1 A baker uses a Web Application program for her customers to view and select her products online. Once a customer submits an order, an invoice is generated and emailed to the customer. At the end of each month, the program will generate a monthly sales report.

The program uses a relational database with three tables: Product, Customer and Order.

Each product has a description, price, and a unique product ID number.

Each customer has a name, an address, a telephone number, and a unique customer ID number.

Each order has a product ID, a quantity, a customer ID and a date of ordering.

(a) Draw an Entity-Relationship (E-R) diagram showing the three tables and the relationships between them. [3]

(b) A table description can be expressed as:

TableName (Attribute1, Attribute2, Attribute3, …)

The primary key is indicated by underlining one or more attributes.

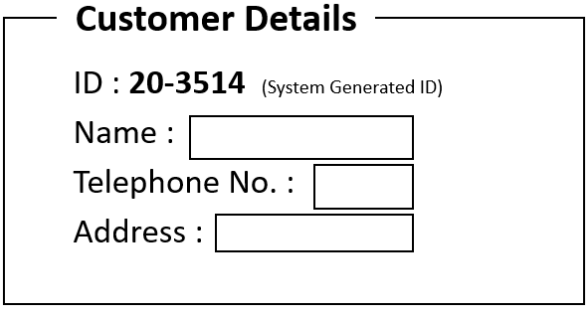
Write a table description for each of the three tables. [3]

The baker can change the price of an item at any time.

(c) **(i)** Explain why this could lead to an error in the monthly sales report on the sales. [2]

(ii) Describe the necessary changes to the database to ensure that the monthly sales report is generated correctly. [2]

On the client device, the customers are required to submit their contact number and delivery address using the form provided on the webpage.



(d) **(i)** Applying the usability principles, explain why the design of the form is not intuitive for the customers. [2]

(ii) State two other design considerations that the baker can adopt in order to improve the user experience for the webpage. [2]

The current program uses a *client-server model* with a web interface for the customer to access via the internet. The baker currently hosts her own web service and keeps the data in a local server.

(e) **(i)** Explain the meaning of the term *client-server model*. [3]

(ii) Describe two security measures that should be adopted to protect the customers' information. [2]

(iii) Describe a strategy that could be used to prevent data loss in the local server. [2]

(f) The baker is considering to host the program using a cloud service. Describe three benefits of using a cloud service. [3]

2 A virus is a biological agent that reproduces inside living host cells. Each virus has a name, a shape, a host and a genetic type. There are four types of shapes that a virus can have: filamentous, isometric, enveloped, and head and tail. The host can either be a plant, bacteria or human. The genetic type for a virus is either DNA or RNA. Some viruses are zoonotic, which means that they can be transmitted between animals and humans.

An airborne virus is a class of virus that is spread via droplets through air. For such viruses, we want to know the airborne duration and the transmission radius.

A vector-borne virus is a class of virus that is spread via an organism. For example, the Dengue virus is spread by the Aedes Mosquitoes. For such viruses, we want to know the vector.

A computational biologist wants to use object-oriented programming language to store and process information regarding different types of viruses.

(a) **(i)** Draw a UML class diagram, with base class `VIRUS`, showing: [8]

- appropriate sub-class(es)
- inheritance
- the properties required
- the associated methods, including **one** pair of 'get' and 'set' methods for **one** of the properties.

(ii) Explain why inheritance is an important feature of object-oriented programming. [2]

(b) **(i)** Explain the meaning of the term encapsulation. [2]

(ii) Explain what is meant by an object in object-oriented programming. [2]

(iii) Explain the meaning of the term polymorphism. [2]

~ End of Paper 1 ~