



# Victorian Certificate of Education 2011

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

## STUDENT NUMBER

Letter

Figures

Words


# INFORMATION TECHNOLOGY: SOFTWARE DEVELOPMENT

## Written examination

Thursday 17 November 2011

Reading time: 11.45 am to 12.00 noon (15 minutes)

Writing time: 12.00 noon to 2.00 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	6	6	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 21 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**

The stages of the problem-solving methodology are

- A. analysis, design, document, report.
- B. analysis, design, development, report.
- C. analysis, design, development, evaluation.
- D. analysis, solution, development, evaluation.

**Question 2**

Michael is getting an Internet connection in his home and wants to set up a network so all the family can access the connection. He has a PC in his home office; his wife has a laptop she likes to use in the lounge room. Both of his children have netbooks for school that they use in their bedrooms and often in the family room.

From the family's point of view, which characteristic of a wireless network **most** suits their needs?

- A. cost
- B. security
- C. mobility
- D. bandwidth

**Question 3**

The diagram that best represents the Open Systems Interconnections (OSI) model of network architecture is

**A.**

application
data link
network
transport
session
presentation
physical

**B.**

application
data link
network
physical
presentation
session
transport

**C.**

application
presentation
session
transport
network
data link
physical

**D.**

application
presentation
session
transport
network
physical
data link

**Question 4**

Miklos is writing a program for a mobile phone.

With which layer of the OSI model will the program directly interact?

- A. physical
- B. network
- C. data link
- D. application

**Question 5**

An example of an evaluation criterion that measures the effectiveness of a newly developed software solution to process invoices would be

- A. processing speeds have increased by 35%.
- B. the time taken to process items has reduced by 50%.
- C. the number of staff required to process items has been halved.
- D. the accuracy of invoices generated by the new software has improved.

**Question 6**

User documentation that would be the most appropriate for worldwide customers using a new web-based booking system would be

- A. online user help.
- B. a procedures manual.
- C. a printed quick start guide.
- D. a technical specifications manual.

**Question 7**

What is the correct output for the following algorithm?

**Begin**

a ← 4

b ← 2

**Repeat**

a ← a + 1

b ← b\*b

**Until** b > a

DISPLAY a, b

**End**

- A. 4, 5
- B. 5, 4
- C. 16, 6
- D. 6, 16

**Question 8**

The algorithm below uses a function JOIN (string 1, string 2) to combine two strings into one.

**Begin**

```
name[1] ← 'Sue'
name[2] ← 'Bill'
name[3] ← 'Fred'
a ← 2
b ← 1
bigname ← JOIN (name[b], name[a])
DISPLAY bigname
```

**End**

What is the correct output for this algorithm?

- A. SueBill
- B. FredBill
- C. Bill Sue
- D. Fred Sue

**Question 9**

In a program, a line of code that modifies a variable's content is best described as a

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

*Use the following information to answer Questions 10–13.*

The manager of the SmallBank Company phoned Michelle and asked her to write a program for a mobile phone for the bank. During their short conversation, the manager specified that the program must cater for visually impaired people as well as people with normal vision. It will be available to customers via the bank's website. The manager also indicated that the bank was only trialling this idea. This means Michelle must focus on making the required functions work properly and not spend time adding extra functions to the program. Michelle agreed to write the program and was given 60 days to create a solution that would meet the bank's needs.

**Question 10**

Before Michelle can begin designing the solution, she has to determine exactly what the program is required to do. The most appropriate method for her to collect data about what the program is required to do is to

- A. conduct a survey of the bank's customers.
- B. interview the SmallBank Company's manager.
- C. investigate the mobile phone's technical specifications.
- D. observe another bank's customers using a similar program.

**Question 11**

The constraint on the solution that will most influence Michelle's design is that

- A. the bank is trialling this idea.
- B. she has been given 60 days to create the solution.
- C. she should not spend time adding extra functions.
- D. the solution must cater for visually impaired people and people with normal vision.

**Question 12**

The factor that will most limit the scope of Michelle's solution is that

- A. the bank does not want her to add extra functions.
- B. the program will be made available via the bank's website.
- C. the bank is only small and does not require a complex program.
- D. the program must cater for visually impaired people and people with normal vision.

**Question 13**

Michelle has completed her analysis and written the Software Requirements Specifications (SRS) for the bank. It lists all the tasks that must be undertaken in order to successfully complete the project.

The best order to undertake three of these tasks is

- A. survey a sample of customers; test the program; write internal documentation.
- B. write internal documentation; test the program; survey a sample of customers.
- C. test the program; survey a sample of customers; write internal documentation.
- D. test the program; write internal documentation; survey a sample of customers.

**Question 14**

Which statement 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 move individual data bits across a shared medium to another point in the network
- C. to ensure that packets of data are assembled and presented to an application in the correct order
- D. to ensure that packets of data received from another point in the network are free of any errors caused by the medium connecting the two points

**Question 15**

Nola's and Ben's computers are part of a network. Recently Nola's computer became infected with a worm. Which statement is **most** correct?

- A. The worm will not spread to Ben's computer because it is not a useful program.
- B. The worm will spread to Ben's computer **only** if Nola sends an infected file to Ben as an email attachment.
- C. The worm will spread to Ben's computer **only** if a copy of one of Nola's infected files is opened on his computer.
- D. The worm will spread to Ben's computer by sending a copy of itself through the network and infecting one of his files.

**Question 16**

Which of the following is **not** a feature of a Virtual Private Network?

- A. has high-level data security
- B. connects multiple locations
- C. may use public telecommunications infrastructure
- D. relies on leased telecommunications lines to connect

**Question 17**

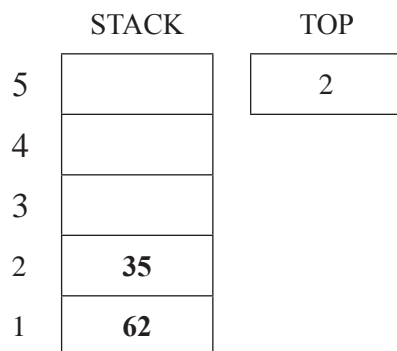
The principal of a secondary college is considering purchasing some new software to enable teachers to mark the roll quickly at the start of each lesson. He has downloaded a trial copy of QuickMarkT and notes that it only uses three different screens.

What is the most important characteristic the principal should look for in this software?

- A. use of multimedia
- B. consistency of navigation
- C. lengthy on-screen instructions
- D. a pleasing and colourful design

**Question 18**

Consider the following stack, where STACK holds the values and TOP indicates the current position of the top of the stack.



The following three operations are carried out on the stack in the order

1. Push(21)
2. Push(10)
3. Pop

Which of the following is the correct stack at the end of the three operations?

A.		B.		C.		D.	
	STACK		TOP		STACK		TOP
	10		5		10		4
	10		4		21		3
	21		35		35		10
	35		62		62		21
	62		10		10		35
			21		21		62

**Question 19**

A data structure in which the **first** data item entered is always the **first** item removed is known as

- A. a stack.
- B. an array.
- C. a queue.
- D. a record.

**Question 20**

A program is being written for a hand-held touch-screen device with no physical keyboard. It will allow the user to look up facts about any country in the world (there are about 200). The user will be able to choose from the five languages shown.

Chinese	澳大利亚
English	Australia
French	l'Australie
German	Australien
Japanese	オーストラリア

To find information about a country, the user will have to input the name of the country in the chosen language.

To make the input as efficient as possible for the user, the programmer should write code that

- A. gets a selection from a scrollable list.
- B. gets a selection from the display of a world map.
- C. gets a selection from a list that is matched to characters as they are entered by the user.
- D. reads the country name from a single text box that has had the name entered into it by the user.

**SECTION B – Short answer questions**

**Instructions for Section B**  
Answer **all** questions in the spaces provided.

**Question 1**

Maria has a program that works well on her laptop and she would like to put it onto her Personal Digital Assistant (PDA).

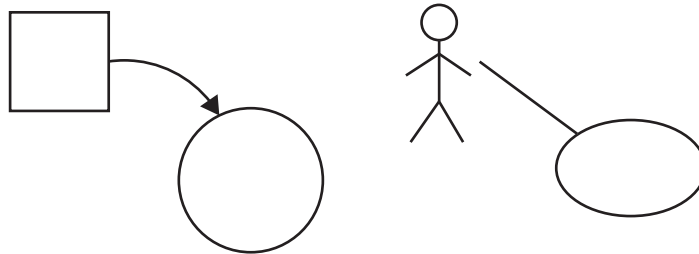
Other than the operating system, state two important characteristics of the PDA that will need to be considered when she modifies her program to work on the PDA.

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

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

2 marks

**Question 2**



As shown in the diagram above, data flow diagrams (DFD) and use case diagrams (UCD) share similar symbols, but their purposes are not the same.

a. Describe the difference in purpose between the arrowed line in the DFD and the straight line in the UCD.

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2 marks

b. Describe the difference in purpose between the circle in the DFD and the ellipse in the UCD.

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2 marks



**Question 3**

Brian is a programmer for a large IT services company. He is in charge of the development of a security system for a financial services company that maintains a large credit references database that big banks rely on when people apply for loans. The system is due to be finished in a month's time. Brian's manager has just told him that they will need to deliver it to the customer in one week as he has promised the finance company that it will be ready by then. Brian knows that the testing process will not be finished and that he cannot guarantee the security of the system. He knows that this is not right for the customer, but does not really know what to do about his manager's request.

- a. Explain how a code of ethics could assist Brian in dealing with this situation.

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2 marks

- b. Assuming Brian's organisation has a code of ethics, outline how a decision support framework could assist in resolving this ethical dilemma.

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2 marks

**Question 4**

Big O Television’s secure computer network was recently breached. Big O Television has hired an independent IT security company, Secure TVtech, to test the security of its network and provide support in identifying and repairing any weaknesses in its security.

- a. Suggest a technique that Secure TVtech might use to test the security of Big O Television’s computer network and describe how it would work.

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2 marks

- b. Explain how a security audit of the computer network may have prevented the original network breach at Big O Television.

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2 marks

**Question 5**

Caitlin and Ryan are discussing the best way to store their new software solution and the data files it uses. The software, which company employees will need to access every day, is 80 gigabytes (GB) and uses several data files which will grow in size over time.

Caitlin suggests the software should be stored on the file server and the data files could be stored on DVDs. Ryan suggests that as the software is not very large (80 GB) it could also be kept on the same DVD as the data files. The network administrator is not happy with either solution.

Provide a better solution for Caitlin and Ryan and give **three** reasons to support your solution.

Solution \_\_\_\_\_

\_\_\_\_\_

Reasons \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

1 + 3 = 4 marks

**Question 6**

Wendy and Gareth have been asked to design an intranet for the residents of an aged-care facility. This intranet will provide access to suitable mind-challenging games. It will also allow residents to upload photos and leave comments.

Choose two important characteristics of the users of this website that Wendy and Gareth will need to consider when designing the intranet. State how these will influence Wendy and Gareth's design.

User characteristic 1 \_\_\_\_\_

Effect on design \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

User characteristic 2 \_\_\_\_\_

Effect on design \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2 marks

**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**

While looking at the plan drawn by James, the engineer, Kirsten noted that there would be four different data transfers. She also noted that one of the data transfers will not need TCP/IP.

Identify this data transfer and explain why TCP/IP is not needed.

Data transfer from \_\_\_\_\_ to \_\_\_\_\_

Explanation \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

1 + 2 = 3 marks

**Question 2**

To check that she had understood James' plan, Kirsten showed him the use case diagram. He expressed concern that the dedicated computer was not shown in the diagram.

State why Kirsten did not include the dedicated computer in her use case diagram.

\_\_\_\_\_

\_\_\_\_\_

1 mark

**Question 3**

Kirsten will include the use case diagram in the Software Requirements Specifications (SRS) she is writing. In addition, Kirsten will include a context diagram in her SRS.

State two functional requirements of the Parking Infringement Monitoring System (PIMS) that this context diagram would show. Give an example of each.

Functional requirement 1 \_\_\_\_\_

Example \_\_\_\_\_

\_\_\_\_\_

Functional requirement 2 \_\_\_\_\_

Example \_\_\_\_\_

\_\_\_\_\_

4 marks

**Question 4**

When writing the SRS, Kirsten identifies user-friendliness, response rates and maintainability as important non-functional requirements of the system.

Which of these three requirements is the **most** critical for the success of the system? Justify your choice.

Most critical non-functional requirement \_\_\_\_\_

Justification \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

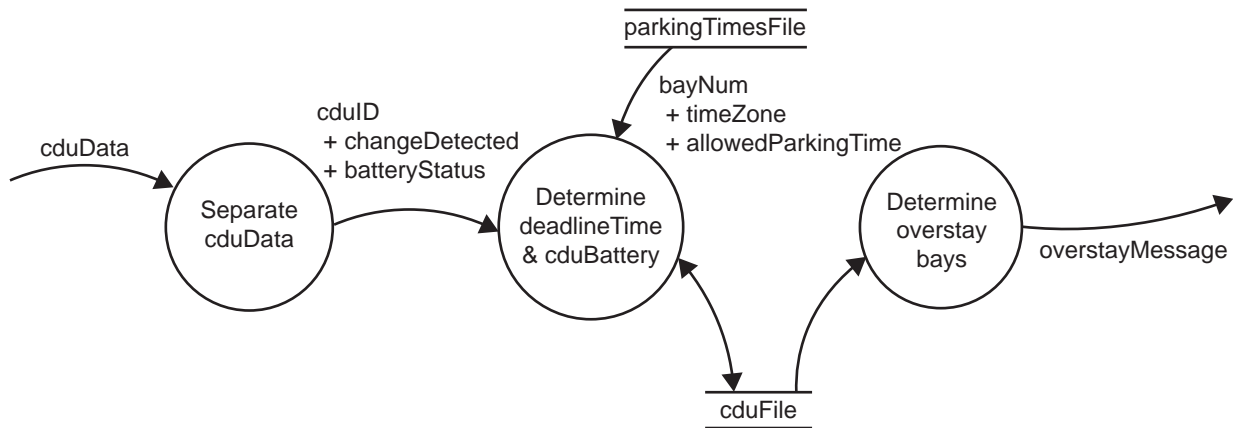
\_\_\_\_\_

\_\_\_\_\_

1 + 3 = 4 marks

The analysis is now complete. Kirsten has submitted the SRS to James and he has told her to begin designing the software for the dedicated computer and the mobile phones.

Kirsten starts with the dedicated computer. It will deal with the use case 'register car arrivals and/or departures'. Kirsten has drawn the following data flow diagram (DFD) to help her with the design of the software.



For the process 'Determine deadlineTime & cduBattery' she has developed the following algorithm. It updates deadlineTime and cduBattery in cduFile. The variable currentTime is set by the system and represents the current time of day in 24-hour time.

**Procedure** updateCduFile (cduID, changeDetected, batteryStatus)

**Begin**

**If** batteryStatus = batteryLow **Then**

    cduBattery ← True

**Else**

    cduBattery ← False

**Endif**

bayNum ← bayNumFind(cduID)

**If** changeDetected = carArrived **Then**

    deadlineTime ← currentTime + findParkingTime(bayNum, currentTime)

**Elseif** changeDetected = carDeparted **Then**

    deadlineTime ← -1

**Endif**

**Write** deadlineTime, cduBattery **To** current record in cduFile

**End**

**Question 5**

The structure of cduFile is shown in the table below.

Using the information in the DFD, the algorithm and case study, complete the table to indicate the most appropriate data type for each field.

Select from: integer, floating point number, Boolean, array, string.

Field name	Type	Use
cduID	Integer	Unique identifier for the CDU
bayNum		Number of the parking bay in which the CDU is located
bayLocation		Street address of the parking bay
cduBattery		Is the CDU's battery getting low?
deadlineTime		The time by which the car must have left the parking bay (24-hour time)

4 marks

**Question 6**

The updateCduFile algorithm uses a function called bayNumFind. It will search cduFile for the bay number that matches the given cduID.

- a. Kirsten plans to use a binary search in the function bayNumFind.

What does this tell us about how the data must be organised in cduFile?

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2 marks

- b. Kirsten can choose to have cduFile either as a serial file or a random file.

Which should she choose and why?

Choice \_\_\_\_\_

Reason \_\_\_\_\_

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2 marks

**Question 7**

For the process ‘Determine overstay bays’ Kirsten has developed the following algorithm. It goes through every record in cduFile and finds any that have overstayed. There is one record per parking bay.

```

Procedure determineOverStays
Begin
    go to first record in cduFile
    For bayNum ← 1 To numberOfParkingBays
        Read deadlineTime From cduFile
        If deadlineTime <> -1 Then
            If currentTime > deadlineTime Then
                Send Overstaymessage
            Endif
        Endif
        go to next record in cduFile
    Endfor
End
    
```

Normally currentTime is set by the system, but for testing purposes Kirsten will set it to 1300 (1.00 pm). To properly test the algorithm, Kirsten believes she will need to have four different values for deadlineTime. Complete the table below with samples that test the algorithm. State which line is being tested.

deadlineTime	Expected outcome	Line of code	Reason

8 marks



Kirsten now works on the mobile phone software. This software will be responsible for the three use cases associated with the parking officers.

**Question 8**

Messages containing overstay parking data are sent from the dedicated council computer to the mobile phone of the parking officer in the area. The phone software must process the messages in the order they are received. Which data structure, stack or queue, should Kirsten use to store the messages? Justify your choice.

Choice \_\_\_\_\_

Justification \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

4 marks

**Question 9**

When the parking officers arrive at the parking bays they will enter the car's number plate into their mobile phones. The software must check that each number plate entered is in the correct format. Then each number plate is sent to the dedicated computer. Kirsten has proposed the following algorithm.

The number plates can only contain numbers and letters and be no longer than 6 characters. The function length() is used to find the number of characters in a string.

**Procedure** checkNumberPlateFormat (numberPlate)

**Begin**

numberPlateValid  $\leftarrow$  true

**If** length(numberPlate) > 0 **And** length(numberPlate) < 6 **Then**

**For** position  $\leftarrow$  1 **To** length(numberPlate)

**If** character(position) is **Not** (numeric **Or** alphabetic) **Then**

numberPlateValid  $\leftarrow$  false

**Endif**

**Endfor**

**Else**

numberPlateValid  $\leftarrow$  false

**Endif**

**If** numberPlateValid = false **Then**

**Display** Invalid number plate message

**Endif**

**End**

- a. Kirsten desk checks this algorithm with test data for the numberPlate, as shown below. Complete the test table.

Test	Test data	Expected outcome	Actual outcome
1	ABC123		
2	*ABC		
3	123AB&		

4 marks

- b. Describe the error that this test data shows.

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1 mark

- c. Write down the line of the algorithm that has caused this error.

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1 mark

- d. Write down the line as it should have been written.

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1 mark

**Question 10**

Kirsten is concerned about the storing of offenders' details if parking officers lost or even left their mobile phones on their desks at work.

State two features Kirsten should build into the mobile phone software to ensure that the data in the parking officers' mobile phones is secure.

For each feature, explain how it would help secure the data.

Feature 1 \_\_\_\_\_

Explanation \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Feature 2 \_\_\_\_\_

Explanation \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

4 marks

**Question 11**

A friend, José, argues with Kirsten that if she uses single letters for variable and procedure names, her program code would be 20% smaller and hence she would be producing more efficient software.

a. Explain why Kirsten should ignore this advice.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2 marks

b. State one other action, besides using meaningful names, Kirsten could perform to make her program code more programmer friendly.

\_\_\_\_\_

\_\_\_\_\_

1 mark

**Question 12**

During the development of the software, Kirsten finds a module developed by the Fast Fines company. If she could use this module she would not have to develop the module herself.

Explain Kirsten’s legal obligations if she wishes to use this module.

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2 marks

**Question 13**

Kirsten is sure that all of the errors are now out of the software and that it is ready to be used by the Bigton City Council. The final testing process is to complete the User Acceptance Testing (UAT), but James is not entirely sure what this is and how he will be involved.

- a. Explain the process of UAT and how James and the other staff will be involved.

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3 marks

- b. Provide an example of a criterion that the new PIMS must meet to pass the UAT process.

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1 mark

**Question 14**

To evaluate the success of the PIMS, Kirsten needs to collect a range of data.

Suggest a strategy that she might use to acquire data relating to the accuracy of the parking fines that are issued.

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3 marks

**Question 15**

The key users of the new PIMS developed by Kirsten are the parking officers. The Council wants Kirsten to develop a training program to teach them how to use the new software.

a. Describe a suitable training program she could use.

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2 marks

b. Suggest how the Council could measure the suitability of this program.

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1 mark

**Question 16**

The introduction of the new PIMS at the Bigton City Council will affect a number of stakeholders.

Outline the conflict that may occur between the Council and each of the following stakeholders.

Parking officers

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Motorists using parking bays

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2 marks

**CASE STUDY INSERT FOR SECTION C**

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

**Case study**

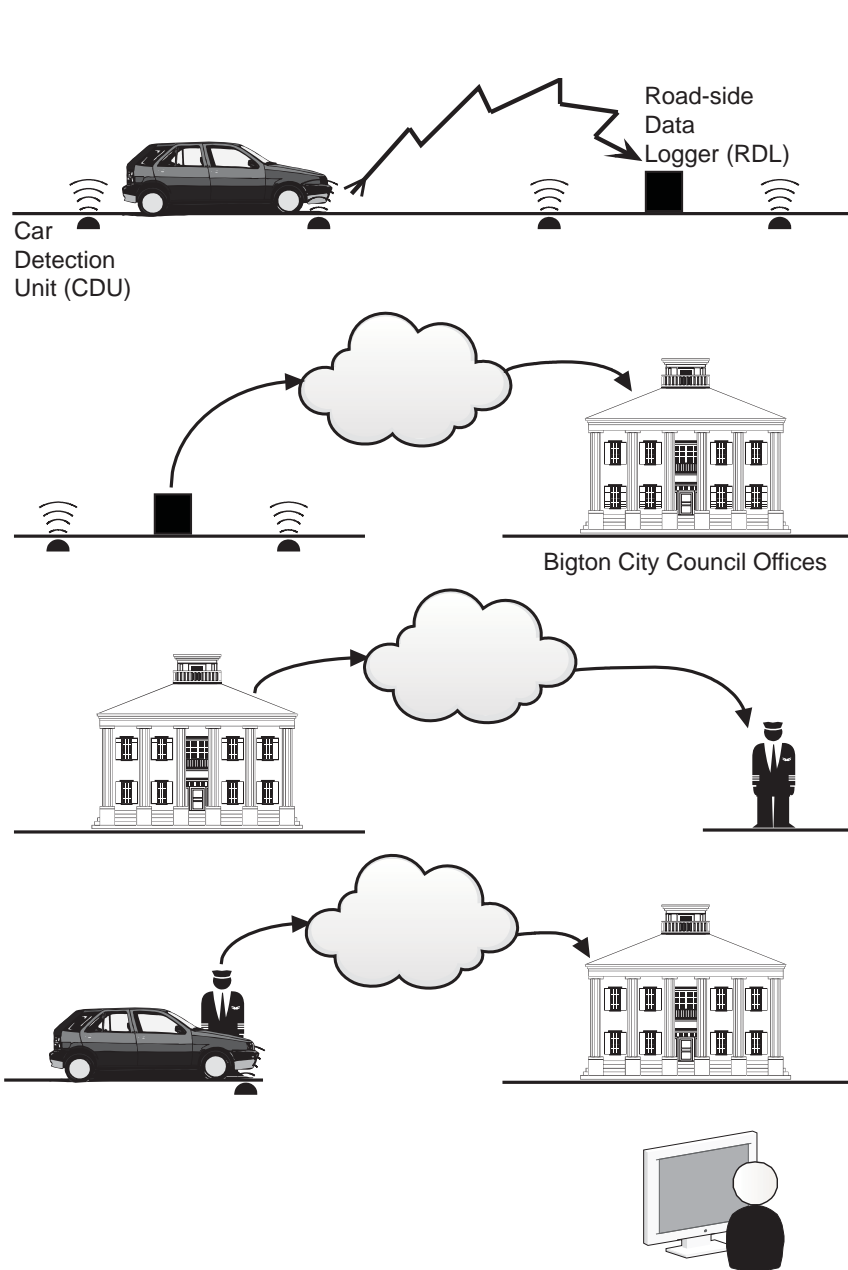
**Bigton City Car Parking**

The large regional city of Bigton has a busy central business district (CBD). Over the last few years parking in the CBD has become a concern. One difficulty is that too many people overstay the time limits of the parking bays in the CBD's streets. Employing enough parking officers has also become a problem, so the Bigton City Council has decided to look for a technological solution to the problem.

City Engineer, James Jones, proposed that the city purchases and installs a commercially available solution that detects vehicles that have overstayed the time limit. However, after examining one such solution, the Council decided that it provided a lot of features the city would never use and it was too expensive. The Council asked James to investigate creating the city's own solution. Its only purpose would be to detect overstaying vehicles and notify parking officers where these vehicles are parked.

After some thought and investigation, James drew the plan shown below.

**Parking Infringement Monitoring System (PIMS)**



A Car Detection Unit (CDU) in each parking bay detects the arrival (or departure) of a car. When an arrival (or departure) occurs the CDU sends a signal to a nearby Road-side Data Logger (RDL). The signal identifies the CDU and the presence (or absence) of a car.

At set intervals, RDLs send the data they have collected to a dedicated computer at the Council's offices. This is done via the Internet, using the mobile phone network.

The Council's dedicated computer determines which cars have stayed too long. It then sends the location of the cars and the overstay details to a parking officer's mobile phone.

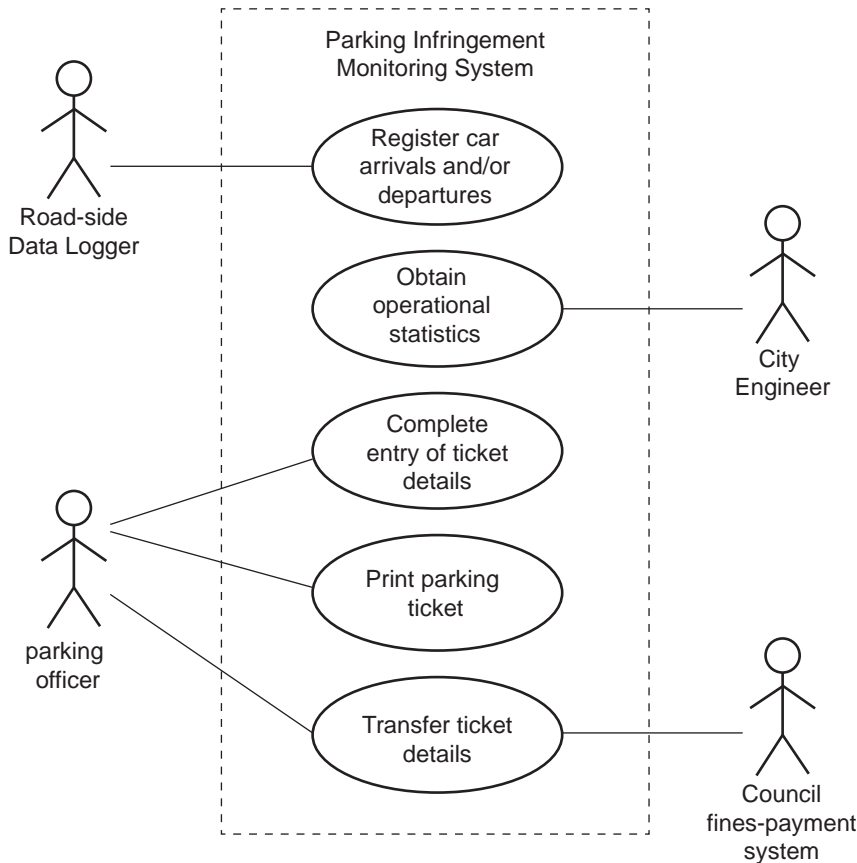
The parking officer locates each car and confirms that it is the overstaying car. If so, the officer gets the car's details, prints a ticket, and then sends this information to the Council's fines-payment information system.

From time to time the City Engineer will access the dedicated computer to obtain statistics regarding the operation of the system.

During his investigation James found out that the Council gives all its parking officers a mobile phone for use on the job, which means that these do not have to be purchased for the system; they would just need some software written for them. He also found that all the other hardware needed for the system, including a portable Bluetooth printer, can be purchased ‘off the shelf’. The CDUs and RDLs operate automatically, but the dedicated computer would need software written for it. The computer can be connected to the Council’s existing network, which would allow it to interact with the Council’s fines-payment system.

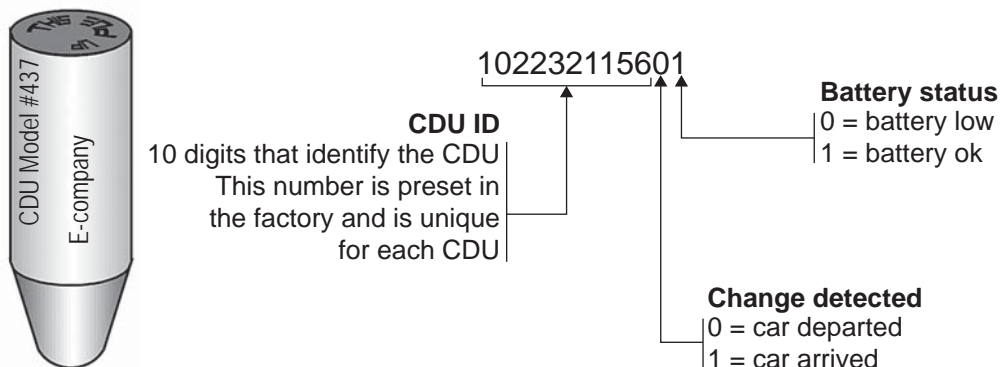
To take his idea further, James hired programmer Kirsten Koder.

After interviewing James, Kirsten drew a use case diagram of the proposed Parking Infringement Monitoring System (PIMS). It is shown below.



**The Car Detection Unit (CDU)**

The type of CDU James has decided to use in the system is a small self-contained device about 5 cm long. It is designed to be placed just under the surface of a road. When the magnetic field around it is disturbed by a car, the CDU transmits a data signal that contains a 12-digit code as shown below.



**TURN OVER**



### Parking bays

Since 1990, each parking bay in Bigton has been allocated a bay number, as shown in a section of the city map below. Since the CDU ID number is programmed at the factory and cannot be changed, James has decided that the best way to provide its location is to match the CDU ID to the bay number.

