[10 points] Complete the following sentences using the best choices given in the table below (each correctly filled entry is worth 2 points). No entry in the table is to be used more than once in filling the blanks. There may exist more than one possible answer for some of the blanks.

class(es)	abstract	attribute(s)	state(s)
operations	changeability	single inheritance	multiplicity
stereotype	subclass(es)	interface(s)	Superclass(es)

(a) Attributes of classes can have _______________.
(b) Parameters for _____________ have directions.
(c) Assigning _______________to an operation of a class cannot affect its modularity.
(d) Values of _______________ in a class are used as state values for developing state machines.
(e) _______________ may have overlapping relationship.

[4 points] Determine ways in which modularity of any class can be achieved (complete the table below by placing **X** in either True or False column in each row). Answers must be clearly marked in the table.

	True	False
Scope of attributes		
Cardinality of attributes		
Scopes assigned to methods		
Visibility for attributes		

[4 points] Consider the Abstract and Interface classifiers

(a) [2 points] The Interface and Abstract classifiers can be used interchangeably.
___________ True; ___________ False

(b) [2 points] Justify your answer.

[4 points] Constraints and stereotypes can be used to design class diagrams. Can stereotype be used instead of constraint. Place **X** next to one of the choices below.

(a) [2 points] ___________ True; ___________ False

(b) [2 points] Provide a brief justification.

[4 points] Consider a state machine that has a simple state and an advanced state. In one transition, the simple state is the source and the advanced state is the target. There is another transition in the reverse direction. Do these transitions have the same semantics. Place **X** next to one of the choices below.
(a) [2 points] ___________ True; ___________ False
(b) [2 points] Justify your answer.

[6 points] Consider the following specifying UML classes.

```
[<<stereotype>>] [visibility] name ([parameter-list])
[: returntype] [{property-string}]
```

(a) [2 point] Consider the above. Which part of a UML class can it be used for?______________

(b) [2 points] Given a method and an attribute of a class, can the method with *protected* visibility constrain the *public* visibility of the attribute? Place **X** next to one of the choices below.
__________ Yes; __________ No

(c) [2 points] Justify your answer.

[6 points] Consider a concrete class **`G`** for an abstract class **`K`**. The abstract class has a superclass **`P`**. As applicable, assign leaf and root designations to these classifiers. Show your answer as a UML class diagram.

[30 points] Consider a basic software that can move files from one device to another device. This can be called File Transfer software. The sizes of the files can be small, medium, and large. Files can have readable and writable or only readable. When the number of files reaches a threshold value **high**, half of them are automatically moved from device **AA** to the device **BB**. A user can add files to the device **AA**. Th user may also transfer any number of the files.

(a) [10 points] Develop a use-case diagram for the above system. A use-case diagram generally has actors, use-cases, and different kinds of relationships. Be sure to provide descriptions for the actors and use-cases.

(b) [4 points] Determine a classification technique that is best suitable for creating an abstraction for the files stored in the file system. Justify your choice of the classification technique.

(c) [12 pts] Develop a class for the part of the software that can automatically transfer files from one device to another. Provide details including brief descriptions for the class attributes and methods.

(d) [4 points] Define one pre-condition and one post-conditions for the user transferring files (moving files from device **AA** to device **BB**).

[12 points] Consider many types of sensors. One type can measure the inside temperatures of vehicles. One kind measures in 5-minute intervals. Another kind measures the temperatures at 1-minute intervals and calculates an average measurement of over a 5-minute interval.

(a) [8 points] Develop an advanced structural UML specification for the sensors. Use the Generalization set method to define relationships among classifiers.

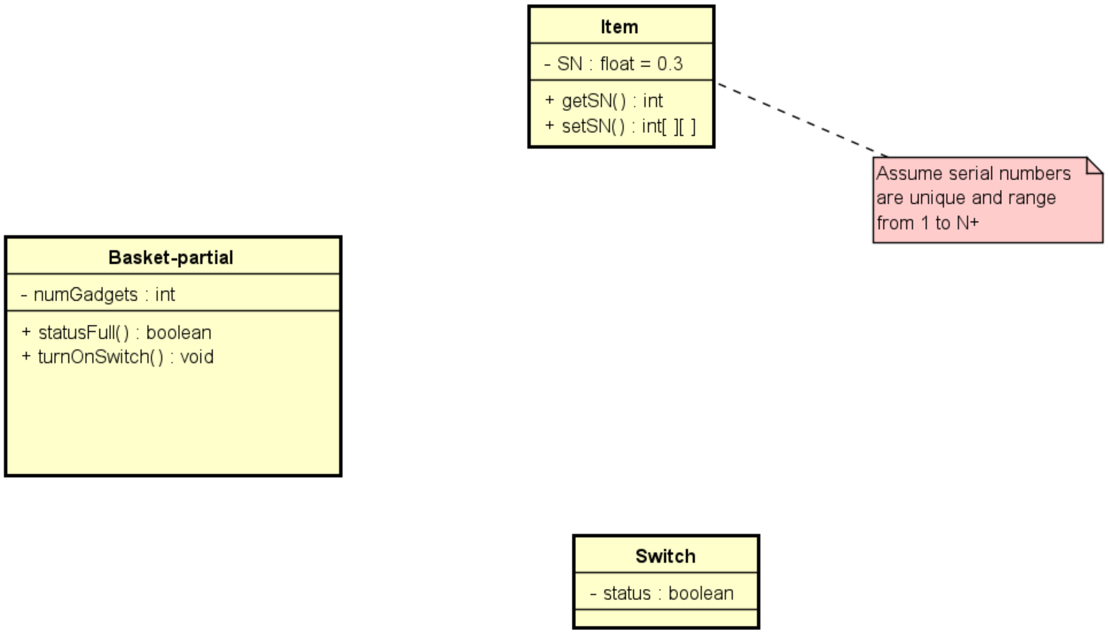
(b) [4 points] Redesign the specification from part (a) such that the specific ways these sensors work *are hidden* from any other class that uses them.

[20 points] Consider a shopping basket with a finite capacity for a company selling health-care products such as vitamins, soap, and hand sanitizer. The shopping basket has a switch that turns on when its number of items exceeds a threshold value equal to **Max**, a finite natural number. Assume items can only be added to the shopping basket. Otherwise, the switch is off. Consider the partial class diagram provided below. **NOTE:** not all elements in the class diagram are necessarily correct or complete. Certain elements may also be poorly designed. For example, should all methods have public visibility? Should some methods have arguments (parameters)?

(a) [4 point] Specify a UML class named **`Switch`** for the switch. Include an attribute named **`status`** and specify a suitable initial value for it.

(b) [6 points] Specify a UML class called **`Item`** for items. The elements of the class should have details.

(c) [6 points] Complete the specification for the **`Basket-partial`** class by adding attributes and methods that can satisfy the above problem description. The default setting for the given attributes and methods should be examined and changed for the design to have high quality.



(d) [4 [points] Define suitable relationship specifications for the classes given in the partial class diagram below. Each relationship specification must have details necessary for the design to have high quality.