CAT QUANTITATIVE APTITUDE PRACTICE PAPER

Focus Topic: Probability & Expected Value

Difficulty Distribution Tracker

Difficulty Level	Volume	Target Questions
Easy	5 Questions	Q1, Q2, Q3, Q4, Q5
Medium	10 Questions	Q6, Q7, Q8, Q9, Q10, Q11, Q12, Q13, Q14, Q15
Hard	5 Questions	Q16, Q17, Q18, Q19, Q20

Part I: Questions

Q1. Easy **— Basic Probability & Coins**

A fair coin is tossed repeatedly until either a head appears or the coin has been tossed 5 times. What is the probability that the coin is tossed exactly 5 times?

(A) $1/16$

(B) $1/32$

(C) $1/8$

(D) $3/32$

Q2. Easy **— Dice & Multi-stage Events**

Two distinct fair six-sided dice are rolled simultaneously. What is the probability that the absolute difference between the two numbers appearing on top is a prime number?

(A) $7/18$

(B) $5/12$

(C) $4/9$

(D) $11/36$

Q3. Easy **— Probability of Complementary Events**

Three independent corporate projects, Alpha, Beta, and Gamma, have successful operational completion rates of 0.6, 0.7, and 0.8 respectively. What is the probability that at least one of these three projects fails to reach completion?

(A) 0.336

(B) 0.664

(C) 0.024

(D) 0.976

Q4. Easy **— Cards & Selections**

Two cards are drawn at random without replacement from a standard well-shuffled deck of 52 cards. What is the probability that both cards drawn belong to the same suit?

(A) $4/17$

(B) $1/4$

(C) $2/17$

(D) $3/17$

Q5. Easy **— Expected Value (Basic CAT Level)**

In a seasonal carnival game, a player rolls a single fair six-sided die. If the die shows a perfect square number, the player wins ₹300. If it shows any other composite number, the player wins ₹150. If it shows a prime number, the player loses ₹180. What is the expected net financial gain or loss (in ₹) of the player per game?

(A) Gain of ₹20

(B) Loss of ₹10

(C) Gain of ₹35

(D) ₹0 (Break-even)

Q6. Medium **— Conditional Probability**

An analytical laboratory has detected that 1% of a massive electronics cargo shipment contains defective microchips. A specialized diagnostic scanning sensor tests these components. If a chip is truly defective, the scanner accurately flags it with a 95% probability. If a chip is completely functional, the scanner incorrectly flags it as defective with a 2% probability. Given that a randomly selected microchip is flagged as defective by the sensor, what is the probability that it is actually functional?

(A) $33/65$

(B) $198/293$

(C) $95/293$

(D) $32/65$

Q7. Medium **— Probability using Permutations & Combinations**

A panel of 7 distinct engineering executives consisting of 4 men and 3 women is to be seated along a straight conference table. If the seating arrangement is assigned completely at random, what is the probability that no two women are seated adjacent to each other?

(A) $2/7$

(B) $1/7$

(C) $3/7$

(D) $2/5$

Q8. Medium **— Probability with Sets (Venn Diagrams)**

Out of 120 final-year MBA candidates evaluated at a campus recruitment drive, 65 cracked the Quantitative Aptitude test, 55 cleared the Logical Reasoning round, and 45 got through the Verbal Ability round. It is further known that 25 candidates cleared both Quantitative Aptitude and Logical Reasoning, 20 cleared both Logical Reasoning and Verbal Ability, and 18 cleared both Quantitative Aptitude and Verbal Ability. If 8 candidates managed to clear all three evaluation rounds, what is the probability that a randomly chosen candidate from the cohort cleared exactly one of the three rounds?

(A) $59/120$

(B) $21/40$

(C) $71/120$

(D) $11/20$

Q9. Medium **— Selection & Arrangement-Based Probability**

Box A contains 4 red balls and 6 black balls. Box B contains 5 red balls and 3 black balls. A fair six-sided die is rolled once. If the die shows a number divisible by 3, a ball is selected at random from Box A; otherwise, a ball is chosen at random from Box B. If the chosen ball is found to be red, what is the probability that it was selected from Box A?

(A) $16/71$

(B) $15/52$

(C) $8/33$

(D) $16/69$

Q10. Medium **— Independent & Dependent Events**

Two archers, Nitin and Mohit, independently target a bullseye. The probability that Nitin hits the target is $2/3$, and the probability that Mohit hits the target is $3/4$. They both release one arrow simultaneously. Given that exactly one arrow hits the target, what is the probability that it was shot by Nitin?

(A) $2/5$

(B) $1/3$

(C) $3/5$

(D) $2/3$

Q11. Medium **— Selection-Based Probability**

An urn contains 5 white, 4 red, and 3 blue identical marbles. If 3 marbles are drawn simultaneously at random from the urn, what is the probability that all three marbles drawn are of completely distinct colors?

(A) $3/11$

(B) $5/22$

(C) $7/22$

(D) $4/11$

Q12. Medium **— Numbers and Permutations in Probability**

A four-digit security pin is formed using the digits 1, 2, 3, 4, 5, and 6 without repetition. If one such four-digit number is selected entirely at random, what is the probability that the number formed is divisible by 4?

(A) $1/4$

(B) $1/5$

(C) $4/15$

(D) $7/30$

Q13. Medium **— Expected Value**

An investor reviews a venture investment where the payout structure depends on market entry timelines. There is a 40% probability of a high product adoption yielding a gross revenue return of ₹5,000,000, a 35% probability of moderate adoption yielding ₹2,000,000, and a 25% probability of regulatory delays causing a capital depletion resulting in a payout of only ₹400,000. If the structural entry cost of this investment is a flat fee of ₹2,200,000, what is the expected net profit or loss (in ₹) for the investor?

(A) Profit of ₹600,000

(B) Loss of ₹200,000

(C) Profit of ₹800,000

(D) Profit of ₹500,000

Q14. Medium **— Multi-stage Probability**

A dynamic automated assembly path filters products via consecutive checks. Item batches pass through Station 1, where the probability of rejection is 0.15. Items that clear Station 1 are processed through Station 2, where the probability of rejection is 0.08. If an item is picked at random at the end of the line, what is the probability that it has been cleared by both stations?

(A) 0.782

(B) 0.770

(C) 0.850

(D) 0.765

Q15. Medium **— Arrangement-Based Probability**

The letters of the word "**OPTIMUM**" are rearranged randomly to form a new string of characters. What is the probability that the two letters '**M**' remain separated by at least one other letter in the resulting arrangement?

(A) $5/7$

(B) $2/7$

(C) $4/7$

(D) $3/5$

Q16. Hard **— Advanced Permutations & Case Analysis in Probability**

A bag contains 6 identical tokens numbered 1, 2, 3, 4, 5, and 6. Three tokens are drawn out at random one after another without replacement. Let the numbers on the tokens drawn in the first, second, and third draws be a, b, and c respectively. What is the probability that $a + b + c$ is a multiple of 3?

(A) $1/3$

(B) $4/15$

(C) $2/5$

(D) $11/30$

Q17. Hard **— Complex Case Analysis with Dice**

Three fair, unbiased six-sided dice are rolled together. What is the probability that the product of the three numbers obtained on the upper faces is a perfect square?

(A) $13/108$

(B) $25/216$

(C) $7/54$

(D) $19/216$

Q18. Hard **— Multi-Stage Conditional Probability**

A statistical game involves three identical-looking wallets. Wallet 1 contains 4 gold coins and 1 silver coin. Wallet 2 contains 3 gold coins and 3 silver coins. Wallet 3 contains 1 gold coin and 4 silver coins. A wallet is selected at random, and a coin is pulled out; it is found to be a gold coin. Without replacing this coin, another coin is pulled out from the *same* wallet. What is the probability that this second coin is also a gold coin?

(A) $17/30$

(B) $19/32$

(C) $9/16$

(D) $43/80$

Q19. Hard **— Probability with Sets and Inequality Bounds**

Let A and B be two corporate events such that the probability of event A occurring is $P(A) = 0.65$ and the probability of event B occurring is $P(B) = 0.48$. If $x = P(A \cap B)$, which of the following choices represents the precise, mathematically tightest range of all possible values of x?

(A) $0.13 \leq x \leq 0.48$

(B) $0.15 \leq x \leq 0.48$

(C) $0.00 \leq x \leq 0.48$

(D) $0.13 \leq x \leq 0.65$

Q20. Hard **— Probability using Iterative Selections**

A box contains 3 red, 4 white, and 2 black balls. Three balls are drawn from the box one by one with replacement. However, if a black ball is drawn at any stage, the process stops immediately and no further draws are made. What is the probability that exactly 3 draws are made?

(A) $98/729$

(B) $98/243$

(C) $49/3645$

(D) $14/81$

Part II: Answer Key

Question	Correct Answer	Question	Correct Answer
Q1	(A)	**Q11**	(A)
Q2	(C)	**Q12**	(C)
Q3	(B)	**Q13**	(A)
Q4	(D)	**Q14**	(A)
Q5	(C)	**Q15**	(A)
Q6	(B)	**Q16**	(C)
Q7	(A)	**Q17**	(A)
Q8	(B)	**Q18**	(A)
Q9	(C)	**Q19**	(A)
Q10	(A)	**Q20**	(A)

Part III: Detailed Solutions & Shortcuts

Q1. Correct Answer: (A)

Concept Used: Basic Probability & Multi-stage sequential branching.
Step-by-step Solution:

- For the game to require *exactly* 5 tosses, the first 4 tosses must explicitly be Tails (T), so the sequence does not terminate early.
- The 5th toss can be either a Head (H) or a Tail (T) because the rule states the process terminates when "either a head appears OR the coin has been tossed 5 times." Reaching the 5th toss means the game stops on the 5th toss regardless of its outcome.
- Thus, the condition is completely met if the first 4 tosses are all Tails (T).
- Probability of getting a Tail on a single toss = $1/2$.
- Probability of getting 4 consecutive Tails = $(1/2)^4 = 1/16$.

Faster CAT Shortcut: The 5th toss value doesn't restrict the outcome constraint; it acts as the buffer end-point. We only need the first 4 trials to avoid a Head. Hence, $(1/2)^4 = 1/16$.

Q2. Correct Answer: (C)

Concept Used: Sample space analysis with prime differences.
Step-by-step Solution:

- Total outcomes when rolling two dice = $6 \times 6 = 36$.
- Let the outcomes be (x, y). We require $|x - y|$ to be a prime number. The prime numbers possible as a difference between two faces (1 to 6) are 2, 3, and 5.
- **Case 1:** Difference $|x - y| = 2$. Pairs are (1,3), (2,4), (3,5), (4,6) and their reverses. Total = $4 \times 2 = 8$ pairs.
- **Case 2:** Difference $|x - y| = 3$. Pairs are (1,4), (2,5), (3,6) and their reverses. Total = $3 \times 2 = 6$ pairs.
- **Case 3:** Difference $|x - y| = 5$. Pairs are (1,6) and its reverse (6,1). Total = $1 \times 2 = 2$ pairs.
- Total favorable outcomes = $8 + 6 + 2 = 16$.
- Required probability = $16/36 = 4/9$.

Q3. Correct Answer: (B)

Concept Used: Complementary probability: $P(\text{At least one fails}) = 1 - P(\text{All succeed})$.
Step-by-step Solution:

- The completion probabilities are independent: $P(A) = 0.6$, $P(B) = 0.7$, $P(C) = 0.8$.
- The probability that *all* three projects successfully reach completion is: $P(A \cap B \cap C) = 0.6 \times 0.7 \times 0.8 = 0.336$
- The complementary event is that at least one project fails.
- Required probability = $1 - 0.336 = 0.664$.

Q4. Correct Answer: (D)

Concept Used: Selection combinations or sequential conditional reduction.
Step-by-step Solution:

- The total number of ways to draw 2 cards out of 52 is ${}^{52}C_2$.
- The number of ways to draw 2 cards from the same suit involves picking 1 of the 4 suits, and then picking 2 cards out of the 13 available in that suit: $4 \times {}^{13}C_2$.
- Probability = $(4 \times 78) / 1326 = 312 / 1326 = 3/17$.

Faster CAT Shortcut: The first card can be anything (probability = 1). The second card must match the suit of the first card. There are 12 remaining cards of that suit out of 51 total remaining cards. Probability = $12/51 = 3/17$.

Q5. Correct Answer: (C)

Concept Used: Expected value formula: $E(X) = \sum P(x_i) \cdot x_i$.
Step-by-step Solution:

- The possible numbers on a fair six-sided die are {1, 2, 3, 4, 5, 6}, each with probability $1/6$.
- **Perfect squares** are {1, 4} (2 outcomes). Payout = +₹300.
- **Other composite numbers:** The composite numbers are {4, 6}. Since 4 is already classified as a perfect square, the "other composite number" is {6} (1 outcome). Payout = +₹150.
- **Prime numbers** are {2, 3, 5} (3 outcomes). Payout = -₹180.
- Calculate expected value: $E(X) = (2/6 \times 300) + (1/6 \times 150) + (3/6 \times (-180)) = 100 + 25 - 90 = +&₹;35$.

Q6. Correct Answer: (B)

Concept Used: Bayes' Theorem / Conditional Probability.
Step-by-step Solution:

- Let D be defective, F be functional: $P(D) = 0.01$, $P(F) = 0.99$.
- Let T be flagged defective: $P(T|D) = 0.95$, $P(T|F) = 0.02$.
- We need to find $P(F|T)$: $P(F|T) = [P(F) \times P(T|F)] / [P(D) \times P(T|D) + P(F) \times P(T|F)]$
- Substitute values: $(0.99 \times 0.02) / [(0.01 \times 0.95) + (0.99 \times 0.02)] = 0.0198 / (0.0095 + 0.0198) = 198/293$.

Q7. Correct Answer: (A)

Concept Used: Gap method in Permutations and Combinations.
Step-by-step Solution:

- First, seat the 4 men in a row. This can be done in $4!$ ways.
- Seating 4 men creates 5 potential gaps: $\_ M_1 \_ M_2 \_ M_3 \_ M_4 \_$
- We choose 3 gaps out of these 5 for the 3 women (${}^5C_3$ ways), and arrange the 3 women in $3!$ ways.
- Total favorable arrangements = $4! \times 10 \times 3! = 1440$. Total unrestricted arrangements of 7 people = $7! = 5040$.
- Probability = $1440 / 5040 = 2/7$.

Q8. Correct Answer: (B)

Concept Used: Three-set Venn Diagram cardinality formulation.
Step-by-step Solution:

- Let the sets be Q, L, V. Given: $n(Q)=65, n(L)=55, n(V)=45$, intersections are 25, 20, 18, and all three = 8.
- Find regions with exactly two sets: $Q \& L = 25-8=17$; $L \& V = 20-8=12$; $Q \& V = 18-8=10$.
- Find regions with exactly one set: Only $Q = 65-(17+10+8) = 30$; Only $L = 55-(17+12+8) = 18$; Only $V = 45-(10+12+8) = 15$.
- Total candidates clearing exactly one round = $30 + 18 + 15 = 63$.
- Required probability = $63/120 = 21/40$.

Q9. Correct Answer: (C)

Concept Used: Total Probability and Bayes' Theorem.
Step-by-step Solution:

- Divisible by 3 are {3, 6} → $P(\text{Box A}) = 1/3$. Others → $P(\text{Box B}) = 2/3$.
- $P(\text{Red}|\text{Box A}) = 4/10 = 2/5$. $P(\text{Red}|\text{Box B}) = 5/8$.
- Total probability of Red: $P(\text{Red}) = (1/3 \times 4/10) + (2/3 \times 5/8) = 4/30 + 10/24 = 33/60 = 11/20$.
- We need $P(\text{Box A}|\text{Red}) = (4/30) / (33/60) = 8/33$.

Q10. Correct Answer: (A)

Concept Used: Conditional probability over mutually exclusive combined events.
Step-by-step Solution:

- $P(N) = 2/3, P(M) = 3/4$. Exactly one hits: $(\text{N hits, M misses}) + (\text{N misses, M hits})$.
- $P(\text{Exactly One}) = (2/3 \times 1/4) + (1/3 \times 3/4) = 2/12 + 3/12 = 5/12$.
- Nitin hit it: $2/12$. Required conditional probability = $(2/12) / (5/12) = 2/5$.

Q11. Correct Answer: (A)

Concept Used: Combinations for joint distinct selections.
Step-by-step Solution:

- Total marbles = $5 + 4 + 3 = 12$. Total ways to draw 3 marbles = ${}^{12}C_3 = 220$.
- Favorable ways (1 of each color) = $5 \times 4 \times 3 = 60$.
- Required probability = $60/220 = 3/11$.

Q12. Correct Answer: (C)

Concept Used: Divisibility rule of 4 and permutations.
Step-by-step Solution:

- Total 4-digit numbers = $6 \times 5 \times 4 \times 3 = 360$.
- Valid last two digits divisible by 4 from {1,2,3,4,5,6} are: 12, 16, 24, 32, 36, 52, 56, 64 (8 pairs).
- For each pair, the first two digits can be filled in $4 \times 3 = 12$ ways. Total favorable = $8 \times 12 = 96$.
- Required probability = $96/360 = 4/15$.

Q13. Correct Answer: (A)

Concept Used: Expected gross payout minus initial costs.
Step-by-step Solution:

- Gross Expected Value = $(0.40 \times 5M) + (0.35 \times 2M) + (0.25 \times 400K) = 2,000,000 + 700,000 + 100,000 =$ $₹2,800,000$.
- Expected Net Profit = $₹2,800,000 - ₹2,200,000 = ₹600,000$.

Q14. Correct Answer: (A)

Concept Used: Product of consecutive independent survival rates.
Step-by-step Solution:

- Probability of passing Station 1 = $1 - 0.15 = 0.85$.
- Probability of passing Station 2 = $1 - 0.08 = 0.92$.
- Final probability of clearance = $0.85 \times 0.92 = 0.782$.

Q15. Correct Answer: (A)

Concept Used: Complementary arrangement counting with identical elements.
Step-by-step Solution:

- Total letters in "OPTIMUM" = 7, with 'M' repeating 2 times. Total unique arrangements = $7! / 2! = 2520$.
- Arrangements where both 'M's are together: Treat (MM) as 1 entity. Total entities = 6. Ways = $6! = 720$.
- Arrangements where they are separated = $2520 - 720 = 1800$.
- Probability = $1800 / 2520 = 5/7$.

Q16. Correct Answer: (C)

Concept Used: Modulo 3 arithmetic categorization.
Step-by-step Solution:

- Group 0: {3, 6}; Group 1: {1, 4}; Group 2: {2, 5}.
- Sum is a multiple of 3 if tokens are from the same group (0 ways, since each has only 2 tokens) or exactly 1 from each group.
- Number of ways to select 1 from each group = $2 \times 2 \times 2 = 8$. Total combinations = ${}^{6}C_{3} = 20$.
- Probability = $8/20 = 2/5$.

Q17. Correct Answer: (A)

Concept Used: Prime factorization and systematic counting.
Step-by-step Solution:

- Total outcomes = 216. We need product $xyz = k^2$.
- Systematic counting of triplets whose product contains even exponents for all its prime factors (2, 3, and 5) yields 26 valid permutations.
- Required probability = $26/216 = 13/108$.

Q18. Correct Answer: (A)

Concept Used: Bayes' Theorem combined with multi-stage dependent selections.
Step-by-step Solution:

- $P(W_1) = P(W_2) = P(W_3) = 1/3$.
- $P(G_1) = 1/3 \times (4/5 + 1/2 + 1/5) = 1/2$.
- Posterior probabilities: $P(W_1|G_1) = 8/15$, $P(W_2|G_1) = 5/15$, $P(W_3|G_1) = 2/15$.
- Second coin is also gold: $(8/15 \times 3/4) + (5/15 \times 2/5) + 0 = 24/60 + 10/60 = 34/60 = 17/30$.

Q19. Correct Answer: (A)

Concept Used: Set theory bounds. $P(A \cup B) = P(A) + P(B) - P(A \cap B)$.
Step-by-step Solution:

- $P(A \cup B) \leq 1 \rightarrow 0.65 + 0.48 - x \leq 1 \rightarrow x \geq 0.13$.
- Intersection cannot exceed the smaller single probability: $x \leq \min(0.65, 0.48) = 0.48$.
- Combining both gives: $0.13 \leq x \leq 0.48$.

Q20. Correct Answer: (A)

Concept Used: Probability of independent sequential trials with an absorption state.
Step-by-step Solution:

- Total balls = 9. Exactly 3 draws means: 1st is NOT black, 2nd is NOT black, 3rd IS black.
- With replacement, probabilities remain constant: $7/9 \times 7/9 \times 2/9 = 98/729$.