Question 2

_Only a couple of people did this and neither were close to the right answers._

This question is about practical Java programming using loops and arrays

You are writing a class which contains information about events and the dates on which they occurred. Events are just Strings. Dates are objects of a class called Date, for which the following items are relevant:

- The Date class has a method
  ```java
go public boolean moreRecentThan(Date other) which returns true if
the Date object the method is called on is more recent than the other Date object
```
- It also has a method `public boolean equals(Date other)` which is true if
  the dates are the same.
- It has a constant `BEGINNING_OF_TIME` which is guaranteed to be older than
  any other Data objects.
- It has a `toString()` method which returns a sensible String representation of a
  Date.

In your class you have an array of Date objects called `_dates` and an array of Strings
called `_events`. Each element of `_dates` is the date of the corresponding element of

2.1. How would you check whether the fifth date is more recent than the seventh,
assuming that there are at least 7 dates. Hint: if you don’t know how to do this, it would
in inadvisable to continue with this question. 2 marks

```java
_dates[4].moreRecentThan(_dates[6]);
```

2.2. Write a method `public Date mostRecent()` which returns the most recent date in the
`_dates` array. Hint: the `BEGINNING_OF_TIME` constant and the
`moreRecentThan()` method are useful here. 4 marks

Note: equivalent while or C-style for loops are ok, although students have not been
formally taught the latter

```java
public Date mostRecent() {
    Date result = BEGINNING_OF_TIME;
    
    return result;
```
for (Date recent: _dates) {
    if (recent.moreRecentThan(result) {
        result = recent;
    }
    else {
        // Do nothing
    }
}
return result;

2.3 Write a method public String eventAt(Date date) which returns the event at the given date, if any (you can assume there is not more than one). If there is no event at that date, it should return the String “No event at that date”. Hint: the equals() method is useful here. 4 marks

Note: this would normally be written with a boolean to stop as soon as a result is found, but I’ve not shown them an example like that. They most certainly have not been told about break.

public String eventAt(Date date) {
    String result = “No event at that date”;  
    int i=0;
    while(i < _dates.length) {
        if (_dates[i].equals(date)) {
            result = events[i];
        }
        else {
            // Do nothing
        }
        i++;
    }
    return result;
}

2.4. Write a method which prints the most recent event and its date on one line. 5 marks

public void printMostRecent() {
    int index = 0;
Date date = BEGINNING_OF_TIME;
String event = "No event found";
for (Date recent: _dates) {
    if (recent.moreRecentThan(result) {
        date = recent;
        event = events[index];
    }
    else {
        // Do nothing
    }
    index++;
}
System.out.println(event + date);

Question 3

Most people did this question, and it was done fairly well in general.

This question is about **inheritance**. It involves writing code, but you only need to write the code which exactly corresponds to the items mentioned in the question.

3.1 Explain how inheritance in programming languages is related to the way we manage complexity in the real world, and what its main advantages are. 4 marks

**Bookwork** – key idea is that one of the ways we manage complexity in the real world is by thinking in terms of concept hierarchies, so use of inheritance in programming is natural. Inheritance provides code reuse, but it’s more important to structure our code in a natural way.

3.2 Draw a UML class diagram which shows an abstract class FormOfTransport, with subclasses Bus and Train. 3 marks

Trivial, but must use the notation correct.

3.3 Show how the three classes would be declared in Java. 3 marks

```java
public abstract class FormOfTransport
public class Bus extends FormOfTransport
public class Train extends FormOfTransport
```

*I was pleased how many people got this right, even though it was on a practice test.*

3.4 Write the FormOfTransport class, assuming that:
- It stores its owner as a String and its capacity as an int
- There are public methods to get the owner and the capacity
- There is a method to get its current position, a Position object. This method will be implemented differently in each subclass. 5 marks

```java
public abstract class FormOfTransport {

    private String _owner;
    private int _capacity;

    public FrmOfTransport(String owner, int capacity) {
        _owner = owner;
        _capacity = capacity;
    }

    public String getOwner() { return _owner; }

    public String getCapacity() { return _capacity; }

    public abstract Position getPosition();
}
```

*I was even more pleased how many people got this right, or at least partially right.*

Question 4

*Only a couple of people attempted this and neither got close to the right answers.*

This question is about Collections

Note. The following description of the Date class is the same as in question 2.

You are writing a class which contains information about events and the dates on which they occurred. Events are just Strings. Dates are objects of a class called Date, for which the following items are relevant:

- The Date class has a method
  ```java
  public boolean moreRecentThan(Date other) which returns true if the Date object the method is called on is more recent than the other Date object
  ```
- It also has a method `public boolean equals(Date other) which is true if the dates are the same.`
- It has a constant `BEGINNING_OF_TIME` which is guaranteed to be older than any other Data objects.
- It has a `toString()` method which returns a sensible String representation of a Date.

In your class you have two Lists, _dates and _events, where
each element of _dates is the date of the corresponding element of _events, e.g. the third element of _dates is the date of the third element of events.

4.1 How would you declare and initialise the list of dates, assuming that you are using ArrayLists? 2 marks

private List<Date> _dates;

(in the constructor)
_dates = new ArrayList<Date>();

4.2 How would you check whether the fifth date is more recent than the seventh, assuming that there are at least 7 dates?. 2 marks

_dates.get(6).moreRecentThan(_dates.get(8));

4.3 Write a method public String eventAt(Date date) which returns the event at the given date, if any (you can assume there is not more than one). If there is no event at that date, it should return the String “No event at that date”. Hint: the equals() method is useful here. 4 marks

public String eventAt(Date date) {
    String result = “No event at that date”;
    int i=0;
    while(i < _dates.size()) {
        if (_dates.get(i).equals(date)) {
            result = events.get(i);
        } else {
            // Do nothing
        }
        i++;
    }
    return result;
}

4.4 Suppose instead of ArrayLists you use a Map, _eventMap from dates to events.
4.4.a Show how this map would be declared and initialised  2 marks

Private Map<Date, String> _eventMap;

(in the constructor)
_eventMap = new HashMap<Date,String>();
4.4 b Show how the eventAt method would be implemented using the Map 2 marks

```java
public String eventAt(Date date) {
    String result = _eventMap.get(date);
    if (result == null) {
        result = "No event at that date";
    } else // do nothing
    {
        return result;
    }
}
```
(1 mark if no test for null, i.e. just return _eventMap.get(date))

4.5 Briefly discuss the advantages of using a Map rather than a pair of ArrayLists or a pair of arrays. Are there any disadvantages? 3 marks

Firstly ArrayLists are better than arrays because it’s much easier to add events. The map is much more natural and makes it much easier to get the event at a given date. Operations like mostRecent() can be done with getKeys(). Disadvantage is that it’s harder to get the date of an event – could fix this with a second map.

Question 5

*This was done by almost everybody, with mixed results.*

This question is about data storage

5.1 For three of the four forms of data storage introduced in the course, explain in one sentence how data is stored in that form from a Java program. 3 marks

**Serialization:** just do writeObject to write the root object to an ObjectOutputStream
**CSV:** Write to a text file, typically one line per object
**XML:** Write to a text file, with the appropriate tags and data between then
**RDB:** Use JDBC to insert or update into database tables.

* A lot of answers said what the forms of data storage were, without specifically saying how data is stored in that format.

5.2 For the same three forms, explain in one sentence how stored data is read back into a Java program. 3 marks

**Serialization:** just do readObject to read the root object from an ObjectInputStream
CSV: Read a text file line by line, typically one line per object
XML: Use an XML parser to input the data, then convert it to the objects required
RDB: Use JDBC to select from database tables.

Here the answers tended more specific, which should have caused people who gave generic answers to the previous part to revisit it.

5.3 Which of the forms is not normally used for long-term data storage, and why? 1 mark

Serialization because minor changes in the format of classes can invalidate stored objects (schema evolution).

A number of people said CSV here. Although CSV is very simple there’s no reason not to use it for long term storage if it is otherwise appropriate.

5.4 The exam software you are using uses all four forms. While you are taking the exam, backups of your work are sent to the server using Java serialization. These backups and exam and answer data generally are stored as XML files on the server. Information about which students are taking which courses etc. (hundreds of thousands of records) are stored in a relational database. Finally, marks are produced as CSV files.

5.4 a. For each of the formats, suggest one reason why we use it in the particular role (i.e. real time data backup, long term exam data storage, student data storage, result production) stated above. 4 marks

Serialization: fast and efficient, doesn’t require XML handling on the client side.
XML: Compact and efficient, exams are naturally tree structured
RDB: Large amount of data, naturally table structure, required proper management
CSV: Simple and convenient, can be viewed in Excel.

Answers were mostly ok, a few people didn’t read the question properly and actually had different formats from those given.

5.4 b For each role, suggest an alternative form of data storage we could have used, briefly explaining why. 4 marks

Marks for anything sensible. Only absolute no-no is using serialization for long-term storage.

Well actually neither CSV or a database (both of which were suggested) make much sense for backup, XML is the only sensible alternative to serialisation as the data is tree-structured.