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| **Name:** |  | **Index Number:** |  | **Class:** |  |

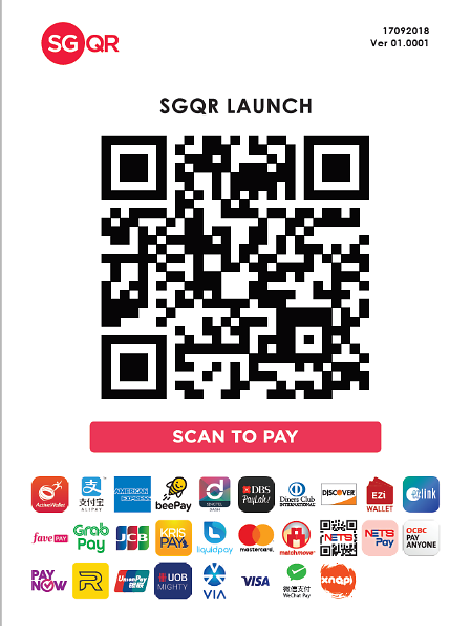
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| DHS logo CMYK | **DUNMAN HIGH SCHOOL**  **Preliminary Examination**  **Year 6** |

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| COMPUTING PAPER 2 | | **9597** |
| Higher 2  100 marks | | **20 September 2018**  **3 hours** |
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| **Instructions: Answer all questions.** |  |
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| This paper consists of **6** questions. | |
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| **[Turn over]** | |

**1.** The Singapore Quick Response Code (SGQR) is a single QR code that combines multiple   
 e-payment solutions into one. It is intended to simplify QR e-payments in Singapore for   
 both consumers and merchants.

Currently, consumers see multiple QR codes at merchant stores promoting various   
 e-payment solutions. This can be confusing for consumers who have to manually find if   
 their preferred e-payment option is accepted. Merchants are also impacted by the   
 aesthetic and logistics constraints of supporting multiple QR codes on their limited display   
 and retail space. With SGQR, consumers will see a single SGQR label that shows all QR   
 payment options that the merchant accepts. For merchants, SGQR will be an   
 infrastructure-light and cheaper way to accept multiple types of e-payments.



Merchants that currently offer QR code payments will have their existing QR codes   
 replaced with a single SGQR label over the next six months. The first phase of SGQR   
 label replacement, starting with merchants in the Central Business District, will be   
 commencing in late September 2018.

**(a)** You have been engaged as a project manager to oversee the implementation of SGQR   
 in Dunman High School (DHS) canteen. Produce a project proposal outlining the key   
 activities to make DHS canteen cashless by March 2019. Your proposal should include   
 the essential elements such as problem statement, project management processes and   
 tools (e.g. PERT chart and Gantt chart), roles of team members, etc. [19]

**(b)** Beyond SGQR and in line with the Smart Nation drive, you have also engaged a systems   
 analyst to come up with an online food ordering application to allow students and staff to   
 avoid long queues and streamline the food preparation process using their mobile   
 devices. The school management also wishes to keep track of the situation to provide   
 feedback to the canteen vendors.

Outline the deliverables in the various phases of the software development life cycle   
 (specification, design, development, documentation, implementation, testing/modification   
 and maintenance). Be sure to adapt your answer to the question context. [12]

**(c)** Networking is critical in such a project/system. Give an example of where each of the   
 following networking concept is applicable in your project/system.

**(i)** synchronous and asynchronous data transmission

**(ii)** simplex, half duplex and full duplex mode of data transmission

**(iii)** packet switching and circuit switching for data transmission

[6]

**(d)** You are also mindful about and is determined to prevent cybersecurity attacks like the   
 recent SingHealth data breach of the personal information of 1.5 million patients. Outline   
 a comprehensive organisational security plan which goes beyond technical controls   
 (user authentication, access levels, antivirus, firewalls) to ensure that both the hardware   
 infrastructure and software applications are well secured against cybersecurity hacks. [8]

**2.** Mergesort uses a divide and conquer approach to successively divide a list into half,   
 forming two sublists, until each sublist is of length 1. The sublists are then sorted and   
 merged into larger sublists until they are recombined into a single sorted list. An algorithm   
 for mergesort is given below.

procedure mergesort(mergelist)

if len(mergelist) > 1 then

mid = len(mergelist) div 2

lefthalf = mergelist[:mid]

righthalf = mergerlist[mid:]

mergesort(lefthalf)

mergesort(righthalf)

i = 0

j = 0

k = 0

while i < len(lefthalf) and i < len(righthalf)

if lefthalf[i] < righthalf[j] then

mergelist[k] = lefthalf[i]

i = i + 1

else

mergelist[k] = righthalf[j]

j = j + 1

endif

k = k + 1

endwhile

while i < len(lefthalf)

mergelist[k] = lefthalf[i]

i = i + 1

k = k + 1

endwhile

while j < len(righthalf)

mergelist[k] = righthalf[j]

j = j + 1

k = k + 1

endwhile

endif

endprocedure

**(a)** The following list of numbers is to be sorted using mergesort:

mergelist = [5, 3, 2, 7, 9, 1, 3, 8]

What are the first two lists to be merged? [2]

**(b)** Draw a graphical representation of how the above list is first split into halves until each   
 sublist contains zero or one items, and then the sublists are merged to become the   
 sorted list. [4]

**(c)** Give and justify the time complexity of mergesort. [2]

**(d)** Compare the space complexities of mergesort and quicksort. [2]

**3(a)** Devise an algorithm to sort a list of words so that the anagrams are grouped together.   
 For example, if the unsorted list is

tar, phone, rat

after sorting we should get

tar, rat, phone

since tar and rat are anagrams, they are grouped together.

[5]

**(b)** Devise an algorithm to find the length of the longest palindrome in a string s. [5]

**4.** A program needs to be written to store and manage product information. The program will  
 have the following functionality:

* able to display a list of products in alphabetical order
* able to support efficient additions and deletions
* able to search for a product efficiently

**(a)** Explain why it is better to use a binary search tree (BST) than an ordered array to store   
 and manage product information. [2]

The initial list of products to be stored are:

battery, cable, detergent, medicine, soap, towel, yoyo

**(b)** Draw the BST

**(i)** from the initial list to support efficient seach, addition and deletion

**(ii)** when new items earphone and eraser have been inserted in that order

**(iii)** when medicine has been deleted

[5]

**(c)** State the postorder traversal output of the updated BST. [1]

**(d)** Outline how the BST can be reorganised after a series of additions and deletions to   
 ensure optimal search performance. [2]

**5.** A digital media company currently sells electronic books and audio books. Each book has   
 a unique id, title, image and price. An electronic book has a default number of pages while   
 an audio book has a duration.

**(a)** Draw a class diagram showing the relationship between the different digital book types.   
 [3]

**(b)** Using appropriate examples, explain the following terms:

**(i)** encapsulation

**(ii)** inheritance

**(iii)** polymorphism

[6]

**(c)** To improve sales, the company decides to

**(i)** offer discounts on selected book items. Discounts on each book may vary from 0 to   
 50%.

**(ii)** sell digital movies. Each movie has a duration as well as a rating with possible values G,   
 PG and PG13.

(iii) offer a monthly subscription service with unlimited access to all digital media.

Explain how these changes will affect your design in **part (a)**. [6]

**6.** The following figure shows the partial contents of an unnormalised relational database   
 table for library book loans by an amateur database administrator.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CallNo | Title | Author | PublisherID | PublisherName | BorrowerID | BorrowerName | Email | LoanDate |
| A2345 | Superhuman | Peter Smith | P0928 | Healthy Global | X894 | Robert Lim | roblim@gmail.com | 20181004 |
| A1133 | Agile Methodology | Sophia Jones | P7823 | CS Books | X894 | Robert Lim | roblim@gmail.com | 20181004 |
| B5104 | Python Advanced | Zen Wang | P8246 | Make It Harder | Y532 | Mary Tan | maryt@yahoo.com | 20181007 |
| A2257 | Computer Science | Berry Mile | P8246 | Make It Harder | X451 | Ben Neo | benn@gmail.com | 20181007 |
| B7513 | Alibaba | Jacky Ma | P3245 | Ali Pub | X451 | Ben Neo | benn@gmail.com | 20181007 |

**(a)** Give **two** potential anomalies that can occur with this design. [2]

**(b)** Give **two** advantages of normalisation. [2]

**(c)** Give the table specification in

**(i)** 1NF

**(ii)** 2NF

**(iii)** 3NF

[6]

**(d)** Draw an E-R diagram to represent your normalised design. [3]

**(e)** The following figure shows the notification email sent to the borrower upon successful   
 loan of library books.

|  |
| --- |
| Oct 4, 2018, 6:52 PM  From: NLB <helpdesk@nlb.gov.sg>  To: roblim@gmail.com  Dear Robert Lim  Thank you for using NLB's e-notification service through email, a free service available to all library members.  This notification service confirms the number of items you have borrowed at the library book borrowing station.  You have borrowed 2 item(s) at 18:52 on 4 Oct 2018 at Serangoon Public Library:  1. Superhuman  Due on: 25 October 2018  2. Agile Methodology  Due on: 25 October 2018  You may also check your updated account status at http://www.nlb.gov.sg |

Describe how the customised contents of the notification email are generated from the   
 database. You may assume that the default loan period is 21 days. [3]

**\*\*\* END OF PAPER \*\*\***