VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2021

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER | | | | | | | | | | Letter |

APPLIED COMPUTING: SOFTWARE DEVELOPMENT

Written examination

Friday 12 November 2021

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	5	5	20
C	13	13	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 correction fluid/tape.

Materials supplied
- Question and answer book of 27 pages
- Detachable insert containing a case study for Section C in the centrefold
- Answer sheet for multiple-choice questions

Instructions
- Detach the insert from the centre of this book 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.
- You may keep the detached insert.

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

Consider the following incomplete data dictionary for the design of a security system's software solution.

Variable name	Data type	Format	Description
door_closed		True / False	stores the status of whether a door is closed
accessed		99	logs the number of times a door is accessed each day

The data types for 'door_closed' and 'accessed' are respectively

A. Boolean and integer.
B. character and integer.
C. Boolean and floating point.
D. character and floating point.

Question 2

Which one of the following statements best describes a characteristic of the associative array data structure?

A. Associative arrays have integer indexes.
B. Elements stored in associative arrays are ordered.
C. Elements of associative arrays are composed of key value pairs.
D. Associative arrays are used when several different data types need to be stored together as a field.

Question 3

A functional requirement for a software solution that collects the contact details of customers who dine at a restaurant could be

A. saving customer data to a file.
B. that the solution can be used on multiple devices.
C. that the solution can fail to take an order no more than once a month.
D. that the restaurant's customers should be able to easily enter their details into the solution.

Question 4

Which one of the following would be considered an information system goal?

A. to decrease the time taken to create resupply orders by 50%

B. to identify three low-selling products to highlight for sales each month

C. to improve communication with customers by cutting the time taken to reply to within 24 hours

D. to manage accounts with suppliers more efficiently by using a digital warehouse system

Question 5

The best sequence of tests when validating data is

A. type, existence then range.

B. range, existence then type.

C. range, type then existence.

D. existence, type then range.

Question 6

A characteristic of an efficient software solution includes the

A. usability of the solution.

B. speed of processing.

C. accuracy of a calculation.

D. readability of a screen layout.

Question 7

To assess the effectiveness of a project plan, one should assess the project plan

A. against the project's scope and timeline.

B. by applying relevant usability testing strategies.

C. by applying relevant software auditing strategies.

D. against the evaluation criteria developed in the design stage.

Question 8

Lenny connects to the internet via a public unsecured wireless network to shop online. He creates a new account at a store and makes a purchase with a new credit card that has never been used. Later that day, he discovers unauthorised transactions on his credit card.

What has happened to Lenny may be an example of

A. a data breach.

B. social engineering.

C. cross-site scripting.

D. a man-in-the-middle attack.

Question 9

Chiara is developing a software solution and would like to communicate to her colleagues the data that will go in and out of the system.

Which one of the following types of diagrams would be most appropriate for Chiara to use?

A. a context diagram

B. a network diagram

C. a use case diagram

D. a data flow diagram

Question 10

Francisca is integrating voice commands into an existing application.

Which one of the following is **not** an affordance consideration?

A. including a list of standard voice commands

B. providing appropriate aural signifiers to confirm perceived functionality

C. providing appropriate visual signifiers to indicate the presence of voice control

D. offsetting development costs elsewhere to ensure the application remains affordable

Question 11

When developing criteria for evaluating the efficiency and effectiveness of a software solution, the most important consideration is that

A. the software solution is new and innovative.

B. programs will be tested to ensure that they are free of bugs.

C. the requirements and constraints documented in the software requirements specification (SRS) will be met.

D. programs will be tested to ensure that they run with appropriate time efficiency.

Question 12

The designers of a new banking app believe that new clients should not only enter their client number and password but also a verification code, and scan one of their fingerprints to sign into their account.

This security measure is best described as

A. general authentication.

B. two-factor authentication.

C. multi-factor authentication.

D. single-factor authentication.

Question 13

Sergei wants to transfer his completed video project from his desktop to his laptop.

The file size is 4 GB.

What is the time difference between copying Sergei's file using a cable at 5 Gbps and using his wi-fi network at 3.5 Gbps, correct to the nearest second?

A. Cable is 3 seconds faster.

B. Wi-fi is 6 seconds faster.

C. Cable is 3 seconds slower.

D. Wi-fi is 9 seconds slower.

Question 14

Characteristics of data that has integrity include

A. authenticity, clarity and relevance.

B. accuracy, clarity and completeness.

C. accuracy, relevance and readability.

D. accuracy, reasonableness and relevance.

Question 15

Actual data sets are not used to test software. Data sets are manufactured to test software.

If a manufactured data set was accidentally stored with an actual data set, what characteristic of data integrity would be most undermined by this mix-up?

A. value

B. timeliness

C. authenticity

D. reasonableness

Question 16

Which one of the following best represents an ethical, but not legal, issue that may arise during the software development process?

A. using customer data for personal financial gain

B. incorporating addictive design elements in a children's online learning application

C. collecting sensitive data during a survey without the participant knowing what the data will be used for

D. using code from a similar piece of software without the permission of the original developer

Question 17

A trace table has been completed for a selection sort algorithm with the following data.

$A \leftarrow [4, 5]$ $n \leftarrow 2$

Step	Statement	i	min	j	A[i]	A[min]	A[j]
1	**Begin**						
2	**For** i ← 0 **To** n – 2 **Do**	0			4		
3	min ← i	0	0		4	4	
4	**For** j ← i + 1 **To** n – 1 **Do**	0	0	1	4	4	5
5	**If** A[j] < A[min] **Do**	0	0	1	4	4	5
6	min ← j	0	1	1	4	5	5
7	**Swap** A[i] and A[min]	0	1	1	5	4	5
8	**Return** A	0	1	1	5	4	5

Which one of the following is the first error in the trace table?

A. min is set to 0 in step 3.

B. A[j] is not set to A[min] in step 5.

C. min is set to the value of j in step 6.

D. A[i] and A[min] are swapped in step 7.

Question 18

[5, 6, 2, 11, 3, 0, 8]

How many swaps will a selection sort algorithm carry out on the array above?

A. 3

B. 5

C. 7

D. 11

Use the following information to answer Questions 19 and 20.

A set of algorithms for a simple form of data encryption is shown below.

```
Start Encrypt
        Read text
        For i ← 1 To text.Length Do
            value ← CharToNumberInAlphabet(text[i])- 2
            If value < 0 Then
                    text[i] ← NumberInAlphabetToChar(value + 26)
            Else
                    text[i] ← NumberInAlphabetToChar(value)
            End If
        End For
        Return text
Stop Encrypt

Start CharToNumberInAlphabet(character)
        //This function returns the number position of a character in
        //the alphabet, such that:
        //a returns 1, b returns 2 ... z returns 26
        Return numberPosition
Stop

Start NumberInAlphabetToChar(numberPosition)
        //This function returns the character in the alphabet based on
        //the number position given, such that:
        //1 returns a, 2 returns b ... 26 returns z
        Return character
Stop
```

Question 19

The algorithm named Encrypt is an example of

A. a loop.

B. a class.

C. a function.

D. an instruction.

Question 20

If 'alley' was encrypted by the set of algorithms, what would be the text returned?

A. yjjcw

B. cnnga

C. leyal

D. eyall

END OF SECTION A
TURN OVER

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SECTION B – Short-answer questions

Instructions for Section B

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

Question 1 (4 marks)

State two purposes of using internal documentation when programming. For each purpose, explain how a naming convention would be useful.

Purpose 1 _____

Explanation _____

_____

_____

Purpose 2 _____

Explanation _____

_____

_____

Question 2 (3 marks)

Haru is preparing the software requirements specification (SRS) for a new public transport ticketing system.

Classify each of the following constraints as economic, legal, social, technical or relating to usability.

Constraint	Classification
Existing tickets will need to work with the new system.	
The new system will process payments in Australian dollars.	
Location tracking data must be de-identified.	

Question 3 (3 marks)

A Victorian company that provides cloud storage services to manufacturers of wearable medical devices has been approached by an Australian university. The university would like to access the stored data for research purposes.

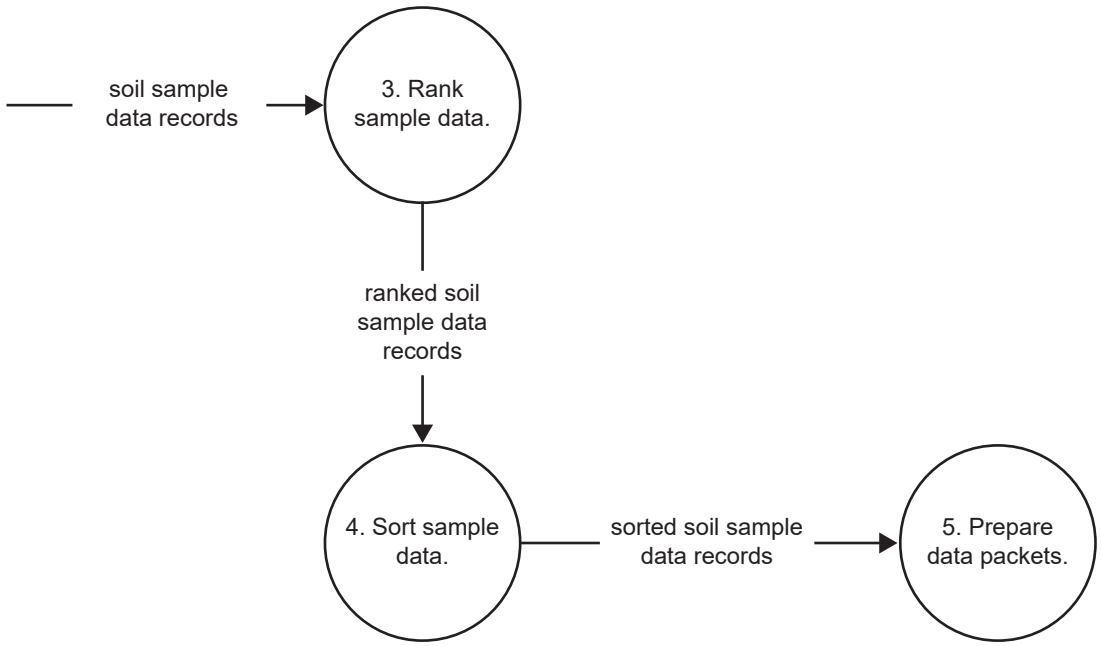
Discuss the possible legal consequences for the company of providing its stored data to the Australian university. In your response, refer to the *Privacy Act 1988* and the *Health Records Act 2001*.

Question 4 (4 marks)

A new exploratory robot, named Relentless, is being designed to drill into the soil of the planet Mars, collect and analyse soil samples, and send relevant data back to Earth. The Relentless robot has many constraints placed on its design to make it fit for its Mars mission, including having only limited battery size, computing resources and data storage capacity.

The section of the data flow diagram below shows part of the design of the Relentless robot's software system. It represents the flow of data that originates as records based on the analysis of individual soil samples. A process is then used to give a rank of importance to each soil sample. Soil sample data records are then sorted by their importance rankings, and a transmission preparation process takes the sorted data and breaks it into data packets that are ready to be sent.

Section of data flow diagram for the Relentless robot's software system



a. Identify **one** mistake in the section of the data flow diagram shown and suggest an appropriate fix. 2 marks

b. Would quick sort or selection sort be a more appropriate sorting algorithm for the 'Sort sample data' process? 2 marks

Question 5 (6 marks)

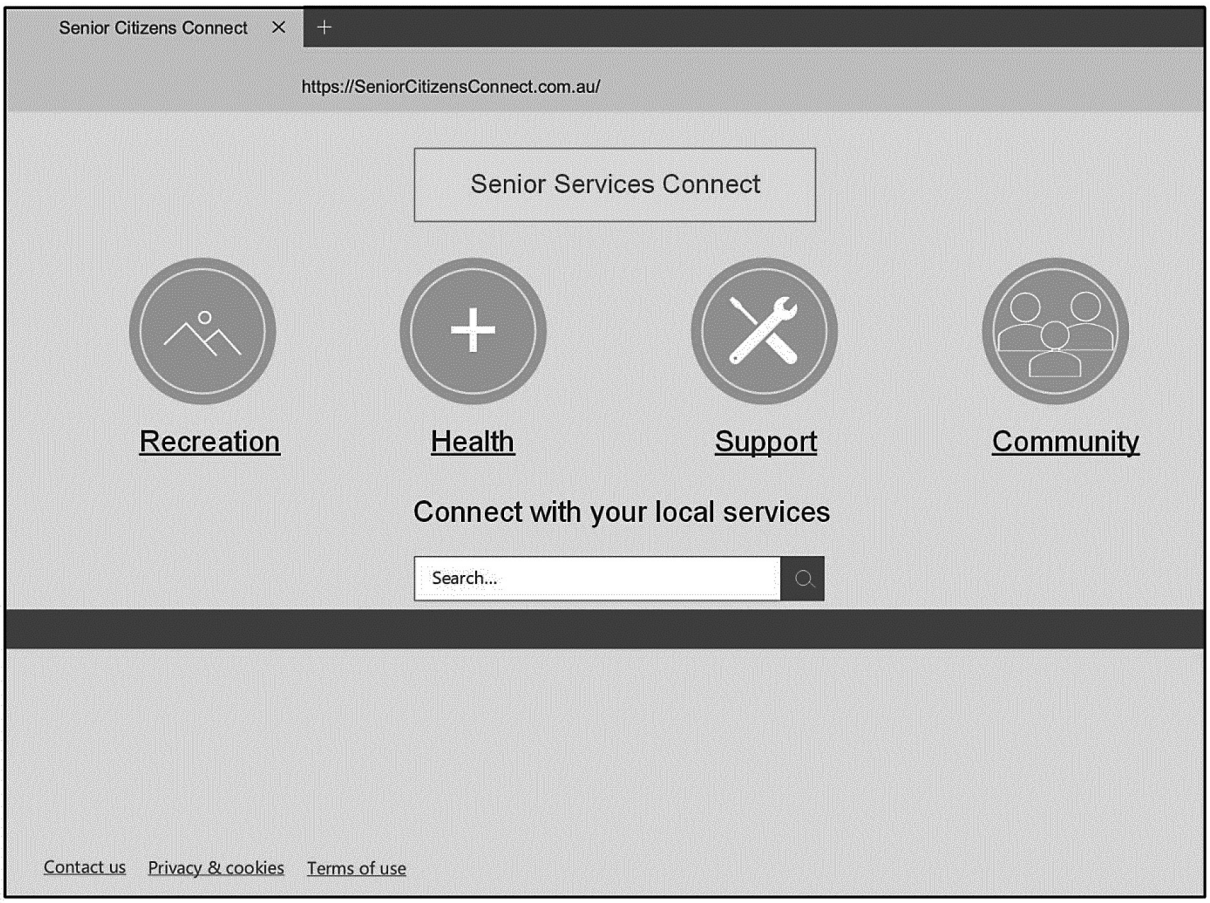
A software development company wants to test the usability of an application it is developing that will connect senior citizens with local council services.

a. State the purpose of usability testing and explain how it is different from functional testing. 2 marks

b. To save money, the company is considering conducting usability testing using its own employees.

Explain why this is **not** a good idea. 2 marks

c. The landing page of the application will have the following menu.



Suggest one method that could be used to gather qualitative data and one method that could be used to collect quantitative data when conducting usability testing on this landing page. 2 marks

Qualitative data _____

_____

Quantitative data _____

_____

END OF SECTION B
TURN OVER

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SECTION C – Case study

Instructions for Section C

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

Use the case study provided in the insert to answer the questions in this section. Answers must apply to the case study.

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

Question 1 (3 marks)

After developing the project task table on page 3 of the insert, Melissa decided to use the waterfall development model to plan the web solution for Timothy's sports medicine company.

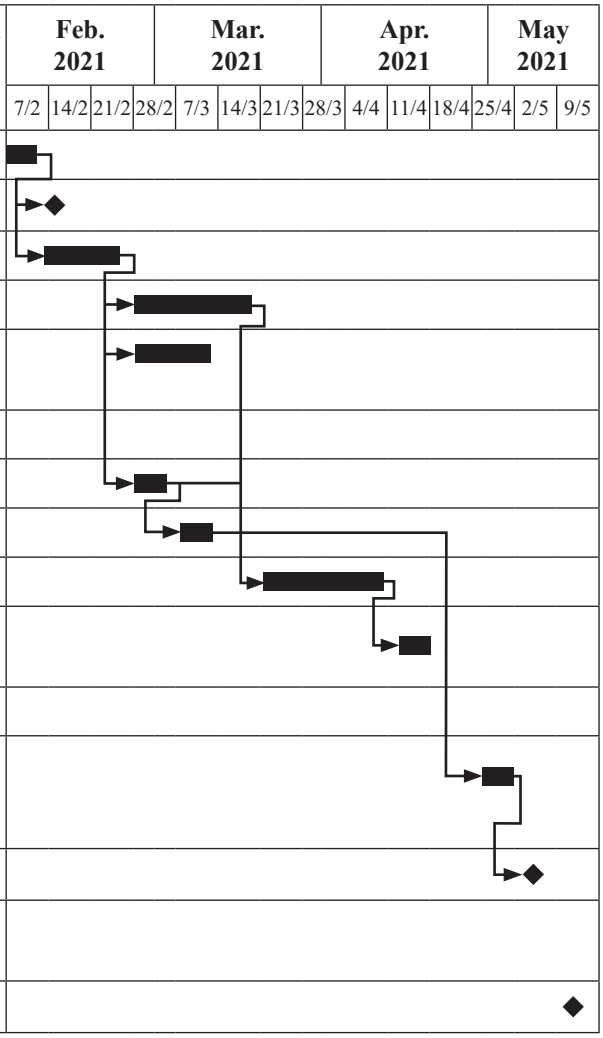
Justify Melissa's decision to use this development model.

Question 2 (6 marks)

After developing the Gantt chart, Melissa identified three tasks that had not been shown in the Gantt chart.

a. Complete the Gantt chart by filling in the missing information, shapes and dependencies using the project task table on page 3 of the insert. 3 marks

Task no.	Task	Start	Duration
1	Complete analysis of project	8/2/2021	1w
2	Analysis completed	15/2/2021	0w
3	Design database	15/2/2021	2w
4	Design website	1/3/2021	3w
5	Design integration plan for video conferencing solution	1/3/2021	2w
6	Design completed	22/3/2021	
7	Develop database	1/3/2021	1w
8	Import data into database	8/3/2021	1w
9	Develop website	22/3/2021	3w
10	Integrate video conferencing with web solution	12/4/2021	1w
11	Test web solution	19/4/2021	
12	Demonstrate the entire web solution to client and make changes	26/4/2021	1w
13	Development complete	3/5/2021	0w
14	Install new web solution and hand over to client	3/5/2021	
15	Project complete	10/5/2021	0w



The team working on the SQL database has reviewed the Gantt chart and is concerned about having only one week to complete Task 8. The team is worried that the project will fall behind.

b. Determine whether this team should be concerned about the project falling behind. 2 marks

c. Calculate the critical path for this project, giving your answer in weeks. 1 mark

Question 3 (3 marks)

Melissa advised Timothy that the development of the website will begin with the development of the SQL database. She also told him that the integration of video conferencing with the web solution will occur after the completion of the website.

a. Identify two items that are within the scope of the project for Melissa's software development company. 2 marks

Item 1 _____

Item 2 _____

b. Identify **one** item that is outside the scope of the project for Melissa's software development company. 1 mark

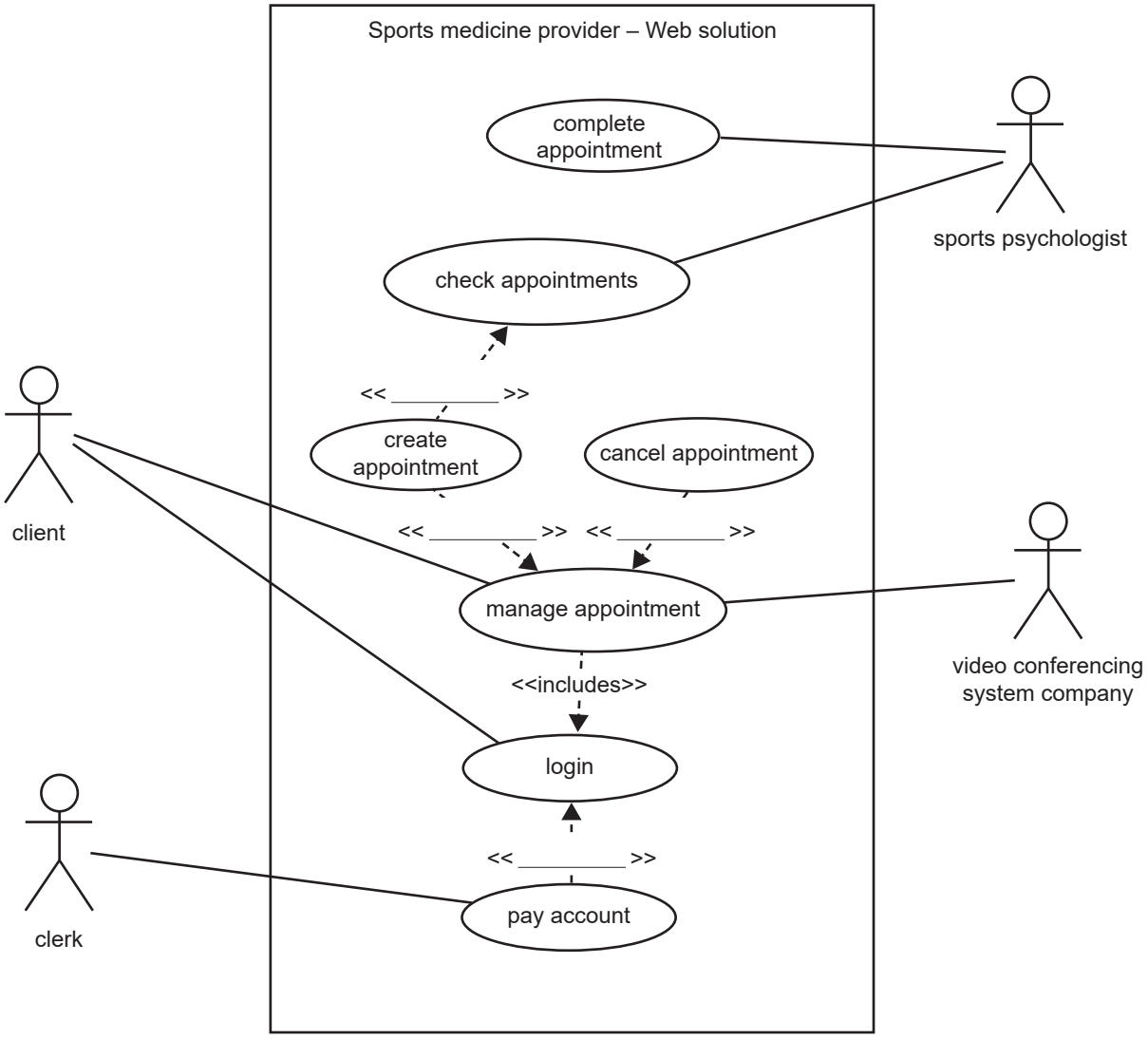
_____

Question 4 (4 marks)

Melissa drew a partial use case diagram documenting the following functionality for users:

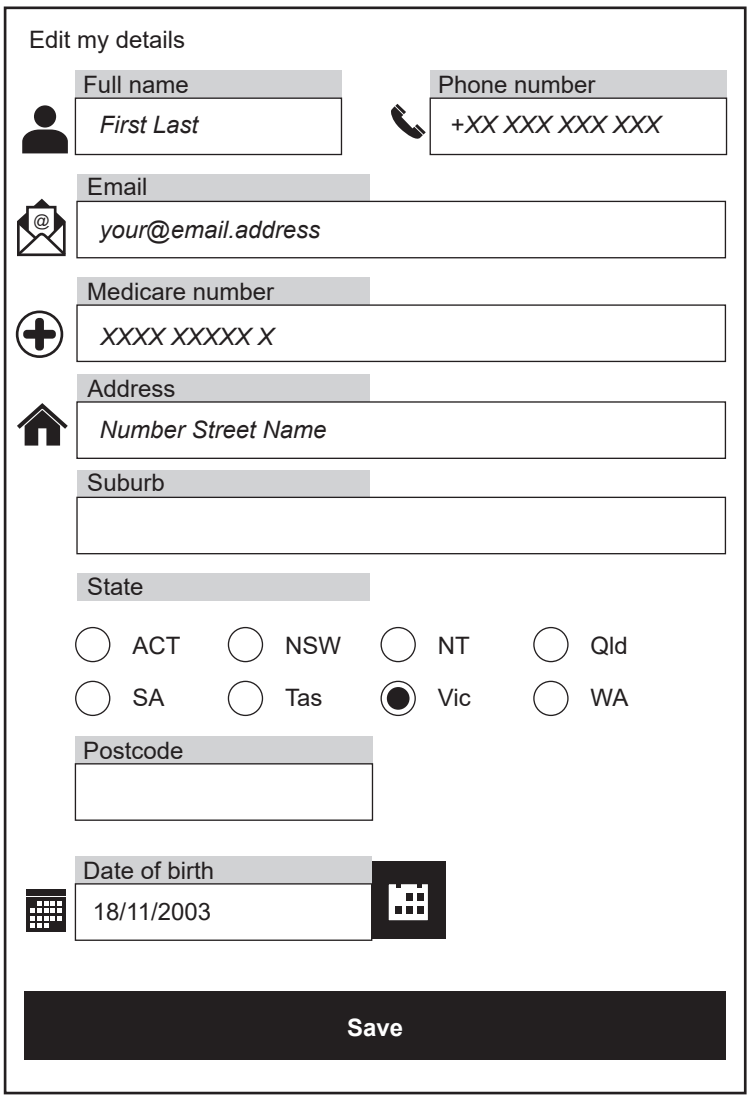
- client
  - log in with their username and password
  - manage their appointments (create, cancel and check appointments)
  - payment feature comes up during login if a new payment needs to be made
- clerk
  - pay account
- sports psychologist
  - complete appointment
  - check appointments
- video conferencing system company
  - manage appointment

Using the information provided above, complete the use case diagram below by adding any missing <<includes>> and <<extends>> details.



Question 5 (6 marks)

The team developing the website created a mock-up of the user input screen for managing personal details, as shown below.



For each of the following validation techniques, explain, with examples, how the use of a control and its features minimise data entry errors and ensure that only validated data is provided.

Existence checking

Range checking

Type checking

Question 6 (6 marks)

The team working on the SQL database developed the pseudocode below. The algorithm reads a list of current appointment IDs from a file and then checks if a new appointment can be made.

Each appointment data item has an ID value that uniquely identifies each appointment. This ID is an integer and is created by joining the year, month, day, hour and minute of the appointment together. An appointment for 9.30 am on 5 November 2021 will have the ID 202111050930. Each appointment has a fixed duration of 30 minutes.

Fill in the missing lines of the pseudocode below so that the algorithm correctly determines if a new appointment can be made.

```
Begin AppointmentAvailable(NewApptID)
    //Read all upcoming appointment IDs from their file into an array.
    //IDs are stored in ascending order
    CurrentApptIDs[ ] ← Read appointments From file
    ApptExists ← False
    HighAppt ← CurrentApptIDs.Length
    LowAppt ← 0

    //Search through all appointment IDs setting "ApptExists"
    //to true if found.
    While ApptExists = False And HighAppt > LowAppt
        MidAppt ← RoundDown(HighAppt + LowAppt)/2)
```

_____

_____

_____

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```
    End While
    If ApptExists Then
        Return False
    Else
        Return True
    End If
End
```

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Question 7 (8 marks)

The team working on the SQL database developed the following pseudocode to create a booking for an appointment.

```
Begin Create_Appointment(Appointment)
    Current_Date ← Get_Date()
    Current_Time ← Get_Time()
    Booking_Available ← False
    If Current_Date < Appointment.Date Then
            Booking_Available ← Appointment_Available
            (Appointment)
    Else If Current_Date = Appointment.Date Then
            If Current_Time > Appointment.Time Then
                  Booking_Available ← Appointment_Available
                  (Appointment)
            Else
                  Return "Invalid appointment"
            End If
    Else
            Return "Invalid appointment"
    End If
    If Booking_Available Then
            Create_New_Appointment_XML_File(Appointment)
            Return "Appointment created"
    End If
End
```

a. Complete the test table provided below given that Current_Date and Current_Time are initialised with 20/01/2022 and 13:30 respectively. 5 marks

Test	Expected result	Actual result
Appointment.Date = 22/01/2022	Appointment created	

b. Identify the line of the pseudocode on page 22 that produces an error. 1 mark

c. Rewrite the line of pseudocode identified in **part b.** so that the correct output is produced. 1 mark

d. Usability testing was carried out on the web solution. The sports psychologists reported that the web solution sometimes created new appointments within one hour of an existing appointment, but this did not provide them with enough time to prepare.

Identify a modification to the pseudocode that would ensure that appointments could not be created within one hour of an existing appointment time. 1 mark

Question 8 (2 marks)

Kareem worked on the user login module. The code has been tested and is ready to add to the rest of the program. Melissa says that this module needs to be audited before it can be added to the program. With the testing complete, Kareem does not think that the audit is needed.

Explain why software auditing should be performed on the module that Kareem developed.

Question 9 (4 marks)

Integration with the video conferencing system company's video conferencing web app is achieved by uploading and downloading an XML file for appointments. A sample XML file is shown below.

```
<?xml version="1.0" encoding="utf-8"?>
<!--New Video conferencing appointments for Timothy's sports
medicine company-->
<VideoConferencingAppointments>
      <Appointment ID="7575">
            <Date>10 Dec 2021</Date>
            <Time>13:00:00</Time>
            <Participants>
                  <Host_ID>123987</Host_ID>
                  <Attendee_ID>32145Y6</Attendee_ID>
            </Participants>
      </Appointment>
      <Appointment ID="9682">
            <Date>12 Dec 2021</Date>
            <Time>09:00:00</Time>
            <Participants>
                  <Host_ID>333352</Host_ID>
                  <Attendee_ID>32145Z6</Attendee_ID>
                  <Attendee_ID>12456X7</Attendee_ID>
            </Participants>
      </Appointment>
</VideoConferencingAppointments>
```

a. For each of the XML items listed in the table below, identify the XML element type. 1 mark

XML item	Element type
ID="7575"	
<VideoConferencingAppointments>	

b. Justify the use of XML files rather than CSV files when transferring data between the video conferencing system company's platform and the sports medicine company's platform. 3 marks

Question 10 (3 marks)

During development, the team working on the SQL database changed the file structure several times. This caused the team working on the website to experience delays because they had to troubleshoot problems caused by accessing out-of-date database files.

Recommend an appropriate security control that Melissa's software development company could use to protect the entire development process from this issue and explain how this security control could assist the team working on the website.

Question 11 (6 marks)

The code that accesses the database includes an SQL statement that reads directly from the input textboxes on the webpage, with no data validation.

a. Identify the type of web solution risk that exists because of this code. 1 mark

b. Describe the type of web solution risk identified in **part a.** 2 marks

c. How would data validation help minimise the type of web solution risk identified in **part a.** to the security of the solution? 3 marks

Question 12 (2 marks)

Usability testing has revealed that the 'client records' data structure developed by Melissa's software development company does not allow for easy retrieval based on a client's use of services provided by Timothy's sports medicine company. The data structure only provides a field that indicates the date of a client's last session.

Identify and explain how the 'client records' data structure might be modified to allow Timothy's sports medicine company to give discounts to the five most frequent users of its services each month.

Question 13 (7 marks)

Timothy provided Melissa's software development company with access to his company's existing database of clients' medical and personal data, which will be imported into the newly developed database. Timothy asked Melissa to decommission his sports medicine company's existing database as part of this process.

a. Describe **two** actions that Melissa's software development company should take when decommissioning the sports medicine company's existing database. 2 marks

b. Timothy asked Melissa to document a database backup scheme for ongoing management of the database upon handover.

Outline **three** considerations that should be taken into account when designing a backup scheme. 3 marks

c. Timothy specified that data from clients who no longer use his company's services should be archived for a period of seven years. Melissa decided that archived data will be stored separately from the main database.

Outline **two** benefits of storing archived data on a system that is separate from the main database. 2 marks

END OF QUESTION AND ANSWER BOOK

Insert for Section C – Case study

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

A software development solution for a sports medicine company

A small sports medicine company delivers performance and sports psychology services. The sports medicine company wants to implement a new web solution that will enable better access to services for its clients and improved communication with its clients. The sports medicine company's clients include both people who play sport for fun at local competitions and athletes who compete at an international level.

Timothy is the owner of the sports medicine company and he wants the new web solution to enable his clients to:

- manage their stored medical and personal details
- manage bookings for services
- participate in video conferencing sessions.

Timothy has employed Melissa and her software development company to create the web solution. Melissa's software development company specialises in secure web solutions.

A number of project decisions have been made by Melissa's software development company and Timothy's sports medicine company. The web solution that will be developed will comprise three components:

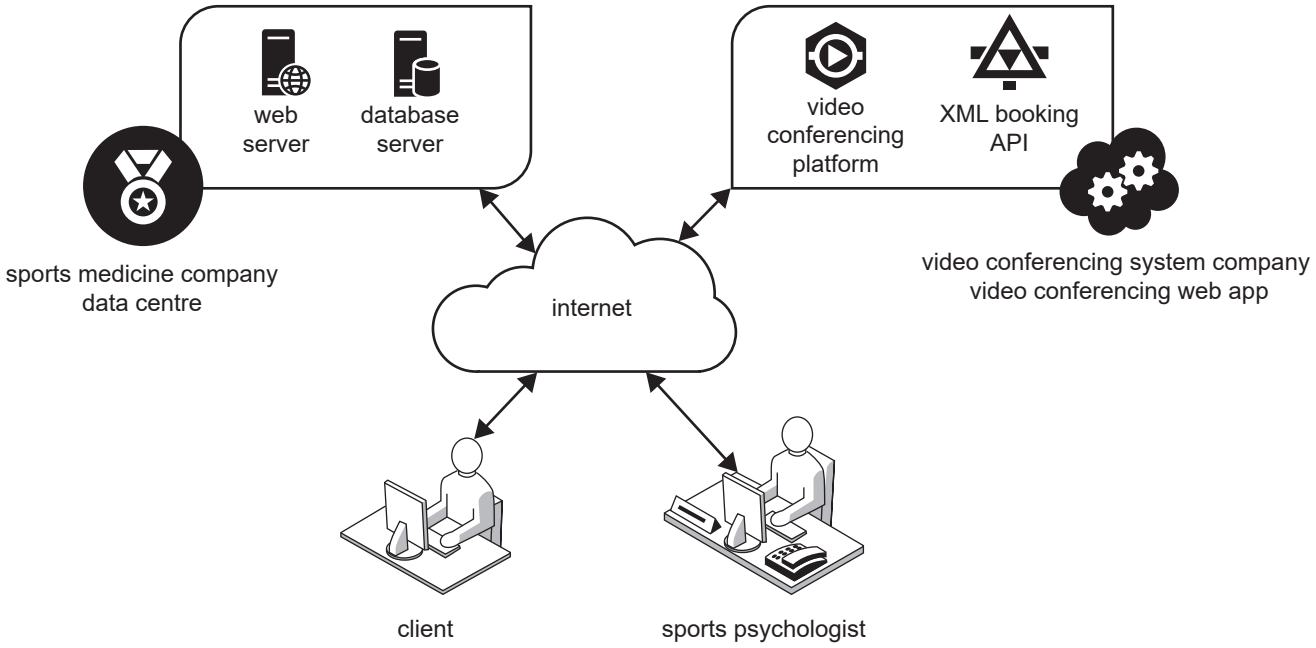
1. a secure data-driven website
2. an SQL server holding all the data
3. a video conferencing application

The website will enable the clients of Timothy's sports medicine company to securely log in using a username and password. This website will be implemented using a responsive user interface and all its data will be stored in an SQL server. The SQL server will hold personal and private client data, including:

- client details – name, address, age, phone number, email address, Medicare number
- medical details – history of illnesses, history of injuries, current medication
- session details – psychologist's name, date of last session, information from client, psychologist's notes, plan from session

The video conferencing functions will be provided by an external video conferencing system company and will be fully integrated with the web solution.

Architecture diagram



Melissa's software development company has allocated three teams to work on this project: one team will work on the website, the second team will work on the SQL database and the third team will be responsible for integrating the video conferencing web app with the web solution. To help coordinate the teams and manage the project for the sports medicine company, Melissa has put together a project task table. This table contains all the tasks, their relationships to other tasks and the time assigned to each task for the whole project.

Project task table

Task no.	Task	Duration	Start date	Dependency
1	Complete analysis of project	5	8/2/2021	
2	Analysis completed	0	15/2/2021	1
3	Design database	10	15/2/2021	1
4	Design website	15	1/3/2021	3
5	Design integration plan for video conferencing solution	10	1/3/2021	3
6	Design completed	0	22/3/2021	4
7	Develop database	5	1/3/2021	3
8	Import data into database	5	8/3/2021	7
9	Develop website	15	22/3/2021	4,7
10	Integrate video conferencing with web solution	5	12/4/2021	9
11	Test web solution	5	19/4/2021	10
12	Demonstrate the entire web solution to client and make changes	5	26/4/2021	11,8
13	Development complete	0	3/5/2021	12
14	Install new web solution and hand over to client	5	3/5/2021	12
15	Project complete	0	10/5/2021	14

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