Note to UoL exam system programmer - please find below the multiple choice quiz questions, with correct answer options displayed below the question.

PART A

Candidates should answer **ALL** of Question 1 in Part A.

Question 1

(a) The E/R diagram below is part of a model for a new system that will track zoo animals for breeding programmes. If this Entity/Relationship model is going to be implemented as a relational model, what will need to change?
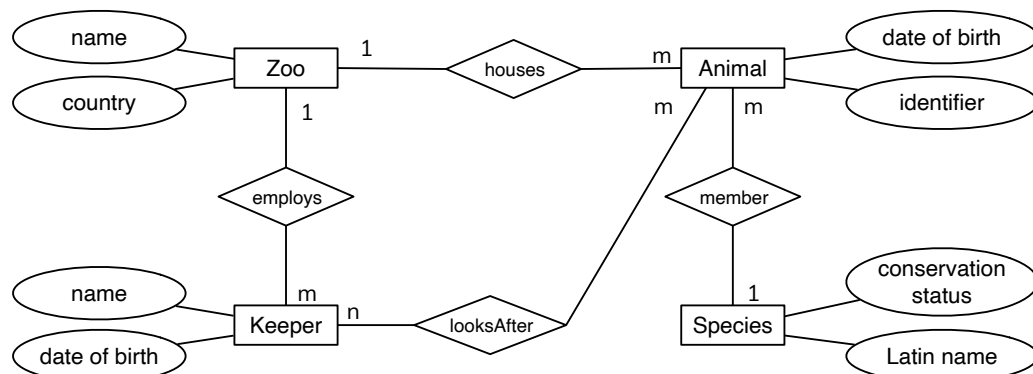
Choose ONE option   [4]

  i. Some attributes have the same name (**name** and **date of birth**). They must be renamed to be unique.

 ii. The relationship between **Keeper** and **Animal** is many-to-many and will need to be rewritten with a new entity between them.

iii. The circular relationship between **Zoo**, **Animal** and **Keeper** should be rewritten to remove the loop.

 iv. Spaces are not permitted in attributes in the relational model. Attributes such as **date of birth** and **conservation status** must be renamed.

(b) Look carefully at the following table and assess its level of normalisation.

Animal	Species	Feed
Simba	Lion	Meat
Hiss	Royal python	Meat
Eeyore	Donkey	Silage
Fozzy	Brown bear	Nuts
Fozzy	Brown bear	Berries
Baloo	Brown bear	Nuts
Baloo	Brown bear	Berries

Select ALL correct statements [4]

   i. The table is in 1NF – all rows are a single data type

   ii. The table is in 2NF – no attribute is dependent on any non-key element or any subset of the primary key.

   iii. The table is in 3NF – it is in 2NF and any transitive dependencies depend on the primary key.

   iv. The tables is in 4NF – there are no multivalued dependencies.

(c) At the beginning of the school year, a temporary administrator is hired to add students to the school database. Which of these `GRANT` commands would be most appropriate to use for the new hire?

Choose ONE option. [4]

   i. `GRANT ALL ON * TO 'temp' WITH GRANT OPTION;`

   ii. `GRANT SELECT ON Students to 'temp';`

   iii. `GRANT INSERT, UPDATE, SELECT, DELETE ON Students to 'temp';`

   iv. `GRANT ALL ON Students to 'temp';`

(d) How many triples are there in the following RDF/Turtle?

```
chEvents:22498 a event:Event, ecrm:E7_Activity, schema:Event ;
               dct:date "1952-11-30T17:30:00"^^xsd:dateTime ;
               rdfs:label "Cordelle Walcott"@en .
```

Choose ONE option. [4]

   i. 3

   ii. 4

   iii. 5

   iv. 7

   v. 9

   vi. 11

(e) Look at the data and associated XML schema fragments below. The XML below is not **well-formed**. Why not?

```
movies.xml
```

```
<movie>
  <title>Citizen Kane</title>
  <cast>
    <actor>Orson Welles</actor>
    <actor role="Jebediah Leland">Joseph Cotton</actor>
</movie>


movies.xsd

<xs:element name="movie">
  <xs:complexType>
    <xs:all maxOccurs="unbounded">
      <xs:element ref="cast"/>
      <xs:element ref="releaseYear"/>
      <xs:element ref="title"/>
    </xs:all>
  </xs:complexType>
</xs:element>
<xs:element name="cast">
  <xs:complexType>
    <xs:sequence>
      <xs:element maxOccurs="unbounded" ref="actor"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
<xs:element name="actor">
  <xs:complexType mixed="true">
    <xs:attribute name="role"/>
  </xs:complexType>
</xs:element>
<xs:element name="releaseYear" type="xs:integer"/>
<xs:element name="title">
  <xs:complexType mixed="true">
    <xs:attribute name="lang" use="required"/>
  </xs:complexType>
</xs:element>
```

Select ALL correct statements. [4]

    i. `cast` should come before title

    ii. The `cast` element is not closed

    iii. `title` should have a `lang` attribute

    iv. `actor` element containing Orson Welles should have a `role` attribute

    v. `releaseYear` is missing

(f) Look again at the code from the previous question. The XML is not **valid**. Why not? **Exclude any aspects that mean the XML is not well-formed in your answer.** Select ALL correct statements. [4]

    i. `cast` should come before title

    ii. The `cast` element is not closed

    iii. `title` should have a `lang` attribute

    iv. `actor` element containing Orson Welles should have a `role` attribute

    v. `releaseYear` is missing

(g) Which of the following are true statements comparing MongoDB with SQL

    i. Unlike SQL, MongoDB has no explicit indexes.

    ii. Unlike MongoDB, a SQL DBMS can guarantee ACID compliance in all transactions.

    iii. A single MongoDB `update` would often map to more than one command in SQL.

    iv. A MongoDB document can have a more complex structure than an SQL table.

Select ALL correct statements. [4]

(h) An international researcher will be arriving to visit an archive. They want a list of all documents that satisfy their research requirements, which they will then digitise during their visit. After they return, they will work through the results manually and discard documents that shouldn't be there. Assume that digitisation in this case is quick, easy and cost free, but has to be done by the researcher when they are present. How would you best evaluate the IR system they use?

    i. Evaluate the system's **precision** (recall is less important here).

    ii. Evaluate the system's **recall** (precision is less important here).

iii. Evaluate the system's **F-measure** (precision and **recall** need to be balanced).

iv. Evaluate the system's **Shannon entropy** (the information content is most important in this case).

Choose ONE option. [4]

(i) What distinguishes a graph from a tree?

  i. A graph does not need a root node, a tree does.

  ii. A tree can include text, a graph can not

  iii. A node in a tree has exactly one parent node, a graph has no such constraint

  iv. A tree does not need a root node, a graph does.

Select ALL correct statements. [4]

(j) Which of the following statements about types of join in SQL are correct?

  i. A LEFT JOIN will produce at least as many rows as an INNER JOIN

  ii. An INNER JOIN will produce at least as many rows as a LEFT JOIN

  iii. A CROSS JOIN will produce at least as many rows as a LEFT JOIN

  iv. A LEFT JOIN will produce at least as many rows as a CROSS JOIN

  v. No type of join can produce more rows than a CROSS JOIN

Select ALL correct statements. [4]

PART B

Candidates should answer any **TWO** questions from Part B.

Question 2

The table below is an extract from a bird spotter's records

Species	Date	Number sighted	Conservation status	Nature reserve	Location
Bar-tailed godwit	2021-04-21	31	Least concern	Rainham Marshes	51.5N 0.2E
Wood pigeon	2021-04-21	31	Least concern	Rainham Marshes	51.5N 0.2E
Greater spotted woodpecker	2021-06-13	1	Least concern	Epping Forest	51.6N 0.0E
European turtle dove	2021-06-13	2	Vulnerable	Epping Forest	51.6N 0.0E
Wood pigeon	2021-06-13	2	Least concern	Epping Forest	51.6N 0.0E
Great bustard	2020-04-15	3	Vulnerable	Salisbury Plain	51.1N -1.8W
Bar-tailed godwit	2020-04-20	53	Least concern	Rainham Marshes	51.5N 0.2E

(a) This is the `sightings` table is in a MySQL database. Give a query to retrieve all bird types seen since the first of January 2021. [4]

(b) Is this table in 1NF? Explain your reasoning [3]

(c) Normalise this data, listing the tables that result and their primary and foreign keys. [7]

(d) What normal form have you reached? Explain your conclusion. [4]

(e) Give a query for your new tables to retrieve bird types **and their conservation status** for birds seen since the first of January 2021. [5]

(f) The bird spotter wants to be sure that their next set of updates go in correctly. Would a **transaction** make a difference? Give example SQL operations to illustrate your argument. [7]

Question 3

Here is an extract of an MEI file.

```
<measure>
    <staff n="2">
        <layer n="1">
            <chord xml:id="d13e1" dur="8" dur.ppq="12"
                    stem.dir="up">
                <note xml:id="d1e101" pname="c" oct="5"/>
                <note xml:id="d1e118" pname="a" oct="4"/>
                <note xml:id="d1e136" pname="c" oct="4"/>
            </chord>
        </layer>
    </staff>
    <staff n="3">
        <layer n="1">
            <chord xml:id="d17e1" dur="8" dur.ppq="12"
                    stem.dir="up">
                <note xml:id="d1e157" pname="f" oct="3"/>
                <note xml:id="d1e174" pname="f" oct="2"/>
            </chord>
        </layer>
    </staff>
</measure>
```

(a) List all the element types you can see in this code [2]

(b) I am trying to retrieve all chords in the staff with `n` of `2` – that is, they are in the right hand – but I only want chords that contain notes with a `pname` of `f`, but my XPath is incorrect. My attempt is:

`/staff[n="2"]/layer/chord[note/@pname="c"]`

Give an XPath expression that **would** work. [3]

(c) A group of developers have decided to evaluate a MongoDB implementation of the MEI model.

  i. Translate the first `chord` element in the XML into JSON as effectively as you can [5]

  ii. Imagining the whole data structure was an array of `chord` objects, give a MongoDB `find` command that would return only chords with upward stems that have `f` in one of their notes. [5]

(d) A different group of developers have mapped the MEI model into linked data. The following SPARQL query finds all chords with at least one F in them.

```
SELECT DISTINCT ?chord
WHERE {
  ?chord rdfs:member ?note .
  ?note mei:pitchClass mei:FPitchName .
}
```

   i. `rdfs:member` is defined by the W3 ontology RDF Scheme. Why are we using it here instead of a new `mei:hasNotes` property? [3]

   ii. Give some RDF (in whichever serialisation you are most comfortable with) for the first chord element. Invent any new concepts you need in the mei `namespace` [5]

(e) How do these three models – XML, MongoDB/JSON and Linked Data – differ in what they might offer for music notation? What advantages and disadvantages does each have. [7]

Question 4

The E/R diagram below part of the design for a database system for coordinating zoos and other animal collections worldwide.
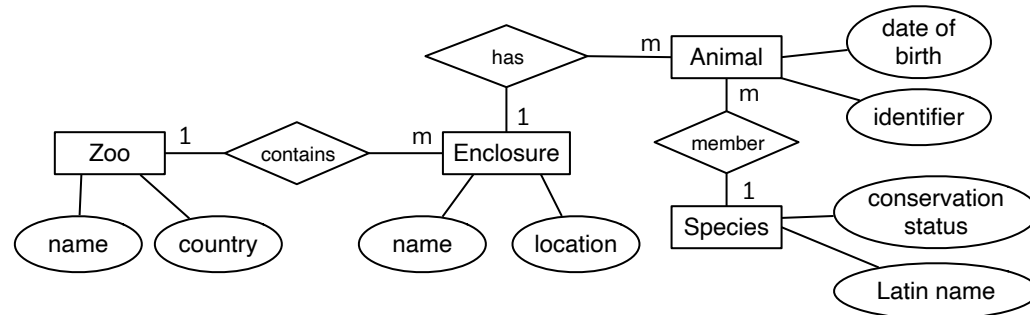
(a) List the tables and their fields for an SQL implementation of this design. Indicate primary keys for each table. [4]

(b) Give SQL `CREATE TABLE` commands for any TWO of your tables, including any **foreign keys**. [6]

(c) Give a single SQL query to find out how many species are housed in the zoo which has the name 'Singapore Zoo'. [5]

(d) Give a single SQL query to find out the date of birth of the oldest animal of the species called 'Buceros bicornis' in each zoo. [5]

(e) Choose ONE of XML or RDF and:

   i. BRIEFLY assess the suitability of this model for your chosen technology (i.e. XML or RDF graph) [3]

   ii. Give some instance data for the database in your chosen technology. You should aim to cover all or nearly all the entities and attributes in the E/R diagram. [7]

END OF PAPER

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