SQL

- We write $r(ABC)$ for a relational schema with relation name $r$ and attributes (or fields) $A$, $B$, and $C$. The underlined attribute is the primary key.

Given following relational schema, write SQL queries to answer the following queries.

Relational schema of question 1.
Product(model, maker, type)
PC(model, speed, ram, hd, price)
Laptop(model, speed, ram, hd, screen, price)
Printer(model, color, type, price)
The sample data for relations of question 1. These data are not used to calculate results of following questions.

**Product:**

<table>
<thead>
<tr>
<th>model</th>
<th>maker</th>
<th>type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001</td>
<td>A</td>
<td>PC</td>
</tr>
<tr>
<td>3001</td>
<td>B</td>
<td>Printer</td>
</tr>
<tr>
<td>2001</td>
<td>C</td>
<td>laptop</td>
</tr>
</tbody>
</table>

**PC:**

<table>
<thead>
<tr>
<th>model</th>
<th>speed</th>
<th>ram</th>
<th>hd</th>
<th>price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001</td>
<td>2.66</td>
<td>1024</td>
<td>250</td>
<td>2114</td>
</tr>
<tr>
<td>1002</td>
<td>1.42</td>
<td>512</td>
<td>250</td>
<td>955</td>
</tr>
<tr>
<td>1003</td>
<td>3.20</td>
<td>2048</td>
<td>160</td>
<td>1049</td>
</tr>
</tbody>
</table>

**Laptop:**

<table>
<thead>
<tr>
<th>model</th>
<th>speed</th>
<th>ram</th>
<th>hd</th>
<th>screen</th>
<th>price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>2.00</td>
<td>1024</td>
<td>250</td>
<td>15</td>
<td>2114</td>
</tr>
<tr>
<td>2002</td>
<td>1.73</td>
<td>512</td>
<td>80</td>
<td>24</td>
<td>955</td>
</tr>
<tr>
<td>2003</td>
<td>1.83</td>
<td>2048</td>
<td>60</td>
<td>20</td>
<td>1049</td>
</tr>
</tbody>
</table>

**Printer:**

<table>
<thead>
<tr>
<th>model</th>
<th>color</th>
<th>type</th>
<th>price</th>
</tr>
</thead>
<tbody>
<tr>
<td>3001</td>
<td>true</td>
<td>ink-jet</td>
<td>99</td>
</tr>
<tr>
<td>3002</td>
<td>false</td>
<td>laser</td>
<td>239</td>
</tr>
<tr>
<td>3003</td>
<td>true</td>
<td>laser</td>
<td>899</td>
</tr>
</tbody>
</table>
1. What PC models have a speed of at least 3.00?
   
   ```sql
   select model
   from PC
   where PC.speed >= 3.00
   ```

2. Find the model numbers of all color laser printers.
   
   ```sql
   select model
   from Printer
   where type='lazer' and color='true'
   ```

3. Which manufacturers make laptops with a hard disk of at least 100GB?
   
   ```sql
   select DISTINCT P.maker
   from Product P, Laptop L
   where P.model = L.model and L.hd >= 100
   ```

4. Find the model number and price of all products (of any type) made by manufacturer B.
   
   ```sql
   select PC.model, PC.price
   from Product P, PC
   where P.maker='B' and P.model = PC.model
   union
   select L.model, L.price
   from Product P, Laptop L
   where P.maker='B' and P.model = L.model
   union
   select PR.model, PR.price
   from Product P, Printer PR
   where P.maker='B' and P.model = PR.model
   ```

5. Find those manufacturers that sell Laptops, but not PC’s.
   
   ```sql
   select DISTINCT maker
   from product P
   where P.type='Laptop'
   EXCEPT
   select DISTINCT maker
   from product P
   where P.type='PC'
   ```

6. Find those manufacturers that sell all models of PCs and lazer Printers.
   
   ```sql
   select DISTINCT P.maker
   ```
from product P
where not exists(( select PC.model
    from PC)
EXCEPT
(select P1.model
    from Product P1
    where P1.maker=P.maker and P1.type='PC'))
INTERSECT
select DISTINCT P.maker
from product P
where not exists(( select Pr.model
    from Printer Pr)
EXCEPT
(select P2.model
    from Product P2, Printer Pr
    where Pr.model = P2.model and P2.maker=P.maker
    and Pr.type='lazer'))

7. Find those manufacturers whose laptops have all ram sizes that manufacturer B’s laptops have.

select DISTINCT P.maker
from Product P
where not exists(( select Lp.ram
    from Laptop Lp, Product P1
    where Lp.model = P1.model and P1.maker = 'B')
EXCEPT
(select Lp1.ram
    from Laptop Lp1, Product P2
    where Lp1.model = P2.model and P2.maker=P.maker))

8. Find those manufacturers of at least two different computers (PC’s or laptops) with speeds of at least 2.80.

select DISTINCT P.maker
from Product P, Product P1,
where P.maker = P1.maker
and P.model in (select PC.model
    from PC
    where PC.speed > 2.80
UNION
select LP.model
from Laptop LP
where Lp.speed > 2.80
)
and P1.model in (select PC.model
from PC
where PC.speed > 2.80
UNION
select LP.model
from Laptop LP
where Lp.speed > 2.80)
and P.model <> P1.model

9. Find the manufacturers of PC’s with at least two different speeds.
   select DISTINCT P.maker
   from Product P, Product P1
   where P.maker=P1.maker
   and exists(
       select PC.model
       from PC, PC PC1
       where PC.model <>PC1.model
       and PC.speed <> PC1.speed
       and PC.model = P.model
       and PC1.model = P1.model
   )

10. Find the manufacturers who sell exactly two different models of PC.
    select DISTINCT P.maker
    from Product P, Product P1
    where P.maker=P1.maker and
    exists ( 
        select PC1.model
        from PC PC1, PC PC2
        where PC1.model <> PC2.model
        and PC1.model=P.model and PC2.model=P1.model
    )
    )
    EXCEPT
    select DISTINCT P.maker
    from Product P, Product P1, Product P2
    where P.maker=P1.maker and P1.maker=P2.maker
exists (  
    select PC1.model  
    from PC PC1, PC PC2, PC PC3  
    where PC1.model <> PC2.model  
    and PC1.model <> PC3.model  
    and PC2.model <> PC3.model  
    and PC1.model = P.model  
    and PC2.model = P1.model  
    and PC3.model = P2.model  
    )

11. Find those pairs of PC models that have both the same speed and RAM. A pair should be listed only once; e.g., list (i, j) but not (j, i).  
    *Hint: The model numbers can be compared.*  
    select P1.model, P2.model  
    from PC P1, PC P2  
    where P1.model < P2.model and P1.speed = P2.speed  
    and P1.ram = P2.ram

12. Find the manufacturer(s) of the computer (PC or laptop) with the highest available speed.  
    *Hint: the highest speed means that it is not smaller than any other speeds. If you can find all the speeds which are smaller than some speed, you can solve this problem.*  
    select DISTINCT P.maker  
    from Product P  
    where P.model in (  
        select Computer.model  
        from (select PC.model, PC.speed  
               from PC  
               UNION  
               select LP.model, LP.speed  
               from Laptop LP  
         ) AS Computer  
        where Computer.speed = (  
        select MAX(Computer1.speed)  
        from (SELECT PC1.model, PC1.speed  
              FROM PC PC1  
              UNION  
              SELECT Lp1.model, Lp1.speed  
        ) AS Computer1  
    )  
)  

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FROM Laptop Lp1) AS Computer1)}
)