



MATHS

BOOKS - RS AGGARWAL MATHS (HINGLISH)

Relations



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).

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

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

 $(iii)(A imes B) \cap (B imes$

pairs.

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

(i)

A imes B (ii)B imes A

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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) $A imes (B \cup C)$

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

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7. Let
$$A = \left\{x \in N: x^2 - 5x + 6 = 0\right\}, B = \{x \in W: 0 \le x < 2\}$$
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 $(A imes B) = \{(3,2), (3,4), (5,2), (5,4)\}$, find A and B.

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 $A imes A = \{(a,a), (a,b), (b,a), (b,b)\}$ and every subset of A imes 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 imes R and R imes R imes R represent?



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

A and the remaining elements of (A imes A).

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

 $\mathsf{A}_{\cdot}\{(1, 1, 1), (1, 1, 2), (1, 2, 1), (2, 1, 1), (2, 1, 2), (2, 2, 1), (2, 2, 2)\}.$

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

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

D. None of these

Answer: A



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?

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

 $n(A\cap B)=3.$

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

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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.

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

Define a relation from A to B, given by

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

- (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.

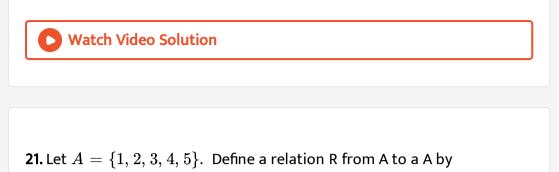
(ii) Find dom (R) and range (R).

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

(i) Write R in roster form.

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



- $R = \{(x, y) : y = 2x 3\}.$
- (i) Depict R using arrow diagram.
- (ii) Find dom (R) and range (R).

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

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.

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

to B.



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.



25. Let N be the set of all natural numbers. Let $R=\{(a,b):a,b\in N ext{ and } 2a+b=10\}.$ 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 $\left(R^{-1}
ight)$ (ii) range $\left(R
ight)=dom\left(R^{-1}
ight)$.

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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.

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

relation.



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 $R = ig\{(a,b)\!:\!a,b\in N \; ext{ and } \; a=b^2ig\},$ 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.



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.

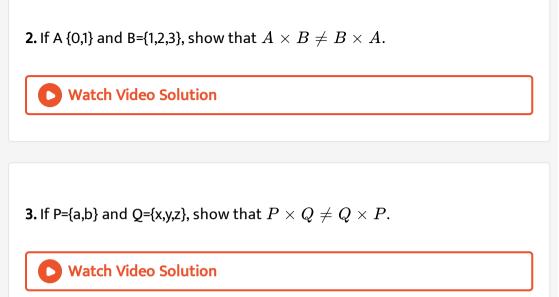
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Exercise 2 A

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



- **4.** If A={2,3,5} and B={5,7}, find:
- (i) A imes B
- (ii) B imes A
- (iii) A imes A
- (iv) B imes B

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

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

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

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

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Let

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

Verify that:

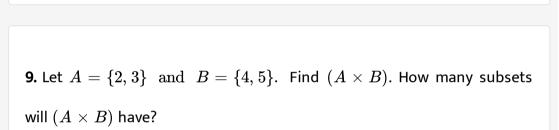
(i)
$$A imes (B \cup C) = (A imes B) \cup (A imes C)$$

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

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



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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10. Let
$$A imes B = \{(a, b) : b = 3a - 2\}.$$
 If

(x, -5) and (2, y) belong to A imes B, find the values of x and y.

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.



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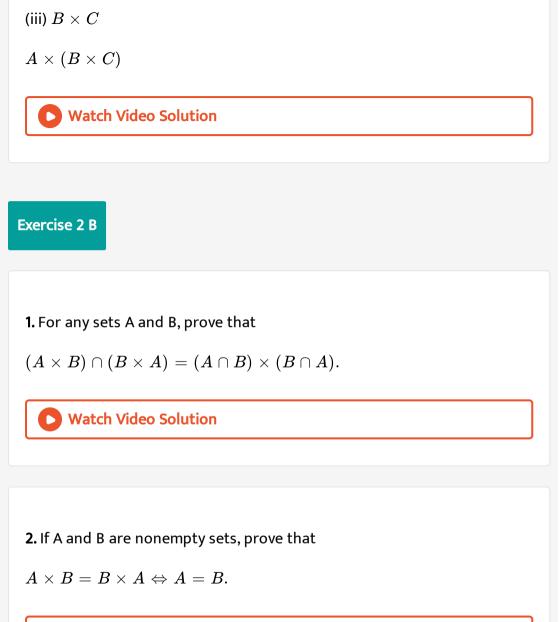
13. If $A = \{5, 7\}$, find $(i)A \times A$ and $(ii)A \times A \times A$.

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

(i) A imes B

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



$A imes B \subseteq C imes D \ \ ext{and} \ \ A imes B eq \phi, \ \ ext{prove that} \ \ A imes C \subseteq B imes D.$



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?

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



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



- 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?

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

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

- **3.** Let $A = \{1, 3, 5, 7\}$ and $B = \{2, 4, 6, 8\}$.
- ${\sf Let}\ R=\{(x,y)\!:\!x\in A,y\in B \ \text{ and } \ x>Y\}.$
- (i) Write R in roster form.
- (ii) Find dom (R) and range (R).
- (iii) Depict R by an arrow diagram.



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.



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.

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).

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

$$R = \{(x,x+5) \colon \! x \in \{0,1,2,3,4,5\} \}$$
 .

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



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

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

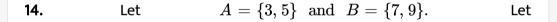
domain of R .

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?

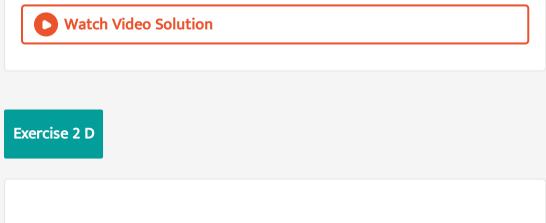
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 $R=\{(a,b)\!:\!a\in A,b\in B \hspace{0.2cm} ext{and}\hspace{0.2cm}(a-b) \hspace{0.2cm} ext{is odd}\}.$

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

Hint The difference of two odd numbers cannot be odd.



- **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?

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.



Let

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

Find its domain and range.

3.

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

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

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

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

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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 $R = \{(a, b) : a, b \in A \text{ and } |a^2 - b^2| \leq 5.$

Write R as set of ordered pairs.

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

Give reason in each case.



8.

 $R = \{(a,b) : a,b \in Z \hspace{.1in} ext{and} \hspace{.1in} b = 2a-4 \}. \hspace{.1in} ext{If} \hspace{.1in} (a,-2) \in R \hspace{.1in} ext{and} \hspace{.1in} (4,b^2) \in R$

Let

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



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

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

Hint $A imes A = \{(a, a), (a, b), (b, a), (b, b)\}$ and every subset of A imes 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)

$$egin{aligned} n(A\cup B) & (ii)n(A imes B) & (iii)n\{(A imes B)\cap (B imes A)\} \end{aligned}$$
Hint (i) $n(A\cup B) = n(A) + n(B) - n(A\cap B).$
(ii) $n(A imes B) = n(A).$ $n(B)$
(iii) If $n(A\cap B) = m$ then $n\{(A imes B)\cap (B imes A)\} = 2^m.$

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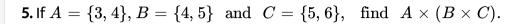
2. Find a and b when (a - 2b, 13) = (7, 2a - 3b).

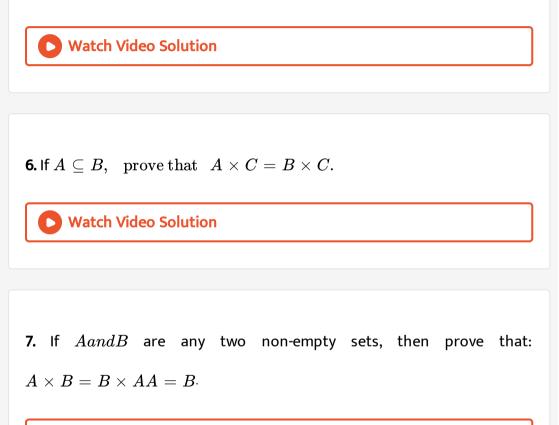
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3. If
$$A = \{1, 2\}$$
, find $A \times A \times A$.

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



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.

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.