

STUDENT NUMBER           Letter

# INFORMATION TECHNOLOGY: SOFTWARE DEVELOPMENT

## Written examination

Friday 14 November 2014

Reading time: 3.00 pm to 3.15 pm (15 minutes)

Writing time: 3.15 pm to 5.15 pm (2 hours)

## QUESTION AND ANSWER BOOK

### Structure of book

Section	Number of questions	Number of questions to be answered	Number of marks
A	20	20	20
B	5	5	20
C	16	16	60
			Total 100

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers and one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

#### Materials supplied

- Question and answer book of 22 pages with a detachable insert containing a case study for Section C in the centrefold.
- Answer sheet for multiple-choice questions.

#### Instructions

- Remove the insert containing the case study during reading time.
- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- All written responses must be in English.

#### At the end of the examination

- Place the answer sheet for multiple-choice questions inside the front cover of this book.

**Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.**

**SECTION A – Multiple-choice questions****Instructions for Section A**

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

**Question 1**

During which stage of the problem-solving methodology should user documentation be produced?

- A. design
- B. analysis
- C. evaluation
- D. development

**Question 2**

Antivirus software

- A. needs to be installed only when your computer is networked.
- B. needs to be installed once you have detected a virus on your computer.
- C. needs to be updated regularly in order to ensure protection from newly created viruses.
- D. works quickest when you install multiple antivirus programs from different companies.

**Question 3**

The maximum amount of data that can be transmitted electronically during a given period of time is known as

- A. frequency.
- B. broadband.
- C. fibre-optic.
- D. bandwidth.

**Question 4**

Spyware, trojans and worms are examples of

- A. spam.
- B. malware.
- C. freeware.
- D. antivirus software.

**Question 5**

Which one of the following statements best describes the purpose of the Open Systems Interconnections (OSI) physical layer?

- A. to route a packet of data through a network to a remote location
- B. to ensure that packets of data received across a network are in the correct order
- C. to ensure that packets of data received across a shared medium are free of errors
- D. to move individual bits of data across a shared medium to another point on the network

Use the following information to answer Questions 6 and 7.

The following algorithm finds a given value of a variable in an array.

```

Begin
  Get idValue
  idx ← 1
  Found ← false
  While idx <= arraylen(array) and Found <> true
    If array[idx] = idValue Then
      Begin
        print 'found the value of idValue'
      EndIf
    idx ← idx + 1
  Endwhile
End

```

### Question 6

The algorithm is using a

- A. quick sort.
- B. bubble sort.
- C. linear search.
- D. binary search.

### Question 7

Which one of the following lines could be inserted into the algorithm to improve its efficiency?

- A. Found ← true
- B. idValue ← idx
- C. idx ← arraylen(array)
- D. print 'the value of idValue not found'

### Question 8

The following algorithm produces an error when tested.

```

Begin
  A ← 12
  B ← 3
  While B >= 0
    A ← A/B
    B ← B - 1
  Print A
  Endwhile
End

```

The reason for this error is

- A. the variable A never changes.
- B. a variable cannot be divided by 0.
- C. the algorithm never exits the loop.
- D. A and B are not good names for variables.

Use the following information to answer Questions 9 and 10.

**Begin**

TotTemp  $\leftarrow$  0

**For** Week  $\leftarrow$  1 to 7

Input (DailyTemp)

TotTemp  $\leftarrow$  TotTemp + DailyTemp

**Endfor**

AveTemp  $\leftarrow$  TotTemp/7

Print ('Average temperature for the week:', AveTemp)

**End**

**Question 9**

Which control structures does the algorithm contain examples of?

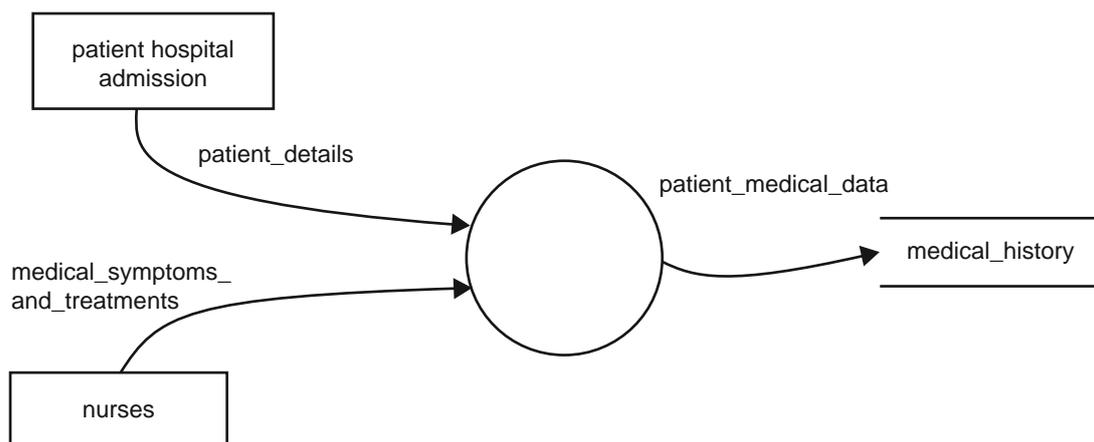
- A. repetition and division
- B. selection and sequence
- C. sequence and repetition
- D. selection and repetition

**Question 10**

The **best** data type for AveTemp is

- A. string.
- B. integer.
- C. Boolean.
- D. floating point.

**Question 11**



Which one of the following statements best describes what is shown in the diagram above?

- A. Two data flows are combined in a data store and sent to a file.
- B. A process reads data from two data stores and combines them into a medical history.
- C. A patient is admitted into a hospital and their medical details are recorded in a hospital file.
- D. Two processes move patient information to a data store which then sends it to an entity called medical\_history.

*Use the following information to answer Questions 12 and 13.*

A large company has recently installed a new software solution. The software solution has been operating in its network environment for about three months and management is keen to determine how well it is working. Management has employed a consultant to assess the effectiveness of the network and whether the software solution is still producing the required results.

**Question 12**

Which type of testing should the consultant undertake to assess the effectiveness of the network?

- A. existence
- B. reliability
- C. processing
- D. penetration

**Question 13**

Which quality of the software solution is the consultant required to assess?

- A. useability
- B. efficiency
- C. effectiveness
- D. maintainability

**Question 14**

One of the purposes of software requirements specifications (SRS) is to provide

- A. the breakdown of a problem into its component parts.
- B. instructions to users, describing how to use the new solution.
- C. instructions to programmers on how the new program works.
- D. evaluation criteria to ensure solution requirements have been met.

**Question 15**

A football club wants to create an electronic version of its membership records. The functional requirements of the software solution include

- A. being easily maintained.
- B. storing all member details.
- C. retrieving a record in less than a second.
- D. displaying records in an easy-to-read format.

**Question 16**

A manager is notified that the software she requested to be produced is ready for installation onto the company network. She is asked to set a date for acceptance testing to take place.

Acceptance testing is when

- A. users are tested to see if they can use the software.
- B. the manager checks that the software price is what she agreed to.
- C. the manager and a few users of the software check if it does what they require.
- D. the manager sends out a survey to all users to provide feedback after using the software for three months.

**Question 17**

A decision-support framework

- A. is a framework outlining all workplace behaviour.
- B. helps organisations make decisions about programming.
- C. provides a set of decisions that organisations must follow.
- D. provides a structure for conflict resolution within organisations.

**Question 18**

Which one of the following techniques would capture data to measure the effectiveness of a software solution?

- A. surveying users
- B. measuring average login time
- C. running the network under load
- D. timing the execution of a process

**Question 19**

Lines of code that are frequently called from another part of a program and do not return a value back to the code where they were called are best described as

- A. a function.
- B. a procedure.
- C. an instruction.
- D. a control structure.

**Question 20**

The most appropriate data structure to store information about customer orders on a computer's hard drive is a

- A. file.
- B. character.
- C. one-dimensional array.
- D. two-dimensional array.

**SECTION B – Short-answer questions****Instructions for Section B**

Answer **all** questions in the spaces provided.

**Question 1** (3 marks)

Match each type of security threat below to its correct description in the table that follows:

worm      trojan      spyware

Security threat	Description
	a program that always self-replicates
	a program where the major feature is monitoring user activity
	a program that disguises itself as useful

**Question 2** (4 marks)

**a.** Explain how a bubble sort works.

2 marks

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**b.** Briefly explain how a quick sort works and how this differs from a bubble sort.

2 marks

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**Question 4** (5 marks)

Liana is developing software for online learning programs. She gives one of her new programmers, Andrew, the client specifications for one element of the package, and gives him the freedom to design and develop the solution. He must then bring his program to Liana for approval. Andrew has presented a program that looks very much like a commercial program produced by one of Liana’s competitors. The program also appears to collect information on users that can be retained by the business for marketing purposes.

- a. Outline two legal issues that Liana should be concerned about. 2 marks

Legal issue 1 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Legal issue 2 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

- b. What should Andrew do to resolve Liana’s legal concerns? 2 marks

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- c. What could Liana do to make sure that **one** legal issue stated in **part a.** does not occur again? 1 mark

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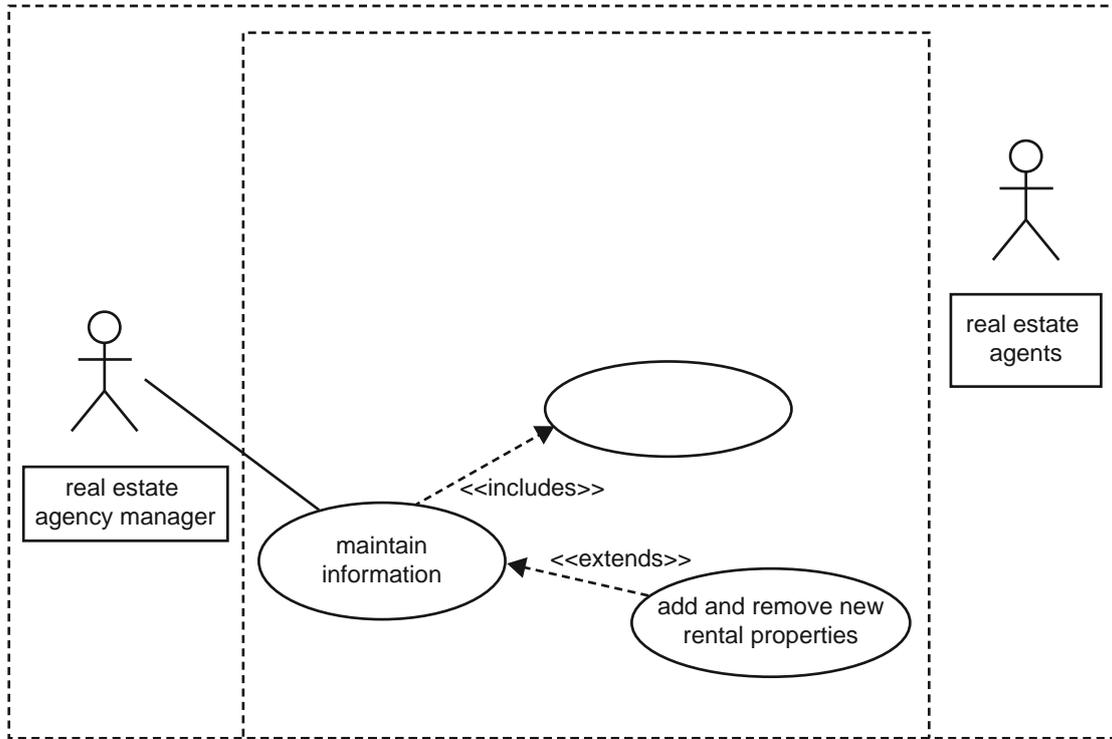
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**Question 5** (3 marks)

The manager of a real estate agency is having new software developed. He wants to be able to use the software in order to maintain the information on the system as well as add and remove new rentals. All his agents need to be able to add the details of new clients who take up a rental property. Everyone must login.

Complete the use case diagram below to show the stated requirements.



**SECTION C – Case study****Instructions for Section C**

Answer **all** questions in the spaces provided. Remove the case study insert and read **all** the information provided before you answer these questions. Answers must apply to the case study.

**Question 1** (4 marks)

Nicole's office is 600 km from the Wide Hill cattle station. She needs to begin the analysis as soon as possible. There are four techniques Nicole could use to help her with her analysis: observation, interviews, questionnaires and reviews of Wide Hill's software documentation.

Outline a major strength of each of these techniques.

- Observation \_\_\_\_\_

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- Interviews \_\_\_\_\_

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- Questionnaires \_\_\_\_\_

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- Reviews \_\_\_\_\_

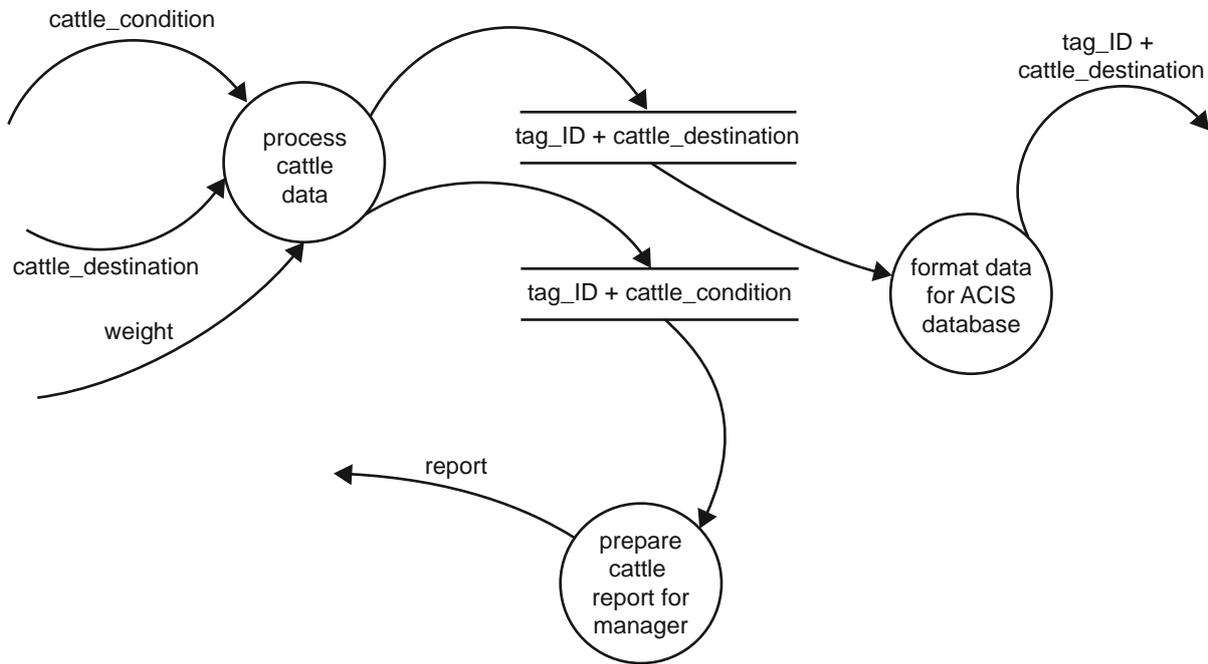
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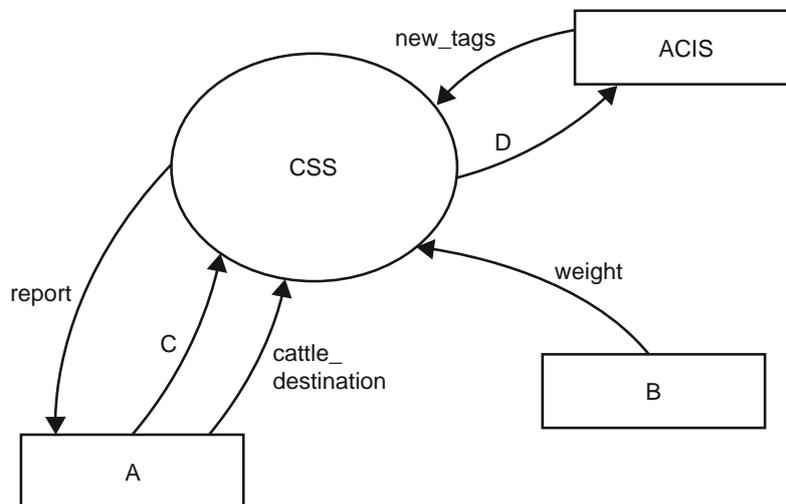
**Question 2** (4 marks)

As part of her analysis, Nicole has begun a data flow diagram (DFD; Diagram 3) and a context diagram (Diagram 4).

**Diagram 3: Data flow diagram (DFD)**



**Diagram 4: Incomplete context diagram**



Using the information in the DFD, complete the context diagram by writing the labels for A, B, C and D below.

- A \_\_\_\_\_
- B \_\_\_\_\_
- C \_\_\_\_\_
- D \_\_\_\_\_

**Question 3** (5 marks)

Nicole decides that, when each animal is weighed, if its weight is below 50 kg or over 500 kg, the software solution will seek confirmation of that value before it is entered into the animal's records. Animal weights are recorded to one decimal place.

- a. What type of validation is this? 1 mark
- 

- b. Five different items of test data are required to test this weight function. The first item of test data has been provided in the table below.

Complete the table with the remaining four items. 4 marks

Test no.	Cattle weight	Expected output
1	49.5 kg	confirmation required
2		
3		
4		
5		

**Question 4** (4 marks)

Nicole decides that the Cattle Software Solution (CSS) will store its data in a single file. This file will be regularly searched using the ACIS code. The file contains only one type of record and includes the field names given in the table below.

From the following list of data types, select the most appropriate data type for each field name and its accompanying description in the table below. An example has been provided.

integer    floating point    Boolean    character    string

Field name	Description	Type
ACISMother	holds the ACIS code of the mother or is left blank if not known	string
ACISNo	holds the ACIS code and is a 16-digit number with the fourth digit blank	
Weight	holds the last weight known for that animal in kilograms	
Gender	C for cow, B for bull and S for steer	
BreedingDefects	T if a defect exists that would prevent it from being used for breeding and F if a defect does not exist	

**Question 5** (1 mark)

When an animal's ACIS code is identified, a number of steps are undertaken. One step is represented by the algorithm below.

```

Search station records using ACIS code
If Found then
    ACISFound  $\leftarrow$  True
Else
    ACISFound  $\leftarrow$  False
    Display 'This animal does not belong to this station'
EndIf

```

What is the name of this type of check?

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**Question 6** (10 marks)

Mike wants to know how each animal compares to others of its age before deciding whether he wants to keep it for breeding or sell it. Cattle between six months and 24 months are broken into three age groups:

- AgeGroup = 1 is for cattle older or equal to six months and less than 12 months
- AgeGroup = 2 is for cattle older or equal to 12 months and less than 18 months
- AgeGroup = 3 is for cattle older or equal to 18 months and less than 24 months

On start-up, the program will compute the average weight of the cattle in each of the above groups so that Mike can compare an individual animal's weight with the average weight. The algorithm below calculates the CattleAge in months and then the age group of each animal. If the animal is too young or too old, an appropriate message is given.

```

Begin
    AgeGroup  $\leftarrow$  0
    CattleAge  $\leftarrow$  Difference in months between current date and date of birth
    If CattleAge < 6 Then
        Display 'Cattle Too Young'
    EndIf
    If CattleAge >= 6 And CattleAge < 12 Then
        AgeGroup  $\leftarrow$  1
        Display 'AgeGroup = 1'
    EndIf
    If CattleAge >= 12 And CattleAge < 18 Then
        AgeGroup  $\leftarrow$  2
        Display 'AgeGroup = 2'
    EndIf
    If CattleAge >= 18 And CattleAge < 24 Then
        AgeGroup  $\leftarrow$  3
        Display 'AgeGroup = 3'
    Else
        Display 'Cattle over 24 months'
    EndIf
End

```

- a. The following table contains a subset of the test data that was used to test the algorithm before coding it.

Complete the table for each date of birth given. An example has been provided.

For the testing, Current Date = 14/11/2014 was used.

6 marks

Test no.	Date of birth	Expected output	Actual output
1	14/8/2012	<i>message 'Cattle over 24 months'</i>	<i>message 'Cattle over 24 months'</i>
2	14/1/2013		
3	14/1/2014		
4	14/8/2014		

- b. Explain the major error in the algorithm.

2 marks

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- c. Explain how to fix the error in the algorithm. Where a line(s) of code needs to be rewritten, write the line(s) in full.

2 marks

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**Question 7** (2 marks)

Mike wants to use a tablet to record the weight of the cattle. Nicole tells him that the tablet has 512 MB of primary storage (RAM) and 16 GB of secondary storage. She could go to 32 GB of secondary storage, but she cannot alter the 512 MB of RAM.

Apart from cost, outline the technical difference between the two types of storage used on the tablet and how this may affect access to the data stored.

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**Question 8** (2 marks)

Each record contains less than 200 bytes of information. It is expected that the software solution will initially hold 30 000 records and will eventually hold a maximum of 100 000 records.

To help with planning, Nicole needs to estimate the range of the file size, from minimum to maximum size, in terms of megabytes.

What would be the minimum and maximum expected file sizes?

Minimum expected file size \_\_\_\_\_

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Maximum expected file size \_\_\_\_\_

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**Question 9** (6 marks)

For the software solution to be successful, rapid searching of the records on the ACIS code is essential. Nicole suggests using a random access file stored on the homestead's computer and sorted on the ACIS code. Also, with 100 000 records, it would be best to read a record only when required and modify it when required.

Adam, a programmer friend, suggests using a sequential file sorted on the ACIS code. When the program starts up, it will load all the data from the homestead's computer onto the tablet and all records will be stored in a one-dimensional array that will then be searched. When the program is shut down, the file will be rewritten back onto the homestead's computer.

a. Describe **one** advantage of Nicole's method.

2 marks

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b. Describe **one** advantage of Adam's method.

2 marks

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c. Suggest an alternative method that may overcome a problem with either Nicole's or Adam's method. Justify your suggestion.

2 marks

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**Question 10** (2 marks)

Nicole is also concerned that as the number of records increases, it will take more time to search these records.

What would be the effect on the number of records read (on average) if the total number of records increased from 32 000 to 64 000 (doubled) using

- a linear search

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- a binary search?

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**Question 11** (2 marks)

Mike is still concerned that the tablet may take too long to transfer files containing 100 000 records. He wants Nicole to design a simple test that will show him whether the tablet can transfer the data between the homestead’s computer and the tablet within a given time and under stated conditions.

Outline a test that Nicole could use to demonstrate this.

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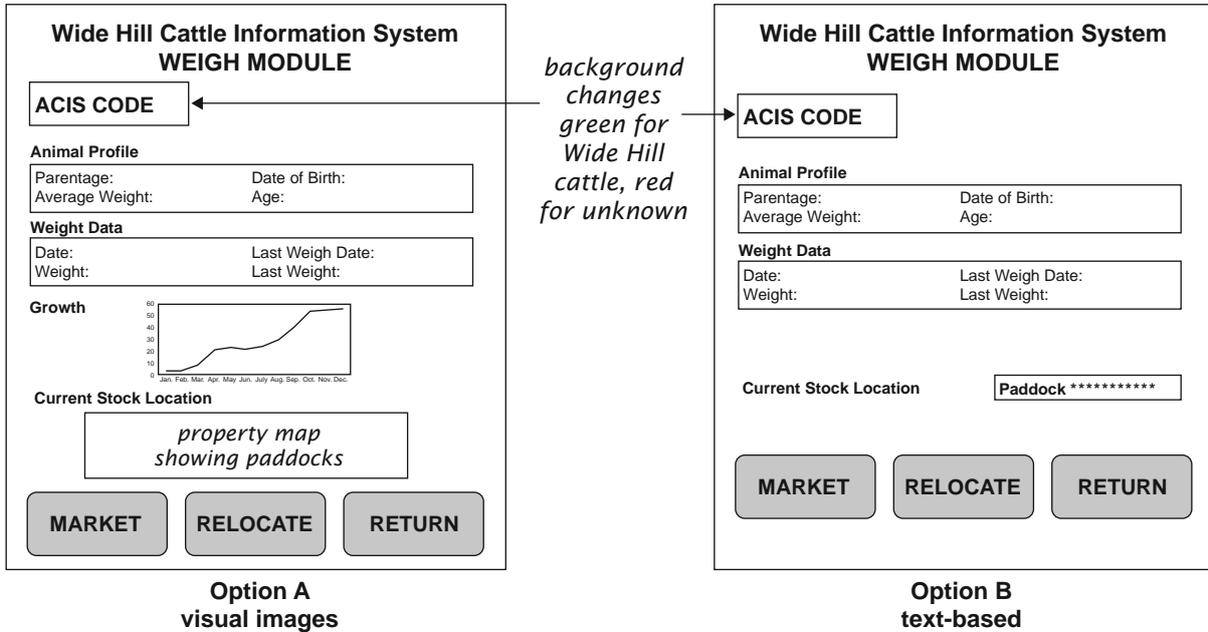
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**Question 12** (3 marks)

Nicole has been working on the interface for the CSS. She knows that when Mike is weighing the cattle, he will be required to make split-second decisions based on the information presented to him by the software. This makes the interface design very important as Mike will need all relevant information in front of him in order to make those decisions.

Nicole has produced the following designs for the Weigh Module of the ID screen for each animal. She is currently deciding whether to include visual representations of some information (Option A) or to just present the data in text and numbers (Option B).



Which option would you recommend? Justify your answer.

Recommendation \_\_\_\_\_

Justification \_\_\_\_\_

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Question 13** (6 marks)

- a. Identify two hardware items that could be needed to connect the Wide Hill homestead with the ACIS database. State the role of each. 4 marks

Hardware item 1 \_\_\_\_\_

Role \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Hardware item 2 \_\_\_\_\_

Role \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

- b. Explain **one** effect on Wide Hill if one of the items identified in **part a.** failed. 2 marks

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Question 14** (4 marks)

Mike feels that a satellite connection is the only option for connecting the outlying cattle yards. Nicole suggests that this would be a very expensive option and that Mike should consider using microwave. Mike says that he has heard there are some issues with using microwave as a method of transmitting data.

State two characteristics of microwave transmission that Nicole needs to explain to Mike before installing it on Wide Hill cattle station. Explain the relevance of each of these characteristics for the cattle station.

Characteristic 1 \_\_\_\_\_

Explanation \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Characteristic 2 \_\_\_\_\_

Explanation \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Question 15** (3 marks)

Nicole is concerned that if the hardware fails or is destroyed by accident, all of the cattle station's records would be lost and so would years of information. Mike suggests that the records be copied onto a DVD each week and stored in his filing cabinet.

- a. State **one** potential fault with this method. 1 mark

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- b. State a better method. 1 mark

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- c. Nicole also suggests that when one of the cattle is sold and it has not been used in the breeding program, its record should be removed from the main records and stored in a different file that can then be removed from the computer and kept in case it is ever required.

State the name of this process.

1 mark

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**Question 16** (2 marks)

Each time the cattle is rounded up for weighing, Mike employs extra staff on-site. The extra staff are usually a mix of contracted farmhands and backpackers. This arrangement works well for Mike, who provides the staff with free access to his internet connection via wi-fi. Recently, Mike has had to bring in more staff than in the past as his herd has grown.

With a large number of people accessing the internet connection, describe a conflict that might arise among the users of the system and outline what Mike could do to minimise this conflict.

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**CASE STUDY INSERT FOR SECTION C**

Please remove from the centre of this book during reading time.

## Case study

The Wide Hill cattle station is in Central Australia and measures approximately 80 km by 50 km. It is situated 200 km from a town of about 100 people. Currently, there is a herd of approximately 30 000 cattle on the station. The station provides cattle for a variety of markets. Some require cattle of a certain weight, while others require cattle of a certain age. All cattle in Australia are registered with the **Australian Cattle Identification System (ACIS)** and, when cattle are bought and sold, the information must be transmitted to a national database that is available online. All cattle producers have login access to this information. The cattle carry a radiofrequency identification (RFID) tag that can be scanned easily by an electronic reader. This provides a unique RFID code for each animal. The electronic reader can also record the current weight of each animal through a sensor set up in the cattle yards. The RFID tag provides many advantages to producers as all cattle in Australia can be traced.

Mike McIntosh, the station's owner and manager, would like to expand the use of ACIS to help him work more efficiently and help him keep records that will provide information to improve his herd. He has identified a number of concerns he would like to address:

- Cattle from other stations get mixed in with Mike's herd and he wants to use the system to quickly identify these cattle. Currently, he has to read the animal's tag and check the RFID against his paper records to find out if it is one of his animals. If it is not one of his, he has to login to ACIS to find out where the animal belongs.
- Currently, Mike's limited breeding information is kept on paper. In the future, Mike would like these records to be electronic. He hopes he will then be able to identify his best breeding stock and improve the quality of his herd.
- Mike weighs cattle for certain markets (which specify a specific range) and he hopes to be able to produce cattle that grow quicker, using this weighing and his electronic breeding records.
- Mike would also like to introduce some new breeding lines into his cattle and wants his records to keep track of these animals to see how they compare to the rest of the herd. If they do well, he will switch to these new breeding lines in the future.

Mike recognises that the remote location of his cattle station may present some problems. The only access to the internet is from a satellite connection based at the station's homestead, where Mike's office is. The only other form of communication around the station is via handheld radios. Mike has set up a wi-fi network of beacons around the homestead so that the buildings and cattle yards within 400 m of the main house have wi-fi available.

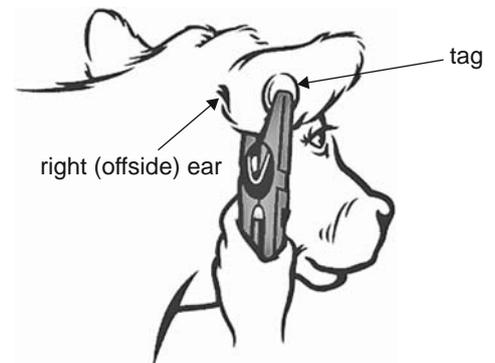
The weighing and scanning set-up is portable and can be moved to any one of six yards located around the station as well as the main homestead yards. However, the only way of communicating with Mike's office is through a simple radio voice system when Mike is away from the homestead and out of wi-fi range. He is considering using a satellite system to transfer data to and from the homestead's computer.

Mike would like to have a new software solution that will scan an animal's RFID tag and enter its weight into his records while he is using a tablet computer in any of his cattle yards. He would then like to be able to upload these records onto the homestead's computer.

He would also like the following information to be stored and displayed on the tablet:

- whether each animal belongs to him
- where each animal was born and its parentage
- the age of each animal
- a comparison of each individual animal's weight with the average for the herd (at that age)
- any other relevant information about the cattle (e.g. how many calves each cow has produced)

**Diagram 1: Attaching the RFID tag**



Source: © State of Victoria, Department of Economic, Development, Jobs, Transport and Resources 2015; reproduced with permission

On viewing this information, Mike can then make a decision as to what to do with each animal and direct his station workers accordingly. As he has approximately 30 000 cattle on the station, these decisions need to be made quickly. If he finds an animal with an excellent growth rate, for example, he may wish to keep it for future breeding.

Mike has contracted Nicole to design and develop his new Cattle Station Software (CSS) to provide all the extra information. The new software must be able to provide communication between his office in the homestead and the portable weighing and scanning system when it is used at each of the six cattle yards around the station.

**Diagram 2: Communications at the cattle station**

