
COMPUTING

9691/32

Paper 3 Written Paper

May/June 2016

MARK SCHEME

Maximum Mark: 90

Published

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- 1 (a) The rule is defined in terms of itself [1]
 Rule 6 [1]
- (b) (i) dog [1]
 This is a <noun> using rule 3 [1]
 A <noun> is a <nounPhrase> using rule 4 [1]
- (ii) a puppy sat [1]
 <article><noun><verb> [1]
 puppy is not a valid <noun> [1]
- (iii) a cat slept the snake **Max [4]**
 <article><noun><verb><article><noun>
 1 3 2 1 3
 <nounPhrase><verb><nounPhrase>
 4 4
 <verbPhrase><nounPhrase>
 5
 <sentence><nounPhrase>
 6
 <sentence>
 6
 1 mark for each key-change row
- (iv) <adverb> ::= quietly | quickly | slowly [1]
 <verbPhrase> ::= [1]
 <nounPhrase><verb> | <nounPhrase><adverb><verb> [1]
- 2 (a) The table has a repeated group of attributes // [1]
 BandName + Genre + NumberInBand + SetFee are repeated for each manager
- (b) (i) Many bands are managed by one manager // many-to-one [1]
- (ii) The primary key `ManagerName` in the `MANAGER` table [1]
 links to foreign key `ManagerName` in the `BAND` table. [1]
- (c) There are non-key attributes which are dependent on only part of the primary key [1]
 Genre + NumberInBand and SetFee will be known from only the BandName [1]

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(d) (i) Issue 1
The Booking table now includes an `AgreedFee` attribute [1]

(ii) Issue 2
The booking table now records a `BookingTime` [1]

(iii) Issue 3
There is an additional table `VENUE` [1]

(iv)

Table	Primary key	Foreign key(s) (if any)
BAND	<code>BandName</code>	<code>ManagerName</code>
MANAGER	<code>ManagerName</code>	
BOOKING	<code>BandName-BookingDate-BookingTime</code>	<code>BandName</code> <code>VenueName</code>
VENUE	<code>VenueName</code>	

3 (a) (i) $x a b + /$ [1]

(ii) $p 2 \wedge 2 q + 3 / +$
(1) (1) [2]

(b) $3 * (a + b + c + d - e)$
(1) (1) [2]

(c)

[8]

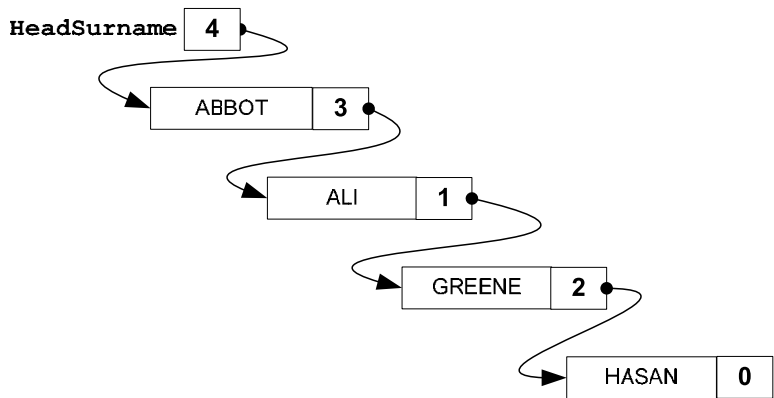
RPNString	ThisChar	StackContents	Temp	INFIXString			
x y +	x	<table border="1"><tr><td> </td></tr><tr><td> </td></tr><tr><td>x</td></tr></table>			x		
x							
	y	<table border="1"><tr><td> </td></tr><tr><td>y</td></tr><tr><td>x</td></tr></table>		y	x		
y							
x							
	+	<table border="1"><tr><td> </td></tr><tr><td>y</td></tr><tr><td>x</td></tr></table>		y	x		
y							
x							
		<table border="1"><tr><td> </td></tr><tr><td> </td></tr><tr><td>x</td></tr></table>			x	y	
x							
		<table border="1"><tr><td> </td></tr><tr><td> </td></tr><tr><td>x</td></tr></table>			x		y
x							
		<table border="1"><tr><td> </td></tr><tr><td> </td></tr><tr><td>x</td></tr></table>			x		+ y
x							
		<table border="1"><tr><td> </td></tr><tr><td> </td></tr><tr><td> </td></tr></table>				x	
		<table border="1"><tr><td> </td></tr><tr><td> </td></tr><tr><td> </td></tr></table>					x + y
		<table border="1"><tr><td> </td></tr><tr><td> </td></tr><tr><td> </td></tr></table>					(x + y)
		<table border="1"><tr><td> </td></tr><tr><td> </td></tr><tr><td>(x+y)</td></tr></table>			(x+y)		
(x+y)							

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- 4 (a) Byte 1: 31 (1)
Byte 2: -63 (1) [2]
- (b) 93 07 [2]
1 mark per byte
- (c) 6A F5 [2]
1 mark per byte
- (d) (i) The mantissa starts with a 1 digit [1]
- (ii) Mantissa: $-1 + 5/16$ // $-11/16$ // -0.6875 [2]
Exponent: 11
- (iii) $-11/16 * 2^{11}$ // $-11 * 2^7$ // -1408 [1]
- (e) The mantissa starts with 10 // the first two bits of the mantissa are different [1]
- (f) Smallest [1]
- | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
- Largest [1]
- | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
- 5 (a) (i) Dynamic data structure changes size at execution time [1]
- A static data structure has a fixed size [1]
- (ii) Dynamic data structure matches the size to data requirements // [1]
Takes memory from heap as required //
returns memory as required (following node deletion) //
There is no wasted memory space / makes efficient use of memory
- (b) ABBOT (1)
1 (1) [2]

(c)

[3]

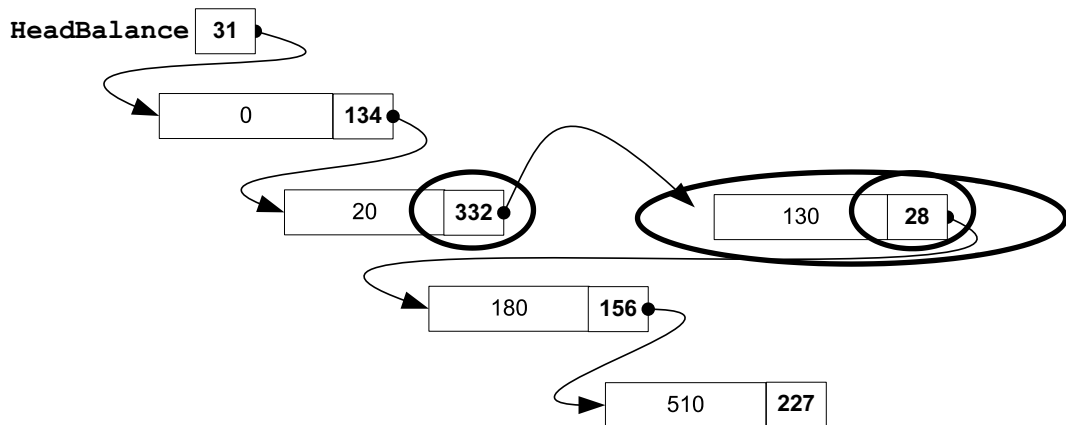


Mark as follows:

- HeadSurname = 4 (1)
- Names in correct order (1)
- Link pointers correct (1)

(d) (i)

[3]



Mark as follows:

- New node inserted (1)
- 332 for the correct node (1)
- 28 for the correct node (1)

- (ii) Start at the head pointer (1)
- Follow the link pointers until (1)
- The value found is greater than the value to insert (1)
- Pointer of previous item points to new item (1)
- New item pointer points to next item in the list (1)

Max [4]

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6 (a) *A production line paint sprayer*

“The robot is a mechanical device”:

The chassis and robotic arm are a mechanical device [1]

“Movable”

The paint sprayer arm must be able to position correctly to spray all parts of the car [1]

“Can sense its surroundings”

Sensors will sense when a car is in position // determine when an obstacle is encountered / edge of the car is reached [1]

“It is a controlled by a computer program”

e.g. The computer program sets the parameters/type of car/paint to be used [1]

(b) **Robotic arm**

Max [4]

To position the spray nozzle to the correct position

Sensor

Capture data

Actuator // Motor

To drive various motors to perform the robot’s movement

Microprocessor

To process the various inputs and execute the control program

Memory

To temporarily store input data // store program

Speaker // bleeper

To provide audio output

Any 2 × 2

7 (a) (i) The program as written by the programmer // the program written with the text editor [1]

(ii) The output from the compiler // the program in machine code / byte code / intermediate code [1]

(b) (i) All the keywords which make up the syntax of the language [1]
A token for each keyword [1]

(ii) DECLARE, CONSTANT, CALL, WHILE (any **three**...) [1]

(iii) A list of all the identifiers used by the programmer. [1]
A pointer to where their value is stored in memory [1]

(iv) Counter, Jobs, Position, ChangeRate, InitialiseGrid (any **three** ...) [1]

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(c) *Lexical analysis ...*

Max [5]

- Remove any whitespace from the source code (1)
- Remove any comment statements (1)
- Check for obvious errors in the use of identifiers, e.g. they do not exceed 64 Characters (1)
- Replace all language keywords with a token (1)
- Add all identifiers to the symbol table (1)
- All identifier names are replaced in the code by a pointer value (1)

(d) (i) Altering the object code so that it runs faster // takes up less memory **[1]**

(ii) The lines that have the expression $x + y$ **[1]**