**Section A – Multiple Choice**

|  |  |  |  |
| --- | --- | --- | --- |
| 1. C 2. D 3. A 4. A 5. C | 1. C 2. D 3. B 4. B 5. D | 1. A 2. B 3. C 4. A 5. C | 1. B 2. D 3. B 4. C 5. B |

**Question 1***U4O1KK12: strategies for evaluating the efficiency and effectiveness of solutions and project plans*

Determining strategies for measuring the extent to which solutions meet the needs of users occurs during which stage of the problem-solving methodology?

1. design
2. analysis
3. evaluation
4. development

**Explanation:** Determination of strategies occurs as part of the evaluation stage of the problem-solving methodology. This is outlined clearly on page 16 of the study design.

**Question 2***U3O1KK7: techniques for linear and binary searching*

An advantage of using a binary search over a linear search is

1. that a binary search would be more efficient and effective.
2. that a binary search requires only 0s and 1s to work.
3. that a binary search would be more effective.
4. that a binary search would be more efficient.

**Explanation:** Option B is a nonsensical answer so it can be eliminated immediately. In a general sense, there are no clear advantages (or disadvantages) between linear and binary search algorithms, in relation to effectiveness, therefore eliminating Options A and C.

Binary search algorithms typically exhibit O(log n) efficiency as compared to linear search algorithms, which exhibit O(n) efficiency. What this means is that as the list size to be searched grows, the number of operations grows much more slowly for binary search than linear search, which grows at the same rate as the list size.

**Question 3***U3O1KK4: formatting and structural characteristics of input and output, including XML file formats*

XML is a software- and hardware-independent language that is used for storing and transporting data.

What does XML stand for?

1. Extensible Markup Language
2. Xylophone Markup Language
3. Extensible Marking Language
4. Extra-long Marking Language

**Explanation:** XML is a mark-up based language – of which the knowledge can be used to eliminate Options C and D. XML is an abbreviation for Extensible Markup Language, further eliminating Option B.

**Question 4***U3O1KK2: types of data structures, including one-dimensional arrays (single data type, integer index) and records (varying data types, field index)*

The following values are stored within a one-dimensional array:

0, 1, 1, 2, 3, 5, 8, 13, 21, 34

The value 8 is stored at which index?

1. 6
2. 7
3. 8
4. 10

**Explanation:** Most implementations of arrays that are used in Software Development are zero-based arrays. 7 would be the answer if this were an index-1 based array, while 8 is the value students are looking for. 10 is the length of the array. The value is stored at *arrayname*[6].

**Question 5***U3O1KK6: processing features of a programming language, including instructions, procedures, methods, functions and control structures*

Individual lines of code are best described as

1. functions.
2. procedures.
3. instructions.
4. control structures.

**Explanation:** Functions are reusable blocks of code that return a value. Procedures execute blocks of code, however do not return a value. Control structures are blocks of code that determine the flow of the program (i.e. sequential means the code is executed the same way each and every time the program is run, selection means the code executes dependent on variables/conditions within the program, while repetition/iteration loops blocks of code, again dependent on variables/conditions within the program). Instructions are individual instructions which are executed at runtime.

**Question 6***U3O1KK9: purposes and characteristics of internal documentation, including comments and meaningful names*

Internal documentation is most effective when

1. it is succinct.
2. it helps the code run faster.
3. it describes the functionality of the program.
4. all of the above

**Explanation:** Internal documentation does not provide any hindrance to compilers or execution time, as compilers know to ignore comments, therefore eliminating Option B. The elimination of Option B also eliminates Option D. Internal documentation is effective when it is succinct and describes the functionality of the program. However, just because internal documentation may be succinct, it does not mean that it will also be effective, therefore eliminating Option A. This leaves Option C as the best choice for students.

**Question 7***U3O2KK9: features of context diagrams and data flow diagrams*

In context diagrams, lines with arrowheads are used to depict data flows. What do lines with arrowheads depict in use case diagrams?

1. actors
2. processes
3. data flows
4. interactions

**Explanation:** Processes and data flows are data flow diagram terms, hence eliminating Options B and C. Actors are represented using stick figures and in terms of data flow diagrams, are loosely related to entities, eliminating Option A. Interactions, while not always requiring arrowheads, is the best option that can be selected for this question.

*Use the following information to answer Questions 8 and 9*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Months** | | | | | | | | | | | | | | | | | | | | | | | |
| **Task** | **1** | | | | **2** | | | | **3** | | | | **4** | | | | **5** | | | | **6** | | | |
| Design building |  |  |  |  |  |  | **** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Get building permits |  |  |  |  |  |  |  |  |  |  |  |  |  | **** |  |  |  |  |  |  |  |  |  |  |
| Excavate site |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Install preliminary plumbing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lay foundations |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **** |  |  |  |

**Question 8***U3O2KK14: project management concepts and processes, including milestones and dependencies (concepts), and task identification, sequencing, time allocation, resources and documentation using Gantt charts (processes)*

On the Gantt chart provided, what are the diamonds representative of?

1. tasks
2. milestones
3. dependencies
4. the critical path

**Explanation:** On the Gantt chart provided, tasks are represented in each row by shading the cells that correspond to when the task will be carried out. Dependencies are represented by the arrows between rows. The critical path is not depicted in this example, therefore, leaving milestones as the only possible selection for students.

**Question 9***U4O1KK10: techniques for recording the progress of projects, including annotations, adjustments to tasks and timeframes, and logs*

Jerry asks George how he could record and monitor the long-term progress of his project.

George should suggest which of the following to Bill?

1. test the usability of the project plan
2. annotate his Gantt chart or keep a project log
3. generate alternative project plan ideas and determine the best project plan
4. all of the above

**Explanation:** Options A and C are nonsensical answers and as such, also eliminates option D. Both options contain similar terminology to other areas within the study design. Option A considers the notion of applying usability testing to the project plan (which to the author’s knowledge doesn’t happen in any industry) and one must remember that testing is very different to evaluation – which does happen. Option C would be a waste of time - if each alternative representation shows the same thing, it becomes relatively inefficient.

**Question 10***U3O2KK15: security considerations influencing the design of solutions, including data protection and authentication*

One technique that software developers can include in their programs to protect sensitive data and information is

1. testing.
2. validation.
3. evaluation.
4. authentication.

**Explanation:** Validation, testing and evaluation provide no protection to sensitive data. Testing occurs during development to ensure the program functions correctly. Validation occurs during run-time to ensure that correct data is entered into the system, while evaluation takes place after implementation to ensure that all functional and non-functional requirements have been met and that the solution is efficient and/or effective.

Authentication, whether it be username/password, biometric or otherwise, is intended to protect user data and information. It is most effective when incorporated with appropriate permissions.

**Question 11***U3O2KK16: styles of modern application architecture, including mobile, rich client, peer-to-peer and internet applications*

A recent article about modern application architectures made the following claims:

1. The peer-to-peer architecture allows users to share resources, such as processing power and storage.
2. The peer-to-peer architecture requires a server to perform processing on behalf of a number of connected clients.

Which of the claims are true?

1. claim 1 only
2. claim 2 only
3. claim 1 and 2
4. neither claim 1 or claim 2

**Explanation:** Claim 1 is factual, so this eliminates Option D as a possible answer. Claim 2 is not factual, therefore leaving only Option A.

The underlying principle of the peer-to-peer architecture is the distributed sharing of resources (processing power, memory, files, etc) and is used in a variety of applications.

**Question 12***U3O2KK3: constraints that influence solutions, including economic, legal, social, technical and useability factors*

Compatibility of hardware and user expertise are examples of which types of constraints?

1. technical, legal
2. technical, usability
3. technical, technical
4. technical, economic

**Explanation:** The key to answering this question is in determining which type of constraint user expertise is, as all four options offer technical constraint as the first response to the question. Legal constraints relate to the law and how it relates to the implementation of a given application. Technical constraints are in relation to the hardware, software and network environment in which the application will operate. Economic constraints are typically around budget and time. Useability constraints are related to the end-user and how they will use the application. Therefore, Option B is the only possible option.

**Question 13***U4O1KK1: ways in which file size, storage medium and organisation of files affect access of data*

A server hosts the website for a large learning organisation in Melbourne. The website hosts a large number of files, which are frequently accessed by its users from across the world. Overall, the server stores approximately 60GB of various file types (including videos) and requires bandwidth of around 500GB. It is almost reaching capacity and the server administrators have decided to upgrade the storage capacity of the server.

Which of the following storage media options would be the best option in this situation?

1. a 128GB USB Hard Disk Drive (HDD) to be used in conjunction with the current 64GB HDD
2. a RAID array of HDDs (totalling 500GB) to replace the current 64GB HDD
3. a 500GB Solid State Drive (SDD) to replace the current 64GB HDD
4. a 500GB HDD to replace the current 64GB HDD

**Explanation:** Capacity is not the issue in the question responses here. This question is asking about how storage medium affects the speed of access of data. SSD’s have been benchmarked as being able to access data significantly faster than HDDs and USBs. It would also be faster than a RAID array of HDDs.

**Question 14***U4O1KK2: uses of data structures to organise and manipulate data, including associative arrays (or dictionaries or hash tables)*

Associative arrays are comprised of what pairs?

1. key/value
2. key/field
3. field/value
4. field/counter

**Explanation:** Associative arrays are collections of key/value pairs. Options B, C, D are pairs of loosely related terminology.

**Question 15***U4O1KK4: processing features of a programming language, including instructions, procedures, methods, functions and control structures*

The algorithm below is for a function that is to be used in a range of software modules.

|  |  |
| --- | --- |
|  | **Start** |
|  | **Input** a, b |
|  | **While** b < a |
|  | c 🡨 b \* a |
|  | **If** c > 15 **Then** |
|  | a 🡨 a – 2 |
|  | b 🡨 b – 2 |
|  | **End If** |
|  | **End While** |
|  | **Finish** |

Lines 5 – 8 are best described as

1. a function
2. sequential instructions
3. a selection control structure
4. a repetition control structure

**Explanation:** Functions are repeatable blocks of code. The question stem identifies the entire algorithm as a function. Sequential instructions execute in the same way every time the function is called. Repetition control structures are looping structures (ie. Do, While, For loops). Selection structures are decision making structures with programs (ie If…Then, IfThenElse, IfThenElseIf Case statements).

**Question 16**

*U4O2KK12: the physical and software controls used by organisations to secure the storage and communication of data in a networked environment*

Firewalls are used to protect

1. the data and information held by and the systems used by organisations from disgruntled workers.
2. the data and information held by and the systems used by organisations from external sources.
3. individuals from natural disasters.
4. the Internet.

**Explanation:** Firewalls do not protect organisations from disgruntled workers that decide to maliciously attack systems when they are on-site or directly connected to the network. They do not provide any protection for individuals in natural disasters. While firewalls can be used to protect the servers which power the Internet, the best response in this question is in fact Option B.

**Question 17***U4O2KK9: goals and objectives of information systems*

BiggerSoft’s aim for its new operating system to provide a better user experience than its competitors by including more out-of-the-box features is an example of

1. an organisational goal.
2. an organisational objective.
3. an information system goal.
4. an information system objective.

**Explanation:** Goals are general statements that give direction to an organisation. Objectives are more specific and provide information about how a goal is to be achieved. The question is referring to the aim of the operating system, which automatically eliminates Options A and B. Since the aim includes information about how the goal is to be achieved (‘by including more out-of-the-box features), it is considered to be an objective.

**Question 18***U4O2KK6: data management practices that cause conflict between information systems, including data mining*

The employees at BiggerSoft often use data from their customer and product usage databases to make decisions about improvements to upcoming software releases. This is an example of

1. ideation.
2. data mining.
3. validation of data.
4. data management practices.

**Explanation:** Ideation is the process where several design ideas are generated. Validation of data is the process of checking that input of data is reasonable. Data management practices are the processes or procedures that organisations put in place to store, secure and dispose of data and information.  
  
Data mining is the process of extracting data from a central repository (or several sources) and analysing the data to identify important patterns and relationships in order to make decisions.

**Question 19**

*U4O2KK11: types and causes of accidental, deliberate and events-based threats to the integrity and security of data and information shared between information systems*

John is an administrative manager with BiggerSoft. He has recently disagreed with several other team managers about the company’s review of their network, specifically about the need for greater security on BiggerSoft’s file servers. He decides to move some folders and files around to try and prove his point to the other managers, who don’t believe that greater security is necessary.

This type of threat to the integrity and security of data can be described as

1. events-based.
2. accidental.
3. deliberate.
4. minimal.

**Explanation:** Events-based threats are those which are out of the control of the users of an information system, thereby eliminating Option A. Given that John has decided to move files and folders around, he has done so intently – therefore eliminating Option B as a possibility. Option D could be used as an adjective to describe the severity of the threat, rather than describe the type of threat, leaving Option C as the best response of those presented.

**Question 20**

*U4O2KK3: types of interactions (inputs and outputs) generated by information systems*

An information system receives hourly data from a number of weather stations situated around Melbourne and the system processes that data using a complex algorithm. It then generates detailed forecasts for different areas of the metropolitan area

In relation to the weather stations, the hourly data is an example of what type of interaction?

1. a process
2. an output
3. an input
4. storage

**Explanation:** This question requires the students to read the entire question. Both the weather stations and the system receiving the weather station data are information systems. For the forecast system, the hourly data is an input, with the forecasts as an output. The algorithm is an example of a process (or several processes). However the question specifically asks about the weather station context, where the hourly data is in fact an output. Storage is an unrelated term in this context.

**Section B – Short Answer**

**Question 1** (3 marks)

*U3O2KK2: features of functional and non-functional requirements  
U3O2KK11: factors influencing the design of solutions, including useability, affordability, security, interoperability and marketability*

Bill has recently employed a software developer to produce dashboard software for his marketing company that will display a range of metrics about his organisation. The developer has asked whether John would like his new software package to be portable or interoperable. John isn’t sure of the difference between the two.

Recommend which he should choose by explaining the difference between interoperability and portability.

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark  1 mark | Definition of interoperability  Definition of portability  Choice |

**Sample high-scoring response:**

Interoperability is the ability of an application to share information with other information systems. Portability is the ability of an application to be executed in different operating environments or on different devices.

John should request that the dashboard software be interoperable as it will display metrics, presumably from a number of other information systems.

**Question 2** (2 marks)

*U4O1KK1: ways in which file size, storage medium and organisation of files affect access of data*

A veterinarian’s clinic plans to store animal records in a software application. Each record is estimated to contain approximately 5 megabytes (MB) of information. The clinic has asked the software developer how much storage they will require on their system if they currently have 5000 records and anticipate this number to grow to 7000 over the next 3 years. The records will be stored in a single file.

What would be the minimum expected file sizes (in GB) for the clinic’s current and future needs?

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark | Correct calculation of current minimum expected file size  Correct calculation of future minimum expected file size |

**Sample response:**

*Current minimum expected file size* 5MB x 5000 records = 25,000MB ≈ 25GB (24.41GB)

*Future minimum expected file size* 5MB x 7000 records = 35,000MB ≈ 35GB (34.17GB)

**Explanation:** For this question, either 1000MB or 1024MB could be used to calculate the expected file sizes in GB. In the solutions above, the value in the brackets is representative of the 1024MB = 1GB. Therefore for current needs, 24GB, 24.41GB or 25GB would be accepted values. For future needs, 34GB, 34.17GB and 35GB would be accepted values.

**Question 3** (4 marks)

*U4O2KK12: the physical and software controls used by organisations to secure the storage and communication of data in a networked environment  
U4O2KK13: the role of hardware, software and technical protocols in managing, controlling and securing data shared between information systems*

Madeline is a network administrator for a large office building in Melbourne. Recently, she hired a high school student for two weeks of work experience. As part of the student’s orientation to the network, Madeline takes him through some network essentials.

1. Select **one** of the listed network devices and describe its potential function within the network.

*2 marks*

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark OR  2 marks | Brief description of functionality  Detailed description of functionality |

**Sample high-scoring responses:**

**router:** a device that forwards packets between networks. Routers are typically used to connect networks to each other and/or the Internet.

**switch:** a device that serves as the central point of connection between other devices on a network. Switches forward packets between various devices on a network.

**wireless access point:** a device that allows Wi-Fi enabled devices to connect to a network and share resources.

**proxy server:** a server that facilitates requests made by the clients connected to it. Proxy servers can be used for a range of functions, such as Internet filtering or masking internal IP addresses from public view.

One week into the work experience program, the student thinks that he has reasonable understanding of the network systems and how they operate. He asks Madeline for full permissions to the network to perform some additional duties.

1. Justify why Madeline should not provide the student with additional permissions. 2 marks

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark | Reason 1  Reason 2 |

**Sample responses:**

Reasons could include, but are not limited to:

* His knowledge of network systems may not be as good as he thinks it is and could damage the network accidentally
* Network security would be compromised, in that he could access data and information that he shouldn’t be able to
* Madeline may forget to remove his credentials at the end of the work experience period, leaving the network vulnerable
* The duties he performs shouldn’t require elevated permissions
* Madeline should be dictating his duties rather than the other way around

**Question 4** (2 marks)

*U4O2KK10: characteristics of wired and wireless networks*

Johnny is the IT manager of a small business in Melbourne. He is currently in the process of deciding whether to upgrade the wireless router that is used to connect up to 4 laptops and 6 smart phones.

Identify two important factors that Johnny will have to consider when purchasing a new wireless router.

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark | Important factor 1  Important factor 2 |

**Sample responses:**

Important factors could include, but are not limited to:

* price
  + Johnny works for a small business so price is always a consideration.
* wireless standards
  + Johnny would want a router that will be compatible with his existing devices (4 laptops, 6 smart phones).
* number of simultaneous connections
  + Johnny requires at least 10 simultaneous connections on site – if everyone is working on-site. Could a new router provide sufficient connections, if the business expands?
* in-built security features
  + The business that Johnny works for will have critical and sensitive data on the network that will need to be protected from external threats. He will need to consider whether the existing wireless router offers sufficient protection.

**NB:** While explanations were not necessary, they have been included for learning purposes.

**Question 5** (4 marks)

*U3O1KK2: types of data structures, including one-dimensional arrays (single data type, integer index) and records (varying data types, field index)*

When discussing data structures, programmers use the terms ‘one-dimensional array’ and ‘record’.

1. What is a one-dimensional array? In your response, include an example of an array. 2 marks

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark | Definition of a one-dimensional array  Appropriate example of a one-dimensional array |

**Sample response:**

A one-dimensional array stores a series of variables (of a single data type), using a common name and (generally) a zero-based integer index.

Example: intNumbers = {0,2,4,6,8,10} intNumber[2] = 4

1. *What is a record? In your response, include an example of a record. 2 marks*

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark | Definition of a record  Appropriate example of a record |

**Sample response:** A record stores related data (of varying data types) using a field-based index.

Example: The record of a student may include data such as student number, given name, family name and their date of birth.

**Question 6** (5 marks)

*U3O1KK3: methods of representing designs, including data dictionaries, object descriptions, mock-ups and pseudocode  
U3O2KK10: methods of expressing designs, including data dictionaries, object descriptions, mock-ups and pseudocode*

A program requires three numbers to be input into a program (A, B and C). While A is less than the sum of B and C, A is doubled and both B and C are increased by 1. Once A is greater than or equal to the sum of B and C, all three values are output to the screen.

Write this as pseudocode. You may introduce other variables if necessary.

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark  1 mark  1 mark  1 mark | Appropriate use of indentation  While loop used correctly (WHILE….END WHILE)  Correct condition used in while loop 🡪 A < (B + C)  Complete set of calculations (A, B, C)  Complete set of variables is output (A, B, C) |

|  |  |
| --- | --- |
| **Sample response:** | **Sample response (with an additional variable)** |
| ***Begin***  *Input A, B, C*  WHILE A < (B + C)  A = 2 \* A  B = B + 1  C = C + 1  END WHILE  DISPLAY A, B, C  ***End*** | ***Begin***  *Input A, B, C*  D = B + C  WHILE A < D  A = 2 \* A  B = B + 1  C = C + 1  D = B + C  END WHILE  DISPLAY A, B, C  ***End*** |
|  |  |

**Section C – Case Study**

**Question 1** (3 marks)

*U3O2KK17: types of goals and objectives of organisations and information systems*

South Melbourne Private Hospital (SMPH) has recently set a number of goals and objectives that they plan to meet over the next 12-24 months. The table below outlines some of the goals and objectives that were set by the hospital board.

Complete the table by deciding upon the type of goal or objective that has been set by hospital management. An example has been provided.

|  |  |
| --- | --- |
| **Marking scheme** | |
| 3 marks | Correct classification of goal/objective type (for a maximum of 1 mark per goal) |

**Correct response:**

|  |  |  |
| --- | --- | --- |
| ***Key Principle*** | ***Goal/Objective*** | ***Type*** |
| *Excellence* | *Nurses will be allocated to patients fairly and according to their capabilities and experience* | **Operational** |
| *Excellence* | *Enhance community and stakeholder support* | **Strategic** |
| *Excellence* | *Elective surgery waiting list times are kept to a minimum (target ≤ 3 months)* | **Tactical** |

**Explanation:** Organisational goals and objectives can be classified as strategic, tactical or operational. Strategic goals/objectives are typically longer term and are broad, overarching statements that are based around an organisation’s key values or mission statement. These are typically framed by upper leadership. Tactical goals/objectives are medium term goals/objectives that lead to the achievement of strategic goals and are typically developed at a departmental or middle management level. Operational goals/objectives are shorter term (day-to-day) goals/objectives that are tackled at the worker/lower management level.

The question required students to consider the SMPH Key Values (Diagram 1) and apply their knowledge of organisational goals and objectives.

**Question 2** (4 marks)

*U3O2KK1: techniques for collecting data to determine needs and requirements, including interviews, surveys and observation*

*State* ***two*** *appropriate data collection methods that could be employed to determine solution requirements and justify why using these techniques would be advantageous for Rachel.*

|  |  |
| --- | --- |
| **Marking scheme** | |
| 2 marks  1 mark  1 mark | Data collection methods (for a maximum of 1 mark per method)  Brief justification of DC1, which references the case study  Brief justification of DC2, which references the case study |

**Sample high scoring responses:**

Responses to this question may include, but are not limited to:

**Data collection method:** Observation

**Justification:** Rachel could observe the medical staff carrying out their daily duties, in order to see which processes could become more efficient/effective, as well as the different types of data that are recorded by the medical staff.

**Data collection method:** Surveys

**Justification:** Rachel could survey a large proportion of the hospital staff to determine what they would like (in regards to functionality) from the EPMS.

**Data collection method:** Interviews

**Justification:** Rachel could interview a random sample of the hospital staff in order to gauge opinion on the current system and where improvements could be made.

**Question 3** (3 marks)

*U3O2KK2: features of functional and non-functional requirements*

From the data collection, Rachel has identified that the EPMS will have a number of functional and non-functional requirements. This information will be included in a Software Requirements Specification (SRS).

Identify **three** important functional requirements.

|  |  |
| --- | --- |
| **Marking scheme** | |
| 3 marks | Identification of functional requirements (for a maximum of 1 mark per requirement) |

**Sample responses:**

Responses include, but are not limited to:

|  |  |
| --- | --- |
| * Admit patients to the hospital * Create patient records * Retrieve patient records * Update patient records | * Store patient notes * Store patient charts * Track prescriptions/medications * Discharge patients |

**Question 4** (6 marks)

*U3O2KK9: features of context diagrams and data flow diagrams  
U3O2KK10: tools and techniques for depicting the interfaces between solutions, users and networks, including use case diagrams created using the Unified Modeling Language*

Rachel decides to diagrammatically represent the current admissions and discharges process using a context, data flow and use case diagram. She has finished the context diagram and is now working on the data flow and use case diagrams.

1. Based on the case study, including the data flow diagram, complete the context diagram for Rachel. 3 marks  
   **Correct solution:**

Nurses

Medical\_ information

Notification

Patients

Personal\_  
information

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark  1 mark | Addition of Patient entity (attached to the Medical\_information data flow)  Addition of data flow from Patient entity to EPMS (personal\_details)  Addition of data flow from EPMS to Nurses entity (notification) |

1. Based on the case study, complete the use case diagram to represent the system correctly on the incomplete diagram below. 3 marks

**Correct solution:**

<<includes>>

<<includes>>

Ward Secretary

Patient

<<includes>>

<<includes>>

Nurse

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark  1 mark | Interaction between Ward Secretary and ‘Create record’ Use Case  Both <<includes>> interactions from ‘Create record’ to ‘Allocate bed’ & ‘Allocate nurse’ use cases. Arrowheads (in the correct direction) and the word includes must be present to receive the mark. << >> around the includes are not necessary.  Interactions with ‘Collect patient information’ from ‘Patient’ and ‘Ward Secretary’ |

**Question 5** (3 marks)

*U3O2KK16: styles of modern application architecture, including mobile, rich client, peer-to-peer and internet applications*

Rachel has a number of application architecture options which she may choose from. Hospital management has indicated that they do not intend on streamlining the diverse range of devices (PCs, Macs, hybrid notebooks, smart phones) and platforms (Windows, OS X and iOS) that are currently used across the hospital in the foreseeable future.

Select the most appropriate application architecture from the list provided and justify your selection.

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  2 marks | Selection of the most appropriate application architecture  Justification that references the case study and functional requirements |

**Correct response and sample high-scoring justification:**

**Application architecture:** internet

**Justification:** Justifications may include, but are not limited to:

* Rachel and hospital management have discussed the EPMS being implemented on a range of devices and platforms.
* The software will require a high number of reliable simultaneous client connections.
* The use of an Internet application architecture will lower application maintenance costs, as well as eliminate the need to install the application on each of the individual devices.

**Question 6** (4 marks)

*U3O1KK3: methods of representing designs, including data dictionaries, object descriptions, mock-ups and pseudocode  
U3O2KK10: methods of expressing designs, including data dictionaries, object descriptions, mock-ups and pseudocode*

Rachel, in consultation with Hugh, has written a data dictionary to list all of the variables that will be used in the Patient Admissions module of the EMPS. A sample of this data dictionary is provided.

For each variable in the table below, state the **most appropriate** data type and a description of what it is used for. An example has been provided.

**Data types: character, string, Boolean, integer, floating point**

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark  1 mark  1 mark | date\_of\_birth type and reason  smoker type and reason  patient\_weight type and reason  patient\_height type and reason |

**Sample response:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Data** | **Description** | **Type** | **Reason** |
| *date\_of\_birth* | *the patient’s date of birth in dd-yy-mmmm format* | **string** | **includes hyphens in the format and requires no calculations to be performed on the data** |
| *smoker* | *the smoker status of the patient stored as true or false* | **Boolean** | **data can only take on two values: True and False** |
| *patient\_weight* | *the weight of the patient at admission* | **floating point** | **weight is not a discrete value** |
| *patient\_height* | *the height of the patient at admission, stored in cm* | **integer** | **As the data is stored in cm, decimal values are not necessary.** |

**Question 7** (5 marks)

*U3O2KK7: criteria for evaluating alternative design ideas and the efficiency and effectiveness of solutions*

John, an interface designer for MedSoft, has been busy generating a number of design ideas for the Patient Notes and Charts module of the EPMS. He knows that the nurses and doctors at SMPH will need to make life and death decisions (at times) based on the information provided on screen. This makes the user interface very important as the hospital’s doctors and nurses will need to make clinical decisions quickly.

He has decided to present the following two designs to Hugh and a working group of doctors and nurses at the hospital.

|  |  |
| --- | --- |
| **Option A: Visual-based interface** | **Option B: Text-based interface** |

1. Outline **two** criteria that could be used by Hugh to determine which design could be selected. 2 marks

|  |  |
| --- | --- |
| **Marking scheme** | |
| 2 marks | Relevant criteria that could be used to select a preferred design (for a maximum of 1 mark per criteria) |

**Sample responses:**

Criteria for selecting a preferred design could include, but are not limited to:

* Is the design intuitive?
* Does the design communicate the data in an effective way?
* Will medical staff be able to make medical decisions quickly, based on the information provided by the interface?
* Does the interface communicate all of the necessary information to the medical staff?

1. Which option should Hugh use? Justify your answer with reference to both options and the criteria outlined in a. 3 marks

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark  1 mark | Justification based on criteria 1 (from a)  Justification based on criteria 2 (from a)  Clearly stated selection of option based on Criterion 1 and 2 justification |

**Explanation:** Either option could be selected, provided students relate their choice to the criteria that they provided in part a. Students should also provide a response that makes reference to the case study.

**Question 8** (6 marks)

*U3O1KK8: techniques for checking that modules meet design specifications, including trace tables and test data  
U4O1KK8: techniques for checking that modules meet design specifications, including construction of test data*

As part of the design of the Admissions/Discharges module of the EPMS, Rachel has written an algorithm that will calculate the duration of the patient’s stay, which is to be included in the patient discharge summary.

**Procedure** calculateStayDuration

**Begin**

**Read** admissionDate **From** patient\_records

stayDuration = currentDate – admissionDate

**If** stayDuration ≥ 0 **Then**

**Return** error

**Else**

**Return** stayDuration

**End If**

**End**

1. To check this algorithm before coding, the data in the test table below was generated. For testing purposes, the discharge date will be set to 25/11/16, however, it would normally be set by the system.

Complete the table by filling in both the expected and actual values. 3 marks

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark  1 mark | Correct expected and actual output for Test 1  Correct expected and actual output for Test 2  Correct expected and actual output for Test 3 |

**Correct response:**

|  |  |  |  |
| --- | --- | --- | --- |
| ***Test no.*** | ***Admission date*** | ***Expected output*** | ***Actual output*** |
| *1* | *23/11/16* | **2** | **error** |
| *2* | *25/11/16* | **0** | **error** |
| *3* | *27/11/16* | **error** | **-2** |

1. Outline the major errors in this algorithm. 1 mark

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark | Correct identification of error in algorithm |

**Correct responses:** [There are two potential solutions to this question]

1. Return statements are in the wrong branch of the IF statement.
2. Operator within the IF condition should be < rather than ≥.
3. Write new lines of code to correct the error. 2 marks

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark | Correct IF…ELSE structure  Correct placement of return statements |

**Sample responses:** [There are two potential solutions to this question]

|  |  |
| --- | --- |
| 1. IF stayDuration ≥ 0 THEN   RETURN stayDuration  ELSE  RETURN error  END IF | 1. IF stayDuration < 0 THEN   RETURN error  ELSE  RETURN stayDuration  END IF |

**Question 9** (4 marks)

*U4O2KK3: types of interactions (inputs and outputs) generated by information systems*

Rachel has started to identify the required inputs and outputs for the Patient Discharge process that will be required to be completed within the EPMS when the system goes live.

Based on the case study, identify the key inputs and outputs required by the Discharge module for the EPMS in the table below.

|  |  |
| --- | --- |
| **Marking scheme** | |
| 3 marks  1 mark | Identification of key inputs (for a maximum of 1 mark per input)  Identification of key outputs |

**Correct response:**

|  |  |
| --- | --- |
| **Inputs** | **Output**s |
| * patient admissions information * summary of care * medications list & prescriptions | * discharge summary |

**Question 10** (3 marks)

*U3O1KK7: techniques for linear and binary searching  
U4O1KK5: algorithms for sorting, including selection sort and quick sort and their suitability for a given purpose, measured in terms of algorithm complexity and sort time*

Jessica, a member of the working group, has suggested that administration staff be able to sort patient lists by surname, given name, admission/next appointment date or discharge/last appointment date for a range of purposes. She has also suggested a search function be included in the EPMS so that receptionists can easily direct visitors to the right wards.

1. Given the need to be able to sort the data held by the system, what type of search should the system use? 1 mark

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark | Correct identification of binary search technique |

**Explanation:** The question stem described the suggestion of sorting the data on a range of fields. Given this suggestion/request, it is clear that a binary search would be most appropriate – given the binary search algorithm’s pre-requisite of the data set needing to be sorted.

Hugh has concerns that given the large number of patients staying in and visiting the hospital on any given day (up to 400), the time taken to search the patient lists will take too long if the data is not sorted. Hugh has suggested a selection sort be implemented, while Rachel has suggested a quick sort be used.

1. Should Rachel implement a selection sort or quick sort? Justify your choice. 2 marks

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark | Choice of sorting algorithm  Justification of selection |

**Sample responses:**

|  |  |  |
| --- | --- | --- |
| **Choice** | **Selection sort** | **Quick sort** |
| **Justification** | Selection sort is much more easily implemented than a quicksort. | Quick sort is much more efficient than a selection sort. |

**Question 11** (4 marks)

*U3O2KK18: key legal requirements relating to the ownership and privacy of data and information  
U4O2KK5: key legislation that affects how organisations control the storage, communication and disposal of their data and information*

The SMPH Legal team has some concerns over the security of the data being held by the system. Nicole has assured them that the software will meet all necessary legislative requirements.

1. State the **two** laws that the software will have to be made compliant with? 2 marks

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark | Privacy Act 1988  Health Records Act 2001 |

1. Briefly explain why each of the laws are relevant to this particular piece of software, with reference to the case study. 2 marks

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark | Explanation of need to be compliant with Privacy Act  Explanation of need to be compliant with Health Records Act |

**Sample high-scoring response:**

The EPMS is required to be compliant with the Privacy Act 1988 because it is a private hospital and given the hospital’s size, it would have a turnover greater than $3 million per year.

The EPMS is also required to be compliant with the Health Records Act 2001 as SMPH provides a health service in Victoria.

**Question 12** (5 marks)

*U4O2KK6: data management practices that cause conflict between information systems, including data mining  
U4O2KK7: the advantages and disadvantages for stakeholders affected by the operation of information systems*

Hugh has suggested that implementation of the new software be limited to a single ward (Ward A) within the hospital to ensure that any issues with the software are corrected before the wider implementation across the hospital. Some members of the working party have suggested that this could be an issue if patients are transferred between wards, or when replacement staff from other wards are sent to Ward A to provide additional nursing support.

1. State **one** conflict that may occur. 1 mark

**NB:** For this question, sample responses are numbered for the purposes of providing three coherent sample responses. Responses for 12b and 12c are dependent on the conflict the student chooses to address in 12a (1, 2 or 3).

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark | Identification of **one** conflict |

**Sample responses:**

1. Patient transfers (between wards) could be delayed unnecessarily
2. Replacement staff may feel unable to be supportive of Ward A
3. Duplication of records may lead to diminished data integrity
4. For the stated conflict, identify the stakeholders affected. 2 marks

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark OR  2 marks | Partial identification of stakeholders  Full identification of stakeholders |

**Sample responses:**

1. Patients, nurses, doctors, hospital
2. Ward A nurses, replacement nurses
3. Patients, nurses, doctors
4. Suggest two techniques that could be used to minimise the identified conflict. 2 marks

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark OR  1 marks | Generic minimisation technique  Mimisation technique that makes specific reference to the case study and conflict |

**Sample high-scoring responses:**

1. When patients are admitted on Ward A, admission documentation for other wards could be prepared, just in case the patient may be transferred between wards.
2. Nursing staff on other wards could participate in training for the introduction of the EPMS, which would also help in its implementation on other wards at a later stage. This would be conducted in the event nurses were asked to support Ward A.
3. A verification process for patient information could be introduced to ensure that all personal information held within the EPMS is correct.

**Question 13** (6 marks)

*U4O1KK9: techniques for testing the useability of solutions and forms of documenting test results*

The hospital working group has decided that it would like to test the useability of the new system with its medical staff before a wide scale implementation.

Propose a strategy that could be used to test the useability of the new software.

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark | Appropriate determination of who should be involved in useability testing |
| 1 mark | Appropriate determination of when useability testing should take place |
| 1 mark  1 mark | Appropriate determination of where useability testing should take place  Explanation of why the location was chosen |
| 1 mark OR  2 marks | Brief determination of how the useability testing should be conducted  Detailed determination of how the useability testing should be conducted |

**Sample high scoring response:**

Nurses, doctors and ward secretaries should be included in the usability testing of the EPMS. Hospital administration staff that will use the system could also be included.

Useability testing should occur prior to the implementation of the software within the hospital.

The testing should take place offsite. If the testing took place onsite, medical staff could be called away to other duties, leading to disrupted and potentially incomplete testing taking place.

Testing should cover the range of functions and tasks that will be required to be completed by the medical staff. It should be documented appropriately, with key issues addressed before the implementation of the EPMS.

**Question 14** (4 marks)

*U4O2KK11: types and causes of accidental, deliberate and events-based threats to the integrity and security of data and information shared between information systems*

After a few weeks of being implemented, SMPH suffers a serious breach in data security. It has been determined that the source of the breach was external to SMPH. The hospital’s firewall firmware required a critical update and was required to be restarted as part of the process. After looking through the firewall logs, it has been found that the firewall failed to restart after the update was applied and was not active for 6 hours.

1. State the role that a firewall plays in network security. 1 mark

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark | Correct role stated |

**Sample response:** Afirewall monitors network traffic in order to prevent unauthorised external threats from accessing a network.

1. Identify the type of threat to the security of the hospital’s data as a result of the update process. 1 mark

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark | Correct type of events-based threat |

1. What could IT Services at SMPH have done differently to prevent this from happening again? 2 marks

|  |  |
| --- | --- |
| **Marking scheme** | |
| 1 mark  1 mark | Appropriate threat mitigation 1  Appropriate threat mitigation 2 |

**Sample response:**

Threat mitigation actions may include, but are not limited to:

* supervised the update directly rather than leave the update unattended
* operated a backup/redundancy firewall while the update was taking place
* checked update documentation to see whether the firewall needed to be restarted manually