Probability

Standard difficulty · 20 questions · 40 marks · Time: 36 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. If P(B) = 3/10 and P(A ∩ B) = 3/20, then P(A | B) is:
(a) 9/40 **(b)** 9/200 **(c)** 3/20 **(d)** 1/2

2. A and B are independent with P(A) = 9/10 and P(B) = 4/5. Then P(A ∪ B) is:
(a) 18/25 **(b)** 1 **(c)** 49/50 **(d)** 7/25

3. Two dice are thrown. The probability that the sum is 4, given that both dice show the same number, is:
(a) 5/6 **(b)** 1/36 **(c)** 1/12 **(d)** 1/6

4. Bag I has 6 red and 4 black balls; bag II has 7 red and 5 black balls. A bag is chosen at random and a ball drawn from it is red. The probability that it came from bag I is:
(a) 36/71 **(b)** 3/10 **(c)** 3/5 **(d)** 6/13

5. P(A | B) equals:
(a) P(A) + P(B) **(b)** P(A ∩ B)/P(A)
(c) P(A) P(B) **(d)** P(A ∩ B)/P(B), with P(B) ≠ 0

6. X takes the values 0, 1, 2 with probabilities 5/13, 5/13, 3/13. The mean of X is:
(a) 1/13 **(b)** 11/13 **(c)** 1 **(d)** 12/13

7. $P(X = x) = kx^2$ for x = 1, 2, …, 8 is a probability distribution. Then k is:
(a) 1/102 **(b)** 1/8 **(c)** 1/205 **(d)** 1/204

8. Assertion (A): If P(A) = 3/5, P(B) = 4/5 and P(A ∩ B) = 53/100, then A and B are independent.
Reason (R): A and B are independent when P(A ∩ B) = P(A) P(B).
(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.

Section B — Short answer — 8 × 2 = 16 marks

9. If P(A) = 3/10, P(B) = 3/5 and P(A ∩ B) = 1/4, find P(A | B), P(B | A) and P(A ∪ B).

10. A and B are independent events with P(A) = 9/10 and P(B) = 4/5. Find P(A ∩ B), P(A ∪ B) and P(neither A nor B).

11. A bag has 8 red and 9 blue balls. Two balls are drawn one after the other without replacement. Find the probability that the first is red and the second is blue.

12. Two dice are thrown. Find the probability that the product is even, given that at least one die shows 3.

13. Machines A, B and C make 60%, 20% and 20% of the bolts in a factory, and 5%, 2% and 6% of their bolts are defective. A bolt picked at random is defective. Find the probability that machine A made it.

14. Two balls are drawn together from a bag of 6 red and 2 black balls. X is the number of red balls drawn. Find the probability distribution of X and its mean.

15. The probabilities that A and B solve a problem independently are 4/5 and 2/3. Find the probability that (a) the problem is solved, (b) exactly one of them solves it.

16. X takes the values 0, 1, 2, 3 with probabilities k, 4k, 3k, k. Find k and the mean of X.

Section C — Word problems — 4 × 4 = 16 marks

17. A disease affects 8% of a population. A test detects it in 95% of people who have it, but also gives a positive result for 9% of people who do not. A person tests positive. Find the probability that the person has the disease.

18. Bag I has 6 red and 5 black balls; bag II has 3 red and 5 black balls. One ball is moved from bag I to bag II without looking, and then a ball drawn from bag II is red. Find the probability that the ball moved was red.

19. Two cards are drawn without replacement from a pack of 52. X is the number of spades drawn. Find the probability distribution of X and its mean.

20. Three students try a problem independently; their chances of solving it are 3/5, 3/4, 2/3. Find the probability that (a) the problem is solved, (b) exactly one of them solves it, (c) none of them solves it.

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Answer key

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Q	Answer	Working
1	**(d) 1/2**	P(A ∩ B)/P(B) = (3/20)/(3/10)
2	**(c) 49/50**	P(A) + P(B) − P(A)P(B)
3	**(d) 1/6**	6 outcomes have "both dice show the same number"; 1 of them also have "the sum is 4"
4	**(a) 36/71**	Bayes: (½ × 6/10) ÷ (½ × 6/10 + ½ × 7/12)
5	**(d) P(A ∩ B)/P(B), with P(B) ≠ 0**	—
6	**(b) 11/13**	Σ xp = 11/13
7	**(d) 1/204**	k × 204 = 1
8	**(d) A is false, but R is true.**	A is false: P(A)P(B) = 12/25, not 53/100. R is true.
9	**P(A | B) = 5/12; P(B | A) = 5/6; P(A ∪ B) = 13/20**	P(A | B) = P(A ∩ B)/P(B)
10	**18/25; 49/50; 1/50**	P(A′ ∩ B′) = P(A′)P(B′)
11	**9/34**	8/17 × 9/16
12	**6/11**	6 of the 11 outcomes with "at least one die shows 3"
13	**15/23**	Bayes: 60 × 5 ÷ (60 × 5 + 20 × 2 + 20 × 6)
14	**P(X = 0) = 1/28, P(X = 1) = 3/7, P(X = 2) = 15/28; mean 3/2**	count pairs: 28 in all
15	**(a) 14/15; (b) 2/5**	(a) 1 − P(neither); (b) P(A)P(B′) + P(A′)P(B)
16	**k = 1/9; mean 13/9**	9k = 1; mean = Σ xp
17	**190/397**	Bayes: (2/25 × 19/20) ÷ (2/25 × 19/20 + 23/25 × 9/100)
18	**8/13**	P(red moved) × P(red | red moved) = 6/11 × 4/9; P(black moved) × P(red | black moved) = 5/11 × 3/9
19	**P(X = 0) = 19/34, P(X = 1) = 13/34, P(X = 2) = 1/17; mean 1/2**	P(X = 2) = 13/52 × 12/51
20	**(a) 29/30; (b) 13/60; (c) 1/30**	P(none) = 2/5 × 1/4 × 1/3