CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9691 COMPUTING

9691/31 Paper 3 (Written Paper), maximum raw mark 90

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International Examinations

1 **(a)** **(i)** `a b + 7 /` [1]

(ii) `2 3 z * 5 + /`
`1` [1]
2nd mark for completely correct [1]

(b) evidence for 12 and 4 [1]
3 [1]

(c) **(i)** In-order traversal // (Traverse each subtree in the order) left-root-right [1]

(ii) `E M c 2 ^ * =` [1]

(iii) Post-order traversal // (Traverse each subtree in the order) left-right-root [1]

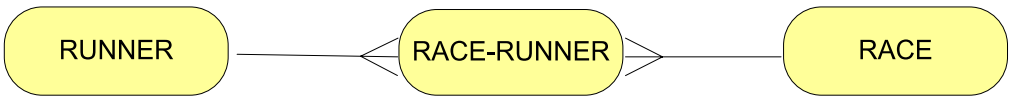
[Total: 8]

2 **(a)** Security is improved/better managed [1]
Different users can have different 'views' of/access to data [1]
Program-data independence // Changing a field does not require an applications program re-write [1]
Queries and reports quickly produced [1]
Reduced data duplication/redundancy [1]
Reduced data inconsistencies [1]
Better managed data integrity/data validation // Validation code does not need to be present in all applications programs [1]
If implemented with a DBMS it will allow concurrent access to the database [1]
MAX 3

(b) **(i)** many runners compete in many races // many-to-many // M:m [1]

(ii) one club organises many races // one-to-many // 1:M [1]

(c) **(i)**



Intermediate table (not labelled `RUNNER, RACE, CLUB`, etc.) [1]
2 X one-to-many relationship [1]

(ii) Primary key of RACE/Primary key `RaceDate`
// Primary key of RUNNER/Primary key `MemberID` [1]
Is used as a foreign key in the link table [1]

(d) **(i)** (Yes) since there is a not a repeated group of attributes [1]

(ii) (Yes) Since there is only a single attribute primary key
// there are no partial dependencies
// all non-key attr. are dependent on the primary key [1]

(iii) There are dependent non-key attributes // `ClubAddress` is dependant on `ClubName` [1]

(iv) `RUNNER(MemberID, RunnerName, RunnerDOB, ClubName)` [1]

`CLUB(ClubName, ClubAddress)` [1]

If primary key not indicated penalise once only

(e) Avoids data duplication/repeated data [1]
Avoids data inconsistencies [1]
Ensures data integrity [1]

(f)
```
SELECT RaceDate, OrganisingClubName                    [1]
FROM RACE                                              [1]
WHERE RaceDate > #01/01/2013# AND Distance < 10        [1]
```

Do not penalise imprecise syntax in the WHERE line

[Total: 19]

3 **(a)** a single processor
program consists of a sequence of stored instructions [1]
Instructions + data [1]
are stored (in a continuous block) of primary/main memory [1]
instructions are executed in sequence [1]
MAX 2

(b) **(i)** 122 [1]

(ii) 5C [1]

(iii) Fewer digits used to represent any number // long string difficult to interpret [1]
Less likely to make a mistake when copying/converting a digit string [1]
Easy to convert from binary to hex (vice versa) than binary to denary [1]
MAX 1

(c) **(i)** 16 bits [1]

(ii)

Fetch stages	Special purpose registers				Busses	
	PC	MAR	MDR	CIR	Address bus	Data bus
	7A					
MAR ← [PC]		7A			√	
PC ← [PC] + 1	7B					
MDR ←[[MAR]]			2150			√
CIR ← [MDR]				2150		

For the buses column penalise once for any additional incorrect ticks MAX 5

(d)

Instruction	Register	
	Accumulator (ACC)	Index Register (IX)
LIX 200		3
LDD 201	216	
LDI 201	96	
LDX 201	63	

1 per contents [4]

[Total: 15]

4 A class is the design/blueprint/template (from which objects are later created) [1]
A class consists of properties/attributes and methods/procedures/functions [1]

An object is an instance of a class [1]
An object must be based on a class definition [1]
Many objects can exist for the same class [1]
MAX 3

(b) The class diagram includes:

`BOOK + RECORDING` subclasses [1]

`FILM + MUSIC` subclasses of `RECORDING` [1]

Recognised notation for inheritance [1]

`RESOURCE` class `Title : STRING`
`OnLoan : BOOLEAN` [1]

`BOOK` class `Author : STRING` [1]

`FILM` class `RunningTime : INTEGER` [1]

`MUSIC` class `NoOfTracks : INTEGER` [1]

`RECORDING` class `ReleaseDate : DATE` [1]

MAX 8

(c) *Encapsulation*
Combining together of an object's properties and the methods [1]
Restricts the programmer's access to the object's data // Hiding of data [1]
Data values can only be read/written using the methods of the class [1]

[Total: 13]

5 (a) Last item added is the first item to leave // or equivalent wording [1]
R. LIFO

(b) (i) HARRIS [1]
17843 [1]

(ii)
```
PROCEDURE PushJob
IF TopOfStack = 1000                                          [1]
   THEN
      OUTPUT "Stack is already FULL"
   ELSE
      INPUT NewUserID
      INPUT NewReferenceNo                                    [1]
      TopOfStack ← TopOfStack + 1                             [1]
      SpoolJob[TopOfStack].JobReference ← NewReferenceNo
      SpoolJob[TopOfStack].UserID ← NewUserID                 [1]
   ENDIF
ENDPROCEDURE
```

(c)
```
PROCEDURE PopJob
    IF TopOfStack = -1                                    [1]
        THEN
            OUTPUT "There are no print jobs waiting"      [1]
        ELSE
            PROCESS SpoolJob[TopOfStack]
                TopOfStack ← TopOfStack - 1               [1]
    ENDIF
ENDPROCEDURE
```

(d) May not be a fair way to order the outputs [1]
Some print jobs may wait a long time before printing [1]
Better choice is a queue [1]
Since first print job sent will be the first to be output // First in – First out [1]
MAX 3

[Total: 13]

6 (a) (i) File allocation table
Storage space is organised into allocation units/clusters [1]
There is a record for each allocation unit/cluster [1]
Records are marked as either used // available // unusable [1]
Allocation units/clusters for each file are maintained as a linked list [1]
There is a separate FAT for each logical volume/partition [1]
MAX 2

(ii) Allocation units allocated to the file … [1]
Have their record status changed to 'available' [1]

(b) (i)
1. Save the contents of the program counter on the **stack** [1]
2. Also save **contents of all other registers** [1]
3. Load and run the appropriate **Interrupt Service routine (ISR)** [1]
4. Restore all other registers
5. Restore the **Program Counter** [1]
6. Continue execution of the interrupted process

(ii) Disable interrupts of a lower priority (before step 1) [1]
Check for receipt of interrupt (during Step 3) [1]
If interrupt received before completion of step 3, go to step 1
// Save the registers for the current process – the ISR [1]
Compare priority with level below which interrupts already disabled [1]
Enable interrupts of a lower priority (after Step 5) [1]
MAX 3

[Total: 12]

7 **(a)** Possible answers include:
Encryption of email traffic [1]
Email data if intercepted cannot be read [1]

Encryption of passwords [1]
Designed to prevent unauthorised access [1]

(b) *Encryption algorithm ...*
The calculation/process/sequence of steps for converting the message text/data [1]

Encryption key
A number/parameter used by the encryption algorithm // e.g. the displacement shift for transposing characters [1]

(c) *Asymmetric encryption ...*
Private key is known only to the owner//Public key is known by both parties [1]
Public and private keys are obtained from the purchase of a digital certificate //
Keys are generated at the start of a secure (e.g. web or email) session [1]
EITHER …
Sender will use their own private key [1]
Receiver decrypts using the sender's public key [1]

OR ….
Sender uses the recipient's public key [1]
Receiver decrypts using their own private key [1]
MAX 3

(d) *Authorisation ...*
Different permissions granted to different users [1]
Restricted access to certain data files/directories/physical devices [1]
User IDs MAX 1

Authentication
Passwords [1]
(Digital) signature // (Digital) certificate [1]
Use of biometric data and methods [1]
MAX 1

[Total: 11]