11 Big data Mark Scheme

Q1.

All marks AO1 (understanding)

Level	Description	Mark Range
4	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response. The response covers all three areas indicated in the guidance below and in at least two of these areas there is sufficient detail to show that the student has a good level of understanding. To reach the top of this mark range, a good level of understanding must be shown of all three areas.	10-12
3	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response which shows a good level of understanding of at least two areas indicated in the guidance below.	7-9
2	A limited attempt has been made to follow a line of reasoning and the response has a mostly logical structure. At least four points have been made. Either a good level of understanding of one area from the guidance has been shown or a limited understanding of two areas.	4-6
1	A few relevant points have been made but there is no evidence that a line of reasoning has been followed. The points may only relate to one or two of the areas from the guidance or may be made in a superficial way with little substantiation.	1-3

Guidance – Indicative Response

For each guidance point, if the student expands on the point to explain in what way the measure will improve performance then this can be considered to be a second point. For example:

- “Using a processor with more cores” is one point.
- “Using a processor with more cores which will be able to execute multiple instructions simultaneously” is two points.

Note that just “faster” is not enough to count as an expansion point without an explanation of why.

1. Server Hardware

Replace the processor with one which has more cores

Replace the processor with one which has more cache memory // increase the amount of cache memory

Replace the processor with one which runs at a faster clock speed **NE.** faster processor

Use a parallel processor architecture // use more processors which can work in parallel

Use a processor with a bigger word size

Use a processor that makes (better) use of pipelining

Install more RAM // main memory // primary memory

Use RAM // main memory // primary memory with a faster access time

Replace HDDs with SSDs // Replace HDDS with HDDs that can read data at a faster rate

Defragment the HDD

Replace the motherboard with one which has buses which run at a faster clock speed

Replace the motherboard with one which has more lines in the data bus

Use the Harvard architecture

Distribute the processing across multiple servers

2. Network

Replace the network cable with cable that has a higher bandwidth // replace copper cable with fibre-optic cable **A.** Ethernet cable for fibre-optic NE. higher bandwidth network

Replace any wireless / WiFi connections with wired ones

Replace the network cards with ones that can transmit data at a higher bitrate

Consider the overall network design eg how the network is divided into subnets **A.** split the network into subnets

Use a star topology (instead of a bus)

Consider using a more efficient protocol for the data across the network

Add additional wireless access points

3. Database and Software

Use a more efficient technique for controlling concurrent access to the database // replace record/table locks with serialisation/timestamp ordering/commitment ordering

Replace the database software with software that uses more efficient algorithms for tasks **A.** examples eg replace linear search with binary search

Use the index feature of the database to speed up searching on fields that are commonly used for this purpose

Rewrite the database software in a language that is suitable for concurrent execution // use a functional programming language for the database software

Ensure the software is compiled rather than executed by an interpreter // rewrite the software in assembly language/machine code

Review the conceptual model of the database to see if it contains any inefficiencies such as data redundancy that could be eliminated **A.** normalise the database design

Consider if it would be appropriate to sacrifice normalisation of the conceptual model to improve performance

Use a non-relational database system **A.** examples eg NoSQL

Distribute the data across multiple servers

Try to reduce the amount of other (unrelated) software that might be running on the database server at the same time

Try to reduce the number of database accesses that need to be made simultaneously // run some tasks at quiet times / overnight

Purge / archive data that is no longer necessary / in use

[12]

Q2.

All marks AO1 (knowledge)

There is a lot / high volume of data (to process) // data will not fit on one server;
NE. “volume” on its own.

The data is generated / received / must be processed at high velocity / very quickly;
NE. “velocity” on its own.
NE. high velocity of data
NE. speed data sent at
A. changed, modified or similar instead of “processed”

[2]

Q3.

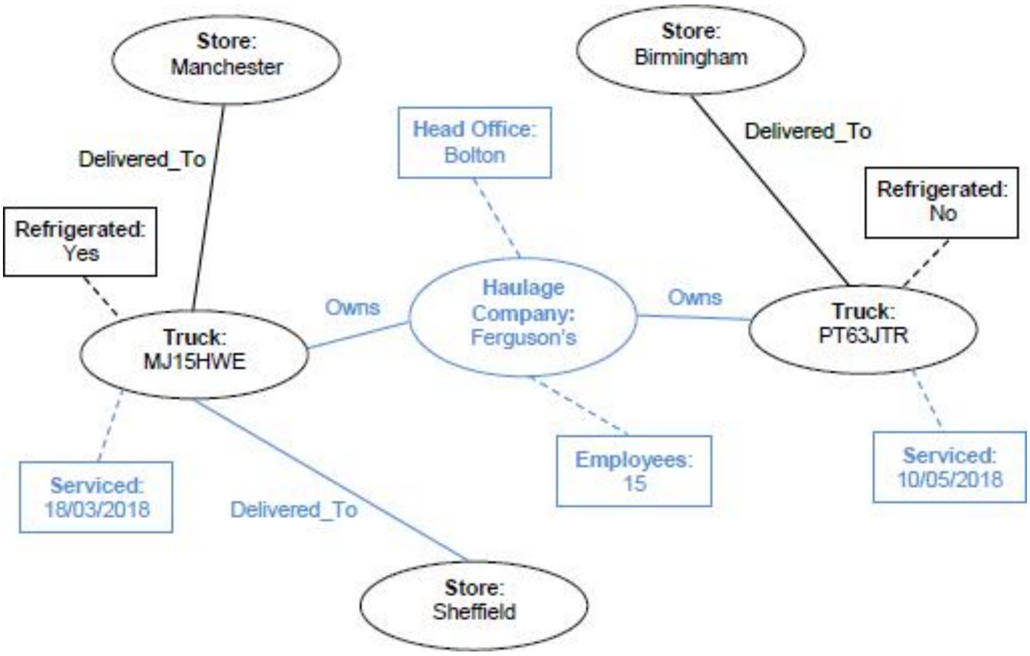
All marks AO2 (apply)

1 mark for representing “Truck MJ15HWE has made a delivery to the Sheffield store” with a solid line joining the truck and the store labelled “Delivered_To”.
A. alternative labels which clearly have the same meaning eg “Delivery”
A. use of directed arrow

1 mark for representing “Truck PT63JTR was last serviced on 10/05/2018 and truck MJ15HWE was last serviced on 18/03/2018” by drawing rectangular boxes containing the data, connected to the trucks with dashed lines.

1 mark for representing “Both of the trucks are owned by a haulage company called "Ferguson’s" which has 15 employees and has a head office in Bolton” by adding an oval for the haulage company with rectangles connected to it by dashed lines indicating the Head Office and Number of Employees, and joining the oval to the trucks using solid lines with appropriate labels such as “owns”.
A. alternative labels which clearly have the same meaning eg “Belongs To”
A. oval only references “Company” not “Haulage” (and possibly but not necessarily additional property added to indicate the type of the company is haulage).
A. instead of Head Office Bolton being drawn as a rectangle and joined with a dotted line it can be drawn as an oval and joined with a solid line.
A. use of directed arrows

An example fully correct diagram is shown below:



Max 2 if diagram contains any errors or incorrect additions

[3]

Q4.

(a) *Declaring PolicyNumber as primary key:*

```
PolicyNumber INT PRIMARY KEY(NOT NULL)
```

Optional

```
  / /
  PolicyNumber INT
  PRIMARY KEY(PolicyNumber)
```

Declaring RegistrationNumber as foreign key:

```
RegistrationNumber CHAR(7) FOREIGN KEY REFERENCES
Vehicle(RegistrationNumber)
/ /
RegistrationNumber CHAR(7)
FOREIGN KEY (RegistrationNumber) REFERENCES
Vehicle(RegistrationNumber)
```

Declaring three other fields:

```
DateStarted DATE
PolicyType VARCHAR(13)
ExcessAmount SMALLMONEY
```

1 mark for PolicyNumber with sensible type and length (if required), and identified as primary key. Type can be either numeric or text.

1 mark for two other fields from RegistrationNumber, DateStarted, PolicyType, ExcessAmount with sensible data types and lengths (if required by the type) *OR* **2 marks** for all four other fields with sensible data types and lengths (if required by the type)

- Length of RegistrationNumber, if specified, must be 7.
- Length of PolicyType, if specified, must be at least 13.

1 mark for identifying RegistrationNumber as a foreign key.

MAX 3

Valid alternative SQL types are:

- Alternative types For *PolicyNumber*: smallint, mediumint, integer, any text field type (see below)
- Alternative types For *DateStarted*: smalldatetime, datetime, datetime2, datetimeoffset
- Alternative types For *PolicyType*: ENUM('Comprehensive', 'Third Party') - accept any type of quotation marks around values - accept data values in any order - accept if ENUM defined as a type separately first
- Alternative types for *ExcessAmount*: money, currency, float, real, decimal, double, numeric, int, smallint, mediumint, integer
- Alternative types for *text fields*: char, varchar, nchar, nvarchar, text, ntext, longvarchar, varchar2, nvarchar2, text, tinytext, mediumtext, longtext

Sensible non-SQL data types can also be credited but MAX 2 if any non-SQL types used.

3

(b)

```
UPDATE Vehicle
SET Colour = "pink"
WHERE RegistrationNumber = "DF24JUT"
```

1 mark per correct line
A double or single quotes around pink and DF24JUT
A table names before fieldnames
A pink written in any case
DPT no quotes
DPT for fieldname before table name
DPT for unnecessary punctuation – allow one semicolon at the very end of the statement, but not at the end of each clause
MAX 2

2

(c)

```
SELECT Model, Colour, Forename, Surname
FROM Owner, Vehicle
WHERE RegistrationNumber = "AB72XHC"
AND Owner.OwnerID = Vehicle.OwnerID
```

1 mark for correct four fields in SELECT clause
1 mark for correct two tables in FROM clause
1 mark for WHERE RegistrationNumber = "AB72XHC"
1 mark for Owner.OwnerID = Vehicle.OwnerID, joined to other condition with AND

--- OR ---

```
SELECT Model, Colour, Forename, Surname
FROM Owner INNER JOIN Vehicle ON Owner.OwnerID = Vehicle.OwnerID
WHERE RegistrationNumber = "AB72XHC"
```

1 mark for correct four fields in SELECT clause
1 mark for correct two tables in FROM clause
1 mark for INNER JOIN using Owner.OwnerID = Vehicle.OwnerID
1 mark for WHERE RegistrationNumber = "AB72XHC"

Marks for SELECT and FROM statements should not be awarded if additional

fields / tables included.
Accept table names before fieldnames.
Accept use of Alias / AS command eg FROM Vehicle AS V then use of V as table name.
Accept insertion of spaces into fieldnames
DPT for unnecessary punctuation – allow one semicolon at the very end of the statement, but not at the end of each clause.
DPT for fieldname before table name.

Refer responses using nested SQL queries to team leaders.

4

(d) (i) Sequence of instructions / program / code;
NE programming language
Note: Do not award mark for program if candidate clearly means HTML
which is executed / run / interpreted on the server (instead of the client);
executed / run / interpreted when a web page is requested;
to generate a web page (and its contents) / result which the server returns to
the client / / generating of dynamic web pages;
MAX 2

2

(ii) **1 mark for this point:**
Retrieve RegistrationNumber / value input by user and store in variable;
R responses that suggest the command makes the user input the values at the point in time when the script is run

MAX 1 point from this list:
from the web page / web site / form / web server / browser / url / request;
using POST / GET methods;

2

(iii) Output the forename and surname;
Back to the web server / web browser / client / terminal;
A display forename and surname on web page (or alternative) for both marks
R responses that imply output is made directly to screen

2

(e) Create a new table / / suitable table name given eg SafetyCertificates;
with CertificateNumber as the primary key ;
Include these fields in new table: CertificateNumber, DateIssued, GarageName;
Add RegistrationNumber into the new table as a foreign key / / as link to Vehicle table;
A relation for table
A different fieldnames for new fields if meaning the same
A adding the extra field ExpiryDate, but not as an alternative to DateIssued
A answers by example eg writing out the new table definition, SQL script to achieve changes
R a composite key in new table
Do not award any marks unless it is clear that a new table has been created

3

[18]

Q5.

LAN;

Justification:

Computers in health centre are in close proximity to each other/geographically close/in same building/on same site;

R Computers within health centre on its own

[2]

Examiner reports

Q1.

A very good range of responses was received to this question, with approximately half of students achieving five or more marks. Most students addressed all three aspects of the question (hardware, network, database and software). Students tended to make more points about how the hardware could be improved than about the other two areas. This was acceptable but students needed to have covered all three areas to achieve a mark of ten or above.

Some students wrote too vaguely to achieve marks, for example by writing that a “faster processor” would improve performance, without referencing a factor such as the clock speed that would make the processor faster. Other mistakes included believing that the question required students to contrast thin-client and thick-client and that the system was web based.

A small number of students wrote about issues which might be causing the system to perform poorly instead of explaining how the performance of the system could be improved. Such responses were not worthy of a mark.

Q2.

Properties of big data were fairly well known, but students sometimes lost marks by expressing them poorly. The question asked for a description and keywords such as “velocity” do not amount to descriptions. Some students lost marks by giving the example stated in the question as one of their responses.

Q3.

The graph schema was well drawn, nearly three quarters of students achieving two or more marks, and a third all three marks. The most common mistake was to fail to label relationships.

Q4.

Overall, students demonstrated a satisfactory ability to use SQL in question parts (a) to (c).

(a) This part was the worst tackled of the three. Commonly made mistakes when defining the table in this part were to use incorrect SQL data types, to include the field EngineSize, to declare RegistrationNumber to be an integer or to use non-SQL syntax. Some students attempted to put a constraint on the PolicyType to ensure that it could only be one of the two valid possibilities. Students were not expected to know how to do this, so incorrect attempts at doing so were not penalised.

(b) In this part, just under half of students got full marks. Many students did not appear to really know the correct syntax of the SQL Update command, but achieved an easy mark by writing the first line of the command as “Update Vehicle”. A common mistake was to fail to put quotation marks around the registration number or colour values.

(c) Responses to this part were disappointing, given the frequency that students have been asked to write SQL queries in the exam over the years, and the fact that this was a fairly simple example, involving only two tables. Only one third of candidates achieved full marks, though half managed to achieve three of the four marks. As in part (b), one common mistake was to miss quotation marks around the registration number. Other mistakes were to use the keyword GET instead of SELECT and to miss out the AND operator in the WHERE clause. Pleasingly, most students realised that a condition was needed to link the two tables together.

(d) Parts (i) to (iii) were about server side scripts. Just under half of candidates were able to achieve full marks for part (i) by explaining that a server side script was program code that was executed on a server. Some also recognised that the trigger for this could be the requesting of a web page and that the output would be a web page. Part (ii) was the least well tackled part, with only around one third of students achieving any marks. The Request object is used to fetch user-inputted data from the web server that it will have been sent when the web page that the data was entered on was submitted. The majority of students believed that the Request object was used to either query a database or that the execution of the command would trigger a request to the user to input data at that time rather than retrieving already input data. Almost all of the candidates got one of the two marks for part (iii) but few clearly explained that the output would be written to a web page which the web server would return to the web browser on the Police Officer’s handheld terminal.

(e) This part was about extending the design of the database to store safety certificate information. The majority of candidates scored at least two of the three marks. Most candidates correctly identified that a new table would need to be created, what the fields in this table would need to be, and that CertificateNumber would be the primary key. Those candidates who scored two but not three marks usually made a mistake with regard to how the new table would be linked to the existing database, stating that the CertificateNumber would be added to the Vehicle table as a foreign key. This solution would not work as this would only allow one certificate to be associated with each vehicle, and it was required that previous certificates could also be stored. The correct solution was to put the RegistrationNumber from the Vehicle table into the new table as a foreign key.

Q5.

Candidates performed well on this question.