ExamPath

CLASS 9 MATHEMATICS · FBISE · UNIT 3 · SECTIONS B AND C PRACTICE

Unit 3: Sets and Relations: short and long questions

Write your working in the boxes. Model answers are on the last pages. These are practice questions written by ExamPath, not official FBISE questions or marking schemes.

Section B style: short questions (3 marks each)

B1 · 3 marks · Operations on sets

If A = {1, 2, 3, 4}, B = {3, 4, 5} and C = {4, 5, 6}, find (a) A ∪ B (b) B ∩ C (c) A − C.

B2 · 3 marks · Laws of sets

Verify the commutative law of intersection, A ∩ B = B ∩ A, for A = {a, b, c, d} and B = {b, d, e}.

B3 · 3 marks · Binary relations

For x ∈ {1, 2, 3, 4}, the relation R is defined by y = 2x − 1. Write R as a set of ordered pairs, and state its domain and range.

B4 · 3 marks · Cartesian product

If A = {1, 2} and B = {a, b}, write A × B and B × A, and show that A × B ≠ B × A.

B5 · 3 marks · Venn diagrams

In a group of 50 students, 30 like tea, 25 like coffee and 10 like both. How many like neither?

B6 · 3 marks · Complement of a set

U = {1, 2, 3, …, 10} and A is the set of even numbers in U. Find A′ and verify that A ∪ A′ = U and A ∩ A′ = ∅.

Section C style: long questions (6 marks each)

C1 · 6 marks · Laws of sets

Let A = {1, 2, 3}, B = {2, 4} and C = {3, 4, 5}.

(a) Verify the associative law of union: A ∪ (B ∪ C) = (A ∪ B) ∪ C. (3 marks)

(b) Verify the distributive law: A ∩ (B ∪ C) = (A ∩ B) ∪ (A ∩ C). (3 marks)

C2 · 6 marks · Venn diagrams

In a survey of 100 people, 60 read newspaper X, 45 read newspaper Y and 20 read both.

(a) Draw a Venn diagram to show this information. (2 marks)

(b) How many read only X, and how many read only Y? (2 marks)

(c) How many read at least one newspaper, and how many read neither? (2 marks)

C3 · 6 marks · Binary relations

Let A = {1, 2, 3, 4, 5, 6}. A relation R on A is defined by: (a, b) ∈ R if a < b and b is a multiple of a.

(a) List all the ordered pairs in R. (3 marks)

(b) Find the domain and the range of R. (2 marks)

(c) Is (4, 2) in R? Give a reason. (1 mark)

Model answers

B1.

1. (a) A ∪ B contains every element in A or B, written once: {1, 2, 3, 4, 5}.
2. (b) B ∩ C contains the elements in both B and C: {4, 5}.
3. (c) A − C contains the elements of A that are not in C: remove 4 to get {1, 2, 3}.

Answer: (a) {1, 2, 3, 4, 5} (b) {4, 5} (c) {1, 2, 3}

Watch out: A − C keeps only elements of A; elements of C that are not in A (5 and 6) do not appear.

B2.

1. A ∩ B = elements in A that are also in B = {b, d}.
2. B ∩ A = elements in B that are also in A = {b, d}.
3. Both sides equal {b, d}, so A ∩ B = B ∩ A is verified.

Answer: A ∩ B = B ∩ A = {b, d}

Watch out: Work out each side separately and then compare; do not assume the answer.

B3.

1. x = 1 gives y = 1; x = 2 gives y = 3; x = 3 gives y = 5; x = 4 gives y = 7.
2. R = {(1, 1), (2, 3), (3, 5), (4, 7)}
3. Domain = first elements = {1, 2, 3, 4}; range = second elements = {1, 3, 5, 7}.

Answer: R = {(1, 1), (2, 3), (3, 5), (4, 7)}; domain {1, 2, 3, 4}; range {1, 3, 5, 7}

Watch out: Write each pair as (x, y), in that order; (3, 2) is not the same pair as (2, 3).

B4.

1. A × B = {(1, a), (1, b), (2, a), (2, b)}
2. B × A = {(a, 1), (a, 2), (b, 1), (b, 2)}
3. The pair (1, a) is in A × B but not in B × A, because order matters in an ordered pair. So A × B ≠ B × A.

Answer: A × B ≠ B × A (although both have 4 elements)

Watch out: Both products have the same number of pairs, n(A) × n(B) = 4, but the pairs themselves are different.

B5.

1. n(T ∪ C) = n(T) + n(C) − n(T ∩ C) = 30 + 25 − 10 = 45.
2. Neither = 50 − 45 = 5.
3. In a Venn diagram: only tea 20, both 10, only coffee 15, outside 5.

Answer: 5 students

Watch out: Subtract the “both” group once; adding 30 + 25 counts those 10 students twice.

B6.

1. A = {2, 4, 6, 8, 10}, so A′ = U − A = {1, 3, 5, 7, 9}.
2. A ∪ A′ = {1, 2, 3, ..., 10} = U.
3. A ∩ A′ = ∅, because no number is both even and odd.

Answer: A′ = {1, 3, 5, 7, 9}; A ∪ A′ = U and A ∩ A′ = ∅

Watch out: The complement depends on the universal set: always take U − A.

C1.

1. (a) B ∪ C = {2, 3, 4, 5}, so A ∪ (B ∪ C) = {1, 2, 3, 4, 5}.
2. A ∪ B = {1, 2, 3, 4}, so (A ∪ B) ∪ C = {1, 2, 3, 4, 5}. Both sides are equal.
3. (b) A ∩ (B ∪ C) = {1, 2, 3} ∩ {2, 3, 4, 5} = {2, 3}.
4. A ∩ B = {2} and A ∩ C = {3}, so (A ∩ B) ∪ (A ∩ C) = {2, 3}. Both sides are equal.

Answer: (a) both sides = {1, 2, 3, 4, 5} (b) both sides = {2, 3}

Watch out: Do the brackets first on each side, and show every set you find; the working earns the marks.

C2.

1. (a) Draw two overlapping circles X and Y inside a rectangle U. Put 20 in the overlap, 40 in X only, 25 in Y only and 15 outside.
2. (b) Only X = 60 − 20 = 40; only Y = 45 − 20 = 25.
3. (c) At least one = 40 + 20 + 25 = 85; neither = 100 − 85 = 15.

Answer: (b) 40 and 25 (c) 85 and 15

Watch out: Fill the overlap first, then the "only" parts, then the outside; the four numbers must add up to 100.

C3.

1. (a) Multiples of 1 greater than 1: (1, 2), (1, 3), (1, 4), (1, 5), (1, 6). Multiples of 2 greater than 2: (2, 4), (2, 6). Multiples of 3: (3, 6). Numbers 4, 5 and 6 have no larger multiples in A.
2. R = {(1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (2, 4), (2, 6), (3, 6)}, which has 8 pairs.
3. (b) Domain = {1, 2, 3}; range = {2, 3, 4, 5, 6}.
4. (c) No. In (4, 2) the first number is larger, and 2 is not a multiple of 4.

Answer: (a) 8 pairs as listed (b) domain {1, 2, 3}, range {2, 3, 4, 5, 6} (c) No

Watch out: R is a subset of A × A, which has 36 pairs; check each first element in turn so you do not miss any.

Free practice from ExamPath (exampath.org). You may print and share for study.