# Data-flow diagrams and exchange-system relationships

## How to use this clinic

This clinic collects authentic QCAA external-assessment questions about data-flow diagrams (DFDs). Attempt each question on paper before viewing the worked response and official marking guide.

1. Read the scenario and underline every user, process, data store and named piece of data.
2. Draw or write your response without looking ahead.
3. Compare your work with the worked response and explanation.
4. Use the complete QCAA sample response and marking criteria to identify missed marks.

> **Important:** The worked responses show one logical solution. A different diagram can earn full marks when it represents every requirement, uses correct conventions and contains no logical contradictions.

# Question 1: online shopping platform

Complete the 2021 question on paper before moving to the worked response.

## 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 three questions and is worth 36 marks.

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**QUESTION 11 (13 marks)**

Business owners use an online platform to sell products. The essential features of the platform are listed.

Platform:

- allows customers and business owners to register and log in
- has four data stores (customer data, products, shopping cart and orders)
- processes order payments
- confirms orders with customers and business owners after successful payment.

Customers:

- register an account
- select products that appear in the shopping cart
- may continue shopping after viewing the shopping cart.

Business owners:

- access confirmed orders
- access customer account details
- update products and prices.

Do not write outside this box.

# Question 1 continued

Symbolise data flow for this system using a diagram that includes all essential features listed.

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

Do not write outside this box.



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## Worked response: account to confirmed order

A complete response converts every feature in the prompt into something visible in the diagram.

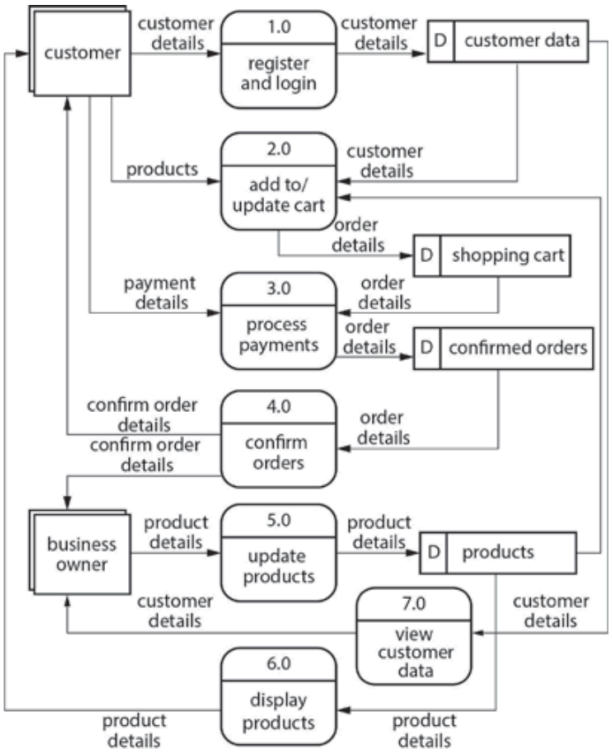
| Prompt detail | What must appear | Logical connection |
|---|---|---|
| Customers and business owners | Two external entities | Each entity exchanges data through a process, never directly with a data store. |
| Register and log in | A numbered process and customer-data store | Customer details flow into the process and then to the store. |
| Shopping and payment | Cart, payment and order-confirmation processes | Products become order details; payment produces a confirmed order. |
| Products and four stores | Customer, shopping-cart, orders and products stores | The owner updates products; customers receive product details. |

**Why this earns marks:** every named feature is represented once, arrows show data rather than actions, each flow has a meaningful label, and the route from customer input to confirmed order is logically traceable.

# Official marking guide: online shopping platform

The complete extract shows QCAA's sample diagram beside all thirteen marking points.

## hort response

| Q | Sample response | The response: |
|---|---|---|
| 11 |  | • symbolises<br>– customer external entity **[1 mark]**<br>– business owner external entity **[1 mark]**<br>– customer data store **[1 mark]**<br>– shopping cart data store **[1 mark]**<br>– orders data store **[1 mark]**<br>– products data store **[1 mark]**<br>– register and login process **[1 mark]**<br>– payments process **[1 mark]**<br>– confirm order process **[1 mark]**<br>– update shopping cart process **[1 mark]**<br>– update products process **[1 mark]**<br>• logically symbolises data flow **[1 mark]**<br>• effectively uses syllabus conventions for data flow diagrams **[1 mark]** |

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# Question 2: fundraising application

Complete the 2022 question on paper. The next page is the supplied response space.

## Section 3

### Instruction

- This section has one question and is worth 31 marks.

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### QUESTION 15 (31 marks)

Digital Solutions students decide to generate an application to manage fundraising activities for their school. Students and staff need to be able to log in, view items and their prices, and select items for purchase. Payments will not be processed by the web application; payment details will be recorded in a database and processed manually by school administration staff.

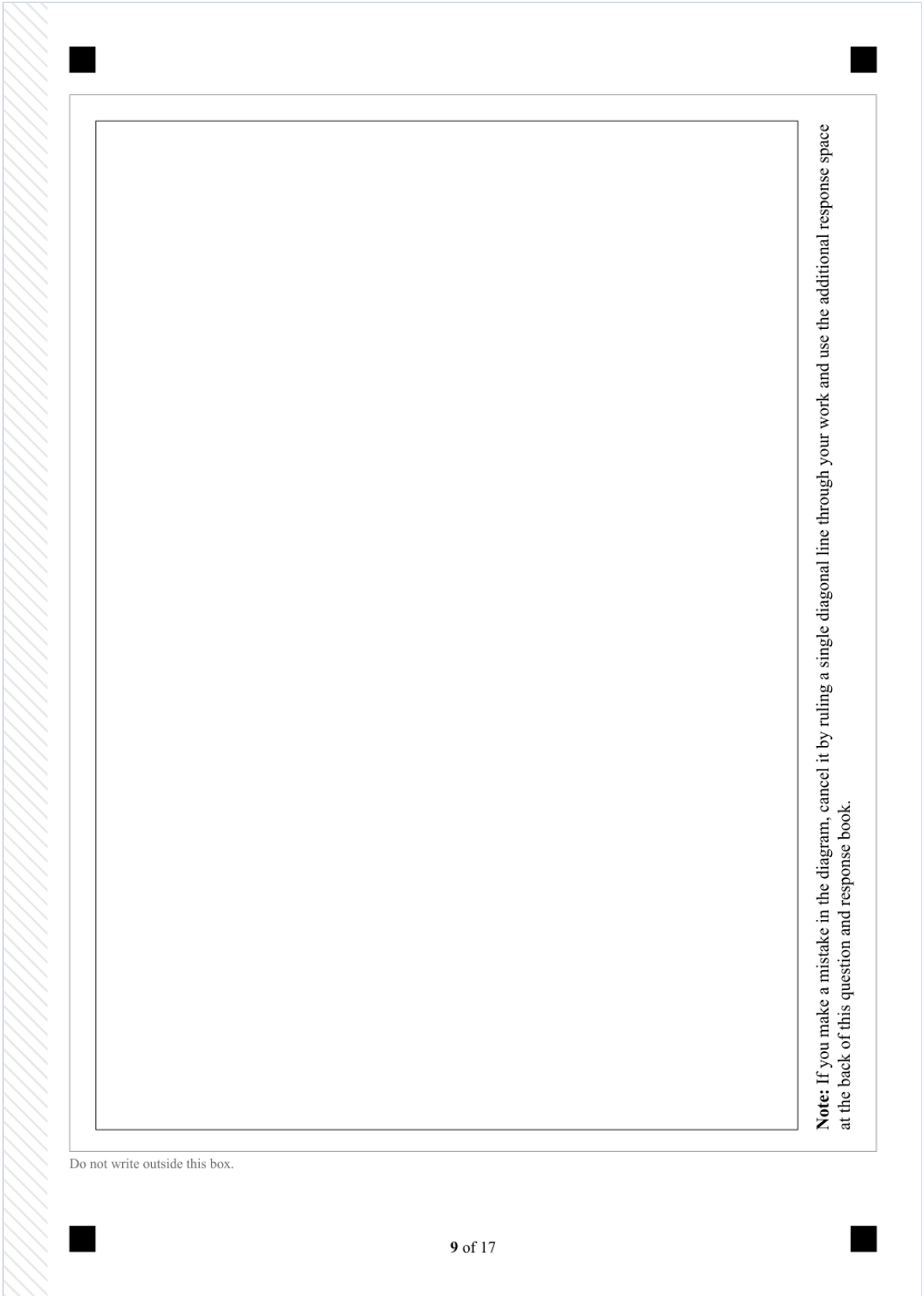
School administration staff manually add item details to the application as they are donated and purchased. Once an order has been placed, stock availability should automatically update.

School administration staff would also like to view order history to determine the popularity of items.

a) Develop a data flow diagram to address all user needs and application requirements, using the response space on the next page. *[19 marks]*

Do not write outside this box.

## Question 2 continued



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

Do not write outside this box.



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## Worked response: fundraising application

Build this large diagram in layers rather than trying to draw every arrow at once.

1. **External entities:** place the student/staff user and school administration outside the system.
2. **Processes:** add login, view items, select items, collect payment details, add item details and update stock.
3. **Data stores:** add users, items, orders and payment details.
4. **Admin-only flows:** connect administration to adding item details, viewing payment details and viewing order history.
5. **Transaction flows:** show credentials into login and a result back; item requests into view items and item details back; selections into orders; payment details into their store; and a completed order causing stock to update.

> **Final logic check:** Every process that receives data must also produce or store something meaningful. No external entity should connect directly to a data store, and no data store should connect directly to another data store.

## Marking guide: fundraising application

The 2022 guide lists each element and data flow that must be visible. It does not publish a sample diagram for this part.

### xtended response — Question 15

| Q | The response |
|---|---|
| 15a) | • symbolises process for<br>– login/user authentication **[1 mark]**<br>– viewing/displaying items **[1 mark]**<br>– selecting items **[1 mark]**<br>– collecting payment details **[1 mark]**<br>– adding item details **[1 mark]**<br>– updating stock **[1 mark]**<br>• symbolises admin-only access for<br>– adding item details **[1 mark]**<br>– viewing payment details **[1 mark]**<br>– viewing order history **[1 mark]**<br>• symbolises datastore for<br>– users **[1 mark]**<br>– items **[1 mark]**<br>– orders **[1 mark]**<br>– payment details **[1 mark]**<br>– and effectively uses data flow diagram conventions **[1 mark]**<br>• symbolises incoming and outgoing data flow for<br>– login/user authentication **[1 mark]**<br>– viewing/displaying items **[1 mark]**<br>– selecting items **[1 mark]**<br>– collecting payment details **[1 mark]**<br>– updating stock **[1 mark]** |

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# Question 3: school voting system

The DFD task depends on the system description and voting rules on these three pages. Read all three before drawing.

## Section 3

### Instructions

- This section has one question and is worth 25 marks.

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### QUESTION 15 (25 marks)

A school has developed a digital system to vote on student leadership positions. The system is incomplete, and a few unprogrammed processes remain.

Programmed components include:

- a registration and login feature using a universal password provided on voting day and their student or staff email address
- a list of candidates organised by nominated leadership positions
- the ability to cast votes
- the ability to count votes.

Unprogrammed processes include site administration:

- distributing a universal password to registered users via email on voting day
- importing candidate details and nominations in XML format
- checking/verifying votes
- publishing results.

a) In XML format, symbolise how data would be structured for "Candidate X", who is in Year 11 and has been nominated for esports captain. *[4 marks]*

Do not write outside this box.

# Question 3 context continued

The voting rules for the system are:

- only students and staff can vote
- each user can only vote once
- voting takes place on a nominated day between 8:30 am and 4:00 pm.

b) Explain system features that would ensure the implementation of the three voting rules. *[3 marks]*

Do not write outside this box.

# Question 3: draw the DFD

To maintain data integrity, the school plans to integrate the voting system with the existing school database to access student and staff profiles. The school database contains all active user profiles and will enable identification of any conflicts of interest. A conflict of interest exists where a voter is related to a candidate, e.g. staff cannot vote for their own children.

c) Symbolise data flow for a programmed component that will allow all voting rules to be enforced while integrating the existing school database. *[14 marks]*

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

Do not write outside this box.



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## Worked response: enforce the voting rules

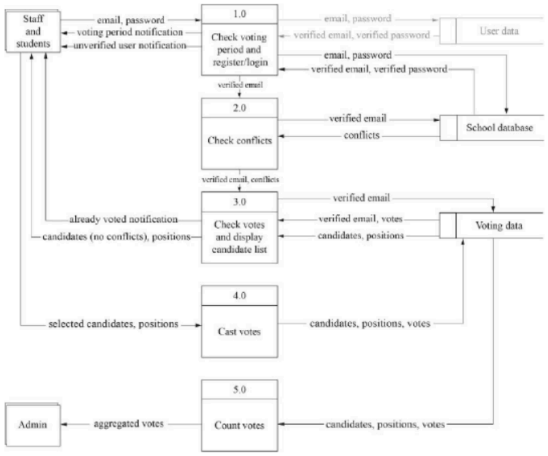
The central idea is that a vote cannot travel directly from the user to the voting-data store. It must pass through checks that enforce every rule.

| Stage | Required relationship |
|---|---|
| **Authenticate** | Email, password and current time enter a login process; the school database returns whether the person is a valid student or staff member. |
| **Check conflicts** | The candidate selection and verified identity are checked against school profiles so related candidates can be removed. |
| **Check previous vote** | The voting store is queried using the verified email; an existing vote blocks another vote. |
| **Cast and count** | A valid selection is stored as a vote. After the voting period, an administrator requests aggregate results from a counting process. |

**Why this earns marks:** the processes do not merely have suitable names; the labelled flows show how identity, time, conflicts and previous-vote data are used to enforce all three voting rules.

# Official marking guide: school voting system

The complete extract shows QCAA's sample diagram and the fourteen marking points.

| Q | Sample response | The response: |
|---|---|---|
| 15c) |  | • symbolises a process or processes that<br>– setup the voting system **[1 mark]**<br>– checks conflicts **[1 mark]**<br>– casts and counts votes **[1 mark]**<br>– enforces all three voting rules **[1 mark]**<br><br>• symbolises datastores for<br>– voting data **[1 mark]**<br>– users and school data **[1 mark]**<br><br>• symbolises logical incoming and outgoing data flow for<br>– user registration/login **[1 mark]**<br>– displaying candidate list **[1 mark]**<br>– checking conflicts **[1 mark]**<br>– casting votes **[1 mark]**<br>– counting votes **[1 mark]**<br>– all three voting rules<br>▪ only staff and students can vote **[1 mark]**<br>▪ each user can only vote once **[1 mark]**<br>▪ the voting period **[1 mark]** |

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# Question 4: one-time-pad message exchange

Complete the 2024 question on paper before viewing the worked response.

**QUESTION 14 (10 marks)**

Two friends want to send each other encrypted messages. They have decided to use a one-time pad encryption algorithm.

Use a data flow diagram to symbolise the data flows required for one friend to send an encrypted message to the other friend. Include external entities, processes and any relevant data stores in your response.

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

Do not write outside this box.

**11** of 21

2024 QCAA external assessment, Question 14. © State of Queensland (QCAA), CC BY 4.0.

## Worked response: encrypted message flow

**Sender -> Encrypt message:** label the incoming flow *unencrypted message*.

**Key store -> Encrypt message:** label the flow *one-time key*.

**Encrypt message -> Receiver:** label the outgoing flow *encrypted message*.

**Receiver and decryption:** a logically complete solution may include a decryption process supplied with the matching key, followed by the recovered message reaching the receiving friend.

**Key handling:** show a suitable key store, or make the diagram's alternative key source explicit and logically workable.

**Why this earns marks:** the two friends are external entities, encryption is a process, the message changes state at the process boundary, and every arrow is labelled with data rather than an action.

# Official marking guide: encrypted message flow

The 2024 guide lists the required entities, process, flows, storage decision and convention marks. No sample diagram was published for this question.

| Q | The response: |
|---|---|
| 14 | • symbolises an external entity for<br>– one user **[1 mark]**<br>– a second user **[1 mark]**<br>• symbolises a process for<br>– encrypting a message with a key **[1 mark]**<br>• symbolises logical data flows for<br>– an unencrypted message **[1 mark]**<br>– a key **[1 mark]**<br>– an encrypted message **[1 mark]**<br>• symbolises data store or a solution that works without one **[1 mark]**<br>• uses<br>– conventions of the data flow diagram with no errors **[2 marks]**<br>**OR**<br>– conventions of the data flow diagram with 1 error **[1 mark]**<br>• shows overall understanding of the problem with no logic errors **[1 mark]** |

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# Question 5: explain a library DFD

This question reverses the task: the diagram is supplied and you must explain its relationships.

## Section 2

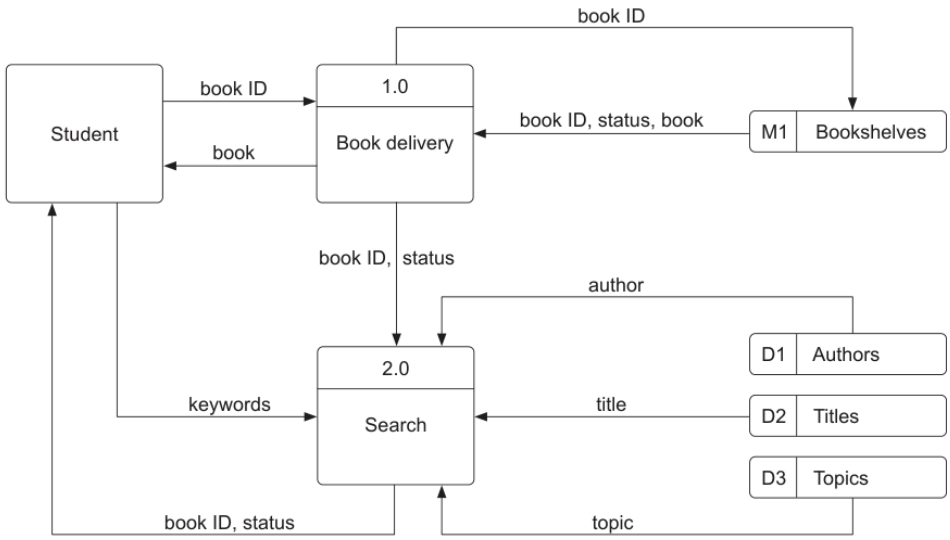
### Instructions

- 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.

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### QUESTION 11 (7 marks)

The data flow diagram of a library system is shown.




Do not write outside this box.

## Question 5 continued

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

Do not write outside this box.



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## Worked response: explain every relationship

The **Student** sends a book ID to the **Book delivery** process. That process uses the ID to obtain the physical book from the manual **Bookshelves** store and supplies the book to the student. It also sends the book ID and status to the **Search** process.

The Student sends keywords to Search. Search compares those keywords with author, title and topic data obtained from the **Authors**, **Titles** and **Topics** stores. It returns matching book IDs and their availability status to the Student.

Bookshelves is a **manual** store because it holds physical books. The identifiers and status values that travel between processes are digital data, while the book delivered to the Student is a physical object.

## Why this response earns the marks

The answer follows the arrows instead of listing definitions. It explains the Student's relationship with both processes, then explains how each of the four stores contributes data or a physical item. It also explicitly recognises the manual relationship between Bookshelves and Book delivery.

# Official marking guide: library DFD

The complete extract shows QCAA's sample response beside all seven marking points.

### 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<br>– Book delivery process **[1 mark]**<br>– Search process **[1 mark]**<br>– Bookshelves data store **[1 mark]**<br>– Authors data store **[1 mark]**<br>– Titles data store **[1 mark]**<br>– Topics data store **[1 mark]**<br>• recognises the manual nature of the relationship between Bookshelves and Book delivery **[1 mark]** |

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