

4.1 Use sets, relations and functions with a stated universe

Name: _____ Class: _____ Date: _____

Total: 24 marks

KEY WORDS set 集合 • set complement 补集 • function 函数

Objective

Use sets, relations and functions with a stated universe. Original GAC004-aligned practice, not an official assessment. Show the method as well as the result. All applied scenarios are invented classroom problems.

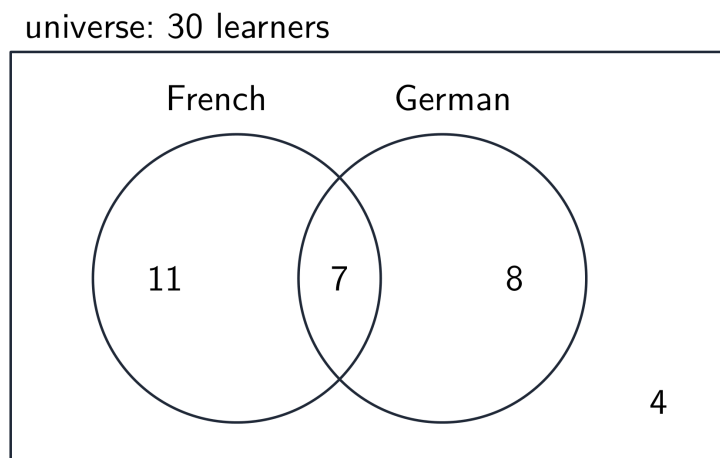
1 Key knowledge and worked examples

■ **Key knowledge: each operation depends on which elements are allowed**

A **set** 集合 contains distinct elements; listing order and repeated entries do not change it. Union contains elements in either set, intersection elements in both. A **set complement** 补集 is relative to a specified universe U . A subset contains only elements of its parent set.

A relation pairs elements of two sets. A **function** 函数 assigns exactly one output to every input in its stated domain; several inputs may share an output. An inverse relation is a function on the original range only when each output comes from exactly one input. For finite sets, $|A \cup B| = |A| + |B| - |A \cap B|$.

■ Worked example: subtract an overlap only once



Known: 30 learners, 18 study French, 15 German, and 7 both. The overlap is included in both subject totals.

$$|F \cup G| = |F| + |G| - |F \cap G| = 18 + 15 - 7 = 26$$

$$N_{\text{neither}} = |U| - |F \cup G| = 30 - 26 = 4$$

French-only is $18 - 7 = 11$ and German-only $15 - 7 = 8$. The four disjoint regions sum to 30.

2 Practice

2.1 For $A = \{1, 2, 3\}$ and $B = \{3, 4\}$, list $A \cap B$ and $A \cup B$. [2]

2.2 Let $U = \{1, 2, 3, 4, 5, 6\}$ and $A = \{1, 3, 5\}$. List the complement of A in U and explain why 7 is not in it. [2]

2.3 A relation from domain $\{1, 2, 3\}$ to $\{a, b\}$ is $\{(1, a), (2, a), (3, b)\}$. State its range, decide whether it is a function, and justify the decision. [3]

2.4 Finite sets have $|A| = 15$, $|B| = 12$ and $|A \cap B| = 5$. Their universe has 30 elements. Find the union count and the number outside both sets. [3]

3 Exam-style questions

3.1 In a class of 40, 23 take music, 18 take drama and 7 take both. Find (a) music only, (b) drama only, (c) neither, and (d) exactly one of the two. Check your four-region totals. [6]
