Set

GATE PYQs

Instructor:

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GATE CSE AIR 53; AIR 67; AIR 206; AIR 256;

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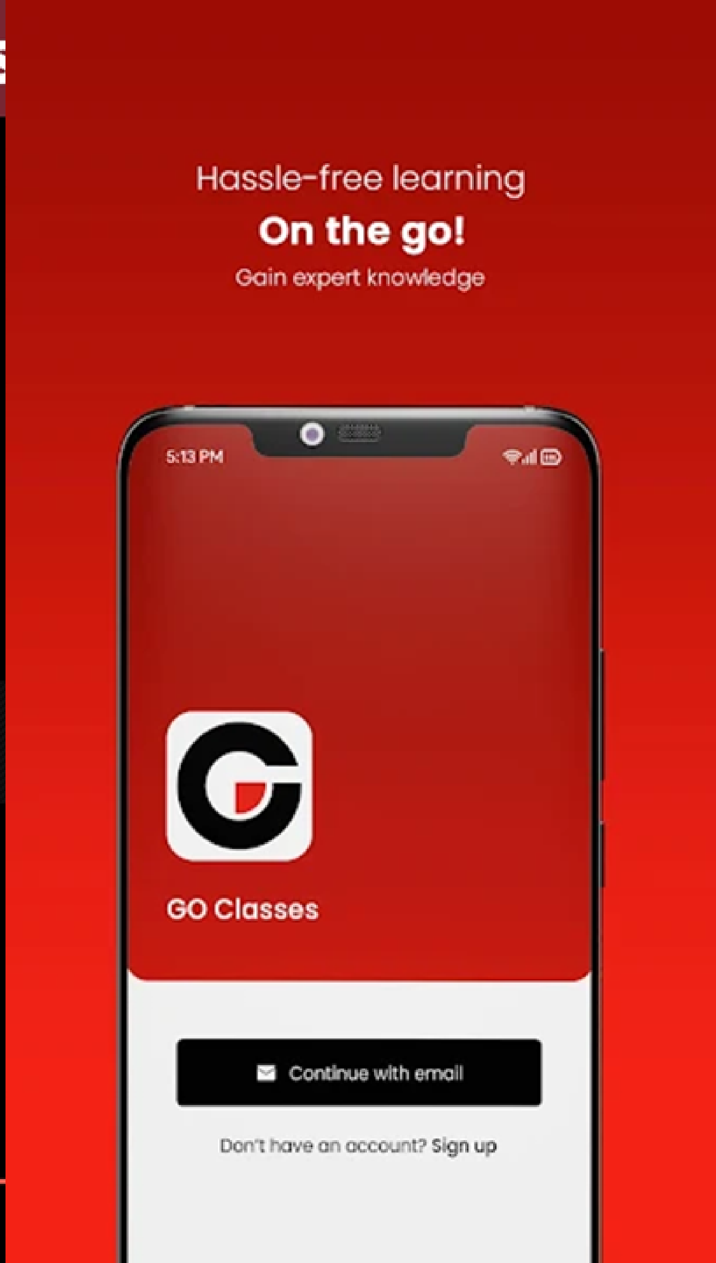

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Set Basics

GATE PYQs

Source of these Questions:

GATEOverflow Website (for GATE CSE)

Download "BEST GATE CSE PYQs Books" for FREE:
https://github.com/GATEOverflow/GO-PDFs/releases/tag/gatecse-2022-vol1%2C2

BEST Website for GATE CSE Questions:
https://gateoverflow.in/

4.11.5 Sets: GATE CSE 1995 | Question: 1.20 top

☛ https://gateoverflow.in/2607

The number of elements in the power set $P(S)$ of the set $S = \{\{\emptyset\}, 1, \{2, 3\}\}$ is:

A. 2
B. 4
C. 8

Set S ; $|S| = n$

$|P(S)| = 2^n$

4.11.5 Sets: GATE CSE 1995 | Question: 1.20 top https://gateoverflow.in/2607

The number of elements in the power set $P(S)$ of the set $S = \{\{\emptyset\}, 1, \{2, 3\}\}$ is:

A. 2
B. 4
C. 8

$|S| = 3$

$|P(S)| = 2^3 = 8$

an element of S

$\{\phi\}$

10.9.1 Power Set: UGC NET CSE | December 2012 | Part 2 | Question: 4 top

The power set of the set $\{\Phi\}$ is

A. $\{\Phi\}$
B. $\{\Phi, \{\Phi\}\}$
C. $\{0\}$
D. $\{0, \Phi, \{\Phi\}\}$

ugcnetcse-dec2012-paper2 set-theory&algebra set-theory power-set

$S = \{\phi\} \Rightarrow P(S) = \{\phi, \{\phi\}\}$

10.9.1 Power Set: UGC NET CSE | December 2012 | Part 2 | Question: 4 top

The power set of the set $\{\Phi\}$ is

A. $\{\Phi\}$
B. $\{\Phi, \{\Phi\}\}$
C. $\{0\}$
D. $\{0, \Phi, \{\Phi\}\}$

ugcnetcse-dec2012-paper2 set-theory&algebra set-theory power-set

$|P(S)| = 2$

$|S| = 1$

$\phi \subseteq S$ for all sets

$\{\phi\} \neq \phi$

ϕ → Empty set

$\{\phi\}$ → Not empty set

$|\phi| = 0$

$|\{\phi\}| = 1$

4.11.7 Sets: GATE CSE 1996 | Question: 1.1 top

☛ https://gateoverflow.in/2705

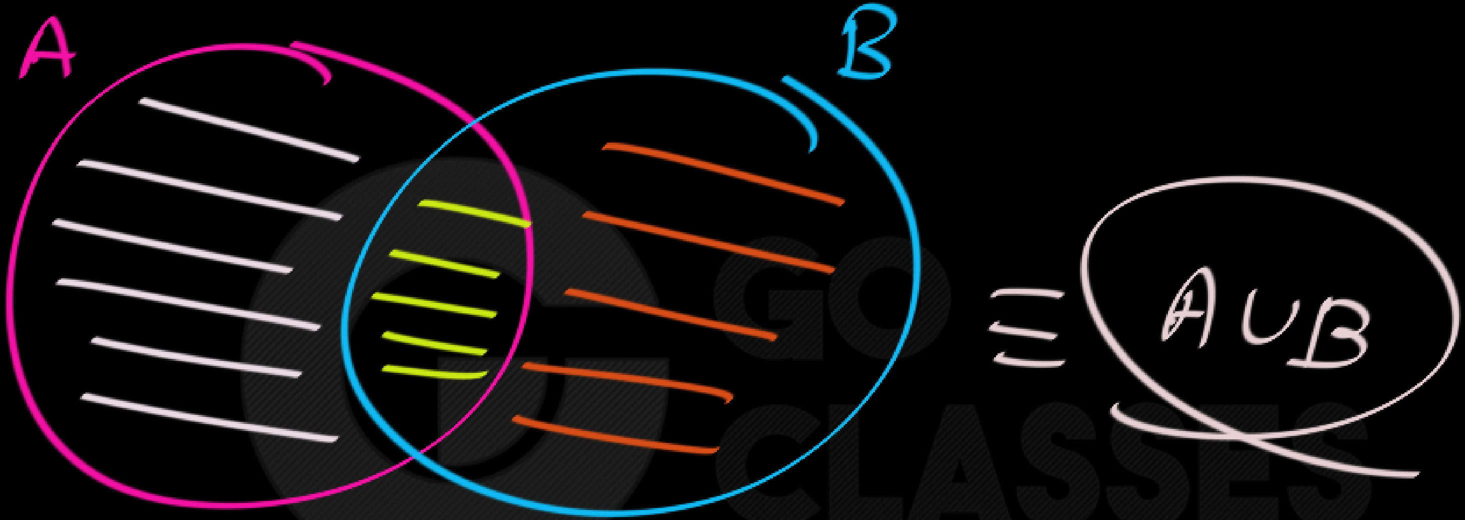
Let A and B be sets and let A^c and B^c denote the complements of the sets A and B. The set $(A - B) \cup (B - A) \cup (A \cap B)$ is equal to

A. $A \cup B$

B. $A^c \cup B^c$

C. $A \cap B$

D. $A^c \cap B^c$



$(A-B) \cup (B-A) \cup (A \cap B)$

$$P \,\Delta\, Q = (P \cup Q) - (P \cap Q)$$

$$= (P - Q) \cup (Q - P)$$

$$= (P \cap Q') \cup (Q \cap P')$$

4.11.26 Sets: GATE IT 2006 | Question: 23 top

https://gateoverflow.in/3562

Let P, Q and R be sets let Δ denote the symmetric difference operator defined as $P \Delta Q = (P \cup Q) - (P \cap Q)$. Using Venn diagrams, determine which of the following is/are TRUE?

I. $P \Delta (Q \cap R) = (P \Delta Q) \cap (P \Delta R)$
II. $P \cap (Q \cap R) = (P \cap Q) \Delta (P \Delta R)$

A. I only
B. II only
C. Neither I nor II
D. Both I and II

4.11.26 Sets: GATE IT 2006 | Question: 23 top

https://gateoverflow.in/3562

Let P, Q and R be sets let Δ denote the symmetric difference operator defined as $P\Delta Q = (P \cup Q) - (P \cap Q)$. Using Venn diagrams, determine which of the following is/are TRUE?

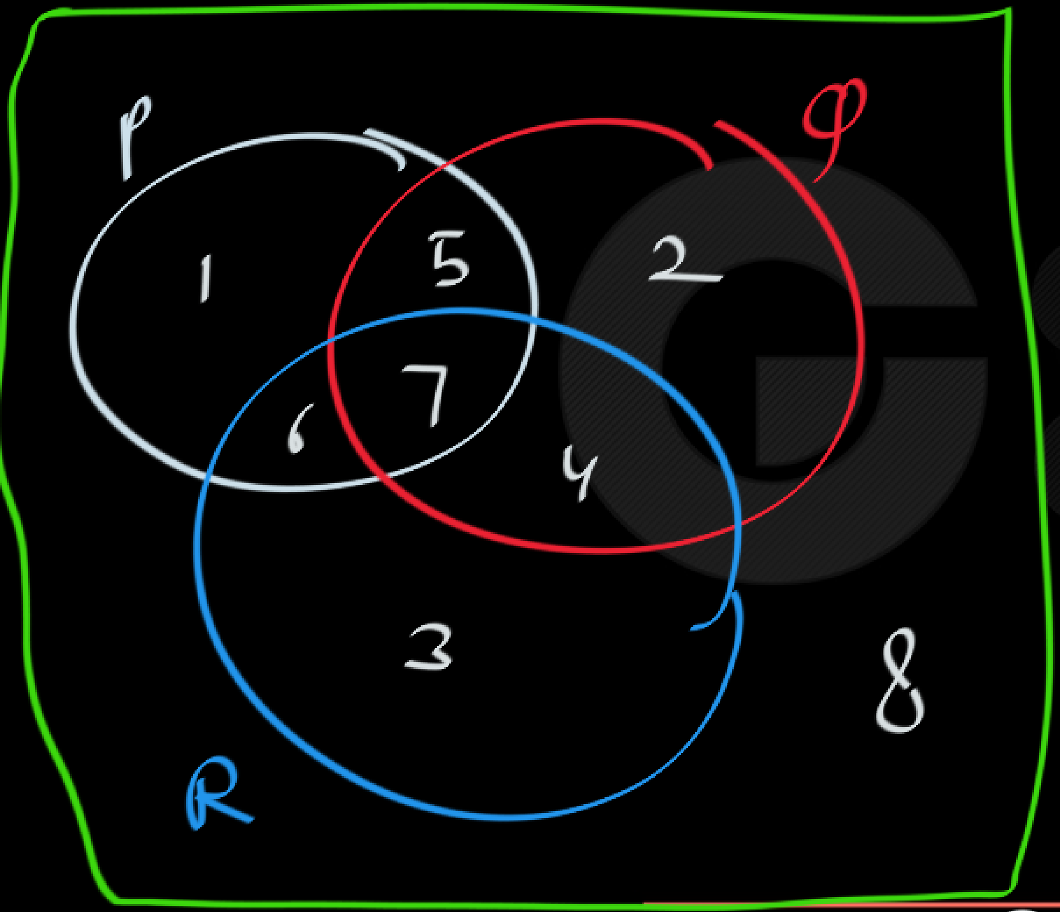
I. $P\Delta(Q \cap R) = (P\Delta Q) \cap (P\Delta R)$ false

II. $P \cap (Q \cap R) = (P \cap Q)\Delta(P\Delta R)$ false

$P \cap Q \cap R$

A. I only
B. II only
C. Neither I nor II
D. Both I and II

1



3 set P, Q, R

2^3 Areas in Venn Diagram

Exclusive News:

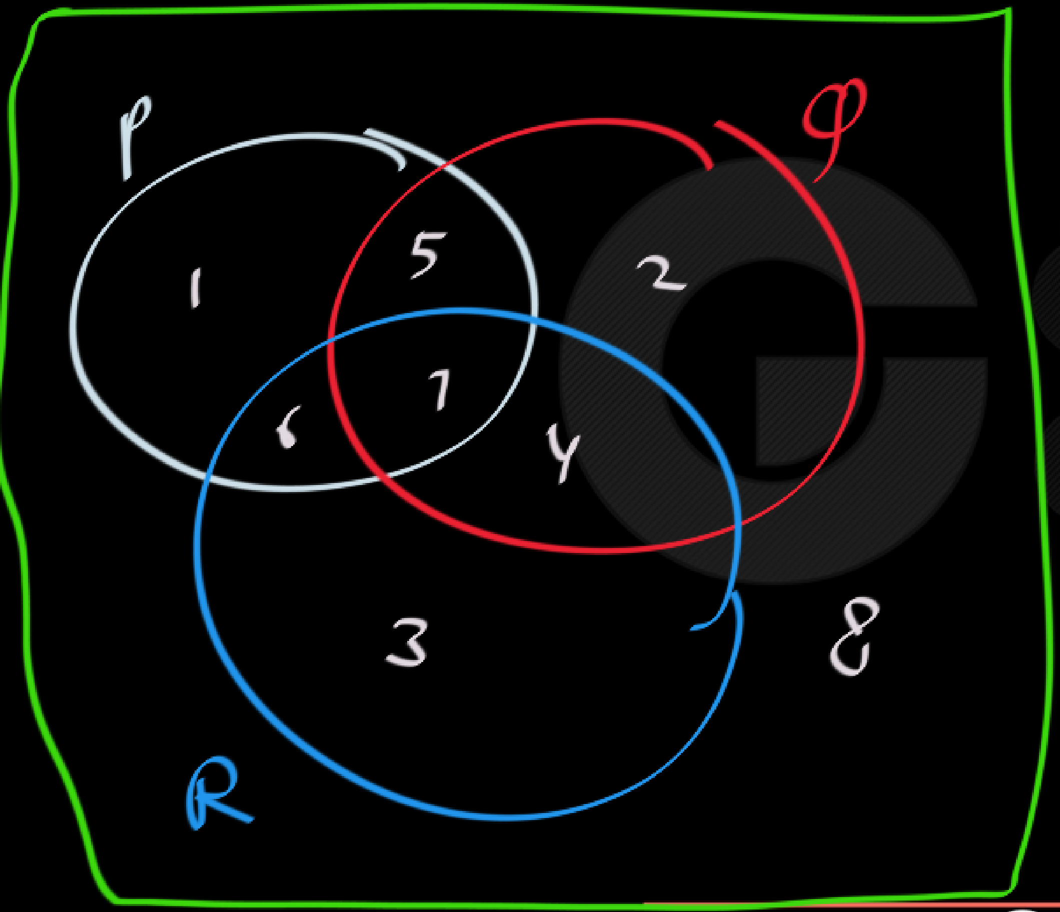
Tv channels: ZN, AT

ZN and $\overline{\text{AT}}$

OR

AT and $\overline{\text{ZN}}$

1



$P \Delta (Q \cap R)$

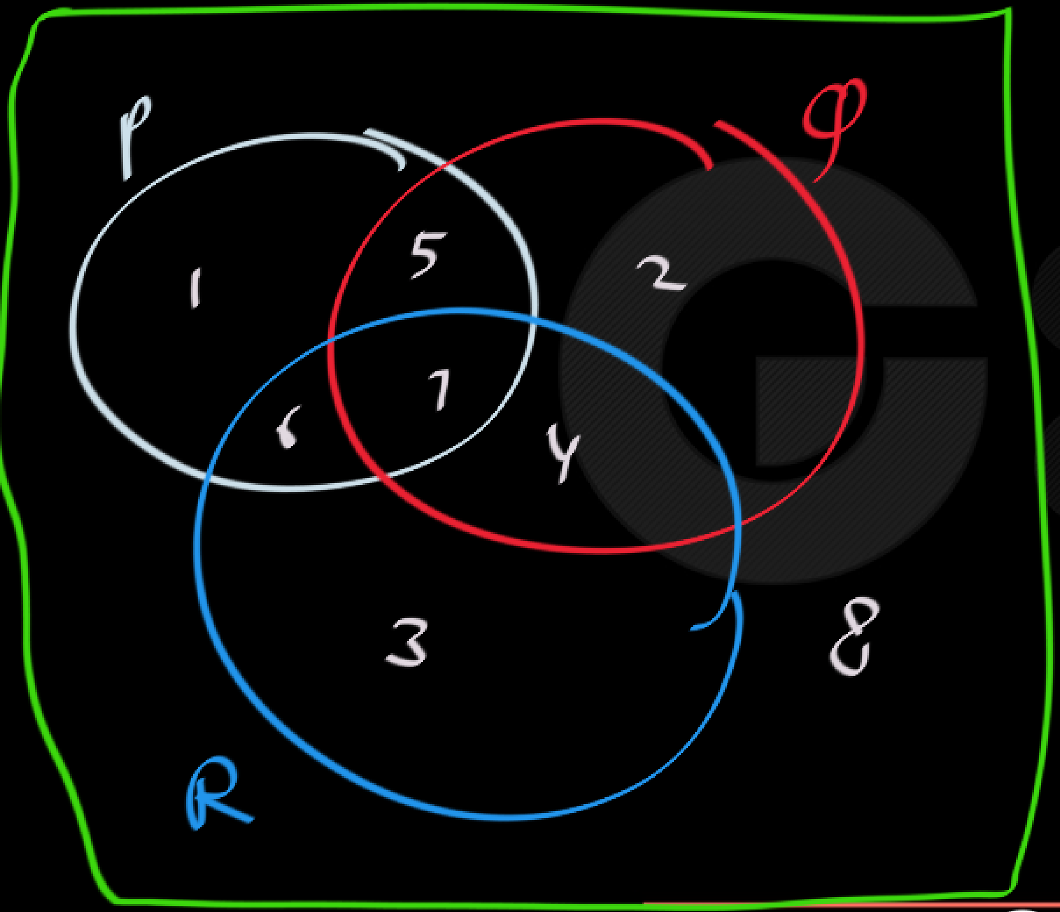
Exclusive

4, 7

1, 5, 6, 7

1, 5, 6, 4

1



$P \Delta (Q \cap R)$: 1, 5, 6, 4

1567 2457 1567

$(P \Delta Q) \cap (P \Delta R)$

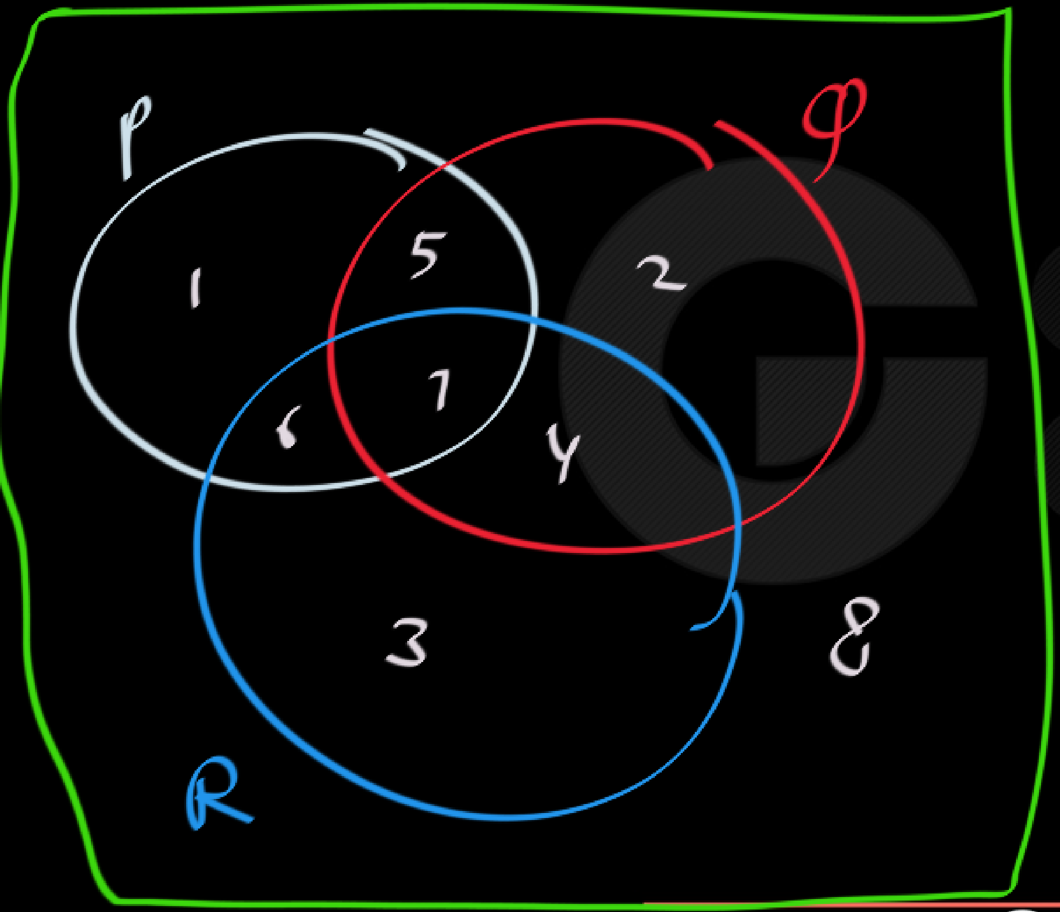
3, 4, 6, 7

exclusive exclusive

1624 1534

14

1

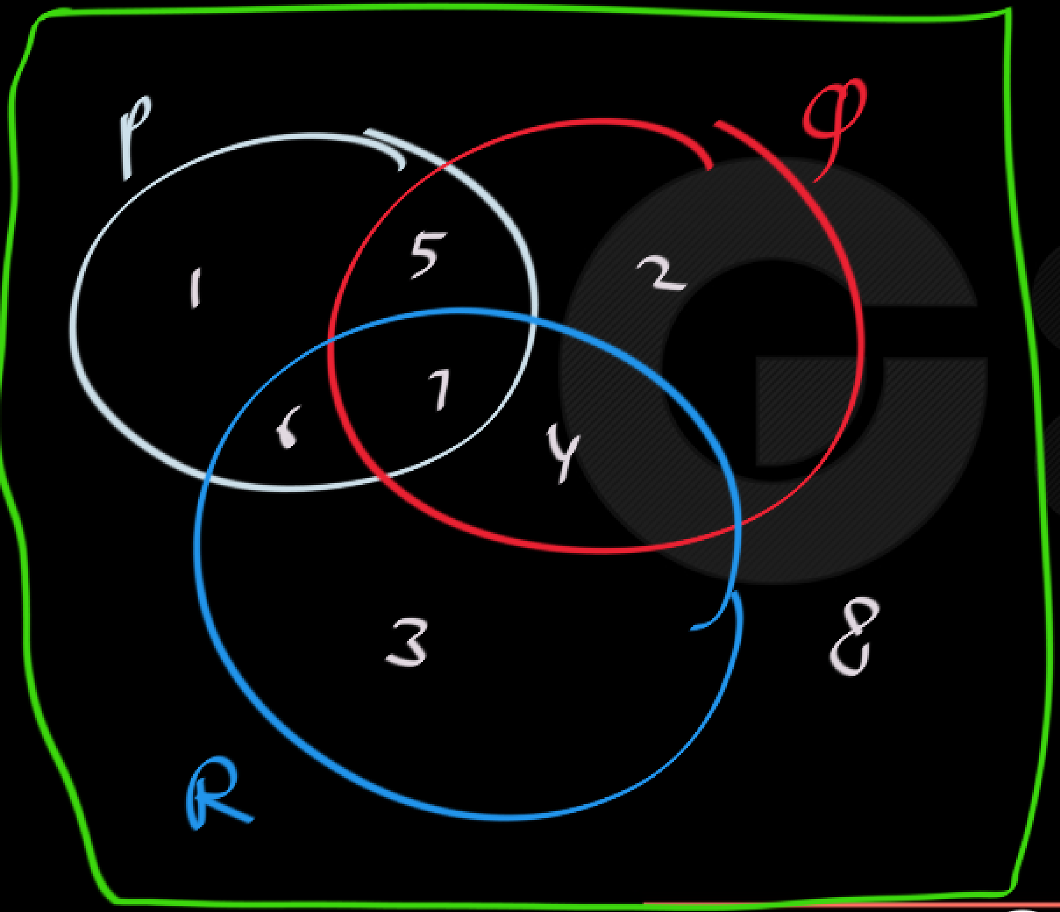


$P \Delta (Q \cap R)$: 1, 5, 6, 4

$(P \Delta Q) \cap (P \Delta R)$: 1, 4

$(P \Delta Q) \cap (P \Delta R) \neq P \Delta (Q \cap R)$

1



$P \Delta (Q \cap R)$: 1, 5, 6, 4

$(P \Delta Q) \cap (P \Delta R)$: 1, 4

$(P \Delta Q) \cap (P \Delta R) \subseteq P \Delta (Q \cap R)$

1 : false

$$\boxed{P \Delta (Q \cap R) = (P \Delta Q) \cap (P \Delta R)}$$

false

means: Δ is NOT Distributive over $\cap$.

2

$P \cap Q \cap R = \underbrace{(P \cap Q)}_{5,7} \, \Delta \, (P \, \Delta \, R)$

$P \cap Q \cap R \to 7$ ✓

1567

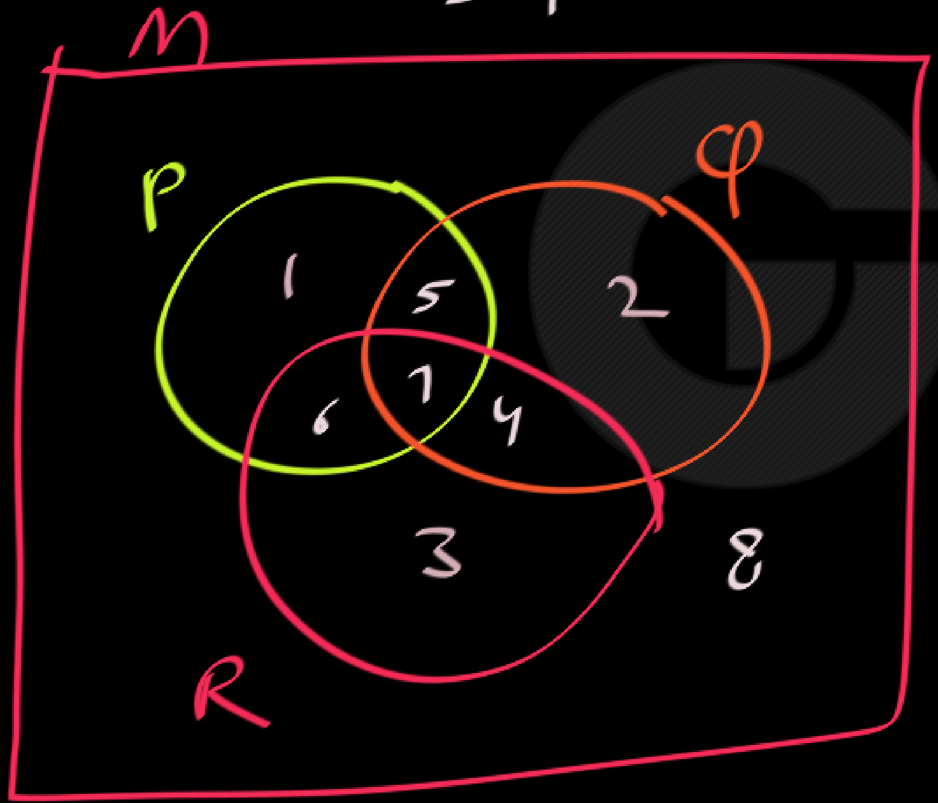
3467

exclusive

1347

exclusive

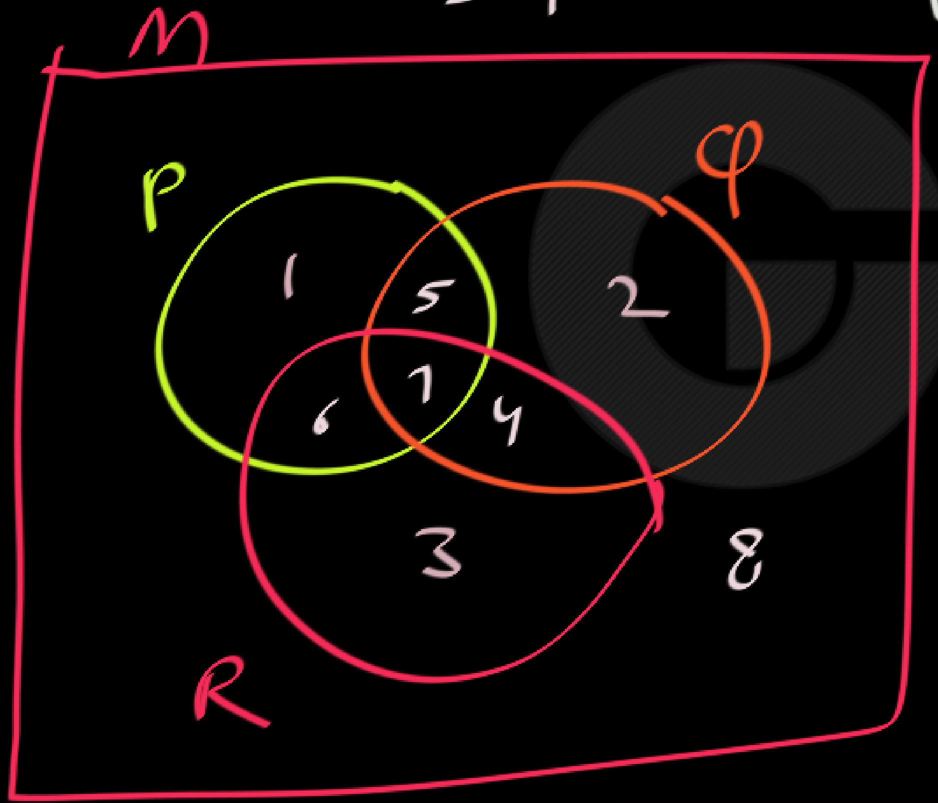
1534



2

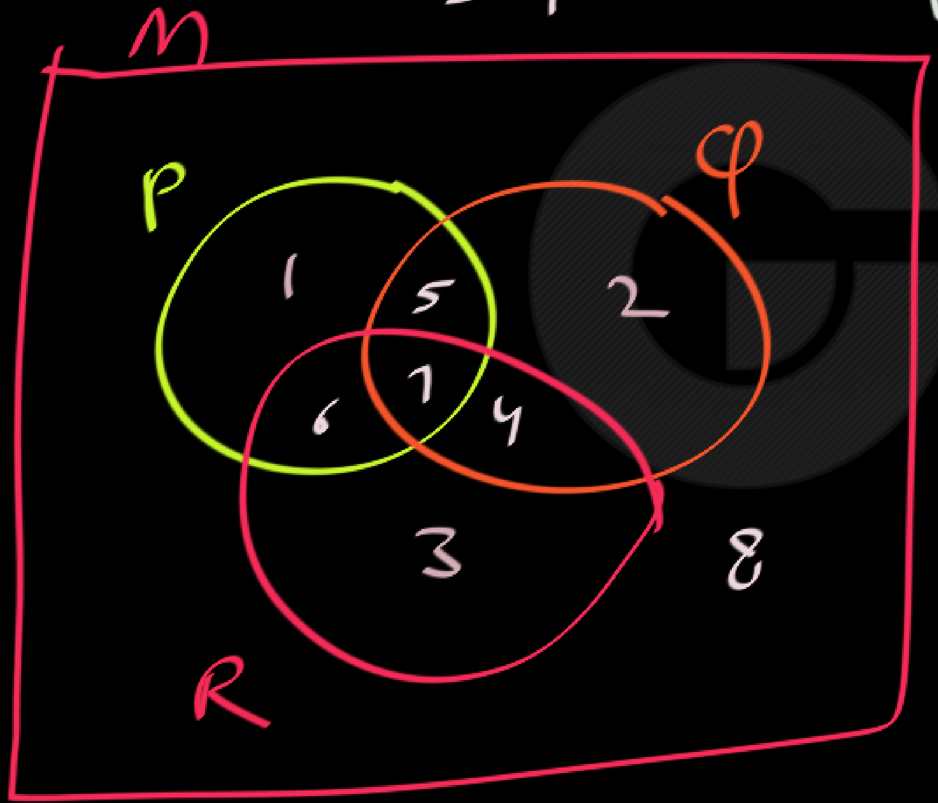
$$\underbrace{P \cap Q \cap R}_{7} = \underbrace{(P \cap Q) \, \Delta \, (P \, \Delta \, R)}_{1347}$$

false



2

$$\underbrace{P \cap Q \cap R}_{7} \subseteq \underbrace{(P \cap Q)\ \Delta\ (P\ \Delta\ R)}_{134\}}$$



4.11.16 Sets: GATE CSE 2008 | Question: 2 top

https://gateoverflow.in/400

If P, Q, R are subsets of the universal set U, then

$$(P \cap Q \cap R) \cup (P^c \cap Q \cap R) \cup Q^c \cup R^c$$

is

A. $Q^c \cup R^c$
B. $P \cup Q^c \cup R^c$
C. $P^c \cup Q^c \cup R^c$
D. U

$\overline{Q} \cup QR = \overline{Q} \cup R$

m

4.11.16 Sets: GATE CSE 2008 | Question: 2 top

https://gateoverflow.in/400

If P, Q, R are subsets of the universal set U, then

$$(P \cap Q \cap R) \cup (P^c \cap Q \cap R) \cup Q^c \cup R^c$$

is

A. $Q^c \cup R^c$
B. $P \cup Q^c \cup R^c$
C. $P^c \cup Q^c \cup R^c$
D. U ✓

$(Q \cap R) \cup Q^c \cup R^c$

$\overline{Q} \cup R \cup \overline{R} = m$

$\mathcal{M}$

4.11.16 Sets: GATE CSE 2008 | Question: 2 top

https://gateoverflow.in/400

If P, Q, R are subsets of the universal set U, then

$$(P \cap Q \cap R) \cup (P^c \cap Q \cap R) \cup Q^c \cup R^c$$

is

A. $Q^c \cup R^c$
B. $P \cup Q^c \cup R^c$
C. $P^c \cup Q^c \cup R^c$
D. U $= \mathcal{M}$

M

4.11.16 Sets: GATE CSE 2008 | Question: 2 top

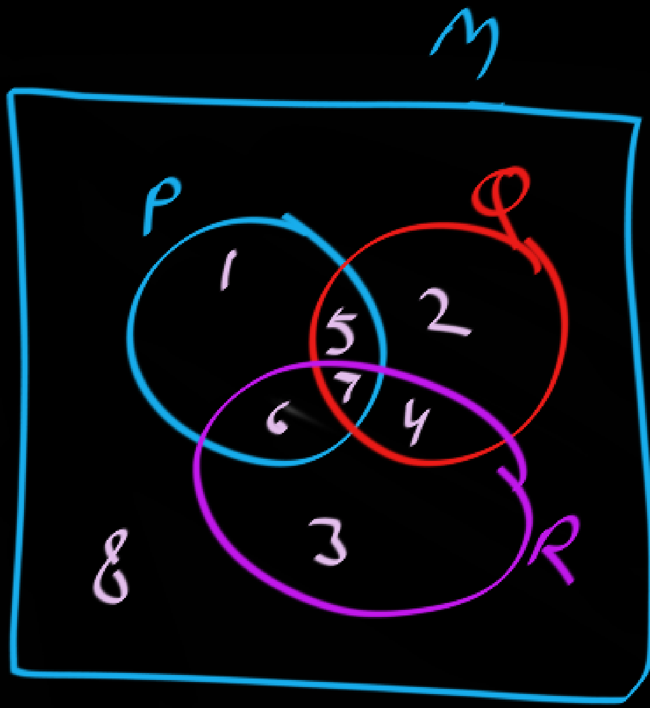
If P, Q, R are subsets of the universal set U, then

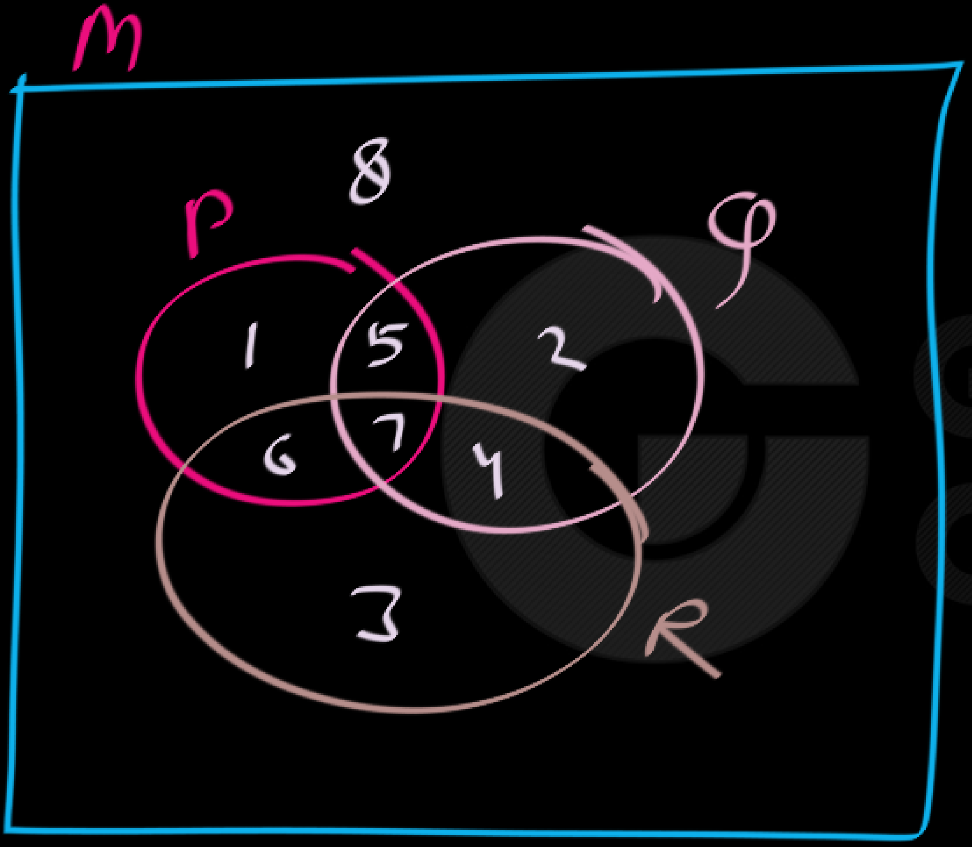
$$(P \cap Q \cap R) \cup (P^c \cap Q \cap R) \cup Q^c \cup R^c$$

7 ∪ 4 ∪ 1368 ∪ 1258

is

A. $Q^c \cup R^c$
B. $P \cup Q^c \cup R^c$
C. $P^c \cup Q^c \cup R^c$
D. U = M





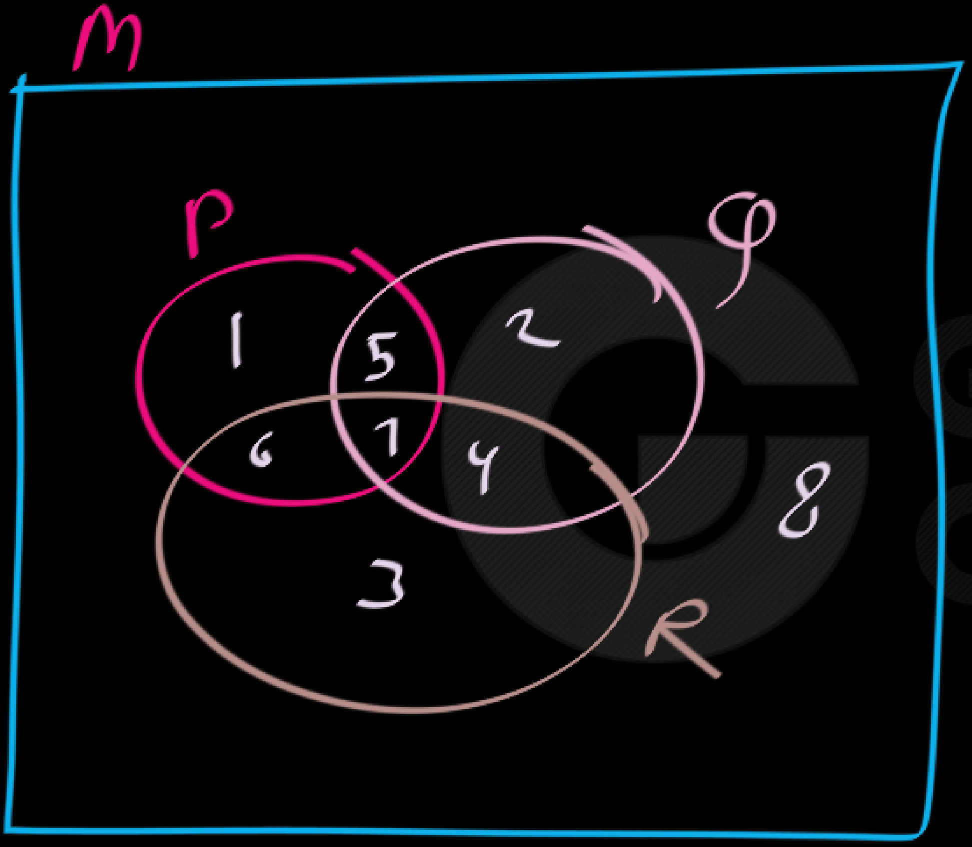
$$(\underline{P \cap Q} \cap R) \rightarrow 7$$

$P^c \cap Q \cap R$

means

In Q and R BUT

Not in P

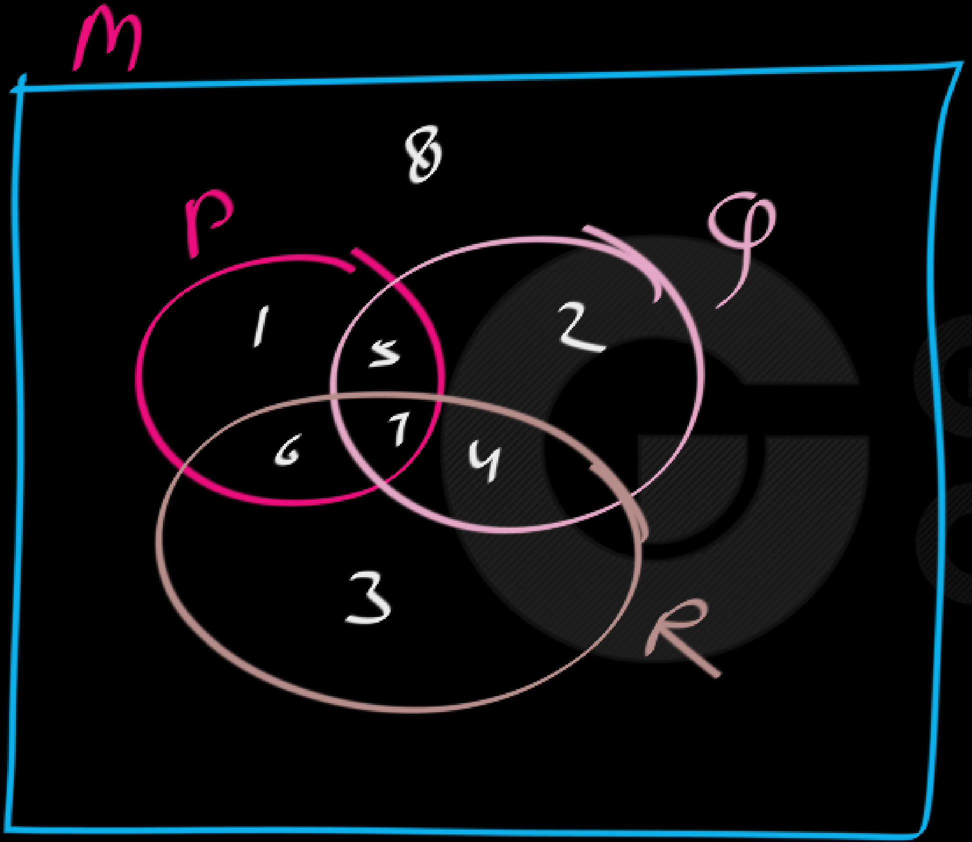


$(P \cap Q \cap R) \cup (P^c \cap Q \cap R)$

7

4

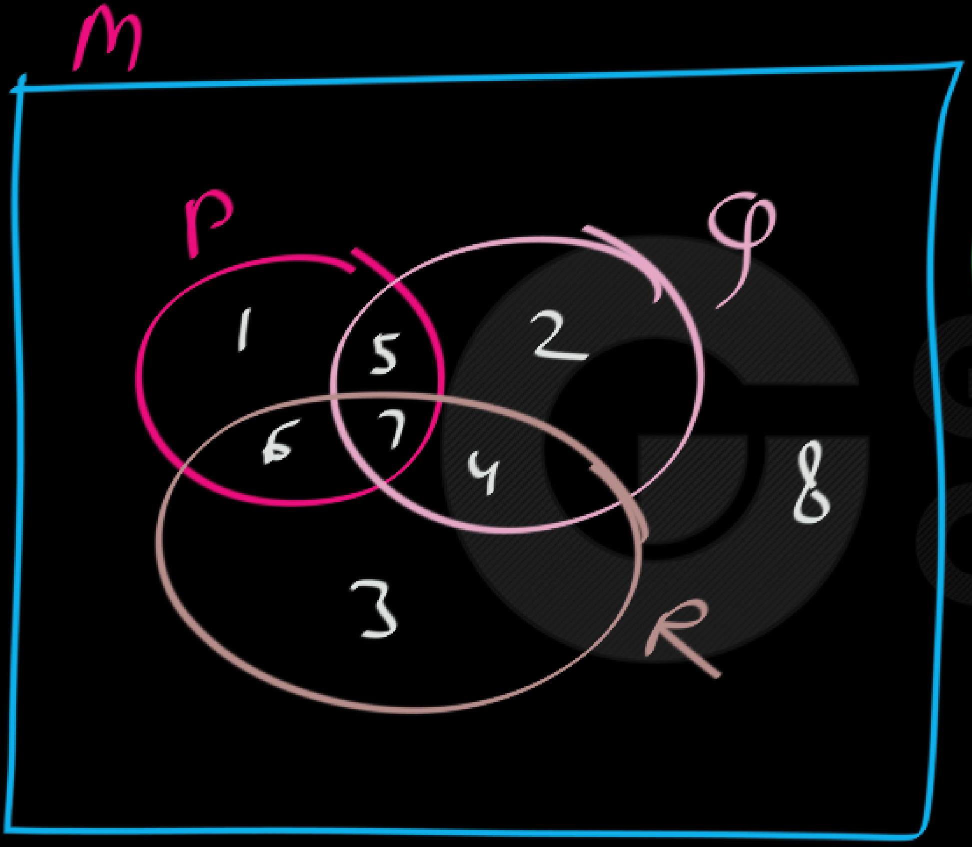
4, 7



$$\boxed{(P \cap Q \cap R) \cup (P^c \cap Q \cap R)} \rightarrow 4, 7$$

$$\cup\ (Q^c) \rightarrow 1, 3, 6, 8$$

$$\rightarrow 1, 3, 4, 6, 7, 8$$



$$(P \cap Q \cap R) \cup (P^c \cap Q \cap R) \cup (Q^c) \cup (R^c)$$

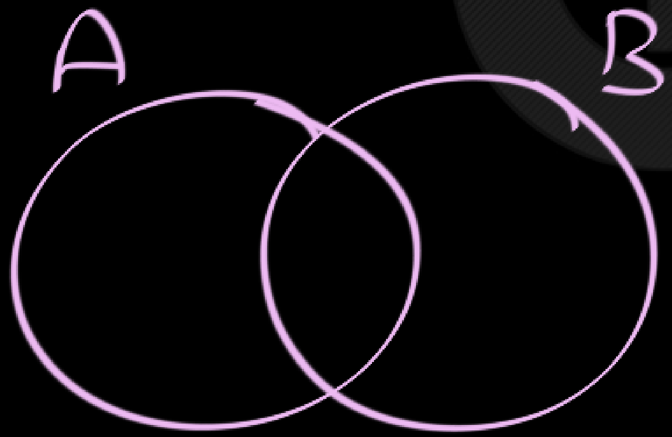
1 3 4 6 7 8

1 2 5 8

1 2 3 4 5 6 7 8 $= U$

$A \cup (\bar{A} \cap B) = A \cup B$

$B - A$



$\bar{A} \cup (A \cap B)$

$= \bar{A} \cup B$

$$p \cup \cancel{\bar{p}}\,q = p \cup q$$

$$\bar{p} \cup \cancel{p}\,q = \bar{p} \cup q$$

<u>Boolean Alg</u>: $a + \cancel{\bar{a}}\,b = a + b$

$$\bar{a} + ab = \bar{a} + b$$

Method 2 :

$$(PQR) \cup (\bar{P}QR) \cup (\bar{Q}) \cup (\bar{R})$$

$$PQR \cup \left(\left(\bar{Q} \cup \bar{P}R\right) \cup (\bar{R}) \right)$$

$$P\cancel{Q}R \cup \bar{Q} \cup \bar{R} \cup \bar{P}$$

$\cancel{PR} \cup \overline{Q} \cup \overline{R} \cup \overline{P}$

$P \cup \overline{Q} \cup \overline{R} \cup \overline{P}$

$M \cup \overline{Q} \cup \overline{R} = M$

universal set

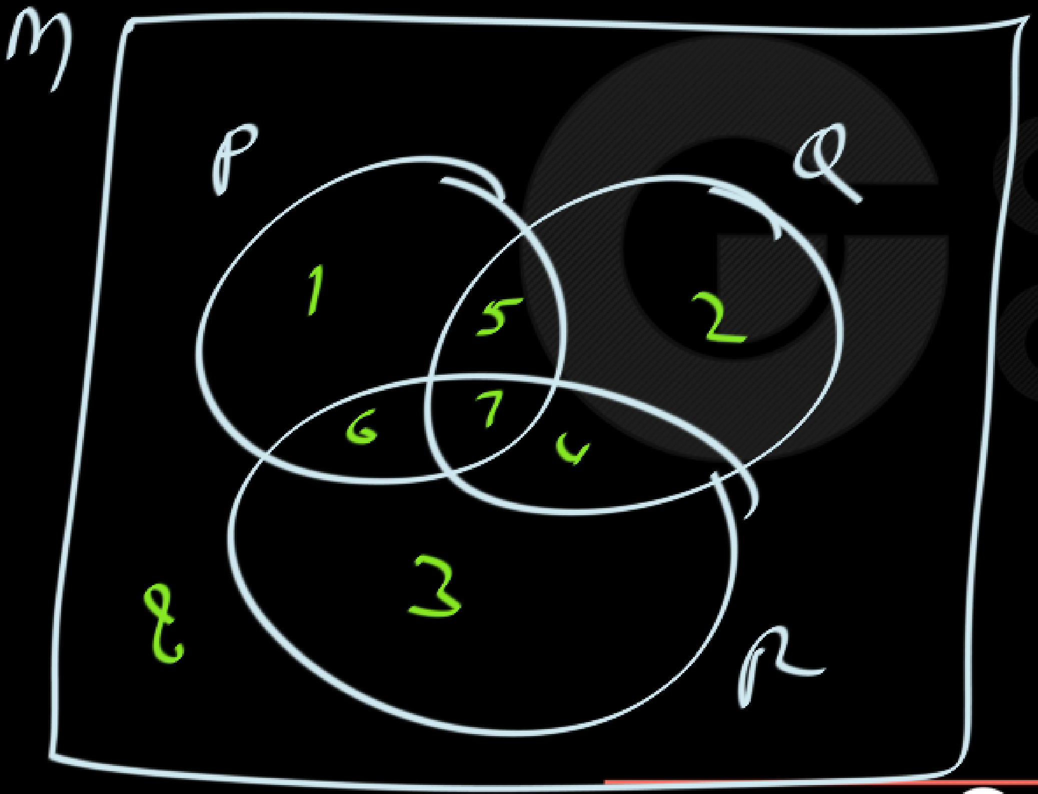
Note:

$$A \cup \cancel{\overline{A}}B = A \cup B$$

$$\overline{A} \cup AB = \overline{A} \cup B$$

Q:

$PQR \cup \bar{P}QR$?

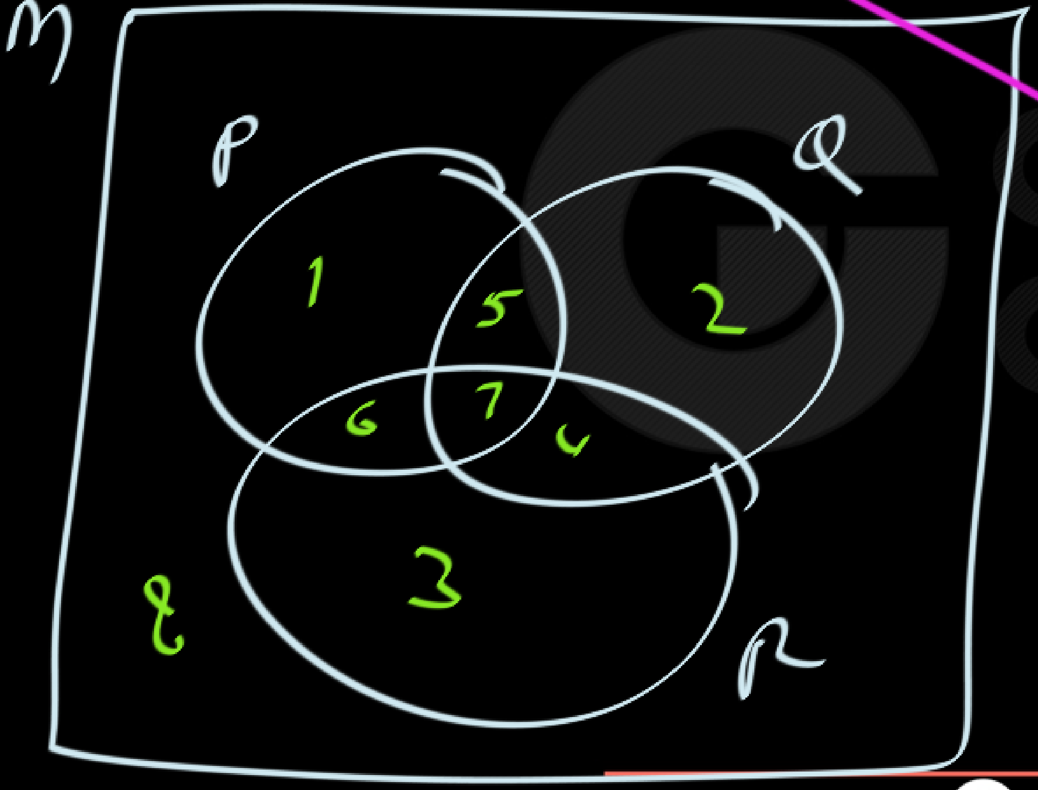


$\phi :$ $PQR \cup \bar{P}QR \} = 4,7$

7

4

$Q \cap R$



$$\boxed{PQR \cup \bar{P}QR = QR}$$

Boolean Alg:
$$abc + ab\bar{c}$$
$$= ab(c+\bar{c}) = ab$$

intersection

$PQR \cup PQ\overline{R}$

Universal set m

$= PQ\left(R \cup \overline{R}\right)$

$= (PQ) \cap (m) = PQ$

Note:

$$PQR \cup PQ\bar{R} = PQ$$

$$P \cup PQ = P$$

$$P \cup \bar{P}Q = P \cup Q$$

video
Solution

4.11.2 Sets: GATE CSE 1993 | Question: 8.3 top

https://gateoverflow.in/2301

Let S be an infinite set and $S_1 \ldots, S_n$ be sets such that $S_1 \cup S_2 \cup \cdots \cup S_n = S$. Then

A. at least one of the sets S_i is a finite set
B. not more than one of the sets S_i can be finite
C. at least one of the sets S_i is an infinite
D. not more than one of the sets S_i can be infinite
E. None of the above

https://gateoverflow.in/2301/gate-cse-1993-question-8-3

Video solution

4.11.3 Sets: GATE CSE 1993 | Question: 8.4 top

https://gateoverflow.in/2302

Let A be a finite set of size n. The number of elements in the power set of $A \times A$ is:

A. 2^{2^n}
B. 2^{n^2}
C. $(2^n)^2$
D. $(2^2)^n$
E. None of the above

https://gateoverflow.in/2302/gate-cse-1993-question-8-4

9.7.1 Set Theory: TIFR CSE 2010 | Part A | Question: 15 top

Let A, B be sets. Let $\bar{A}$ denote the compliment of set A (with respect to some fixed universe), and $(A - B)$ denote the set of elements in A which are not in B. Set $(A - (A - B))$ is equal to:

A. B B. $A \cap \bar{B}$ C. $A - B$ D. $A \cap B$ E. $\bar{B}$

tifr2010 set-theory&algebra set-theory

9.7.1 Set Theory: TIFR CSE 2010 | Part A | Question: 15 top

Let A, B be sets. Let $\bar{A}$ denote the compliment of set A (with respect to some fixed universe), and $(A - B)$ denote the set of elements in A which are not in B. Set $(A - (A - B))$ is equal to:

A. B

B. $A \cap \bar{B}$

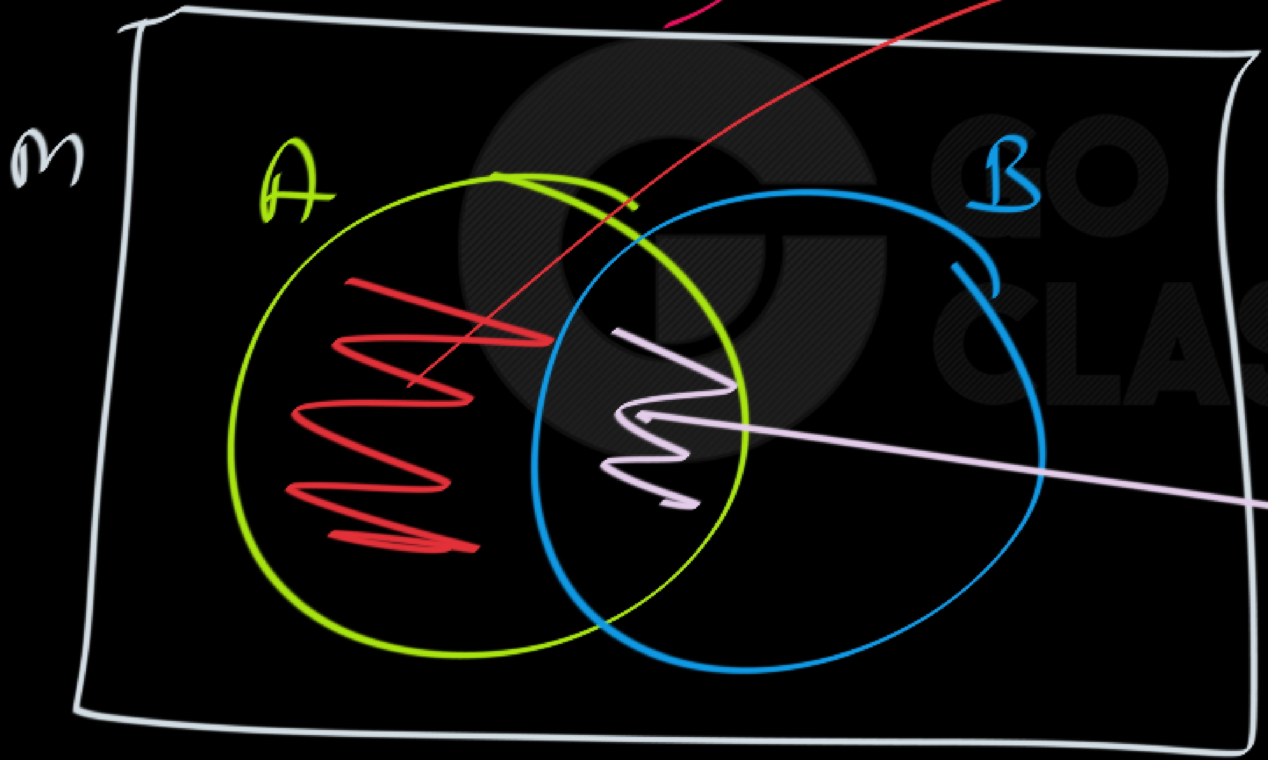
C. $A - B$

D. $A \cap B$

E. $\bar{B}$

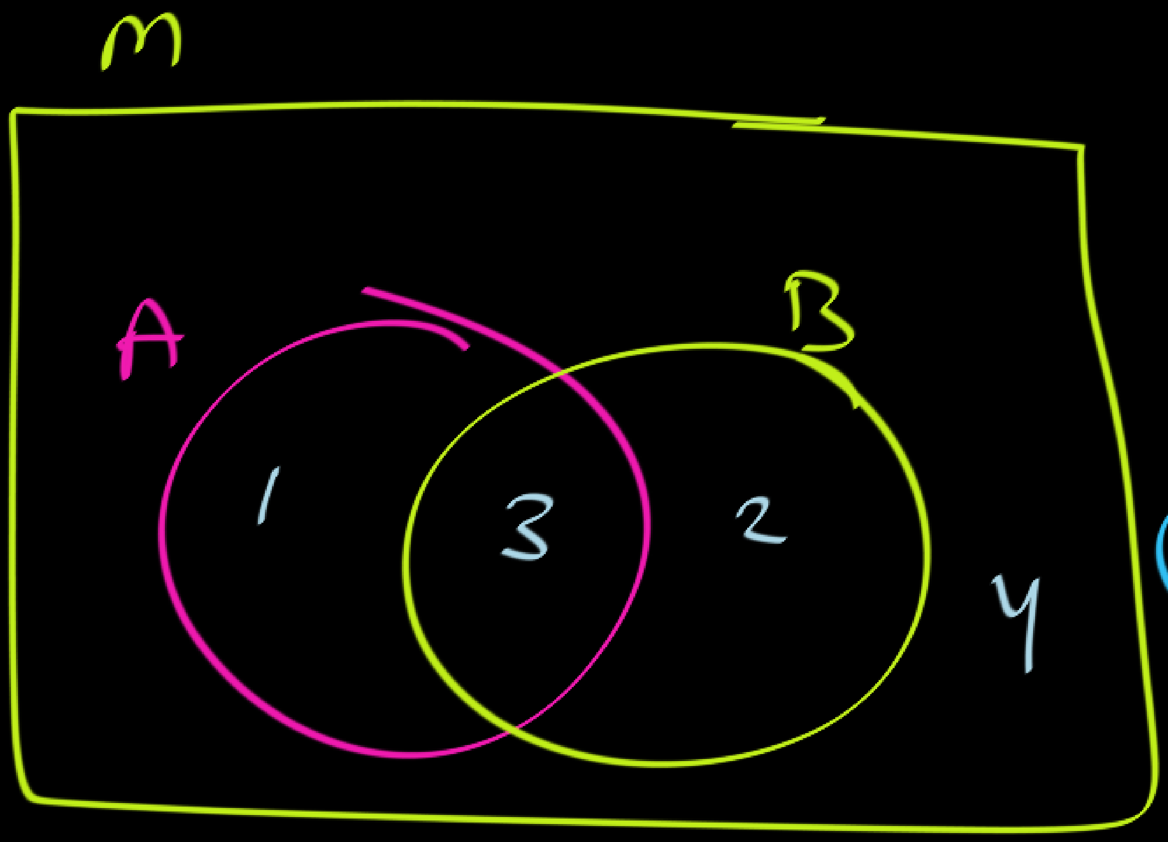
tifr2010 set-theory&algebra set-theory

$A - (A - B)$



$A - (A - B)$

$= A \cap B$



$A - (A - B)$

$1,3 - 1$

$3 = A \cap B$

Standard Q: (Illinois)

Problem 2

(Multiple choice. Circle the correct answer.) For arbitrary sets A and B, the difference set $A - B$ is equal to

(a) $\overline{B - A}$ (b) $\overline{\overline{A} \cup B}$ (c) $\overline{B} \cup A$ (d) $\overline{B} \cap A$ (e) $\overline{A \cup B}$ (f) None of the above.

$$A - B = A \cap \overline{B}$$

$$B - A = B \cap \overline{A}$$

$$\left(\overline{A - B}\right) = \left(\overline{A \cap \overline{B}}\right) = \overline{A} \cup B$$

$$\left(\overline{B - A}\right) = \overline{B} \cup A$$

Standard Q: (Illinois)

Problem 2

MSQ

$A - B = A \cap \overline{B}$

(Multiple choice. Circle the correct answer.) For arbitrary sets A and B, the difference set $A - B$ is equal to

(a) $\overline{B - A}$ (b) $\overline{\overline{A} \cup B}$ (c) $\overline{B} \cup A$ (d) $\overline{B} \cap A$ (e) $\overline{A \cup B}$ (f) None of the above.

$\overline{(B \cap \overline{A})}$

$= \overline{B} \cup A$

$A \cap \overline{B}$

Ans: B, D

Standard Q: (Illinois)

Problem 2

(Multiple choice. Circle the correct answer.) For arbitrary sets A and B, the difference set $A - B$ is equal to

(a) $\overline{B - A}$ (b) $\overline{\overline{A} \cup B}$ (c) $\overline{B} \cup A$ (d) $\overline{B} \cap A$ (e) $\overline{A \cup B}$ (f) None of the above.

Solution: $A - B$ is the set of elements which are in A, but not in B, so it is equal to $\boxed{\overline{B} \cap A}$. Also correct is $\boxed{\overline{\overline{A} \cup B}}$. (A Venn diagram shows that the latter is the same as $\overline{B} \cap A$.)

Note: Set A;

If $S \in P(A)$ then $S \subseteq A$

If $S \subseteq A$ then $S \in P(A)$

Standard Q: (Illinois)

(d) (True/false) With the set $A = \{1, 2, 3\}$ defined as above, determine which of the following statements about the power set $P(A)$ are true, and which are false. Mark those that are true by $\boxed{\text{T}}$, and those that are false by $\boxed{\text{F}}$. If you are unsure, leave the answer blank. (There will a small penalty for an incorrectly marked answer.)

A. $\{2, 3\} \in P(A)$

B. $\{2, 3\} \subseteq P(A)$

C. $\emptyset \in P(A)$

D. $\emptyset \subseteq P(A)$

Standard Q: (Illinois)

(d) (True/false) With the set $A = \{1, 2, 3\}$ defined as above, determine which of the following statements about the power set $P(A)$ are true, and which are false. Mark those that are true by $\boxed{\text{T}}$, and those that are false by $\boxed{\text{F}}$. If you are unsure, leave the answer blank. (There will a small penalty for an incorrectly marked answer.)

A. $\{2, 3\} \in P(A)$

B. $\{2, 3\} \subseteq P(A)$

C. $\emptyset \in P(A)$

D. $\emptyset \subseteq P(A)$

$\{2,3\} \subseteq A$ so; $\{2,3\} \in P(A)$

means: $2 \in P(A)$, $3 \in P(A)$ — false

Note: for EVERY set S

$\phi \subseteq S$ ✓

for Every Powerset P

$\phi \in P$; $\phi \subseteq P$

If P is a powerset

then for some set A

$$P = P(A)$$

set

$\phi \subseteq P$

$$\phi \subseteq A \implies \phi \in P$$

Standard Q: (Illinois)

(d) (True/false) With the set $A = \{1, 2, 3\}$ defined as above, determine which of the following statements about the power set $P(A)$ are true, and which are false. Mark those that are true by $\boxed{\text{T}}$, and those that are false by $\boxed{\text{F}}$. If you are unsure, leave the answer blank. (There will a small penalty for an incorrectly marked answer.)

A. $\{2, 3\} \in P(A)$

B. $\{2, 3\} \subseteq P(A)$

C. $\emptyset \in P(A)$

D. $\emptyset \subseteq P(A)$

Solution: $\boxed{\text{A,C,D are true, B is false.}}$ Reason: By definition, $P(A)$ is the set whose elements are the subsets of $\{1, 2, 3\}$. Since $\{2, 3\}$ and $\emptyset$ are among these subsets, they are elements of $P(A)$, so A and C are true. D is true since any set contains the empty set **as a subset**. However, B is false, since $\{2, 3\}$ is an **element**, not a subset of $P(A)$.

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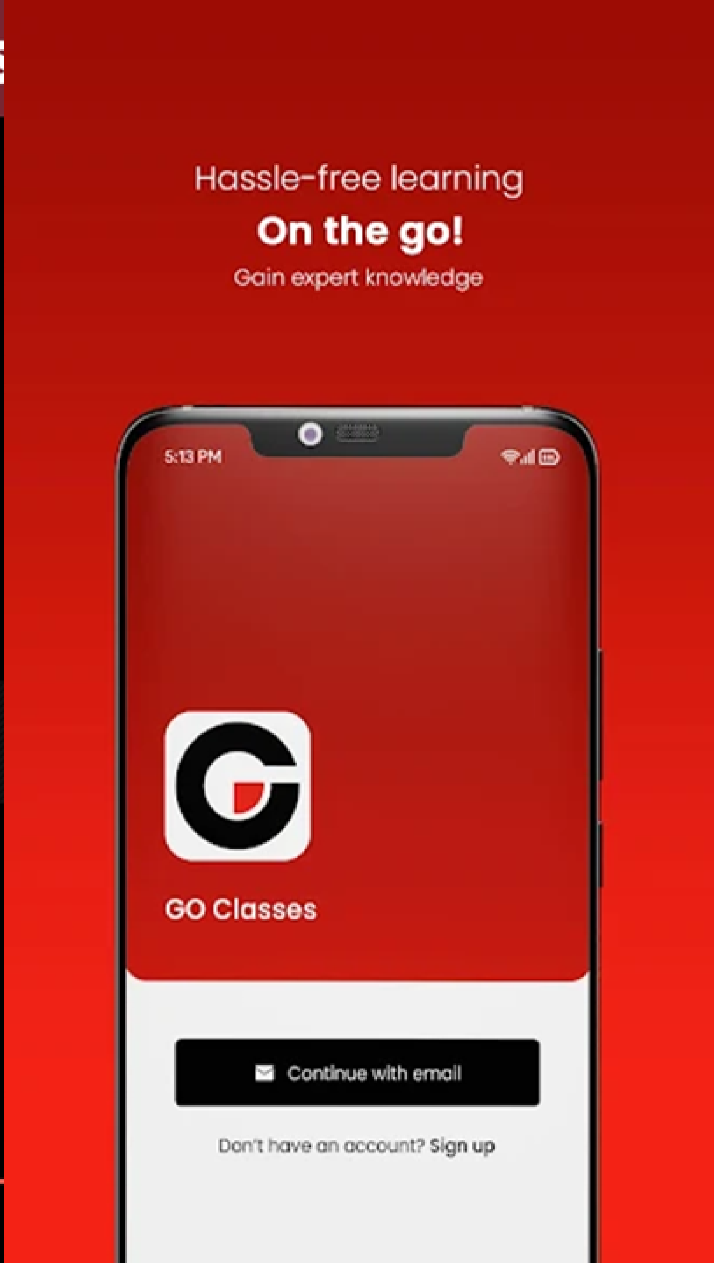


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