1) R(ABCD)

A->B

B->C

C->A

To find out candidate key?

(AD)+=ADBC

BD+=BDCA

CD+=CDAB

2) R(ABCD)

AB->CD

D->A

ANS

(AB)+=ABCD

(BD)+=BD

BDA

ABCD

(BC)+=

3) R(ABCDEF)

AB->C

C->D

B->AE

ANS

(BF)+=BFAECD

4) R(ABCD)

AB->CD

C->A

D->B

(A)+=A

(B)+=B

(C)+=CA

(D)+=DB

(AB)+=ABCD

(AC)+=AC ACB=

(AD)+=ADBC ACD

(BC)+=BCAD BDA

(BD)+=BD BDC

(CD)+=CDBA

5) R(ABCDE)

AB->CD

D->A

BC->DE

(AB)+=ABCDE

(BC)+=BCDEA

(BD)+=BDACD

(BE)+=

6) R(WXYZ)

Z->W

Y->XZ

XW->Y

(W)+=W

(X)+=X

(Y)+=YXZW

(Z)+=ZW

WX=WXYZ

WZ=WZ

XZ=XZWY

7) R(ABCDEF)

AB->C

DC->AE

E->F

(ABD)+=ABDCEF

(BCD)+=BCDAEF

(BDE)+=BDEF

(BDF)+=BDF

BDEF=BDEF

8) R(ABCDEF)

CE->D

D->B

C->A

9) R(ABCDEFGHIJ)

AB->C

AD->GH

BD->EF

A->I

H->J

10) R(ABCDE)

A->B

BC->E

DE->A

11) R(ABCDE)

BC->ADE

D->B

12) R(ABCDEF)

AB->C

C->D

C->BE

E->F

F->A

13) R(ABCDEFGH)

CH->G

A->BC

B->CFH

E->A

F->EG

.

**PRACTICE PROBLEMS BASED ON FINDING CANDIDATE KEYS-**

**Problem-01:**

Let R = (A, B, C, D, E, F) be a relation scheme with the following dependencies-

C → F

E → A

EC → D

A → B

Which of the following is a key for R?

1. CD
2. EC
3. AE
4. AC

Also, determine the total number of candidate keys and super keys.

**Solution-**

We will find candidate keys of the given relation in the following steps-

**Step-01:**

* Determine all essential attributes of the given relation.
* Essential attributes of the relation are- C and E.
* So, attributes C and E will definitely be a part of every candidate key.

**Step-02:**

Now,

* We will check if the essential attributes together can determine all remaining non-essential attributes.
* To check, we find the closure of CE.

So, we have-

{ CE }+

= { C , E }

= { C , E , F }                       ( Using C → F )

= { A , C , E , F }                  ( Using E → A )

= { A , C , D , E , F }            ( Using EC → D )

= { A , B , C , D , E , F }       ( Using A → B )

We conclude that CE can determine all the attributes of the given relation.

So, CE is the only possible candidate key of the relation.

***Thus, Option (B) is correct.***

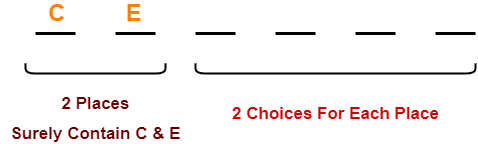
**Total Number of Candidate Keys-**

Only one candidate key CE is possible.

**Total Number of Super Keys-**

There are total 6 attributes in the given relation of which-

* There are 2 essential attributes- C and E.
* Remaining 4 attributes are non-essential attributes.
* Essential attributes will be definitely present in every key.
* Non-essential attributes may or may not be taken in every super key.



So, number of super keys possible = 2 x 2 x 2 x 2 = 16.

Thus, total number of super keys possible = 16.

**Problem-02:**

Let R = (A, B, C, D, E) be a relation scheme with the following dependencies-

AB → C

C → D

B → E

Determine the total number of candidate keys and super keys.

**Solution-**

We will find candidate keys of the given relation in the following steps-

**Step-01:**

* Determine all essential attributes of the given relation.
* Essential attributes of the relation are- A and B.
* So, attributes A and B will definitely be a part of every candidate key.

**Step-02:**

Now,

* We will check if the essential attributes together can determine all remaining non-essential attributes.
* To check, we find the closure of AB.

So, we have-

{ AB }+

= { A , B }

= { A , B , C }                     ( Using AB → C )

= { A , B , C , D }               ( Using C → D )

= { A , B , C , D , E }          ( Using B → E )

We conclude that AB can determine all the attributes of the given relation.

***Thus, AB is the only possible candidate key of the relation.***

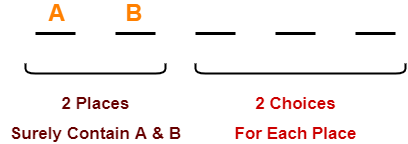
**Total Number of Candidate Keys-**

Only one candidate key AB is possible.

**Total Number of Super Keys-**

There are total 5 attributes in the given relation of which-

* There are 2 essential attributes- A and B.
* Remaining 3 attributes are non-essential attributes.
* Essential attributes will be definitely present in every key.
* Non-essential attributes may or may not be taken in every super key.



So, number of super keys possible = 2 x 2 x 2 = 8.

Thus, total number of super keys possible = 8.

**Problem-03:**

Consider the relation scheme R(E, F, G, H, I, J, K, L, M, N) and the set of functional dependencies-

{ E, F } → { G }

{ F } → { I , J }

{ E, H } → { K, L }

{ K } → { M }

{ L } → { N }

What is the key for R?

1. { E, F }
2. { E, F, H }
3. { E, F, H, K, L }
4. { E }

Also, determine the total number of candidate keys and super keys.

**Solution-**

We will find candidate keys of the given relation in the following steps-

**Step-01:**

* Determine all essential attributes of the given relation.
* Essential attributes of the relation are- E, F and H.
* So, attributes E, F and H will definitely be a part of every candidate key.