MATHS

BOOKS - RS AGGARWAL MATHS (HINGLISH)

Relations

Example

1. Find a and b, when $(a-1, b+5) = (2, 3)$.

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2. Find a and b, when $(2a+b, 11) = (1, a-3b)$.

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3. If $\left(\frac{x}{3}+1, y-\frac{2}{3}\right)=\left(\frac{5}{3}, \frac{1}{3}\right)$, find the values of x and y.

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4. Express $\{(x, y): x^2+y^2=25, \text{where } x, y \in W\}$ as a set of ordered pairs.

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5. If $A=\{1,3,5\}$ and $B=\{2,3\}$ then find:

(i)

$A \times B$ $(ii) B \times A$ $(iii)(A \times B) \cap (B \times$

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6. If $A=\{1,2,3\}, B=\{3,4\}$ and $C=\{4,5,6\}$ then find:

(i) $A \times (B \cap C)$

(ii) $(A \times B) \cap (A \times C)$

(iii) $A \times (B \cup C)$

(iv) $(A \times B) \cup (A \times C)$

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7. Let $A = \{x \in N : x^2 - 5x + 6 = 0\}$, $B = \{x \in W : 0 \leq x < 2\}$and $C = \{x \in N : x < 3\}$. Verify that

(i) $A \times (B \cup C) = (A \times B) \cup (A \times C)$

(ii) $A \times (B \cap C) = (A \times B) \cap (A \times C)$

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8. If $(A \times B) = \{(3, 2), (3, 4), (5, 2), (5, 4)\}$, find A and B.

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9. If $(1, 3), (2, 5)$ and $(3, 3)$ are the three elements of $A \times B$ and the total number of elements in $A \times B$ is 6 then the remaining elements of $A \times B$ are

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10. Let $A = \{a, b\}$. List all relations on A and find their number.

Hint $A \times A = \{(a, a), (a, b), (b, a), (b, b)\}$ and every subset of $A \times A$ is a relation on A.

So, their number $= 2^4 = 16$.

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11. If R is the set of all real numbers, what do the cartesian products $R \times R$and $R \times R \times R$represent?

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12. If $(A \times A)$ has 9 elements two of which are (-1,0) and (0,1), find the set A and the remaining elements of $(A \times A)$.

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13. If $A = \{1, 2\}, \quad \text{find} \quad A \times A \times A.$

A. $\{(1, 1, 1), (1, 1, 2), (1, 2, 1), (2, 1, 1), (2, 1, 2), (2, 2, 1), (2, 2, 2)\}.$

B. $\{(1, 1, 2), (1, 2, 1), (2, 1, 1), (2, 1, 2), (2, 2, 1), (2, 2, 2)\}.$

C. $\{(1, 1, 1), (1, 1, 2), (1, 2, 1), (2, 1, 1), (2, 1, 2), (2, 2, 1)\}.$

D. None of these

Answer: A

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14. If R is the set of all real numbers, what do the cartesian products $R \times R$and $R \times R \times R$represent?

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

We have

verify that $(A \times B) \times C = A \times (B \times C)$ and hence find $A \times B \times C$.

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16. Let A and B be two nonempty sets such that $n(A) = 5, n(B) = 6$ and $n(A \cap B) = 3$.

Find (i) $n(A \times B), (ii) n(B \times A)$ and $(iii) n\{(A \times B) \cap (B \times A)\}$.

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17. Let $A = \{-2, -1, 0, 1, 2\}$ and $B = \{0, 1, 4, 9\}$.

Let $R = \{(-2, 4), (-1, 1), (0, 0), (1, 1), (2, 4)\}$.

(i) Show that R is a relation from A to B.

(ii) Find dom (R), range (R) and co-domain of R.

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18. Let $A = \{1, 2, 3, 5\}$ and $B = \{4, 6, 9\}$.

Define a relation from A to B, given by

$R = \{(a, b) : a \in A, b \in B \text{ and } (a - b) \text{ is odd}\}$.

(i) Write R in roster form.

(ii) Find dom (R) and range (R).

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19. Let $R = \{(x, x^3) : x \text{ is a prime number less than } 10\}$.

(i) Write R in roster form.

(ii) Find dom (R) and range (R).

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20. Let $R = \{(x, y) : \text{ x and y are integers and } xy = 4\}$.

(i) Write R in roster form.

(ii) Find dom (R) and range (R).

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21. Let $A = \{1, 2, 3, 4, 5\}$. Define a relation R from A to a A by

$R = \{(x, y) : y = 2x - 3\}$.

(i) Depict R using arrow diagram.

(ii) Find dom (R) and range (R).

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22. Let $A = \{(1, 2, 3, 4, 5\}$ and $B = \{1, 4, 5\}$.

Let R be a relation 'is less than' from A to B.

(i) List the elements of R.

(ii) Find the domain, co-domain and range of R.

(iii) Depict the above relation by an arrow diagram.

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23. Let $A = \{x, y, z\} and B = \{1, 2\}$. Find the number of relations from A to B.

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24. Let $A = \{1, 2, 3\}$ and $R = \{(1, 2), (2, 2), (3, 1), (3, 2)\}$. Show that R is a binary relation on A. Find its domoin and range.

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25. Let N be the set of all natural numbers. Let $R = \{(a, b) : a, b \in N \text{ and } 2a + b = 10\}$. Show that R is a binary relation on N. Find its domain, range and co-domain.

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26. Let A be the set of first ten natural number. Let R be a binary relaion on A, defined by

$R = \{(a, b) : a, b \in A \text{ and } a + 2b = 10\}$.

Express R and R^{-1} as sets of ordered pairs.

Show that (i) dom (R)=range $\left(R^{-1}\right)$ (ii) range $(R) = dom\left(R^{-1}\right)$.

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27. Let R be a relation on the set Q of all rationals defined by $R = \{(a, b) : a, b \in Q \text{ and } a - b \in Z\}$. Show that R is an equivalence relation.

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28. Let n be a fixed positive integer. Define a relation R on Z as follows: $(a, b)Ra - b$ is divisible by n. Show that R is an equivalence relation on Z.

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29. Show that set of all parallel lines in any plane is an equivalence relation.

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30. Show that the relation is congruent to on the set of all triangles in a plane is an equivalence relation

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31. Let $R = \{(a, b) : a, b \in N \text{ and } a = b^2\}$, Show that R satisfies none of reflexivity, symmetry and transitivity.

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32. Let a relation R_1 on the set R of real numbers be defined as $(a, b) \in R_{11} + ab > 0$ for all $a, b \in R$. Show that R_1 is reflexive and

symmetric but not transitive.

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33. Prove that the relation R on the set NxN defined by $(a, b)R(c, d)a + d = b + c$ for all $(a, b), (c, d) \in NxN$ is an equivalence relation.

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Exercise 2 A

1. Find the values of a and b, when:

(i) $(a + 3, b - 2) = (5, 1)$

(ii) $(a + b, 2b - 3) = (4, -5)$

(iii) $\left(\frac{a}{3} + 1, b - \frac{1}{3}\right) = \left(\frac{5}{3}, \frac{2}{3}\right)$

(iv) $(a - 2, 2b + 1) = (b - 1, a + 2)$

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2. If A {0,1} and B={1,2,3}, show that $A \times B \neq B \times A$.

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3. If P={a,b} and Q={x,y,z}, show that $P \times Q \neq Q \times P$.

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4. If A={2,3,5} and B={5,7}, find:

(i) $A \times B$

(ii) $B \times A$

(iii) $A \times A$

(iv) $B \times B$

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5. If $A = \{x \in N : x \leq 3\}$ and $B = \{x \in W, x < 2\}$, find $(A \times B)$ and $(B \times A)$. Is $(A \times B) = (B \times A)$?

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6. If $A = \{1, 3, 5\}, B = \{3, 4\}$ and $C = \{2, 3\}$, verify that :

(i) $A \times (B \cup C) = (A \times B) \cup (A \times C)$

(ii) $A \times (B \cap C) = (A \times B) \cap (A \times C)$

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7. Let $A = \{x \in W : x < 2\}, B = \{x \in N : 1 < x \leq 4\}$ and $C = \{3, 5\}$.

Verify that:

(i) $A \times (B \cup C) = (A \times B) \cup (A \times C)$

(ii) $A \times (B \cap C) = (A \times B) \cap (A \times C)$

Hint $A = \{0, 1\}, B = \{2, 3, 4\}$ and $C = \{3, 5\}$.

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8. If $A \times B = \{(-2, 3), (-2, 4), (0, 3), (0, 4), (3, 3), (3, 4)\}$, find A and B.

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9. Let $A = \{2, 3\}$ and $B = \{4, 5\}$. Find $(A \times B)$. How many subsets will $(A \times B)$ have?

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10. Let $A \times B = \{(a, b) : b = 3a - 2\}$. If $(x, -5)$ and $(2, y)$ belong to $A \times B$, find the values of x and y.

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11. Let A and B be two sets such that $n(A) = 3$ and $n(B) = 2$.

If $a \neq b \neq c$ and $(a, 0), (b, 1), (c, 0)$ are in $A \times B$, find A and B.

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12. Let $A = \{-2, 2\}$ and $B = \{0, 3, 5\}$. Find : (i) $A \times B$ (ii) $B \times A$

(iii) $B \times B$ (iv) $A \times A$

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13. If $A = \{5, 7\}$, find $(i) A \times A$ and $(ii) A \times A \times A$.

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14. Let $A = \{-3, -1\}, B = \{1, 3\}$ and $C = \{3, 5\}$. Find:

(i) $A \times B$

(ii) $(A \times B) \times C$

(iii) $B \times C$

$A \times (B \times C)$

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Exercise 2 B

1. For any sets A and B, prove that

$(A \times B) \cap (B \times A) = (A \cap B) \times (B \cap A)$.

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2. If A and B are nonempty sets, prove that

$A \times B = B \times A \Leftrightarrow A = B$.

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3. If

$A \times B \subseteq C \times D$ and $A \times B \neq \phi$, prove that $A \times C \subseteq B \times D$.

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4. If A and B be two sets such that

$n(A) = 3, n(B) = 4$ and $n(A \cap B) = 2$ then find:

(i)

$n(A \times B)$ $(ii) n(B \times A)$ $(iii) n\{(A \times B) \cap (B \times A)\}$

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5. Sets A and B have n elements in common. How many elements will

$(A \times B)$ and $(B \times A)$ have in common?

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6. Let A = {1, 2} and B={2, 3}. Then, write down all possible subsets of $A \times B$.

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7. Let $A = \{a, b, c, d\}, B = \{c, d, e\}$ and $C = \{d, e, f, g\}$. Then verify each of the following identities:

(i) $A \times (B \cap C) = (A \times B) \cap (A \times C)$

(ii) $A \times (B - C) = (A \times B) - (A \times C)$

(iii) $(A \times B) \cap (B \times A) = (A \cap B) \times (A \cap B)$

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Exercise 2 C

1. Let A and B be two nonempty sets.

(i) What do you mean by a relation from A to B?

(ii) What do you mean by the domain and range of a relation?

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2. Find the domain and range of each of the relations given below:

(i) $R = \{(-1, 1), (1, 1), (-2, 4), (2, 4), (3, 9)\}$

(ii) $R = \left\{\left(x, \frac{1}{x}\right) : x \text{ is an integer}, 0 < x < 5\right\}$

(iii) $R = \{(x, y) : x + 2y = 8 \text{ and } x, y \in N\}$

(iv) $R = \{(x, y) : y = |x - 1|, x \in Z \text{ and } |x| \leq 3\}$

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3. Let $A = \{1, 3, 5, 7\}$ and $B = \{2, 4, 6, 8\}$.

Let $R = \{(x, y) : x \in A, y \in B \text{ and } x > Y\}$.

(i) Write R in roster form.

(ii) Find dom (R) and range (R).

(iii) Depict R by an arrow diagram.

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4. If R is a relation from set $A = \{2, 4, 5\}$ to set $B = \{1, 2, 3, 4, 6, 8\}$ defined by $xRy \Leftrightarrow x$ divides y. Write R as a set of ordered pairs Find the domain and the range of R.

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5. A relation R is defined from a set $A = \{2, 3, 4, 5\} \rightarrow a\ set\ B = \{3, 6, 7, 10\}$ as follows: $(x, y) \in R \Leftrightarrow x$ is relatively prime to y. Express R as a set of ordered pairs and determine its domain and range.

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6. A = { 1,2,3,5} and B = {4,6,9} A relation R is defined from A to B by R = { (x,y) : the difference between x & y is odd}. Writer R in roster form.

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7. Let $R = \{(x, y) : x + 3y = 12, x \in N \text{ and } y \in N\}$.

(i) Write R in roster form.

(ii) Find dom (R) and range (R).

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8. Let $A = \{1, 2, 3, 4, 5, 6\}$. Define a relation R on set A by $R = \{(x, y) : y = x + 1\}$ Depict this relation using an arrow diagram Write down the domain, co domain and range of R.

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9. Determine the domain and range of the relation R defined by $R = \{(x, x + 5) : x \in \{0, 1, 2, 3, 4, 5\}\}$.

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10. Let $A = \{1, 2, 3, 4, 6\}$. Let R be the relation on A defined by $\left\{\left(a\dot{b}\right) : a, b \in A, b\text{is exactly divisible by a}\right\}$.(i) Write R in roster form(ii) Find the domain of R(iii) Find the range of R.

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11. Let R be the relation on Z defined by $R = \{(a, b) : a, b \in Z, ab\text{is an integer}\}$.Find the domain and range of R.

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12. If $R = \{(x,\ y) : x^2 + y^2 \leq 4; x,\ y \in Z\}$ is a relation on Z , write the domain of R .

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13. Let $A = \{2, 3\}$ and $B = \{3, 5\}$.

(i) Find $(A \times B)$ and $n(A \times B)$.

(ii) How many relations can be defined from A to B?

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14. Let $A = \{3, 5\}$ and $B = \{7, 9\}$. Let

$R = \{(a, b) : a \in A, b \in B \text{ and } (a - b) \text{ is odd}\}$.

Show that R is an empty relation from A to B.

Hint The difference of two odd numbers cannot be odd.

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Exercise 2 D

1. Let A and B be two nonempty sets.

(i) What do you mean by a relation from A to B?

(ii) What do you mean by the domain and range of a relation?

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2. Let $A = \{2, 3, 5\}$ and $R = \{(2, 3), (2, 5), (3, 3), (3, 5)\}$.

Show that R is a binary relation on A. Find its domain and range.

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3. Let

$A = \{0, 1, 2, 3, 4, 5, 6, 7, 8\}$ and let $R = \{(a, b) : a, b \in A$ and $2a + 3b =$

Express R as a set of ordered pairs. Show that R is a binary relation on A.

Find its domain and range.

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4. If R is a binary relation on a set A, define R^{-1} on A.

Let $R = \{(a, b) : a, b \in W$ and $3a + 2b = 15\}$ where W is the set of whole numbers.

Express R and R^{-1} as sets of ordered pairs.

Show that (i) dom (R)=range $\left(R^{-1}\right)$ (ii) range (R)=dom$\left(R^{-1}\right)$.

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5. What is an equivalence relation?

Show that the relation of'similarity' on the set S of all triangle in a plane is an equivalence relation.

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6. Let $R=\{(a, b): a, b \in Z \text{ and } (a-b) \text{ is even}\}$.

Then, show that R is an equivalence relation on Z.

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7. Let $A=\{1,2,3\}$ and $R=\left\{(a, b): a, b \in A \text{ and } \left|a^2-b^2\right| \leq 5\right.$.

Write R as set of ordered pairs.

Mention whether R is (i) reflexive (ii) symmetric (iii) transitive.

Give reason in each case.

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8. Let $R = \{(a, b) : a, b \in Z \text{ and } b = 2a - 4\}$. If $(a, -2) \in R$ and $(4, b^2) \in$

Then, write the values of a and b.

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9. If R is a relation defined on the set Z of integers by the rule $(x, y) \in R \Leftrightarrow x^2 + y^2 = 9$, then write domain of R.

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10. Let A be the set of first five natural numbers and let R be a relationobn A defined as follows $(x, y) \in R \Leftrightarrow x \leq y$. Express

$R\ and\ R^{-1}$ as sets of ordered pairs. Determine also The domain of R^{-1}

The range of R.

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11. A relation R is defined on the set Z of integers as: $(x, y) \in Rx^2 + y^2 = 25$. Express $RandR^{-1}$ as the sets of ordered pairs and hence find their respective domains.

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12. Find R^{-1}, when

(i) $R = \{(1, 2), (1, 3), (2, 3), (3, 2), (4, 5)\}$,

(ii) $R = \{(x, y) : x, y \in N, x + 2y = 8\}$.

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13. Let $A = \{a, b\}$. List all relations on A and find their number.

Hint $A \times A = \{(a, a), (a, b), (b, a), (b, b)\}$ and every subset of $A \times A$ is a relation on A.

So, their number $= 2^4 = 16$.

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14. Let $R = \{(a, b) : a, b \in N \text{ and } a < b\}$.

Show that R is a binary relation on N, which is neither reflexive nor symmetric. Show that R is transitive.

Hint Since $R \subset N \times N$, so it is a binary relation on N.

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Exercise 2 E

1. Let A and B be two sets such that $n(A) = 5, n(B) = 3$ and $n(A \cap B) = 2$.

(i)

$n(A \cup B)$ $(ii) n(A \times B)$ $(iii) n\{(A \times B) \cap (B \times A)\}$

Hint (i) $n(A \cup B) = n(A) + n(B) - n(A \cap B)$.

(ii) $n(A \times B) = n(A).\, n(B)$

(iii) If $n(A \cap B) = m$ then $n\{(A \times B) \cap (B \times A)\} = 2^m$.

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2. Find a and b when $(a - 2b, 13) = (7, 2a - 3b)$.

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3. If $A = \{1, 2\}$, find $A \times A \times A$.

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4. If $A = \{2, 3, 4\}$ and $B = \{4, 5\}$, draw an arrow diagram to represent $(A \times B)$.

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5. If $A = \{3, 4\}, B = \{4, 5\}$ and $C = \{5, 6\}$, find $A \times (B \times C)$.

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6. If $A \subseteq B$, prove that $A \times C = B \times C$.

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7. If $AandB$ are any two non-empty sets, then prove that: $A \times B = B \times AA = B$.

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8. If $A = \{5\}$ and $B = \{5, 6\}$ write down al possible subsets of $A \times B$.

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9. Let $R = \{(x, x^2) : x \text{ is a prime number less than } 10\}$.

(i) Write R in roster form.

(ii) Find dom (R) and range (R).

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10. Let $A = \{1, 2, 3\}$ and $B = \{4\}$.

How many relations can be defined from A to B?

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11. Let $A = \{3, 4, 5, 6\}$ and $R = \{(a, b) : a, b \in A \text{ and } a > b\}$.

Write R in roster form.

Find: dom (R) and range (R).

Write R^{-1} in roster form.

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12. Let $R = \{(a, b) : a, b \in N, a > b\}$.

Show that R is a binary relation which is neither reflexive, nor symmetric.

Show that R is transitive.

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