Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

$\{1, 2, 3, 4, 5\}$

$\{3, 4\}$

$\{1, 2\}$

$4 \times 3 = \mathbf{12}$

2.2

$\varnothing$, $\{a\}$, $\{b\}$, $\{c\}$, $\{a, b\}$, $\{a, c\}$, $\{b, c\}$, $\{a, b, c\}$

$2^3 = \mathbf{8}$

2.3

(a) bijective

(b) none: 1 and 2 share x, and z is missed

(c) bijective: the inverse is $n - 3$

2.4

reflexive yes; symmetric no: $(1, 2)$ is there but $(2, 1)$ is not

transitive yes: every chain gives a pair in R

3.1

(a) 3, 3, 3; 5, 5

(b) no: 10, 17 and 24 all go to slot 3

(c) 8 keys and 7 slots: by the pigeonhole principle some slot gets two keys

(d) surjective: every slot r is hit, e.g. by $k = r$; not bijective: infinitely many keys share each slot

3.2

(a) $120 + 90 - 50 = \mathbf{160}$

(b) **40**

(c) $120 - 50 = \mathbf{70}$

(d) $70 + 50 + 40 + 40 = 200$

3.3

(a) reflexive: a has the same remainder as itself; symmetric: "same remainder" reads both ways; transitive: if a, b share a remainder and b, c do, then a, c do

(b) $\{0, 3, 6\}$, $\{1, 4, 7\}$; $\{2, 5, 8\}$

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(c) $1 \approx 2$ and $2 \approx 3$, but $|1 - 3| = 2$, so $1 \not\approx 3$

(d) chains of close readings join far-apart readings into one group, e.g. 1 and 3 end up together