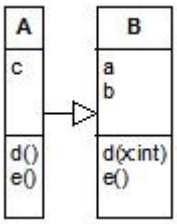
Exercises for Lecture 2
Object concepts

Question 1

Study the following diagram and answer the questions below it.



a. Is A a generalization or a specialization of B?
b. Which operations in B are overridden in A?
c. Which operations in B are overloaded in A?
d. As far as we can tell from the diagram, what instance variables does an object of class A contain?

Question 2

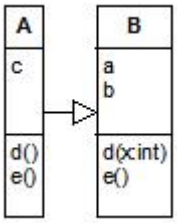
Study the following UML operation declaration and answer the questions that follow it.

```
+ computeSum(x : int, y: int) : int
```

a. What is the selector of this operation?
b. What are the names of the arguments of this operation?
c. What is the return type of this operation?
d. What is the visibility of this operation?

Question 3

Study the following UML diagram.



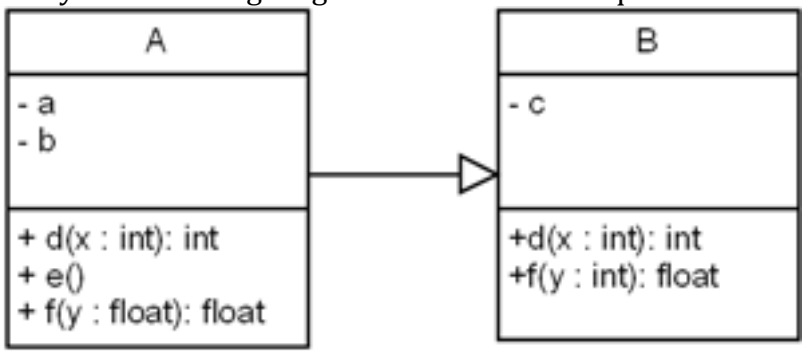
Which of the following statements are true? (There may be more than one true statement.)

a. A is a superclass of B
b. A is a specialization of B
c. A contains only one attribute which is c.
d. B contains three attributes: a, b and c.
e. The operation e() in B is overridden in class A.

f. The operation d(x:int) in B is overloaded in class A.
g. Class A contains at least three attributes: a, b and c.
h. The operation d(x:int) in B is overridden in class A.
i. The operation e() in B is overloaded in class A.
j. Attributes a and b are inherited by class A.

Question 4

Study the following diagram and answer the questions below it.



a. Is A a subclass or a superclass of B?
b. Which operations in B are overridden in A?
c. Which operations in B are overloaded in A?
d. Is variable c visible in objects of class A?

Question 5

Explain, with examples, what is meant by the term *object* in software engineering? Suppose *A* and *B* are objects and that the following line of code occurs in the definition of the class *A*:
B.msg();
This line of code instructs one object to send a message to another one. State what the message is and which objects send and receive it.

Question 6

Define what is meant by the term *object* in software engineering. Suppose *A* and *B* are objects and that the following line of code occurs in the definition of the class *B*:
A.msg();
This line of code instructs one object to send a message to another one. Write down

(a) the message that is sent,
(b) the object that sends the message and
(c) the object that receives the message.

Question 7

Suppose there exists an object called myClock of type Clock and this object understands the following two messages:

readTime(s : String): Time
readTime(f : File): Time

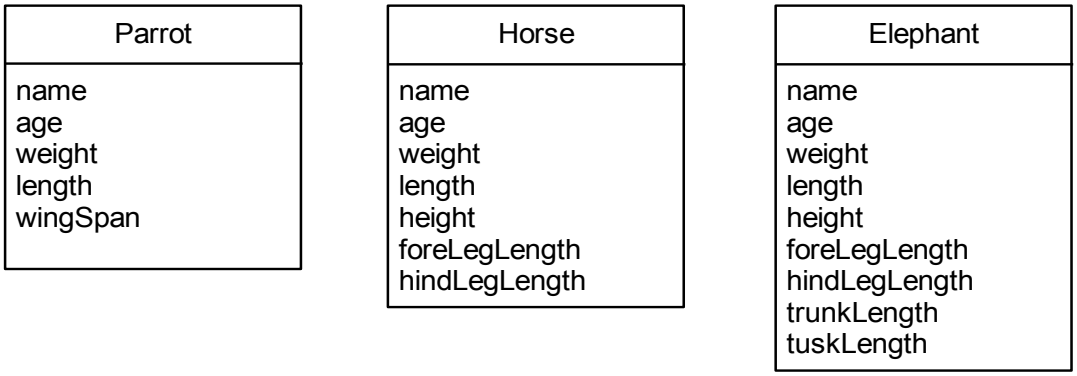
a. Do these two messages have the same signature?
b. Do these two messages have the same selector?
c. Is this an example of "method overloading" or "method overriding"?
d. What is the return type of the first message?
e. What is the argument of the second message?

Question 8

Grady Booch defined an object to be a "thing that has behaviour, state and identity". Explain what the terms *thing*, *behaviour*, *state* and *identity* mean in this context.

Question 9

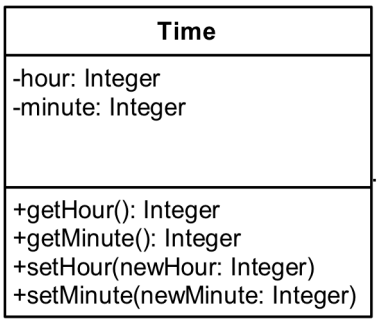
The following UML class diagram shows three classes. Use inheritance to refactor the three classes so that each attribute is defined in exactly one place. Represent the refactored structure using a UML class diagram.



Question 10

a. Explain the difference between an object's *private* and *public interface*. (2 marks)

b. The following UML class diagram describes a class called Time. Study the diagram and answer the questions that follow it.



i. How many private attributes does the Time class have? (1 mark)

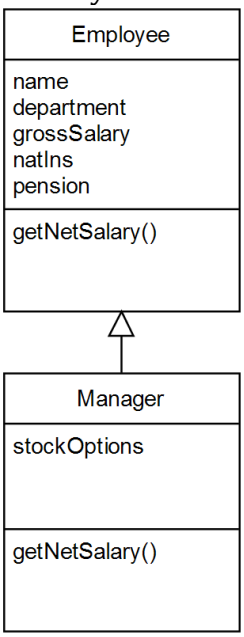
ii. How many public attributes does the Time class have? (1 mark)

iii. What is the selector of the setMinute operation? (1 mark)

iv. What is the visibility of the getMinute operation? (1 mark)

v. What is the signature of the setHour operation? (1 mark)

c. Study the following UML class diagram and answer the questions that follow it.



i. How many attributes does a Manager object have (assuming the diagram shows all of them)? (1 mark)

ii. In the Manager class, is the getNetSalary operation *overloaded* or *overridden*? (1 mark)

iii. Is Manager a subclass or a superclass of Employee? (1 mark)

Question 11

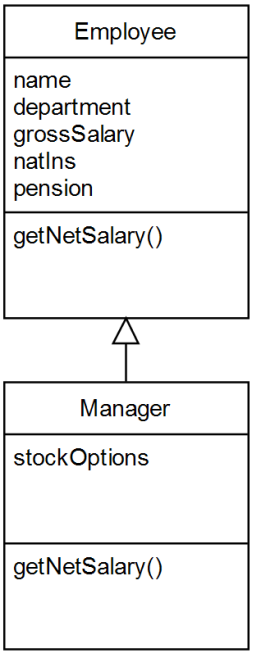
Define each of the following terms as used in the context of object-oriented software engineering and give an example of each.

i. method selector
ii. method signature
iii. member visibility
iv. public interface
v. inheritance

[2 marks each]

Question 12

a. Suppose the following method has been defined in UML:
– calcX(y : int) : float
Write down the *signature,* the *selector,* the *return type*, the *visibility* and the *parameter* of the calcX method. [5 marks]
b. Consider the following UML diagram and answer the questions that follow it.



i. Is Employee a superclass or a subclass of Manager? [1 mark]
ii. Which one of the following statements is true:

1. The Employee class's getNetSalary() method is overridden in the Manager class.
2. The Manager class's getNetSalary() method is overridden in the Employee class.
3. The Employee class's getNetSalary() method is overloaded in the Manager class.
4. The Manager class's getNetSalary() method is overloded in the Employee class.

[2 marks]
c. Does inheritance increase or decrease coupling? Explain your answer.
[2 marks]

Question 13

Which **ONE** of the following is a benefit of keeping instance variables private?

A. It makes code more reusable.
B. It makes the interface of a class less dependent on its implementation.
C. It makes code run faster.
D. It means you have to write less code.

Question 14

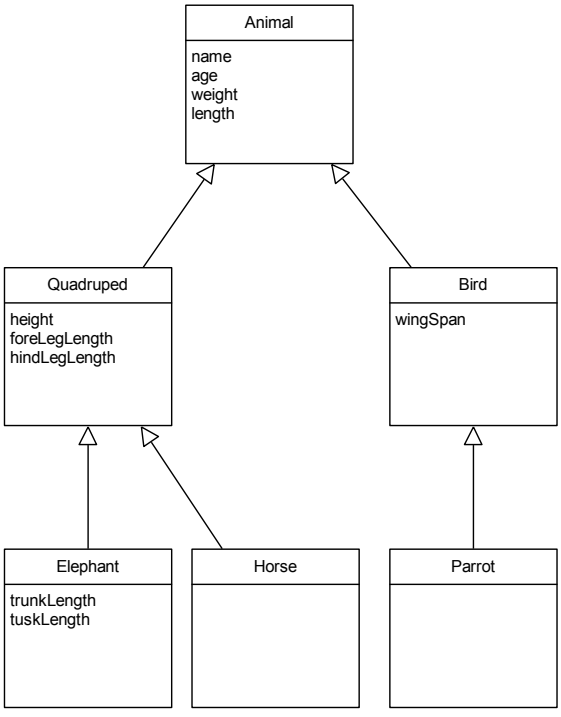
Study the following Java method definition and answer the questions that follow it.

```
public int multiply(int x, int y) {
    return x*y;
}
```

a) What is the selector of this method?
b) What is the return type of this method?
c) What are the arguments of this method and what are their types?
d) What is the signature of this method?
e) What is the visibility of this method?

Question 15

Study the diagram below and answer the questions that follow it.



a) What kind of UML diagram is this?
b) What is the superclass of Parrot?
c) What are the subclasses of Quadruped?
d) What attributes does a Horse object possess?
e) According to the diagram, is a Parrot a Quadruped?

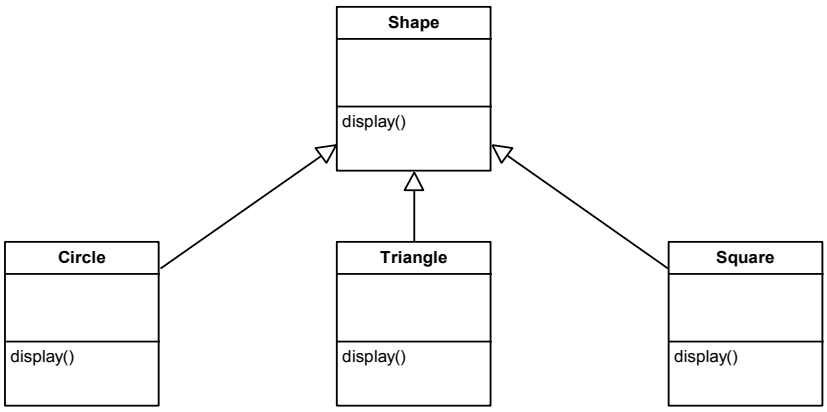
Question 16

Which of the following statements are true? (At least one of the statements is true.)

A. A module's public interface is a superset of its private interface.
B. A module's public interface is a subset of its private interface.
C. The interface of a module encapsulates the module and hides implementational details that users don't need to know about.
D. A module encapsulates its interface and exposes only those parts of its functionality that users need to be aware of.

Question 17

Study the following diagram and answer the question below it.

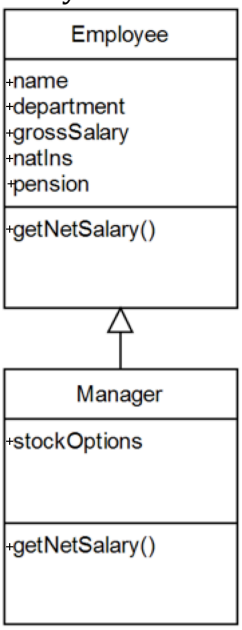


Which of the following statements are true about this diagram? (At least one of the statements is true.)

A. Triangle is a subclass of Shape and Triangle's display method overrides the display method in Shape.
B. Square is a superclass of Shape and Square's display attribute overloads the display attribute in Shape.
C. Circle is a subclass of Shape and Circle's display method overloads the display method in Shape.
D. A variable whose type is Shape can be used to refer to a Circle.

Question 18

Study the following diagram and answer the question below it.



Which of the following statements are true about this diagram? (At least one of the statements is true.)

A. Employee is a subclass of Manager, Employee's getNetSalary method overloads Manager's getNetSalary method and Employee inherits the stockOptions attribute from Manager.
B. Manager is a subclass of Employee, Manager's getNetSalary method overrides the getNetSalary method defined in Employee and the Manager class inherits the department attribute.
C. Employee is a superclass of Manager, Manager inherits the stockOptions attribute from Employee and Employee's getNetSalary method overrides Manager's getNetSalary method.
D. Manager is a subclass of Employee, Manager's getNetSalary attribute overloads Employee's getNetSalary attribute and Manager inherits the grossSalary method from Employee.

Question 19

An object has been defined to be "a thing that has behavior, state and identity" (Booch, 1991). In this definition, explain what is meant by the terms *thing*, *behavior*, *state* and *identity*.

Question 20

Which of the following statements are true? (At least one of the statements is true.)

A. If we want to send the message *msg()* from object *a* to object *b*, then we write *a.msg()* in the definition of the class of object *b*.
B. If *p* is a variable that refers to an object of class *x*, then *p* may refer to any object from any subclass of *x*.
C. If a method in a class has the same signature as a method defined in that class' superclass, then this is an example of method overriding.
D. If *A* is a subclass of *B*, then private instance variables defined in *B* are visible inside *A.*