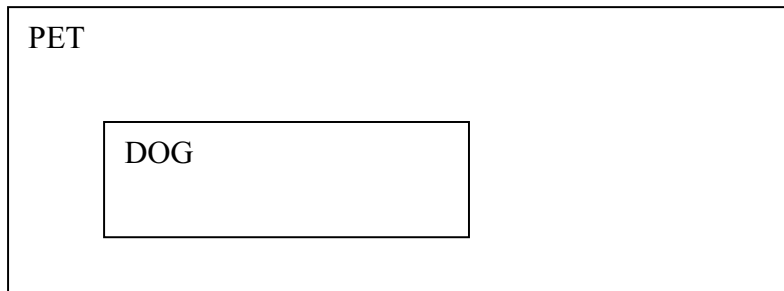**Do not award half marks.**
In all cases give credit for appropriate alternative answers.

Question 1 (Compulsory)

(a)   Consider the following diagram, and, identify whether it illustrates correct or incorrect subtyping. Justify your answer.   [2]

The model is incorrect (1 mark), due to the fact that the subtypes of pet are not exhaustive (1 mark).

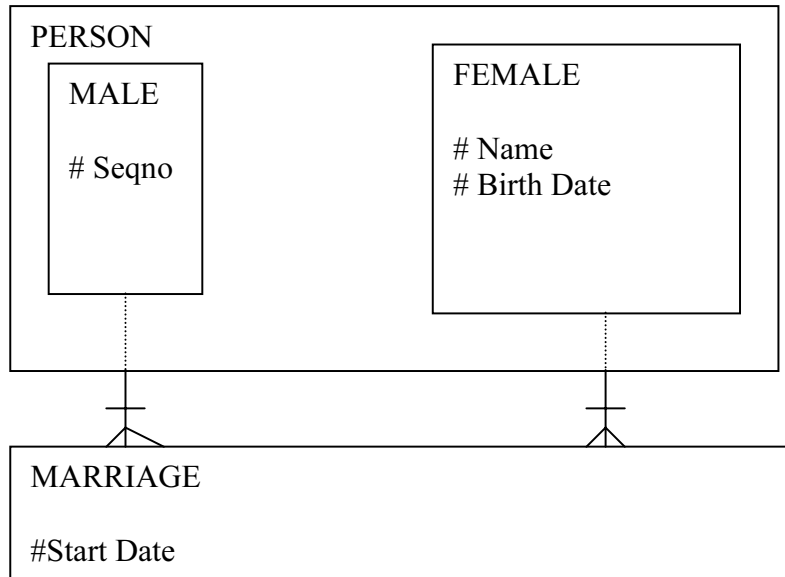(b)   Given the following table suggests appropriate data type supported by Oracle.   [10]

Invoice Table	Suggested Data type
Invoice Number	
Date	
Product Number	
Product Describe	
Qty Order	
Quoted price	
Supplier Number	
Supplier Address	
Supplier Phone	
Supplier Name	

One mark should be awarded for each correct data type.

Invoice Table	Suggested Data type
Invoice Number	**Char**
Date	
Product Number	**Char**
Product Describe	**Varchar2**
Qty Order	**Number**
Quoted price	**Number**
Supplier Number	**Char**
Supplier Address	**Varchar2**
Supplier Phone	**Char**
Supplier Name	**Varchar2**

(c)   The following question parts are concerned with the referential integrity rules that are supported by Oracle.

(i)   What is a *restrict update rule*? Give an example to illustrate your answer.   [3]

(ii)   What is *restrict deletion rule*? Give an example to illustrate your answer.   [3]

(iii)   What is a *cascade deletion rule*? Give an example to illustrate your answer.   [3]

(i)   The *restrict update rule* insists that no updates of a primary (or unique) key value are allowed when referencing values exist (1 mark). A further two marks should be awarded for an appropriate example.

(ii)   The *restrict deletion rule* insists that no deletes of a primary (or unique) key value are allowed when referencing values exist (1 mark). A further two marks should be awarded for an appropriate example.

(iii)   The *cascade delete rule* insists that deletions of a row causes all rows that reference that row through a foreign key marked as "cascade" will be deleted automatically (1 mark). A further two marks should be awarded for an appropriate example.

(d)   Consider the following diagram.

```
┌─────────────────────────────────────────────────────┐
│ PERSON                                                │
│   ┌─────────────┐         ┌──────────────────────┐    │
│   │ MALE        │         │ FEMALE               │    │
│   │             │         │                      │    │
│   │ # Seqno     │         │ # Name               │    │
│   │             │         │ # Birth Date         │    │
│   │             │         │                      │    │
│   └──────┬──────┘         └──────────┬───────────┘    │
│          ┊                           ┊                │
└──────────┊───────────────────────────┊───────────────┘
           ┴                           ┴
          ┬├                          ┬├
┌──────────────────────────────────────────────────────┐
│ MARRIAGE                                               │
│                                                        │
│ #Start Date                                            │
└──────────────────────────────────────────────────────┘
```

Given the above diagram, answer the following questions.

(i)   Can a person marry twice?   [1]

(ii)   Can a person marry twice on the same day?   [1]

(iii)   Can person A marry person B twice?   [1]

(iv)   Can person A marry person B twice on the same day?   [1]

(i)   Yes (1 mark).
(ii)   Yes (1 mark).
(iii)   Yes (1 mark).
(iv)   No (1 mark).

(e)   In the context of databases, what is an *index*? Describe *two* reasons for using indexes in databases.   [5]

Indexes are database structures that are stored separately from the tables they depend on (1 mark). One mark should be awarded for each reason named (up to a maximum of two marks), with a further mark awarded for a satisfactory elaboration in each case (up to a maximum of two marks). Examples include the following.

- **To speed up queries.**
- **To ensure uniqueness if required.**

Do not award half marks.
In all cases give credit for appropriate alternative answers.

Question 2

(a)   Define the term *pattern* in the context of database modelling.   [1]

Patterns are models that contain parts of similar structure (1 mark).

(b)   Why are patterns used?   [2]

It will save your time (1 mark) if you have solved a problem in a particular context and you can apply the solution to another (1 mark).

(c)   Define the term *artificial key*. What is another term for artificial keys?   [2]

An artificial key is a meaningless, usually numeric, value that is assigned to a record which functions as the primary key for the table (1 mark). Another term for artificial keys is surrogate keys (1 mark).

(d)   Give *two* advantages of using artificial keys when compared to composed primary keys.   [2]

One mark should be awarded for each advantage named (up to a maximum of two marks). Examples include the following.

- **The extra space that is needed for the artificial key column and index is less, often far less, than the space you save for the foreign key columns of referring tables.**
- **The joins perform better.**
- **Join conditions consist of a single equation.**

(e)   Give *two* disadvantages of using artificial keys when compared to composed keys.   [2]

One mark should be awarded for each advantage named (up to a maximum of two marks). Examples include the following.

- **Because they are meaningless, they always require joins to collect the meaning of the foreign key column.**
- **More space is required for the indexes, if you decide to create an additional unique key that consists of the original primary key columns.**
- **Because they are meaningless, it is difficult to memorize them.**

(f)   Simplifying user commands is one reason for using views. Describe *two* others.   [4]

One mark should be awarded for each reason named (up to a maximum of two marks), with a further mark awarded for a satisfactory elaboration in each case (up to a maximum of two marks). Examples include the following.

- **Restricting access.**
- **Presenting data.**
- **Isolating applications from data structures.**
- **Saving complex queries and simplifying commands.**

(g)   List *two* benefits of using views   [2]

One mark should be awarded for each advantage named (up to a maximum of two marks). Examples include the following.

- **Dynamic views.**
- **Present denormalized data from normalized tables.**
- **Simplify SQL statements.**

Do not award half marks.
In all cases give credit for appropriate alternative answers.

Question 3

(a)   List *three* goals of entity-relationship modelling.   [3]

One mark should be awarded for each goal named (up to a maximum of three marks). Examples include the following.

- **Capture all required information.**
- **Information should appear only once.**
- **Model no information that is derivable from other information already modelled.**
- **Information should be in a predictable, logical place.**

(b)   In the context of entity-relationship modelling, define the terms *entity, relationship,* and *attribute.*   [3]

An entity is something of significance in the business about which data must be known (1 mark). A relationship explains how two entities are associated (1 mark). An attribute is a single valued property of an entity (1 mark).

(c)   Draw an E-R diagram to represent the following situations and place minimum and maximum cardinalities on the diagram.

A hospital maintains a number of laboratories such as radiology, electro-diagnosis, hematology, and so on. A hospital contains a number of wards such as obstetrics, emergency, rehabilitation, etc. Each ward is assigned a certain number of staff members such as nurses, secretaries, etc. A hospital staffs a number of physicians on its medical staff. A physician may be on the staff of more than one hospital, and physicians may be independent.

There are two associations between physician and patient: diagnoses and prescribed treatments. Each patient may be diagnosed and / or treated by more than one physician. A patient is assigned to a ward. (Note that each patient is in exactly one ward, so there are no out-patients. Also, there is no need to track the movement of the patients if they are transferred between wards). A laboratory performs tests for patients.   [9]
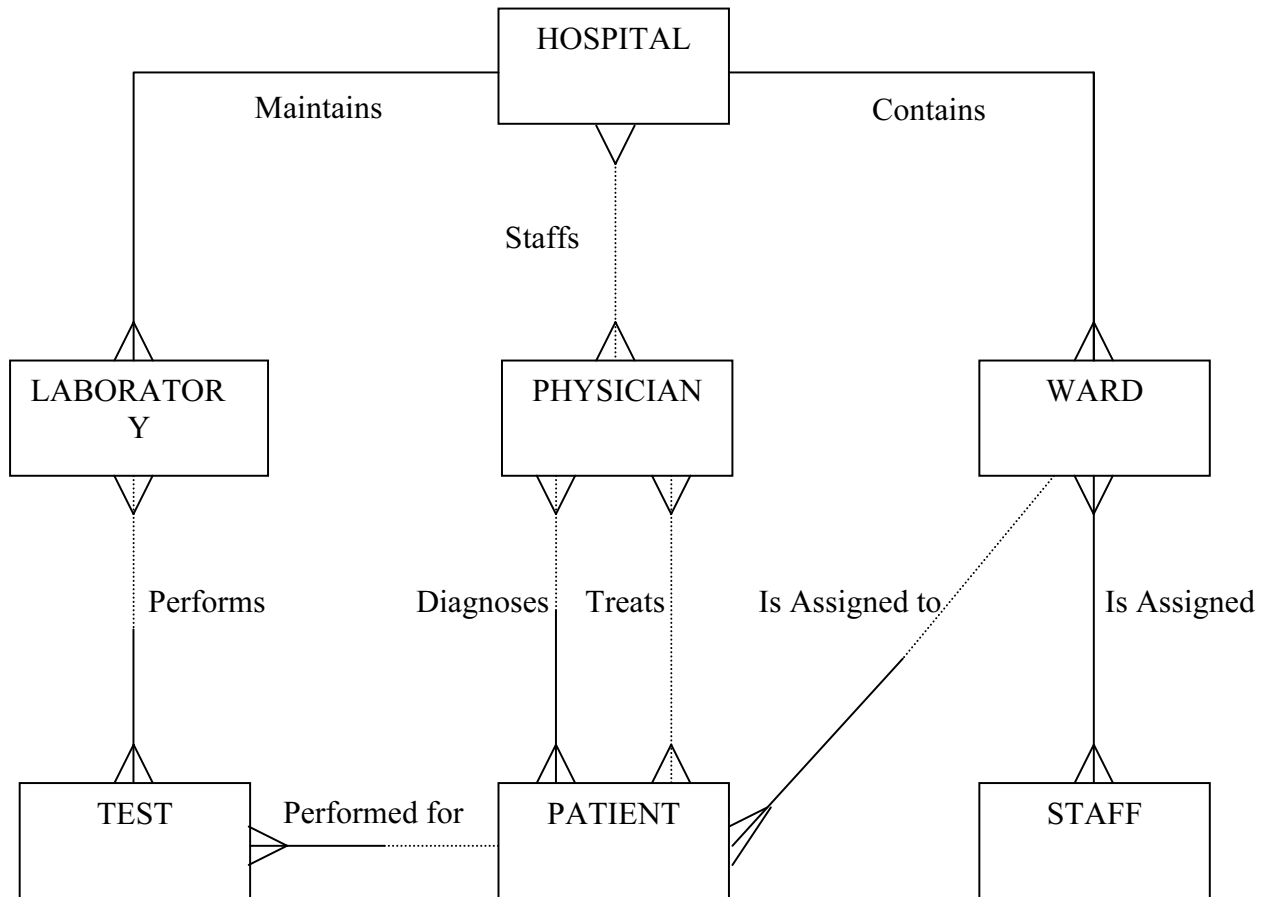
Award three marks for identifying the seven entities; deduct one mark each errors or omissions.

Award six marks for identifying the nine relationships; deduct one mark each errors or omissions.

Do not award half marks.
In all cases give credit for appropriate alternative answers.

Question 4

(a)   Define the term *denormalisation*.   [2]

Denormalisation is the process of systematically adding redundancy to the database (1 mark) to improve performance (1 mark).

(b)   Describe, with the aid of an example, the technique of denormalisation via hard-coded values.   [3]

This involves removing the foreign key and hard coding the allowable values and validation in the application (1 mark). A further mark should be awarded for an appropriate illustration. The technique can be applied when the set of allowable values can reasonably be considered to be static during the life cycle of the system or when the set of possible values is small, say less than 30 (1 mark for either).

(c)   Normalise the following to 3NF.   [10]

Lecturer's View

Student No:	0101-049709910
Name:	John Tan
Course ID:	ADCS
Course Desc:	Advance Diploma
Unit Name	Marks
SD206	45
SE203	70
LD201	86

Administrator's View

Student No:	0101-049709910
Name:	John Tan
Course ID:	ADCS
Course Desc:	Advance Diploma
Registration Date:	1/4/99
Date	Fee Collected
1/4/99	$400
12/4/99	$800
Total collected:	$1200

UNF	1NF	2NF	3NF
Student-No **Name** **Course-ID** **Course-Desc** **Unit-Name** **Marks** **Registration-Date** **Date** **Fee Collected** **Total-Collected**	**Student-No** **Name** **Course-ID** **Course-Desc** **Registration-Date** **Total-Collected** **Student-No** **Unit-Name** **Marks** **Student-No** **Date** **Fee Collected**	**Student-No** **Name** **Course-ID** **Course-Desc** **Registration-Date** **Total-Collected** **Student-No** **Unit-Name** **Marks** **Student-No** **Date** **Fee Collected**	**Student-No** **Name** **Course-ID** **Registration-Date** **Total-Collected** **Course-ID** **Course-Desc** **Student-No** **Unit-Name** **Marks** **Student-No** **Date** **Fee Collected**
	[4 marks]	**[1 mark]**	**[5 marks]**

INF - 1 mark for each correct relation [max 3 marks]
1 mark if all primary keys are shown.
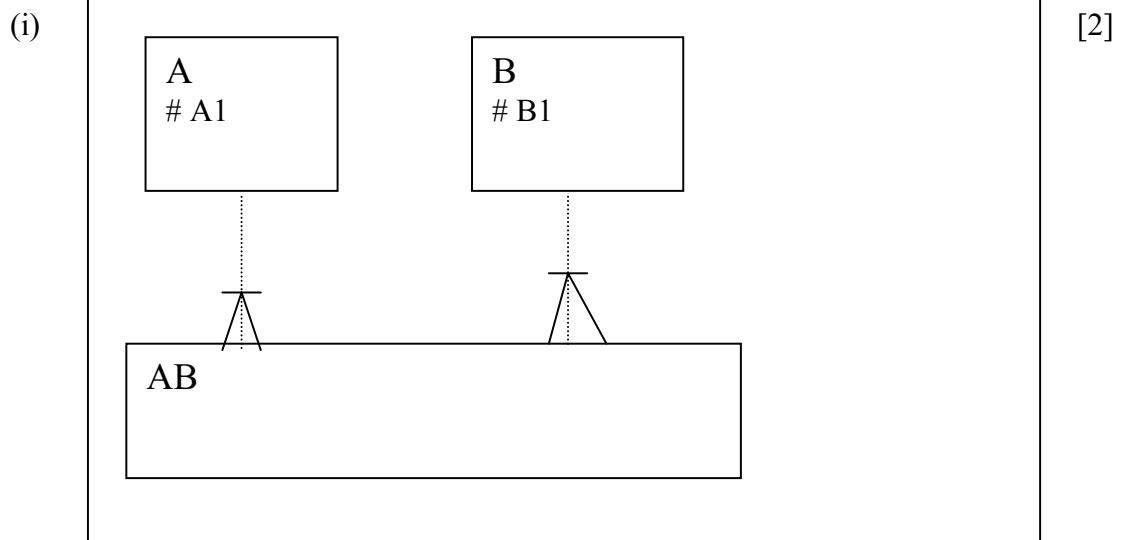
2NF - 1 for no change.

3NF - 1 mark for each correct relations [max 4 marks]
1 mark if all primary keys are shown.

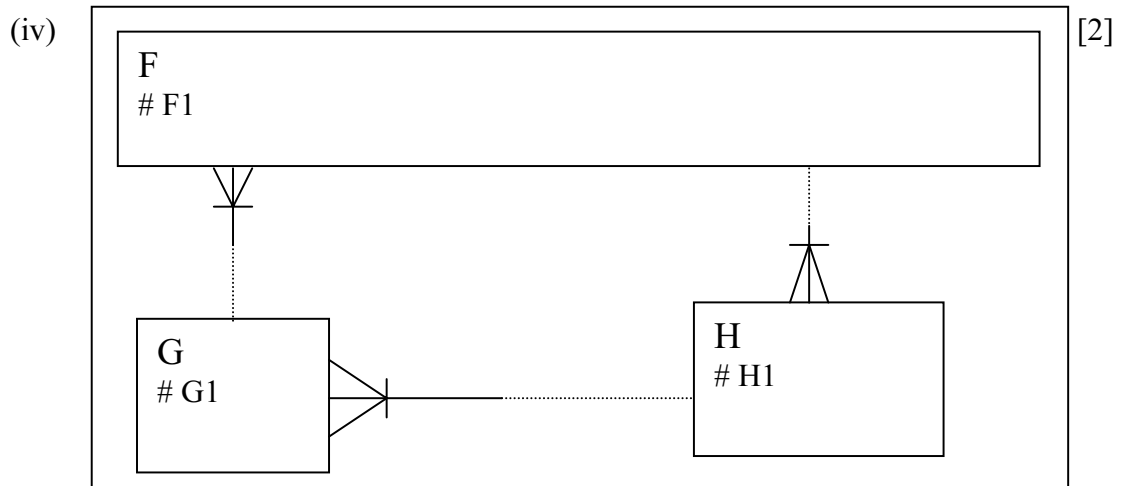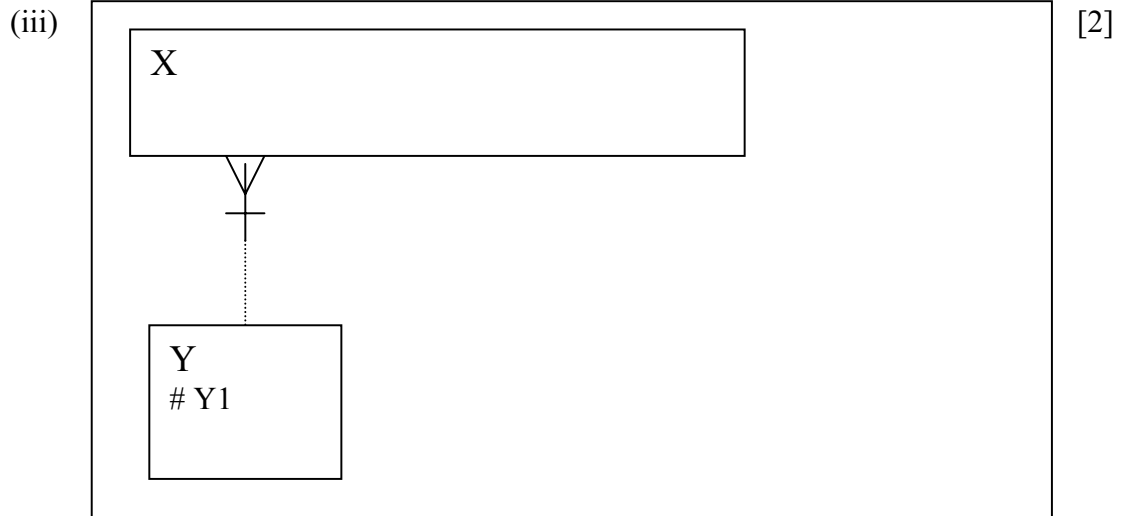**Do not award half marks.**
**In all cases give credit for appropriate alternative answers.**

Question 5

(a)   Explain whether or not the following entities are well-defined unique
   identifiers.

(i)

[2]

(ii)

[2]

(iii) [2]

(iv) [2]
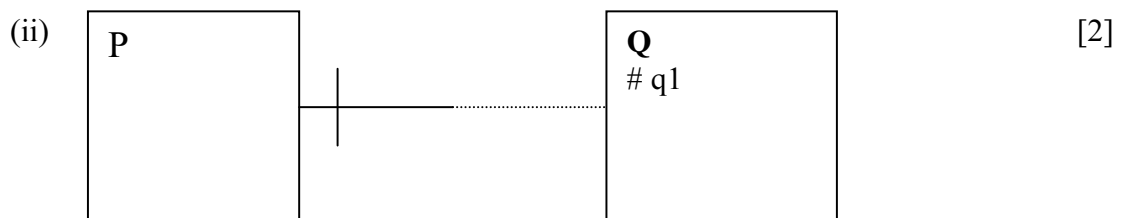
(i)   **Entity AB is not well-defined (1 mark), as there are possibly AB instances that are not related to a A nor a B (1 mark).**

(ii)   **Entity P is well-defined (1 mark), as entity P is well identified by a single relationship (1 mark).**

(iii)   **Entity X is not well-defined (1 mark), because two instances of X can be refer to by the same instance of Y (1 mark).**

(iv)   **Entities F, G and H are not well-defined (1 mark), as the identifiers have a circular structure (1 mark).**

(b)   Draw a diagram that represents a one-to-many relationship.   [1]
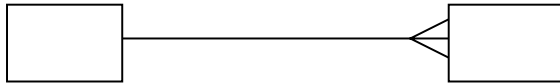
[1]

(c)   For each of the following conditions, explain whether the arc constructs are valid or invalid .

(i)   [2]

(ii)   [2]

(iii)   [2]
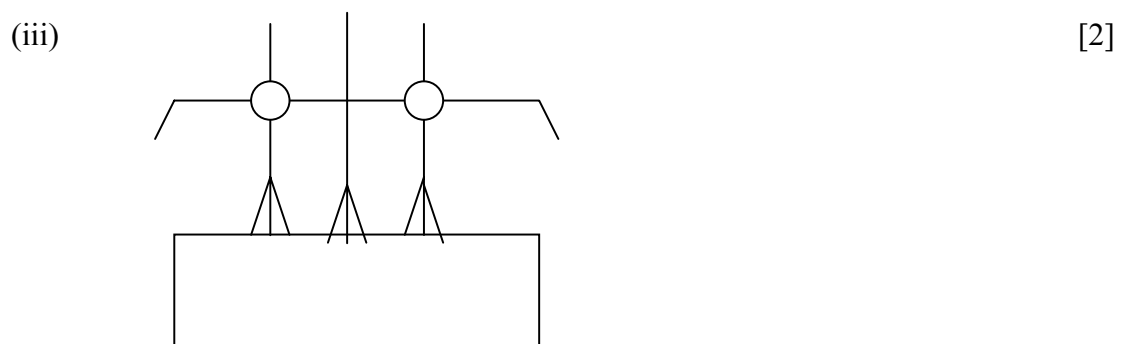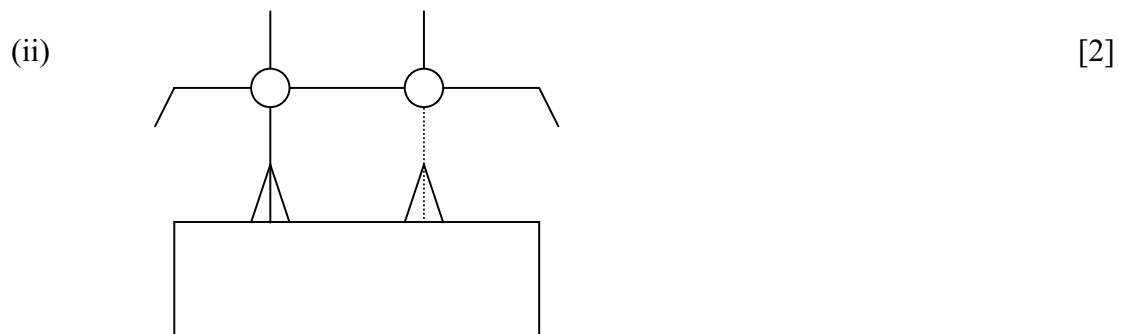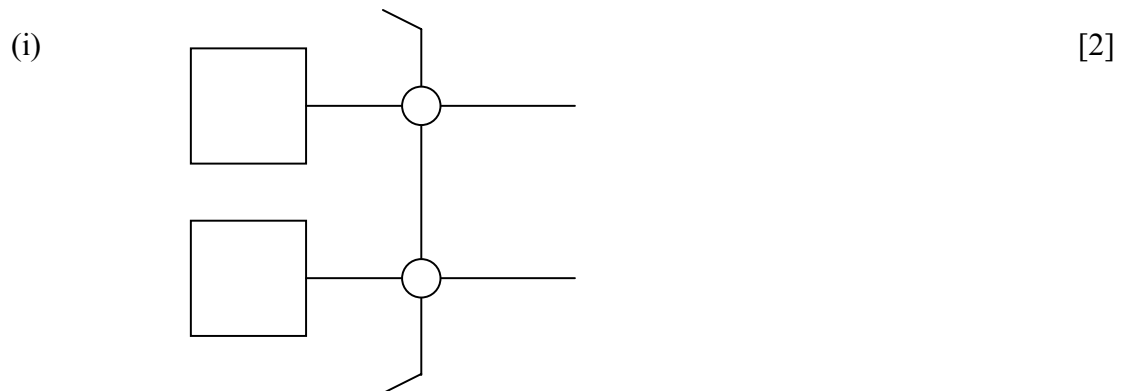
(i)   The arc is invalid (1 mark), as it belongs to one entity only (1 mark).

(ii) **The arcs are invalid are invalid (1 mark), as the relationships in the arc must be of the same optionality (1 mark).**

(iii) **The arc is valid (1 mark), as not all relationships of the entity need to be included in an arc (1 mark).**

- END OF PAPER -