Rewarding Learning

ADVANCED
General Certificate of Education
2015

Software Systems Development

Unit A2 1:

Systems Approaches and Database Concepts

[A2S11]

MONDAY 11 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 Methodologies

Waterfall		SCRUM	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Linear step by step model therefore simpler to understand and manage. Documentation of each stage can be useful for understanding especially in large well defined projects.	Rigid progress through the steps – if an earlier step was not correct causes complications later on e.g. incorrect customer requirements or incorrect design. Customer has limited involvement at beginning and will not see product until the end. Testing is performed at a later stage – delays detection of errors – more costly to fix.	Highly visible progress through continual product releases and high involvement of stakeholders. Facilitates change and therefore good for innovative and novel projects where requirements are uncertain. Daily meetings mean: issues raised at meetings at an early stage; high level of communication between stakeholders; team member's productivity apparent. Minimal Documentation.	Require a big commitment from designated users. Intense lifecycle with frequent product releases and change – demanding on team members. Resources required for daily scrum meetings and frequent reviews. Difficult to plan and structure at the beginning as lacks definition – difficult to produce business plan with costs and estimates.

(4 × [1])   [4]
Other valid answers will be given credit.

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2 Project Management

Management Area	Suggested Activities
Time management	Estimation of time for each activity. Create schedule of activities as a Gantt or PERT chart. Monitor progress over time to check for delays. Take corrective action to ensure deadlines met.
Resources	Identify resources such as staff and equipment and their availability. Estimate costs and prepare budget. Recruit Team. Manage team and conflict.
Risk	Identify and assess risks. Suggest action to be taken if risk occurs. Create contingency plan. Create and review risk log.

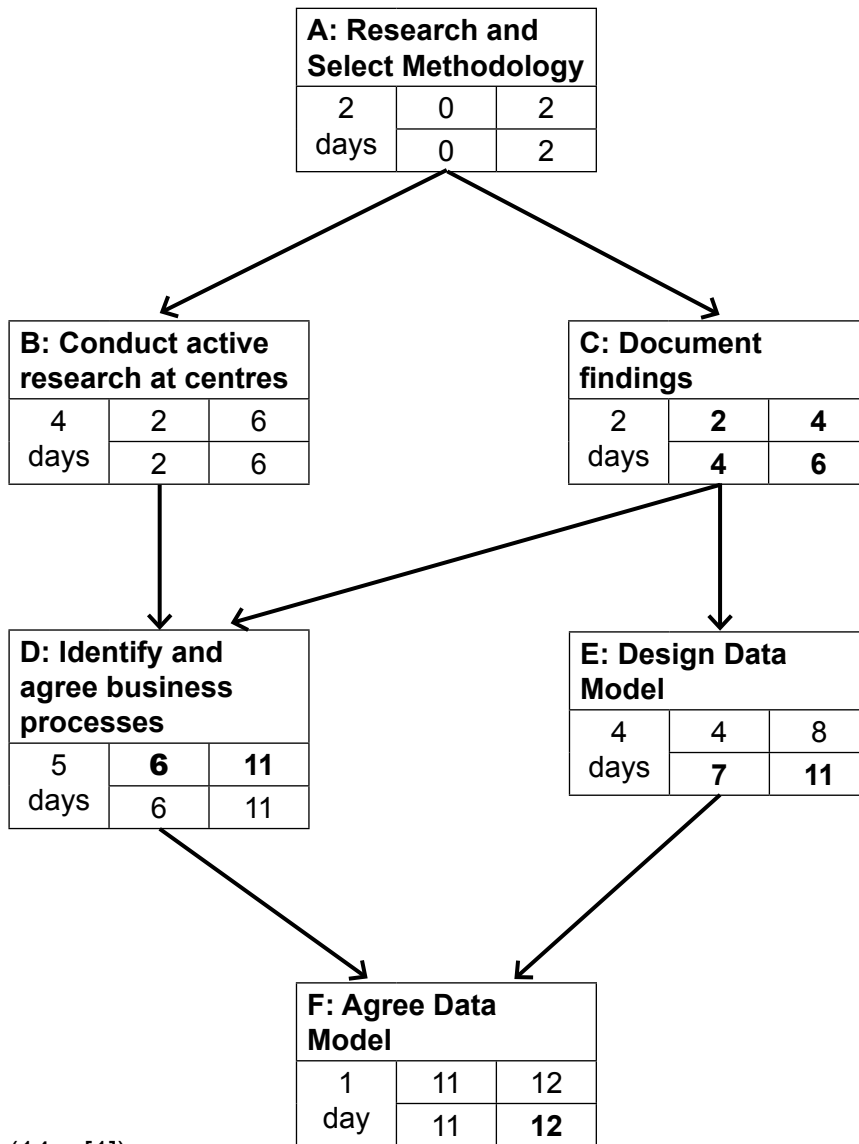(3 × [2])   [6]
Other valid answers will be given credit.

6

3 PERT Chart

(a)

A: Research and Select Methodology		
2	0	2
days	0	2

B: Conduct active research at centres		
4	2	6
days	2	6

C: Document findings		
2	**2**	**4**
days	**4**	**6**

D: Identify and agree business processes		
5	**6**	**11**
days	6	11

E: Design Data Model		
4	4	8
days	**7**	**11**

F: Agree Data Model		
1	11	12
day	11	**12**

(14 × [1]) [14]
Note: [–1] if no direction indicated for dependency arrows.

(b) It is on the critical path; project is delayed by 2 days at least.
(2 × [1]) for each point. [2]

(c) Add more resources such as staff (costs more); extend working hours.
Scope may be reduced by not implementing the lower prioritised
requirements.
(2 × [1]) for each suggestion or 1 suggestion and explanation.
Other answers may be acceptable. [2]

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4   Problems

Problem	Impact	Database
Equipment unavailable because borrowed by another centre, not repaired.	Dive cancelled.	Prompts for equipment checks, reports on stock levels and flags for equipment needing repair. Request additional non-allocated stock from other centres. Access to information regarding stock levels across all centres.
Sophie needs to receive the instructors Dive diaries to calculate wages on time.	Instructors pay may be delayed.	Concurrent access to database.
Loss of course diary.	Unable to readily replicate past bookings of courses, client details, financial transactions, leading to loss of business and dissatisfied customers.	Backup and recovery systems on the database prevent data loss.

(6 × [1])   [6]
Other valid answers will be given credit.

6

5   Testing

Test planning should only begin after implementation to improve software quality.	FALSE
Acceptance testing involves clients examining program code.	FALSE
Unit testing can be planned even before the code has been written.	TRUE
Integration testing may involve examining how software objects work together to achieve a user goal.	TRUE
Alpha Testing will be performed in a Deeper Dives Centre using real data.	FALSE
It would not be cost effective to test all possible user inputs in the Deeper Dives System.	TRUE

(6 × [1])   [6]

6

6   Use Case Analysis

(a)

(i)	Manager	(iv)	Calculate Wages
(ii)	Instructor	(v)	Manage Stock
(iii)	Co-ordinate Courses	(vi)	Award Certificates

(6 × [1])   [6]

(b) The Manage Hire Use case will use the Check Equipment Use Case.
[AO2]   [1]

(c) Static Model: visualises the system's structure showing its classes (possibly attributes and operations) and the associations between them (with multiplicities at the association ends). Level of detail depends on stage of lifecycle. During analysis classes refer to places, events and things about which the system will capture information. Later during implementation classes can refer to software classes: windows, form and other objects used to build the system.
(2 × [1])   [2]

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7   RDBMS; Normalisation and ER

(a) Relational Database Management Systems

Indicative Answers
- **Data entry with Validation/Constraints:** Check that correctly and completely filled in such as in the Hire Agreement Form (forms with fields allow easier data entry) and the Course Diary (with constraint for number of clients enrolled); useful for recording enquiries.
- **Queries/Reports/Automatic Calculations:** Quick and accurate retrieval of data and complex calculations: such as the courses that an instructor are booked on; recreation of a log book; determination of wages; popular courses highlighted; creation of schedule; dive stats and history.
- **Distributed Access** to data within business and across centres e.g. stock, instructors, courses, dives, logs, certifications. This will help in coordination of courses, allocation of equipment, and customer enquiries. Sophie will know what is happening across all centres and all bookings won't have to go through Sophie.
- **Concurrent Access** to data: E.g. Dive books – Sophie and instructors may need them at the same time. Courses could be updated by all managers.
- **Reminders/prompts and flags:** e.g. when stock is low; status of equipment (e.g. available, hired, unavailable [lost, needs repair, needs retested]; texting instructors/customers with prompt as a reminder.
- **Backup, Recovery and Security:** Possibility of data loss – books are very important to the business and may be lost, e.g. in a fire or damaged. For example course diary, dive and log books. Databases can help with **back-up and recovery** which can be kept in a separate location to the main server. **Security** may also be important – Data Protection Act.

Level 1 ([1]–[2])
Overall Impression: Basic
Candidate provides a basic answer demonstrating a simple knowledge of a relational database management systems;
Candidates will identify a limited number of functions available in a relational database management system and/or provide some simple descriptions of a few advantages relevant to Deeper Dives.
The candidate makes only a limited selection and use of an appropriate form and style of writing.
The organisation of material may lack clarity and coherence.
There is little use of specialist vocabulary.
Presentation, spelling, punctuation and grammar may be such that intended meaning is not clear.

Level 2 ([3]–[4])
Overall Impression: Good
Candidate provides a good answer showing a reasonable understanding of relational database management systems and the advantages to the Deeper Dives business.
Candidates will identify a range of functions available in a relational database management system.
Candidates will provide some examples of how some functions of a relational database management system would benefit Deeper Dives.
The candidate makes a reasonable selection and use of an appropriate form and style of writing.
Relevant material is organised with some clarity and coherence.
There is some use of appropriate specialist vocabulary.
Presentation, spelling, punctuation and grammar are sufficiently competent to make meaning clear.

Level 3 ([5]–[6])
Overall Impression: Excellent
Candidate provides an excellent answer showing thorough understanding of relational database management systems and the advantages to the Deeper Dives business.
Candidates will identify of a wide range of functions available in a relational database management system.
Candidates will provide good examples of how several functions of a relational database management system would specifically benefit Deeper Dives.
The candidate successfully selects and uses the most appropriate form and style of writing.
Relevant material is organised with a high degree of clarity and coherence.
There is widespread and accurate use of appropriate specialist vocabulary.
Presentation, spelling, punctuation and grammar are of a sufficiently high standard to make meaning clear.
All other valid answers will be given credit. [6]

(b) ER and Normalisation

Indicative Content

Answers may cover the areas and points below. Students are not expected to provide all the information below for full marks.

ER Modelling	Top Down High Level Design:- Entities [Objects/Events/ Activities etc – look for nouns], Relations, Attributes. Starts with high level model – aims/goals/strategy of organisation – which is then refined – identification of entities and relationships of interest to organisation – Independent of DBMS/programming language. M:M relationships must be decomposed to 1:M for implementation in relational model [other models are hierarchical or network]. Sometimes hard to discover all entities. Better for complex databases – the Deeper Dives system covers many different areas [Managing Instructors/ Clients/Coordinating Courses/Wages/Stock/Dives/ Equipment Hire/Certification] and is relatively large so it would be of benefit to show how these interrelate at a high level. An entity in the Deeper Dives System could be Instructor with possible attributes of ID, Surname and Firstname. The entity Instructor could have a 1:M relationship with another entity such as Dive.
Normalisation	Bottom Up Formalised Process – begins with attributes – grouped into relations based on primary key and the functional dependencies among their attributes. Begin by analysing outputs/inputs/forms – the details. Involves application of a series of rules – in steps – remove undesirable characteristics/problems. Minimises data redundancy/storage/update anomalies: insertion, deletion and modification. In some cases normalisation Is not desirable: splitting tables requires joins in queries and more processing. In Deeper Dives we do have several documents that could be normalised such as the hire equipment form, the course diary, dive log and dive diary. OK for simple databases with relatively small number of attributes – in Deeper Dives we will probably use it in combination with ER – it can test correctness of the ER model – it is complementary to ER modelling.

Level 1 ([1]–[2])
Overall Impression: Basic
Candidate provides a basic answer demonstrating simple knowledge of the use of ER models and Normalisation to derive a data model.
Candidates provide brief descriptions of the process of ER modelling or normalisation and/or examples of ER modelling or normalisation as applied to Deeper Dives.
The candidate makes only a limited selection and use of an appropriate form and style of writing.
The organisation of material may lack clarity and coherence.
There is little use of specialist vocabulary.
Presentation, spelling, punctuation and grammar may be such that intended meaning is not clear.

Level 2 ([3]–[4])
Overall Impression: Good
Candidate provides a good answer showing a reasonable understanding of knowledge of the use of ER models and Normalisation to derive a data model for Deeper Dives.
Candidates provide descriptions of both ER modelling and normalisation.
Candidates provide examples of ER modelling or normalisation as applied to Deeper Dives.
The candidate makes a reasonable selection and use of an appropriate form and style of writing.
Relevant material is organised with some clarity and coherence.
There is some use of appropriate specialist vocabulary.
Presentation, spelling, punctuation and grammar are sufficiently competent to make meaning clear.

Level 3 ([5]–[6])
Overall Impression: Excellent
Candidate provides an excellent answer showing thorough knowledge of knowledge of the use of ER models and Normalisation to derive a data model for Deeper Dives.
Candidates compare ER modelling and normalisation.
Candidates provide examples of ER modelling or normalisation as applied to Deeper Dives and evaluate the two techniques.
Relevant material is organised with a high degree of clarity and coherence.
There is widespread and accurate use of appropriate specialist vocabulary.
Presentation, spelling, punctuation and grammar are of a sufficiently high standard to make meaning clear.
All other valid answers will be given credit.   [6]

AVAILABLE MARKS
12

8 **Normalisation**

Answer shows each field identified with the first letter of each word/part of word
and # to stand for number or ID. Foreign keys are represented with *. Repeating
groups are contained within {}. Students may name the tables differently and use
different notation.

(a) 1st Normal Form [Remove Repeating Groups – in {}]	**HireAgreement** (HA#, DoH, C#, N, A) **HireEquipment** (HA#*, EP#, D, CoH)	[1] for fields in HireAgreement Table. [1] for fields in HireEquipment Table. [1] for identifying primary and correct associated foreign key in HireAgreement & HireEquipment table.
(b) 2nd Normal Form [Remove Partial Dependencies in HireEquipment Table].	**HireAgreement** (HA#, DoH, C#, N, A) **HireEquipment** (HA#*, EP#*) **Equipment** (EP#, D, CoH,)	[1] for removing correct fields [1] for fields in Equipment Table. [1] for identifying primary key in Equipment table and correct associated EP# foreign key in HireEquipment table.
(c) 3rd Normal Form [Remove Transitive Dependencies in HireAgreement].	**HireAgreement** (HA#, DoH, C#*) **Client** (C#, N, A) **HireEquipment** (HA#*, EP#*) **Equipment** (EP#, D, CoH)	[1] for removing correct fields [1] for fields in Client Table. [1] for identifying primary key in Client table and correct associated C# foreign key in HireAgreement table.

(3 × [3]) [9]

9

9   SQL

```
CREATE TABLE DIVE (

    DiveNo INT PRIMARY KEY
    ,LocationNo INT
    ,DiveTypeNo INT
    ,DiveDate DATE
    ,Depth INT
    ,InstructorID INT
    ,FOREIGN KEY(LocationNo) REFERENCES LOCATION
    ,FOREIGN KEY(DiveTypeNo) REFERENCES DIVETYPE
    ,FOREIGN KEY(InstructorID) REFERENCES INSTRUCTOR
    )
```

[1]   CREATE TABLE DIVE
[2]   DiveNo INT, LocationNo INT, DiveTypeNo INT, DiveDate DATE, Depth INT, InstructorID INT (Award [1] if one column definition is incorrect).
[1]   PRIMARY KEY on DiveNo
[3]   FOREIGN KEY REFERENCES for LocationNo, DiveTypeNo and InstructorID.   [7]

```
SELECT DiveDate, DiveTypeDescription
FROM DIVE
JOIN DIVETYPE ON DIVE.DiveTypeNo=DIVETYPE.DiveTypeNo
JOIN INSTRUCTOR ON INSTRUCTOR.InstructorID=DIVE.InstructorID
WHERE InstructorFirstName='Fred' AND InstructorSurname='Smith'
ORDER BY DiveDate asc
```

[2]   SELECT DiveDate, DiveTypeDescription FROM DIVE
[1]   JOIN DIVETYPE ON DIVE.DiveTypeNo=DIVETYPE.DiveTypeNo
[1]   JOIN INSTRUCTOR ON INSTRUCTOR.InstructorID=DIVE.InstructorID
[2]   WHERE InstructorFirstName='Fred' AND InstructorSurname='Smith'
[1]   ORDER BY DiveDate asc   [7]

```
INSERT INTO DIVE
VALUES (23,3,5,GETDATE (), 30,6);
```

[1]   INSERT INTO DIVE
[1]   VALUES()
[1]   23,3,5,30,6 in correct position
[1]   function like GETDATE() in correct position   [4]

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10   Agile Methodologies

Indicative Answer

Answers may cover the areas and points below. Students are not expected to provide all the information below for full marks.

Delivery on Time and Within Budget	Students may provide some of the following characteristics which help avoid time-consuming corrections at the end of the project affecting the deadline and budget. Continuous customer/business **involvement** from an early stage – helps to **rapidly** and **flexibly** respond to **changing** and **evolving** requirements and increases satisfaction and quality. **Iterative** and frequent **incremental** delivery of working software, **prototyping** and **prioritisation** of requirements; evolving **minimal** documentation. Teams are encouraged to be **self-directing**, **pro-active** taking initiatives, **co-operative** and **collaborative**, **self-organising and cross-functional**. Project managers should be respectful, **facilitative**, supportive and empowering. Teams will then be more motivated and produce better results.
Selected Practices	**Facilitated Workshops:** Fast decision making and agreement; high involvement of participants – more motivated and committed; team building and idea development; issues more easily clarified and misunderstandings prevented. **MoSCoW rules:** A prioritisation technique for requirements: Must Have, Should Have, Could Have, Won't Have. Helps to deliver the most important features first. **Timeboxing:** an agreed fixed period of time in which a task/goal or delivered must be produced with specified resources. – deliver on time by varying the number of requirements but not quality.
Application at Deeper Dives	Application to Deeper Dives may include for example: – how members of Deeper Dives may be involved in team and their importance. – allocation of roles such as: Sponsor (funding), Project Manager, Visionary, Leader, Analyst, Developer, Tester, Advisor (often user of system/knowledge of business rules or regulations), Ambassador (representative of business that will use solution), Facilitator. – examples of a must have requirement in comparison with a could have requirement and how these requirements may be left out of a time box such as Add A Dive Event would be more important than View Dive Statistics. – examples of an incremental delivery, e.g. Manage Instructors delivered as one fully working sub-system.

All other valid answers will be given credit.

	AVAILABLE MARKS

Level 1 ([1]–[3])
Overall Impression: Basic
Candidate provides a basic answer demonstrating simple knowledge of the agile approach to software development.
Candidates identify some characteristics of the agile methodology which can help deliver a high quality system on time and within budget.
The candidate makes only a limited selection and use of an appropriate form and style of writing.
The organisation of material may lack clarity and coherence.
There is little use of specialist vocabulary.
Presentation, spelling, punctuation and grammar may be such that intended meaning is not clear.

Level 2 ([4]–[8])
Overall Impression: Good
Candidate provides a good answer showing a reasonable understanding of the agile approach to software development and selected practices from DSDM.
Candidates describe how some characteristics of the agile methodology can help deliver a high quality system on time and within budget.
Candidates will elaborate their discussion with practices from the DSDM methodology and possibly with examples of their application in the Deeper Dives software development project.
The candidate makes a reasonable selection and use of an appropriate form and style of writing.
Relevant material is organised with some clarity and coherence.
There is some use of appropriate specialist vocabulary.
Presentation, spelling, punctuation and grammar are sufficiently competent to make meaning clear.

Level 3 ([9]–[12])
Overall Impression: Excellent
Candidate provides an excellent answer showing thorough understanding of the agile approach to software development and selected practices from DSDM.
Candidates describe how several characteristics in the agile methodology can help deliver a high quality system on time and within budget.
Candidates will elaborate their discussion with several practices from the DSDM methodology supported by specific examples of their application in the Deeper Dives software development project.
The candidate successfully selects and uses the most appropriate form and style of writing.
Relevant material is organised with a high degree of clarity and coherence.
There is widespread and accurate use of appropriate specialist vocabulary.
Presentation, spelling, punctuation and grammar are of a sufficiently high standard to make meaning clear.
All other valid answers will be given credit. [12]

	12
Total	**100**