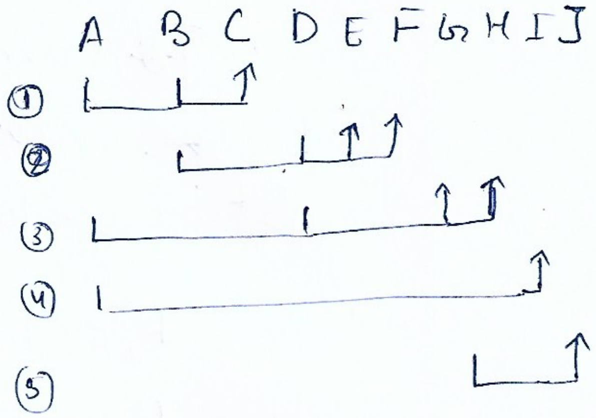
Ans 1.

$$FD = \left\{ \begin{array}{l} \{A, B\} \rightarrow C, \\ \{B, D\} \rightarrow \{E, F\}, \\ \{A, D\} \rightarrow \{G, H\}, \\ \{A\} \rightarrow \{I\} \\ \{H\} \rightarrow \{J\} \end{array} \right\}$$



Now, the Closure of $\{A, B, D\} = R$.

$\{A, B, D\}^+ = \{A, B, C, D, E, F, G, H, I\}$

$\therefore$ $\{A, B, D\}$ is the key of the given relation 'R'.

→ 2NF Normalization

A Relation Schema 'R' is in 2NF if every non-prime attribute of A in 'R' is not partially dependent on any Key of 'R'

Prime Attr. = $\{A, B, D\}$

Non-Prime Attr = $\{C, G, H, I, J\}$

The functional dependencies that are voilating 2NF and their closure are as follows :-

$\{A, B\} \rightarrow \{C\}$, $\{A, B\}^+ = \{A, B, C, I\}$

$\{B, D\} \rightarrow \{E, F\}$, $\{B, D\}^+ = \{B, D, E, F\}$

$\{A, D\} \rightarrow \{G, H\}$, $\{A, D\}^+ = \{A, D, G, H, I, J\}$

$\{A\} \rightarrow \{I\}$, $\{A\}^+ = \{A, I\}$

∴ To convert the Relation 'R' with the given FDs ~~wt~~ into 2NF-Form, we decompose the relation into the following relations :-

$R_1 = \{\underline{A}, \underline{B}, C\}$

$R_2 = \{\underline{B}, \underline{D}, E, F\}$

$R_3 = \{\underline{A}, \underline{D}, G, H, J\}$

$R_4 = \{\underline{A}, I\}$

$R_5 = \{\underline{A}, \underline{B}, \underline{D}\}$

(Underlined attributes are the key of relation).

⇒ 3NF Normalization

A Relation Schema R is in 3NF whenever atleast one of the following holds for a non-trivial fd $X \to A$ in R :

- X is super key
- A is a prime attribute

In general if the Relation is in 2NF and no non-prime attribute is transitively dependent on prime attribute then Relation is in 3NF.

here, $R_3 = \{\underline{A}, \underline{D}, G, H, J\}$ for the given FD voilates 3NF, as $\{\underline{A}, \underline{D}\} \to \{G, H\}$
& $\{H\} \to \{J\}$

transitive dependency exists (or A here is {H} which is not a prime attribute)

∴ We decompose R_3 to convert it into 3NF Form

$R_{3.1} = \{\underline{A}, \underline{D}, G, H\}$

$R_{3.2} = \{\underline{H}, J\}$

Thus, the following Relations are in 3NF for the given FD.

$R_1 = \{\underline{A}, \underline{B}, C\}$

$R_2 = \{\underline{B}, \underline{D}, E, F\}$

$R_{3.1} = \{\underline{A}, \underline{D}, G, H\}$

$R_{3.2} = \{\underline{H}, J\}$ Ans.

$R_4 = \{\underline{A}, I\}$

$R_5 = \{\underline{A}, \underline{B}, \underline{D}\}$

Ans 2. FD = { AB → C, C → A, BC → D,

ACD → B, D → E, D → G, BE → C,

CG → B, CG → D, CE → A, CE → G }

⇒ For finding the minimal cover we follow 3 steps

⇒ Step 1 :- Make the RHS of the FDs into singleton sets.

We don't need to perform this as all the FDs already have singleton set on RHS.

⇒ Step-2 :- Remove the extra attributes on LHS.

For this we will consider all the FDs that have 2 or more attributes on LHS

⇒ AB → C

$\{A\}^+ = \{A\}$

$\{B\}^+ = \{B\}$

As $\{A\}^+$ doesn't have B or C and $\{B\}^+$ doesn't have A or C, we can't remove any of them from AB → C

⇒ BC → D

$\{B\}^+ = \{B\}$

$\{C\}^+ = \{C, A\}$

As $\{B\}^+$ doesn't include C or D and $\{C\}^+$ doesn't include B or D, thus, we can't remove them from $BC \to D$

$\Rightarrow$ $BE \to C$

$\{B\}^+ = \{B\}$

$\{E\}^+ = \{E\}$

As $\{B\}^+$ doesn't include B or E and $\{E\}^+$ doesn't include B or C, ~~thus~~ we can't remove any of them from $BE \to C$

$\Rightarrow$ $CG \to B$

$\{C\}^+ = \{C, A\}$

$\{G\}^+ = \{G\}$

As $\{C\}^+$ doesn't include G or B and $\{G\}^+$ doesn't include C or B, we can't remove any of them from ~~BE~~ $CG \to B$

$\Rightarrow$ $CG \to D$

$\{C\}^+ = \{C, A\}$

$\{G\}^+ = \{G\}$

As $\{C\}^+$ doesn't include G or D and $\{G\}^+$ doesn't include C or D, we can't remove any of them from $CG \to D$

$\Rightarrow$ $CE \rightarrow A$

$\{C\}^+ = \{C, A\}$

$\{E\}^+ = \{E\}$.

As $\{C\}^+$ contains A which on the RHS of this FD, we can remove E. Thus, the FD now becomes

$[E \rightarrow A]$.

$\Rightarrow$ $CE \rightarrow G$

$\{C\}^+ = \{C, A\}$

$\{E\}^+ = \{E\}$

As $\{C\}^+$ doesn't contain E or G and $\{E\}^+$ doesn't contain C or G, we can't remove any of them from $CE \rightarrow G$

$\Rightarrow$ $ACD \rightarrow B$

$\{A\}^+ = \{A\}$

$\{C\}^+ = \{C, A\}$

$\{D\}^+ = \{D, E, G\}$

As $\{C\}^+$ contains A we can remove it from FD, $ACD \rightarrow B$, thus, our FD now becomes $[CD \rightarrow B]$.

The FD after applying step 2 are as follows

$FD = \{ AB \to C,\ C \to A,\ BC \to D,$
$CD \to B,\ D \to E,\ D \to G,$
$BE \to C,\ CG \to B,\ CG \to D,$
$CE \to G \}$

⇒ Step-3 : Removing the Redundant F.D.

⇒ $AB \to C$, finding closure assuming the FD doesn't exists

$\{A, B\}^+ \Rightarrow \{A, B\}$ needs to be included as closure doesn't have RHS.

⇒ $C \to A$, assuming FD doesn't exists

$\{C\}^+ = \{C\}$ → needs to be included as $\{C\}^+$ doesn't have RHS

⇒ $BC \to D$, assuming FD doesn't exist

$\{B, C\}^+ = \{B, C, A\}$ → needs to be included as $\{B, C\}^+$ doesn't include RHS

⇒ $CD \to B$, assuming FD doesn't exist

$\{C, D\}^+ = \{C, A, E, G, B, D\}$ → can be removed as RHS ~~is~~ exists in $\{C, D\}^+$

$\Rightarrow$ $D \rightarrow E$, assuming FD doesn't exist.

$\{D\}^+ = \{D, G\}$ $\rightarrow$ needs to be included as $\{D\}^+$ doesn't have RHS

$\Rightarrow$ $D \rightarrow G$, assuming FD doesn't exist

$\{D\}^+ = \{E\}$ $\rightarrow$ needs to be included as ~~RHS is~~ $\{D\}^+$ doesn't have RHS

$\Rightarrow$ $BE \rightarrow C$, assuming FD doesn't exist

$\{B, E\}^+ = \{B, E\}$ $\rightarrow$ needs to be included

$\Rightarrow$ $CG \rightarrow B$, assuming FD doesn't exist

$\{C, G\}^+ = \{C, G, A, D\}$ $\rightarrow$ needs to be included

$\Rightarrow$ $CG \rightarrow D$, assuming FD doesn't exist

$\{C, G\}^+ = \{C, G, A, B, D, E\}$ $\rightarrow$ can be removed as $\{CG\}^+$ contains RHS

$\Rightarrow$ $CE \rightarrow G$, assuming FD doesn't exist

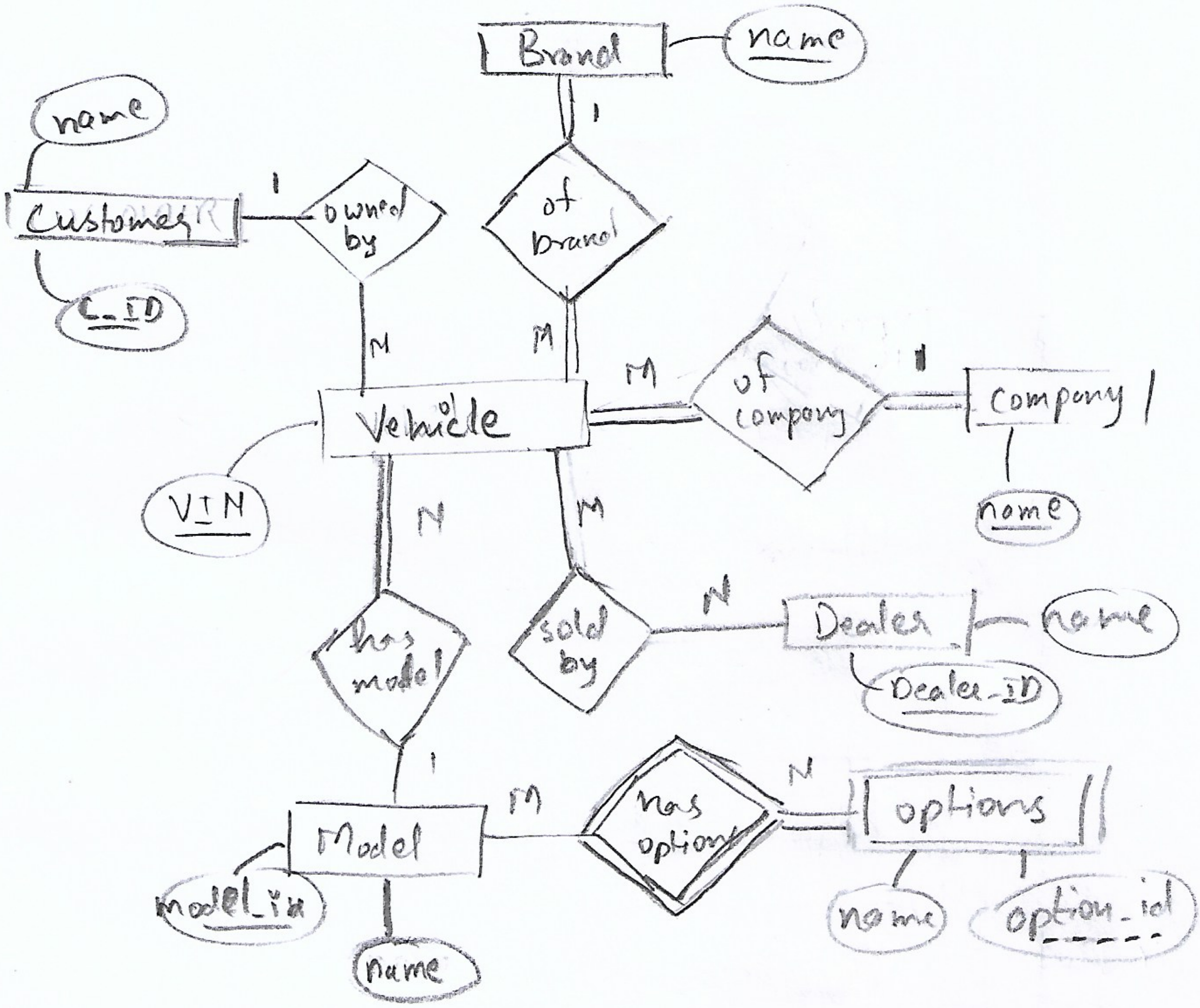
$\{C, E\} = \{C, E, A\}$ $\rightarrow$ needs to be included.

Thus after step 1, 2, 3 we ~~have~~ are left with the Functional Dependencies that are the minimal cover of the Relation.

Minimal Covers = $\{ AB \rightarrow C,\ C \rightarrow A,\ BC \rightarrow D,\ D \rightarrow E,\ D \rightarrow G,\ BE \rightarrow C,\ CG \rightarrow B,\ CE \rightarrow G \}$

Ans.

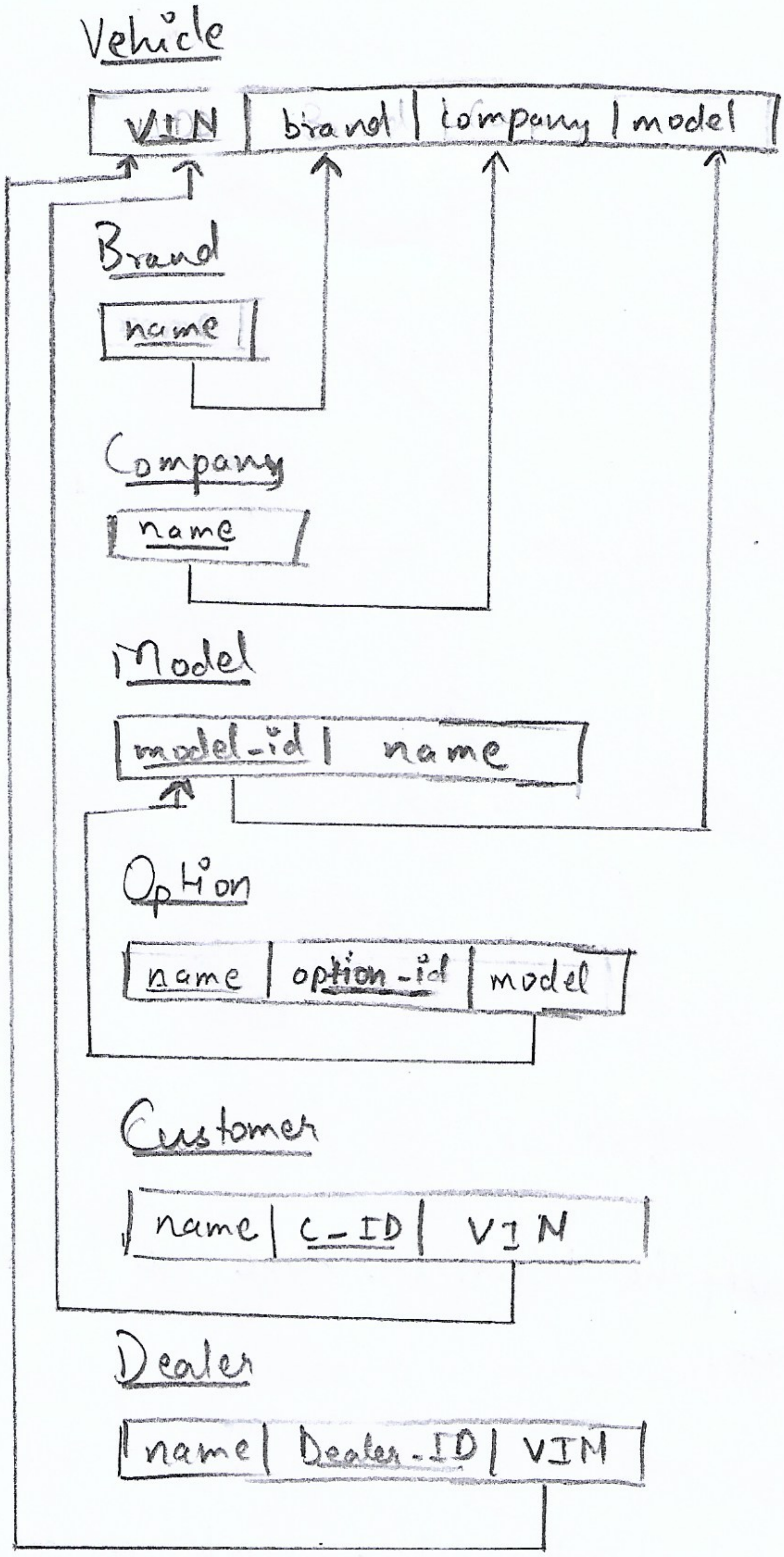
Ans 3.



=) After Reading the details we have the following ER-Digram.

Assumption

- We choose options entity as weak, as according to question a vehicle may have ~~gone or m~~ zero or more entity, hence it only exists if the model wants it to.
- Each Company, Brand will be ~~totally~~ ~~rela~~ a Vehicle Entity.
- One Vehicle is owned by One Customer.
- A Dealer can sell as many vehicles.



⇒ The ER Digram results in the above Relational Schemas, all the underlines represent Primary Key & arrows represent Foreign Keys.

Ans 4.

1. SELECT Name Of Student
FROM Student
WHERE Name of Student LIKE '_I%';

2. SELECT S.Name of Student, P. Paper Code, P. Name Of Paper
FROM (Student AS S JOIN Academic_Details AS A
ON S. College Roll Number = A. College Roll Number)
JOIN Paper_Details AS P ON P. Paper code =
A. Paper Code
WHERE A. Attendance > 75 AND A. Paper code
= "CS9" AND A. Marks (% in home examination)
≥ 60 ;

3. SELECT S.Name of Student, S.Date of Birth
FROM (Student AS S JOIN Academic_details AS A
ON S. College Roll ~~Number~~ number = A. College Roll number)
WHERE A. Marks (% in home examination) =
(SELECT MAX (Marks (% in home examination)
FROM Academic Details WHERE
Paper Code = "CS7");

4. SELECT S. Name of Student, SUM(A. Attendance),
AVG(A. Marks (% in home examination)
FROM (Student AS S JOIN Academic_details AS A
ON S. College Rollnumber = A. College Rollnumber)
GROUP BY A. College Roll number;

5. UPDATE Student
SET Phone number = "1234567899"
WHERE Name of Student = "atKash";

Ans 5.

1. $\sigma_{(\text{Name of Student LIKE '\_I\%'})}(\text{Student}$

2. $\text{Stu\_Acad} \leftarrow (\text{Student}) \bowtie_{(\text{College Roll number} = \text{College Roll number})} (\text{Academic-details})$

$\text{Stu\_Acad\_Paper} \leftarrow (\text{Stu-Acad}) \bowtie_{(\text{Paper code} = \text{Paper Code})} (\text{Paper\_Details})$

$\text{Required} \leftarrow \sigma_{(\text{Mark(\% in home examination} \geq 60) \text{ AND } (\text{Paper code} = \text{"CS9"}) \text{ AND } (\text{Attendence} > 75)} (\text{Stu-Acad-Paper})$

$\boxed{\text{Required}}$ relation is the required query.

3. $\text{CS7} \leftarrow \sigma_{(\text{Paper code} = \text{"CS7"})} (\text{Academic-details})$

$\text{Highest-CS7} \leftarrow \rho(\text{Highest\_Marks})\left(f_{\text{MAXIMUM marks(\% in home examinention)}} (\text{CS7}) \right)$

$\text{Highest\_RollNo} \leftarrow \pi_{(\text{College Roll Number})} \left((\text{CS7}) \bowtie_{(\text{Marks (\% in home examination)} = \text{Higesht-Marks})} (\text{Highest-CS7}) \right)$

$\text{Highest-Details} \leftarrow \pi_{(\text{Name of Student, Date of Birth})} \left((\text{Student}) \bowtie_{(\text{College Roll Number} = \text{College Roll Number})} (\text{Highest-RollNo}) \right)$

$\therefore$ $\boxed{\text{Highest\_Details}}$ relation is the required query.

4.

$$\text{College Roll number} \; \mathcal{G}_{(\text{SUM Attendance},\ \text{AVERAGE Marks (\% in home examination)})} (\text{Academic\_details})$$

The above query is the required relation.

5.

$$S \leftarrow \sigma_{(\text{Name of Student} = \text{'atkash'})} (\text{Student})$$

$$S' \leftarrow \sigma_{(\text{Name of Student} <> \text{'atkash'})} (\text{Student})$$

$$\text{updated\_S} \leftarrow \pi_{(\text{College Roll number, Name of Student, Date of Birth, Address, Marks (\% in home examination), Phone number} = \text{"1234567899"})} (S)$$

$$\text{Student} \leftarrow \cancel{S \cup S}'(S') \cup (\text{updated\_S})$$

Thus, now the Student Relation has the updated value of Phone number for tuple in relation 'S'!