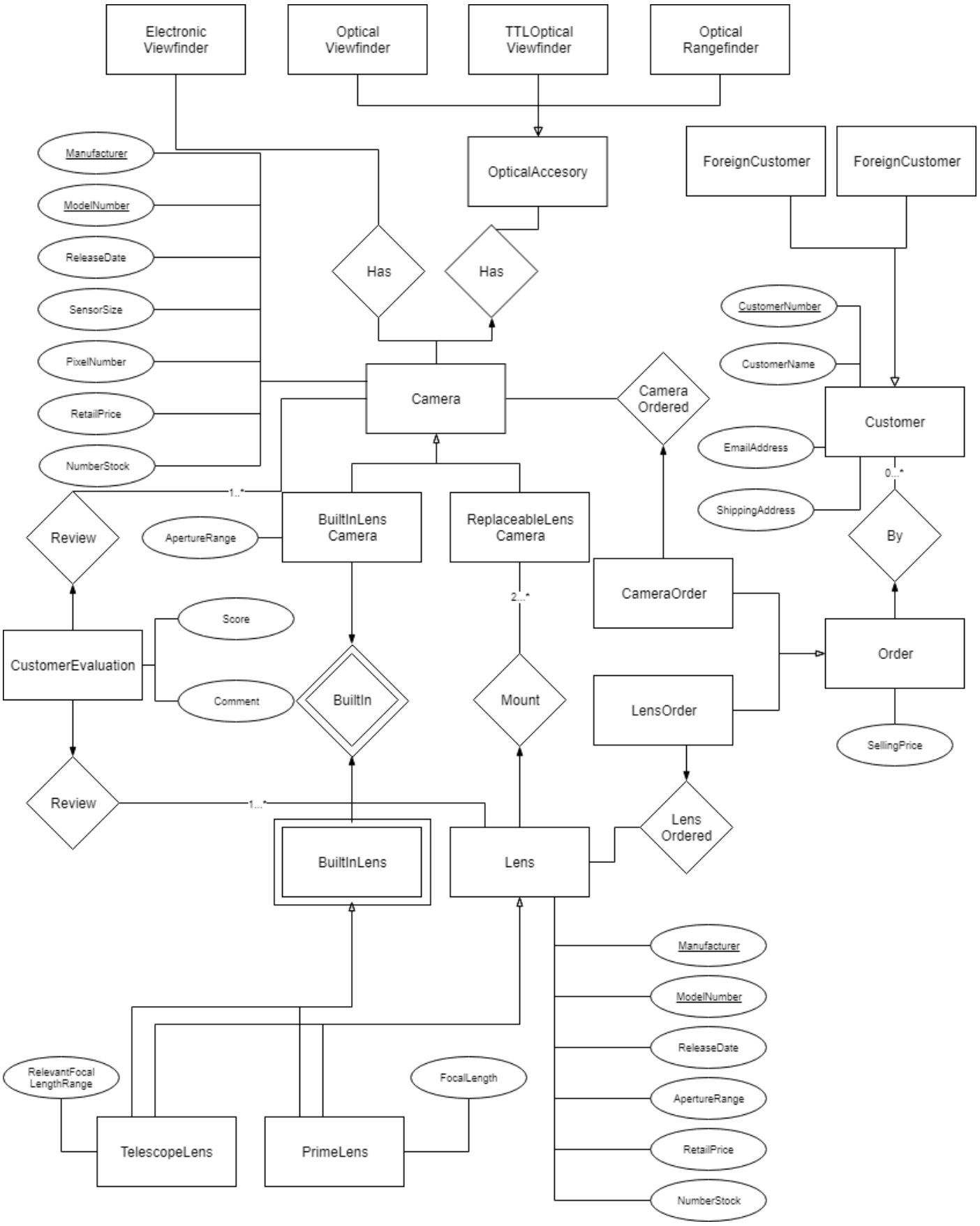
Question 1


Electronic Viewfinder
Optical Viewfinder
TTLOptical Viewfinder
Optical Rangefinder
OpticalAccesory
ForeignCustomer
ForeignCustomer
Manufacturer
ModelNumber
ReleaseDate
SensorSize
PixelNumber
RetailPrice
NumberStock
Has
Has
Camera
Camera Ordered
CustomerNumber
CustomerName
Customer
EmailAddress
ShippingAddress
0...*
By
1..*
Review
ApertureRange
BuiltInLens Camera
ReplaceableLens Camera
CameraOrder
Order
Score
Comment
CustomerEvaluation
BuiltIn
Mount
LensOrder
SellingPrice
2...*
Review
1...*
BuiltInLens
Lens
Lens Ordered
Manufacturer
ModelNumber
ReleaseDate
ApertureRange
RetailPrice
NumberStock
RelevantFocal LengthRange
FocalLength
TelescopeLens
PrimeLens

Question 2

```
create table Camera (
    Manufacturer    varchar(30) not null,
    ModelNumber     integer not null,
    ReleaseDate     date not null,
    SensorSize      integer not null,
    PixelNumber     integer not null,
    RetailPrice     float not null
    NumberStock     integer not null,
    primary key ( Manufacturer, ModelNumber )
    foreign key ( Manufacturer, ModelNumber )
        references Camera ( Manufacturer, ModelNumber )
)

create table ElectronicViewfinder (
    Manufacturer    varchar(30) not null,
    ModelNumber     integer not null,
    foreign key ( Manufacturer, ModelNumber )
        references Camera ( Manufacturer, ModelNumber )
)

create table OpticalViewfinder (
    Manufacturer    varchar(30) not null,
    ModelNumber     integer not null,
    foreign key ( Manufacturer, ModelNumber )
        references Camera ( Manufacturer, ModelNumber )
)

create table TTLOpticalViewfinder (
    Manufacturer    varchar(30) not null,
    ModelNumber     integer not null,
    foreign key ( Manufacturer, ModelNumber )
        references Camera ( Manufacturer, ModelNumber )
)

create table OpticalRangefinder (
    Manufacturer    varchar(30) not null,
    ModelNumber     integer not null,
    foreign key ( Manufacturer, ModelNumber )
        references Camera ( Manufacturer, ModelNumber )
)

create table Lens (
    Manufacturer    varchar(30) not null,
    ModelNumber     integer not null,
    ReleaseDate     date not null,
    ApertureRange   integer not null,
    RetailPrice     float not null
    NumberStock     integer not null,
```

```
    primary key ( Manufacturer, ModelNumber )
)

create table BuiltInCamera (
    Manufacturer    varchar(30) not null,
    ModelNumber     integer not null,
    ApertureRange   float not null,
    primary key ( Manufacturer, ModelNumber ),
    foreign key ( Manufacturer, ModelNumber )
        references Camera ( Manufacturer, ModelNumber )
)

create table ReplaceableLensCamera (
    CameraManufacturer  varchar(30) not null,
    CameraModelNumber   integer not null,
    LensManufacturer    varchar(30) not null,
    LensModelNumber     integer not null,
    primary key ( CameraManufacturer, CameraModelNumber, LensManufacturer, LensModelNumber ),
    foreign key ( CameraManufacturer, CameraModelNumber )
        references Camera ( Manufacturer, ModelNumber ),
    foreign key ( LensManufacturer, LensModelNumber )
        references Lens ( Manufacturer, ModelNumber )
)


create table TelescopeLens (
    Manufacturer            varchar(30) not null,
    ModelNumber             integer not null,
    RelevantFoalLengthRange float not null,
    foreign key ( Manufacturer, ModelNumber )
        references Lens ( Manufacturer, ModelNumber )
)

create table PrimeLens (
    Manufacturer     varchar(30) not null,
    ModelNumber      integer not null,
    FocalLength      float not null,
    foreign key ( Manufacturer, ModelNumber )
        references Lens ( Manufacturer, ModelNumber )
)

create table Customer (
    CustomerNumber      integer not null,
    CustomerName        varchar(50) not null,
    EmailAddress        varchar(50) not null,
    ShippingAddress     varchar(70) not null,
    primary key ( CustomerNumber )
)

create table DomesticCustomer (
```

```
    CustomerNumber      integer not null,
    primary key ( CustomerNumber ),
    foreign key ( CustomerNumber )
        references Customer ( CustomerNumber )
)

create table ForeignCustomer (
    CustomerNumber      integer not null,
    primary key ( CustomerNumber ),
    foreign key ( CustomerNumber )
        references Customer ( CustomerNumber )
)

create table Order (
    CustomerNumber  integer not null,
    SellingPrice    float not null
    primary key ( CustomerNumber ),
    foreign key ( CustomerNumber )
        references Customer ( CustomerNumber )
)

create table CameraOrder (
    CustomerNumber      integer not null,
    CameraManufacturer  varchar(30) not null,
    CameraModelNumber   integer not null,
    primary key ( CustomerNumber, CameraManufacturer, CameraModelNumber ),
    foreign key ( CustomerNumber )
        references Customer ( CustomerNumber ),
    foreign key ( CameraManufacturer, CameraModelNumber )
        references Customer ( Manufacturer, ModelNumber )
)

create table LensOrder (
    CustomerNumber      integer not null,
    LensManufacturer  varchar(30) not null,
    LensModelNumber   integer not null,
    primary key ( CustomerNumber, LensManufacturer, LensModelNumber ),
    foreign key ( CustomerNumber )
        references Customer ( CustomerNumber ),
    foreign key ( LensManufacturer, LensModelNumber )
        references Lens ( Manufacturer, ModelNumber )
)

create table CameraCustomerEvaluation (
    Score               integer not null,
    Comment             varchar(200) not null,
    CameraManufacturer  varchar(30) not null,
    CameraModelNumber   integer not null,
    primary key ( CameraManufacturer, CameraModelNumber ),
    foreign key ( CameraManufacturer, CameraModelNumber )
```

```
        references Camera ( Manufacturer, ModelNumber )
)

create table LensCustomerEvaluation (
    Score               integer not null,
    Comment             varchar(200) not null,
    LensManufacturer  varchar(30) not null,
    LensModelNumber   integer not null,
    primary key ( LensManufacturer, LensModelNumber ),
    foreign key ( LensManufacturer, LensModelNumber )
        references Lens ( Manufacturer, ModelNumber )
)
```

Q2

2.

i. $\Pi_{PrimeLens.Manufacturer,\ PrimeLens.ModelNumber}(Camera \bowtie ReplaceableLens(Camera \bowtie PrimeLens))$

ii. Let a set A_1 = PrimeLens ⋈ Lens and,

A_2 = PrimeLens ⋈ Lens.

$\sigma_{A_1.RetailPrice > A_2.RetailPrice \wedge A_1.FocalLength = A_2.FocalLength \wedge A_1.ApertureRange < A_2.ApertureRange}(A_1 \bowtie A_2)$

Q3

1. $F^+ = \{ABC \to D, D \to A, ABC \to A\}$

⇒ ABC is the candidate key

and this is in 3NF since $D \to A$ violates BCNF.

2. $F^+ = \{A \to B, BC \to D, A \to C, A \to D\}$

⇒ A is the candidate key

and this is in 1N.F since $BC \to D$ violate 3NF

3. $F^+ = \{AB \to C, AB \to D, C \to A, D \to B, AB \to ABCD\}$

⇒ AB is the candidate key

and this is in 3NF since $C \to A$, $D \to B$ violate BCNF.