CHAPTER 13

X CLASS-2023-24 PROBABILITY(Notes)

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1. The definition of probability was given by Pierre Simon Laplace in 1795.
2. Italian physician and mathematician J. Cardan wrote the first book on the probability, The Book on Games of Chance.
3. Random experiment: An experiment is said to be a random experiment if its outcome cannot be predicted that is the outcome of an experiment does not obey any rule.
4. **Sample space**: The set of all possible outcomes of an experiment are called a sample space.

Example:

(i) If a coin is tossed then sample space S={H,T} n(S)=2

(ii) If two coins are tossed then sample space S={HH,HT,TH,TT} n(S)=4

(iii) If a die through once then sample space S={1,2,3,4,5,6} n(S)=6

5. **Event**:

An event is a collection of a specific outcome or some of the specific outcomes of the experiment.

6. An event having only one outcome in an experiment is called an elementary event.
7. Mutually Exclusive Events: Two or more events of an experiment, where occurrences of an event prevents occurrences of all other events, are called Mutually Exclusive Events.
8. **Equally likely events** :

Two or more events are said to be equally likely if each one of them has an equal chance of occurrence.

9. Probability of an event E $= P(E) = \frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$

DO THIS

Give examples of 5 experiments that have equally likely outcomes and five more examples that do not have equally likely outcomes.

Sol: Equally likely outcome (The outcomes having equal probability to occur)

Example:

(i) Getting a head or a tail when a coin tossed.

(ii) Getting a digit 1, 2, 3, 4, 5 or 6 when a dice is rolled

(iii) Units place of a two digit number selected may be 0, 1, 2, 3, 4, 5, 6, 7, 8 or 9

(iv) Picking a different colour ball from a bag of 10 red balls, 10 blue balls and 10 black balls.

Do not have equally likely outcomes:

Example: (i) Winning in a game of carom.

(ii) Picking a different colour ball from a bag of 5 red balls, 4 blue balls and 1 black ball.

(iii) Raining on a particular day of July

Example-1. **Find the probability of getting a head when a coin is tossed once. Also find the probability of getting a tail.**

Sol: when a coin is tossed once

Sample space S={H,T} n(S)=2

$$P(\text{head}) = \frac{\text{Number of favourable outcomes}}{\text{Number of total possible outcomes}} = \frac{1}{2}$$

$$P(\text{tail}) = \frac{1}{2}$$

Example-2. **A bag contains a red ball, a blue ball and an yellow ball, all the balls being of the same size. Manasa takes out a ball from the bag without looking into it. What is the probability that she takes a (i) yellow ball? (ii) red ball? (iii) blue ball?**

Sol: Red balls=1, Blue balls=1, Yellow balls=1

Total balls=3 n(S)=3

$$P(E) = \frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$$

$$P(\text{red ball}) = \frac{1}{3},\ P(\text{blue ball}) = \frac{1}{3},\ P(\text{yellow ball}) = \frac{1}{3}$$

Example-3. **Suppose we throw a dice once. (i) What is the probability of getting a number greater than 4? (ii) What is the probability of getting a number less than or equal to 4?**

Sol: In rolling an unbiased dice

Sample space S = {1, 2, 3, 4, 5, 6} , n(S) = 6

$$P(E) = \frac{Number\ of\ outcomes\ favourable\ to\ E}{Number\ of\ all\ possible\ outcomes} = \frac{n(E)}{n(S)}$$

(i)Favourable outcomes for number greater than 4 =E={5,6} , n(E) = 2

$$P(\text{number greater than } 4) = \frac{2}{6} = \frac{1}{3}$$

(ii) Favourable outcomes for number less or equal to 4= F = {1, 2, 3, 4} , n(F)=4

$$P(\text{number less or equal to } 4) = \frac{4}{6} = \frac{2}{3}$$

COMPLEMENTARY EVENTS AND PROBABILITY

Event of all other outcomes in the sample survey which are not in the favourable event is called Complementary event.

The complementary event of an even E is $\bar{E}$ (not E).

P (E) + P (not E) = 1 i.e., P (E) + P (E) = 1, which gives us $P(\bar{E}) = 1 - P(E)$

DO THIS

(i) **Is getting a head complementary to getting a tail? Give reasons.**

Sol: $P(\text{head}) = \frac{1}{2}, \quad P(\text{tail}) = \frac{1}{2}$

$P(\text{head}) + P(\text{tail}) = \frac{1}{2} + \frac{1}{2} = \frac{2}{2} = 1$

So, getting a head is complementary to getting a tail.

(ii) **In case of a die is getting a 1 complementary to events getting 2, 3, 4, 5, 6? Give reasons for your answer.**

Sol: When a die is thrown S={1,2,3,4,5,6} n(S)=6

$P(E) = \frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{\text{n(E)}}{\text{n(S)}}$

$P(\ getting\ 1) = \frac{1}{6}, \quad P(\ getting\ 2,3,4,5,6) = \frac{5}{6}$

$P(\ getting\ 1) + P(\ getting\ 2,3,4,5,6) == \frac{1}{6} + \frac{5}{6} = \frac{6}{6} = 1$

IMPOSSIBLE AND CERTAIN EVENTS:

- The probability of an event which is impossible to occur is 0. Such an event is called an impossible event.
- The probability of an event which is sure (or certain) to occur is 1. Such an event is called a sure event or a certain event.
- The probability of an event E is a number P(E) such that $0 \leq P(E) \leq 1$

TRY THIS

1. **A child has a dice whose six faces show the letters A, B, C, D, E and F. The dice is thrown once. What is the probability of getting (i) A? (ii) D?**

Sol: Sample space S={A,B,C,D,E,F} n(S)=6

$P(E) = \frac{Number\ of\ outcomes\ favourable\ to\ E}{Number\ of\ all\ possible\ outcomes} = \frac{n(E)}{n(S)}$

$P(\text{ getting } A) = \frac{1}{6}, \quad P(\text{ getting } D) = \frac{1}{6}$

2. **Which of the following cannot be the probability of an event?**

Sol: (a) 2.3 is greater than 1. So,2.3 cannot be the probability of an event.

(b) -1.5 is less than 0. So,-1.5 cannot be the probability of an event.

(c) $15\% = \frac{15}{100} = \frac{3}{20}$ it is lie between 0 and 1 . So, 15% be the probability of an event.

(D) $0.7 = \frac{7}{10}$ it is lie between 0 and 1 . So, 0.7 be the probability of an event

THINK - DISCUSS

1. **Why is tossing a coin considered to be a fair way of deciding which team should get the ball at the**

beginning of any game?

Sol: When we toss a coin, possible outcomes head and tail which are both equally likely outcomes. The same chance of occurring. So it is a fair way.

2. **Can $\frac{7}{2}$ be the probability of an event? Explain.**

Sol: We know that P (E) is probability of an event E then $0 \leq P(E) \leq 1$

Since $\frac{7}{2} = 3.5 > 1$,therefore $\frac{7}{2}$ cannot be the probability of an event.

DECK OF CARDS AND PROBABILITY

- A deck of playing cards consists of 52 cards.
- Black cards =26 (spades (♠)=13+ clubs (♣)=13)
- Red cards =26(hearts (♥)=13+ diamonds (♦)=13)
- The cards in each suit are Ace,2,3,4,5,6,7,8,9,10, Jack, Queen, King
- Kings, Queens and Jacks are called face cards.
- Number of face cards=12

Example-4. One card is drawn from a well-shuffled deck of 52 cards. Calculate the probability that the card will (i) be an ace, (ii) not be an ace.

Sol: One card is drawn from a well-shuffled deck of 52 cards. n(S)=52

$$\text{P(E)} = \frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$$

(i) Number of ace cards=4.

$$P(\text{ an ace}) = \frac{4}{52} = \frac{1}{13}$$

(ii) Number of not ace cards=52-4=48

$$P(\text{not be an ace}) = \frac{48}{52} = \frac{12}{13}$$

TRY THIS

You have a single deck of well shuffled cards. Then,

1. What is the probability that the card drawn will be a queen?

Sol: Number of cards in deck=52

Number of queen cards=4

$$P(\text{ queen card}) = \frac{4}{52} = \frac{1}{13}$$

2. **What is the probability that it is a face card?**

Sol: Number of cards in deck=52

Number of face cards=12

$$P(\text{ face card}) = \frac{12}{52} = \frac{3}{13}$$

3. **What is the probability it is a spade?**

Sol: Number of cards in deck=52

Number of spade cards=13

$P(\text{spade card}) = \frac{13}{52} = \frac{1}{4}$

4. **What is the probability that is the face card of spades?**

Sol: Number of cards in deck=52

Number the face card of spades =3

$P(\text{ the face card of spades}) = \frac{3}{52}$

5. **What is the probability it is not a face card?**

Sol: Number of cards in deck=52

Number of not a face card=52-12=40

$P(\text{ not a face card}) = \frac{40}{52} = \frac{10}{13}$

Example-5. Sangeeta and Reshma, play a tennis match. It is known that the probability of Sangeeta winning the match is 0.62. What is the probability of Reshma winning the match?

Sol: The probability of Sangeetha winning chance=P(S)=0.62

The probability of Reshma winning chance=P(R)=1-P(S)=1-0.62=0.38

Example-6. Sarada and Hamida are friends. What is the probability that both will have (i) different birthdays? (ii) the same birthday? (ignoring a leap year)

Sol: Total days in the year=365 n(S)=365

$\text{P(E)} = \frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$

(i) If Hamida's birthday is different from Sarada's, the number of favourable outcomes for her birthday is 365 - 1 = 364

$So, P\ (Hamida's\ birthday\ is\ different\ from\ Sarada's\ birthday) = \frac{364}{365}$

(ii) P(Sarada and Hamida have the same birthday) = 1 - P (both have different birthdays)

$= 1 - \frac{364}{365} = \frac{1}{365}$

EXERCISE - 13.1

1. **Complete the following statements:**

(i) Probability of an event E + Probability of the event 'not E'=1

(ii) The probability of an event that cannot happen is 0. Such an event is called **impossible event.**

(iii) The probability of an event that is certain to happen is 1. Such an event is called **Sure event.**

(iv) The sum of the probabilities of all the elementary events of an experiment is **1.**

(v) The probability of an event is greater than or equal to 0 and less than or equal to 1

2. Which of the following experiments have equally likely outcomes? Explain

(i) A driver attempts to start a car. The car starts or does not start.

Sol: Not equally likely outcomes.

Car starts depend on the fuel and car condition.

(ii) A player attempts to shoot a basketball. She/he shoots or misses the shot.

Sol: Not equally likely outcomes.

The amount of shoots depending on player abilty.

(iii) A trial is made to answer a true-false question. The answer is right or wrong.

Sol: This experiment has equally likely outcomes. Since both have same probability $\frac{1}{2}$.

(iv) A baby is born. It is a boy or a girl.

Sol: This experiment has equally likely outcomes. Since both have same probability $\frac{1}{2}$.

3. If P(E) = 0.05, what is the probability of 'not E'?

Sol: We know that P(E)+P(not E)=1

$\Rightarrow$ P(not E) $= 1 - P(E) = 1 - 0.05 = 0.95$

4. A bag contains lemon flavoured candies only. Malini takes out one candy without looking into the bag. What is the probability that she takes out (i) an orange flavoured candy? (ii) a lemon flavoured candy?

Sol: A bag contains lemon flavoured candies only.

(i) Taking an orange flavoured candy is an imposssible event and the probability is 0.

(ii) Taking a lemon flavoured candy is a sure event and the probability is 1.

5. Rahim takes out all the hearts from the cards. What is the probability of

(i) Picking out an ace from the remaining pack

Sol: Total number of cards in the deck=52

Number of heart cards=13

When hear cards removed remaining cards=52-13=39 n(S)=39

Number of ace cards in remaining cards=3

$$P(E) = \frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$$

$$P(\text{an ace card}) = \frac{3}{39} = \frac{1}{13}$$

(ii) Picking out a diamonds.

Number of diamond cards=13

$P(\text{diamond card}) = \frac{13}{39} = \frac{1}{3}$

(iii) **Picking out a card that is not a heart.**

Number of not a heart card=39

$P(\text{not a heart card}) = \frac{39}{39} = 1$

(iv) Picking out the Ace of hearts.

Number of ace heart cards=0

Picking out the Ace of hearts is an impossible event probability is 0.

6. It is given that in a group of 3 students, the probability of 2 students not having the same birthday is 0.992. What is the probability that the 2 students have the same birthday?

Sol: The probability of 2 students not having the same birthday =P($\bar{E}$)=0.992.

The probability that the 2 students have the same birthday=P(E) $= 1 - P(\bar{E})$

$= 1 - 0.992 = 0.008$

7. A die is thrown once. Find the probability of getting (i) a prime number; (ii) a number lying between 2 and 6; (iii) an odd number.

Sol: : Probability of an event E = P(E) $= \frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$

A die is thrown once then S={1,2,3,4,5,6} n(S)=6

(i) Prime number={2,3,5} n(E)=3

P (prime number)= $\frac{3}{6} = \frac{1}{2}$

(ii) Number lying between 2 and 6 ={3,4,5} n(E)=3

P (Number lying between 2 and 6)= $\frac{3}{6} = \frac{1}{2}$

(iii) An odd number = {1,3,5} n(E)=3

P (an odd number)= $\frac{3}{6} = \frac{1}{2}$

8. What is the probability of for drawing out a red king from a deck of cards?

Sol: Total number of cards in the deck=52 n(S) =52

Number of red king cards=2 n(E)=2

$P(\text{red king}) = \frac{2}{52} = \frac{1}{26}$

Example-8. A box contains 3 blue, 2 white, and 4 red marbles. If a marble is drawn at random from the box, what is the probability that it will be (i) white? (ii) blue? (iii) red?

Sol: Blue marbles=3

White marbles=2

Red marbles=4

The number of possible outcomes=3+2+4=9 , n(S)=9

Probability of an event E = P(E) = $\frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$

(i) Number of white marbles=2

$P(white\ marble) = \frac{2}{9}$

(ii) Number of blue marbles=3

$P(blue\ marble) = \frac{3}{9} = \frac{1}{3}$

(iii) Number of red marbles=4

$P(red\ marble) = \frac{4}{9}$

Example-9. Harpreet tosses two different coins simultaneously (say, one is of ₹.1 and other of ₹.2). What is the probability that she gets at least one head?

Sol: We write H for 'head' and T for 'tail'.

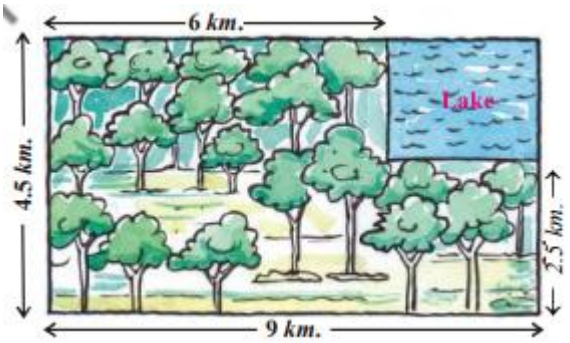
When two coins are tossed simultaneously S={(H,H),(H,T),(T,H),(T,T)}, n(S)=4

Favourable outcomes to the event 'at least one head={(H,H),(H,T),(T,H)}, n(E)=3

P(at least one head) = $\frac{n(E)}{n(S)} = \frac{3}{4}$.

The probability that Harpreet gets at least one head is $\frac{3}{4}$.

Example-11. A missing helicopter is reported to have crashed somewhere in the rectangular region as shown in the figure. What is the probability that it crashed inside the lake shown in the figure?



Sol: n(S)=Area of the entire region=$l \times b$

$= 9 \times 4.5 = 40.5\ km^2$

n(E)= Area of lake=$l \times b = 2 \times 3 = 6\ km^2$

P (helicopter crashed in the lake) = $\frac{n(E)}{n(S)} = \frac{6}{40.5} = \frac{60}{405} = \frac{4}{37}$

Example-12. A carton consists of 100 shirts of which 88 are good, 8 have minor defects and 4 have major defects. Jhony, a trader, will only accept the shirts which are good, but Sujatha, another trader, will only reject the shirts which have major defects. One shirt is drawn at random from the carton. What is the probability that (i) it is acceptable to Jhony? (ii) it is acceptable to Sujatha?

Sol: Total shirts =100 n(S)=100

Good shirts=88, minor defect shirts=8, major defect shirts=4

(i) The number of outcomes favourable to Jhony =good shirts= 88

P $(shirt\ is\ acceptable\ to\ Jhony) = \frac{88}{100} = 0.88$

(ii) The number of outcomes favourable to Sujatha =non major defect shirts = 100-8 = 96

$$P\ (shirt\ is\ acceptable\ to\ Sujatha) = \frac{96}{100} = 0.96$$

Example-13. Two dice, one red and one yellow, are thrown at the same time. Write down all the possible outcomes. What is the probability that the sum of the two numbers appearing on the top of the dice is (i) 8 (ii) 13 (iii) less than or equal to 12?

Sol: When two dice are drawn then

S={(1,1), (1,2),(1,3), (1,4), (1,5),(1,6), (2,1), (2,2),(2,3), (2,4), (2,5),(2,6),
(3,1), (3,2),(3,3), (3,4), (3,5),(3,6), (4,1), (4,2),(4,3), (4,4), (4,5),(4,6),
(5,1), (5,2),(5,3), (5,4), (5,5),(5,6), (6,1), (6,2),(6,3), (6,4), (6,5),(6,6)}

n(S)=36

(i) The outcomes favourable to the event 'the sum of the two numbers is 8'

E={(2,6),(3,5),(4,4),(5,3),(6,2)} n(E)=5

$$P(\text{the sum of the two numbers is 8}) = \frac{n(E)}{n(S)} = \frac{5}{36}$$

(ii) 'the sum of two numbers is 13' is an impossible event.

P(the sum of the two numbers is 13) = 0

(iii) 'the sum of the two numbers is less than or equal to 12' is sure event.

P('the sum of the two numbers is less than or equal to 12')=1

EXERCISE - 13.2

1. **A bag contains 3 red balls and 5 black balls. A ball is drawn at random from the bag. What is the probability that the ball drawn is (i) red ? (ii) not red?**

Sol: Number of red balls=3, Number of black balls=5

Total number of balls=3 + 5 =8 balls , n(S) =8

$$\text{Probability of an event E} = P(E) = \frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$$

(i) Number of favourable outcomes to red ball=3

$$P(\text{red ball}) = \frac{3}{8}$$

(ii) $P(\text{ not red ball}) = 1 - P(\text{red ball})$

$$= 1 - \frac{3}{8} = \frac{5}{8}$$

2. **A box contains 5 red marbles, 8 white marbles and 4 green marbles. One marble is taken out of the box at random. What is the probability that the marble taken out will be (i) red? (ii) white ? (iii) not green?**

Sol: Red marbles=5, white marbles=8, and green marbles=4

Total marbles=5+8+4=17 , n(S)

Probability of an event E = P(E) = $\frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$

(i) Number of favourable outcomes to red marble=5

P(red marble) = $\frac{5}{17}$

(ii) Number of favourable outcomes to white marble=8

P(white marble) = $\frac{8}{17}$

(iii) Number of favourable outcomes to non-green marble=17-4=13

P(not green marble) = $\frac{13}{17}$

3. A Kiddy bank contains hundred 50p coins, fifty ₹1 coins, twenty ₹2 coins and ten ₹5 coins. If it is equally likely that one of the coins will fall out when the bank is turned upside down, what is the probability that the coin (i) will be a 50 p coin? (ii) will not be a ₹5 coin?

Sol: Number of 50p coins=100

Number of ₹1 coins=50

Number of ₹2 coins=20

Number of ₹5coins=10

Total number of coins=100+50+20+10=180 , n(S)=180

(i) Number of favourable outcomes to 50 p coin=100

P(50 p coin) = $\frac{100}{180} = \frac{5}{9}$

(ii) Number of favourable outcomes to not be a ₹5 coin=180-10=170

P(not be a ₹5 coin) = $\frac{170}{180} = \frac{17}{18}$

4. Gopi buys a fish from a shop for his aquarium. The shopkeeper takes out one fish at random from a tank containing 5 male fish and 8 female fish (See figure). What is the probability that the fish taken out is a male fish?

Sol: Number of male fish=5

Number of female fish=8

Total number of fish=5+8=13

Probability of an event E = P(E) = $\frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$

Number of favourable outcomes to male fish=5

P(male fish) = $\frac{5}{13}$

5. **A game of chance consists of spinning an arrow which comes to rest pointing at one of the numbers 1, 2, 3, 4, 5, 6, 7, 8 (See figure), and these are equally likely outcomes. What is the probability that it will point at (i) 8 ? (ii) an odd number? (iii) a number greater than 2? (iv) a number less than 9?**

Sol: S={1,2,3,4,5,6,7,8}, n(S)=8

Probability of an event E = P(E) = $\frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$

(i) Number of favourable outcomes to 8=1

$P(8) = \frac{1}{8}$

(ii) Favourable outcomes to an odd number={1,3,5,7}

Number of favourable outcomes to odd number=4

$P(\text{ an odd number}) = \frac{4}{8} = \frac{1}{2}$

(iii) Favourable outcomes to greater than 2={3,4,5,6,7,8}

Number of favourable outcomes to greater than 2=6

P(a number greater than 2) = $\frac{6}{8} = \frac{3}{4}$

(iv) Favourable outcomes to a number less than 9={1,2,3,4,5,6,7,8}

Number of favourable outcomes to a number less than 9=8

P(a number less than 9) = $\frac{8}{8} = 1$

6. **One card is drawn from a well-shuffled deck of 52 cards. Find the probability of getting (i) a king of red colour (ii) a face card (iii) a red face card (iv) the jack of hearts (v) a spade (vi) the queen of diamonds.**

Sol: Total number of cards=52, n(S)=52

Probability of an event E = P(E) = $\frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$

(i) Number of favourable outcomes to the king of red colour=2

$P(a\ king\ of\ red\ colour) = \frac{2}{52} = \frac{1}{26}$

(ii) Number of favourable outcomes to the face card =12

$P(a\ face\ card\ ) = \frac{12}{52} = \frac{3}{13}$

(iii) Number of favourable outcomes to the red face card =6

$P(a\ red\ face\ card\ ) = \frac{6}{52} = \frac{3}{26}$

(iv) Number of favourable outcomes to the jack of hearts =1

$P(the\ jack\ of\ hearts\ ) = \frac{1}{52}$

(v) Number of favourable outcomes to a spade card =13

$P(a\ spade\ card\ ) = \frac{13}{52} = \frac{1}{4}$

(vi) Number of favourable outcomes to the queen of diamonds =1

$P(the\ queen\ of\ diamonds\ ) = \frac{1}{52}$

7. Five cards-the ten, jack, queen, king and ace of diamonds, are well-shuffled with their face downwards. One card is then picked up at random. (i) What is the probability that the card is the queen? (ii) If the queen is drawn and put aside, what is the probability that the second card picked up is (a) an ace? (b) a queen?

Sol: Total number of cards=5 n(S) =5

Probability of an event E = P(E) = $\frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$

(i) Number of favourable outcomes to the queen=1

$P(queen\ card) = \frac{1}{5}$

(ii) When the queen is drawn and put aside remaining cards=4 n(S)=4

a. Number of favourable outcomes to ace=1

$P(\ an\ ace) = \frac{1}{4}$

b. Number of favourable outcomes to the queen=0

$P(queen\ card) = 0$

8. 12 defective pens are accidentally mixed with 132 good ones. It is not possible to just look at a pen and tell whether or not it is defective. One pen is taken out at random from this lot. Determine the probability that the pen taken out is a good one.

Sol: Number of good pens=132

Number of defective pens=12

Total number of pens=132+12=144

One pen is taken out at random from these lot total possible outcomes=n(S)=144

Probability of an event E = P(E) = $\frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$

Number of favourable outcomes to taking a good pen=132

$$P(a\ good\ pen) = \frac{132}{144} = \frac{11}{12}$$

9. A lot of 20 bulbs contain 4 defective ones. One bulb is drawn at random from the lot. What is the probability that this bulb is defective? Suppose the bulb drawn in previous case is not defective

and is not replaced. Now one bulb is drawn at random from the rest. What is the probability that this bulb is not defective?

Sol: Number of bulbs=20

Number of defective bulbs=4

Number of non-defective bulbs=20-4=16

If a bulb is selected at random the total outcomes=n(S)=20

Probability of an event E = P(E) $= \frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$

$P(\ defective\ bulb) = \frac{4}{20} = \frac{1}{5}$

Suppose the bulb drawn in previous case is not defective and is not replaced then remaining bulbs=20-1=19 , n(S)=19

Number of favourable outcomes to not defective bulb=16-1=15

$P(\ not\ defective\ bulb) = \frac{15}{19}$

10. A box contains 90 discs which are numbered from 1 to 90. If one disc is drawn at random from the box, find the probability that it bears (i) a two-digit number (ii) a perfect square number (iii) a number divisible by 5.

Sol: A box contains 90 discs which are numbered from 1 to 90.

S={1,2,3,4,.....,89,90}, n(S)=90

Probability of an event E = P(E) $= \frac{\text{Number of outcomes favourable to E}}{\text{Number of all possible outcomes}} = \frac{n(E)}{n(S)}$

(i) Two digit numbers=[10,11,12,13,....,89,90}

Number of favourable outcomes to two digit number=81, n(E)=81

$P(\ a\ two\ digit\ number) = \frac{81}{90} = \frac{9}{10}$

(ii) Perfect square numbers={1,4,9,16,25,36,49,64,81} , n(E)=9

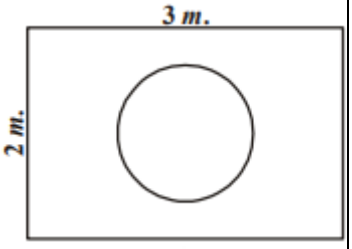
$P(\ Perfect\ square\ number) = \frac{9}{90} = \frac{1}{10}$

(iii) Numbers divisible by 5={5,10,15,20,25,30,35,40,45,50,55,60,65,70,75,80,85,90}

n(E)= 18

$P(a\ number\ divisible\ by\ 5) = \frac{18}{90} = \frac{1}{5}$

11. Suppose you drop a die at random on the rectangular region shown in figure. What is the probability that it will land inside the circle with diameter 1m?



Sol: n(S)= Area of rectangle= $l \times b = 3 \times 2 = 6m^2$

$$n(E) = \text{Area of circle} = \pi\frac{d^2}{4} = \frac{22}{7} \times \frac{1 \times 1}{4} = \frac{22}{28} = \frac{11}{14}\ m^2$$

The probability that die will land inside the circle $= \frac{n(E)}{n(S)} = \frac{\frac{11}{14}}{6} = \frac{11}{6 \times 14} = \frac{11}{84}$

12. A lot consists of 144 ball pens of which 20 are defective and the others are good. The shopkeeper draws one pen at random and gives it to Sudha. What is the probability that (i) She will buy it? (ii) She will not buy it ?

Sol: Total number of ball pens =144 , n(S)=144

Number of defective pens=20

Number of good ball pens=144-20=124

Number of favourable outcomes to sudha buy it (good pens)=124

$$P(\text{sudha buy a pen}) = \frac{124}{144} = \frac{31}{36}$$

$$P(\text{sudha not buy a pen}) = 1 - P(\text{sudha buy a pen})$$

$$= 1 - \frac{31}{36} = \frac{36 - 31}{36} = \frac{5}{36}$$

13. Two dice are rolled simultaneously and counts are added (i) complete the table given below

Event: Sum on 2 dice	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Probability	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{3}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{6}{36}$	$\frac{5}{36}$	$\frac{4}{36}$	$\frac{3}{36}$	$\frac{2}{36}$	$\frac{1}{36}$

(ii) **A student argues that 'there are 11 possible outcomes 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12. Therefore, each of them has a probability 1 11 . Do you agree with this argument? Justify your answer.**

Sol: The student argument is wrong . The sum 2,3,4.... ,12 have different number of favourable outcomes.

14. **A game consists of tossing a one rupee coin 3 times and recording its outcome each time. Hanif wins if all the tosses give the same result i.e., three heads or three tails, and loses otherwise. Calculate the probability that Hanif will lose the game.**

Sol: If one rupee coin tossing three times then

S={HHH,HHT,HTH,HTT,THH,THT,TTH,TTT} , n(S)=8

Favourable outcomes to lose the game={ HHT,HTH,HTT,THH,THT,TTH} , n(E)=6

$$P(\text{Hanif lossing the game}) = \frac{6}{8} = \frac{3}{4}$$

15. A dice is thrown twice. What is the probability that (i) 5 will not come up either time? (ii) 5 will come up at least once?

Sol: If a dice is thrown twice then

S={(1,1), (1,2),(1,3), (1,4), (1,5),(1,6), (2,1), (2,2),(2,3), (2,4), (2,5),(2,6),
(3,1), (3,2),(3,3), (3,4), (3,5),(3,6), (4,1), (4,2),(4,3), (4,4), (4,5),(4,6),
(5,1), (5,2),(5,3), (5,4), (5,5),(5,6), (6,1), (6,2),(6,3), (6,4), (6,5),(6,6)}, n(S)=36

(i) Number of favourable outcomes to 5 will not come up either time n(E)=25

$$P(\text{5 will not come up either time}) = \frac{25}{36}$$

(ii) $P(\text{5 will come up at lest once}) = 1 - P(\text{5 will not come up either time})$

$$= 1 - \frac{25}{36} = \frac{36-25}{36} = \frac{11}{36}$$