

2012 HIGHER SCHOOL CERTIFICATE EXAMINATION

Software Design and Development

General Instructions

- Reading time 5 minutes
- Working time 3 hours
- Write using black or blue pen Black pen is preferred
- Draw diagrams using pencil
- Write your Centre Number and Student Number at the top of pages 9, 13, 17, 21, 25, 29 and 33, and either pages 37 and 39, or pages 43 and 47

Total marks - 100

Section I Pages 2–7

20 marks

- Attempt Questions 1–20
- Allow about 35 minutes for this section

Section II Pages 9–36

60 marks

- Attempt Questions 21–30
- Allow about 1 hour and 50 minutes for this section

Section III Pages 37–49

20 marks

- Attempt either Question 31 or Question 32
- Allow about 35 minutes for this section

Section I

20 marks Attempt Questions 1–20 Allow about 35 minutes for this section

Use the multiple-choice answer sheet for Questions 1–20.

What are the values of m and p after the following four statements have been executed?

$$m = 1$$

$$p = 2$$

$$m = p$$

$$p = m$$

	m	p
(A)	1	1
(A)(B)(C)(D)	2	2
(C)	2	1
(D)	1	2

A website is to be developed to allow users to provide feedback about certain issues. For each issue, a response is to be chosen from five levels ranging from *very important* to *very unimportant*.

Which of the following screen elements should be used to capture the responses?

- (A) Text boxes
- (B) Check boxes
- (C) Push buttons
- (D) Dropdown lists
- 3 Which of the following is used in the CPU to store the results of a computation?
 - (A) Accumulator
 - (B) Control unit
 - (C) Program counter
 - (D) ROM

		ch of the following is the most appropriate to represent the physical devices and the of processes within a system?
	(A)	Structure charts
	(B)	System flowcharts
	(C)	Program flowcharts
	(D)	Data flow diagrams
5	One	use of serial numbers on computer software is to combat
	(A)	plagiarism.
	(B)	decompilation.
	(C)	software piracy.
	(D)	reverse engineering.
6		rogrammer needs to show a client the input and output screens of a new program or development.
	Whi	ch of the following should be used?
	(A)	A DFD
	(B)	A prototype
	(C)	An IPO diagram
	(D)	A context diagram
7	Whi	ch of the following is used to document the variables and their types in a program?
	(A)	Index
	()	
	(B)	Compilation
		Compilation Program trace

A developer writes a program that will calculate and output the average of positive integers. The user may enter any number of positive integers. Entry of a negative integer indicates there is no more data.

What does this program require?

- (A) Both a loop and an array
- (B) Neither an array nor a loop
- (C) A loop but not necessarily an array
- (D) An array but not necessarily a loop
- **9** Which sorting algorithm finds the largest element in an unsorted list and places it into its correct position during each pass?
 - (A) Binary
 - (B) Bubble
 - (C) Insertion
 - (D) Selection

Use the following information to answer Questions 10 and 11.

```
BEGIN PrintPeople(People)

FOR i = 1 TO the number of people

PRINT People(i).FirstName + " " + People(i).LastName

NEXT i

END
```

- 10 What type of data structure is used for the People variable?
 - (A) A record
 - (B) A sequential file
 - (C) An array of records
 - (D) A two-dimensional array
- What is the control structure used in the algorithm?
 - (A) Pre-test loop
 - (B) Counted loop
 - (C) Post-test loop
 - (D) Multiway loop

12	Wha	at type of error is an arithmetic overflow?
	(A)	Crash
	(B)	Logic
	(C)	Runtime

13 The following table was generated by a programmer who ran a program multiple times under controlled conditions.

Number of items sorted	Average time taken		
10	0.3 seconds		
100	4.0 seconds		
1000	2 minutes 20 seconds		

What is this an example of?

- (A) Benchmarking
- (B) Compiling

(D) Syntax

- (C) Debugging
- (D) Desk checking
- 14 A large DVD collection is ordered according to the release date.

To find a particular movie title, what is the most efficient search method to use?

- (A) Binary
- (B) Insertion
- (C) Linear
- (D) Selection

15 Consider this algorithm.

```
BEGIN

GET AusDollar

USDollar = AusDollar * 1.05

Print "$", USDollar

END
```

Which of the following is the most suitable data type for the variable USDollar?

- (A) Currency
- (B) Floating point
- (C) Integer
- (D) String
- 16 During which stage of the compilation process does type checking of identifiers occur?
 - (A) Linking
 - (B) Lexical analysis
 - (C) Code generation
 - (D) Syntactical analysis
- 17 Consider the following code which operates upon an array of integers called x.

```
i = 1
j = length of array
WHILE i < j
k = x(i)
x(i) = x(j)
x(j) = k
i = i + 1
j = j - 1
ENDWHILE
```

Which of the following best describes what this code does?

- (A) It reverses the order of the elements in the array.
- (B) It copies the second half of the array to the first half.
- (C) It copies the first half of the array to the second half.
- (D) It swaps the first half of the array and the second half of the array.

- Which of the following is the most effective in managing changes and versions during system development?
 - (A) CASE tools
 - (B) Gantt charts
 - (C) Progress logs
 - (D) Document flowcharts
- 19 Consider the following EBNF definition of a mussum string.

```
\label{eq:mussum} mussum = <digit> \mid < letter> \mid < letter> < mussum> < letter> \mid < digit> < mussum> < digit> < < digit> = 1 \mid 2 \mid 3 < < letter> = m \mid u \mid s
```

Which of the following is a legal mussum string?

- (A) m1
- (B) muum
- (C) mu1sm
- (D) mussum
- 20 What does data validation involve?
 - (A) Checking that data conforms to certain rules
 - (B) Checking that data has been entered correctly
 - (C) Checking that test data covers all possible paths
 - (D) Checking that live test data meets volume testing requirements

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Section II 60 marks Attempt Questions 21–30 Allow about 1 hour and 50 minutes for this section Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response. If you include diagrams in your answer, ensure that they are clearly labelled. Question 21 (3 marks) How do pilot and phased installation methods differ? Use examples to illustrate your answer.
Attempt Questions 21–30 Allow about 1 hour and 50 minutes for this section Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response. If you include diagrams in your answer, ensure that they are clearly labelled. Question 21 (3 marks) How do <i>pilot</i> and <i>phased</i> installation methods differ? Use examples to illustrate your 3
length of response. If you include diagrams in your answer, ensure that they are clearly labelled. Question 21 (3 marks) How do <i>pilot</i> and <i>phased</i> installation methods differ? Use examples to illustrate your
Question 21 (3 marks) How do <i>pilot</i> and <i>phased</i> installation methods differ? Use examples to illustrate your 3
How do <i>pilot</i> and <i>phased</i> installation methods differ? Use examples to illustrate your 3

Question 22 (6 marks)

A company is proposing a website where people can register their many friends. The website will be based around a program in which friends is a global array containing thousands of records about people and their friends.

A record for a person has this structure:

DIM RECORD PersonRec personNo as Integer friend as Integer END RECORD

The value in field personNo uniquely identifies each person. The array is organised so that all the values in personNo are in increasing order.

The following shows some of the data currently in the array:

personNo	friend
333	555
348	111
428	348
555	333

These values indicate that 333 and 555 are friends.

The following proposed subroutine BeFriend updates the array to indicate that two people are friends — the two people with identifiers equal to the values in parameters x and y.

BEGIN BeFriend (x, y)
LinearSearch(x, friends, i)
LinearSearch(y, friends, j)
friends(i).friend = y
friends(j).friend = x
END BeFriend

Question 22 continues on page 11

Question 22 (continued)

(a)	Describe changes that could be made to the subroutine BeFriend to improve its maintainability.	2
(b)	What would be the result of running the subroutine BeFriend with the values $x = 348$ and $y = 555$?	1
(c)	Comment on the correctness and efficiency of this system.	3

End of Question 22

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Question 23 (7 marks)

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Question 23 (7 marks)

A music company is planning to offer a facility for its customers to use on their handheld communication devices such as a tablet computer.

The following features have been proposed:

- a registration process for its users
- a secure login for its registered users
- a search engine that allows any user to find music by providing keywords such as the name of an artist or album
- the ability for the registered user to purchase music by clicking on the item and specifying the quantity
- the ability for the registered user to pay by credit card through an external financial institution
- the ability for a registered user to view their past order history.

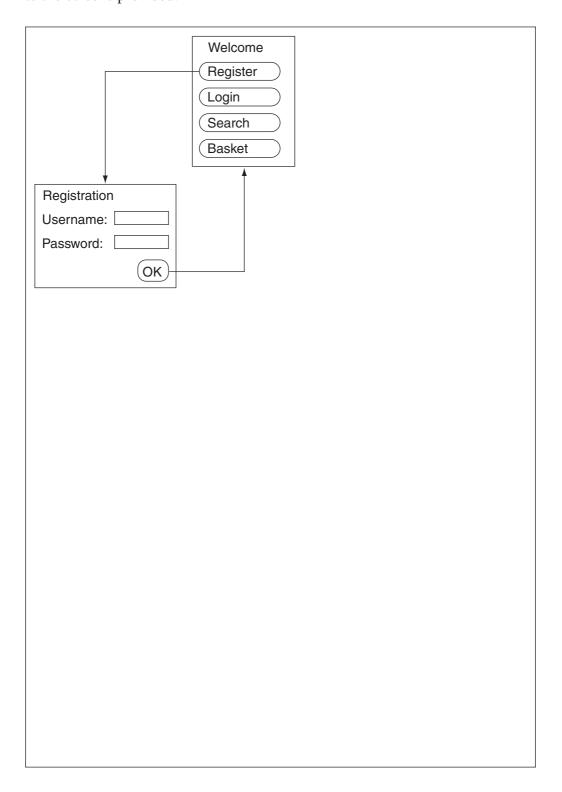
Question 23 continues on page 15

4

Question 23 (continued)

(a) Part of the storyboard for the ordering component of the proposed facility is shown below.

Complete the storyboard, showing relevant features with a level of detail similar to the screens provided.



Question 23 continues on page 16

Ques	stion 25 (continued)
(b)	Draw a data flow diagram to describe ONLY the ordering and payment process

3

End of Question 23

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Question 24 (4 marks)

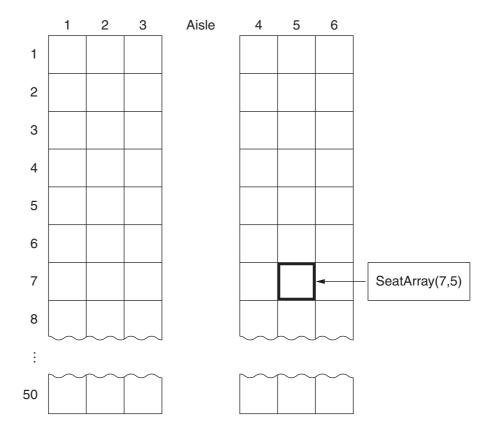
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Question 24 (4 marks)

A software company is developing a computer-based check-in system for an airline. The system includes a module which handles seat allocations for passengers.

The airline only operates one type of aircraft. The cabin of this aircraft has fifty rows with three seats on either side of the aircraft separated by an aisle. In total there are 300 seats in the cabin.



The seating configuration is represented by a two-dimensional array named SeatArray. As an example the seat highlighted in the diagram would be accessed as SeatArray(7,5). Each element of the array contains the unique ticket number of the passenger occupying that seat. A 0 value indicates the seat is vacant (unallocated).

Question 24 continues on page 19

4

Question 24	(continued)						
It is important that the number of passengers on each side of the plane is balanced.							
Develop an algorithm that will count the number of passengers allocated on each side of the plane and return either 'left side too many', 'balanced' or 'right side too many'.							

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Question 25 (7 marks)

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Question 25 (7 marks)

A real estate agency requires a marketing website. The website is to be operated worldwide and is intended for a wide audience using a variety of devices. The following desirable features were identified from a recent customer survey:

- ability to search for properties for sale or rent anywhere any time with fast response
- provision of detailed description and full colour images of the properties
- ability to search by price range, location and the number of bedrooms
- provision of video clips and virtual tours of properties
- ability to enquire about properties or talk to a sales consultant.

The website needs to be developed and released quickly. The management team wants to be able to work with the development team in close collaboration throughout the development, as the specific requirements are difficult to define and the management team want flexibility to make changes and refine the website.

(a)	Identify an appropriate development approach for this website. Justify your choice.	3

Question 25 continues on page 23

Question 25 (continued)

(b)	Identify the functionality requirements, compatibility issues and performance issues for this website.	4

End of Question 25

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Sect	ion II (continued)					
				Stude	ent Nu	mber
Que	stion 26 (9 marks)					
(a)	Describe a situation in which a driver would	be used in s	software to	esting.		2
					••••	
				•••••	••••	
					••••	

Question 26 continues on page 26

Question 26 (continued)

Use the following information to answer parts (b) and (c).

A courier company plans to provide online quotations.

The quotation module in the system will calculate the cost of delivering a package to a particular area. The quotation module uses the data provided on the destination and the weight of the package to determine whether the package is accepted or not, and the cost of delivery.

Quotation (Destination, Weight, Message, Cost)

An extract from a table showing the costs for some situations is shown.

Destination	Package weight	Cost
NSW	<2 kg From 2 kg to 5 kg More than 5 kg	\$1.60 \$4.70 \$8.25
QLD	<2 kg From 2 kg to 10 kg No delivery over 10 kg	\$8.30 \$11.25

A test data file called TestData is to be created during development to test the quotation module. The file contains four fields:

- Destination
- · Weight of parcel
- Expected message indicating acceptance or rejection of the delivery
- Expected cost of the delivery.

b)	Outline the criteria for selecting appropriate test data for the file TestData.

3

4

Question 26 (continued)

:)	D	esign an algorithm that will:
	•	read the data from the file TestData
	•	call the quotation module to determine acceptance and calculate cost if accepted
	•	compare the outputs of the quotation module to the expected outputs from the file TestData
	•	write the data to an error file if the outputs from the quotation module differ from the expected outputs from the file TestData.

Question	27	(6	marks')

Modern technologies enable both software and data to be stored remotely (in the cloud) and accessed locally, for example through a web browser.

(a)	Describe ONE advantage and ONE disadvantage for the user of cloud computing.	3
(b)	Outline technical considerations for developers seeking to maximise their share in the cloud computing market.	3

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Software Design and Development								entre	e Nu	mber
Sect	ion II (continued)						Stı	ıden	t Nin	mber
Que	stion 28 (7 marks)						511	iden	t INU.	
(a)	Consider an array x and a variable length that c in x . The first element of the array is $x(1)$.	onta	ins t	he n	umbe	r of	elen	nents	S	3
	The purpose of the following code is to move all to the right, with the rightmost element being n					-	_	_	2	
	Let temp = $x(length)$ FOR $i = length-1$ TO 1 S x(i + 1) = x(i) NEXT i x(1) = temp	STEP	-1							
	Write code that moves all elements of the array leftmost element being moved to the rightmost			ace t	o the	left	, wit	h the	e	
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3

Question 28 continues on page 30

Question 28 (continued)

- (b) A simple encryption system has the following characteristics:
 - Each message should only contain capital letters and spaces. Other characters are considered invalid.
 - Each letter is encoded by replacing it with the letter two positions along in the alphabet.
 - Spaces are left as spaces.
 - Each invalid character is replaced by a question mark (?).

There are 26 letters in this alphabet.

Original letters	Α	В	С	D	Е	F	G	Н	Ι	J	K	L	М	Ν	0	Р	Q	R	S	Т	U	٧	W	Χ	Υ	Z
Replacement letters	С	D	Е	F	G	Н	I	J	K	L	M	Ν	0	Р	Q	R	S	Т	U	٧	W	Χ	Υ	Ζ	Α	В

Below is an example of an encrypted message.

Original	G	0	Ν	Е	F	I	S	Н	Ι	Ν	G	Υ	Α	Υ	!
Encrypted	Τ	Q	Р	G	Н	K	U	J	K	Р	-	Α	С	Α	?

Each message is stored in an array called MESSAGE. The length of the message is stored in the variable MLENGTH. The letters A to Z are stored in alphabetical order in the array ALPHABET.

Question 28 continues on page 31

4

Question 28 (continued)

End of Question 28

Question 29 (4 marks)

A development team is starting on a project that will take six months to complete. The team members are separated geographically and will provide progress reports via email once every month.

4

Each month after reading the progress reports, the team leader will meet with the client to discuss progress and make changes to specifications. The team leader will then communicate these changes to the development team.

At the end of six months the development team will install the software on the client's system and the user documentation will then be written.

Identify the risks of this development plan and propose changes which could reduce these risks.

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Question 30 (7 marks)

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Please turn over

Question 30 (7 marks)

A system is being developed to track employees as they move around an organisation's building. The software consists of two components.

Component 1

Each employee carries a smart device which stores their employee ID (a unique employee identification code) as a sequence of alphanumeric characters, as shown.



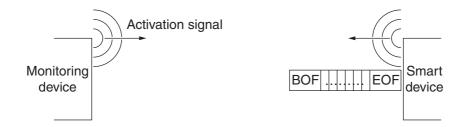
When activated by a signal, the smart device transmits the employee ID one character at a time, beginning with BOF and ending with EOF. This process continues until the activation is turned off (when the device is out of range).

Component 2

Monitoring devices are set up throughout the building and each has its own device ID to identify it.

Each monitoring device has software which continuously transmits an activation signal to any smart device within a range of 10 metres.

The monitoring device checks for a BOF marker, then reads the unique employee ID one character at a time until it reads the EOF marker. This information is formed into a string (IDString) and stored on the monitoring device.



The module which assembles the IDString is listed below.

BEGIN SUBPROGRAM getID(IDString)
READ IDCharacter
WHILE NOT EOF
IDString = IDCharacter + IDString
READ IDCharacter
END WHILE
END SUBPROGRAM

Question 30 continues on page 35

Question 30 (continued)

Th	ne subprogram getID has a logic error.	
Id	entify the error and suggest a correction for it.	
•••		
•••		
•••		
W	rite an algorithm for the main program for the monitoring device which will:	
•	continually scan for a BOF	
•	use the subprogram getID	
•	store the employee ID in an array for later processing.	

Question 30 continues on page 36

Question 30 (continued)

(c)	The system also needs to store the monitoring device ID (a three digit number), the date and the time at which each employee ID was recorded.	2
	It was suggested that a record structure would be most appropriate for recording the data for each individual employee.	
	Justify this choice and describe a suitable record structure.	

End of Question 30

4028 15360 8329310040 2012 HIGHER SCHOOL CERTIFICATE EXAMINATION Software Design and Development Centre Number **Section III** Student Number 20 marks **Attempt either Question 31 or Question 32** Allow about 35 minutes for this section Answer the question in the spaces provided. These spaces provide guidance for the expected length of response. If you include diagrams in your answer, ensure that they are clearly labelled. **Question 31 — Programming Paradigms** (20 marks) Identify TWO limitations of the imperative paradigm, and describe how each is 3 addressed by either the object oriented paradigm or the logic paradigm.

Question 31 continues on page 38

		g is a fragment of code written using the logic planation of some of the syntax.	
player((Sharon)	means that Sharon plays for the netball club	
	(Harley)	, ,	
player(
	(Drayden)	means that Drayden is a coach for the netball club	
	(Min Ji)	•	
	_egends)	means that Legends is the name of a team in the netball club	
•	Rockets)	3	
•	m(Legends, Harley)	means that Harley is with the team called Legends	
in_tear	m(Rockets, Jess)		
in_tear	m(Rockets, Drayden)		
player_	_in_team(X, Y):- playe	r(Y), in_team(X, Y)	
coach_	_of_team(X, Y):- coach	n(Y), in_team(X, Y)	
	fragment of code.	l using either backward OR forward chaining on this	
(ii)		agment to include the following logic:	3
	 Enoch plays for 	the Rockets team and is its Captain.	
	coach_of_player()	X, Y) determines whether X is the coach of player Y.	

A netball club uses a program to keep track of the details of its players, coaches

Question 31 continues on page 39

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Question 31 (continued)

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(c) The following fragment of code from a bank account system is based on the object oriented programming (OOP) paradigm.

```
class ACCOUNT \{
      private -
            balance: integer
      public -
            withdraw(amount: integer)
                  IF balance >= amount THEN
                        balance = balance - amount
                  ELSE
                        Display "withdrawal disallowed: requested amount
                        exceeds balance"
                  END IF
            end withdraw
}
sub-class BlueAccount is a ACCOUNT {
      public -
            minimumAllowedBalance: integer
}
sub-class RedAccount is a ACCOUNT {
      public -
            interestRate: integer
}
```

(i)	Explain why the variable balance is defined in the private section of class ACCOUNT but the method withdraw is in the public section.

2

Question 31 continues on page 41

(ii)	Identify and justify where you would add the following method deposit to the above OOP code so that money may be added to all accounts.	2
	deposit(amount: integer) balance = balance + amount end deposit	
(iii)	A further modification should be made to disallow a withdrawal from a BlueAccount if the new balance would be lower than the value in the variable minimumAllowedBalance. Identify and justify how you would modify the code to achieve this aim. Your justification should contain a reference to polymorphism.	4

(d)	A company has devised a computer game and is now planning how it will design and implement the software for the game.
	The game involves many characters of a few different types, such as people, orcs, elves, trolls, wizards and monsters. Some of these character types share properties and characteristics.
	Individual characters will sometimes fight each other. The winner of a specific fight is determined by a number of factors, including the character types, the energy level of the characters, and the weapons that they possess.
	Some aspects of the game are well suited to the object oriented paradigm and some other aspects are well suited to the logic paradigm.
	Explain how a combination of the two paradigms could be used for designing this game. Include references to the scenario in your answer.

4

End of Question 31

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Section III (continued)								
		•			Stu	ıdent	Nur	nber

Do NOT attempt Question 32 if you have already attempted Question 31.

Question 32 — The Interrelationship between Software and Hardware (20 marks)

(a) The diagram below shows part of an ASCII table.

Hex	Chr	Hex	Chr
41	A	61	a
42	В	62	b
43	С	63	С

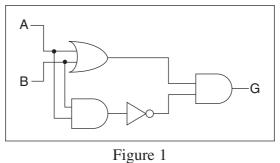
Write down the ASCII code for 'Q' in hexadecimal and use this value to show how to obtain the ASCII code for 'q' in hexadecimal.	3

(b)	A student argues that more numbers can be represented using the 2's complement system than using the sign and modulus system.	3
	Explain your view on this statement. Illustrate your answer using a 4-bit system.	

The notations of Boolean algebra are: (c)

Notation	Meaning
A • B	A AND B
A + B	A OR B
A ⊕ B	A XOR B
Ā	NOT A

In Figure 1, the inputs to the circuit are A and B and the output of the circuit is G.



Question 32 continues on page 45

Draw a simplified circuit to represent the same logic.
Draw a simplified circuit to represent the same logic.
Draw a simplified circuit to represent the same logic.
The circuit in Figure 1 represents two switches A and B and a lightlobe G.
Describe what happens to the light globe G at each stage of the followin sequence of events.
A and B are both off
A is switched on
B is then also switched on
A is then switched off

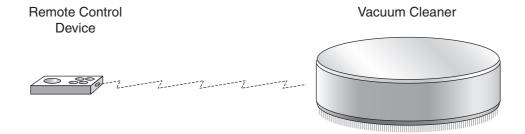
Question 32 continues on page 47

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4031 15360 7909310324 2012 HIGHER SCHOOL CERTIFICATE EXAMINATION Software Design and Development Centre Number **Section III (continued)** Student Number Question 32 (continued) The following diagram shows the single precision floating point representation. Component 3 Component 1 Identify the THREE components above and represent the decimal number 26.125 3 in this notation.

Question 32 continues on page 48

(e) A vacuum cleaner is to be designed so that the user can direct its movement using a remote control device.



Each instruction to the vacuum cleaner from the remote control device is sent in the form of a data stream. Each data stream is made up of:

- a header
- · a data block
- a trailer.

The vacuum cleaner is capable of the following actions:

- Stop
- Forward
- Turn left between 0° and 180°
- Turn right between 0° and 180° .

Question 32 continues on page 49

(i)	State the purpose of the header and of the trailer in each data stream.	2
(ii)	The data block is made up of 10 binary digits and represents an action for the vacuum cleaner.	3
	Design the specification of the data block so that all possible actions of the vacuum cleaner can be represented.	

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