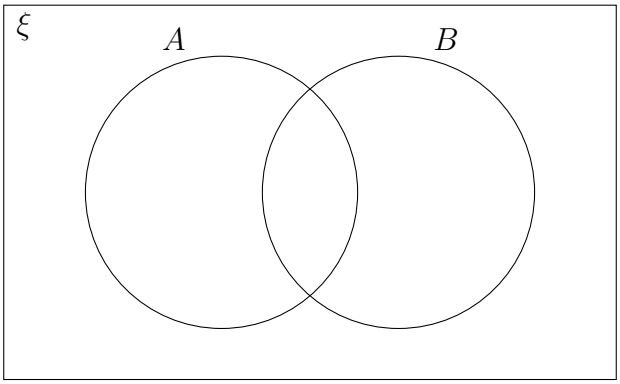
Venn Diagrams and Probability

Practice Worksheet

I Do

The universal set $\xi = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$.
$A = \{\text{prime numbers in } \xi\}$; $B = \{\text{multiples of 3 in } \xi\}$.

(a) Complete the Venn diagram to represent this information.



(3)

(b) A number is chosen at random from ξ.
Find the probability that it is in $A \cup B$.

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(2)

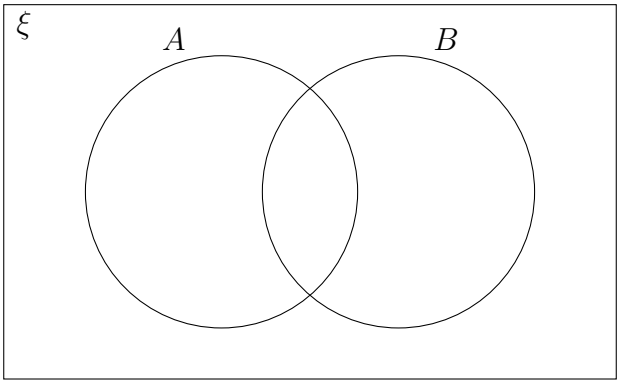
(Total for Question is 5 marks)

Video walkthrough

We Do

Belle is working with sets up to 15.
The universal set contains the integers from 1 to 15 inclusive.
A = {even numbers in the universal set}
B = {factors of 24 in the universal set}

(a) Complete the Venn diagram to represent this information.



(3)

(b) A number is chosen at random from ξ.
Find the probability that it is in A ∪ B.

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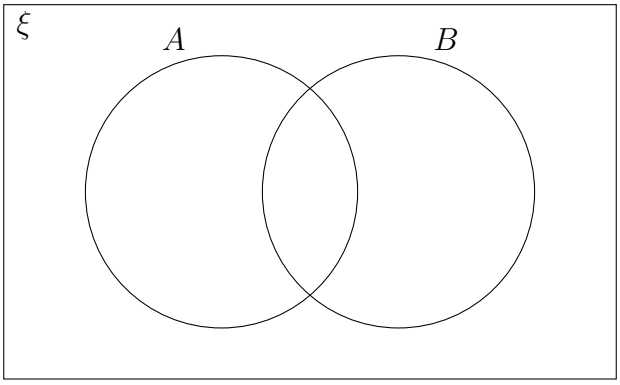
(2)

(Total for Question is 5 marks)

You Do 1

John is working with sets up to 10.
The universal set $\xi = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$.
$A = \{\text{odd numbers in } \xi\}$
$B = \{\text{square numbers in } \xi\}$

(a) Complete the Venn diagram to represent this information.



(3)

(b) A number is chosen at random from ξ.
Find the probability that it is in $A \cap B$.

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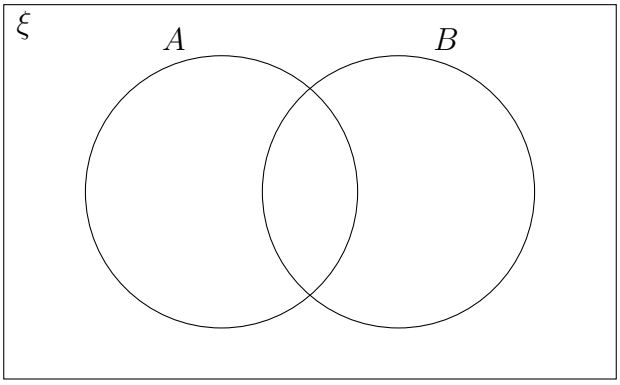
(1)

(Total for Question is 4 marks)

You Do 2

Ryan considers the integers from 10 to 20 inclusive.
The universal set $\xi = \{10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20\}$.
$A = \{\text{prime numbers in } \xi\}$
$B = \{\text{multiples of 4 in } \xi\}$

(a) Complete the Venn diagram to represent this information.



(3)

(b) A number is chosen at random from ξ.
Find the probability that it is in A', the complement of A.

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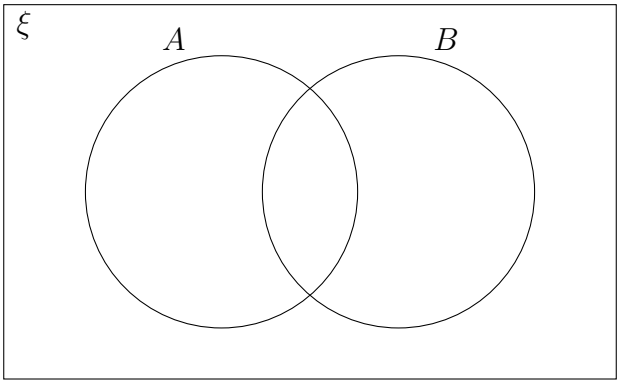
(2)

(Total for Question is 5 marks)

You Do 3

Paul looks at the first 20 positive integers.
The universal set $\xi = \{x \text{ is an integer} : 1 \leq x \leq 20\}$.
$A = \{\text{multiples of 3 in } \xi\}$
$B = \{\text{multiples of 5 in } \xi\}$

(a) Complete the Venn diagram to represent this information.



(3)

(b) A number is chosen at random from ξ.
Find $P(A \cap B')$, the probability that the number is in A but not in B.

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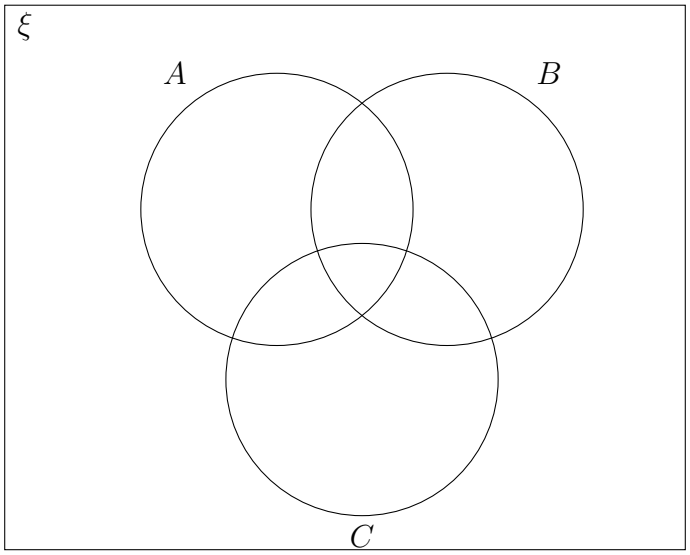
(2)

(Total for Question is 5 marks)

Challenge 1

Sophie is working with three overlapping sets.
The universal set $\xi = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$.
$A = \{\text{even numbers}\}$
$B = \{\text{factors of } 10\}$
$C = \{\text{multiples of } 3\}$

(a) Complete the Venn diagram below.



(4)

(b) A number is chosen at random from ξ.
Find $P((A \cup B \cup C)')$.

.....

(2)

(Total for Question is 6 marks)

Challenge 2

Paige deals with conditional probability on Venn diagrams.
The universal set $\xi = \{x \text{ is an integer} : 1 \leq x \leq 15\}$.
$A = \{\text{prime numbers in } \xi\}$
$B = \{\text{odd numbers in } \xi\}$

A number is chosen at random from the universal set ξ.
Given that the chosen number is in set B, find the probability that it is also in set A.

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(4 marks)

Extreme Challenge

Katie investigates a complex relationship between three sets.
The universal set $\xi = \{x \text{ is an integer} : 1 \leq x \leq 20\}$.
$A = \{\text{factors of } 20\}$
$B = \{\text{multiples of } 4\}$
$C = \{\text{prime numbers}\}$

A number is chosen at random from ξ.
Given that the chosen number is **not** a prime number, what is the probability that it is in $A \cup B$?

You must show all your working clearly.

. . . . . .

(5 marks)

Worked Answers

I Do

(a) $\xi = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$
$A(\text{primes}) = \{2, 3, 5, 7, 11\}$
$B(\text{multiples of } 3) = \{3, 6, 9, 12\}$
Intersection $(A \cap B)$: $\{3\}$
Only A: $\{2, 5, 7, 11\}$
Only B: $\{6, 9, 12\}$
Outside $(A \cup B)'$: $\{1, 4, 8, 10\}$
(b) There are 8 numbers in A $\cup$ B, out of 12 total numbers.
P(A $\cup$ B) = 8/12 = 2/3.

We Do

(a) $\xi = \{1 \text{ to } 15\}$
$A(\text{evens}) = \{2, 4, 6, 8, 10, 12, 14\}$
$B(\text{factors of } 24) = \{1, 2, 3, 4, 6, 8, 12\}$
Intersection $(A \cap B)$: $\{2, 4, 6, 8, 12\}$
Only A: $\{10, 14\}$
Only B: $\{1, 3\}$
Outside: $\{5, 7, 9, 11, 13, 15\}$
(b) Total numbers in $A \cup B$ (the union): $5(\text{middle}) + 2(\text{only A}) + 2(\text{only B}) = 9$.
$P(A \cup B) = \frac{9}{15} = \mathbf{\frac{3}{5}}$.

You Do 1

(a) $\xi = \{1 \text{ to } 10\}$
$A(\text{odds}) = \{1, 3, 5, 7, 9\}$
$B(\text{squares}) = \{1, 4, 9\}$
Intersection $(A \cap B)$: $\{1, 9\}$
Only A: $\{3, 5, 7\}$
Only B: $\{4\}$
Outside: $\{2, 6, 8, 10\}$
(b) There are 2 numbers in the intersection, out of 10 total.
$P(A \cap B) = \frac{2}{10} = \mathbf{\frac{1}{5}}$.

You Do 2

(a) $\xi = \{10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20\}$ (11 numbers total)
A(primes) $= \{11, 13, 17, 19\}$
B(multiples of 4) $= \{12, 16, 20\}$
Intersection ($A \cap B$): $\emptyset$ (Empty)
Only A: $\{11, 13, 17, 19\}$
Only B: $\{12, 16, 20\}$
Outside: $\{10, 14, 15, 18\}$
(b) A' is everything NOT in A. Since there are 4 numbers in A, there are $11 - 4 = 7$ numbers in A'.
$P(A') = \mathbf{\frac{7}{11}}$.

You Do 3

(a) $\xi = \{1$ to $20\}$ (20 numbers total)
A(multiples of 3) $= \{3, 6, 9, 12, 15, 18\}$
B(multiples of 5) $= \{5, 10, 15, 20\}$
Intersection ($A \cap B$): $\{15\}$
Only A: $\{3, 6, 9, 12, 18\}$
Only B: $\{5, 10, 20\}$
Outside: $\{1, 2, 4, 7, 8, 11, 13, 14, 16, 17, 19\}$
(b) $P(A \cap B')$ means the probability of being in A AND NOT in B. This is the "A only" section. There are 5 numbers in A only.
$P(A \cap B') = \frac{5}{20} = \mathbf{\frac{1}{4}}$.

Challenge 1

(a) $\xi = \{1$ to $10\}$.
$A = \{2, 4, 6, 8, 10\}$, $B = \{1, 2, 5, 10\}$, $C = \{3, 6, 9\}$.
Intersections:
$A \cap B = \{2, 10\}$ (in A and B, but not C, so place in the top-middle overlap).
$A \cap C = \{6\}$ (in A and C, not B).
$B \cap C = \emptyset$ (empty).
$A \cap B \cap C = \emptyset$ (empty, central triple overlap is empty).
Only $A = \{4, 8\}$, Only $B = \{1, 5\}$, Only $C = \{3, 9\}$.
Check total placed: $2 + 1 + 0 + 0 + 2 + 2 + 2 = 9$ numbers.
Number remaining outside: $\{7\}$.
(b) $P((A \cup B \cup C)')$ is the probability of choosing a number outside all three circles. There is 1 number (7).
Probability $= \mathbf{\frac{1}{10}}$.

Challenge 2
$\xi = \{1 \text{ to } 15\}$.
$A(\text{primes}) = \{2, 3, 5, 7, 11, 13\}$
$B(\text{odds}) = \{1, 3, 5, 7, 9, 11, 13, 15\}$
The condition "Given that the chosen number is in set B" means our new total number of possible outcomes is restricted to set B only.
There are 8 numbers in set B.
Out of these 8 numbers, we want to know how many are also in set A (so we need the intersection $A \cap B$).
$A \cap B = \{3, 5, 7, 11, 13\}$
There are 5 numbers in this intersection.
Conditional Probability = $\frac{5}{8}$.

Extreme Challenge
$\xi = \{1 \text{ to } 20\}$ (20 numbers total).
$A = \{1, 2, 4, 5, 10, 20\}$
$B = \{4, 8, 12, 16, 20\}$
$C(\text{primes}) = \{2, 3, 5, 7, 11, 13, 17, 19\}$
"Given that the chosen number is not a prime number" means we restrict our universe to C'.
$C' = \{1, 4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20\}$.
There are 12 numbers in this restricted universe.
Now we must find how many of these 12 numbers belong to $A \cup B$.
Let's list $A \cup B = \{1, 2, 4, 5, 8, 10, 12, 16, 20\}$.
Now, intersect $(A \cup B)$ with C' to see which ones are not prime:
1 (not prime), 2 (prime - reject), 4 (not prime), 5 (prime - reject), 8 (not prime), 10 (not prime), 12 (not prime), 16 (not prime), 20 (not prime).
The numbers satisfying the condition are $\{1, 4, 8, 10, 12, 16, 20\}$.
There are 7 such numbers.
Probability = $\frac{7}{12}$.