



2022 VCE Applied Computing: Software Development external assessment report

General comments

The 2022 VCE Applied Computing: Software Development examination comprised three sections: Section A, which contained 20 multiple-choice questions (worth a total of 20 marks); Section B, which had six short-answer questions (worth a total of 20 marks); and Section C, which was a case study with 16 questions (worth a total of 60 marks).

Section A was answered quite well by most students. In Section B and Section C some students found it difficult to demonstrate their theoretical knowledge or use subject-specific terminology correctly. The key weakness in many responses in these sections was a lack of detail and depth of understanding.

Students are encouraged to consider the question stem (for example, 'describe', 'explain' or 'outline'), the number of marks and the number of lines provided as a guide to the detail and depth of the required response.

In Section C some students found it difficult to apply their knowledge to the case study.

During the examination, students should have:

- endeavoured to use correct technical terminology
- discussed all options when asked to justify a choice or compare one option with another
- responded to key instructional terms, such as 'state', 'explain' and 'describe'
- re-read each question and their response to ensure that the question had been answered
- removed the case study insert from the question and answer book, and referred to it when completing Section C
- read the case study and questions carefully, and underlined or highlighted key words to help them formulate their response
- demonstrated their knowledge of the subject and applied that knowledge to the case study.

General responses often resulted in low or no marks, but knowledgeable, clear and appropriate responses received high marks.

Specific information

Note: Student responses reproduced in this report have not been corrected for grammar, spelling or factual information.

This report provides sample answers or an indication of what answers may have included. Unless otherwise stated, these are not intended to be exemplary or complete responses.

The statistics in this report may be subject to rounding, resulting in a total of more or less than 100 per cent.

Section A

Shading indicates the correct response.

Question	Correct Answer	% A	% B	% C	% D	
1	D	1	3	55	40	The key distinction between a function and a method is that a method is called from the object in which it was declared.
2	A & C	30	20	39	11	
3	C	14	6	68	12	
4	A	58	36	1	5	
5	A	45	54	0	1	Students are reminded that there is a distinction between archiving and backing up. An archive contains historical data that is no longer needed and must be kept for a period of time. Backups are made up of data that is currently used by a system.
6	A	68	7	18	7	
7	B	8	63	18	12	
8	A	84	11	2	3	
9	C	9	4	86	1	
10	C	7	10	60	23	
11	D	24	20	6	50	
12	C	5	3	88	4	
13	B	2	92	1	5	
14	A, B, C, D	41	18	11	30	As a result of psychometric analysis, all four options were accepted as correct.
15	D	22	11	7	59	
16	C	17	7	70	6	
17	C	4	3	91	2	
18	D	17	16	19	49	
19	B	55	34	7	3	This question specifically stated that 'an early version of the solution is needed', which indicates a prototype is required. Spiral development allows for this. Agile development allows for repeated consultations, however an 'early version of the solution' is not produced.
20	B	7	52	7	34	

Section B

Question 1

Mark	0	1	2	3	Average
%	4	25	28	43	2.1

Statement	File type		
File contents can be unstructured.	XML	TXT	CSV
Data can be more effectively transferred between different information system.	XML	TXT	CSV
File contents can be more easily read by both humans and computers.	XML	TXT	CSV

Students were awarded marks for circling the file types as shown.

It is important to remember that the structure of XML allows both humans and computers to read it more easily than both TXT and CSV.

Question 2a.

Mark	0	1	2	3	4	Average
%	24	20	25	17	13	1.7

Model 1 – Agile

Marks were awarded for identifying and describing flexibility as being the advantage of the Agile model. Some students correctly stated that the Agile model allows for client feedback to be provided at the end of each sprint, which then influences the requirements of the next sprint. Marks were awarded for describing the Agile model's flexibility, making it suitable for projects where client requirements are not set at the start of the project and are subject to change. Students also correctly identified an advantage of the Agile model being its delivery of working prototypes at the end of each sprint.

The following is an example of a high-scoring response.

Model 1 – Agile: Agile model is where short iterative sprints are conducted of the PSM. In each recursive sprint, the advantage is that it allows for more client and organisation interaction. This ensures that they can work collaboratively on the software solution. Thus, it allows flexibility between the client and the organisation.

Model 1 – Agile: One advantage is that the agile model incorporates client feedback in the project. This means the developers can receive extensive amounts of feedback from the client after each sprint. This makes it suitable when the client's wants and needs are constantly changing.

Model 2 – Waterfall

Marks were awarded for identifying and describing the Waterfall model's advantage being that it is suitable for projects with a clear set of requirements and subsequently allows for a fixed timeline. Some students correctly described that the Waterfall model requires each stage to be completed before the next is started.

Many students incorrectly made generalisations about the advantages of both the Agile and Waterfall models and their suitability for both large and small projects. It is important to note that both Agile and Waterfall are suitable for large and small projects. The same consideration should be made in relation to the level of difficulty and complexity of a project. Some students used incorrect language and described sprints and stages as tasks.

The following is an example of a high-scoring response.

Model 2 – Waterfall: The waterfall model is a sequential model that follows the stages of the problem-solving methodology (analysis, design, development and evaluation) without backtracking. An advantage of this model is that it performs well in projects with strict deadlines as the requirements are set in stone and will not change throughout the project.

Model 2 – Waterfall: The waterfall model is a developmental model which has rigid steps in which the project is worked through. An advantage of the waterfall model is that it prevents scope creep, as the requirements cannot be changed.

Question 2b.

Mark	0	1	2	Average
%	44	35	21	0.8

Students were awarded marks for identifying that the following would help the organisation decide on the better model to adopt:

- complexity of project and known problems
- level of preferred customer involvement/feedback
- length of the project.

Many students incorrectly made recommendations about one model being the more suitable model to use. Some students continued to describe the models, as opposed to identifying information that could be used.

Question 3

Mark	0	1	2	Average
%	15	35	50	1.3

Students were awarded marks for explaining that the purpose of authentication is to verify the identity and credentials of a user, and to confirm that the user being authenticated is accredited to access the resources that they are attempting to access. Students were also awarded marks for identifying authentication methods such as username and password, multi-factor and biometric authentication.

Many students only identified methods of authentication and didn't explain the purpose of authentication.

The following is an example of a high-scoring response.

User authentication allows verified users with the correct login details into a system. At the simplest level, asking users to enter a username and password before providing access to a program will ensure that only authorised users who know the login details can enter. As such, authentication of users is achieved by only allowing users who verify their identify to enter.

Question 4a.

Mark	0	1	2	Average
%	35	30	35	1.0

Test data	Expected result	Actual result
small = 1 big = 10	32, 25, 5	32, 25, 5
small = 10 big = 15	20, 18, 1	20, 18, 1
small = 10 big = 1	10, 1, 0	20, 4, 1
small = 3 big = 3	12, 9, 2	12, 9, 2

Most students were able to trace the algorithm with the first two sets of test data. However, many students experienced difficulties with completing the expected and actual result for the third set of test data where small and big were initialized to the same value.

Question 4b.

Mark	0	1	Average
%	62	38	0.4

Few students were awarded a mark for identifying that the cause of the error was the use of the Repeat ... Until loop, which tests the condition after the first iteration.

The following is an example of a high-scoring response.

The repeat until will execute at least once, even if small is larger than big.

Question 4c.

Mark	0	1	Average
%	85	15	0.2

Students were awarded a mark for suggesting that the Repeat ... Until loop be changed to a While loop, which tests the condition prior to the first iteration.

The following is an example of a high-scoring response.

Replace the Repeat/Until loop with a While loop so the condition is checked first.

Question 5

Mark	0	1	2	Average
%	50	31	19	0.7

Students were awarded marks for explaining that an SQL injection

- is a web security vulnerability that allows an attacker to inject/insert SQL into a web application via an input field
- gives the attacker the ability to access, edit, insert and delete data that they would normally not have access to.

Students were required to use subject-specific terminology.

The following is an example of a high-scoring response.

An SQL injection involves inputting malicious SQL queries into input boxes without validation to steal or modify data in SQL databases.

Question 6

Mark	0	1	2	3	Average
%	8	49	32	11	1.5

Students were awarded marks for outlining strategies that involved multiple and distinct steps for their chosen vulnerability, as shown below.

Issues with weak passwords

- Users are required to use strong passwords with letters, digits and special characters.
- Passwords should be changed every three to six months.
- A password management system should be used to prevent reuse of old passwords.
- Staff should be trained in the importance of the use of strong passwords to minimise the risk of their password being guessed by a hacker.

Computers left unattended

- Ensure staff are familiar with digital systems policies and procedures by undergoing training.
- Computer should automatically shut down at night.
- Computers should automatically lock after a period of inactivity so that unauthorised persons are unable to access confidential material.

Unlimited login attempts

- System admin should restrict the number of login attempts.
- The account should be locked after a set number of attempts.
- An alert should be sent to IT staff and the user should be required to identify themselves in order to unlock their account so that unauthorised persons are unable to access confidential material.

No protection of files on servers

- Encryption of data
- Password protection of files and folders
- Automated backups of each user
- Implementation of a firewall

When answering this question, many students outlined only one step as part of their strategy and subsequently were only awarded partial marks. Some students did not clarify which security vulnerability they were focusing on. Many students described the chosen vulnerability without any reference to risk minimisation.

The following is an example of a high-scoring response. To minimise the risk of a data breach, the manufacturer should force their employee to change their passwords every month to a strong password containing letters, numbers and symbols while being over 10 characters long. They should also ensure that a different password is used each month and the password is never repeated.

Section C

Question 1a.

Mark	0	1	2	Average
%	12	23	65	1.5

Some students incorrectly answered the question by writing a single word such as 'surveys' or 'interviews'. Others referred to gathering data from parents and other members of the school community. Other students incorrectly answered the question from the perspective of gathering data for the existing canteen. Some students incorrectly wrote about gathering feedback about the app for the purposes of evaluation as though the app had already been completed.

Marks were awarded for describing interviews, observations, reports and surveys in the context of the case study and students' expectations.

The following is an example of a high-scoring response.

Method 1: Interview individual students who order food at school regularly, to get detailed answers through follow-up questions of their expectations.

Method 2: Surveys, distribute to all students in school to get large sample size and see what all their expectations are, identify most common needs.

Question 1b.

Mark	0	1	2	3	Average
%	22	32	31	16	1.4

Students were awarded marks for identifying the following constraints:

- Economic: budget constraints will result in the development costing too much or taking too long, resulting in limited functionality.
- Technical: the app will be accessed by members of the school community who will have different devices running platforms.
- Legal: the Privacy Act requires that data be stored securely online and requires hosts to be responsible for student identity details and financial information.

Some students incorrectly stated that having just graduated from university, the limited programming experience of the programming team was a technical constraint. Some also incorrectly stated that as a small business, IszCool wouldn't be able to afford the best technology to support development.

Question 2

Mark	0	1	2	3	4	Average
%	8	25	35	24	9	2.0

Statement	Error (yes or no)
'Purchaser' is shown twice in the DFD.	no
The 'parent' external entity is connected directly to the 'accounts' data store	yes
'Check balance' has the same data flow going out as going in.	yes
'Enter order Item' does not have a data flow to the external entities.	no

Question 3a.

Mark	0	1	2	Average
%	56	31	13	0.6

Some students were awarded full marks for correctly stating that the error in the diagram was that the 'canteen staff' actor had been drawn inside the system boundary and that to correct this error, the actor must be moved outside of the system boundary.

A number of students incorrectly stated that the error was that there was no link between an actor and the 'add item' use case. Students also incorrectly referred to the system boundary as 'the boundary' / 'the system' / 'the box'.

Students are reminded to be familiar with subject-specific terminology in the study design.

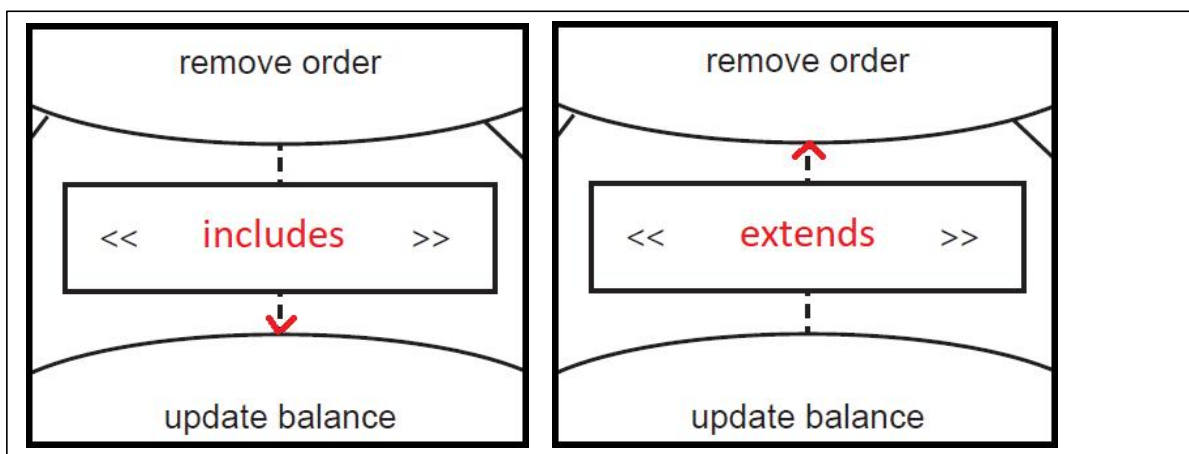
Question 3b.

Mark	0	1	Average
%	79	21	0.2

Marks were awarded for identifying that the student actor initiates the 'remove order' use case when the order is collected. Some students incorrectly identified either 'the parent' or 'canteen staff'.

Question 3c.

Mark	0	1	2	Average
%	48	1	52	1.1



Students were awarded marks for using either 'includes' or 'extends' appropriately.

Some students incorrectly forgot to include an arrow, or had the arrow pointing in the wrong direction.

Students are reminded to be aware of the conventions to be followed when using <<includes>> and <<extends>> in use case diagrams. It is also important to note that the direction of the arrow differs between <<includes>> and <<extends>>.

Question 4

Mark	0	1	2	Average
%	8	29	63	1.6

This question was generally answered well.

Variable	Data type	Description
account_balance	Integer	amount of money in the account, in cents
spend_warning	String	message sent if user tries to spend too much in one day

Some students incorrectly specified floating point decimal as Account_Balance. This answer was not accepted as floating-point decimal was not one of the options to select in the question, and because it is not possible to have a decimal of a cent.

Question 5a.

Mark	0	1	Average
%	78	22	0.2

Few students correctly defined affordance as intuitiveness of usability of a user interface.

Many incorrectly defined it in the context of cost and budgetary constraint.

The following is an example of a high-scoring response.

The characteristic of a solution that regard its intuitiveness, i.e. how much the solution shows you how it should be used.

Question 5b.

Mark	0	1	Average
%	72	28	0.3

Some students provided examples of how Mockup A lacks affordance as follows:

- The process that the user has to follow to add funds to their account is unclear.
- The mock-up lacks structure and flow with the placement of elements such as the 'Update Balance' being in the top right-hand corner.
- The language selection is counterintuitive as it requires all users to be able to read English in order to select a language.

Question 6a.

Mark	0	1	2	3	Average
%	2	3	20	75	2.7

Evaluation criteria	Efficiency or effectiveness
Can users from different language backgrounds easily use the app?	Effectiveness
Does the user interface enable input on a range of devices?	Effectiveness
Are users able to quickly update their payment details?	Efficiency

Some students incorrectly classified 'Can users from different language backgrounds easily use the app?' as 'Efficiency'; however, it is important to note that usability is a measure of effectiveness.

Students are reminded to be familiar with the Terms used in this study section of the study design.

Question 6b.

Mark	0	1	2	3	Average
%	6	46	34	15	1.6

Preferred Mock-up: B

- Mock-up B displays the American flag in the top right-hand corner, allowing an affordance that the user can click the flag to change the language. Mock-up A requires the user to be able to read English to know that selecting 'English' allows the language to be changed.
- Mock-up B contains larger buttons and components than Mock-up A. It would be easier to select buttons/components on Mock-up B on a smaller device compared to Mock-up A.
- Mock-up B contains an image of a credit card, which is more intuitive than a standalone button containing text as in Mock-up A.

Although many students were awarded a mark for selecting Mock-up B as their preferred mock-up, few justified their response in relation to the evaluation criteria and/or by making a comparison to Mock-up A. Many wrote generic statements such as 'Mock-up B is more user-friendly than Mock-up A' and were not awarded marks because what they had written was not related to the evaluation criteria.

The following is an example of a high-scoring response.

Preferred mock-up: Mock-up B

Justification: In mockup A, it is less clear where to change the language settings for a non-english speaking person. In Mock-up B, however, the use of a flag makes the app much easier to use for "users with different language backgrounds."

Question 7a.

Mark	0	1	Average
%	29	71	0.7

The correct answer was existence check.

The existence check ensures that a value has been entered and is not blank. This check must be completed before any other validation can occur.

Question 7b.

Mark	0	1	Average
%	45	55	0.6

Students were awarded a mark for describing a range check in the context of checking that the total cost of the lunch order was less than the daily limit / account balance.

Some students incorrectly described type check; however, as the total cost is a derived value (and not entered by the user), this was not accepted.

The following is an example of a high-scoring response.

A range check could be performed on the lunch order to see if it is within the daily limit set by parents beforehand and above zero.

Question 8

Mark	0	1	2	3	4	Average
%	14	10	38	13	25	2.2

Students were awarded marks for outlining concerns and subsequently recommending a procedure to ensure the proper handling and managing of files. See examples in the table below.

Concern	Procedure
No naming conventions in file names	All files need to have descriptive file names with a convention that makes the purpose clear
No version control	Implement version control to ensure staff are working on the latest version
Lack of security of sensitive files and data	All folders should have access restrictions depending on what the user needs to access Files that are sensitive can have password protection Shared folders should be encrypted and have password protection
Folders are not organised	Reorganise content into clearly named (hierarchical) folders Keep dummy and real data separate
Files saved locally (at home) – making data accessible by others and compromising security	Files should not to be saved on personal devices Staff training

Many students found it difficult to outline two distinct concerns. Some wrote the procedure as the concern, or offered other potential problems not referenced in the diagram, such as backup procedures.

The following are examples of high-scoring responses.

Concern 1: One concern would be losing track of which file is latest version such as the ProjectPlanner file and using out of date files.

Procedure: IszCool Solutions should use a version control system which has a consistent naming convention. The convention should name all files using specific names and date of creation. This would help IszCool avoid using out of date files and keep track of latest versions.

Concern 2: All staff can access sensitive data.

Procedure: Access control should be implemented so that sensitive data cannot be accessed by those that don't need it.

Concern 2: The file names are random, poorly spelt, and sometimes irrelevant or generic

Procedure: Establishing a naming convention, which in IszCool's case should include provisions for versioning, can ensure the proper naming of files.

Question 9a.

Mark	0	1	Average
%	56	44	0.4

Both record and class/object were accepted as answers to this question.

Many students incorrectly identified arrays and dictionaries in their answer to this question. It is important to remember that both records and class/objects can store data of different data types.

Question 9b.

Mark	0	1	2	Average
%	66	21	14	0.5

Some responses were able to explain that either a record or a class/object could allow for data of multiple data types to be stored within it, making it suitable to store such data as username, date of birth, mobile number etc.

Some students didn't provide an answer within the context of the case study.

The following is an example of a high-scoring response.

Allows multiple different data types to be stored as values such as daily limit requires a numeric type and names require string. Other data structures may not be able to support different data types or provide efficient organisation of data through fields.

Question 10a.

Mark	0	1	2	Average
%	53	12	35	0.8

Students were awarded marks for the following:

- Selection/Condition
- Iteration/Repetition.

Many students were unable to list the control structures from the study design. Some students incorrectly wrote about methods, classes and CSV/XML files.

Question 10b.

Mark	0	1	2	Average
%	66	9	25	0.6

Students were awarded marks for selecting either Selection or Iteration and stating how either would be applied in the context of editing an order within the Canteen app. For example:

- Selection: If an item is unavailable the canteen provides a substitute item or a refund.
- Iteration: An order may involve multiple items and subsequently iteration to total the cost of the order.

The following is an example of a high-scoring response.

A conditional or [selection] control structure would be most appropriate in this case as staff will only need to edit a students order on certain cases like if one of them is out of stock.

Question 11a.

Mark	0	1	2	Average
%	5	19	76	1.7

Students were awarded marks for identifying that Soula has the more acceptable approach. Marks were also awarded for stating that internal documentation is essential as it describes the functionality of the code, making collaboration easier between colleagues.

Question 11b.

Mark	0	1	2	Average
%	26	50	23	1.0

Students were awarded marks for describing two characteristics of internal documentation. Accepted solutions include the following:

- Internal documentation must include logically placed statements in (simple) English that describe the functionality of the code and outline the purpose of the variables / data structures (making code easier to understand / clear, concise).
- Internal documentation should assist with the updating and maintenance of the solution to support the ongoing use of its end-users.
- Naming conventions and explanation of meaningful variable names.
- Header/footer for functions describing input, output, purpose.

Some students found it difficult to describe two distinct characteristics.

The following are examples of high-scoring responses.

Naming conventions allow for consistency across the program, it is where each name is based on the content of the object and is structured in a similar way.

A header comment outlines the name, version, developers and conventions used in a project.

Question 12

Mark	0	1	2	3	Average
%	24	21	30	26	1.6

accountBalance	dailyLimit	totalPurchase	Output
20	15	20	You have exceeded your daily limit
20	15	15	5
20	15	Any value between 0 and 14	Calculate 20 - totalPurchase
20	15	Any reasonable value greater than 20	Top up your account

Students were awarded marks for testing each branch of the conditional statement and nested conditional statement.

Some students incorrectly repeated the test that was provided. Some students provided a value for the totalPurchase between 0 and 14 but didn't correctly subtract that value from 20 in the output column. Other students incorrectly printed a '\$' before their output or wrote 'Output = 5'.

Question 13a.

Mark	0	1	2	Average
%	16	46	38	1.2

Students were awarded marks for listing one physical security and one software security control.

Physical security control:

- restrict access to authorised users
- notebooks to be physically checked in and out
- locked room / restricted areas / computers
- biometrics.

Software security control:

- version control
- restricted permissions limits access to known developers/users
- password access
- encryption
- firewall
- system protection software / antivirus.

This question was generally answered well.

Some students incorrectly listed a physical security control as a software security control and vice versa.

Some responses incorrectly listed backups and version control as a software security control; they were not

awarded marks as the software security control had to be in the context of protecting the development of the app, given that unauthorised copies were being accessed by external parties.

Question 13b.

Mark	0	1	2	Average
%	61	19	20	0.6

Marks were awarded for identifying and describing any of the following in the context of the case study.

- Version control only allows tested code to be added to the working program by allowing the development team to access the latest version.
- Authorisation / username password / 2FA: Only authorised developers are permitted to add to the working version.
- Access restrictions: No sections are to be deleted to ensure continuity with other sections.
- Encryption can be used to ensure that if unauthorised access occurs files cannot be accessed/edited.

Many students made reference to backups without mentioning version control and were not awarded full marks. Other students referenced version control but in the context of rolling back to a previous version if the working version failed.

The following is an example of a high-scoring response.

Effective use authentication would prevent an unauthorised person from deleting software versions.

Question 14a.

Mark	0	1	Average
%	19	81	0.8

Any valid or reasonable feature of the app as per the case study. The most common responses were 'placing an order', 'collecting an order' or 'creating an account'.

Question 14b.

Mark	0	1	2	3	Average
%	26	38	26	10	1.2

Most students were awarded marks for making a comparison between the abilities of different users. Some explained the impact of a range of users on the usability testing of the different features of the app. Few students mentioned the impact of the range of devices and operating systems that users of the system will use to run the app.

There were misconceptions that testing the app with users involved testing for errors and bugs.

Different users provide different data, which can be analysed as they use the app in different ways. Students with a lot of technological experience may find it easy to use whilst those with less experience may struggle. If only one demographic is tested, then usability issues will be missed. A variety of tests are required for the same session. More tests mean more opportunities to find issues.

Question 15a.

Mark	0	1	2	Average
%	33	16	50	1.2

Many students were awarded marks for identifying two of the relevant characteristics from the study design: accuracy, authenticity, correctness, reasonableness, relevance and timeliness.

Question 15b.

Mark	0	1	2	Average
%	51	25	25	0.7

Students were awarded marks for explaining the impact of a characteristic from Question 15a. on integrity of data and subsequent impact on the functioning of the app. Most students who were awarded marks commented on the impact on the selection of items from the canteen and the calculation of the total cost of the order. Marks were awarded for also commenting on the impact of their chosen characteristic on the professional reputation of IszCool.

Many students incorrectly wrote about a characteristic that they did not list in Question 15a.; others incorrectly wrote about the impact on students or the canteen itself.

Question 16a.

Mark	0	1	2	Average
%	38	41	21	0.8

Students were awarded marks for proposing two of the following components of a security strategy:

- staff training / education
- user authentication
- biometrics
- encryption
- firewalls
- TLS (Transport Layer Security).

Students were not awarded marks for proposing backup or archiving.

Question 16b.

Mark	0	1	2	Average
%	58	24	18	0.6

Students were awarded marks for selecting a component from Question 16a. and explaining how it would improve security in the context of the case study.

Many students wrote about a component that was not listed in Question 16a. (and were not awarded marks).

The following are examples of high-scoring responses.

By encrypting all data stored by IszCool Solutions, this will prevent or help prevent further data leaks as unauthorised users will not be able to use or decrypt the data without the decryption key.

Staff training would reduce the chance of successful phishing attacks, reducing the chance of a person successfully bypassing user authentication to steal a copy of the app.