events  $E_1, E_2$  &  $E_3$  are defined as follows:
- $E_1$ : getting a prime numbered face on each dice  
 $E_2$ : getting the same number on each dice  
 $E_3$ : getting a sum total of dots on two dice equal to 8. Then:
- (A) the events  $E_1, E_2$  &  $E_3$  are mutually exclusive  
(B) the events  $E_1, E_2$  &  $E_3$  are not pairwise mutually exclusive  
(C) the events  $E_1, E_2$  are independent  
(D)  $P(E_3 | E_1) = 2/9$ .
8. The probability that a bulb produced by a factory will fuse after an year of use is 0.1. Then the probability that out of 4 such bulbs
- (A) None of then bulb will fuse after an year of use is  $\frac{9^4}{10^4}$   
(B) More then three bulbs will fuse after an year of use is  $\frac{1}{10^4}$   
(C) Not more then three bulbs will fuse after an year of use is  $\frac{9999}{10000}$   
(D) All the bulbs will fuse after an year of use is  $\frac{1}{10^4}$
9. If 4 whole numbers taken at random are multiplied together
- (A) Probability that the last digit in the product is 1, 3, 7 or 9 is  $\frac{16}{625}$   
(B) Probability that the last digit in the product is '5' is  $\frac{369}{10^4}$   
(C) Probability that the last digit in the product is 0 is  $\frac{3727}{10^4}$   
(D) Probability that the last digit in the product is 0 is  $\frac{2357}{10^4}$
10. The probability that  $4^{\text{th}}$  power of a positive integer ends in the digit  $\lambda$  is  $P(\lambda)$
- (A)  $P(6) = \frac{4}{10}$       (B)  $P(1) = \frac{4}{10}$       (C)  $P(5) = \frac{1}{10}$       (D)  $P(0) = \frac{1}{10}$



11. Mean and variance of a Binomial variate of 10 trials of the experiment are in the ratio of 3 : 2.  
 (A) The most probable number of happening of variable is 3  
 (B) Sum of the mean and variance is 10  
 (C) Probability of getting exactly 5 success is  $\frac{8064}{3^{10}}$   
 (D) The most probable number of happening of variable is 5
12. A student appears for tests I, II & III. The student is successful if he passes either in tests I & II or tests I & III. The probabilities of the student passing in the tests I, II & III are p, q &  $\frac{1}{2}$  respectively. If the probability that the student is successful is  $\frac{1}{2}$ , then:  
 (A)  $p = 1, q = 0$  (B)  $p = \frac{2}{3}, q = \frac{1}{2}$   
 (C)  $p = \frac{3}{5}, q = \frac{2}{3}$  (D) there are infinitely many values of p & q.
13. A student has to match three historical events i.e. Dandi March, Quit India Movement and Mahatma Gandhi's assassination with the years 1948, 1930 and 1942 and each event happens in different years. The student has no knowledge of the correct answers and decides to match the events and years randomly. Let  $E_i : (0 \leq i \leq 3)$  denote the event that the student gets exactly i correct answer, then  
 (A)  $P(E_0) + P(E_3) = P(E_1)$  (B)  $P(E_0) \cdot P(E_1) = P(E_3)$   
 (C)  $P(E_0 \cap E_1) = P(E_2)$  (D)  $P(E_0) + P(E_1) + P(E_3) = 1$
14. For any two events A & B defined on a sample space,  
 (A)  $P(A/B) \geq \frac{P(A) + P(B) - 1}{P(B)}$ ,  $P(B) \neq 0$  is always true  
 (B)  $P(A \cup \bar{B}) = P(A) - P(A \cap B)$   
 (C)  $P(A \cup B) = 1 - P(A^c) \cdot P(B^c)$ , if A & B are independent  
 (D)  $P(A \cup B) = 1 - P(A^c) \cdot P(B^c)$ , if A & B are disjoint
15. An unbiased coin is tossed n times. Let X denote the number of times head occurs. If  $P(X = 4)$ ,  $P(X = 5)$  and  $P(X = 6)$  are in AP, then the value of n can be  
 (A) 7 (B) 10 (C) 12 (D) 14
16. A random variable x takes values 0, 1, 2, 3, ....., with probability proportional to  $(x + 1) \left(\frac{1}{5}\right)^x$ , then  
 (A)  $P(x = 0) = \frac{16}{25}$  (B)  $P(x \leq 1) = \frac{112}{125}$  (C)  $P(x \geq 1) = \frac{9}{25}$  (D)  $E(x) = \frac{25}{32}$
17. Let X be a set containing 'n' elements. If two subsets A and B of X are picked at random. The probability of A and B having same number of elements  
 (A)  $\frac{{}^{2n}C_n}{2^{2n}}$  (B)  $\frac{1}{{}^{2n}C_n}$  (C)  $\frac{1 \cdot 3 \cdot 5 \cdots (2n-1)}{2^n \cdot n!}$  (D)  $\frac{3^n}{4^n}$
18. A square matrix of order  $3 \times 3$  is formed using the elements of the set  $\{-2016, 0, 2016\}$   
 (A) Probability of getting a matrix which is symmetric  $\frac{1}{3^3}$  is  
 (B) Probability of getting a matrix which is skew symmetric  $\frac{1}{3^6}$  is  
 (C) Probability of getting a matrix which has maximum trace is  $\frac{1}{3^3}$   
 (D) Probability of getting a matrix which has minimum trace is  $\frac{1}{3^3}$



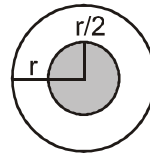
## PART - IV : COMPREHENSION

### Comprehension # 1

If sample space contains infinite number of points then with the help of geometry that is length, area, volume many problems of probability can be solved

**For example :** A point is selected randomly inside the circle then the probability that it is nearer to centre than its circumference

$$\text{Probability} = \frac{\text{Favourable Area}}{\text{Total Area}} = \frac{\frac{\pi r^2}{4}}{\pi r^2} = \frac{1}{4}$$



- A sphere is circumscribed over a cube. Find the probability that a point lies inside the sphere, lies outside the cube.  
 (A)  $1 - \frac{2}{\pi\sqrt{3}}$       (B)  $1 - \frac{1}{\pi\sqrt{3}}$       (C)  $1 - \frac{1}{2\pi\sqrt{3}}$       (D)  $1 - \frac{2}{2\pi\sqrt{3}}$
- A parallelogram is inscribed inside a circle of radius 10 cm. One side of parallelogram being 12 cms. Then the probability that a point inside the circle also lies inside the parallelogram.  
 (A)  $\frac{48}{25\pi}$       (B)  $\frac{24}{25\pi}$       (C)  $\frac{42}{25\pi}$       (D)  $\frac{1}{2}$
- The sides of a rectangle are chosen at random, each less than 10 cm, all such lengths being equally likely. The chance that the diagonal of the rectangle is less than 10 cm is  
 (A) 1/10      (B) 1/20      (C)  $\pi/4$       (D)  $\pi/8$

### Comprehension : # 2

A JEE aspirant estimates that he will be successful with an 80 percent chance if he studies 10 hours per day, with a 60 percent chance if he studies 7 hours per day and with a 40 percent chance if he studies 4 hours per day. He further believes that he will study 10 hours, 7 hours and 4 hours per day with probabilities 0.1, 0.2 and 0.7 respectively.

- The chance he will be successful is  
 (A) 0.28      (B) 0.38      (C) 0.48      (D) 0.58
- Given that he is successful the chance that he studied for 4 hours, is  
 (A)  $\frac{6}{12}$       (B)  $\frac{7}{12}$       (C)  $\frac{8}{12}$       (D)  $\frac{9}{12}$
- Given that he does not achieve success, the chance that he studied for 4 hour, is  
 (A)  $\frac{18}{26}$       (B)  $\frac{19}{26}$       (C)  $\frac{20}{26}$       (D)  $\frac{21}{26}$

### Comprehension : # 3

A bag contain 6 Red and 4 White balls. 4 balls are drawn one by one without replacement and were found to be atleast 2 white.

- Then the probability that next draw of a ball from this bag will give a white ball.  
 (A)  $\frac{34}{115}$       (B)  $\frac{19}{115}$       (C)  $\frac{90}{115}$       (D)  $\frac{24}{115}$
- If the next draw of a ball from this bag will give a white ball then the probability that the drawn of four balls initially contain two white and two red balls.  
 (A)  $\frac{8}{17}$       (B)  $\frac{15}{17}$       (C)  $\frac{13}{17}$       (D)  $\frac{13}{34}$

**Comprehension : # 4**

Eight digit number can be formed using all the digits 1,1,2,2,3,3,4,5.

9. A number is selected at random then the probability such that no two identical digits appear together  
 (A)  $\frac{37}{84}$  (B)  $\frac{43}{84}$  (C)  $\frac{17}{84}$  (D)  $\frac{23}{84}$
10. A number is selected at random then the probability that it has exactly two pair of identical digits occurring together  
 (A)  $\frac{1}{7}$  (B)  $\frac{2}{9}$  (C)  $\frac{3}{5}$  (D)  $\frac{4}{9}$

## Exercise-3

➤ Marked questions are recommended for Revision.

\* Marked Questions may have more than one correct option.

### PART - I : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

1. ➤ Let  $\omega$  be a complex cube root of unity with  $\omega \neq 1$ . A fair die is thrown three times. If  $r_1, r_2$  and  $r_3$  are the numbers obtained on the die, then the probability that  $\omega^{r_1} + \omega^{r_2} + \omega^{r_3} = 0$  is  
**[IIT-JEE 2010, Paper-1, (3, -1), 84]**  
 (A)  $\frac{1}{18}$  (B)  $\frac{1}{9}$  (C)  $\frac{2}{9}$  (D)  $\frac{1}{36}$
2. ➤ A signal which can be green or red with probability  $\frac{4}{5}$  and  $\frac{1}{5}$  respectively, is received by station A and then transmitted to station B. The probability of each station receiving the signal correctly is  $\frac{3}{4}$ . If the signal received at station B is green, then the probability that the original signal was green is  
**[IIT-JEE 2010, Paper-2, (5, -2), 79]**  
 (A)  $\frac{3}{5}$  (B)  $\frac{6}{7}$  (C)  $\frac{20}{23}$  (D)  $\frac{9}{20}$

**Comprehension (Q.3 & 4)**

Let  $U_1$  and  $U_2$  be two urns such that  $U_1$  contains 3 white and 2 red balls, and  $U_2$  contains only 1 white ball. A fair coin is tossed. If head appears then 1 ball is drawn at random from  $U_1$  and put into  $U_2$ . However, if tail appears then 2 balls are drawn at random from  $U_1$  and put into  $U_2$ . Now 1 ball is drawn at random from  $U_2$ .  
**[IIT-JEE 2011, Paper-1, (3, -1), 80]**

3. The probability of the drawn ball from  $U_2$  being white is  
 (A)  $\frac{13}{30}$  (B)  $\frac{23}{30}$  (C)  $\frac{19}{30}$  (D)  $\frac{11}{30}$
4. Given that the drawn ball from  $U_2$  is white, the probability that head appeared on the coin is  
 (A)  $\frac{17}{23}$  (B)  $\frac{11}{23}$  (C)  $\frac{15}{23}$  (D)  $\frac{12}{23}$



- 5.\* Let E and F be two independent events. The probability that exactly one of them occurs is  $\frac{11}{25}$  and the probability of none of them occurring is  $\frac{2}{25}$ . If P(T) denotes the probability of occurrence of the event T, then

[IIT-JEE 2011, Paper-2, (4, 0), 80]

(A)  $P(E) = \frac{4}{5}$ ,  $P(F) = \frac{3}{5}$

(B)  $P(E) = \frac{1}{5}$ ,  $P(F) = \frac{2}{5}$

(C)  $P(E) = \frac{2}{5}$ ,  $P(F) = \frac{1}{5}$

(D)  $P(E) = \frac{3}{5}$ ,  $P(F) = \frac{4}{5}$

- 6\*. A ship is fitted with three engines  $E_1$ ,  $E_2$  and  $E_3$ . The engines function independently of each other with respective probabilities  $\frac{1}{2}$ ,  $\frac{1}{4}$  and  $\frac{1}{4}$ . For the ship to be operational at least two of its engines must function. Let X denote the event that the ship is operational and let  $X_1$ ,  $X_2$  and  $X_3$  denotes respectively the events that the engines  $E_1$ ,  $E_2$  and  $E_3$  are functioning. Which of the following is (are) true ?

(A)  $P[X_1^c | X] = \frac{3}{16}$

(B)  $P[\text{Exactly two engines of the ship are functioning} | X] = \frac{7}{8}$

(C)  $P[X | X_2] = \frac{5}{16}$

(D)  $P[X | X_1] = \frac{7}{16}$

[IIT-JEE 2012, Paper-1, (4, 0), 70]

7. Four fair dice  $D_1$ ,  $D_2$ ,  $D_3$  and  $D_4$  each having six faces numbered 1,2,3,4,5 and 6 are rolled simultaneously. The probability that  $D_4$  shows a number appearing on one of  $D_1$ ,  $D_2$  and  $D_3$  is

[IIT-JEE 2012, Paper-2, (3, -1), 66]

(A)  $\frac{91}{216}$

(B)  $\frac{108}{216}$

(C)  $\frac{125}{216}$

(D)  $\frac{127}{216}$

- 8\*. Let X and Y be two events such that  $P(X | Y) = \frac{1}{2}$ ,  $P(Y | X) = \frac{1}{3}$  and  $P(X \cap Y) = \frac{1}{6}$ . Which of the following is (are) correct ?

[IIT-JEE 2012, Paper-2, (4, 0), 66]

(A)  $P(X \cup Y) = \frac{2}{3}$

(B) X and Y are independent

(C) X and Y are not independent

(D)  $P(X^c \cap Y) = \frac{1}{3}$

9. Four persons independently solve a certain problem correctly with probabilities  $\frac{1}{2}$ ,  $\frac{3}{4}$ ,  $\frac{1}{4}$ ,  $\frac{1}{8}$ . Then the probability that the problem is solved correctly by at least one of them is

[JEE (Advanced) 2013, Paper-1, (2, 0)/60]

(A)  $\frac{235}{256}$

(B)  $\frac{21}{256}$

(C)  $\frac{3}{256}$

(D)  $\frac{253}{256}$

10. Of the three independent events  $E_1$ ,  $E_2$  and  $E_3$ , the probability that only  $E_1$  occurs is  $\alpha$ , only  $E_2$  occurs is  $\beta$  and only  $E_3$  occurs is  $\gamma$ . Let the probability p that none of events  $E_1$ ,  $E_2$  or  $E_3$  occurs satisfy the equations  $(\alpha - 2\beta)p = \alpha\beta$  and  $(\beta - 3\gamma)p = 2\beta\gamma$ . All the given probabilities are assumed to lie in the interval (0, 1).

Then  $\frac{\text{Probability of occurrence of } E_1}{\text{Probability of occurrence of } E_3} =$

[JEE (Advanced) 2013, Paper-1, (4, -1)/60]



**Comprehension (Q.11 & 12)**

A box  $B_1$  contains 1 white ball, 3 red balls and 2 black balls. Another box  $B_2$  contains 2 white balls, 3 red balls and 4 black balls. A third box  $B_3$  contains 3 white balls, 4 red balls and 5 black balls.

11. If 1 ball is drawn from each of the boxes  $B_1$ ,  $B_2$  and  $B_3$ , the probability that all 3 drawn balls are of the same colour is

[JEE (Advanced) 2013, Paper-2, (3, -1)/60]

- (A)  $\frac{82}{648}$  (B)  $\frac{90}{648}$  (C)  $\frac{558}{648}$  (D)  $\frac{566}{648}$

12. If 2 balls are drawn (without replacement) from a randomly selected box and one of the balls is white and the other ball is red, the probability that these 2 balls are drawn from box  $B_2$  is

[JEE (Advanced) 2013, Paper-2, (3, -1)/60]

- (A)  $\frac{116}{181}$  (B)  $\frac{126}{181}$  (C)  $\frac{65}{181}$  (D)  $\frac{55}{181}$

13. Three boys and two girls stand in a queue. The probability, that the number of boys ahead of every girl is at least one more than the number of girls ahead of her, is

[JEE (Advanced) 2014, Paper-2, (3, -1)/60]

- (A)  $\frac{1}{2}$  (B)  $\frac{1}{3}$  (C)  $\frac{2}{3}$  (D)  $\frac{3}{4}$

**Comprehension (Q.14 & 15)**

Box 1 contains three cards bearing numbers 1, 2, 3; box 2 contains five cards bearing numbers 1, 2, 3, 4, 5; and box 3 contains seven cards bearing numbers 1, 2, 3, 4, 5, 6, 7. A card is drawn from each of the boxes. Let  $x_i$  be the number on the card drawn from the  $i^{\text{th}}$  box,  $i = 1, 2, 3$ .

[JEE (Advanced) 2014, Paper-2, (3, -1)/60]

14. The probability that  $x_1 + x_2 + x_3$  is odd, is

- (A)  $\frac{29}{105}$  (B)  $\frac{53}{105}$  (C)  $\frac{57}{105}$  (D)  $\frac{1}{2}$

15. The probability that  $x_1, x_2, x_3$  are in an arithmetic progression, is

- (A)  $\frac{9}{105}$  (B)  $\frac{10}{105}$  (C)  $\frac{11}{105}$  (D)  $\frac{7}{105}$

16. The minimum number of times a fair coin needs to be tossed, so that the probability of getting at least two heads is at least 0.96, is

[JEE (Advanced) 2015, P-1 (4, 0) /88]

**Comprehension (Q.17 & 18)**

Let  $n_1$  and  $n_2$  be the number of red and black balls, respectively, in box I. Let  $n_3$  and  $n_4$  be the number of red and black balls, respectively, in box II.

[JEE (Advanced) 2015, P-2 (4, -2)/ 80]

17. One of the two boxes, box I and box II, was selected at random and a ball was drawn randomly out of this box. The ball was found to be red. If the probability that this red ball was drawn from box II is  $\frac{1}{3}$ ,

then the correct option(s) with the possible values of  $n_1, n_2, n_3$  and  $n_4$  is(are)

- (A)  $n_1 = 3, n_2 = 3, n_3 = 5, n_4 = 15$  (B)  $n_1 = 3, n_2 = 6, n_3 = 10, n_4 = 50$   
(C)  $n_1 = 8, n_2 = 6, n_3 = 5, n_4 = 20$  (D)  $n_1 = 6, n_2 = 12, n_3 = 5, n_4 = 20$

18. A ball is drawn at random from box I and transferred to box II. If the probability of drawing a red ball from box I, after this transfer, is  $\frac{1}{3}$ , then the correct option(s) with the possible values of  $n_1$  and  $n_2$  is(are)

- (A)  $n_1 = 4$  and  $n_2 = 6$  (B)  $n_1 = 2$  and  $n_2 = 3$   
(C)  $n_1 = 10$  and  $n_2 = 20$  (D)  $n_1 = 3$  and  $n_2 = 6$



19. A computer producing factory has only two plants  $T_1$  and  $T_2$ . Plant  $T_1$  produces 20% and plant  $T_2$  produces 80% of the total computers produced. 7% of computers produced in the factory turn out to be defective. It is known that  
 $P(\text{computer turns out to be defective given that it is produced in plant } T_1)$   
 $= 10 P(\text{computer turns out to be defective given that it is produced in Plant } T_2),$   
 where  $P(E)$  denotes the probability of an event  $E$ . A computer produced in the factory is randomly selected and it does not turn out to be defective. Then the probability that it is produced in plant  $T_2$  is  
**[JEE (Advanced) 2016, Paper-1, (3, -1)/62]**

### Comprehension (Q.20 & 21)

Football teams  $T_1$  and  $T_2$  have to play two games against each other. It is assumed that the outcomes of the two games are independent. The probabilities of  $T_1$  winning, drawing and losing a game against  $T_2$  are  $\frac{1}{2}$ ,  $\frac{1}{6}$  and  $\frac{1}{3}$ , respectively. Each team gets 3 points for a win, 1 point for a draw and 0 point for a loss in a game. Let  $X$  and  $Y$  denote the total points scored by teams  $T_1$  and  $T_2$ , respectively, after two games.  
**[JEE (Advanced) 2016, Paper-2, (3, -1)/62]**

20.  $P(X > Y)$  is  
 (A)  $\frac{1}{4}$  (B)  $\frac{5}{12}$  (C)  $\frac{1}{2}$  (D)  $\frac{7}{12}$
21.  $P(X = Y)$  is  
 (A)  $\frac{11}{36}$  (B)  $\frac{1}{3}$  (C)  $\frac{13}{36}$  (D)  $\frac{1}{2}$
22. Let  $X$  and  $Y$  be two events such that  $P(X) = \frac{1}{3}$ ,  $P(X|Y) = \frac{1}{2}$  and  $P(Y|X) = \frac{2}{5}$ . Then  
**[JEE(Advanced) 2017, Paper-1, (4, -2)/61]**  
 (A)  $P(Y) = \frac{4}{15}$  (B)  $P(X' | Y) = \frac{1}{2}$  (C)  $P(X \cup Y) = \frac{2}{5}$  (D)  $P(X \cap Y) = \frac{1}{5}$
23. Three randomly chosen nonnegative integers  $x$ ,  $y$  and  $z$  are found to satisfy the equation  $x + y + z = 10$ . Then the probability that  $z$  is even, is  
**[JEE(Advanced) 2017, Paper-2, (3, -1)/61]**  
 (A)  $\frac{1}{2}$  (B)  $\frac{36}{55}$  (C)  $\frac{6}{11}$  (D)  $\frac{5}{11}$

### Comprehension (Q.24 & 25)

There are five students  $S_1, S_2, S_3, S_4$  and  $S_5$  in a music class and for them there are five seats  $R_1, R_2, R_3, R_4$  and  $R_5$  arranged in a row, where initially the seat  $R_i$  is allotted to the student  $S_i$ ,  $i = 1, 2, 3, 4, 5$ . But, on the examination day, the five students are randomly allotted the five seats.

**(There are two questions based on PARAGRAPH "A", the question given below is one of them)**

**[JEE(Advanced) 2018, Paper-1, (3, -1)/60]**

24. The probability that, on the examination day, the student  $S_1$  gets the previously allotted seat  $R_1$ , and **NONE** of the remaining students gets the seat previously allotted to him/her, is  
 (A)  $\frac{3}{40}$  (B)  $\frac{1}{8}$  (C)  $\frac{7}{40}$  (D)  $\frac{1}{5}$
25. For  $i = 1, 2, 3, 4$ , let  $T_i$  denote the event that the students  $S_i$  and  $S_{i+1}$  do **NOT** sit adjacent to each other on the day of the examination. Then, the probability of the event  $T_1 \cap T_2 \cap T_3 \cap T_4$  is  
 (A)  $\frac{1}{15}$  (B)  $\frac{1}{10}$  (C)  $\frac{7}{60}$  (D)  $\frac{1}{5}$



26. There are three bags  $B_1$ ,  $B_2$  and  $B_3$ . The bag  $B_1$  contains 5 red and 5 green balls.  $B_2$  contains 3 red and 5 green balls and  $B_3$  contains 5 red and 3 green balls. Bags  $B_1$ ,  $B_2$  and  $B_3$  have probabilities  $\frac{3}{10}$ ,  $\frac{3}{10}$  and  $\frac{4}{10}$  respectively of being chosen. A bag is selected at random and a ball is chosen at random from the bag. Then which of the following options is/are correct ?  
[JEE(Advanced) 2019, Paper-1, (4, -1)/62]
- (A) Probability that the chosen ball is green, given that the selected bag is  $B_3$ , equals  $\frac{3}{8}$
- (B) Probability that the selected bag is  $B_3$ , given that the chosen ball is green, equals  $\frac{5}{13}$
- (C) Probability that the chosen ball is green equals  $\frac{39}{80}$
- (D) Probability that the selected bag is  $B_3$ , given that the chosen ball is green, equals  $\frac{3}{10}$
27. Let  $S$  be the sample space of all  $3 \times 3$  matrices with entries from the set  $\{0, 1\}$ . Let the events  $E_1 = \{A \in S : \det A = 0\}$  and  $E_2 = \{A \in S : \text{Sum of entries of } A \text{ is } 7\}$   
[JEE(Advanced) 2019, Paper-1, (4, -1)/62]  
If a matrix is chosen at random from  $S$ , then the conditional probability  $P(E_1|E_2)$  equals \_\_\_\_\_
28. Let  $|X|$  denote the number of elements in a set  $X$ . Let  $S = \{1, 2, 3, 4, 5, 6\}$  be a sample space, where each element is equally likely to occur. If  $A$  and  $B$  are independent events associated with  $S$ , then the number of ordered pairs  $(A, B)$  such that  $1 \leq |B| < |A|$  equals  
[JEE(Advanced) 2019, Paper-2, (4, -1)/62]

## PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. Four numbers are chosen at random (without replacement) from the set  $\{1, 2, 3, \dots, 20\}$ .  
**Statement -1 :** The probability that the chosen numbers when arranged in some order will form an AP is  $\frac{1}{85}$ .  
[AIEEE 2010 (8, -2), 144]  
**Statement -2 :** If the four chosen numbers form an AP, then the set of all possible values of common difference is  $\{\pm 1, \pm 2, \pm 3, \pm 4, \pm 5\}$
- (1) Statement -1 is true, Statement-2 is true ; Statement -2 is not a correct explanation for Statement 1.  
(2) Statement-1 is true, Statement-2 is false.  
(3) Statement -1 is false, Statement -2 is true.  
(4) Statement -1 is true, Statement -2 is true; Statement-2 is a correct explanation for Statement-1.
2. An urn contains nine balls of which three are red, four are blue and two are green. Three balls are drawn at random without replacement from the urn. The probability that the three balls have different colours is  
[AIEEE 2010 (4, -1), 144]
- (1)  $\frac{2}{7}$  (2)  $\frac{1}{21}$  (3)  $\frac{2}{23}$  (4)  $\frac{1}{3}$
3. Consider 5 independent Bernoulli's trials each with probability of success  $p$ . If the probability of at least one failure is greater than or equal to  $\frac{31}{32}$ , then  $p$  lies in the interval : [AIEEE 2011, I, (4, -1), 120]
- (1)  $\left[\frac{1}{2}, \frac{3}{4}\right]$  (2)  $\left[\frac{3}{4}, \frac{11}{12}\right]$  (3)  $\left[0, \frac{1}{2}\right]$  (4)  $\left[\frac{11}{12}, 1\right]$
4. If  $C$  and  $D$  are two events such that  $C \subset D$  and  $P(D) \neq 0$ , then the correct statement among the following is : [AIEEE 2011, I, (4, -1), 120]
- (1)  $P(C|D) = P(C)$  (2)  $P(C|D) \geq P(C)$  (3)  $P(C|D) < P(C)$  (4)  $P(C|D) = \frac{P(D)}{P(C)}$



5. Let A, B, C be pairwise independent events with  $P(C) > 0$  and  $P(A \cap B \cap C) = 0$ . Then  $P(A^c \cap B^c / C)$ .  
**[AIEEE 2011, II, (4, -1), 120]**  
 (1)  $1 - P(B^c)$  (2)  $P(A^c) + P(B^c)$  (3)  $P(A^c) - P(B^c)$  (4)  $P(A^c) - P(B)$
6. Three numbers are chosen at random without replacement from  $\{1, 2, 3, \dots, 8\}$ . The probability that their minimum is 3, given that their maximum is 6, is :  
**[AIEEE-2012, (4, -1)/120]**  
 (1)  $\frac{3}{8}$  (2)  $\frac{1}{5}$  (3)  $\frac{1}{4}$  (4)  $\frac{2}{5}$
7. A multiple choice examination has 5 questions. Each question has three alternative answers of which exactly one is correct. The probability that a student will get 4 or more correct answers just by guessing is :  
**[AIEEE - 2013, (4, -1) 120]**  
 (1)  $\frac{17}{3^5}$  (2)  $\frac{13}{3^5}$  (3)  $\frac{11}{3^5}$  (4)  $\frac{10}{3^5}$
8. Let A and B be two event such that  $P(\overline{A \cup B}) = \frac{1}{6}$ ,  $P(A \cap B) = \frac{1}{4}$  and  $P(\overline{A}) = \frac{1}{4}$ , where  $\overline{A}$  stands for the complement of the event A. Then the events A and B are : **[JEE(Main) 2014, (4, -1), 120]**  
 (1) independent but not equally likely (2) independent and equally likely  
 (3) mutually exclusive and independent (4) equally likely but not independent
9. If 12 identical balls are to be placed in 3 identical boxes, then the probability that one of the boxes contains exactly 3 balls is  
**[JEE(Main) 2015, (4, -1), 20]**  
 (1)  $\frac{55}{3} \left(\frac{2}{3}\right)^{11}$  (2)  $55 \left(\frac{2}{3}\right)^{10}$  (3)  $220 \left(\frac{1}{3}\right)^{12}$  (4)  $22 \left(\frac{1}{3}\right)^{11}$
10. Let two fair six-faced dice A and B be thrown simultaneously. If  $E_1$  is the event that die A shows up four,  $E_2$  is the event that die B shows up two and  $E_3$  is the event that the sum of numbers on both dice is odd, then which h of the following statements is NOT True ? **[JEE(Main) 2016, (4, -1), 120]**  
 (1)  $E_2$  and  $E_3$  are independent (2)  $E_1$  and  $E_3$  are independent  
 (3)  $E_1, E_2$  and  $E_3$  are independent (4)  $E_1$  and  $E_2$  are independent
11. For three events A, B and C,  $P(\text{Exactly one of A or B occurs}) = P(\text{Exactly one of B or C occurs}) = P(\text{Exactly one of C or A occurs}) = \frac{1}{4}$  and  $P(\text{All the three events occur simultaneously}) = \frac{1}{16}$ . Then the probability that at least one of the events occurs, is : **[JEE(Main) 2017, (4, -1), 120]**  
 (1)  $\frac{7}{32}$  (2)  $\frac{7}{16}$  (3)  $\frac{7}{64}$  (4)  $\frac{3}{16}$
12. It two different numbers are taken from the set  $\{0, 1, 2, 3, \dots, 10\}$ ; then the probability that their sum as well as absolute difference are both multiple of 4, is **[JEE(Main) 2017, (4, -1), 120]**  
 (1)  $\frac{6}{55}$  (2)  $\frac{12}{55}$  (3)  $\frac{14}{45}$  (4)  $\frac{7}{55}$
13. A box contains 15 green and 10 yellow balls. If 10 balls are randomly drawn, one-by-one, with replacement, then the variance of the number of green balls drawn is  
**[JEE(Main) 2017, (4, -1), 120]**  
 (1)  $\frac{12}{5}$  (2) 6 (3) 4 (4)  $\frac{6}{25}$
14. A bag contains 4 red and 6 balck balls. A ball is drawn at random from the bag, its colour is observed and this ball along with two additional balls of the same colour are returned to the bag. If now a ball is drawn at random from the bag, then the probability that this drawn ball is red, is  
**[JEE(Main) 2018, (4, -1), 120]**  
 (1)  $\frac{1}{5}$  (2)  $\frac{3}{4}$  (3)  $\frac{3}{10}$  (4)  $\frac{2}{5}$



15. Two cards are drawn successively with replacement from a well-shuffled deck of 52 cards. Let  $X$  denote the random variable of number of aces obtained in the two drawn cards. Then  $P(X = 1) + P(X = 2)$  equals : **[JEE(Main) 2019, Online (09-01-19), P-1 (4, -1), 120]**  
 (1)  $52/169$  (2)  $24/169$  (3)  $49/169$  (4)  $25/169$
16. Let  $S = \{1, 2, \dots, 20\}$ . A subset  $B$  of  $S$  is said to be "nice", if the sum of the elements of  $B$  is 203. Then the probability that a randomly chosen subset of  $S$  is "nice" is : **[JEE(Main) 2019, Online (11-01-19), P-2 (4, -1), 120]**  
 (1)  $\frac{4}{2^{20}}$  (2)  $\frac{5}{2^{20}}$  (3)  $\frac{7}{2^{20}}$  (4)  $\frac{6}{2^{20}}$
17. In a random experiment a fair die is rolled until two fours are obtained in succession the probability that the experiment will end in the fifth throw of the die is equal **[JEE(Main) 2019, Online (12-01-19), P-1 (4, -1), 120]**  
 (1)  $\frac{200}{6^5}$  (2)  $\frac{175}{6^5}$  (3)  $\frac{150}{6^5}$  (4)  $\frac{225}{6^5}$
18. In a game, a man wins Rs. 100 if he gets 5 or 6 on a throw of a fair die and loses Rs. 50 for getting any other number on the die. If he decides to throw the die either till he gets a five or a six or to a maximum of three throws, then his expected gain/loss (in rupees) is – **[JEE(Main) 2019, Online (12-01-19), P-2 (4, -1), 120]**  
 (1) 0 (2)  $\frac{400}{9}$  loss (3)  $\frac{400}{3}$  gain (4)  $\frac{400}{3}$  loss
19. Let  $A$  and  $B$  be two non-null events such that  $A \subset B$ . Then, which of the following statements is always correct ? **[JEE(Main) 2019, Online (08-04-19), P-1 (4, -1), 120]**  
 (1)  $P(A|B) \geq P(A)$  (2)  $P(A|B) \leq P(A)$  (3)  $P(A|B) = P(B) - P(A)$  (4)  $P(A|B) = 1$
20. The minimum number of times one has to toss a fair coin so that the probability of observing at least one head is at least 90% is : **[JEE(Main) 2019, Online (08-04-19), P-2 (4, -1), 120]**  
 (1) 3 (2) 2 (3) 5 (4) 4
21. An unbiased coin is tossed 5 times. Suppose that a variable  $X$  is assigned the value  $k$  when  $k$  consecutive heads are obtained for  $k = 3, 4, 5$  otherwise  $X$  takes the value  $-1$ . Then the expected value of  $X$ , is : **[JEE(Main) 2020, Online (07-01-20), P-1 (4, -1), 120]**  
 (1)  $\frac{3}{16}$  (2)  $-\frac{1}{8}$  (3)  $-\frac{3}{16}$  (4)  $\frac{1}{8}$
22. In a workshop there are five machines and the probability of any one of them to be out of service on a day is  $\frac{1}{4}$ . If the probability that at most two machines will be out of service on the same day is  $\left(\frac{3}{4}\right)^3 k$ , then  $k$  is equal to: **[JEE(Main) 2020, Online (07-01-20), P-2 (4, -1), 120]**  
 (1)  $\frac{17}{2}$  (2)  $\frac{17}{4}$  (3)  $\frac{17}{8}$  (4) 4
23. In an box, there are 20 cards, out of which 10 are labelled as A and the remaining 10 are labelled as B. Cards are drawn at random, one after the other and with replacement, till a second A-card is obtained. The probability that the second A-card appears before the third B-card is : **[JEE(Main) 2020, Online (09-01-20), P-1 (4, -1), 120]**  
 (1)  $\frac{13}{16}$  (2)  $\frac{15}{16}$  (3)  $\frac{9}{16}$  (4)  $\frac{11}{16}$



# Answers

## EXERCISE - 1

### PART - I

#### Section (A) :

- A-1. (i) {HHH, HHT, HTH, THH, HTT, THT, TTH, TTT}  
 (ii)  $\{B_1 B_2, B_1 B_3, B_1 G_1, B_1 G_2, B_2 B_3, B_2 G_1, B_2 G_2, B_3 G_1, B_3 G_2, G_1 G_2\}$
- A-2. 43 to 34      A-3.  $\frac{4}{5}$       A-4.  $\frac{5}{9}$       A-5.  $\frac{1}{6}$       A-6. (i)  $\frac{4}{15}$       (ii) 10
- A-7. (a) No (b) No      A-8.  $\frac{29}{36}$       A-9.  $B = \frac{2}{5}, C = \frac{4}{15}$       A-10.  $\frac{3}{10}$
- A-11. (i)  $\frac{22}{425}$       (ii)  $\frac{16}{5525}$       A-12.  $\frac{5}{36}$       A-13.  $\frac{1}{462}$       A-14. (i)  $\frac{2197}{20825}$       (ii)  $\frac{{}^{13}C_4 \times 4^4}{{}^{52}C_4}$

#### Section (B) :

- B-2 (i) 0.5      (ii) 0.8      B-3. (i) 0.72      (ii) 0.32      (iii) 0.28      (iv) 0.56
- B-4.  $\frac{5}{21}$

#### Section (C) :

- C-1. (i)  $\frac{2}{3}$       (ii)  $\frac{1}{2}$       C-2.  $\frac{3}{4}$       C-3. (i)  $\frac{2}{13}$       (ii)  $\frac{4}{13}$
- C-4.  $\frac{52}{77}$       C-5.  $\frac{16}{37}, \frac{12}{37}, \frac{9}{37}$       C-6.  $\frac{3}{5}$       C-7.  $\frac{17}{125}$
- C-8. (i)  $\frac{27}{56}$       (ii)  $\frac{8}{29}$       C-9.  $\frac{1}{17}$       C-10.  $\frac{5}{9}$       C-11.  $\frac{1}{4}$

#### Section (D) :

- D-1.  $\frac{7}{2^{13}}$       D-2.  ${}^{10}C_2 \cdot \frac{(14)^8}{15^{10}}$       D-3.
- |      |                 |                 |                |                |
|------|-----------------|-----------------|----------------|----------------|
| X    | 0               | 1               | 2              | 3              |
| P(X) | $\frac{27}{64}$ | $\frac{27}{64}$ | $\frac{9}{64}$ | $\frac{1}{64}$ |
- D-4. 28 rupees
- |       |                                |                               |                              |                    |
|-------|--------------------------------|-------------------------------|------------------------------|--------------------|
| $x_i$ | 0                              | 1                             | 2                            | 3                  |
| $p_i$ | $\left(\frac{19}{25}\right)^3$ | $18 \times \frac{19^2}{25^3}$ | $108 \times \frac{19}{25^3}$ | $\frac{216}{25^3}$ |
- D-5.
- D-6. mean = 2.5,      variance = 1.25

### PART - II

#### Section (A) :

- A-1. (D)      A-2. (C)      A-3. (C)      A-4. (D)      A-5. (A)      A-6. (D)      A-7. (A)
- A-8. (B)      A-9. (C)

#### Section (B) :

- B-1. (B)      B-2. (i) (D)      (ii) (B)      (iii) (C)      B-3. (B)      B-4. (D)

#### Section (C) :

- C-1. (B)      C-2. (C)      C-3. (B)      C-4. (B)      C-5. (A)      C-6. (A)      C-7. (D)

**Section (D) :**

D-1. (C)    D-2. (A)    D-3. (A)    D-4. (D)    D-5. (B)    D-6. (B)

**PART -III**

1. (A)  $\rightarrow$  (q), (B)  $\rightarrow$  (r), (C)  $\rightarrow$  (s), (D)  $\rightarrow$  (r)  
 2. (A)  $\rightarrow$  (s), (B)  $\rightarrow$  (r), (C)  $\rightarrow$  (q), (D)  $\rightarrow$  (p)

**EXERCISE - 2****PART -I**

1. (A)    2. (A)    3. (C)    4. (A)    5. (B)    6. (B)    7. (A)  
 8. (A)    9. (A)    10. (D)    11. (A)    12. (B)    13. (A)    14. (B)  
 15. (B)

**PART -II**

1. 82.00    2. 00.27    3. 13.33    4. 00.50    5. 00.22    6. 29.50    7. 06.00  
 8. 20.00    9. 14.75    10. 00.34    11. 00.68 or 00.69    12. 16.25  
 13. 00.52 or 00.53    14. 00.68    15. 00.18 or 00.19    16. 09.33    17. 05.00  
 18. 01.26    19. 36.00    20. 11.00

**PART -III**

1. (AC)    2. (ACD)    3. (CD)    4. (ABC)    5. (AD)    6. (ABC)  
 7. (BD)    8. (ABCD)    9. (AB)    10. (ABCD)    11. (AC)    12. (ABCD)  
 13. (ABCD)    14. (AC)    15. (AD)    16. (ABC)    17. (AC)    18. (ABCD)

**PART -IV**

1. (A)    2. (A)    3. (C)    4. (C)    5. (B)    6. (D)    7. (A)  
 8. (B)    9. (A)    10. (A)

**EXERCISE - 3****PART -I**

1. (C)    2. (C)    3. (B)    4. (D)    5. (A, D)    6\*. (BD)    7. (A)  
 8\*. (AB)    9. (A)    10. 6    11. (A)    12. (D)    13. (A)    14. (B)  
 15. (C)    16. 8    17. (A,B)    18. (C,D)    19. (C)    20. (B)    21. (C)  
 22. (A,B)    23. (C)    24. (A)    25. (C)    26. (AC)    27. (0.50)    28. (422)

**PART -II**

1. (2)    2. (1)    3. (3)    4. (2)    5. (4)    6. (2)    7. (3)  
 8. (1)    9. (1)    10. (3)    11. (2)    12. (1)    13. (1)    14. (4)  
 15. (4)    16. (2)    17. (2)    18. (1)    19. (1)    20. (4)    21. (4)  
 22. (3)    23. (4)