CLASS XI – MATHEMATICS (041)

CHAPTER 1 : SETS

PRACTICE PAPER – STEP-BY-STEP SOLUTIONS & MARKING SCHEME

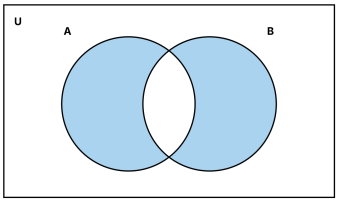
Section A – Answer Key (1 mark each)

Q1	Q2	Q3	Q4	Q5	Q6	Q7
B	A	C	D	A	D	C
Q8	**Q9**	**Q10**	**Q11**	**Q12**	**Q13**	**Q14**
B	A	C	D	B	B	D

SECTION – A (14 × 1 = 14)

Multiple Choice and Assertion–Reason Questions

Q1. Answer: (B) — 1 mark



In Fig. 1 the shaded part is made of the portion of A that is not in B and the portion of B that is not in A. The common part A ∩ B and the outside region are **not** shaded.
So the shaded region = (A ∪ B) − (A ∩ B) (the elements of A ∪ B that are not in A ∩ B). Option (A) is only the unshaded lens, (C) is only the outside region, and (D) = (A ∩ B)′ includes the outside region.

Q2. Answer: (A) — 1 mark

The filled dot at −3 means −3 is included; the open dot at 4 means 4 is excluded.
Hence the set is {x : x ∈ R, −3 ≤ x < 4}, i.e. the interval [−3, 4).

Q3. Answer: (C) — 1 mark

Primes less than 8: A = {2, 3, 5, 7}, so n(A) = 4.
Count subsets by size: 0 elements → 1; 1 element → 4; 2 elements → 6; 3 elements → 4; 4 elements → 1. Total = 16 (= 2^4).
Proper subsets exclude the set A itself: 16 − 1 = **15**.

Q4. Answer: (D) — 1 mark

−5 < 2x + 1 ≤ 7 ⇒ −6 < 2x ≤ 6 ⇒ −3 < x ≤ 3.
Integers satisfying this: −2, −1, 0, 1, 2, 3. So the set has **6** elements.

Q5. Answer: (A) — 1 mark

(A) No natural number lies strictly between 3 and 4, so this set is empty.
(B) = {−2, 2}; (C) |x| < 1 gives x = 0, so it is {0}; (D) = {4}. All three are non-empty.

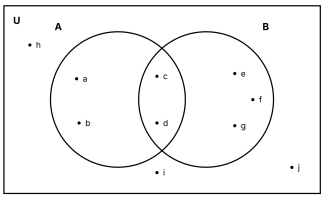
Q6. Answer: (D) — 1 mark

If A ⊂ B: A ∪ B = B, A ∩ B = A and A − B = φ are all true.
B − A = φ would need B ⊂ A as well (i.e. A = B). Counter-example: A = {1}, B = {1, 2} gives B − A = {2} ≠ φ.

Q7. Answer: (C) — 1 mark

U = {1, 2, . . . , 12}; A = {3, 6, 9, 12}; B = {2, 4, 6, 8, 10, 12}.
A′ ∩ B = elements of B that are not in A = B − A = {2, 4, 8, 10}. Number of elements = **4**.

Q8. Answer: (B) — 1 mark



From Fig. 3: A = {a, b, c, d} and B = {c, d, e, f, g}.
B′ = U − B = {a, b, h, i, j}.
A ∪ B′ = {a, b, c, d, h, i, j}, which has **7** elements.

Q9. Answer: (A) **1 mark**

Distinct letters of MISSISSIPPI: {M, I, S, P}.
IMPS gives {I, M, P, S} – the same set. SIMPLE has extra letters L, E; MISS lacks P; SIMPSON has extra letters O, N.

Q10. Answer: (C) **1 mark**

$2x + 1 > 9 \Rightarrow x > 4$, so A = {5, 6, 7, . . .}.
$A' = N - A = \{1, 2, 3, 4\}$.

Q11. Answer: (D) **1 mark**

The elements of A are 2, {3} and 4. Note that the number 3 itself is **not** an element; the set {3} is.
So $\{3\} \in A$ is true. $\{3\} \subset A$, $3 \in A$ and $\{2, 3\} \subset A$ would all need $3 \in A$, which is false.

Q12. Answer: (B) **1 mark**

$A - B = \{x : x \in [-3, 5) \text{ and } x \notin (1, 8]\}$.
$x \notin (1, 8]$ means $x \leq 1$ or $x > 8$. Combined with $-3 \leq x < 5$ this gives $-3 \leq x \leq 1$.
So $A - B = [-3, 1]$ (the point 1 is included because $1 \notin B$).

Q13. Answer: (B) **1 mark**

Natural numbers start from 1, so no natural number is less than 1: the set is empty. Assertion (A) is true.
N is indeed an infinite set, so Reason (R) is true – but it does not explain why the given set is empty.
Both true, R is not the correct explanation → option (B).

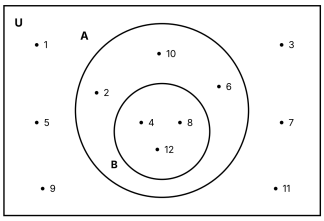
Q14. Answer: (D) **1 mark**

Assertion is false. Take A = {1, 2}, B = {2, 3}: $A - B = \{1\}$ but $B - A = \{3\}$. In general $A - B = B - A$ only when A = B.
Reason is the correct definition of $A - B$, so it is true. → option (D).

SECTION – B (4 × 2 = 8)

Very Short Answer Questions

Q15. 2 marks



From Fig. 4: U = {1, 2, . . . , 12}, A = {2, 4, 6, 8, 10, 12}, B = {4, 8, 12}; B lies inside A (B ⊂ A).

(i) A − B = elements of A not in B = **{2, 6, 10}**. **[1]**

(ii) Since B ⊂ A, A ∪ B = A. So (A ∪ B)′ = A′ = **{1, 3, 5, 7, 9, 11}**. **[1]**

Q16. 2 marks

Numerators: 1, 2, 3, 4, 5 → n. Denominators: 2, 5, 10, 17, 26 = 1^2+1, 2^2+1, 3^2+1, 4^2+1, 5^2+1 → $n^2 + 1$. **[1]**

Set-builder form: **$\{x : x = n/(n^2 + 1), n \in N \text{ and } 1 \le n \le 5\}$**. **[1]**

Q17. 2 marks

(A) $x^2 - 5x + 6 = 0 \Rightarrow (x - 2)(x - 3) = 0 \Rightarrow x = 2, 3$. So X = {2, 3}. **[1]**

Y = natural numbers strictly between 1 and 4 = {2, 3}. **[½]**

Every element of X is in Y and every element of Y is in X, so **X = Y** (the sets are equal). **[½]**

OR (B) The set A has two elements: a and {b}. **[½]**

Subsets with 0 elements: φ. With 1 element: {a}, {{b}}. With 2 elements: {a, {b}}. **[1]**

So all subsets are **φ, {a}, {{b}}, {a, {b}}**. **[½]**

Q18. 2 marks

(A) A = {1, 2, . . . , 8}; B = {2, 4, 6, 8, 10, 12}; C = {3, 6, 9, 12}.

B ∪ C = {2, 3, 4, 6, 8, 9, 10, 12}, so A ∩ (B ∪ C) = **{2, 3, 4, 6, 8}**. **[1]**

A ∩ B = {2, 4, 6, 8}, A ∩ C = {3, 6}, so (A ∩ B) ∪ (A ∩ C) = **{2, 3, 4, 6, 8}**. **[½]**

Observation: both sets are equal – A ∩ (B ∪ C) = (A ∩ B) ∪ (A ∩ C), the distributive law. **[½]**

OR (B) A = (−4, 3] means $-4 < x \le 3$; B = [−1, 6) means $-1 \le x < 6$.

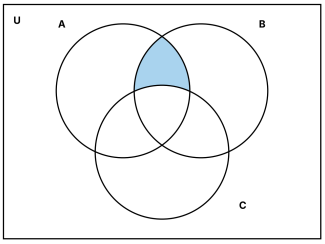
Common values: $-1 \le x \le 3$, so A ∩ B = **[−1, 3]**. **[1]**

The intervals overlap, so together they cover everything from −4 (excluded) to 6 (excluded): A ∪ B = **(−4, 6)**. **[1]**

SECTION – C (3 × 3 = 9)

Short Answer Questions

Q19. 3 marks



(i) The shaded region lies in A and in B but outside C: **(A ∩ B) − C** (equivalently A ∩ B ∩ C′). **[1]**
(ii) A ∩ B = {2, 4, 6, 7}. **[1]**
Remove the elements of C = {3, 4, 5, 6, 9}: 4 and 6 are removed. So (A ∩ B) − C = **{2, 7}**. **[1]**

Q20. 3 marks

(A) To prove A − (A − B) = A ∩ B, we show each side is a subset of the other.
Step 1. Let x ∈ A − (A − B). Then x ∈ A and x ∉ (A − B). Now x ∉ (A − B) means "x ∈ A and x ∉ B" is false, i.e. x ∉ A or x ∈ B. Since x ∈ A, we must have x ∈ B. Hence x ∈ A ∩ B, so A − (A − B) ⊂ A ∩ B. **[1½]**
Step 2. Let x ∈ A ∩ B. Then x ∈ A and x ∈ B. Since x ∈ B, x cannot belong to A − B (which has only elements not in B). So x ∈ A and x ∉ (A − B), i.e. x ∈ A − (A − B). Hence A ∩ B ⊂ A − (A − B). **[1]**
From Steps 1 and 2: **A − (A − B) = A ∩ B**. **[½]**
OR (B) Given A ⊂ B. **Step 1.** Let x ∈ A ∪ (B − A). If x ∈ A then x ∈ B (as A ⊂ B); if x ∈ B − A then x ∈ B. So A ∪ (B − A) ⊂ B. **[1½]**
Step 2. Let x ∈ B. Either x ∈ A, so x ∈ A ∪ (B − A); or x ∉ A, so x ∈ B − A and again x ∈ A ∪ (B − A). So B ⊂ A ∪ (B − A). **[1]**
Therefore **A ∪ (B − A) = B**. **[½]**

Q21. 3 marks

(A) U = {1, . . . , 10}, A = {2, 3, 5, 7}, B = {1, 3, 5, 7, 9}.
Law 1. A ∪ B = {1, 2, 3, 5, 7, 9} ⇒ (A ∪ B)′ = {4, 6, 8, 10}. A′ = {1, 4, 6, 8, 9, 10}, B′ = {2, 4, 6, 8, 10} ⇒ A′ ∩ B′ = {4, 6, 8, 10}. Equal ✓ **[1½]**
Law 2. A ∩ B = {3, 5, 7} ⇒ (A ∩ B)′ = {1, 2, 4, 6, 8, 9, 10}. A′ ∪ B′ = {1, 2, 4, 6, 8, 9, 10}. Equal ✓ **[1½]**
OR (B) $x^2 - 7x + 10 = (x - 2)(x - 5) = 0 \Rightarrow A = \{2, 5\}$. $x^2 = 4 \Rightarrow B = \{-2, 2\}$. $|x| \le 2 \Rightarrow C = \{-2, -1, 0, 1, 2\}$. **[1]**
A ∪ B = {−2, 2, 5}, so (A ∪ B) ∩ C = **{−2, 2}**. **[1]**
A − B = {5}; B − C = φ (every element of B is in C); so (A − B) ∪ (B − C) = **{5}**. **[1]**

SECTION – D (1 × 5 = 5)

Long Answer Question

Q22. **5 marks**

(A) U = {1, . . . , 10}; A = {1, 2, 3, 4, 5, 6}; B = {2, 4, 6, 8, 10}; C = {3, 6, 9}.

(i) B ∪ C = {2, 3, 4, 6, 8, 9, 10}. LHS: A − (B ∪ C) = {1, 5}. **[1]**

A − B = {1, 3, 5}; A − C = {1, 2, 4, 5}. RHS: (A − B) ∩ (A − C) = {1, 5}. LHS = RHS ✓ **[1]**

(ii) B − C = {2, 4, 8, 10}. LHS: A ∩ (B − C) = {2, 4}. **[1½]**

A ∩ B = {2, 4, 6}; A ∩ C = {3, 6}. RHS: (A ∩ B) − (A ∩ C) = {2, 4}. **[1]**

LHS = RHS ✓ **[½]**

OR (B) (i) B′ = {x : x ∈ U and x ∉ B}. So A ∩ B′ = {x : x ∈ A and x ∉ B} (because every x ∈ A already belongs to U) = A − B. **[2]**

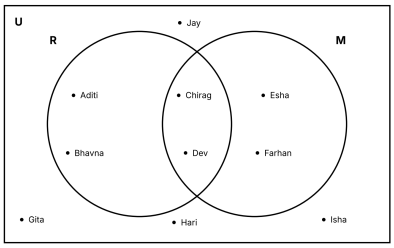
(ii) (⇒) Let A ⊂ B and let x ∈ B′, so x ∉ B. If x ∈ A, then x ∈ B (since A ⊂ B), a contradiction. So x ∉ A, i.e. x ∈ A′. Hence B′ ⊂ A′. **[1½]**

(⇐) Let B′ ⊂ A′ and let x ∈ A. Suppose x ∉ B; then x ∈ B′ ⊂ A′, so x ∉ A, a contradiction. Hence x ∈ B and A ⊂ B. **[1½]**

SECTION – E (1 × 4 = 4)

Case Study Based Question

Q23. **4 marks**



From Fig. 6: R = {Aditi, Bhavna, Chirag, Dev}; M = {Chirag, Dev, Esha, Farhan}; U = {Aditi, Bhavna, Chirag, Dev, Esha, Farhan, Gita, Hari, Isha, Jay}.

(i) R ∪ M = **{Aditi, Bhavna, Chirag, Dev, Esha, Farhan}**. **[1]**

(ii) R ∩ M = **{Chirag, Dev}** – students who joined both clubs. R − M = **{Aditi, Bhavna}** – students who joined only Robotics. **[1]**

(iii)(a) (R ∪ M)′ = U − (R ∪ M) = **{Gita, Hari, Isha, Jay}**, the students who joined neither club. **[2]**

OR (b) (R ∩ M)′ = U − {Chirag, Dev} = {Aditi, Bhavna, Esha, Farhan, Gita, Hari, Isha, Jay}. R′ = {Esha, Farhan, Gita, Hari, Isha, Jay}; M′ = {Aditi, Bhavna, Gita, Hari, Isha, Jay}. R′ ∪ M′ = {Aditi, Bhavna, Esha, Farhan, Gita, Hari, Isha, Jay} = (R ∩ M)′ ✓ **[2]**

— End of Solutions —