STD 9 Maths [Manjari]
Probability

*** Choose the right answer from the given options. [1 Marks Each]** **[15]**

1. The sum of the probabilities of all possible outcomes of a trial is:

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

   Ans. : (B) 1

   The total of all probabilities always equals 1. When you toss a coin, you'll get either a head or a tail, so P(H) + P(T) = 1.

2. Which of the following CANNOT be the probability of an event?

   (A) 1 (B) 0 (C) 0.75 (D) 1.3

   Ans. : (D) 1.3

   Since probability must always lie between 0 and 1, any value greater than 1 is invalid. 1.3 > 1, so it cannot be a probability.

3. If P(E) = 0.44, then P(not E) is:

   (A) 0.44 (B) 0.55 (C) 0.50 (D) 0.56

   Ans. : (D) 0.56

   Using the complementary rule: P(E) + P(not E) = 1

   $\therefore P(\text{ not } E) = 1 - P(E) = 1 - 0.44 = 0.56$

4. The probability of an impossible event is:

   (A) 1 (B) 0 (C) More than 1 (D) Less than 0

   Ans. : (B) 0

   An impossible event is one that can never happen. Since it never occurs, the number of favourable outcomes is 0, making P(E) = 0/n = 0.

5. A coin is tossed 1000 times. Heads appear 455 times and tails 545 times. What is the empirical probability of getting a head?

   (A) 0.455 (B) 0.5 (C) 0.545 (D) 455

   Ans. : (A) 0.455

   P(Head) = Number of heads / Total trials = 455 / 1000 = 0.455

6. A die is thrown. What is the probability of getting an odd number less than 4?

   (A) 1/6 (B) 1/2 (C) 1/3 (D) 0

   Ans. : (C) 1/3

   Sample space $= \{1,2,3,4,5,6\}$

   Odd numbers less than $4 = \{1,3\}$ i.e., 2 favourable outcomes

   $P(E) = 2/6 = 1/3$

7. Two coins are tossed 1000 times. 0 heads appeared 250 times, 1 head appeared 500 times, and 2 heads appeared 250 times. What is the probability of getting at most one head?

(A) 1/5 (B) 1/4 (C) 3/4 (D) 4/5

Ans. : (C) 3/4

'At most one head' means 0 heads or 1 head.

Favourable outcomes = 250 + 500 = 750

P(at most 1 head) = 750/1000 = 3/4

8. A die is thrown once. What is the probability of getting a prime number?

(A) 1/6 (B) 1/3 (C) 1/2 (D) 2/3

Ans. : (C) 1/2

Prime numbers on a die $= \{2,3,5\} \Rightarrow 3$ outcomes

$P(\text{ prime }) = 3/6 = 1/2$

9. What is the probability of drawing a queen from a deck of 52 cards?

(A) 1/26 (B) 1/52 (C) 1/13 (D) 3/52

Ans. : (C) 1/13

There are 4 queens in a deck of 52 cards.

P(Queen) = 4/52 = 1/13

10. The probability of drawing the 10 of a black suit from a deck of 52 cards is:

(A) 1/52 (B) 1/26 (C) 1/13 (D) 2/13

Ans. : (B) 1/26

Black suits = Clubs and Spades. Each has a 10 card. So there are 2 black 10s in a deck of 52 cards.

P(10 of black suit) = 2/52 = 1/26

11. There are 5 red balls and 3 black balls in a bag. What is the probability of drawing a black ball?

(A) 5/8 (B) 1/2 (C) 3/8 (D) 1/8

Ans. : (C) 3/8

Total balls = 5 + 3 = 8

P(Black) = 3/8

12. In a survey of 364 children aged 19–36 months, 91 liked to eat potato chips. If a child is selected at random, what is the probability that the child does NOT like potato chips?

(A) 0.25 (B) 0.50 (C) 0.75 (D) 0.80

Ans. : (C) 0.75

Children who do NOT like potato chips = 364 − 91 = 273

P(does not like chips) = 273/364 = 0.75

13. There are 5 prizes on 1000 lottery tickets. What is the probability of winning a prize?

(A) 1/500 (B) 1/200 (C) 1/100 (D) 1/50

Ans. : (B) 1/200

P(winning) = 5/1000 = 1/200

14. A number is selected at random from the numbers 1, 2, 3, ... 15. What is the probability that the selected number is a multiple of 4?

(A) 1/5 (B) 1/3 (C) 4/15 (D) 2/15

Ans. : (A) 1/5

Multiples of 4 between 1 and 15: $\{4,8,12\} \Rightarrow 3$ numbers

$P($ multiple of 4$) = 3/15 = 1/5$

15. What is the probability of a leap year having 53 Sundays?

(A) 1/7 (B) 1/4 (C) 2/7 (D) 3/7

Ans. : (C) 2/7

A leap year has 366 days = 52 complete weeks + 2 extra days.

These 2 extra days can be any pair from: {Mon-Tue, Tue-Wed, Wed-Thu, Thu-Fri, Fri-Sat, Sat-Sun, Sun-Mon} ⇒ 7 possibilities.

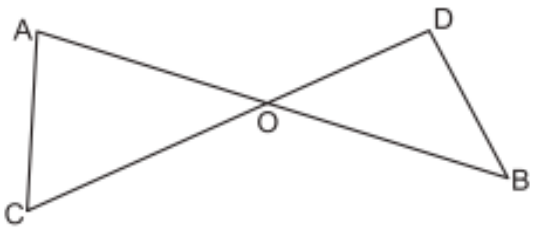
Pairs containing Sunday $=\{$ Sat-Sun, Sun-Mon $\} \Rightarrow 2$ out of 7

$\Rightarrow P(53$ Sundays in a leap year $) = 2/7$

*** A statement of Assertion (A) is followed by a statement of Reason (R). [4]**
Choose the correct option.

Directions: In each question below, there are two statements labelled as Assertion (A) and Reason (R). Choose the correct answer as per the options given below:
(a) Both (A) and (R) are true and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(c) (A) is true but (R) is false
(d) (A) is false but (R) is true

16.



Assertion (A) : In the given figure, O is the mid point of AB and CD . $\triangle AOC \cong \triangle BOD$ can be proven by SAS.

Reason (R) : Two triangles are congruent if two sides and the included angle of one are equal to the corresponding sides and the included angle of the other.

Ans. : A

17. **Assertion (A) :** ABC is an isosceles triangle with $AB = AC$. Draw $AP \perp BC$. Then $\angle B = \angle C$

    Reason (R) : Angles opposite to equal sides are equal.

    Ans. : A

18. **Assertion(A) :** In right triangles ABC and DEF , if hypotenuse $AB = EF$ and side $AC = DE$, then $\triangle ABC \cong \triangle EFD$.

    Reason (R) : Two triangles are congruent, if the three sides of one triangle are equal to the corresponding three sides of other triangle.

    Ans. : B

19. **Assertion (A) :** In $\triangle ABD$ and $\triangle ADC, AD = AD$, $BD = DC$, then $\angle ADB = \angle ADC$. So $\triangle ABD \cong \triangle ACD$ (by SAS) $AB = AC$

    Reason (R) : Corresponding parts of congruent triangles.

    Ans. : A

*** Answer the following short questions. [2 Marks Each]** **[42]**

20. Toss a coin 20 times and record the result each time (heads or tails).
    (i) How many times did you get heads.
    (ii) How many times did you get tails?
    (iii) Calculate the experimental probability of getting heads.
    (iv) If you toss the coin once more, what is the probability of getting tails?

    Ans. : (i) 11 times
    (ii) 9 times
    (iii) P(heads) = (Number of heads)/(Total number of tosses) = 11/20 = 0.55
    (iv) This is a new independent toss. The theoretical probability of getting tails on any single fair coin toss is always: P(tails) = 1/2

21. What is the probability of getting an even number when rolling fair 6-sided die?

    Ans. : Total possible outcomes S = {1, 2, 3, 4, 5, 6},
    Even numbers = {2, 4, 6}
    Therefore,the number of favourable outcomes = 3
    So, P(even number) = 3/6 = 1/2.

22. When a single 6-sided die is rolled, what is the total number of possible outcomes in the sample space?

    Ans. : When a 6-sided die is rolled, the possible outcomes are: 1, 2, 3, 4, 5, 6
    Sample Space S = {1, 2, 3, 4, 5, 6}
    Total number of possible outcomes = 6, i.e., n(S) = 6

23. For the following experiments write down the sample space S.
    Rolling a die and tossing a coin together.

Ans. : Die outcomes: 1, 2, 3, 4, 5, 6
Coin outcomes: H (Heads), T (Tails)
Each outcome is a pair: (die number, coin result)
Therefore, S = {(1, H), (1 T), (2, H), (2,T), (3, H), (3, T) (4,H), (4,T), (5,H), (5,T), (6,H), (6,T)}
Hence, n(S) = 12

24. For the following experiments write down the sample space S.
Choosing a random integer between -5 and +5

Ans. : Integers between -5 and +5 (including both endpoints):
-5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5
Therefore, S = {-5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5}
So, n(S) = 11

25. Write the sample space and calculate the probability based on the given information.
Two coins are tossed at the same time. What is the probability of getting at least one head?

Ans. : S = {HH, HT, TH, TT}
⇒ n(S) = 4
Event E = at least one head = {HH, HT, TH}
⇒ n(E) = 3
P(at least one head) = n(E)/n(S) = 3/4.

26. Write the sample space and calculate the probability based on the given information.
Ten identical cards numbered 1 to 10 are placed in a box. One card is drawn at random. What is the probability of drawing a card with an even number?

Ans. : S = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}
⇒ n(S) = 10
Even numbers = {2, 4, 6, 8, 10},
⇒ n(E) = 5
Hence, P(even number) = n(E)/n(S) = 5/10 = 1/2.

27. Write the sample space and calculate the probability based on the given information.
A die is rolled once, What is the probability of getting a number greater than 4?

Ans. : S = {1, 2, 3, 4, 5, 6}
⇒ n(S) = 6
Numbers greater than 4 = {5, 6}
⇒ n(E) = 2
P(number greater than 4) = n(E)/n(S) = 2/6 = 1/3.

28. Write the sample space and calculate the probability based on the given information.
A bag contain 3 red balls, 2 blue balls and 1 green ball. One ball is picked at random. What is the probability that it is not red?

Ans. : Total balls = 3 + 2 + 1 = 6
Not red = blue + green = 2 + 1 = 3
P(not red) = 3/6 = 1/2.

29. Write the sample space and calculate the probability based on the given information.
Three coins are tossed simultaneously. What is the probability of getting exactly two heads?

Ans. : S = {HHH, HHT, HTH, THH, HTT, THT, TTH, TTT}
⇒ n(S) = 8
Exactly two heads = {HHT, HTH, THH}
⇒ n(E) = 3
P(exactly two heads) = n(E)/n(S) = 3/8.

30. A bag has 3 candies: strawberry, lemon, and mint. One is picked at random. What is the probability of picking a strawberry candy?

Ans. : S = {strawberry, lemon, mint}
⇒ n(S) = 3
n(E) = 1 [strawberry]
P(strawberry) = 1/3.

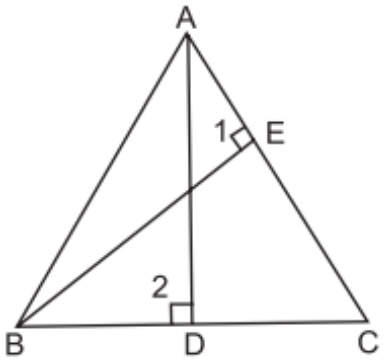
31. I throw a pair of 6-sided dice. Write down an event that has a probability of 0 and an outcome that has a probability of 1.

Ans. : Event with probability 0 (Impossible):
Getting a sum of 1. (Minimum sum when throwing two dice is 1 + 1 = 2, so sum = 1 is impossible)
Outcome with probability 1 (Certain):
Getting a sum that is less than 13. (Maximum sum is 6 + 6 = 12, which is always less than 13, so this is certain.)

32. List the elements of a sample space for the simultaneous tossing of a coin and drawing of a card from a set of 6 cards numbered 1 through 6.

Ans. : Coin outcomes: H, T
Card outcomes: 1, 2, 3, 4, 5, 6
S = {(H,1), (H,2), (H,3), (H,4), (H,5), (H,6), (T,1), (T,2), (T,3), (T,4), (T,5), (T,6)}
n(S) = 12.

33. ABC is an isosceles triangle in which $AC = BC$. AD and BE are respectively two altitudes to sides BC and AC. Prove that $AE = BD$.



Ans. : In triangles ABE and ABD , we have

$\angle 1 = \angle 2$ $[90^\circ$ each $]$

$AB = AB$ [Common]

and $\angle BAE = \angle ABD$ [Angles opposite to equal sides]

$\Rightarrow$ $\triangle ABE \cong \triangle BAD$ [Using AAS congruence rule]

$\therefore$ $AE = BD$

34. If two triangles are congruent, what can you say about:
(i) Their sides?
(ii) Their angles? State the converse also.

Ans. : (i) equal
(ii) equal

35. In $\triangle ABC$, given $AB = AC$.Prove that $\angle B = \angle C$. State its converse.

Ans. : $\triangle ABC$ and $\triangle ACB$.

$AB = AC$ (Given)

$AC = AB$

$BC = CB$ (Common side)

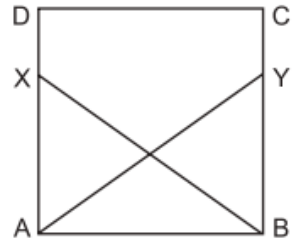
$\triangle ABC \cong \triangle ACB$

$\angle B = \angle C$

$\angle B = \angle C$

$AB = AC$

36. $ABCD$ is a square, X and Y are points on sides AD and BC respectively, such that $AY = BX$. Prove that $BY = AX$.



Ans. : $AB = BC = CD = AD$

$\angle DAB = \angle ABC = 90^\circ$

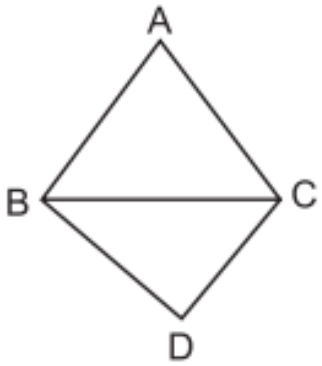
$AB = BA$(Common side)

$BX = AY$ (Given)
$\angle ABX = \angle BAY = 90^\circ$
$\triangle ABX \cong \triangle BAY$
$AX = BY$

37. ABCD is a quadrilateral in which $AB = BC$ and $AD = CD$. Show that BD bisects both the angles ABC and ADC .

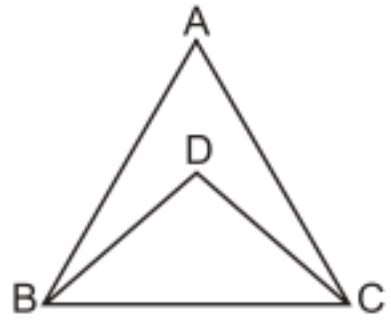
Ans. : $\triangle ABD$ and $\triangle CBD$.
$AB = BC($ Given $)$
$AD = CD$ (Given)
$BD = BD$ (Common side)
$\triangle ABD \cong \triangle CBD$
$\angle ABD = \angle DBC$
$\angle ADB = \angle BDC$

38. In the figure, $AB = AC$ and $DB = DC$. Prove that $\angle ABD = \angle ACD$.



Ans. : $\triangle ABD$ and $\triangle ACD$.
$AB = AC$ (Given)
$AB = AC$ (Given)
$AD = AD$ (Common side)
$\triangle ABD \cong \triangle ACD$
$\angle ABD = \angle ACD$

39. $\triangle ABC$ and $\triangle DBC$ are two triangles on the same base BC such that $AB = AC$ and $DB = DC$. Prove that $\angle ABD = \angle ACD$.



Ans. : $\triangle ABD$ and $\triangle ACD$.
$AB = AC$ (Given)

$BD = DC$ (Given)
$AD = AD$ (Common side)
$\triangle ABD \cong \triangle ACD$
$\angle ABD = \angle ACD$

40. Prove that if the line bisecting the vertical angle of a triangle is perpendicular to the base the triangle is isosceles

Ans. : $\triangle ABD$ and $\triangle ACD$.
$\angle ADB = \angle ADC = 90^\circ$
$\angle BAD = \angle DAC$
$AD = AD$
$\triangle ABD \cong \triangle ACD$
$AB = AC$

*** Answer the following questions. [3 Marks Each]** **[33]**

41. A teacher mixes a large bag of sweets of different colours and randomly selects a sample of 30 sweets. She counts the number of sweets of each colour:
10 red | 8 green | 7 yellow | 5 blue
(i) Calculate the probability that a randomly picked sweet from the sample is green.
(ii) If there are 600 sweets in total in the large bag, estimate how many are likely to be yellow, based on the sample results.

Ans. : (i) Number of green sweets = 8
Total sweets in sample = 30
$P(\text{ green }) = 8/30 = 4/15 \approx 0.267$
(ii) Number of yellow sweets = 7
Total sweets in sample = 30
P(yellow) = 7/30
Estimated number of yellow sweets in $600 = (7/30) \times 600 = 7 \times 20 = 140$
Approximately 140 sweets are likely to be yellow.

42. A survey is conducted at a school where a random sample of 40 students is asked about their favourite club. The responses are:
14 students: Science Club | 11 students: Arts Club |
9 students: Sports Club | 6 students: Debate Club
Assume there are 800 students in the whole school.
(i) What is the probability that a randomly chosen student from the sample prefers the Arts Club?
(ii) Using the sample results, estimate how many students in the whole school are likely to prefer the Sports Club.

Ans. : (i) Number of students who prefer Arts Club = 11
Total students in sample = 40

P(Arts Club) = 11/40 = 0.275

(ii) Number of students who Sports Club = 9

Total students in sample = 40

P(Sports Club) = 9/40

Estimated number in whole school = (9/40) × 800 = 9 × 20 = 180

Approximately 180 students in the whole school prefer the Sports Club.

43. Toss a paper cup into the air 100 times. After each toss record whether the cup lands on its bottom, upside down on its bottom, upside down its top or on its side (See Fig.). Assign probabilities to the outcomes by using experimental probability.

Fig.: Paper cup landing positions (left to right)—bottom, top and side

Ans. : This is a hands-on activity. I get the following observation from the experiment:

bottom = 35, top = 15, side = 50

Therefore:

P(bottom) = Number of times it landed on bottom / 100

⇒ P(bottom) = 35/100

P(top) = Number of times it landed on top / 100

⇒ P(top) = 15/100

P(side) = Number of times it landed on side / 100

⇒ P(side) = 50/100

44. Suppose you roll a 6-sided die 12 times and get a '3' times.

(i) What is the experimental probability of rolling a '3'?

(ii) What is the theoretical probability of rolling a '3'?

(iii) Why might these probabilities be different? What would you expect to happen if you roll the die 60, 600, or 6000 times?

Ans. : (i) P(3) experimentally = 3/12 = 1/4

(ii) P(3) theoretically = 1/6

(iii) Experimental probability is based on actual results from a limited number of trials. With only 12 rolls, the results can vary a lot by chance.

The theoretical probability assumes a perfectly fair die with all outcomes equally

likely.

As the number of trials increases:

• At 60 rolls: Experimental probability will come closer to 1/6 but may still vary.

• At 600 rolls: It will be very close to 1/6.

• At 6000 rolls: It will be almost exactly equal to 1/6.

This is the Law of Large Numbers – as the number of trials increases, the experimental probability approaches the theoretical probability.

45. For the following experiments write down the sample space S.
A box containing 5 green and 7 red balls. One ball is drawn at random.

Ans. : Case 1: If balls are identical.

There are two type of balls: Green (G) and Red (R)

S = {Green ball, Red ball} or S = {G, R}

n(s) = 2

Case 2: If balls are not identical.

If balls are individually distinguishable, S would have 12 elements: G_1, G_2, G_3, G_4, G_5 , $R_1, R_2, R_3, R_4, R_5, R_6, R_7$, but for probability purposes the colour-based sample space is standard at this level.

46. In a village fair, there are 3 popular snacks available: Samosa, Pakora, and Bhaji. For drinks, villagers can choose either Chai or Lassi.
(i) List the sample space of all possible snack and drink combinations a person could choose at the fair.
(ii) List the event 'Selecting Samosa as a snack."

Ans. : (i) S = {Samosa, Chai), (Samosa, Lassi), (Pakora, Chai), (Pakora, Lassi), (Bhaji, Chai), (Bhaji, Lassi)}

n(S) = 6

(ii) E = {(Samosa, Chai), (Samosa, Lassi)}

The event has 2 outcomes out of 6 total outcomes.

P(Samosa) = 2/6 = 1/3

47. A tyre company records distances before replacement in 1000 cases.

Distance (km)	**Less than 4000**	**4001 to 9000**	**9001 to 14000**	**More than 14000**
Number of cases	20	210	325	445

Find the probability that a randomly chosen tyre lasts:
(i) Less than 4000 km.
(ii) Between 4000 and 14000 km.
(iii) More than 14000 km.

Ans. : (i) Total number of tyres = 1000

Number of tyre for less than 4000 km = 20

Therefore, P(Less than 4000 km) = 20/1000 = 1/50

(ii) Total number of tyres = 1000

Cases between 4001 to 14000 = 210 + 325 = 535

Therefore, P(Between 4000 and 14000 km) = 535/1000

(iii) Total number of tyres = 1000

Cases More than 14000 km = 445

Therefore, P(More than 14000 km) = 445/1000

48. The letter of the word 'PEACE' are placed on cards. Leela draws a card without looking

(i) What is the probability that it is a P, E or C?

(ii) What is the probability that it is not an E?

Ans. : (i) Total number of cards in P E A C E = 5

Cards with P, E or C:

P = 1, E = 2, C = 1

⇒ total = 4 cards

Therefore, P(P, E or C) = 4/5

(ii) Number of E cards = 2

Cards that are not E = 5 – 2 = 3 (P, A, C)

Therefore, P(not E) = 3/5.

49. A box contains 4 balls numbered 1 to 4. Record a sample space using a tree diagram for the following experiments:

(i) A ball is drawn, and the number is recorded. Then the ball is returned, and a second ball is drawn and recorded.

(ii) A ball is drawn and recorded. Without replacing the first ball, the experimenter draws and records a second ball.

(iii) What are the sizes of these two sample spaces?

Ans. : (i) Sample Space (all ordered pairs):

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

n(S) = 16

(ii) Sample Space (all ordered pairs where both numbers are different):

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

n(S) = 12

(iii) With replacement: n(S) = 16 Without replacement: n(S) = 12.

50. Three coins are tossed, and the number of heads is recorded. Which of the following lists is a sample space for this experiment? Why do the other lists fail to qualify as a sample space?

(i) {1, 2, 3}
(ii) {0, 1, 2}
(iii) {0, 1, 2, 3, 4}
(iv) {0, 1, 2, 3}

Ans. : When 3 coins are tossed, possible number of heads = 0, 1, 2 or 3.
(i) {1, 2, 3} — Not a valid sample space. It does not include 0 heads (all tails = TTT).
(ii) {0, 1, 2} — Not a valid sample space. It does not include 3 heads (HHH).
(iii) {0, 1, 2, 3, 4} — Not a valid sample space. The value 4 is not possible since only 3 coins are tossed. Maximum heads = 3.
(iv) {0, 1, 2, 3} — Yes, this is the correct sample space. It includes all possible values: 0 heads (TTT), 1 head, 2 heads, and 3 heads (HHH).

51. Suppose you drop a dye at random on the rectangular region show in fig What is the probability that it will land inside the circle with a diameter of 1 m?

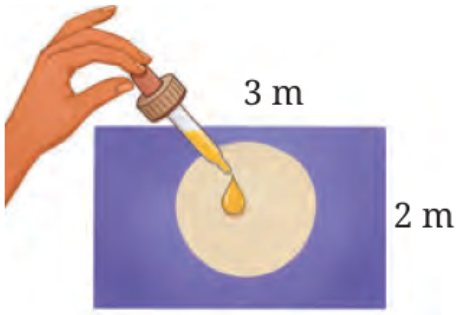


Fig.

Ans. : Area of rectangle $= 3 \times 2 = 6m^2$
Diameter of circle = 1 m, so radius = 0.5 m
Area of circle $= \pi \times r^2$
$= \pi \times (0.5)^2$
$= \pi \times 0.25 = \pi/4$
P(lands inside circle) = Area of circle / Area of rectangle
$= (\pi/4)/6$
$= \pi/24$

*** Answer the following questions. [5 Marks Each]** **[60]**

52. Rank the following events on a scale from 0 (Impossible) to 1 (Certain). Label each event: Impossible, less likely, equally likely (even chance), more likely, certain. Give reasons why you gave each event its ranking.
(i) The next Monday will come after Sunday.
(ii) It will snow in Mumbai in July.
(iii) An elephant will walk through your classroom today.
(iv) You will greet at least one friend at school tomorrow.

Ans. : (i) Certain (Probability = 1)

Reason:

Days of the week always follow a fixed order. Sunday is always followed by Monday. This will definitely happen, so its probability is 1.

(ii) Impossible (Probability $= 0$)

Reason:

Mumbai has a tropical climate. In July it experiences the monsoon season with hot and humid weather. Snowfall is not possible there. So this event cannot happen at all, its probability is 0.

(iii) Impossible (Probability $= 0$)

Reason:

Under normal circumstances, it is not possible for an elephant to walk into a school classroom. This event practically cannot happen, so its probability is 0 (or extremely close to 0).

(iv) More likely (Probability is close to 1 , but not exactly 1)

Reason:

At school there are many friends around you. It is very likely that you will greet at least one friend. The chances are very high, so this event is "more likely." It is not "certain" because there could be rare situations (like you are absent or school is closed), but normally it will happen.

53. There are two fruit baskets A and B. Basket A has one apple and two oranges. Basket B has one banana and one mango. You randomly pick one fruit from each basket.
(i) Draw a tree diagram showing all possible pairs of fruits.
(ii) List the sample space.
(iii) What is the probability of picking one apple and one banana?

Ans. : (i) Tree Diagram

Basket A

/ \

Apple Orange

/ \ / \

Banana Mango Banana Mango

Possible pairs:

(Apple, Banana)

(Apple, Mango)

(Orange, Banana)

(Orange, Mango)

(ii) Sample Space

S = {(Apple, Banana), (Apple, Mango), (Orange, Banana), (Orange, Mango)}

(iii) Probability of picking one apple and one banana

Number of favourable outcomes = 1 [(Apple, Banana)]

Total number of outcomes = 4

Probability = 1/4

54. Let us say that you have a box containing 3 red pens, 4 black pens and 2 green pens. You pick a pen (without looking) from the box and put it back. Then you friend does the same.

(i) What are the possible outcomes of the pen colours? Can you draw a tree diagram representing the possible outcomes?

(ii) Can you use the tree diagram to guess the probability that both you are your friend pick pens of the same colour?

Ans. : (i) Possible outcomes of the pen colours

The possible colours are:

Red (R)

Black (B)

Green (G)

So, the sample space is

S = {(R, R), (R, B), (R, G), (B, R), (B, B), (B, G), (G, R), (G, B), (G, G)}

Tree Diagram

First Pick

/ | \

R B G

/ | \ / | \ / | \

R B G R B G R B G

(ii) Probability that both pick pens of the same colour

From the sample space, the outcomes in which both pick pens of the same colour are:

(R, R), (B, B), (G, G)

Number of favourable outcomes = 3

Total number of outcomes = 9

Therefore, Probability = 3/9 = 1/3

Hence, the probability that both pick pens of the same colour is 1/3.

55. Which of the following experiments have equally likely outcome? Explain.

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

(ii) Tossing a fair coin once.

(iii) Rolling a fair 6-sided die.

(iv) Choosing a marble randomly from a bag that contains 3 red marbles and 7 blue marbles.

Ans. : (i) Not equally likely.

The car starting depends on the condition of the car, fuel, battery etc. The two outcomes (starts / does not start) are not equally likely under normal conditions.

(ii) Yes, equally likely.

Heads and Tails each have probability = 1/2. A fair coin gives equal chance to both outcomes.

(iii) Yes, equally likely.

Each of the 6 faces (1 to 6) has an equal probability = 1/6.

(iv) Not equally likely.

P(red) = 3/10 and P(blue) = 7/10. The two colours have different probabilities.

(v) Yes, equally likely.

Biologically, the probability of a boy or girl is approximately 1/2 each, so these can be considered roughly equally likely.

56. A child has 2 shirts (one red and one blue) and 3 types of pants (jeans, khakis, and shorts) List all the possible combinations of outfits consisting of one shirt and one pair of pants. Display your answer in a table format.

Ans. : The possible combinations of outfits consisting of one shirt and one pair of pants:

Shirt	Pants	Outfit
Red	Jeans	Red shirt + Jeans
Red	Khakis	Red shirt + Khakis
Red	Shorts	Red shirt + Shorts
Blue	Jeans	Blue shirt + Jeans
Blue	Khakis	Blue shirt + Khakis
Blue	Shorts	Blue shirt + Shorts

Therefore the total possible combinations = 6 outfits.

57. A game of chance consists of spinning an arrow (see Fig) which comes to rest pointing at one of the numbers 1,2,3,4,5,6,7,8 and these are equally likely outcomes. What is the probability that it will point at

Fig.

(i) 8?

(ii) An odd number?
(iii) A number greater than 2?
(iv) A number less than 9?
(v) A multiple of 3?

Ans. : (i) P (Pointing at 8)
Favourable outcomes = {8}
⇒ n(E) = 1
Therefore, P(8) = 1/8
(ii) P (odd number)?
Odd numbers = {1, 3, 5, 7}
⇒ n(E) = 4
Therefore, P (odd) = 4/8 = 1/2
(iii) P(number greater than 2)
Numbers greater than 2 = {3, 4, 5, 6, 7, 8}
⇒ n(E) = 6
Therefore, P(number greater than 2) = 6/8 = 3/4
(iv) P(number less than 9)
All numbers 1 to 8 are less than 9.
⇒ n(E) = 8
Therefore, P(number less than 9) = 8/8 = 1
(v) P(multiple of 3)
Multiple of 3 from 1 to 8 = {3, 6}
⇒ n(E) = 2
Therefore, P(multiple of 3) = 2/8 = 1/4.

58. A basket contains 4 red ball and 5 blue balls. One ball is drawn and laid aside, and a second ball is drawn. Draw a tree diagram to represent the possible outcomes and probabilities. Use the tree diagram to answer the following questions. (i) What is the probability of drawing a red ball and then a blue ball? (ii) What is the probability of drawing 2 blue balls?

Ans. : Total balls = 4 red + 5 blue = 9 balls
Since one ball is laid aside, the second ball is drawn without replacement.
Possible outcomes: {(R, R), (R, B), (B, R), (B, B)}
Tree Diagram
First Draw
/ \
R B
4/9 5/9
/ \ / \
R B R B
3/8 5/8 4/8 4/8
(i) Probability of drawing a red ball and then a blue ball

Probability of first drawing a red ball = 4/9
After drawing one red ball, remaining balls: 3 red and 5 blue
Total remaining balls = 8
Probability of drawing a blue ball next = 5/8
Therefore, P(R, B) = (4/9) × (5/8)
= 20/72
= 5/18
Hence, the probability of drawing a red ball and then a blue ball is 5/18
(ii) Probability of drawing 2 blue balls
Probability of first drawing a blue ball = 5/9
After drawing one blue ball, remaining balls: 4 red and 4 blue
Total remaining balls = 8
Probability of drawing another blue ball = 4/8
Therefore, P(B, B) = (5/9) × (4/8)
= 20/72
= 5/18
Hence, the probability of drawing 2 blue balls is 5/18.

59. Write the sample space and calculate the probability based on the given information.
Two dice are rolled. What is the probability that the sum is a prime number greater than 5?

Ans. : When two dice are rolled, the sample space 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)}
Total number of outcomes = 36.
Prime numbers greater than 5 up to 12: 7, 11
Outcomes with sum = 7: (1,6), (2,5), (3,4), (4,3), (5,2), (6,1) ⇒ 6 outcomes
Outcomes with sum = 11: (5,6), (6,5) ⇒ 2 outcomes
Total favourable = 6 + 2 = 8
P(sum is a prime number greater than 5) = 8/36 = 2/9

60. Write the sample space and calculate the probability based on the given information.
A bag contain 4 red, 3 green, and 2 blue balls. Two balls are drawn without replacement. What is the probability that both are of different colours?

Ans. : Total balls = 4 red + 3 green + 2 blue = 9 balls
Two balls are drawn without replacement.

We need probability that both balls are of different colours.
Total possible outcomes:
First ball can be chosen in 9 ways.
Second ball can be chosen in 8 ways.
Total outcomes = 9 × 8 = 72
Favourable outcomes (different colours)
Red and Green:
First Red then Green = 4 × 3 = 12
First Green then Red = 3 × 4 = 12
Total = 24
Red and Blue
Red then Blue = 4 × 2 = 8
Blue then Red = 2 × 4 = 8
Total = 16
Green and Blue
Green then Blue = 3 × 2 = 6
Blue then Green = 2 × 3 = 6
Total = 12
Total favourable outcomes = 24 + 16 + 12 = 52
Therefore, P(different colours) = 52/72 = 13/18.

61. Write the sample space and calculate the probability based on the given information.
Three coins are tossed. What is the probability that the first coin shows heads and exactly two heads occur in total?

Ans. : S = {HHH, HHT, HTH, HTT, THH, THT, TTH, TTT}
⇒ n(S) = 8
First coin shows H and exactly 2 heads total: {HHT, HTH}
⇒ n(E) = 2
Therefore, Probability = 2/8 = 1/4

62. Write the sample space and calculate the probability based on the given information.
A four-digit number is formed using the digits 1, 2, 3 and 4 with no repetition. What is the probability that the number is even?

Ans. : Total arrangements of 4 different digits:
= 4 × 3 × 2 × 1
= 24
Condition for even number:
A number is even if its last digit is even.
Even digits here: 2 and 4
So, last digit can be 2 or 4.

Case 1: Last digit = 2
Remaining digits: 1, 3, 4
Number of ways to arrange them = 3 × 2 × 1 = 6
Case 2: Last digit = 4
Remaining digits: 1, 2, 3
Number of ways = 3 × 2 × 1 = 6
Total favourable outcomes = 6 + 6 = 12
Therefore, P(even number) = 12/24 = 1/2.

63. Write the sample space and calculate the probability based on the given information.
A student takes a multiple-choice test with 3 questions, each having 4 options (A, B, C, D), with only one correct answer. What is the probability that the student guesses and gets exactly 2 answer correct?

Ans. : Each question has 4 options and only 1 is correct.
So for each question:
Probability of correct answer = 1/4
Probability of wrong answer = 3/4
Total questions = 3
We need probability of exactly 2 correct answers.
Possible cases for exactly 2 correct
There are 3 ways this can happen: {(C, C, W), (C, W, C), (W, C, C)}
Probability of each case
Each case has:
2 correct answers ⇒ (1/4) × (1/4)
1 wrong answer ⇒ (3/4)
So probability of one case = (1/4) × (1/4) × (3/4) = 3/64
Since there are 3 such cases, so
P(exactly 2 correct) = 3 × (3/64) = 9/64.

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