# SENG 301 Software Analysis and Design

*Fall 2016 Midterm Examination*

Instructor: Dr. Rob Walker

Time allowed: 75 minutes.

## EXAMINATION RULES

(1) Students late in arriving will not normally be admitted after one-half hour of the examination time has passed.
(2) No candidate will be permitted to leave the examination room until one-half hour has elapsed after the opening of the examination, nor during the last 15 minutes of the examination. All candidates remaining during the last 15 minutes of the examination period must remain at their desks until their papers have been collected by an invigilator.
(3) All inquiries and requests must be addressed to supervisors only.
(4) **Candidates are strictly cautioned against:**

(a) speaking to other candidates or communicating with them under any circumstances whatsoever;
(b) bringing into the examination room any textbook, notebook or memoranda not authorized by the examiner;
(c) making use of calculators and/or portable computing machines not authorized by the instructor;
(d) leaving answer papers exposed to view;
(e) attempting to read other students' examination papers.

The penalty for violation of these rules is suspension or expulsion or such other penalty as may be determined.
(5) Candidates are requested to write on both sides of the page, unless the examiner has asked that the left hand page be reserved for rough drafts or calculations.
(6) Discarded matter is to be struck out and not removed by mutilation of the examination answer book.
(7) Candidates are cautioned against writing in their answer book any matter extraneous to the actual answering of the question set.
(8) The candidate is to write his/her name on each answer book as directed and is to number each book.
(9) A candidate must report to a supervisor before leaving the examination room.
(10) Answer books must be handed to the supervisor-in-charge promptly when the signal is given. Failure to comply with this regulation will be cause for rejection of an answer paper.
(11) If during the course of an examination a student becomes ill or receives word of a domestic affliction, the student should report at once to the supervisor, hand in the unfinished paper and request that it be cancelled. If physical and/or emotional ill health is the cause, the student must report at once to a physical/counsellor so that subsequent application for a deferred examination is supported by a completed Physician/Counsellor Statement form. Students can consult professionals at University Health Services or University Counselling Services during normal working hours or consult their physician/counsellor in the community.
**Should a student write an examination, hand in the paper for marking, and later report extenuating circumstances to support a request for cancellation of the paper and for another examination, such a request will be denied.**
(12) Smoking during examinations is strictly prohibited.

~~There are 18 pages on which are 53 multiple choice questions.~~ ***[THIS WAS TRUE ON THE REAL EXAM. MY COMMENTS HAVE MESSED THIS UP NOW.]*** Pick the best answer for each.

Your name: _____

Your student number: _____

"Questions" 1 through 3 are used to identify which kind of exam you have. Enter exactly the following information.

1. Mark the following letter: **X**
2. Mark the following letter: **X**
3. Mark the following letter: **X**

***GREEN highlighting indicates the answer(s) for full marks [1]. YELLOW highlighting is close-but-not-quite [0.75]. RED highlighting is half marks [0.5]. All other answers are worth 0.***

4. Which of the following is the LEAST reasonable, potential way to represent a software model?
   a) UML state machine diagram
   b) source code
   c) a single rectangle *BECAUSE IT SAYS NOTHING; ALL THE OTHERS CAN REPRESENT A MODEL, INCLUDING THE SOURCE CODE*
   d) documentation
   e) PDF

5. Which of the following would be the LEAST reasonable, potential audience for a structural diagram?
   a) another developer
   b) a member of the general public *BECAUSE THEY CANNOT APPRECIATE THE POINT OF IT; ALL THE OTHERS ARE TECHNICAL PEOPLE*
   c) a technical manager
   d) team lead
   e) a member of the Quality Assurance team

6. Imagine a job situation. You are asked to document part of a system by drawing a set of detailed, structural diagrams. In which of the following situations does this make the LEAST sense.
   a) the system is being debugged
   b) the system will be having minor functionality added to it
   c) the system is undergoing initial development *BECAUSE THE SYSTEM IS GOING TO CHANGE A LOT SO IT IS TOO EARLY TO DRAW THESE KINDS OF DIAGRAMS; THE MANAGER MAY NOT BE THE INTENDED AUDIENCE; MINOR CHANGES WILL NOT AFFECT THESE DIAGRAMS MUCH*
   d) someone else needs to port the system to a different environment
   e) your manager is non-technical

7. Consider a model with certain properties. For which of the following properties would that model be a BAD model.
   a) It is complex
   b) It has no specific purpose *BECAUSE WITHOUT A PURPOSE THERE IS NO WAY TO JUDGE WHETHER IT MEETS NEEDS OR NOT*
   c) It accurately represents the reality
   d) It is physically plausible
   e) It uses language familiar to the target audience

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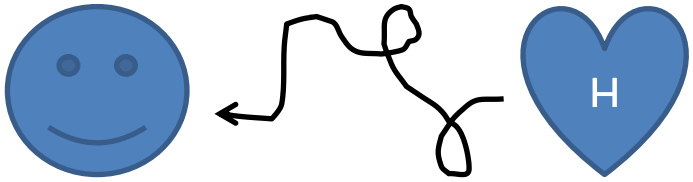
Consider the following diagram in answering Questions 8 and 9.




You are told, through text or verbally, that the heart represents a hardware class, the smiley face represents a concrete listener, and the arrow represents the complicated path that a message takes to travel from one to the other.

8. Imagine that this diagram is part of the formal documentation. Which critique below is MOST relevant?
   a) This is not standard UML.
   b) The shapes distract from the point. *DISTRACTION IS SOMETHING TO BE AVOIDED WHEN POSSIBLE*
   c) Formal documentation should be more serious.
   d) The shapes should be labelled Hardware and Listener. *THIS IS ACTUALLY A WORSE ANSWER, BUT I DECIDED TO LET IT GO*
   e) A sequence diagram would be better to use here.

9. For which purpose would this diagram be MOST appropriate?
   a) Conceptual overview for a non-technical person *A NON-TECHNICAL PERSON WON'T BE INTERESTED IN THE INNER WORKINGS OF THE MACHINE AND SO NO DIAGRAM ABOUT IT WILL BE APPROPRIATE. BUT SOMEONE CONVINCED ME THAT THERE ARE THOSE "IN-BETWEEN" CASES, WHERE A NON-TECHNICAL PERSON IS CURIOUS …*
   b) Abstract explanation for end-users of the system *SOME END USERS MIGHT BE TECHNICAL (FOR USERS OF AN API FOR EXAMPLE) SO I GAVE THIS PART MARKS*
   c) Test planning
   d) Design review

e) Conceptual overview for a technical person *IT DEALS WITH A STRICTLY TECHNICAL SITUATION, ALBEIT IN A SILLY WAY*

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10. Consider the following UML structural diagram.


What is the relationship depicted?

a) A is a subclass of B
b) A is associated with B *IT COULD ALSO BE INTERPRETED AS B IS ASSOCIATED WITH A ,OR BOTH: THERE ARE NO ARROWHEADS*
c) A depends on B
d) B aggregates A
e) A is linked to B

11. Consider the following UML structural diagram.


What is the relationship depicted?

a) A is linked to B *THESE ARE EXPLICITLY OBJECTS; OBJECTS CAN ONLY BE INVOLVED IN LINKS (THIS WAS A HARD-ISH QUESTION)*
b) A is a subclass of B
c) A depends on B
d) A is associated with B
e) B aggregates A

12. Consider the following UML structural diagram.


What is the relationship depicted?

a) A is a subclass of B
b) A depends on B
c) B aggregates A
d) A is linked to B
e) A is associated with B

13. Consider the following UML structural diagram.


What is the relationship depicted?

a) A is a subclass of B
b) A depends on B *IT COULD ALSO BE INTERPRETED AS B DEPENDS ON A, OR BOTH, SINCE THERE ARE NO ARROWHEADS*
c) B aggregates A
d) A is linked to B
e) A is associated with B

14. Consider the following UML structural diagram.


What is the relationship depicted?

a) A is a subclass of B
b) A depends on B
c) B aggregates A
d) A is linked to B
e) A is associated with B

15. Consider the following UML structural diagram.

What is the relationship depicted?

a) A is a subclass of B
b) A depends on B
c) B aggregates A
d) A is linked to B
e) A is associated with B

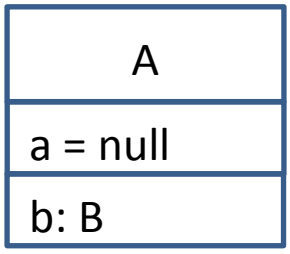
16. Consider the following UML structural diagram.


What relationship is NOT IMPLIED by this relationship?

a) B depends on A
b) B aggregates A
c) B contains A
d) B is associated with A
e) B composes A

---

Consider the following UML structural diagram in answering Questions 17 through 20.




17. What is "a"?
    a) A local variable
    b) An operation
    c) A field *THE MIDDLE BOX ALWAYS CONTAINS FIELDS (A.K.A. MEMBER VARIABLES)*
    d) A formal parameter
    e) An object

18. What is "b"?
    a) A local variable

b) An operation *THE BOTTOM BOX ALWAYS CONTAINS OPERATIONS, THOUGH YOU WOULD NORMALLY SEE AT LEAST AN EMPTY PARAMETER LIST. HARD-ISH*
c) A field
d) A formal parameter
e) An object

19. Which detail is suppressed regarding "a"?
a) Its formal parameters
b) Its relationship with A
c) Its type *THE INITIAL STATE IS SHOWN; ARGUMENTS AND FORMAL PARAMETERS ARE NOT RELEVANT HERE; ITS RELATIONSHIP WITH A IS IMPLIED*
d) Its initial state
e) Its arguments

20. Which detail is suppressed regarding "b"?
a) Its formal parameters
b) Its relationship with A
c) Its type
d) Its initial state
e) Its arguments *THIS IS NOT STRICTLY CORRECT, BUT YOU GOT THE GENERAL IDEA*

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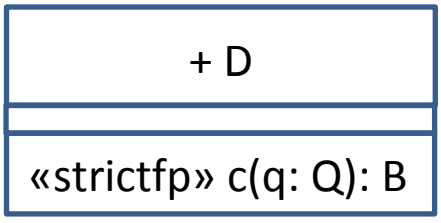
Consider the following UML structural diagram in answering Questions 21 through 25.




21. What is "D"?
a) A field
b) An operation
c) A formal parameter
d) An object
e) A type

22. What is "c"?
a) A field

b) An operation
c) A formal parameter
d) An object
e) A type

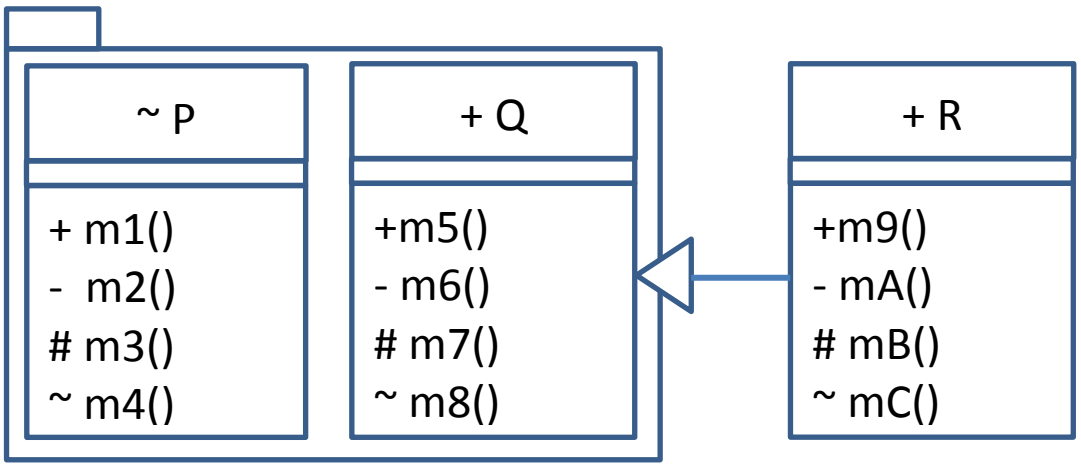
23. What is “q”?
a) A field
b) An operation
c) A formal parameter
d) An object
e) A type

24. What is “Q”?
a) A field
b) An operation
c) A formal parameter
d) An object
e) A type

25. What is “B”?
a) A field
b) An operation
c) A formal parameter
d) An object
e) A type

---

Consider the following UML structural diagram in answering Questions 26 through 28.



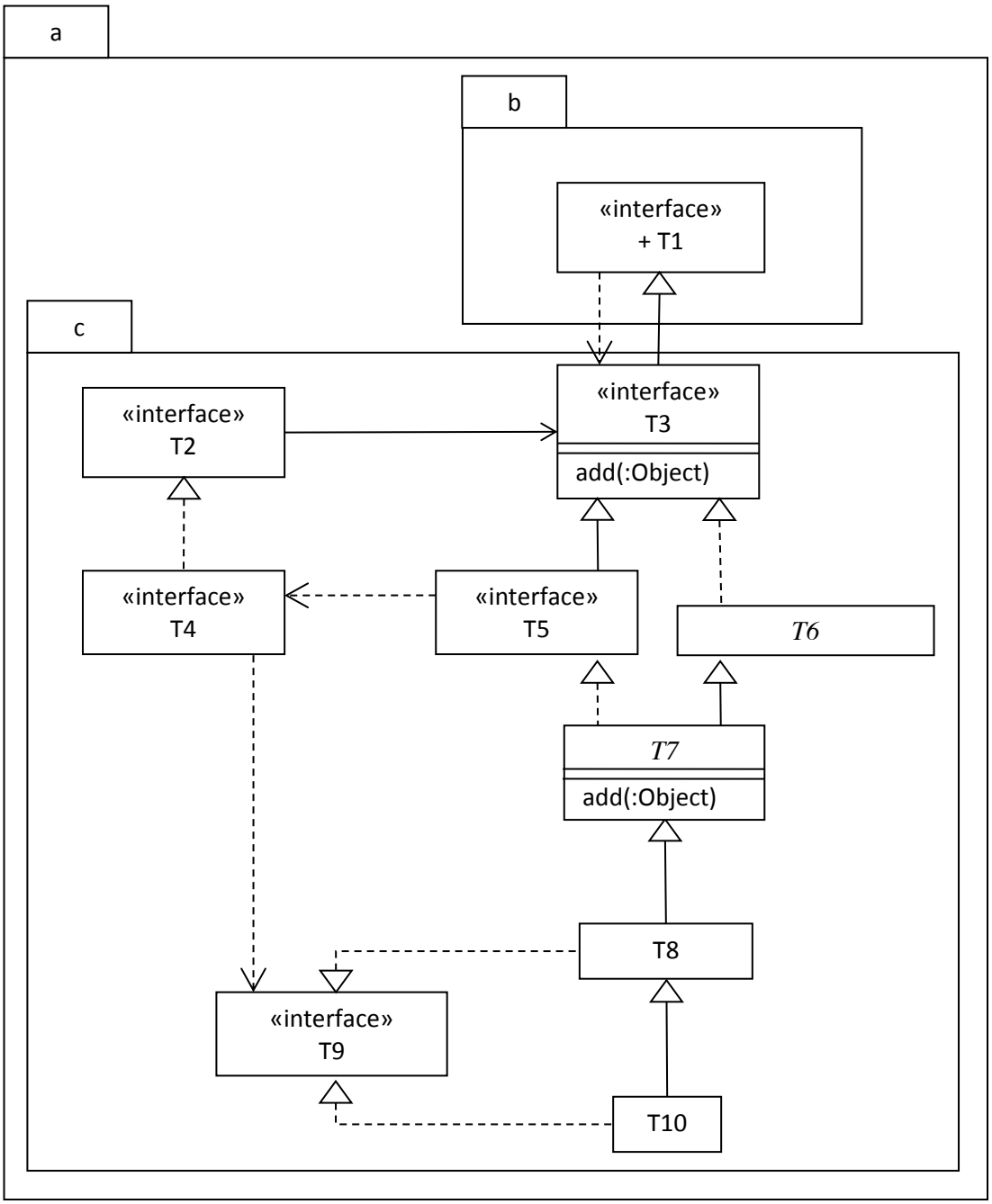
26. Which methods can m1() invoke?
    a) All
    b) m1(), m5(), m9()
    c) m1(), m2(), m3(), m4(), m5(), m9()
    d) m1(), m2(), m3(), m4(), m5(),m8(), m9() *A CLASS CAN ALWAYS CALL ALL OF ITS OWN METHODS. A CLASS CAN CALL ALL PUBLIC AND PACKAGE-PROTECTED METHODS ON OTHER CLASSES IN ITS OWN PACKAGE. A CLASS CAN CALL PUBLIC METHODS IN PUBLIC CLASSES PLUS PROTECTED METHODS IN SUPERCLASSES.*
    e) m1(), m2(), m3(), m4(), m5(), m6(), m7(), m8(), m9(), mA(), mB(), mC()

~~27. Which methods can m6() invoke?~~
    ~~a) All~~
    ~~b) m2(), m6(), mA()~~
    ~~c) m2(), m5(), m6(), m7(), m8(), mA()~~
    ~~d) m1(), m3(), m4(), m5(), m6(), m7(), m8(),m9()~~
    e) ~~m1(), m2(), m3(), m4(), m5(), m6(), m7(), m8(), m9(), mA(), mB(), mC()~~

*I SCREWED UP THIS ONE AND DIDN'T COUNT IT. THE CORRECT ANSWER WAS m1(), m4(), m5(),m6(), m7(), m8(), m9().*

28. Which methods can mB() invoke?
    a) All
    b) m3(), m7(), mB()
    c) m1(), m5(), m9(), mA(), mB(), mC()
    d) m5(), m7(), m9(), mA(), mB(), mC() *P IS PACKAGE PROTECTED SO R'S METHODS CAN'T ACCESS IT. THIS IS HARD-ISH.*
    e) m1(), m5(), m6(), m7(), m8(), m9(), mA(), mB(), mC()

Consider the following UML structural model in answering Questions 29 through 31. Assume that no relationships between the types have been abstracted away, other than ones that are implied.




29. Which line of Java code is LEGAL (i.e., it compiles)?
    a) T10 obj = new T8();

b) T5 obj = new T4();
c) T4 obj = new T5();
d) T9 obj = new T9();
e) T5 obj = new T8(); *THE TYPE WHOSE CONTRUCTOR IS CALLED HAS TO BE CONCRETE AND NOT AN INTERFACE. THE TYPE ON THE LEFT HAS TO BE A (NON-STRICT) SUPERTYPE OF THE TYPE ON THE RIGHT.*

30. Which program fragment is LEGAL (where "…" means I have removed some details)?
    a) T10 obj = …; obj.add(null); *ONLY T8 and T10 ARE CONCRETE TYPES THAT INHERIT THE CONCRETE METHOD BEING CALLED HERE, SO THIS IS THE ONLY VALID ANSWER.*
    b) T9 obj = …; obj.add(null);
    c) T4 obj = …; obj.add(null);
    d) T1 obj = …; obj.add(null);
    e) T2 obj = …; obj.add(null);
31. The statement "T3 obj = new T7();" is ILLEGAL. Why?
    a) Human developers won't understand what T3 and T7 are.
    b) T7 is abstract. *THE SLANTED TEXT TELLS YOU THIS. YOU CAN'T INSTANTIATE AN ABSTRACT CLASS; INTERFACES ARE ALWAYS IMPLICITLY ABSTRACT.*
    c) T3 and T7 are different.
    d) T3 is an interface.
    e) Because T7 has two parents.

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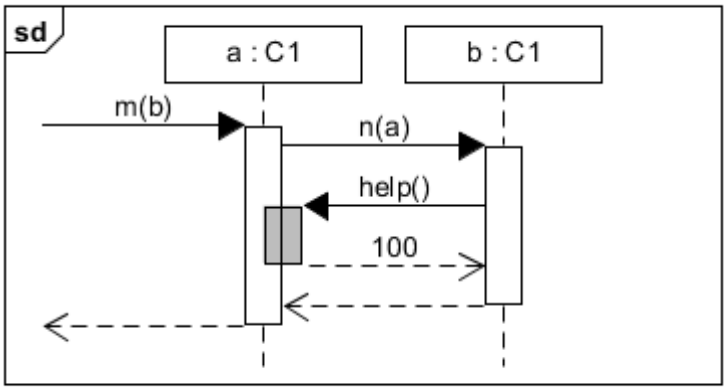
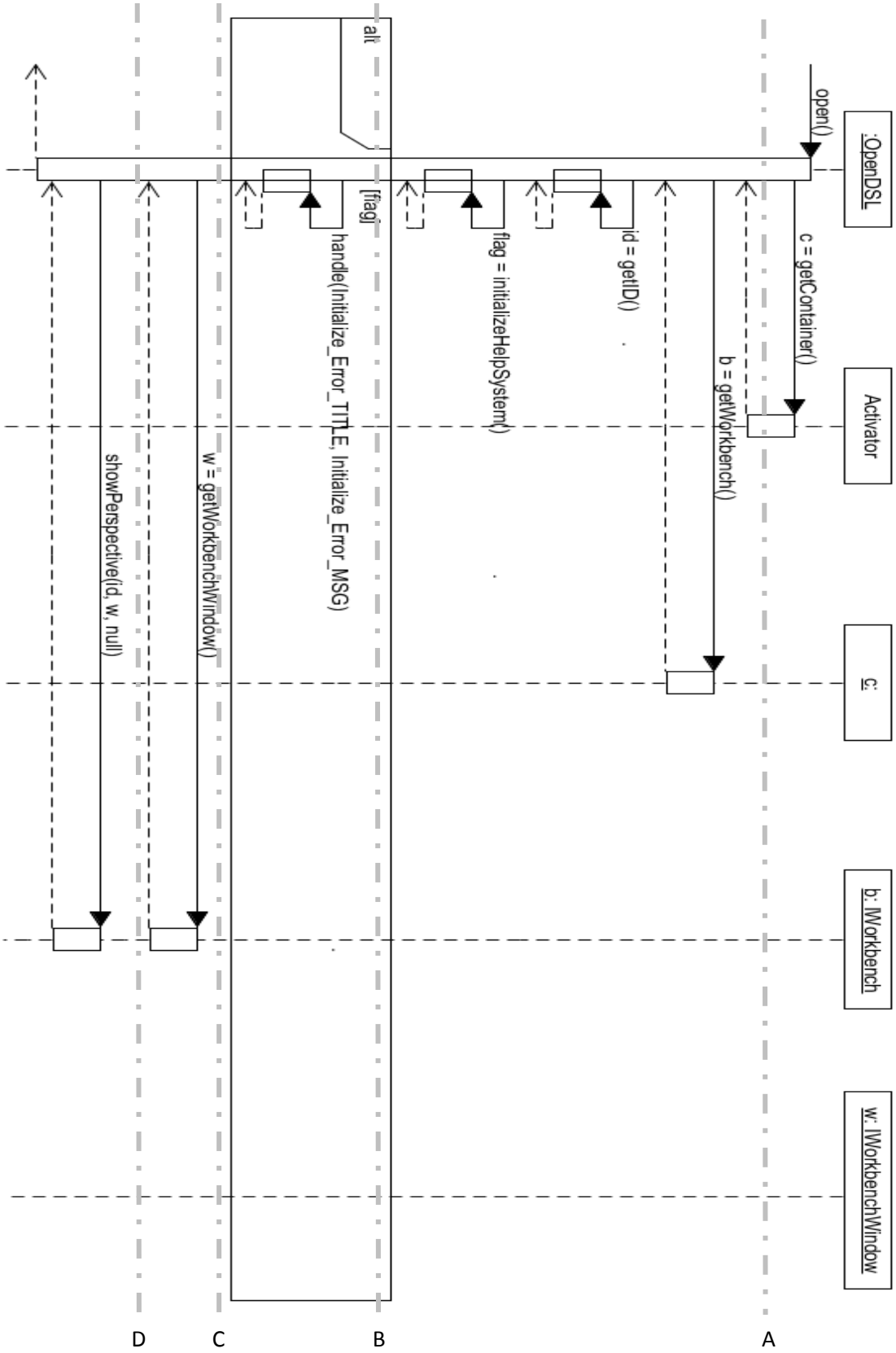
32. Consider the following UML diagram.




Which sequence does it model best?

a) sd, a : C1, b : C1, m(b), n(a), help(), 100, blank, blank
b) *unknown*.m(b), a.n(a),b.help(), 100, return, return
c) a.m(b), b.n(a), a.help(), return 100 from a.help(), return from b.n(a), return from a.m(b)
d) a : C1, b : C1, m(b), n(a), help(), return 100, return, return
e) a.m(b), b.n(a), a.help(), return 100 from a.m(b), return from b.n(a), return from a.help()

Consider the following UML diagram with four dash-dot lines superimposed in answering Questions 33 through 37. Note the labels A through D at the end of these superimposed lines.




33. Which objects exist at the point marked A?

a) anonymous OpenDSL

b) anonymous OpenDSL, Activator (a class)
c) anonymous OpenDSL, Activator (a class), c, b, w *NO OBJECTS ARE CREATED OR DESTROYED HERE*
d) none
e) anonymous OpenDSL, Activator (a class), c

34. Which conditions must be true at the point marked B?
    a) flag is true, open() is executing on anonymous OpenDSL, handle() is executing on anonymous OpenDSL
    b) flag is true, handle() is executing on anonymous OpenDSL
    c) flag is true, open() is executing on anonymous OpenDSL
    d) it depends
    e) flag is executing, alt is executing

35. Which objects does the anonymous OpenDSL instance know about, at the point marked C?
    a) itself
    b) none
    c) itself, b, c, w, Activator class
    d) itself and Activator class
    e) itself, b, c, Activator class *IT HAS NOT LEARNED ABOUT w YET*

36. Which objects exist at the point marked D?
    a) anonymous OpenDSL
    b) anonymous OpenDSL, Activator class
    c) none
    d) anonymous OpenDSL, Activator class, c
    e) anonymous OpenDSL, Activator class, c, b, w *NOW IT ALSO KNOWS ABOUT w*

37. What causes the anonymous OpenDSL object to be created?
    a) the Activator class
    b) the return from showPerspective()
    c) a listener
    d) unknown from this diagram *IT ALREADY EXISTS AT THE START OF THIS DIAGRAM*
    e) the arrival of the open() message

---

38. Consider the following classes:

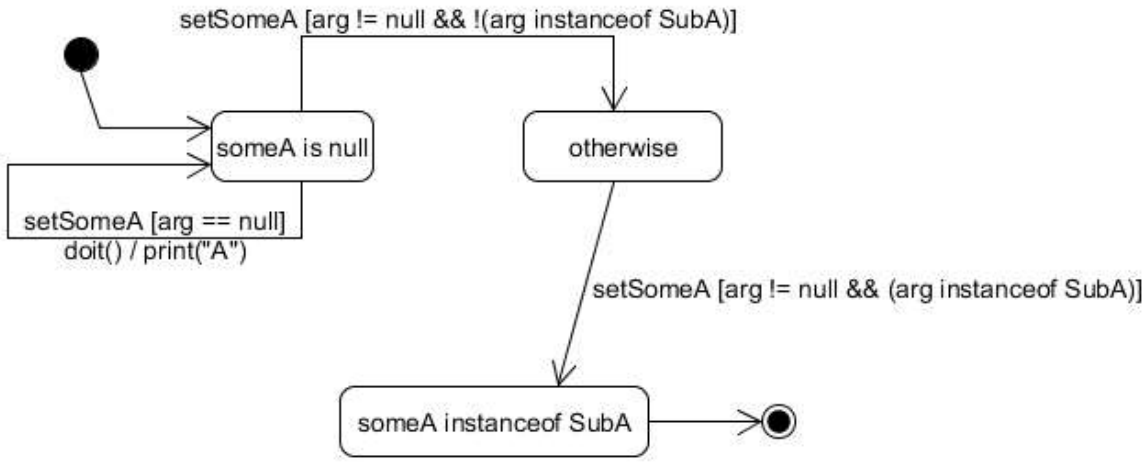
```
class A {
     void m() {
          System.out.print("A");
     }
}

class SubA extends A {
     void m() {
      System.out.print("SubA");
     }
}
```

```
public class Client {
     private A someA = null;
     public void setSomeA(A object) {
        someA = object;
     }
     public void doit() {
          someA.m();
     }
}
```

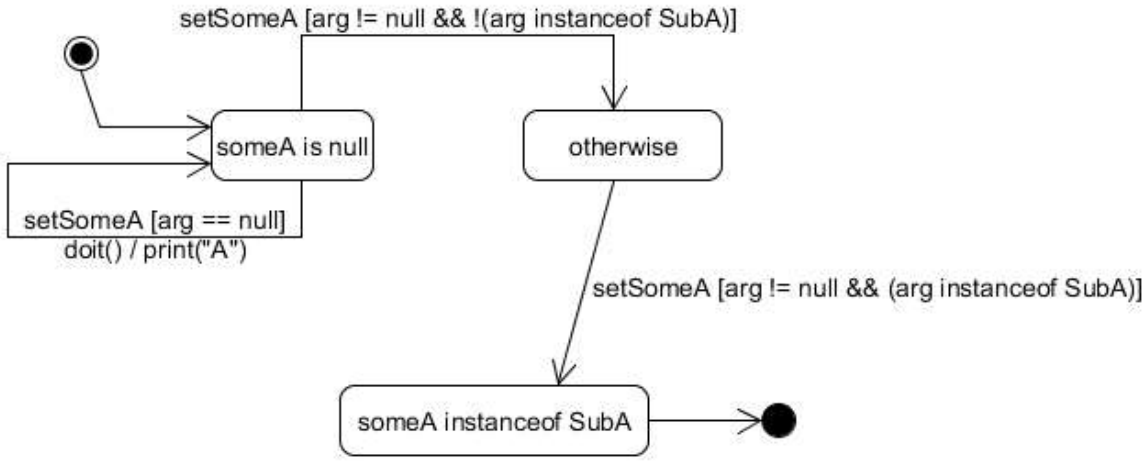
Which of the following state diagrams BEST represents the behaviour of Client?

***THIS QUESTION IS HARD. IT IS INTENDED TO SORT OUT THE A+ STUDENTS FROM THE REST. [MY COMMENTS CAUSED THE CAPTIONS TO JUMP BEFORE THE DIAGRAMS INSTEAD OF AFTER LIKE THEY WERE ORIGINALLY.]***

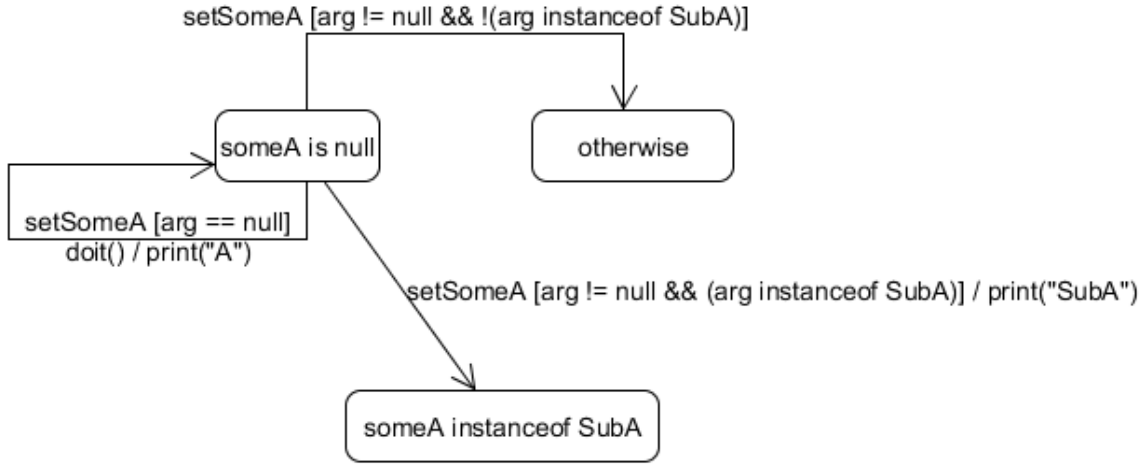
a) *THE TRANSITION TO THE END PSEUDO-STATE WILL HAPPEN IMMEDIATELY; THIS ISN'T REALLY CORRECT.*

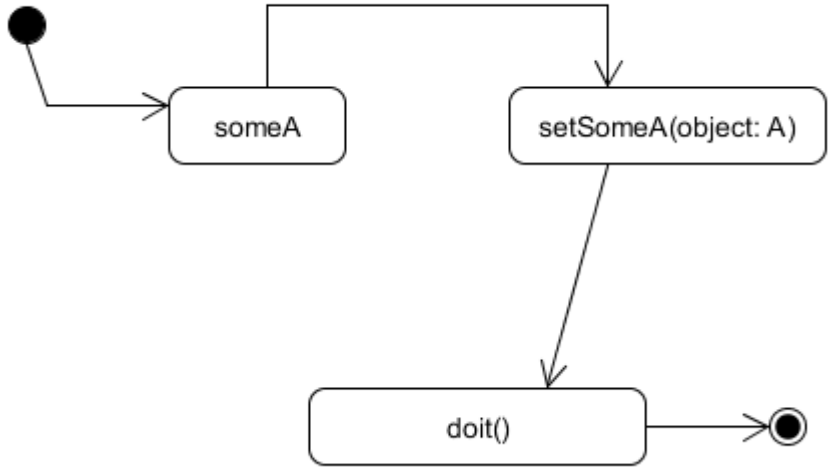


b) *PSEUDO-STATES ARE SWAPPED HERE*



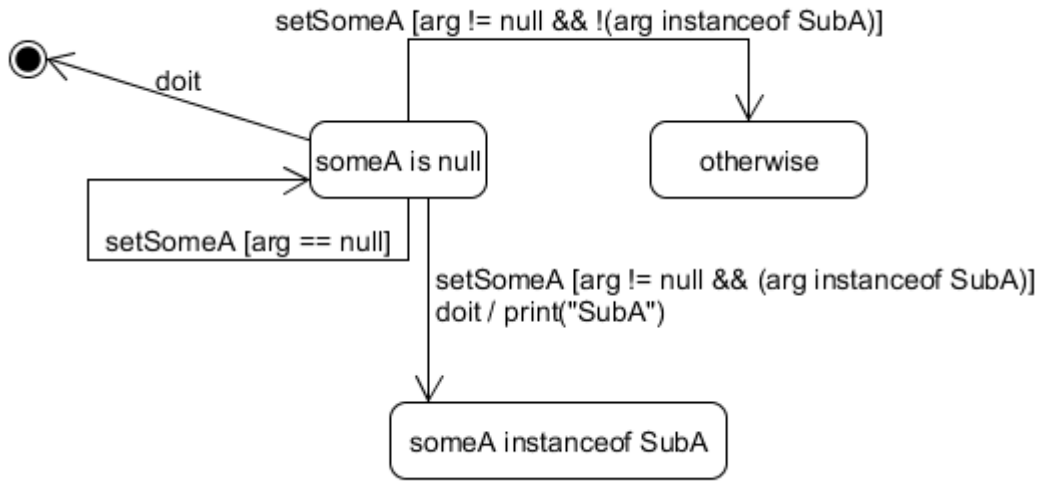

c) *CALLING setSomeA WILL NOT CAUSE PRINTING TO HAPPEN; THE DIAGRAM SAYS OTHERWISE*



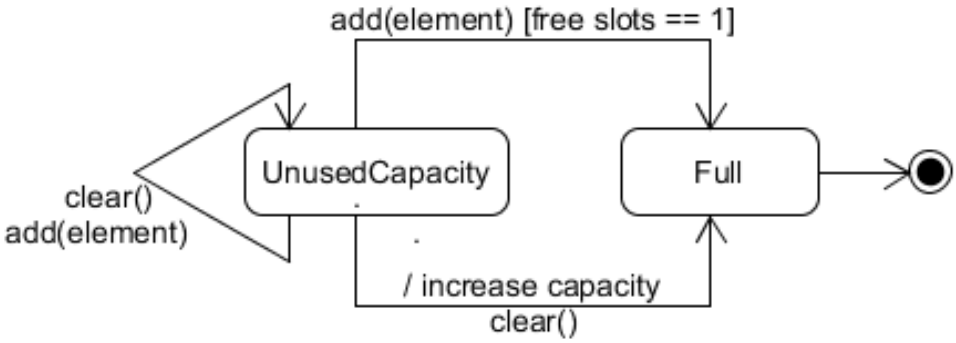




d) *JUST PLAIN WRONG*

e)



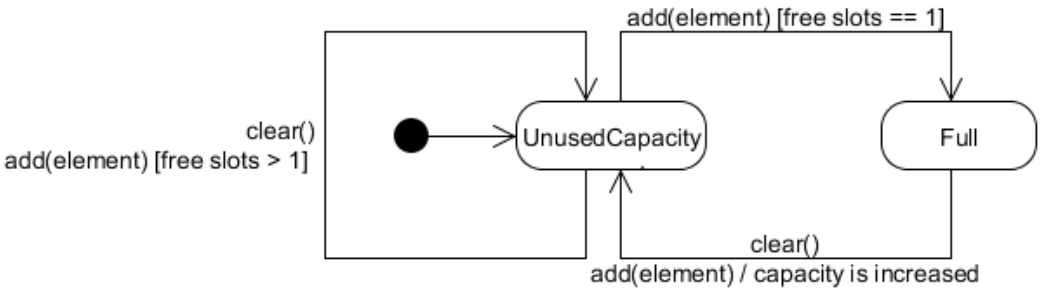

39. ArrayList is a standard data structure that expands as needed to hold more elements. Here is a diagram that models it.




Why is this model non-deterministic?

a) There is no start pseudo-state indicated
b) Two identical events overlap despite a guard *AND THE EVENTS CAUSE DIFFERENT TRANSITIONS FROM THE SAME STATE.*
c) It is unclear how the Unused Capacity state can be reached once it is Full
d) The bottom transition will happen automatically
e) The self-loop on UnusedCapacity will cause an infinite loop

40. Again, consider ArrayList and its expansion mechanism, as modelled below.




Which of the following statements is TRUE?

a) The states don't represent anything in the source code, so this model is abstract.
b) There are too many informal statements on the diagram. We can't tell what it does.
c) No reactions are defined by the state machine.
d) There are two transitions from Unused Capacity both labelled with the same event. This means the diagram is non-deterministic, which is a problem.
e) More than one trigger (or event) on two of the transitions is illegal.

41. Consider the user story, "As an instructor, I want to control hand in deadlines for assignments." Which of the following is a PROBLEM with this user story?
a) The user story provides no rationale for the instructor's desire, which makes it hard to prioritize and to decide on the resources to devote to ensuring that it is achieved.
b) "Control" is not specific enough.
c) It does not deal with other forms of assessment.
d) It does not deal with assignments without deadlines.
e) "Assignments" is too vague.

42. Consider a system like Desire2Learn in which handing in an assignment consists of uploading one or more files to a course-specific location. Which of the following test cases is LEAST worthwhile to try?
a) Attempt the handin with a single file of huge size, say, 5TB.
b) Attempt a handin of a huge number of large files, say, 100,000 files of 1TB each.
c) Attempt the handin with a single, empty file.
d) Attempt the handin with all combinations of: student identity, student enrollment, file size, number of files, and being late/not late. *"ALL COMBINATIONS" IS NOT POSSIBLE*
e) Attempt the handin with no files.

43. Imagine that you create an automated test case. When you execute the test case, it does not pass. Which of the following is the LEAST reasonable explanation for the problem?
    a) There is an error in the standard library's implementation. *CONSIDER HOW MANY OTHER PEOPLE HAVE USED IT IN THE PAST…*
    b) There is an error in the source code being tested.
    c) There is an error in your understanding of how the system is supposed to work.
    d) There is an error in the automated test case.
    e) There is an error in the specification of the behaviour.

---

Consider the following source code fragment in answering Questions 44 through 48.

```
/**
* Returns the sum of the inputs.
*/
public double doSomething(double first, double second, double third) {
    return third + first - second + third + 1;
}
```

44. Which of the following is the expected output of "doSomething(0, 0, 0)"?
    a) 3
    b) 1
    c) 0
    d) 2
    e) It depends.

45. Which of the following is the actual output of "doSomething(0, ***1***, 0)"?
    a) It depends.
    b) 3
    c) 2
    d) 1
    e) 0

46. Which of the following would NEVER be a reasonable reaction to discovering an error in this method?
    a) Delete the method. *IN THIS PARTICULAR CASE, THIS SEEMS LIKE A USELESS METHOD, SO DELETING IT IS AN OPTION; IN GENERAL, DELETING A METHOD IS AN EXTREME REACTION THOUGH.*
    b) Change the Javadoc.
    c) Change the implementation.
    d) Report the issue to other stakeholders.
    *e)* Forget about it and move on. *MOVING ON IS OK, BUT YOU SHOULD RECORD THIS INFORMATION SOMEHOW.*

47. How many test cases should be written for this, and why? *THIS WAS A BIT OF A TRICK QUESTION SO I RELENTED AND GAVE PART MARKS.*
    a) Eight. Because you should check all combinations of the two possibilities for each input.
    b) One. There is only one path.
    c) Two. We should try the smallest and the largest possibilities, as boundary cases.
    d) None. The problem should be found via inspection.
    e) Eight plus all the weird values (like "NaN"). The weird values could screw things up.

48. To perform white-box testing of this code, which of the following is the MOST reasonable approach to follow?
    a) Look at the Javadoc to figure out what it is supposed to do, and ignore the implementation.
    b) Select test cases that fall at the boundaries of the equivalence classes.
    c) Try out the code with several different values.
    d) Determine at least one test case that will cause each instruction to run.
    e) Keep testing until you find a bug or you run out of time.

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49. Which of the following is the MOST reasonable justification for manual testing?
    a) It takes too long to write automated test cases.
    b) Analyzing the code to figure out coverage is complicated.
    c) Test case setup cannot always be automated. *SINCE THIS IS RARELY THE REAL CASE, PEOPLE CLAIMING THIS ARE USUALLY MAKING AN EXCUSE!*
    d) Automated test cases can have bugs in them.
    e) Testing once is fine as long as no bugs are found.

For Questions 50 and 51, consider the following source code fragment, with the line numbers indicated at the left.

```
   public int doit(boolean flag, int val) {
1:     if(!flag)
2:         return val;

3:     if(val > 0)
4:         val *= 2;

5:     return val;
   }
```

50. For the execution of "doit(false, 4)", which lines are covered?
    a) all of them
    b) 1, 2
    c) 1, 3, 4, 5
    d) 3, 4, 5
    e) none of them
51. If we have a set of automated test cases that cover all the lines, which of the following consequences is TRUE?
    a) We have reduced the likelihood that we have missed bugs.
    b) The test cases are good enough.
    c) If there is a bug, we will find it.
    d) We spent too much time creating automated test cases.
    e) The source code is good enough.

---

52. Which of the following is a GOOD reason to repeat tests?
    a) Manual testing is tedious.
    b) After changes, it is important to know that tests still pass.
    c) Exhaustive testing is impossible, in general.
    d) The result of non-deterministic tests will be different.
    e) To find the coverage of the automated test suite.
53. Imagine that we have a Hardware class that uses a Listener interface to announce when events happen. We run the Hardware and interact with it, but we never find out about any events. Which of the following IS a reasonable explanation for why this happened?
    a) Listener is an interface, so it cannot be instantiated.
    b) We were too busy watching YouTube. *IT TOOK GUTS TO GIVE THIS HONEST ANSWER; HERE IS YOUR REWARD.*
    c) We did not rewrite Hardware to call the Listener.
    d) We did not register the Hardware with the Listener. *THIS DESCRIPTION IS BACKWARDS BUT COULD HAVE CONFUSED YOU, SO I GAVE PART MARKS.*

e) The Hardware does not announce the events. *THIS IS THE REAL ANSWER. THE HARDWARE HAS A BUG.*