Name:		Index Number:		Class:	

DUNMAN HIGH SCHOOL
Preliminary Examination
Year 6

COMPUTING 9597

(Higher 2)

Paper 2

26 September 2014
3 hours

Additional Materials: -

READ THESE INSTRUCTIONS FIRST

Answer **all** questions.

The Pioneer Generation Joint Committee (PGJC) is a diverse taskforce set up to manage and promote information about the Pioneer Generation Package (PGP) to honour and thank pioneers for their hard work and dedication to make Singapore what it is today. The PGP will benefit about 450,000 Singaporeans.

1. Beyond the conventional means of raising awareness of PGP via mainstream media (newspapers and television broadcast), PGJC also desires to enhance its outreach using the Internet, new media (e.g. social networks) and mobile applications.

(a) Give two advantages of using the latter modes of outreach compared to traditional mass media. [2]

(b) A significant challenge of using non-conventional outreach methods is that while the Internet and mobile devices are becoming increasingly ubiquitous, many user interfaces are often not well suited to the elderly's specific needs.

Design and justify an appropriate user interface for a pioneer to enter information to file for hospitalisation claim on an insurance company's website using a desktop or laptop computer. The information required are: NRIC, hospital name, from and to dates of hospitalisation, invoice number, invoice amount and brief description of reason for hospitalisation. [4]

(c) Give two factors developers would need to consider to adapt the user interface for a mobile device such as a smartphone. [2]

(d) The development of the PGP mobile application will involve the following phases:

Phase	Description	Duration (mandays)	Preceding Phase
A	Adapt contents for smaller form factors	8	-
B	Prepare development environment	2	A
C	Purchase developer license (include approval time)	2	B
D	Develop and test for Android	4	C
E	Develop and test for iOS	3	C
F	Publish to Google Play	1	D
G	Publish to App Store	5	E
H	Promotion and marketing	3	F, G

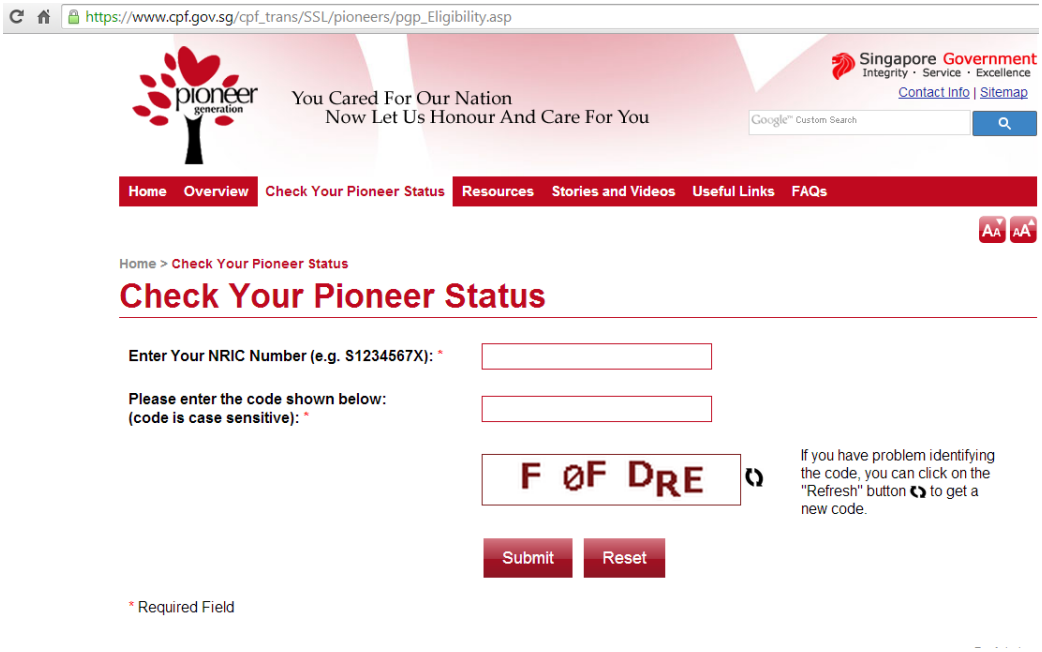
(i) Construct a PERT chart for this project. [3]

(ii) State the critical path and the total time required for the project. [2]

(iii) There is also a need to maintain documentation for the project. Why is documentation important? [2]

(iv) Construct a Gantt chart to include and justify a documentation phase of a reasonable duration. [3]

The following screenshot shows the user interface where a pioneer can verify his/her eligibility.



(e) The code below the NRIC field shows a randomly generated string.

(i) Explain the purpose of this code. [1]

(ii) Outline an algorithm to generate another random string when the refresh button is clicked. [3]

(f) Using examples from the above user interface, explain the following concepts:

(i) validation and verification [4]

(ii) client-side and server-side scripting [4]

(g) Information is transmitted to the server using the https protocol.

(i) Explain the significance of this protocol. [2]

(ii) Describe how information is typically transmitted between a client and a server. [3]

2. The following invoice shows the medical bill incurred by a pioneer in a polyclinic.

HUODAOLAO POLYCLINIC Invoice No: 2324
123 Jian Kang Drive. Singapore 567890. Date: 23-10-2015
Patient NRIC/FIN: S1234567A

Item ID	Description	Unit Price	Quantity	Amount
1923	Aqueous cream	10.50	2	21.00
2145	Panadol	0.60	30	18.00
5588	Folic acid	0.20	60	12.00
			Total Due:	**51.00**

A normalised database solution is to be designed, which has a number of tables.

(a) Derive the normalised process from the unnormalised form (UNF) to the third normal form (3NF). [7]

(b) Draw an ER diagram that shows these tables and the relationships between them. [3]

(c) Using suitable examples, explain the concepts of

(i) primary key [1]

(ii) foreign key [2]

(iii) composite key [2]

3. To enhance the security of online transactions, a one-time randomly generated 5-digit Personal Identification Number (PIN) will be sent to the user's registered mobile phone number as part of the authentication process. The security algorithm, `Secret()`, makes use of the sum of squares of the prime factors of the rightmost 5 digits of the user's mobile number modulo k, where k is a randomly generated prime in the range 100000 – 999999.

As an illustration, consider the mobile phone number 87654321 (n = 54321):

Sum of squares of prime factors of n = $3^2 + 19^2 + 953^2 = 908579$

PIN = 908579 modulo k (let's say k = 102077) = 91963

So a one-time 5-digit PIN 91963 will be sent to the mobile number 87654321.

The algorithm for finding the prime factors of a number n is detailed recursively as follows:

- If n is even, one factor is 2, then find the prime factors of n/2.
- If n is divisible by 3, remove this factor and then find the prime factors of the remainder.
- If n is divisible by 5, remove this factor and then find the prime factors of the remainder.
- If n is divisible by 7, remove this factor and then find the prime factors of the remainder.
- ...

You may assume the availability of a random function `Random()` but should indicate how it is used.

(a) Identify, giving examples, any pitfall(s) with your `Secret()` algorithm, and suggest possible solution(s) to overcome them. [4]

(b) Devise, incorporating your answer to (a), an efficient means of generating a PIN using `Secret()`. Your function should include a recursive algorithm for finding the prime factors of n. State explicitly any necessary assumption(s) made. [6]

4. Leveraging on technology, PGJC intends to connect all pioneers using a social network to help foster a greater sense of community, promote active aging and bridge the digital divide.

(a) What is a social network? Suggest two appropriate applications in this context compared to traditional face-to-face interaction and online communication means such as email and instant messaging. [3]

(b) Give two benefits and one concern of hosting the social network using cloud computing. [3]

(c) Using appropriate examples, explain why the Object-Oriented Programming (OOP) paradigm is well suited to implement the features of a social network. [4]

5. Pioneers who are eligible for the PGP must meet the following conditions:

- still alive
- aged 16 and above in 1965
- obtained citizenship on or before 31 December 1986

Eligible pioneers enjoy the following benefits:

- additional outpatient care subsidies
- Medisave account top-ups
- Medishield Life insurance subsidies and top-ups

A panel will assess appeals for individuals who may have marginally missed out on the PGP on a case-by-case basis.

Citizens aged 55 and above this year who do not qualify for the PGP will receive Medisave account quantum top-ups for five years.

(a) Create a decision table showing all the possible conditions and actions. [3]

(b) Simplify your decision table by removing redundancies. [2]

(c) Draw a program flowchart to determine if an individual is eligible for the PGP and if not, if they qualify for an appeal or will receive five-year quantum top-ups. [4]

(d) Give 3 examples of test cases to test the age criteria for your algorithm in (c). [3]

(e) Given the date of birth in DD/MM/YYYY, write pseudocode to determine if an individual is aged 16 and above in 1965. [3]

6. While English is the official working language in Singapore, beneficiaries of the PGP are elderly and a significant segment of them do not speak or understand English. As a multi-racial society, the pioneer generation also consists of Chinese, Malays and Indians.

(a) What is Unicode and why is it an appropriate representation for PGP information compared to ASCII? [3]

(b) Give two disadvantages of using Unicode in this context. [2]

Mailing information of the pioneers is currently held in a sequential file in NRIC order:

```
<NRIC><Statutory name><Address line><Postal code>
```

Postal code is a 6-digit string representing the geographic location of an address.

To mail the PGP information to the pioneers efficiently, three methods are proposed:

- M1 - Sort the contents of the sequential file using quick sort on the postal code field.
- M2 - Reorganise the contents of the sequential file to a linked list of linked lists in ascending postal code order. Each node of the linked list points to a linked list of addresses with the same postal code.
- M3 - Reorganize the contents of the sequential file to a binary search tree using postal code as the key field. Each node in the binary search tree points to a linked list of addresses with the same postal code.

(c) Why is quick sort appropriate or inappropriate for method M1? [3]

(d) Draw diagrams to represent the scenario in

(i) method M2 using linked list

(ii) method M3 using binary tree

Your diagrams should contain at least 3 nodes for each scenario. [4]

(e) Write an algorithm to insert a new entry to the linked list in method M2, assuming a successful appeal. [4]

(f) Write an algorithm to delete an entry from the binary search tree in method M3, assuming the demise of a pioneer. [4]

END OF PAPER 2