CTFL® Automotive Software Tester 2.0 (“Sample Exam Paper”)

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CTFL®-Automotive Software Tester Sample Exam Paper

Syllabus Version 2.0

Written by:
GermanTestingBoard e.V. – Examination Panel

(SET CTFL®_AuT_2018A)

According to ISTQB®/GTB-CTFL-exam procedures 2015

ISTQB® Certified Tester Foundation Level Specialist:
CTFL® Automotive Software Tester 2.0 (CTFL®-AuT)

CTFL® Automotive Software Tester 2.0 (“Sample Exam Paper”)

Introduction

This is a Sample Exam intended to help the candidates prepare for the real examination. It provides a set of questions whose format is similar to the CTFL®- Automotive Software Tester (CTFL®-AuT) real exam.

It is strictly forbidden to use these exam questions in a real exam.

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3) For almost every question exactly one correct answer is expected. In any exception to this rule, the possibility of multiple answers will be explicitly mentioned.

General terms of the Sample Exam:

Number of questions: 40

Duration of the exam: 60 minutes

Total number of points: 40 (each question scores exactly one point)

Number of points to achieve the passing score (in real exam): 26 (or more)

Percentage to pass the (real) exam: 65% (or more)

Questions for the topic ”Introduction“

1. What are the six stages in the system product life cycle according to ISO/IEC 24748?

K1

a)	Concept, Development, Acceptance, Utilization, Support, Retirement	☐
b)	Concept, Development, Production, Release, Support, Retirement	☐
c)	Concept, Implementation, Production, Utilization, Support, Retirement	☐
d)	Concept, Development, Production, Utilization, Support, Retirement	☒

Justification:

a) INCORRECT: The Acceptance Stage is wrong.

b) INCORRECT: The Release Stage is wrong.

c) INCORRECT: The Implementation Stage is wrong.

d) CORRECT: All stages are mentioned in the correct order, see syllabus; paragraph 1.3.

2. Which of the following statements is TRUE?

K1

a)	The release recommendation of the Certified Automotive Software Tester does NOT have any influence on the release.	☐
b)	The release provisions of the test object do NOT have any influence on the work of the Certified Automotive Software Tester.	☐
c)	The release recommendation of the Certified Automotive Software Tester does NOT have any influence on the level of maturity of the corresponding software.	☒
d)	The release recommendation does NOT have any influence on the scope of delivery.	☐

Justification:

a) INCORRECT: The release recommendation has a considerable influence in the release.

b) INCORRECT: The release provisions affect the test strategy.

c) CORRECT: The testing affects the level of software maturity by the detection of defects, the release recommendation, however, cannot affect the level of maturity.

d) INCORRECT: The scope of delivery can be considerably influenced by the release recommendation.

3. With which of the measures listed below can the objectives of an increasingly complex software development project be best achieved in the short run?

K2

a)	By insourcing an outsourced projects	☐
b)	By using effective methods and processes	☒
c)	By ensuring efficient qualification of employees	☐
d)	By outsourcing of complex projects	☐

Justification:

a) INCORRECT: To insource an already running, outsourced projects again endangers the project objectives as internal resources must be trained and included in the project.

b) CORRECT: By using effective methods and processes, interfacing issues, e.g. by misunderstandings, are reduced and minimized.

c) INCORRECT: Qualification is important, but for the project objectives it does not matter if it is efficient.

d) INCORRECT: Outsourcing means higher administrative efforts and it requires coordination with the contractor – in the short run, the efforts are higher and the project objectives are in danger.

Questions for the topic ”Standards for the testing of E/E-Systems: Automotive SPICE®“

4. Which Automotive SPICE® process is particularly important from the point of view of an employee in the role of a Certified Automotive Software Tester?

K1

a)	System requirements analysis	☐
b)	Configuration management	☐
c)	Software qualification test	☒
d)	Project management	☐

Justification:

a) INCORRECT, as system requirements analysis are only of secondary importance for the Certified Automotive Software Tester.

b) INCORRECT, as configuration management is only of secondary importance for the Certified Automotive Software Tester.

c) CORRECT, as a software qualification test assesses the integrated software based on the software requirements.

d) INCORRECT, as project management is only of secondary importance for the Certified Automotive Software Tester.

5. Which of the following is a dimension defined in Automotive SPICE®?

K1

a)	Process dimension	☒
b)	Time dimension	☐
c)	Resource dimension	☐
d)	Objective dimension	☐

Justification:

a) CORRECT, is defined as dimension in Automotive SPICE®, see syllabus, paragraph 2.1.1.1.

b) INCORRECT, is not defined as dimension in Automotive SPICE®, because the correct dimensions are the process and capability dimensions.

c) INCORRECT, is not defined as dimension in Automotive SPICE®, because the correct dimensions are the process and capability dimensions.

d) INCORRECT, is not defined as dimension in Automotive SPICE®, because the correct dimensions are the process and capability dimensions.

6. According to Automotive SPICE® 3.x, which Software Test Qualification Process Capability Level is characterized by a combination of the following statements?

Work products have been reviewed, established and have been released.
AND
Process activities are planned towards objectives, monitored and adjusted
AND
Requirements for work products are defined.

K2

a)	Capability level 0	☐
b)	Capability level 1	☐
c)	Capability level 2	☒
d)	Capability level 3	☐

Justification:

a) INCORRECT, as none of the above-mentioned statements characterizes a capability level 0.

b) INCORRECT, as not all statements characterize a capability level 1.

c) CORRECT, as all above mentioned statements characterizes a capability level 2.

d) INCORRECT, a capability level 3 requires additional to all above mentioned statements a defined process that is capable of achieving its process outcomes.

7. **Imagine you are participating in an Automotive SPICE® – Assessment in your role as integration tester and you are receiving the information that your process has been assessed as „L,“ using the process attribute PA 1.1.**

Which ONE of the following options is correct?

K1

a)	„L“ not fulfilled	☐
b)	„L“ partly fulfilled	☐
c)	„L“ largely fulfilled	☒
d)	„L“ fully fulfilled	☐

Justification:

a) INCORRECT, as NOT FULFILLED is for „None“.

b) INCORRECT, as PARTLY FULFILLED is for „Partly“.

c) CORRECT, as LARGELY FULFILLED is for „Largely“. (See also syllabus, paragraph 2.1.2.2.).

d) INCORRECT, as FULLY FULFILLED is for „Fully“.

8. Which of the following statements about regression test strategy is TRUE, according to Automotive SPICE®?

K2

a)	The regression test strategy defines the test stage specific test environments and which tests are to be executed in which test environments.	☐
b)	The regression test strategy defines the selection of appropriate test cases for regression testing, including a set of test cases selected as a basis set to be executed.	☒
c)	The regression test strategy typically defines the cross-test stage procedure for the selection of regression tests.	☐
d)	The regression test strategy is an abstract description of the planned test levels and how to proceed within those test stages. It is valid for one organization or one program, for one or more projects.	☐

Justification:

a) INCORRECT, as a regression test strategy does NOT define the test stage specific test environments. This distractor defines a test plan.

b) CORRECT, as a regression test strategy defines the objective and the procedure for the selection of the test cases for the regression tests. (see syllabus, paragraph 2.1.2.3).

c) INCORRECT, as a regression test strategy does NOT define the cross-test level procedure for the selection of regression tests. This distractor partly defines a master test plan.

d) INCORRECT, as a regression test strategy is NOT an abstract description of the planned test stages and how to proceed within those test levels. This distractor describes a test policy.

9. Which traceability requirements are referenced in Automotive SPICE® 3.x?

K2

a)	Traceability of the testers’ working hours to the executed test cases.	☐
b)	Traceability of the specified test cases to the test results.	☒
c)	Traceability of interface description to the specified maintainability tests.	☐
d)	Traceability of the customer requirements to the specified integration tests.	☐

Justification:

a) INCORRECT, as Automotive SPICE® does not require traceability of the working hours of the tester to the completed test cases.

b) CORRECT, as Automotive SPICE® from Version SPICE 3.0 also requires traceability of the specified test cases to the test results (see syllabus, paragraph 2.1.2.6.).

c) INCORRECT, as Automotive SPICE® does not require traceability of the interface descriptions to the specified maintainability tests.

d) INCORRECT, as Automotive SPICE® does not require traceability from customer requirements to integration tests. (Only the traceability between customer requirements and system requirements is required).

10. **You are the test manager for a tier-1-supplier and you are responsible for defining the component verification strategy and criteria according to Automotive SPICE® (SWE.4). The components to be verified are safety relevant ones (up to ASIL-B) as well as non-safety relevant components.**

According to the process requirements of the OEM, the supplier should confirm MISRA-compliance and comply with the guidelines for functional safety.

Which of the following measures is INAPPLICABLE as part of a suitable verification strategy?

K3

a)	Dynamic Black-Box tests of the components with the objective of achieving 100% requirements coverage for the safety relevant components.	☐
b)	Tool-supported measuring of the condition coverage of the tested components, to ensure 100% plausibility of the test results.	☒
c)	Tool-supported static analysis to achieve MISRA compliance of the source code of the components.	☐
d)	Code reviews to check the understandability and correctness of comments in the source code of the components.	☐

Justification:

a) INCORRECT, as applicable, because according to the guidelines for safety (ISO 26262-6) all safety relevant components must be tested regarding the safety requirements.

b) CORRECT, as inapplicable, because measuring the condition coverage would generally be a suitable measure (see syllabus, paragraph 2.1.2.5), but the mentioned criteria for verification cannot be achieved this way. (compare CTFL®).

c) INCORRECT, as applicable, because tool-supported static analysis are a typical part of a verification strategy to confirm the MISRA-compliance. (see also syllabus, paragraph 2.1.2.5).

d) INCORRECT, as applicable, because code reviews as an addition to tool-supported static analysis are a typical part to confirm non-detectable verification criteria like understandability (see also syllabus, paragraph 2.1.2.5).

Questions for the topic ”Standards for the testing of E/E-Systems: ISO 26262“

11. Which statement BEST describes the contribution of an Automotive Software tester to the safety culture?

K1

a)	The tester ensures that all project team members contribute to the safety culture.	☐
b)	The tester checks if all processes required for functional safety activities are implemented.	☐
c)	The tester contributes to the development phases of the safety lifecycle.	☒
d)	The tester carries out all activities that are related to functional safety.	☐

Justification:

a) INCORRECT, as this is not a task of a tester, but of the safety manager.

b) INCORRECT, as this is not a task of a tester, but of the safety manager.

c) CORRECT, as this is the core of the safety culture (see statement in the third paragraph 2.2.1.2).

d) INCORRECT, as the tester only carries out specific measures (typically ones that are connected to the test) in the area of functional safety, but not all of them.

12. Which of the following statements regarding ASIL is TRUE?

K1

a)	The ASIL of a hazard is the result of the hazard analysis and risk assessment.	☒
b)	ASIL A represents the highest criticality, ASIL D the lowest one.	☐
c)	An ASIL is assigned to all hazards classified.	☐
d)	ASIL stands for „Automotive Security Integrity Level“.	☐

Justification:

a) CORRECT, as the hazard analysis and risk assessment can add an ASIL to hazards (see 2.2.4.1 paragraph 2).

b) INCORRECT, as ASIL D shows the highest criticality, ASIL A the lowest (see 2.2.4.1 paragraph 3).

c) INCORRECT, as there can be hazards identified in the hazard analysis and risk assessment, which do not get any ASIL assigned, but are classified ast QM (Quality Management) (see 2.2.4.1. paragraph 4).

d) INCORRECT, as ASIL stands for Automotive Safety Integrity Level (see 2.2.4.1 paragraph 1).

13. Which two volumes of ISO 26262 are the MOST IMPORTANT ones for the Automotive Software tester?

K1

a)	Volume 4 (Product development at the system level), volume 6 (Product development at the software level)	☒
b)	Volume 3 (Concept phase) and volume 6 (Product development at the software level).	☐
c)	Volume 2 (Management of functional safety) and volume 6 (Product development at the software level).	☐
d)	Volume 5 (Product development at the hardware level) and volume 6 (Product development at the software level).	☐

Justification:

a) CORRECT, as the volumes 4, 6 are explicitly mentioned in 2.2.3.2 (see paragraph 1 and 3).

b) INCORRECT, as volume 3 is only of minor relevance for the software tester and is not even mentioned in 2.2.3.2.

c) INCORRECT, as volume 2 is only of minor relevance for the software tester and is not even mentioned in 2.2.3.2.

d) INCORRECT, as volume 5 addresses hardware-specific aspects which are less important to the software tester.

14. Which of the following statements regarding safety aspects is TRUE?

K2

a)	For the development of automotive E/E systems, ISO 26262 describes requirements to ensure functional safety.	☒
b)	Functional safety and cybersecurity of automotive E/E systems contradict each other.	☐
c)	Functional safety of an automotive E/E system can be assumed if unreasonable risks for people can be avoided during the normal operation of this system.	☐
d)	For the development of automotive E/E Systems, ISO 26262 describes the requirements to ensure cybersecurity.	☐

Justification:

a) CORRECT, as ISO 26262 is a standard / norm for functional safety (see 2.2.1.1 paragraph 3) which is applicable to (automotive) E/E systems (see 2.2.1.1 paragraph 3), and therefore provides requirements (among others) to achieve functional safety.

b) INCORRECT. Functional safety and cybersecurity are aspects of E/E systems that must be separated from each other (see 2.2.1.1 paragraph 4). A lack of Cybersecurity might impact functional safety (for example via a denial-of-service attack) (see 2.2.1.1 paragraph 4). However, an E/E system can be functional safe and secure at the same time, so the two characteristics don’t contradict each other.

c) INCORRECT, as ISO 26262 defines functional safety as absence of unreasonable risk due to hazards caused by malfunctioning behaviour of E/E systems (see 2.2.1.1 paragraph 4). ISO 26262 does not focus on the safety of the intended function during normal operation.

d) INCORRECT, as functional safety must be separated from cybersecurity and ISO 26262 only offers limited statements regarding cybersecurity (see 2.2.1.1 paragraph 4).

15. Which of the following statements BEST describes the contribution of an Automotive Software tester in the safety lifecycle?

K2

a)	The tester executes tests related to functional safety primarily during the product development phase.	☒
b)	The tester executes tests related to functional safety primarily during the concept phase.	☐
c)	The tester executes tests related to functional safety to the same extent in all phases of the safety lifecycle.	☐
d)	The tester executes tests related to functional safety primarily during the post-release phase, while in production.	☐

Justification:

a) CORRECT, as the tester contributes to multiple phases (see paragraph 3 of 2.2.2, first sentence), but executing tests mainly takes place in the phase of product development (see paragraph 3 of 2.2.2, last sentence and paragraph 4 of 2.2.2).

b) INCORRECT, as the tester carries out activities related to test planning and test design in the concept phase, but does not execute tests in this phase (see paragraph 4 of 2.2.2).

c) INCORRECT, as the focus of the test execution is the product development phase (see paragraph 4 of 2.2.2).

d) INCORRECT, as the focus of the test execution is the product development phase (see paragraph 4 of 2.2.2).

16. ISO 26262 recommends the use of specific test design techniques and test types depending on the Automotive Safety Integrity Level (ASIL).

Which statement is TRUE?

K2

a)	For safety requirements with a higher ASIL, more extensive testing must be done in comparison to safety requirements with a lower ASIL, as the number of recommended test design techniques and test types is higher.	☐
b)	For safety requirements with a higher ASIL, more extensive testing must be done in comparison to safety requirements with a lower ASIL, as the recommended test design techniques and test types lead to more test cases.	☐
c)	For safety requirements with a higher ASIL, an more extensive testing in comparison to safety requirements with a lower ASIL often occurs, as the number of recommended test design techniques and test types doubles with each ASIL.	☐
d)	For safety requirements with a higher ASIL, more extensive testing in comparison to safety requirements with a lower ASIL often occurs, as the recommended test design techniques and test types lead to more test cases.	☒

Justification:

a) INCORRECT, as there is no compelling causal connection („must“) between the number of methods and the extent of testing. Further, a higher ASIL does not necessarily require more procedures.

b) INCORRECT, as there is no compelling causal connection („must“) between the number of methods and the number of derived test cases and a higher ASIL does not necessarily require more procedures.

c) INCORRECT, as a higher ASIL typically requires more, or more intensive test methods. However, there is no rule that requires to double the number of recommended test design techniques and test types which each ASIL.

d) CORRECT, as a higher ASIL typically requires more, or more intensive test methods, which typically lead to more test cases and therefore to an increased extent of testing (see 2.2.4.2 paragraph 1 and example in paragraph 3).

17. The following table shows a ISO 26262 methods table regarding code coverage metrics.

Methods		ASIL			
		A	B	C	D
1a	Statement coverage	++	++	+	+
1b	Branch coverage	+	++	++	++
1c	Modified condition decision coverage (MC/DC)	+	+	+	++

Which of the following decisions documented in the test plan is consistent with the above methods table?

K3

a)	For ASIL A, branch coverage is used and statement coverage is not used, as 100% branch coverage implies 100% statement coverage.	☒
b)	For ASIL B, statement coverage is used and branch coverage is not used, as it is positioned at a higher position in the table and is therefore more important.	☐
c)	For ASIL D, MC/DC coverage is used as it is the only possible option.	☐
d)	For ASIL B, statement coverage is used and branch coverage is not used, as 100% statement coverage implies 100% branch coverage.	☐

Justification:

Due to the numbering scheme for the methods, i.e., 1a, 1b and 1c, it is clear that these are alternative methods, i.e. usually at least one method must be selected (paragraph 2.2.5, section 11).

a. CORRECT, as the justification is correct (see CTFL®) and therefore in ASIL A a method is used that is at least as good as the highly recommended statement coverage for ASIL A. Furthermore, branch coverage is recommended for ASIL A anyway.

b. INCORRECT, as the order of the methods in the table does not matter and for ASIL B, branch coverage is highly recommended as well. Thus, a really plausible content-related justification is necessary to explain why this method is not used.

c. INCORRECT, as the justification does not suffice to eliminate the strongly recommended modified condition decision coverage for ASIL D. This would only be possible, if there were no multiple conditions, as in exactly this special case, 100% MC/DC and 100% branch coverage provide the same result.

d. INCORRECT, as the justification is factually wrong (counter-example: empty else-branches, see CTFL®) and thus, the highly recommended branch coverage for ASIL B is not used.

Questions for the topic „Standards for the testing of E/E-Systems: AUTOSAR"

18. Which of the following statements regarding AUTOSAR is TRUE?

K1

a)	AUTOSAR defines a closed architecture, which can only be used by the companies, who are members of the AUTOSAR consortium.	☐
b)	AUTOSAR is not compliant to international standards.	☐
c)	AUTOSAR supports only AUTOSAR-control units.	☐
d)	AUTOSAR standardizes the basic functionality of the software of automotive control devices.	☒

Justification:

a) INCORRECT, as AUTOSAR defines an open architecture (see item 4 in paragraph 2.3.1).

b) INCORRECT, as AUTOSAR is compliant with international standards (see item 9 in paragraph 2.3.1).

c) INCORRECT, as AUTOSAR supports a variety of domains (see item 3 in paragraph 2.3.1).

d) CORRECT, see item 8 in paragraph 2.3.1.

19. Which of the following statements regarding AUTOSAR is TRUE?

K1

a)	The integration test of the AUTOSAR software in a virtual test environment cannot be implemented, as real hardware is necessary.	☐
b)	The RTE is a suitable test interface for the system test of the software.	☒
c)	The AUTOSAR acceptance test must be performed to prove the AUTOSAR conformity of the software.	☐
d)	AUTOSAR-specific tests are limited to the software of a single control device.	☐

Justification:

a) INCORRECT, as AUTOSAR SW-C can be tested virtually in an RTE-Simulation (see first bullet point in paragraph 2.3.3).

b) CORRECT, as the RTE can be used for stimulating the software (see first/second bullet point in paragraph 2.3.3).

c) INCORRECT, as the AUTOSAR acceptance test is optional (see third bullet point in paragraph 2.3.3).

d) INCORRECT, as AUTOSAR also provides the infrastructure for a functionality spread over several electronic control units via VFB and therefore supports cross-control unit tests (see fourth bullet point in 2.3.3).

Questions for the topic „Standards for the testing of E/E – Systems: Comparison"

20. Which of the following statements regarding the objectives of Automotive SPICE® and the ISO 26262 is NOT TRUE?

K1

a)	Automotive SPICE® has the objective of rating the capability of the development processes of the sub-contractors by using assessments.	☐
b)	ISO 26262 has the objective of rating the capability of the development processes of the supplier by using assessments.	☒
c)	ISO 26262 has the objective of avoiding risks from systematic errors during development by specifying suitable requirements and processes.	☐
d)	ISO 26262 has the objective of defining requirements for the processes and methods to be used by the tester in the development of E/E-Systems.	☐

Justification:

a) CORRECT, as Automotive SPICE® defines the ability of the product development process (see paragraph 2.4.1, 3rd section), no matter on which supplier level.

b) INCORRECT, as this statement is true for Automotive SPICE® (syllabus paragraph 2.4.1, 3rd section), but not for the ISO 26262.

c) CORRECT, as ISO 26262 is supposed to avoid these risks (see paragraph 2.4.1, 2nd section).

d) CORRECT, as ISO 26262 defines these requirements (see paragraph 2.4.1, 2nd section).

21. Which of the following statements is TRUE?

K2

a)	Automotive SPICE® defines the test techniques to be used for each test level.	☐
b)	ISTQB® defines the test techniques to be used depending on the test levels.	☐
c)	ISO 26262 and Automotive SPICE® define method tables for all mentioned test levels.	☐
d)	Depending on the ASIL, the method tables of the ISO 26262 recommend test techniques that shall be used.	☒

Justification:

a) INCORRECT, as Automotive SPICE® does usually not make any statement regarding the test techniques to be used per test level (see paragraph 2.4.2, 3rd section).

b) INCORRECT, as ISTQB® usually defines the test techniques independently from the test levels (see 2.4.2, 3rd section).

c) INCORRECT, as method tables are only defined by the ISO 26262 and not by Automotive SPICE® (see paragraph 2.4.2, 3rd section).

d) CORRECT, as the ISO 26262 provides method tables and the recommendations of techniques that depend on the ASIL (see paragraph 2.4.2, 3rd section).

Questions for the topic „Testing in virtual environment – Test environments in general "

22. Which items are part of an automotive specific test environment?

K1

a)	Control computer, simulation software, data logger	☒
b)	Real-time capable computer, network accesses, report database	☐
c)	Measuring devices, specification documents, laboratory	☐
d)	Data management tool, operating system, environment model	☐

Justification:

a) CORRECT: As all three items are included in the list in paragraph 3.1.2.

b) INCORRECT: The report database is not part of the test environment as the test report is a downstream step in the test process.

c) INCORRECT: The specification documents are needed in the test design and the test case generation. However, these documents are not part of the test environment.

d) INCORRECT: Data management tools are up- or downstream systems in the test process, which are not part of the test environment.

23. Which interfaces are used to collect and distribute information in an electronic control unit (ECU)?

K1

a)	Environment model, bus system and diagnosis interface	☐
b)	Analogue and digital inputs, watchdog and internal data memory	☐
c)	Analogue and digital inputs, supply voltage and diagnosis interface	☐
d)	Analogue and digital inputs, bus system and diagnosis interface	☒

Justification:

a) INCORRECT: The environment model does not belong to the electronic control unit (ECU).

b) INCORRECT: The watchdog is not an interface, but a supervision mechanism of the software processes.

c) INCORRECT: The supply voltage is not an information carrier.

d) CORRECT: All three interfaces are mentioned in 3.1.4 (first and second section) as information interfaces.

24. Which of the statements is true?

K2

a)	In a closed-loop-system, the output signals of the test object are directly linked to the inputs of the test object.	☐
b)	In a closed-loop-system, the output signals of the test object are linked to the inputs of the test object via an environment model.	☒
c)	In an open-loop-system, the output signals of the test object are directly linked to the inputs of the test object.	☐
d)	In an open-loop-system, the output signals of the test object are linked to the inputs of the test object via an environment model.	☐

Justification:

a) INCORRECT: In a closed-loop-system the link of the output signals to the inputs of the test object is not direct, but via the environment model (compare first section in paragraph 3.1.3.2).

b) CORRECT: The stimulation in the closed-loop-system takes into consideration the outputs of the test object (compare first section in paragraph 3.1.3.2).

c) INCORRECT: This statement describes a closed-loop-system (compare first section in paragraph 3.1.3.2).

d) INCORRECT: This statement is an extension of answer c.) and describes a closed-loop-system (compare first section in paragraph 3.1.3.2).

Questions for the topic ”Testing in virtual environment: XIL – Test environments “

25. Which of the following statements is NOT true?

K1

a)	In the Model-in-the-Loop (MiL) test environment, the test object is readable for humans.	☐
b)	In the Model-in-the-Loop (MiL) test environment, the test object exists as a model.	☐
c)	In the Model-in-the-Loop (MiL) test environment, additional hardware is necessary.	☒
d)	A Model-in-the-Loop (MiL) test environment is used early in the development process.	☐

Justification:

a) INCORRECT: The test object is readable for humans, as it exists as a model and is not yet compiled (compare paragraph 3.2.1.1).

b) INCORRECT: The test object in a Model-in-the-Loop (MiL) test environment is usually a model and not yet compiled (compare paragraph 3.2.1.1).

c) CORRECT: The Model-in-the-Loop (MiL) test environment does not need additional hardware (compare paragraph 3.2.1.1).

d) INCORRECT: The environment model of a Model-in-the-Loop (MiL) test environment is usually implemented in the same development environment as the test object and can therefore be used very early in the development process (compare paragraph 3.2.1.1).

26. Which of the following statements is NOT true?

K1

a)	In the Software-in-the-Loop (SiL) test environment, additional hardware is necessary.	☒
b)	In the Software-in-the-Loop (SiL) test environment, the test object exists as compiled object code.	☐
c)	In the Software-in-the-Loop (SiL) test environment, a wrapper is necessary to stimulate and observe inputs and outputs.	☐
d)	In the Software-in-the-Loop (SiL) test environment, the number of access points is limited by the wrapper.	☐

Justification:

a) CORRECT: Test execution takes place on a computer without specific hardware (compare second section in paragraph 3.2.2.1), i.e. no additional hardware is necessary.

b) INCORRECT: The source code of the test object is compiled (compare first section in paragraph 3.2.2.1).

c) INCORRECT: A wrapper generates access points in the test object (compare first section in paragraph 3.2.2.1).

d) INCORRECT: The number of access points is limited by the wrapper (compare first section in paragraph 3.2.2.1).

27. Which tests are typically performed in a Software-in-the-Loop (SiL) test environment?

K1

a)	Tests of the response time for diagnosis requests.	☐
b)	Tests for electromagnetic compatibility.	☐
c)	Performance tests of the target hardware.	☐
d)	Interface and integration tests.	☒

Justification:

a) INCORRECT: Realistic runtimes of diagnosis requests can only be determined, if the environment model simulated the target hardware in detail, because the target hardware is not available in the Software-in-the-Loop (SiL) test environment (compare first section in paragraph 3.2.2.2, last sentences). Such tests would typically be carried out in a Hardware-in-the-Loop (HiL) test environment, as a detailed hardware simulation takes a lot of effort.

b) INCORRECT: EMV-Tests are only possible in Software-in-the-Loop (SiL) test environment if the environment model would simulate the target hardware in detail, because the target hardware is not available in Software-in-the-Loop (SiL) test environment (compare first section in paragraph 3.2.2.2, last sentence). Such tests would typically be carried out in a Hardware-in-the-Loop (HiL) test environment, as a detailed hardware simulation takes a lot of effort.

c) INCORRECT: As no hardware exists yet, performance tests are impossible to implement in a Software-in-the-Loop (SiL) test environment (compare second section in paragraph 3.2.2.2).

d) CORRECT: Interface and integration tests are typical parts of a Software-in-the-Loop (SiL) test environment (compare second section in paragraph 3.2.2.2).

28. Which three items are all parts of a Hardware-in-the-Loop (HiL) test environment?

K1

a)	Test case generator, rest bus simulation, power supply	☐
b)	Breakout box, software compiler, real parts	☐
c)	Power supply, real-time capable computer, electric error simulation	☒
d)	Electric error simulation, signal processing, processor simulation	☐

Justification:

a) INCORRECT: The test case generator is a software tool for the generation of test cases and is not part of the test environment.

b) INCORRECT: The software compiler is part of the build environment and is not part of the test environment.

c) CORRECT: The listed parts are all included in the list from paragraph 3.2.3.1.

d) INCORRECT: The processor simulation is not a part of the Hardware-in-the-Loop (HiL) test environment, as real hardware is available for the test object.

29. Which statement regarding the test environment is true?

K1

a)	For integration tests is only the Hardware-in-the-Loop (HiL) test environment suitable.	☐
b)	For component tests a Model-in-the-Loop (MiL) test environment and Software-in-the-Loop (SiL) test environment are both suitable.	☒
c)	For system tests, a Model-in-the-Loop (MiL) and Hardware-in-the-Loop (HiL) test environments are both suitable.	☐
d)	Any XiL test environment can be used on every test level.	☐

Justification:

a) INCORRECT: Model-in-the-Loop (MiL) and Software-in-the-Loop (SiL) test environments are suitable mainly for integration tests. The Hardware-in-the-Loop (HiL) test environment is specialized to system tests (compare third section in paragraph 3.2.4.3).

b) CORRECT: Model-in-the-Loop(MiL) and Software-in-the-Loop(SiL) test environments are suitable for component test (compare first and second section in paragraph 3.2.4.3).

c) INCORRECT: A Model-in-the-Loop (MiL) test environment is not suitable for system tests (compare first section in paragraph 3.2.4.3).

d) INCORRECT: Not every test environment can be used on every test level (compare paragraph 3.2.4.3).

30. Which statement regarding a Model-in-the-Loop (MiL) test environment is most likely TRUE?

K2

a)	The test execution duration of the simulation depends on the complexity of the model and the computing power of the test system.	☒
b)	Access to bus and diagnosis interfaces are implemented in the environment.	☐
c)	The environment model provides extensive implementations of physical processes (like for example electromagnetic compatibility or cable breaks).	☐
d)	The simulation of the Model-in-the-Loop (MiL) test environment can only be started and stopped. Pausing the simulation is not possible.	☐

Justification:

a) CORRECT: The more complex a system, the more computing time or more power a computer needs to provide all information (compare third section in paragraph 3.2.1.2).

b) INCORRECT: These access points are not common in the Model-in-the-Loop (MiL) test environment (compare second section in paragraph 3.2.1.2).

c) INCORRECT: This implementation is not common in the Model-in-the-Loop (MiL) test environment (compare second section in paragraph 3.2.1.2).

d) INCORRECT: Pausing is one of the biggest advantages of a Model-in-the-Loop (MiL) test environment (compare fourth section in paragraph 3.2.1.2).

31. Which test is typically performed at a Component Hardware-in-the-Loop (HiL) test environment?

K2

a)	Test of the overall system requirements for the vehicle.	☐
b)	Test of the driving behavior of the chassis.	☐
c)	Test of the electronic control unit functions for correct behavior.	☒
d)	Test of the data exchange between the electronic control units.	☐

Justification:

a) INCORRECT: The overall system requirements can be tested at the system HiL, but not at the Component Hardware-in-the-Loop (HiL) test environment (compare second section in paragraph 3.2.3.2).

b) INCORRECT: The driving behavior is a complex function and is carried out by several electronic control units. Thus, the Component Hardware-in-the-Loop (HiL) test environment is not suitable (compare second section in paragraph 3.2.3.2).

c) CORRECT: At the Component Hardware-in-the-Loop (HiL) test environment, single electronic control units and their functions are tested (compare second section in paragraph 3.2.3.2).

d) INCORRECT: To test the data exchange between electronic control units, at least two electronic control units (ECU´s) are necessary. Thus, those tests must be carried out at the System Hardware-in-the-Loop (HiL) test environment (compare second section in paragraph 3.2.3.2).

32. Which statement is TRUE?

K2

a)	The cost of a detected error in the test object is highest if the error is found in the Model-in-the-Loop (MiL) test environment.	☐
b)	A Hardware-in-the-Loop (HiL) test environment is a more realistic test environment than a Software-in-the-Loop (SiL) test environment.	☒
c)	The amount of effort for design, commissioning and maintenance of a Hardware-in-the-Loop (HiL) test environment is lower than a Software-in-the-Loop (SiL) test environment.	☐
d)	Hardware components are tested in a Software-in-the-Loop (SiL) test environment.	☐

Justification:

a) INCORRECT: The cost for error handling increases in the test environments in the following order: MiL, SiL, HiL test environment (compare second row in the table in paragraph 3.2.4.1). Costs are therefore lowest in the Model-in-the-Loop (MiL) test environment.

b) CORRECT: The closeness to reality increases in the test environments in the following order: MiL, SiL, HiL test environment (compare first row in the table in paragraph 3.2.4.1). The HiL test environment is the most realistic in comparison to the other test environments.

c) INCORRECT: The effort for the commissioning and maintenance increases in the test environments in the following order: MiL, SiL, HiL test environment (compare third row in the table in paragraph 3.2.4.1). The efforts are therefore highest in the Hardware-in-the-Loop (HiL) test environment.

d) INCORRECT: The necessary level of maturity of the test object increases in the test environments in the following order: MiL, SiL, HiL test environment (compare fifth row in the table in paragraph 3.2.4.1). In a Software-in-the-Loop (SiL) test environment the test object typically does not include target hardware, but only the software (compare paragraph 3.2.2.1).

33. **You are a member of a test team and you are to test the software code of an electronic control unit. The electronic control unit has been provided as a model and as a development board by the development team, as no electronic control unit hardware is available yet. The test is supposed to ensure the mechanisms for error detection and error handling in the electronic control unit work properly.**

Which test environment is to be preferred in this situation given the test types?

K3

a)	A Hardware-in-the-Loop (HiL) test environment, as errors for the test of the error handling can only be simulated in this test environment.	☐
b)	A Software-in-the-Loop (SiL) test environment, as development boards are available and error detection is to be tested.	☐
c)	A Model-in-the-Loop (MiL) test environment, as no hardware is available yet and the test object is available as a model.	☒
d)	If no electronic control unit hardware is available, the software cannot be tested.	☐

Justification:

a) INCORRECT: As there is no hardware, which can be used in the Hardware-in-the-Loop (HiL) test environment (compare first section in paragraph 3.2.3.1).

b) INCORRECT: As a Software-in-the-Loop (SiL) test environment does not require additional hardware like a development board (compare second section in paragraph 3.2.2.1).

c) CORRECT: As no hardware is available and the test object is available as a model, a Model-in-the-Loop (MiL) test environment is to be preferred (compare paragraph 3.2.1.1 and table 4, 2nd item in paragraph 3.2.4.2).

d) INCORRECT: Even without the hardware, tests are already possible (see Model-in-the-Loop (MiL) and Software-in-the-Loop (SiL) test environments; compare paragraph 3.2.1.1 and 3.2.2.1).

Questions for the topic ”Static test techniques“

34. Which statement regarding coding standards is TRUE?

K1

a)	A coding standard defines the necessary test practices (e.g. test techniques, test logging).	☐
b)	A coding standard defines the necessary test specification languages (e.g. test automation, test case selection).	☐
c)	A coding standard defines the necessary development practices (e.g. commenting, naming conventions).	☒
d)	A coding standard defines the necessary modelling techniques (e.g. states, state transitions).	☐

Justification:

a) INCORRECT: not compliant with the definition of the term.

b) INCORRECT: not compliant with the definition of the term.

c) CORRECT: see definition of the term.

d) INCORRECT: not compliant with the definition of the term.

35. Which of the following statements regarding MISRA C:2012 is TRUE?

K2

a)	Rules of the category required must not be neglected by the developer, even if he gives a reason.	☐
b)	The binding character of guidelines is predefined for every organization.	☐
c)	Rules of the category mandatory should avoid typical coding anomalies.	☒
d)	MISRA guidelines are fully testable by static analysis tools.	☐

Justification:

a) INCORRECT, see 4th bullet point in chapter 4.1.1: „required" guidelines may only be disregarded by the developer, if he can provide a compelling reason.

b) INCORRECT, see last sentence in chapter 4.1.1: Organizations can intensify the binding character of a rule for themselves.

c) CORRECT, see introduction in chapter 4.1.1: Coding standards help to avoid anomalies. Typical violation of coding standards are part of these anomalies.

d) INCORRECT, see second bullet point in chapter 4.1.1: Directives are not fully testable by static analysis tools.

36. The requirements for a car radio on system level are given below:

1) **After switching it on, the system shows the message „Welcome“ for 3 seconds.**
2) **In a switched on state, the radio is in one of the states „active“, „passive“ or „in maintenance“ and in a switched off state the last state is saved.**
3) **In a switched on state the radio function is engaged by pressing the button „Radio”.**
4) **If the CD function is engaged and no CD is in the drive, the system shows the message “No Disc”.**

Which of the following statements about the given quality criteria for requirements according to ISO/IEC/IEEE 29148 is TRUE?

K3

a)	Requirement 1 is not verifiable.	☐
b)	Requirement 2 is not singular.	☒
c)	Requirement 3 is inconsistent.	☐
d)	Requirement 4 is not unambiguous.	☐

Justification:

a) INCORRECT: The requirement is verifiable, and can thus be verified in an easy system test.

b) CORRECT: The requirement 2 can be split in two partial requirements: in the one about the inner states in a switched on state and in the statement about the switched off state.

c) INCORRECT: the requirement 3 is not inconsistent.

d) INCORRECT: The test requirements are unambiguous. It is mentioned clearly what should be considered.

Questions for the topic ”Dynamic test techniques“

37. Which of the following statements regarding requirement based tests is CORRECT?

K1

a)	Requirement based tests are only focused on the coverage of requirements and do not allow the use of intuitive or explorative tests.	☐
b)	Requirement based tests have the objective to test the requirements until they are consistent and complete.	☐
c)	Requirement based tests have the objective to cover requirements with test cases.	☒
d)	Requirement based tests verify the test object independently from the quality of the customer requirements for the fulfilment of customer requests.	☐

Justification:

a) INCORRECT: see second section in paragraph 4.2.4.

b) INCORRECT: Requirements are the basis here, not the test object. The described technique would also be more a review of the requirements.

c) CORRECT: see first section in paragraph 4.2.4.

d) INCORRECT: see third section in paragraph 4.2.4.

38. Which of the following statements is NOT a description of a fault injection test?

K2

a)	Fault injection tests insert faults in the behavior of external components to detect that the system can deal with erroneous situations.	☐
b)	Fault injection tests insert faults in internal interfaces, e.g. as lost messages.	☐
c)	Fault injection tests insert faults in the system specification, e.g. as too low parameters for the required performance.	☒
d)	Fault injection tests insert faults in the operating unit that show as internal defects.	☐

Justification:

a) INCORRECT, this statement is correct, see paragraph 4.2.3, first bullet point.

b) INCORRECT: this statement is correct, see paragraph 4.2.3, second bullet point.

c) CORRECT: this statement is wrong, as fault injection tests are not about errors in requirements, but about errors in the system, see 2nd sentence in paragraph 4.2.3.

d) INCORRECT, this statement is correct: see paragraph 4.2.3, third bullet point.

39. What is especially important in the selection of test design techniques in the context of ISO 26262?

Choose the BEST POSSIBLE answer.

K3

a)	White-box-test design techniques should be preferred over black-box-test design techniques, as the tester can take advantage of knowledge of the code.	☐
b)	The recommendation of the ISO 26262 for the identified ASIL is the decisive factor for the selection of the test design techniques.	☐
c)	The combination of the suitability of the test basis and the test level together with a high risk of non-detected errors is the decisive factor for the test design techniques to be selected.	☒
d)	Intuitive test design techniques should always be preferred over structure based test design techniques.	☐

Justification:

a) INCORRECT: Each test technique has its own strengths and weaknesses. None of them should generally be preferred over another. Especially if the source code as a starting point does not exist, white box test design techniques cannot be used.

b) INCORRECT: see paragraph 4.2.5: The selection depends on several factors, not only on the ASIL. Mentioned are: state of the art, test basis, risk observation, test level.

c) CORRECT: see 4.2.5: The selection depends on several factors. Even though the mentioning of the ASIL as stated in table 6 of the syllabus is missing, the mentioning of 3 of the most principal factors makes this answer the closest to perfect.

d) INCORRECT: If this was the case, then one would not need to include the white-box-test design techniques in the considerations about the different test techniques. Especially if it is about the coverage of the source code, structure based techniques are the method of choice.

40. **Below is a decision with three single conditions (B1 AND B2) OR B3. The task for the tester is to design test cases according to the principle of the modified condition decision test (MC/DC).**

The tester has already designed three test cases:

1) **B1 = TRUE, B2 = TRUE, B3 = FALSE**
2) **B1 = FALSE, B2 = TRUE, B3 = FALSE**
3) **B1 = FALSE, B2 = TRUE, B3 = TRUE**

Which of the following test cases is necessary to achieve 100% modified condition decision coverage?

K3

a)	B1 = TRUE, B2 = FALSE, B3 = TRUE	☐
b)	B1 = TRUE, B2 = TRUE, B3 = TRUE	☐
c)	B1 = FALSE, B2 = FALSE, B3 = FALSE	☐
d)	B1 = TRUE, B2 = FALSE, B3 = FALSE	☒

Justification:

The following truth table belongs to the decision (B1 AND B2) OR B3:

B1	B2	B3	(B1 AND B2) OR B3
TRUE	TRUE	TRUE	TRUE
TRUE	TRUE	FALSE	TRUE
TRUE	FALSE	TRUE	TRUE
TRUE	FALSE	FALSE	FALSE
FALSE	TRUE	TRUE	TRUE
FALSE	TRUE	FALSE	FALSE
FALSE	FALSE	TRUE	TRUE
FALSE	FALSE	FALSE	FALSE

This shows that the three given test cases show the influence of the requirements B1 and B3 on the result: The tests 1 and 2 only differ by the value for B1 and lead to a different result. For B3, it is tests 2 and 3. Between tests 1 and 3, several requirements are changed. Thus, a test is missing, which shows the isolated influence of B2.

a) INCORRECT: this test does not show the impact of only one parameter in comparison to any of the earlier mentioned tests.

b) INCORRECT: B2 is TRUE. As B2 is always TRUE in the three given tests, it should be FALSE.

c) INCORRECT: is equivalent to test 2, only B2 has changed, but in this test and in test 2, FALSE comes up as a result, so this test is not suitable as a input for the coverage goal of B2.

d) CORRECT: This test shows together with test 1 the isolated influence of B2.

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