



Rewarding Learning

**ADVANCED
General Certificate of Education
2024**

Software Systems Development

Unit A2 1:

Systems Approaches and Database
Concepts

[ADV11]

THURSDAY 23 MAY, AFTERNOON

**MARK
SCHEME**

General Marking Instructions

Introduction

Mark schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

1 (a) *Sample answer:*

The purpose of a feasibility study is to assess several viable alternative solutions looking at cost and benefits of each and making a recommendation. Involves assessing various factors such as technical feasibility, economic viability, legal considerations, and operational feasibility. For example, within TCS, it would ensure that their IT infrastructure can support a new claim form system, compare the costs of manual versus automated processing of claims, ensure compliance with relevant laws, and determine if staff need additional training. Key personnel include the project sponsor (e.g. Jean/Henry), the systems analyst (Catherine) who conducts the study, and the project manager (e.g. Pat) who coordinates the process.

If a decision is taken to go ahead with the project then...

A "Terms of Reference" is established.

This represents an agreement and possibly a legal contract between the customer/business sponsor and the software development consultancy. The Terms of Reference defines the vision, objectives, scope and deliverables for the new project. It also describes the organisation structure; activities, resources and funding required to undertake the project. It may reference other documents such as the feasibility study. Any risks, issues, assumptions and constraints are also identified. Personnel involved in creating the ToR include the project manager, the systems analyst, and a business representative.

Level 1 ([1]–[2])

Overall impression: Basic

Candidate provides a basic answer demonstrating limited knowledge of either feasibility study or Terms of Reference document.

Candidate provides a basic linkage to case study.

Candidate makes only a limited selection and use of an appropriate form and style of writing.

The organisation of the material may lack clarity and coherence.

There is little use of specialist vocabulary.

Presentation, spelling, punctuation and grammar may be such that the intended meaning is not clear.

Level 2 ([3]–[4])

Overall impression: Good

Candidate provides a good answer demonstrating sound knowledge of either feasibility study or Terms of Reference document.

Candidate provides a good linkage to case study.

Candidate makes good selection and use of an appropriate form and style of writing.

Relevant material is organised with some clarity and coherence.

There is good use of specialist vocabulary.

Presentation, spelling, punctuation and grammar are used appropriately so the intended meaning is clear.

Level 3 ([5]–[6])

Overall impression: Excellent

Candidate provides an excellent answer demonstrating comprehensive knowledge of both feasibility study and Terms of Reference document.

Candidate provides excellent linkage to case study.

Candidate makes excellent selection and use of an appropriate form and style of writing.
Relevant material is organised with a high degree of clarity and coherence.
There is excellent use of specialist vocabulary.
Presentation, spelling, punctuation and grammar are used to a high standard so the intended meaning is clear. [6]

(b) Stakeholder Examples:

Stakeholder: Staff/Sally McKenna

Staff are primary users of the form [1]
Staff can provide valuable commentary regarding the problem [1]
Staff can offer relevant suggestions for improvement [1]
Staff want to ensure that correct calculations are made for overtime hours [1]
Any other valid point [1]

Stakeholder: Systems Analyst

Essential that problems are accurately identified [1]
Essential that all necessary requirements are gathered [1]
Requirements must be accurately communicated to the design team [1]
Ensures that a high quality solution is produced to satisfy requirements [1]
Any other valid point [1]

Stakeholder: Owners/Jean/Henry

Understands daily operational challenges with the claim form [1]
Can provide detailed user requirements for the new form [1]
Ensures improvements streamline operations and reduce errors [1]
Ensures necessary resources are available for form improvements [1]

Stakeholder: Administrative Staff/Accountant

Use data from the form to ensure precise overtime payments [1]
Ensure that all calculations related to overtime are accurate [1]
Provide insights on how to improve data entry processes to reduce errors [1]
Suggest enhancements based on daily use [1]

Stakeholder: Developer

Verify that the system meets user requirements and operates correctly [1]
Improve the system's performance and efficiency based on user feedback [1]

*Note: Each point must clearly explain how the chosen stakeholder would be needed to help **resolve the problems with the overtime claims form.***

[1] for identifying any relevant stakeholder

[1] for each valid point (max [2])

[6]

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2 (a)

Key Values of the Agile		
H	over	E
C	over	G
B	over	F
A	over	D

[1] for each correct match (ignore row order)

[3]

(b) Contrast the differences in the key features of Agile and Traditional approaches to systems development, providing examples that illustrate which approach is more suitable for TCS.

Key Feature Differences Between Traditional and Agile Methodologies:

Traditional (e.g. Waterfall):

- Phases and Rigidity: It consists of sequential phases that must be completed before moving to the next. Changes are hard to implement once a phase is completed.
- Documentation: Heavy emphasis on detailed documentation at each phase.
- Customer Involvement: Less frequent client interaction, usually at the beginning and end.
- Delivery Time: Longer delivery time; the complete product is delivered at the end.
- Flexibility: Less adaptable to changes and feedback.
- Management Control: More hierarchical and management-driven.

Agile:

- Iterations and Flexibility: Consists of short iterations with constant reviews and adaptations. It's easier to make changes at any stage of the development.

Example link to case study: By working in short sprints or iterations, the staff at TCS can frequently review and adjust the system's functionality. If an element of the 'Client-Cleaner' matching module isn't working well, it can be revised in the next iteration, ensuring a tailored fit for the business's specific needs.

- Documentation: Focuses on working software over extensive documentation, though documentation is not ignored.

Example link to case study: Rather than waiting for comprehensive documentation, staff at ICS can interact with prototypes or initial versions of the scheduling or overtime billing system, providing feedback based on actual use.

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- Customer Involvement: Regular collaboration with the customer to ensure that the product meets expectations.

Link to case study: Regular collaboration with stakeholders (which could include clients, cleaning staff, and administrative staff) ensures that the software is being developed according to the real needs of the business. For example, if the admin staff need a specific feature to efficiently validate and upload details from the client application forms, their feedback can be incorporated quickly.

- Delivery Time: Shorter delivery time with continuous deployment of smaller, usable pieces of the software.

Example link to case study: Jean and Henry can start implementing functional parts of the system sooner. For instance, if the payments module is completed first, it can be deployed, allowing for immediate benefits while other parts of the system are still under development.

- Flexibility: Highly adaptable to changes and feedback.

Example link to case study: If the business discovers a new requirement, such as integration with a local cleaning equipment supplier's inventory management system, Agile's flexibility allows for such changes to be incorporated without derailing the entire project.

- Team Collaboration: Encourages self-organising teams with frequent communication.

Example link to case study: Encouraging self-organising teams ensures that developers, designers, and stakeholders can work closely together. This might mean faster problem-solving and innovation tailored to the matching process, like creating an algorithm that finds the optimal match based on specific criteria.

Note: any reasonable link to case study is acceptable.

Level 1 ([1]–[3])

Overall impression: Basic

Candidate provides a basic answer demonstrating limited knowledge of either agile or traditional methodologies.

Candidate provides a basic explanation of the key feature differences of agile and traditional methodologies.

Candidate provides a basic example to illustrate why agile is the favourable approach for TCS.

Candidate makes only a limited selection and use of an appropriate form and style of writing.

The organisation of the material may lack clarity and coherence.

There is little use of specialist vocabulary.

Presentation, spelling, punctuation and grammar may be such that the intended meaning is not clear.

Level 2 ([4]–[6])

Overall impression: Good

Candidate provides a good answer demonstrating sound knowledge of both agile and traditional methodologies.

Candidate provides good explanations of the key feature differences of agile and traditional methodologies.

Candidate provides good examples to illustrate why agile is the favourable approach for TCS.
Candidate makes good selection and use of an appropriate form and style of writing.
Relevant material is organised with some clarity and coherence.
There is good use of specialist vocabulary.
Presentation, spelling, punctuation and grammar are used appropriately so the intended meaning is clear.

Level 3 ([7]–[8])


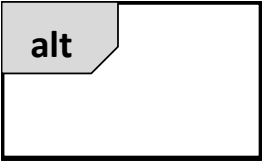




Overall impression: Excellent

Candidate provides an excellent answer demonstrating comprehensive knowledge of both agile and traditional methodologies.
Candidate provides excellent explanations of the key feature differences of agile and traditional methodologies.
Candidate provides excellent examples to illustrate why agile is the favourable approach for TCS.
Candidate makes excellent selection and use of an appropriate form and style of writing.
Relevant material is organised with a high degree clarity and coherence.
There is excellent use of specialist vocabulary.
Presentation, spelling, punctuation and grammar are used to a high standard so the intended meaning is clear. [8]

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3 (a)

Component Symbol	Component Name
<p>A</p> 	<p>Actor</p>
<p>B</p> 	<p>Alternative Frame</p>
<p>C</p> 	<p>Return Message</p>
<p>D</p> 	<p>Activation (box) (allow active/activity box - this year only)</p>
<p>E</p> 	<p>Message (allow outward/forward/send message - this year only)</p>
<p>F</p> 	<p>Lifeline</p>

[1] for each correct component name

[4]

(b) Describe the interactions in the sequence diagram that ensure that there are no missing referees.

[1] for each of the following explanations:

- A CheckRefereeSection() message is sent from the InterviewScheduler object to the Database object [1]
- The Database object sends a RefereeStatus() (return) message to the InterviewScheduler object, indicating whether or not the referee section has been filled. [1]
- If the RefereeStatus() is not set to Filled, then a message is sent to the Candidate requesting referee details. [1]

[3]

Note to examiner: answer should include correct reference to (or obvious description of) CheckRefereeSection, RefereeStatus and whether RefereeStatus is set to 'filled' or not (or a description of what happens if it is filled/is not filled) for credit.

(c) UML Diagram 1: Class Diagrams
Intended Audience type: Developers/Technical users

UML Diagram 2: Use case
Intended Audience type: Business Stakeholders/clients/non-technical users

[4]

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4 Sample Answer:

The Iron Triangle refers to the triple constraints of project management and highlights the interrelationship between **time, cost** and **scope**. Changing one of these aspects will have an impact on the others.

If the interview scheduling system proves more complex to design and implement than what was initially anticipated, it **may lead to a broader scope**, possibly introducing additional tasks or redefining current ones. This expansion **can divert resources from other essential requirements**, like the **matching module or payment and overtime systems** and **could necessitate a reduction in scope of these requirements**. It could also result in **time overruns**. This means **other requirements might face delays**. For instance, the time allocated for the payment system's development and testing might be shortened or postponed, which could affect its efficiency or thoroughness. Increased complexity will **demand more financial resources**, either due to increased labour hours or the need for specialised tools or expertise. This **could stretch the budget**, leaving less room for thorough design, testing or optimisation of other requirements such as application management module.

Pat could employ several strategies to manage the project effectively. She could **utilise project management** tools like PERT charts to identify and leverage slack time, allowing Pat to reallocate resources to more pressing tasks, ensuring that bottlenecks are minimised and that all requirements such as the overtime system, progress efficiently. While the interview scheduling system is important, if it's becoming a drain on resources, it might be worth **revisiting and reducing the initial scope**. Perhaps some features can be streamlined or rolled out in phases rather than all at once.

Level 1 ([1]–[2])

Overall impression: Basic

Candidate provides a basic answer demonstrating limited knowledge and understanding of the Iron Triangle.

Candidate provides a basic explanation of how an increase in complexity for the interview scheduling requirement can impact the other constraints of the Iron Triangle.

Candidate identifies few requirements that may be affected.

Candidate makes only a limited selection and use of an appropriate form and style of writing.

The organisation of the material may lack clarity and coherence.

There is little use of specialist vocabulary.

Presentation, spelling, punctuation and grammar may be such that the intended meaning is not clear.

Level 2 ([3]–[4])

Overall impression: Good

Candidate provides a good answer demonstrating sound knowledge and understanding of the Iron Triangle.

Candidate provides a good explanation of how an increase in complexity for the interview scheduling requirement can impact the other constraints of the Iron Triangle.

Candidate identifies other requirements that may be affected.

Candidate makes good selection and use of an appropriate form and style of writing.

Relevant material is organised with some clarity and coherence.

There is good use of specialist vocabulary.

Presentation, spelling, punctuation and grammar are used appropriately so the intended meaning is clear.

Level 3 ([5]–[6])

Overall impression: Excellent

Candidate provides an excellent answer demonstrating comprehensive knowledge and understanding of the Iron Triangle.

Candidate provides a comprehensive explanation of how an increase in complexity for the interview scheduling requirement can impact the other constraints of the Iron Triangle.

Candidate fully identifies and explains how other requirements may be affected.

Candidate makes excellent selection and use of an appropriate form and style of writing.

Relevant material is organised with a high degree clarity and coherence.

There is excellent use of specialist vocabulary.

Presentation, spelling, punctuation and grammar are used to a high standard so the intended meaning is clear.

[6]

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5 (a)

Test Data	Reason for Test Data	Expected Outcome
Day Worked: Weekday (allow explicit weekday e.g. Monday) Time Period: 9am – 5.30pm Specialist Code: Null allow 'None'	To ensure that the base rate is applied.	Base rate applied.
Day Worked: Saturday/Sunday Time Period: 9am – 5.30pm Specialist Code: S1/S2/S3	To ensure that the base rate +18% is applied	Base rate applied + 18% applied.

[1] for each correct test data

[6]

(b) *Answers should include the following:*

Extreme Test Data: Extreme, or boundary, testing involves providing inputs at the very edge of what is considered valid. For example, time period values can only be between 06:00 and 22:00. Extreme test data would be 06:00 and 22:00. These tests are important because software often fails at the boundaries.

Erroneous/Invalid Test Data: Invalid data testing ensures that the software can effectively handle inputs that it should not accept. This can involve inputs outside the allowable range or inputs of the wrong data type. This is important to test, as a robust software solution should not crash or behave unpredictably when it encounters invalid data. For example, entering a code such as T1, which does not exist.

Null Test Data: Null testing involves providing no input (or a null value) when input is expected. This can test for issues with how the software handles the absence of data, for example leaving Specialist Code blank in test 1 (or entering null).

Using all four types of test data helps to ensure that a software solution is robust and reliable, regardless of the input it receives.

Level 1 ([1]–[2])

Overall impression: Basic

Candidate provides a basic answer demonstrating limited knowledge and understanding of test data.

Candidate provides basic examples of how test data could be applied for overtime rates.

Candidate makes only a limited selection and use of an appropriate form and style of writing.

The organisation of the material may lack clarity and coherence.

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There is little use of specialist vocabulary.
Presentation, spelling, punctuation and grammar may be such that the intended meaning is not clear.

Level 2 ([3]–[4])

Overall impression: Good

Candidate provides a good answer demonstrating sound knowledge and understanding of test data.

Candidate provides good examples of how test data could be applied for overtime rates.

Candidate makes good selection and use of an appropriate form and style of writing.

Relevant material is organised with some clarity and coherence.

There is good use of specialist vocabulary.

Presentation, spelling, punctuation and grammar are used appropriately so the intended meaning is clear.

Level 3 ([5]–[6])

Overall impression: Excellent

Candidate provides an excellent answer demonstrating comprehensive knowledge and understanding of test data.

Candidate provides excellent examples of how test data could be applied for overtime rates.

Candidate makes excellent selection and use of an appropriate form and style of writing.

Relevant material is organised with a high degree clarity and coherence.

There is excellent use of specialist vocabulary.

Presentation, spelling, punctuation and grammar are used to a high standard so the intended meaning is clear. [6]

6 Databases – missing words/phrases

Databases come in various types, but the three most common ones are the **relational**, **hierarchical**, and **network** models. The **relational** model is widely used today due to its flexibility and efficiency. It organises data into **tables** and relationships are established using **primary key** and **foreign key** concepts.

*Note: For "relational, hierarchical and network models" in the paragraph above, the words **relational**, **hierarchical** and **network** are interchangeable*

In contrast, the **hierarchical** model organises data in a **parent-child** structure, much like a family tree. The **network** model is similar, but it allows a **child** to have multiple **parents**, creating a more complex set of relationships.

A critical part of modern database design is the **entity-relationship** model.

This method of database design involves identifying **entities** and their **attributes/relationships**, as well as the **relationships/cardinality** between them.

*Note: Accept only **one** instance of 'relationships' in the sentence above*

The **cardinality** of a relationship, that is, the number of instances of an **entity** that can be associated with instances of another, is a crucial aspect of this model.

It's important to note that all these operations and manipulations are made possible by a database **management** system, which uses languages like **SQL** for data manipulation and definition.

[1] for each **two** correct answers

[10]

10

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7 (a) Max [3] marks for inclusion of the following:

- Reduces data redundancy [1]
- Increases data integrity [1]
- Prevents inconsistency [1]
- Simplifies database design [1]

Sample answer:

Normalising data in database systems ensures efficiency, accuracy, and reliability. It eliminates redundant data, conserving storage space and preventing inconsistencies that can arise from data duplication. By promoting data integrity, normalisation ensures the reliability and consistency of the data. Normalisation simplifies database design, making it easier to maintain. [3]

(b) (i) Remove repeating groups [1]

(ii) Remove partial key dependencies [1]

(iii) Remove non-key/transitive dependencies [1] [3]

(c) 1NF

OTMONTH_STAFF

OTMonthID, StaffID, FName, SName, EmploymentType, ContractHours, FormReceived

OTMONTH_STAFF_DATE

OTMonthID*, StaffID*, OTDate, StartTime, EndTime, DayType

OTMONTH_STAFF_DATE_SPECIALIST

OTMonthID*, StaffID*, OTDate*, SpecialistID

[1] each fully correct table including PK/FK notation [3]

2NF

OTMONTH_STAFF

OTMonthID, StaffID*, FormReceived

STAFF

StaffID, FName, SName, EmploymentType, ContractHours

OTMONTH_STAFF_DATE

OTMonthID*, StaffID*, OTDate, StartTime, EndTime, DayType

OTMONTH_STAFF_DATE_SPECIALIST

OTMonthID*, StaffID*, OTDate*, SpecialistID

[1] New **STAFF** table

[1] New PK

[1] New FK [3]

3NF

[1] for acknowledgement that tables are already in 3NF [1]

- 8 (a) INSERT INTO STAFF_AVAILABILITY (StaffID, SlotID)
VALUES
(3, 1),
(3, 2);
- INSERT INTO [1], table name [1], VALUES [1], values correctly inserted [1]
Allow two separate INSERT statements [4]
- (b) UPDATE STAFF_SPECIALTY
SET SpecialID = 3
WHERE StaffID = 3 AND SpecialID = 2;
- Update table [1]
Set correct [1]
Where StaffID = 3 [1]
AND SpecialID = 2 [1] [4]
- (c) (i) ALTER TABLE STAFF
ADD StartDate DATE DEFAULT GETDATE());
- ALTER TABLE [1] STAFF [1]
ADD (COLUMN) StartDate DATE [1] DEFAULT GETDATE() [1] [4]
- (ii) NULL [1]
- (d) SELECT
T.TownName,
COUNT(DISTINCT S.StaffID) AS NumberOfCleaners
FROM
STAFF S
INNER JOIN
STAFF_SPECIALTY SS ON S.StaffID = SS.StaffID
INNER JOIN
STAFF_AVAILABILITY SA ON S.StaffID = SA.StaffID
INNER JOIN
TOWN T ON S.StaffTownID = T.TownID
WHERE
DATEDIFF(YEAR, S.StartDate, GETDATE()) >= 5
AND SS.SpecialID = 4
AND SA.SlotID != 5
GROUP BY
T.TownName
- Sample alternative if using DATEADD instead of DATEDIFF:
DATEADD(YEAR, 5, S.StartDate) <= GETDATE()*

[1] SELECT includes TownName
 [1] COUNT (must include StaffID)
 [1] DISTINCT
 [1] FROM
 [1] **Each** JOIN
 [1] WHERE includes DATEDIFF/DATEADD
 [1] DATEDIFF/ DATEADD correct
 [1] AND specialID = 4
 [1] AND slotid != 5
 [1] GROUP BY (must include all fields in the SELECT that are not part of an aggregate function)

[12]

Total

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25

100