Digital Solutions

External assessment 2025

Practice examination and explained answers

About this booklet

This booklet combines the original stimulus, multiple-choice questions, question and response book, and marking guide with newly written teaching explanations. Complete the paper first, then use the official guide and the explanations to review your reasoning.

Topics covered

Encryption and hashing; programming and JSON; privacy and security; file transfer; data-flow diagrams; constraints; data dictionaries; desk checking; smart traffic systems; and useability.

How to use the booklet

Read the stimulus and answer the examination questions on paper. Then compare your work with the original marking guide. Finally, read the independent explanations at the end: they introduce the ideas, connect them to the scenario and explain what a strong response needs.

Source and status

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External assessment 2025

Stimulus book

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General instruction

- Work in this book will not be marked.

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Stimulus 1

The JSON sample shows review data for two movies.

```
{
  "movies": [{
      "title": "The Legends List",
      "reviews": [{
          "review_id": 1,
          "reviewer_name": "Amanda",
          "rating": 5,
          "review_text": "Amazing movie!"
        },
        {
          "review_id": 2,
          "reviewer_name": "Julian",
          "rating": 4,
          "review_text": "Great concept"
        },
        {
          "review_id": 3,
          "reviewer_name": "Saoirse",
          "rating": 3,
          "review_text": "Average"
        }
      ]
    },
    {
      "title": "The Sequel",
      "reviews": [{
          "review_id": 1,
          "reviewer_name": "Gary",
          "rating": 2,
          "review_text": "Nope"
        },
        {
          "review_id": 2,
          "reviewer_name": "Jaspreet",
          "rating": 1,
          "review_text": "Why?"
        },
        {
          "review_id": 3,
          "reviewer_name": "Kim",
          "rating": 2,
          "review_text": "Two hours of my life I'd like back, please!"
        }
      ]
    }
  ]
}
```

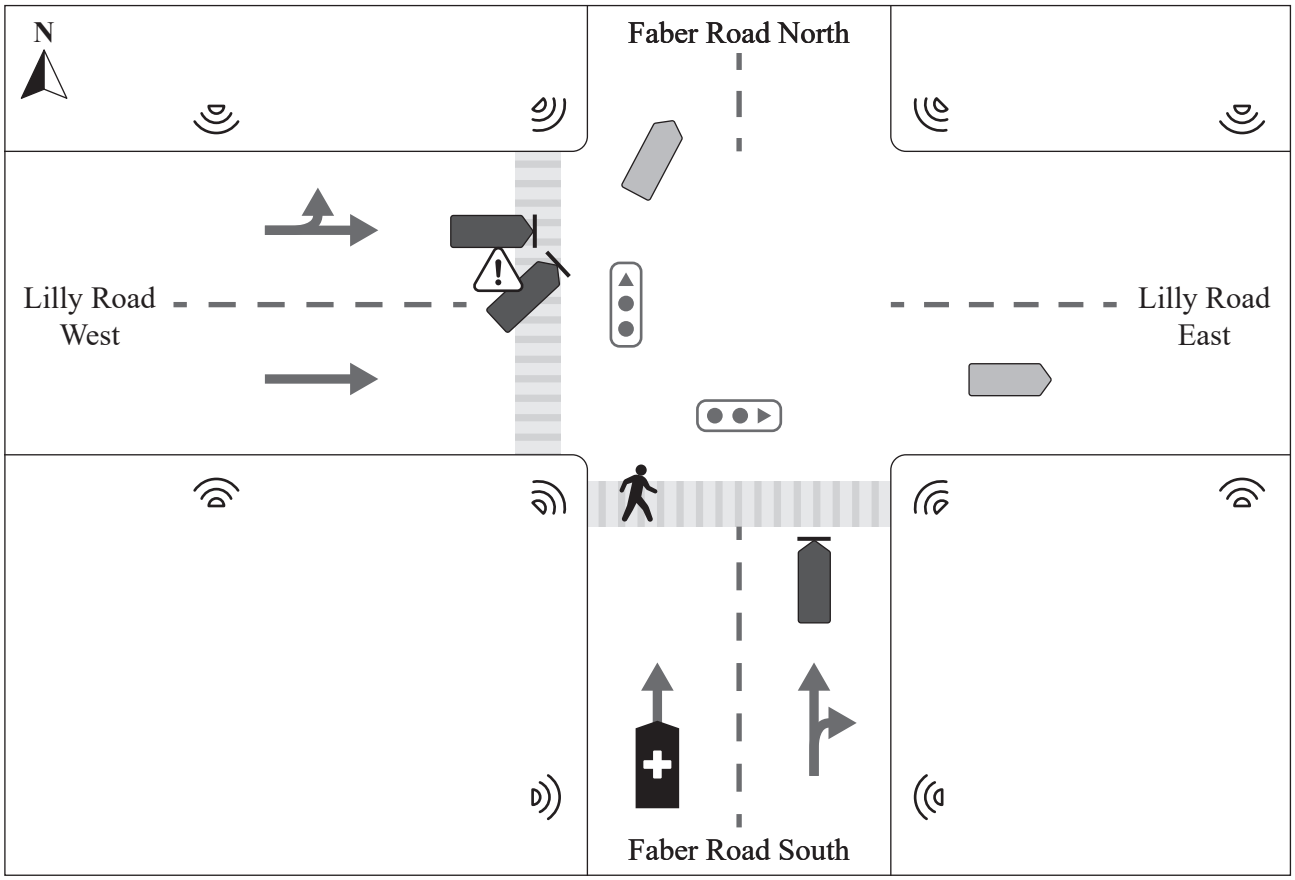
Stimulus 2

Real-time data are collected to monitor the status of adaptive traffic signals, pedestrian signals and traffic conditions. The code library of functions enables the processing of real-time data for the smart traffic management system.

Function call: `getAdaptiveSignal(signal_name)` **Purpose:** This function gets the adaptive traffic signal for a given road or crossing. It returns text describing the signal status, e.g. `"red"`, `"yellow"` or `"green"`
Function call: `setAdaptiveSignal(signal_name, signal)` **Purpose:** This function sets the adaptive traffic signal for a given road or crossing.
Function call: `evaluateCongestion(signal_name)` **Purpose:** This function evaluates the current congestion level for a given road or crossing based on the real-time traffic conditions. It returns text describing the congestion, e.g. `"none"`, `"low"`, `"medium"` or `"high"`
Function call: `getVehicleCount(lane)` **Purpose:** This function retrieves and returns the number of vehicles currently detected on a specific lane. It uses real-time sensor data to estimate traffic volume. It returns the number of vehicles currently detected.

The diagram shows a traffic scenario at the intersection of Lilly Road and Faber Road. Both are one-way roads with two lanes of traffic. All traffic signals for Faber Road are red, and a pedestrian is crossing the road. An accident has occurred on Lilly Road West, and an emergency vehicle is approaching from Faber Road South.

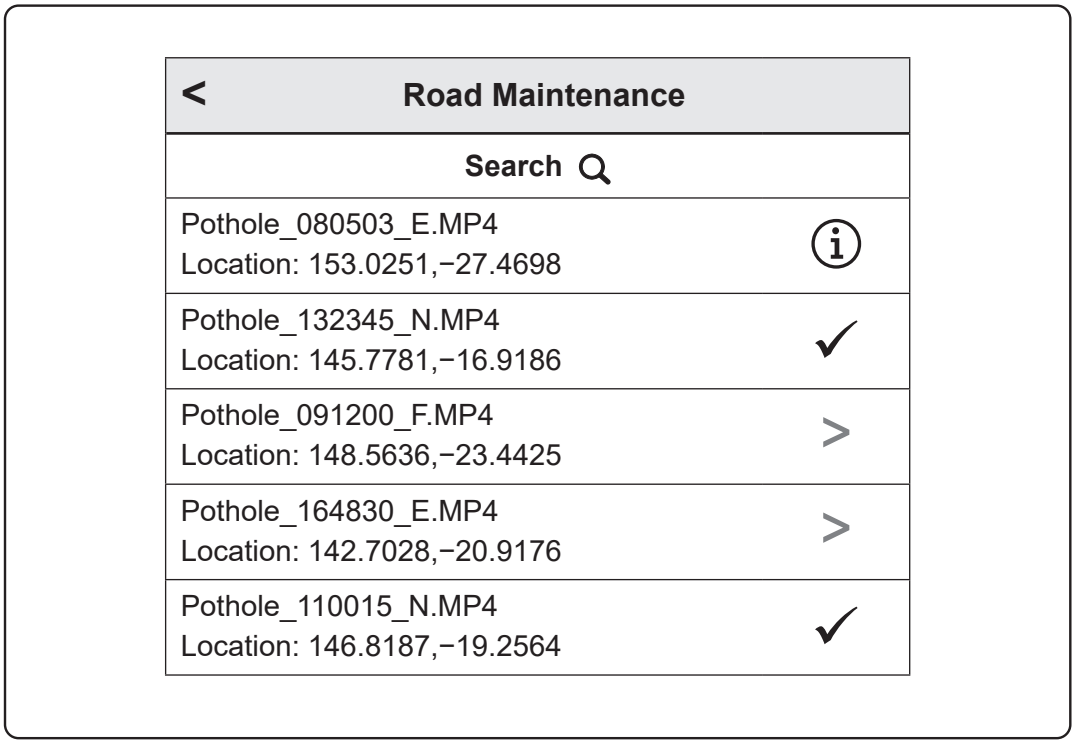




Stimulus 3

A diagram of the user interface of the Road Maintenance mobile app is shown.

Potholes are named according to the filenames of their corresponding dash cam footage. The longitude and latitude of each pothole is also given.



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External assessment 2025

Multiple choice question book

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General instruction

- Work in this book will not be marked.

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Section 1

Instruction

- Respond to these questions in the question and response book.

QUESTION 1

Which statement about RSA encryption keys is true?

(A) The key sizes are small for better security.

(B) The keys are an example of symmetric encryption.

(C) A private key is used for both encryption and decryption.

(D) One key is used for encryption, and a second key is used for decryption.

QUESTION 2

What type of algorithm irreversibly takes a variable-length input and outputs a fixed-length string?

(A) hashing

(B) decryption

(C) encryption

(D) compression

QUESTION 3

When blocks of code reduce the complexity of a system, this is known as

(A) iteration.

(B) selection.

(C) sequencing.

(D) modularisation.

QUESTION 4

An unauthorised party gained access to video and audio recordings of various court hearings.
Which Australian Privacy Principle was breached?

(A) security of personal information

(B) use or disclosure of personal information

(C) collection of solicited personal information

(D) open and transparent management of personal information

QUESTION 5

In the context of network transmission, what is the primary function of FTP?

(A) rendering web pages in a browser

(B) transferring files between computers on a network

(C) encrypting data during transmission over a network

(D) acting as a protocol for real-time communication and messaging

QUESTION 6

A JSON string is shown.

```
{"song":"Butterfly", "duration":320, "band":"zerogarage"}
```

How many properties are defined by the string?

(A) 1

(B) 3

(C) 5

(D) 6

QUESTION 7

A Vigenère cipher has the keyword ‘BANANA’, a Gronsfeld cipher has the key number ‘123456’ and a Caesar cipher has the key number ‘7’.

Rank the encryption algorithms from least secure to most secure, based on their vulnerability to brute force attacks.

(A) Vigenère, Caesar, Gronsfeld

(B) Gronsfeld, Vigenère, Caesar

(C) Caesar, Gronsfeld, Vigenère

(D) Caesar, Vigenère, Gronsfeld

QUESTION 8

An encryption algorithm is shown.

```
0 BEGIN
1   INPUT plaintext
2   INPUT key
3     IF length of key < length of plaintext THEN
4       RETURN error // Key must be at least as long as the plaintext
5     ENDIF
6
7     ciphertext = ''
8     FOR each character in plaintext
9       Convert character and corresponding key character to binary
10      ciphertextCharacter = XOR(character, keyCharacter)
11      Convert ciphertextCharacter back to character
12      Append ciphertextCharacter to ciphertext
13    ENDFOR
14
15    RETURN ciphertext
16 END
```

What is the role of line 10 of the algorithm?

(A) encrypting each character of the plaintext

(B) ensuring that the ciphertext is longer than the plaintext

(C) generating a random key as long or longer than the plaintext

(D) converting each character of the plaintext into binary format

QUESTION 9

Which component of a digital solution is required for efficient data processing?

(A) secure login and authentication processes

(B) visually appealing interface design

(C) maintainable programming

(D) scalable database design

QUESTION 10

A user accidentally modifies critical data in a shared document. This is a compromise of data

(A) access.

(B) integrity.

(C) availability.

(D) confidentiality.

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LUI | | | | | | | | | | | School code | | | | |

School name

Given name/s

Family name

Attach your barcode ID label here

Book of books used

External assessment 2025

Question and response book

Digital Solutions

Time allowed

- Perusal time — 15 minutes
- Working time — 120 minutes

General instructions

- Answer all questions in this question and response book.
- Planning paper will not be marked.

Section 1 (10 marks)

- 10 multiple choice questions

Section 2 (36 marks)

- 5 short response questions

Section 3 (21 marks)

- 1 extended response question

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Section 1

Instructions

- This section has 10 questions and is worth 10 marks.
- Use a 2B pencil to fill in the A, B, C or D answer bubble completely.
- Choose the best answer for Questions 1–10.
- If you change your mind or make a mistake, use an eraser to remove your response and fill in the new answer bubble completely.

	A	B	C	D
Example:	●	○	○	○

	A	B	C	D
1.	○	○	○	○
2.	○	○	○	○
3.	○	○	○	○
4.	○	○	○	○
5.	○	○	○	○
6.	○	○	○	○
7.	○	○	○	○
8.	○	○	○	○
9.	○	○	○	○
10.	○	○	○	○

Ensure you have filled an answer bubble for each question.

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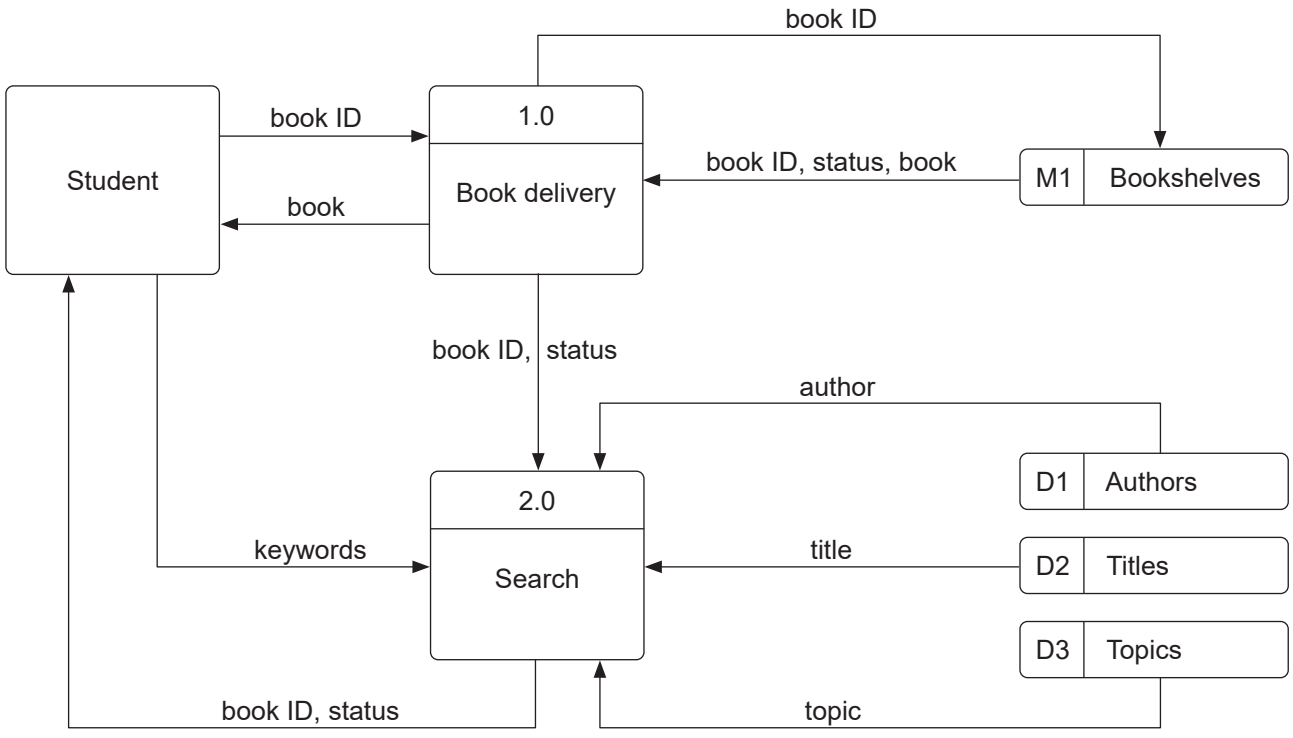
Section 2

Instructions

- Write using black or blue pen.
- If you need more space for a response, use the additional pages at the back of this book.
  - On the additional pages, write the question number you are responding to.
  - Cancel any incorrect response by ruling a single diagonal line through your work.
  - Write the page number of your alternative/additional response, i.e. See page …
  - If you do not do this, your original response will be marked.
- This section has five questions and is worth 36 marks.

QUESTION 11 (7 marks)

The data flow diagram of a library system is shown.



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Explain the relationship between the external entity and each of the processes and data stores.

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QUESTION 12 (9 marks)

A high school coding club was asked to develop a mobile app to manage the sale of items at fundraising events. To comply with school policies, app data must be stored on the school's local servers. The coding club has four weeks until the next fundraising event.

a) Identify and explain the impact of three constraints on the app's development. *[3 marks]*

Constraint 1: _____

Constraint 2: _____

Constraint 3: _____

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The coding club was unable to develop all the app's intended features in four weeks. The following processes were done manually during the first fundraising event:

- updating inventory
- authenticating users
- updating account balances.

b) Analyse the scenario to determine a risk to data confidentiality, integrity and availability. Justify each risk in your response. *[6 marks]*

Risk to data confidentiality:

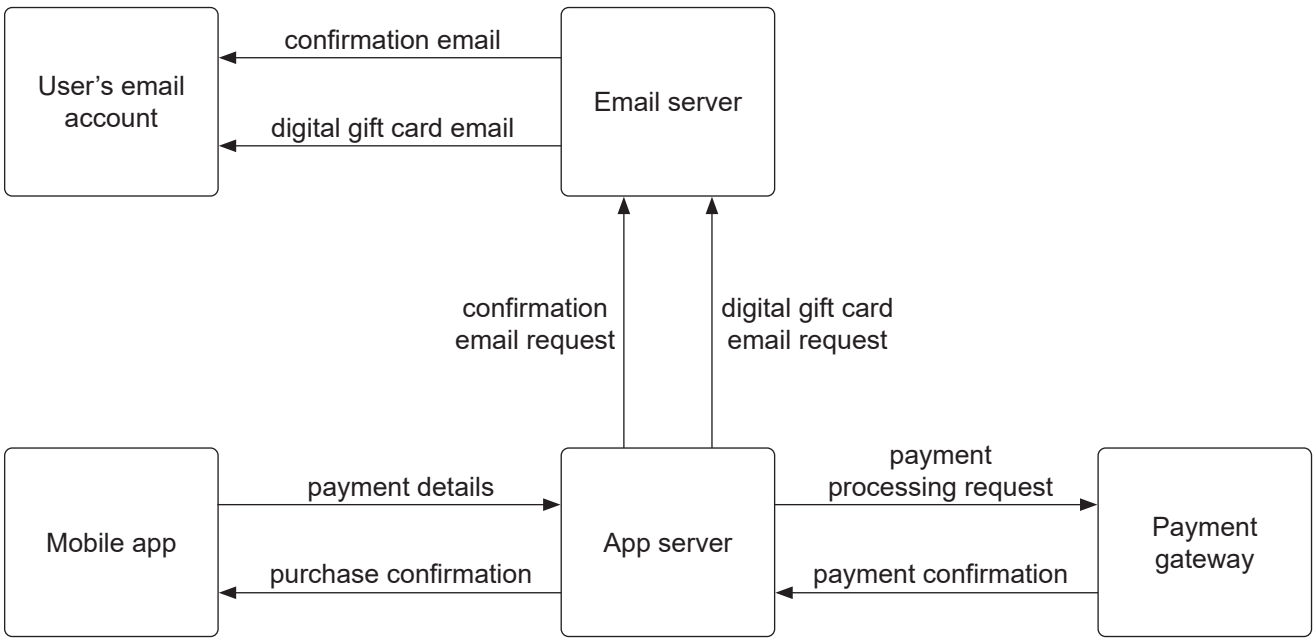
Risk to data integrity:

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Risk to data availability: _____

QUESTION 13 (4 marks)

The diagram shows the data exchange involved in purchasing digital gift cards on a mobile app.
After making a purchase, the user receives a confirmation email, and then a second email containing the digital gift card.



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Identify and explain two points of the data exchange that are vulnerable to risk and recommend a security strategy for each. Justify your response.

Do not write outside this box.

QUESTION 14 (8 marks)

Refer to Stimulus 1 in the stimulus book.

The algorithm shown calculates the average ratings from movie review data.

```
0  BEGIN
1   READ jsonData into movieData
2   INITIALISE a dictionary object to store averageRatings
3
4   FOR each movie in movieData DO
5     SET totalRating = 0
6     SET numberOfReviews = 0
7
8     GET movieTitle = movie["title"]
9     GET reviews = movie["reviews"]
10
11    FOR each review in reviews DO
12      totalRating = totalRating + review["rating"]
13      numberOfReviews = numberOfReviews + 1
14    ENDFOR
15    IF numberOfReviews > 0 THEN
16      averageRating = totalRating / numberOfReviews
17    ELSE
18      averageRating = "No ratings"
19    ENDIF
20    STORE averageRating in the dictionary object with the movie title
      as the key
21    OUTPUT "Average Rating for ", movieTitle, " is: ", averageRating
22  ENDFOR
23  RETURN averageRatings
24 END
```

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Desk check all variables used to calculate the average rating for each movie.

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QUESTION 15 (8 marks)

A journalist used an open data source about Queensland driver licence holders to add statistics to a newspaper article. An excerpt of the article is shown.

> The average age of people with valid driver licences in Central Queensland, Maranoa and Wide Bay–Burnett is 22 years old. Across all three regions, there are more people on provisional licences than on learner licences. The most popular month for getting a new licence is December.
>
> Most licences are valid for five (5) years, but people on learner or provisional licences usually have shorter licence periods. A lot of new licences are registered between 10 and 20 December.

a) Based on this excerpt, complete the data dictionary shown. *[6 marks]*

_id	Field name	Data type
1	region	
2	valid_licence	
3	licence_type	
4	registration_period	
5	date_of_birth	
6	registration_date	

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b) Recommend a change to the data dictionary in Question 15a) that would help the journalist explore **one** of these questions:

i) Is the average age of drivers higher for certain postcodes or licence types?

ii) How many learner licences expire before conversion to provisional?

Justify your response. *[2 marks]*

Selected question number: _____

Recommendation and justification: _____

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Section 3

Instruction

- This section has one question and is worth 21 marks.

QUESTION 16 (21 marks)

Refer to Stimulus 2 in the stimulus book.

An intersection at Lilly Road and Faber Road is fitted with a smart traffic management system, where data exchange components work together to improve the flow of traffic, reduce congestion, support road maintenance and increase safety.

System components include:

- adaptive traffic signals that respond to real-time data
- strategically placed sensors that capture data on vehicle flow and speed
- data processing units that analyse data in real time, recognise traffic patterns and make predictions.

One of the smart traffic system's sensors has detected an emergency vehicle approaching the intersection.

a) Explain how the system components could work together to optimise the flow of traffic through the intersection, prioritising passage for the emergency vehicle. *[4 marks]*

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You have been asked to develop a programmed component that responds to the hazardous situations at the Lilly and Faber Roads intersection.

Criteria:

- detects hazard locations
- prioritises passage for emergency vehicles
- keeps pedestrians safe.

b) Use pseudocode to complete the algorithm for the programmed component, addressing all the criteria. Incorporate at least three code library functions. Include comments to identify where each criterion is addressed. *[8 marks]*

```
BEGIN

#Define the intersection roads and crossings
SET roads = ["LillyE", "LillyW","FaberS","FaberN"]
SET crossings = ["LillyE_cross", "LillyW_cross","FaberS_cross",
"FaberN_cross"]
```

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Do not write outside this box.

c) Recommend one new system feature and one new component that would improve the current system's ability to ensure the safety of all vehicles and pedestrians. Justify your response. *[3 marks]*

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Refer to Stimulus 3 in the stimulus book.

Workers have been using the Road Maintenance mobile app, which integrates smart traffic data with dash cam footage from vehicles to identify the location of potholes. Workers have experienced errors and delays completing and logging work in the app. The filenames provide no useful information and the internet is required to locate potholes using the longitude and latitude values on a map for directions.

d) Evaluate the Road Maintenance mobile app to identify two useability principles that may be responsible for the errors and delays. Justify your response. *[4 marks]*

Useability principle 1: _____

Useability principle 2: _____

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e) Create a user interface mock-up symbolising features that will improve the Road Maintenance mobile app's implementation of the two useability principles identified in Question 16d) and prevent errors and delays. Use annotations to explain your ideas. *[2 marks]*

Note: If you make a mistake, cancel it by ruling a single diagonal line through your work and use the additional response space at the back of this book.

END OF PAPER

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ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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Digital Solutions marking guide and response

External assessment 2025

Combination response (67 marks)

Assessment objectives

This assessment instrument is used to determine student achievement in the following objectives:

1. recognise and describe programming elements, components of exchange systems, privacy principles and data exchange processes
2. symbolise and explain programming ideas, data specifications, data exchange processes, and data flow within and between systems
3. analyse problems and information related to a digital problem
5. synthesise information and ideas to determine possible low-fidelity components of secure data exchange solutions
7. evaluate impacts, components and solutions against criteria to make refinements and justified recommendations

Note: Objectives 4, 6 and 8 are not assessed in this instrument.

Purpose

This document consists of a marking guide and a sample response.

The marking guide:

- provides a tool for calibrating external assessment markers to ensure reliability of results
- indicates the correlation, for each question, between mark allocation and qualities at each level of the mark range
- informs schools and students about how marks are matched to qualities in student responses.
- The sample response demonstrates the qualities of a high-level response.

Mark allocation

Where a response does not meet any of the descriptors for a question or a criterion, a mark of ‘0’ will be recorded.

Marking guide

Multiple choice

Question	Response
1	D
2	A
3	D
4	A
5	B
6	B
7	C
8	A
9	D
10	B

Short response

Q	Sample response	The response:
11	The Student entity inputs a book ID into the Book delivery process, and the Book delivery process then releases the book from the manual Bookshelves data store and provides it to the Student. The Bookshelves data store is a manual data store, while the book ID and status data are digital, and the book data is the physical book object. book IDs and statuses are passed via the Book delivery process to the Search process, which combines this with the Authors, Titles and Topics data to check for a match to the keywords inputted by the student. The Search process then outputs the matching book IDs with their statuses to the Student, who then uses this to request books that are available from the manual Bookshelves datastore using their IDs.	• explains the relationships between the external Student entity and the – Book delivery process **[1 mark]** – Search process **[1 mark]** – Bookshelves data store **[1 mark]** – Authors data store **[1 mark]** – Titles data store **[1 mark]** – Topics data store **[1 mark]** • recognises the manual nature of the relationship between Bookshelves and Book delivery **[1 mark]**

Q	Sample response	The response:
12a)	Constraint 1: The coding club has less than four weeks to develop the app; this is a time constraint that may affect the club's ability to thoroughly test the system before rolling it out for use. Constraint 2: Using an existing school server for data storage. This may result in limited storage space, and developers will need to consider data compression, particularly for storing images of items. Constraint 3: Developing a mobile app may present some technical constraints in terms of compatibility across different platforms, e.g. iOS or Android.	• identifies and explains the impact of – one constraint **[1 mark]** – a second constraint **[1 mark]** – a third constraint **[1 mark]**
12b)	Risk to data confidentiality: There is no user authentication process implemented; therefore, updating account balances and accessing user details risks the confidentiality of private information of all users, staff and students, including financial information. Risk to data integrity: Updating inventory manually during a fundraising event would be a time-consuming process. There is a real risk to data integrity that could lead to overselling if the inventory data is not accurate at the point of sale. Risk to data availability: Manually updating account balances risks the availability of user account information due to the delay caused by manually processing calculations while managing other distractions during a fundraising event.	• determines and justifies – a risk to data confidentiality **[2 marks]** – a risk to data integrity **[2 marks]** – a risk to data availability **[2 marks]**

Q	Sample response	The response:
13	When the payment details are sent from the mobile app to the app server, this is vulnerable to man-in-the-middle attacks and should be secured by strong encryption such as SSL/TSL or with the use of a VPN. The user should avoid using public wi-fi to make payments and ensure that they are accessing the internet over a secured network connection that is password protected. The confirmation email and the second email containing the gift card are both at risk of being compromised if the user's email account is not secured. The user would need to ensure that their device is both free of malware, e.g. keylogger software, and adequately secured with a strong password and multifactor authentication to prevent unauthorised access.	• identifies and explains – one data exchange vulnerability **[1 mark]** – a second data exchange vulnerability **[1 mark]** • recommends and justifies a security strategy for – the first identified vulnerability **[1 mark]** – the second identified vulnerability **[1 mark]**

Q	Sample response	The response:
14	See sample response below.	• desk checks, for one movie, the values of – totalRating **[1 mark]** – numberOfReviews **[1 mark]** – review["rating"] **[1 mark]** • desk checks, for a second movie, the values of – totalRating **[1 mark]** – numberOfReviews **[1 mark]** – review["rating"] **[1 mark]** • correctly calculates averageRating for one movie **[1 mark]** • correctly calculates averageRating for a second movie **[1 mark]**

<table>
<tr><th>Q</th><th>Sample response</th><th>The response:</th></tr>
<tr><td>15a)</td><td>
<table>
<tr><td>_id</td><td>Field name</td><td>Data Type</td></tr>
<tr><td>1.</td><td>region</td><td>VARCHAR</td></tr>
<tr><td>2.</td><td>valid_licence</td><td>BOOLEAN</td></tr>
<tr><td>3.</td><td>licence_type</td><td>VARCHAR</td></tr>
<tr><td>4.</td><td>registration_period</td><td>INT</td></tr>
<tr><td>5.</td><td>date_of_birth</td><td>DATETIME</td></tr>
<tr><td>7.</td><td>registration_date</td><td>DATETIME</td></tr>
</table>
</td><td>
• identifies a valid data type for
– region [1 mark]
– valid_licence [1 mark]
– licence_type [1 mark]
– registration_period [1 mark]
– date_of_birth [1 mark]
– registration_date [1 mark]
</td></tr>
<tr><td>15b)</td><td>
Selected question number: i)
Recommendation and justification: Add a new field called postcode with a data type of INT. Adding a postcode field lets the journalist compare driver ages in smaller, more specific areas, instead of just large regions. This makes it possible to find patterns in average age between different postcodes and answer the question more accurately.

OR

Selected question number: ii)
Recommendation and justification: Add one new field, called licence_number with a data type of VARCHAR to enable tracking of changes to a specific licence over time, and replace valid_licence with licence_status with a data type of VARCHAR to identify the status of a licence more easily, e.g. “active”, “expired”. These two data fields will enable tracking of the change of status for licences over time, combined with licence_type to filter the data accordingly.
</td><td>
• recommends a valid change [1 mark]
• justifies the recommendation [1 mark]
</td></tr>
</table>

Extended response: Question 16

Q	Sample response	The response:
16a)	The data processing units would need to analyse sensor data to safely time stopping the flow of traffic intersecting with the path of the emergency vehicle while also keeping traffic moving to allow the emergency vehicle to pass through smoothly without delay. The system would need to use its predictive ability to change the timing of the adaptive traffic lights to prioritise green lights for the emergency vehicle's predicted path while managing the signals for all other vehicles to keep everyone safe and prevent accidents. It may be possible for the system to rely on known traffic patterns to guide the emergency vehicle along the fastest possible route. Since the system has access to real-time data, it can adapt as needed to ensure traffic is managed effectively to ensure passage for the emergency vehicle.	• explains the optimisation of traffic flow with the use of – adaptive traffic lights **[1 mark]** – sensor data **[1 mark]** – data processing units **[1 mark]** • explains how the system could prioritise passage for the emergency vehicle **[1 mark]**
16b)	See pages 10–12 for sample response. Accept other suitable responses consistent with a reasonable understanding.	• uses pseudocode to symbolise an unambiguous algorithm that – implements control structures consistent with a coherent and logical solution **[1 mark]** – detects hazard locations **[1 mark]** – prioritises passage for emergency vehicles **[1 mark]** – keeps pedestrians safe **[1 mark]** • incorporates – one code library function **[1 mark]** – a second code library function **[1 mark]** – a third code library function **[1 mark]** • includes code comments to identify where criteria are addressed **[1 mark]**

Q	Sample response	The response:
16c)	Adding a feature for enhanced object recognition would enable the system to recognise more obstacles. Adding cameras in additional strategic locations, such as non-crossings where pedestrians frequently cross, would improve the system's ability to trigger necessary actions to protect all parties. These additions would improve the safety of both pedestrians and vehicles, as runaway animals or obstacles that have fallen off the back of utes pose a threat to drivers on the road. Cameras could better identify such hazards and integrate with other system components to keep all pedestrians and vehicles safe.	• recommends one new system feature **[1 mark]** • recommends one new system component **[1 mark]** • justifies the recommendations **[1 mark]**
16d)	Useability principle 1: Safety. If workers are experiencing errors, the system is not safe to use, and based on the current user interface, it is likely that users are making errors when selecting and updating pothole records. They will need to remember the filename and/or the location of a job they have just completed–especially if they are unable to complete the jobs in a sequential order, from top to bottom, because the locations may not make this possible. Useability principle 2: Effectiveness. Listing the locations of the potholes as longitude and latitude is not useful to the maintenance workers and is almost certainly why they are experiencing delays. They would not be able to use the search function as there is no clear way to filter the list e.g. by suburb, post code or date logged. Workers would need to convert longitude and latitude location data into an address to determine the distance of a pothole to their current location. They would then need to work through the list of potholes in order, travelling a suboptimal route, or waste time converting all the locations to addresses to determine the fastest route.	• identifies one useability principle **[1 mark]** • justifies the useability principle **[1 mark]** • identifies a second useability principle **[1 mark]** • justifies the second useability principle **[1 mark]**
16e)	See page 13 for sample response.	• symbolises and explains features that improve the implementation of – one identified useability principle **[1 mark]** – a second identified useability principle **[1 mark]**

Question 16b)

```
#Define the intersection roads and crossings
SET roads = ["LillyE", "LillyW","FaberS","FaberN"]
SET crossings = [“LillyE_cross", "LillyW_cross","FaberS_cross", “FaberN_cross"]
SET hazard = False
SET hazardLocation = None
SET vehicleDirection = True #vehicles are facing the right way
SET emergencyVehicle = False

#Detect hazard locations
IF (distance between two vehicles ≤ 0) AND
   (speed of both vehicles = 0) OR (vehicleDirection for any non-emergency vehicles = False)
   SET hazardLocation = detect the emergency location using sensor data
   SET hazard = True
ENDIF

#Detect emergency vehicle
IF (speed of emergency vehicles > 0)
   SET emergencyVehicle = True
ENDIF
```

```
#Evaluate congestion on each road
FOR each road in roads
   IF emergencyVehicle = False AND hazard = False THEN
      IF evaluateCongestion(road) = "high" THEN
         setAdaptiveSignal(road, "green") #prioritise flow on congested road
      ENDIF
   ENDIF
ENDFOR

#Keep pedestrians safe
WHILE hazard = True DO
   FOR each crossing in hazardLocation
       setAdaptiveSignal(crossing, "danger")
   ENDFOR
ENDWHILE

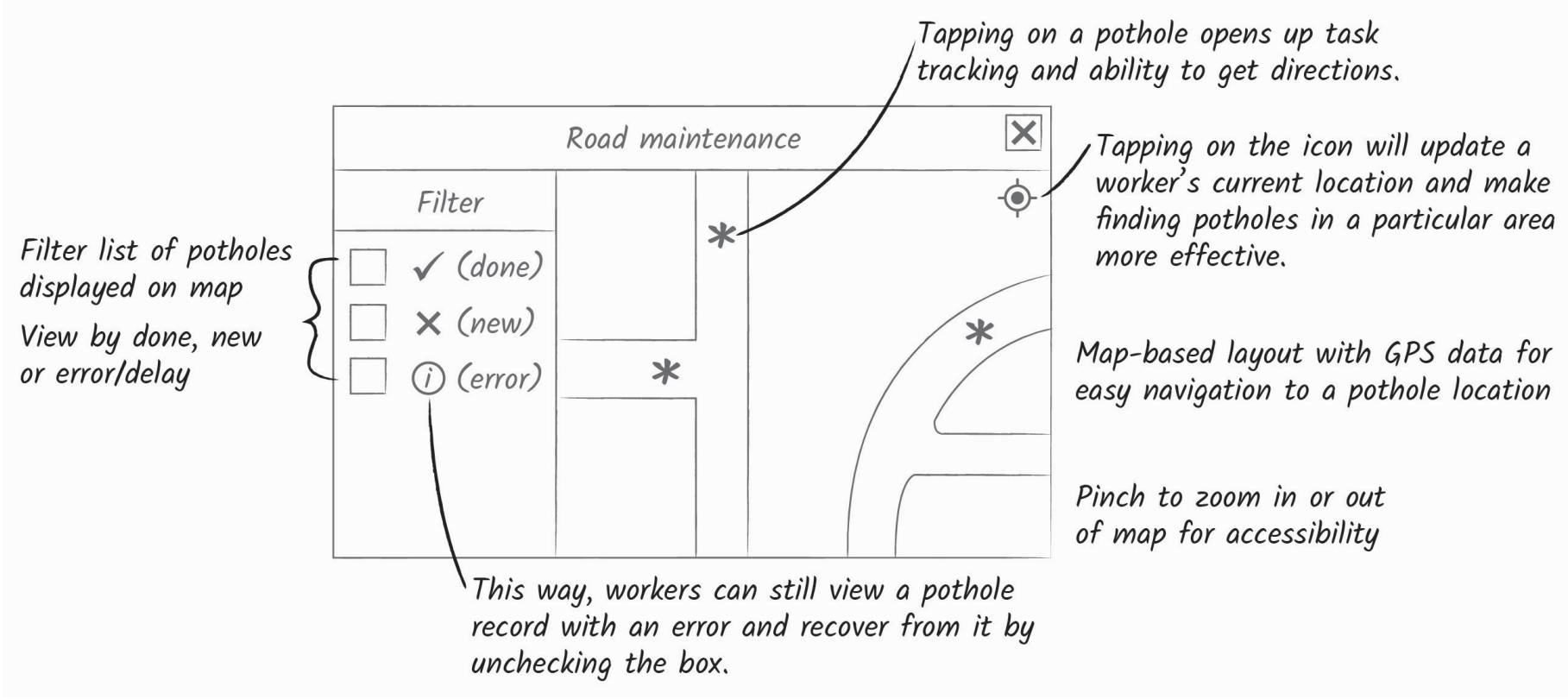
#Prioritise passage for emergency vehicles
IF emergencyVehicle = True
   GET emergencyVehicle predicted path #use data processing units to calculate
   FOR each crossing along predicted path
       status = getAdaptiveSignal(crossing)
       IF status = "walking" THEN
         setAdaptiveSignal(crossing, "danger")
       ELSE
         setAdaptiveSignal(crossing, "stop")
       ENDIF
   ENDFOR


   SORT roads along predicted path from furthest away to closest
```

```
   FOR each road along predicted path
      setAdaptiveSignal(road, "yellow")
      WAIT 30 seconds #Sudden changes could risk harm to motorists or pedestrians
      setAdaptiveSignal(road, "green") #prioritise passage for emergency vehicles
   ENDFOR

ELSE # emergencyVehicle = False
  Commence regular smart management of traffic using adaptive traffic and pedestrian signals.
ENDIF
```

Question 16e)



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Independent explanations begin here

Explained answers - 2025

These independent teaching notes use the official marking guide as a starting point. They explain the ideas in accessible language; the original marking guide remains the authority for its sample responses and marking descriptors. Multiple-choice questions have one best answer in this paper, so each explanation also distinguishes the distractors. Written-response questions can have several valid answers; green panels show alternatives that meet the same criteria.

Section 1: Multiple choice

Question 1 - Answer D

RSA is asymmetric. In the basic confidentiality model, the recipient's public key encrypts and the matching private key decrypts. The pair can also support signing and verification, but that is a different purpose. A is wrong because small keys are easier to attack; B describes symmetric encryption; C describes one key rather than a pair.

Question 2 - Answer A

A cryptographic hash maps input of varying length to a fixed-length digest and is designed to be infeasible to reverse. Decryption reverses encryption when the correct key is available; encryption protects data reversibly; compression reduces representation size and is not necessarily fixed-length.

Question 3 - Answer D

Modularisation divides a system into smaller blocks with distinct responsibilities, reducing the complexity each part must manage. Iteration repeats steps; selection chooses a branch; sequencing orders steps. Those are control structures, not the decomposition described.

Question 4 - Answer A

APP 11 concerns taking reasonable steps to protect personal information from unauthorised access, among other risks. The question describes unauthorised access. Disclosure (B), collection (C), and open management (D) concern different aspects of handling information; the precise legal application depends on context.

Question 5 - Answer B

FTP stands for File Transfer Protocol and transfers files between computers over a network. A is a browser function; C is not a guarantee of ordinary FTP, which does not itself encrypt the transport; D describes other communication protocols. FTPS and SFTP are separate secure alternatives and should not be confused with plain FTP.

Question 6 - Answer B

A JSON object contains name-value pairs called properties. Here song, duration and band are three names, each with one value. Counting only the object (A) or counting individual names and values as separate properties (C or D) misses the pair structure.

Question 7 - Answer C

Under the question's simplified brute-force and key-space model, a Caesar shift offers comparatively few keys, the six-digit Gronsfeld key has more combinations, and a six-letter Vigenere key space has more still. Thus the intended ranking is Caesar, Gronsfeld, Vigenere. In real cryptanalysis, BANANA repeats BAN and has a shorter period that an attacker may exploit. Key repetition and attack method matter, and all three classical ciphers are insecure for modern sensitive data.

Question 8 - Answer A

XOR combines the binary form of a plaintext character with the corresponding key character to produce the encrypted character. It does not make the ciphertext longer (B), generate the key (C), or perform the earlier conversion to binary (D).

Question 9 - Answer D

A scalable database design can handle growing data and workloads effectively, supporting efficient processing. Authentication (A) supports security, visual design (B) supports presentation, and maintainability (C) supports future changes; none is the most direct answer to the stated processing requirement.

Question 10 - Answer B

Integrity means information remains accurate and has not been improperly changed. An accidental modification compromises that accuracy. Access and availability concern being able to use the information; confidentiality concerns preventing unauthorised disclosure.

Sections 2 and 3: Written responses

For each part, begin with the concept, then connect it to the information and criteria in the question. Compare your own response with the original guide as well as these notes.

Question 11 - Reading a data-flow diagram

The Student is external because the student supplies and receives data but is not a process or store. The Student sends a book ID to Book delivery and receives the physical book. Book delivery sends the requested ID to the manual Bookshelves store; Bookshelves returns the book ID, availability status and physical book. Book delivery also passes book ID and status to Search. For searching, the Student sends keywords to Search. Search compares author, title and topic data received from Authors, Titles and Topics, then returns matching IDs and statuses to the Student. The Student's relationships with those stores are indirect: data must pass through a process. The M label means Bookshelves is manual; the book flow is physical while IDs and status are digital.

Alternative answers and guidance

Other valid answer: The relationships can be explained in a different order or grouped by process. A student might begin with Search: keywords enter, the process compares data from Authors, Titles and Topics, and matching book IDs and status return to the Student. They could then explain how Book delivery uses the requested ID and the manual Bookshelves store to release the physical book.

Further examples or guidance: Do not invent direct flows that the diagram does not show. In particular, the Student does not directly query Authors, Titles or Topics; those stores exchange data with the Search process.

Question 12a - Constraints

A constraint is a limit on the solution or its development. The four-week deadline limits development and testing time. The required local school server may limit storage capacity or require compatibility with existing infrastructure. The need for a mobile app can constrain device and platform compatibility. Link each constraint to a plausible development impact; avoid presenting an invented fact as a certainty.

Alternative answers and guidance

Other valid answer: Time may force the club to reduce the first release, automate fewer features or test less extensively. The local-server requirement may limit available storage, performance or integration options. Mobile delivery may require support for different screen sizes and operating systems.

Further examples or guidance: These are three explicit constraints from the scenario. Different impacts are valid if they are plausible and explained. Budget or skill could be relevant in a real project, but the scenario does not give evidence for them, so they are weaker choices here.

Question 12b - CIA risks

Confidentiality means preventing unauthorised access: because authentication is manual, an inconsistent identity check could let an impersonator see private or financial details. Integrity means accuracy: manual stock updates or balance arithmetic can be missed, duplicated or transcribed incorrectly. Availability means current data is accessible when needed: a backlog of manual account updates may leave the latest balance unavailable during a busy event. For each risk explain the mechanism and consequence, not merely the CIA label.

Alternative answers and guidance

Other valid answer: Confidentiality alternative: a paper or shared manual account list may be visible to people who do not need it. Integrity alternative: two sellers may update stock inconsistently and oversell an item. Availability alternative: the current balance may not be ready when a student attempts another purchase.

Further examples or guidance: A different scenario link can be valid, but it must state what may happen, why the manual process creates that risk and which CIA property is affected.

Question 13 - Exchange vulnerabilities

Follow a labelled arrow and ask what could go wrong there. Payment details travelling from the mobile app to the app server, or the payment processing request between the app server and payment gateway, could be intercepted or altered; authenticated TLS with certificate validation protects data in transit. The gift-card email travelling from the email server to the user's account could be exposed in transit or after an account takeover; TLS protects the transfer, while a strong unique password and multifactor authentication reduce unauthorised account access. Give two distinct exchange points, explain each vulnerability, and justify a matching strategy. A private network or VPN is defence in depth, not a replacement for end-to-end authenticated TLS; SSL is obsolete terminology.

Alternative answers and guidance

Other valid answer: At the payment exchange, authenticated TLS with certificate validation can reduce interception and tampering; tokenising payment details can reduce the sensitive data held by the app. At the email end, multifactor authentication and a strong unique password can reduce account takeover; device updates and malware protection can reduce credential theft.

Further examples or guidance: A secure network or correctly configured VPN may also protect traffic on an untrusted network. Two answers may select different arrows in the diagram, but each vulnerability and control must logically match.

Question 14 - Desk checking nested loops

A desk check records values as instructions execute. The outer loop selects a movie and resets totalRating and numberOfReviews to zero. The inner loop visits each review, adds its rating and increments the count. For The Legends List, the successive rating / total / count values are 5 / 5 / 1, 4 / 9 / 2 and 3 / 12 / 3; the average is 12 / 3 = 4. For The Sequel they are 2 / 2 / 1, 1 / 3 / 2 and 2 / 5 / 3; the average is 5 / 3, approximately 1.67. The reset between movies is essential. If no reviews exist, the ELSE branch stores “No ratings”.

Completed teaching-model desk check

Movie	review["rating"]	totalRating	numberOfReviews	average after loop
The Legends List	-	0	0	
	5	5	1	
	4	9	2	
	3	12	3	12 / 3 = 4
The Sequel	-	0	0	
	2	2	1	
	1	3	2	
	2	5	3	5 / 3 = 1.67 (rounded)

Alternative answers and guidance

Other valid answer: The final average for The Legends List may be written as 4 or 4.0. The Sequel may be written as 5/3, 1.666... or an explicitly rounded 1.67. All represent the same calculation unless the question specifies a rounding rule.

Further examples or guidance: A vertical trace table, one table per movie, or a combined table can all work. It must still show review rating, running total and review count for both movies, followed by each average.

Question 15a - Data types

A data dictionary defines fields and the kind of values they hold. Region and licence_type are text (for example VARCHAR); valid_licence is a Boolean true/false value; registration_period is an integer number of years; date_of_birth and registration_date use a date or datetime type. A database may use different valid type names. Do not use a number merely because a field contains digits when its meaning is textual.

Alternative answers and guidance

Other valid answer: VARCHAR, CHAR or another text type can be reasonable for region and licence_type. BOOLEAN is the clearest type for valid_licence, though a database without Boolean support may use a constrained integer or text value. INT or another whole-number type fits registration_period. DATE is sufficient when time-of-day is not stored; DATETIME is also valid when the system records it.

Further examples or guidance: Use the conventions of the named database if one is supplied. The essential reasoning is that each type must hold the values described without losing their meaning.

Question 15b - Improving a data dictionary

Choose one investigation and explain how the change enables it. For the postcode question, add a postcode field and group driver ages by postcode. The marking-guide sample uses INT; CHAR(4) or VARCHAR(4) is also defensible because a postcode is an identifier rather than a quantity and text preserves leading zeros. For the licence-transition question, use a stable licence ID plus dated status-history records, or learner-expiry and provisional-conversion dates. A single current Boolean or status cannot reconstruct whether expiry happened before conversion.

Alternative answers and guidance

Other valid answer: For question i, add postcode as CHAR(4) or VARCHAR(4), or as an integer if the chosen database and dataset treat it numerically. The field lets the journalist group records by postcode and compare average ages. Existing licence_type already supports comparison by licence type.

Further examples or guidance: For question ii, add a stable licence_number plus dated status-history records, or add learner_expiry_date and provisional_conversion_date. These structures can establish the order of events. A single current licence_status may describe the present state, but cannot show whether expiry happened before a later conversion.

Question 16a - Smart traffic components

Sensors measure conditions such as vehicle flow and speed, including an approaching emergency vehicle. Processing units analyse that data and predict a path or traffic conditions. Adaptive signals receive the resulting decisions and adjust timings, giving a safe green route to the emergency vehicle while managing conflicting movements. Link all three components and explain how priority is achieved safely.

Alternative answers and guidance

Other valid answer: One valid strategy creates a temporary green corridor along the predicted emergency route after safely stopping conflicting traffic and pedestrians. Another adjusts the route itself when processing units predict that a different approach is safer or faster.

Further examples or guidance: The exact timing can vary. Every valid answer still needs the chain: sensors collect real-time data, processing units interpret or predict from it, adaptive signals act on the decision, and conflicting movements are handled safely.

Question 16b - Criteria-driven pseudocode

First translate each criterion into observable behaviour: locate hazards, prioritise an emergency vehicle, and protect pedestrians. Define the sensor inputs and route collections before using them. Values returned by library functions must contribute to decisions, rather than being called and ignored. A coherent solution identifies hazardous locations from readings, checks congestion and signal state, safely ends pedestrian and conflicting-traffic phases, then gives an unobstructed emergency route priority or requests a reroute. Comments should identify where each criterion is met. The teaching model below uses three supplied functions meaningfully; other coherent structures are valid.

Illustrative pseudocode

```
BEGIN
  SET roads = ["LillyE", "LillyW", "FaberS", "FaberN"]
  INPUT sensorReadings, emergencyDetected, emergencyPath
  INPUT pathCrossings, conflictingRoads
  SET hazardLocations = []

  # Criterion: detect hazard locations
  FOR EACH reading IN sensorReadings
    IF (reading.vehicleGap <= 0 AND reading.firstSpeed = 0
        AND reading.secondSpeed = 0)
       OR reading.wrongWayVehicle = TRUE THEN
      APPEND reading.location TO hazardLocations
    ENDIF
  ENDFOR

  SET roadConditions = empty dictionary
  FOR EACH road IN roads
    SET roadConditions[road] = evaluateCongestion(road)
  ENDFOR

  IF emergencyDetected = TRUE THEN
    # Criterion: keep pedestrians safe
    FOR EACH crossing IN pathCrossings
      IF getAdaptiveSignal(crossing) != "red" THEN
        setAdaptiveSignal(crossing, "red")
      ENDIF
    ENDFOR
    WHILE a pedestrian is within pathCrossings DO
      WAIT for the next sensor reading
    ENDWHILE

    FOR EACH road IN conflictingRoads
      IF getAdaptiveSignal(road) = "green" THEN
        setAdaptiveSignal(road, "yellow")
        WAIT safe clearance time
      ENDIF
      setAdaptiveSignal(road, "red")
    ENDFOR
    WAIT safe clearance time

    # Criterion: prioritise the emergency vehicle
    IF no road in emergencyPath is in hazardLocations THEN
      FOR EACH road IN emergencyPath
        setAdaptiveSignal(road, "green")
      ENDFOR
    ELSE
      SEND hazardLocations and roadConditions
           TO the processing unit
      REQUEST a safe alternative emergencyPath
    ENDIF
  ENDIF
END
```

This is a teaching sketch, not deployable traffic-control software. The real implementation must define valid crossing signal values, clearance timing, collision-free phases and how hazard locations affect each decision.

Alternative answers and guidance

Other valid answer: An event-driven answer may respond when a sensor reports a hazard or emergency vehicle. A loop-based answer may continually evaluate every road and crossing. Either structure can be valid if it is unambiguous, addresses all three criteria, uses at least three supplied functions and comments where each criterion is met.

Further examples or guidance: Function choices can vary. getVehicleCount measures traffic volume for a defined lane and can contribute when combined with speed or hazard sensor data; it cannot by itself prove that vehicles are stationary. evaluateCongestion can compare approaches, getAdaptiveSignal can check an existing state and setAdaptiveSignal can change it. Calling a function is not enough by itself; its returned value must contribute logically to a decision.

Question 16c - Feature and component

A feature is a capability; a component is a part that makes it possible. For example, enhanced obstacle recognition is a feature and an additional strategically placed camera is a component. Explain that the camera supplies images and the recognition feature detects hazards that current sensors may miss, allowing a safer response. A recommendation needs a causal link to safety.

Alternative answers and guidance

Other valid answer: Feature/component pair 1: detect pedestrians outside marked crossings, supported by additional cameras or LiDAR. Pair 2: detect slippery conditions, supported by road-surface or weather sensors. Pair 3: warn approaching connected vehicles, supported by a vehicle-to-infrastructure communication unit.

Further examples or guidance: Any pair needs one capability, one physical or software component that enables it, and a clear explanation of how the pair improves safety.

Question 16d - Evaluating useability

Safety concerns preventing or recovering from errors. Opaque filenames can cause a worker to select or update the wrong job. Effectiveness concerns completing the task accurately and completely: coordinates without useful addresses or directions make locating a pothole difficult and can delay completion. Identify two principles and connect the specific interface problem to the observed errors or delays. Although the scenario mentions delays, efficiency is not one of the five syllabus-listed interface useability principles: accessibility, effectiveness, safety, utility and learnability.

Alternative answers and guidance

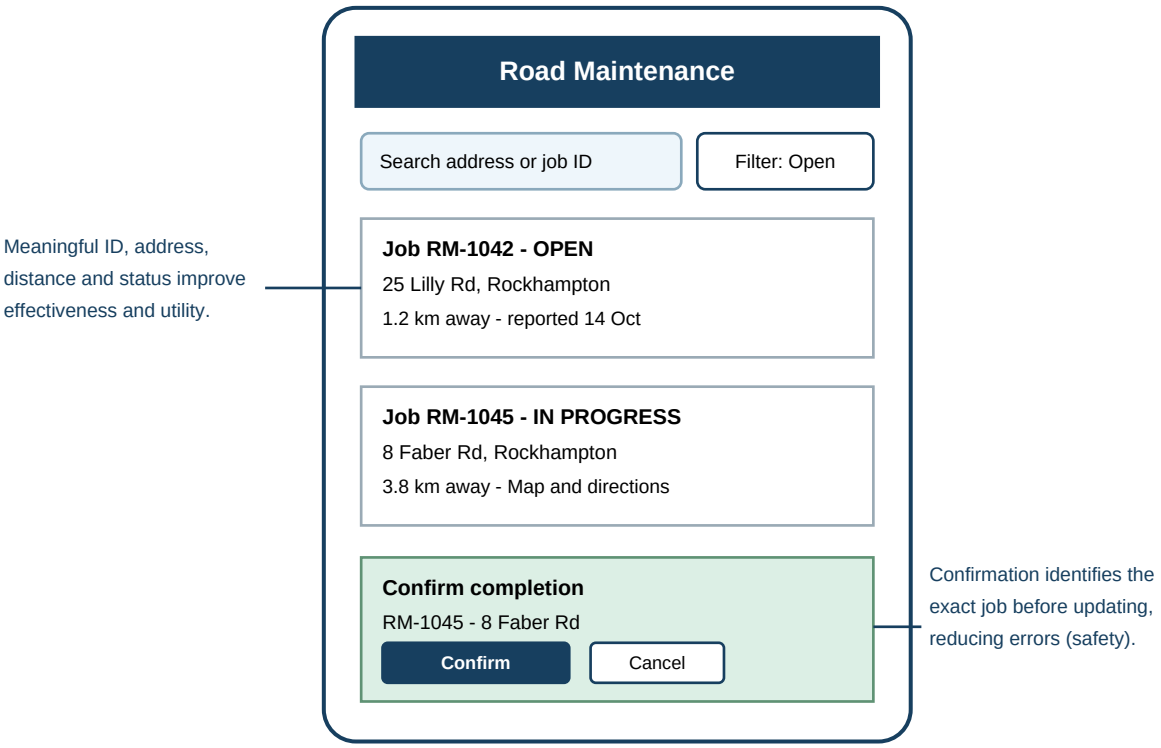
Other valid answer: Safety and effectiveness are the strongest pair because the prompt reports errors and delays. Utility can also be justified if raw coordinates and meaningless filenames do not provide the information workers need. Learnability can be justified if workers cannot infer how to find or update a job from the labels and controls.

Further examples or guidance: Accessibility would need evidence about a user characteristic or access barrier, such as unreadable text or controls. Do not select a principle only because it is on the syllabus list; connect it to evidence in the stimulus.

Question 16e - Improved mock-up

Sketch a mobile screen with meaningful street addresses, a map or directions, and job status controls. Add a confirmation showing the selected address before marking a job complete, to reduce wrong-record updates. Annotate how the location and directions improve effectiveness and how confirmation improves safety. The drawing and its explanations should connect back to the two principles chosen in part d.

Teaching model: safer, more effective maintenance screen



Alternative answers and guidance

Other valid answer: A safety-focused mock-up could show a confirmation dialogue with the address and photo before a job is marked complete, plus Undo after an update. An effectiveness-focused mock-up could show street address, suburb, distance, map preview, directions and filters for status or area.

Further examples or guidance: If part d instead selected utility or learnability, the annotations can explain meaningful job names, familiar icons, clear status labels and a short guided workflow. The features must improve the same two principles identified in part d.