Eton College King's Scholarship Examination 2013

GENERAL I   **(One and a half hours)**

You must answer all three questions.
Each of the three questions is worth the same number of marks.

You need not answer the questions in the order set,
but you must start each one on a separate piece of paper.

Remember to write your candidate number on every sheet of answer paper used.
If you have not finished a question after 30 minutes, you are strongly advised to leave it and go on to another. Return to any unfinished question if you have time left at the end of the paper.

You are permitted fifteen minutes' reading time before starting this paper. It is recommended that you use this time to familiarise yourself with the outline of the questions rather than trying to work out any of the answers in detail. ***You may not write anything during this period.***

<u>**ADDITIONAL MATERIALS**</u>:   **SINGLE SHEET INSERT**

Do not open the paper until instructed to do so.

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Question 1 : *START A NEW SHEET OF PAPER NOW*
THIS QUESTION REFERS TO SOURCES ON THE INSERT

Please look at Source A on the Insert. It is a self-portrait by Rembrandt.

(a)   What do you think Rembrandt is suggesting about himself in his self-portrait?

[5]

Now please look at Source B on the Insert. It is a self-portrait by Pablo Picasso.

(b)   What are the key differences between the approaches of Picasso and Rembrandt in their self-portraits?

[8]

Now please read the following paragraph.

'The purpose of art, surely, is not merely to depict or represent reality – for that can be accomplished very easily with a camera – but to enhance, transcend, or indeed even to distort reality. … What the artist tries to do (either consciously or unconsciously) is to not only capture the essence of something but also to amplify it in order to more powerfully activate the same neural mechanisms that would be activated by the original object.'

V.S. Ramachandran

(c)   Using the two self-portraits as a starting point, what are your views on the extent to which artists should aim to 'depict and represent reality' in their paintings?
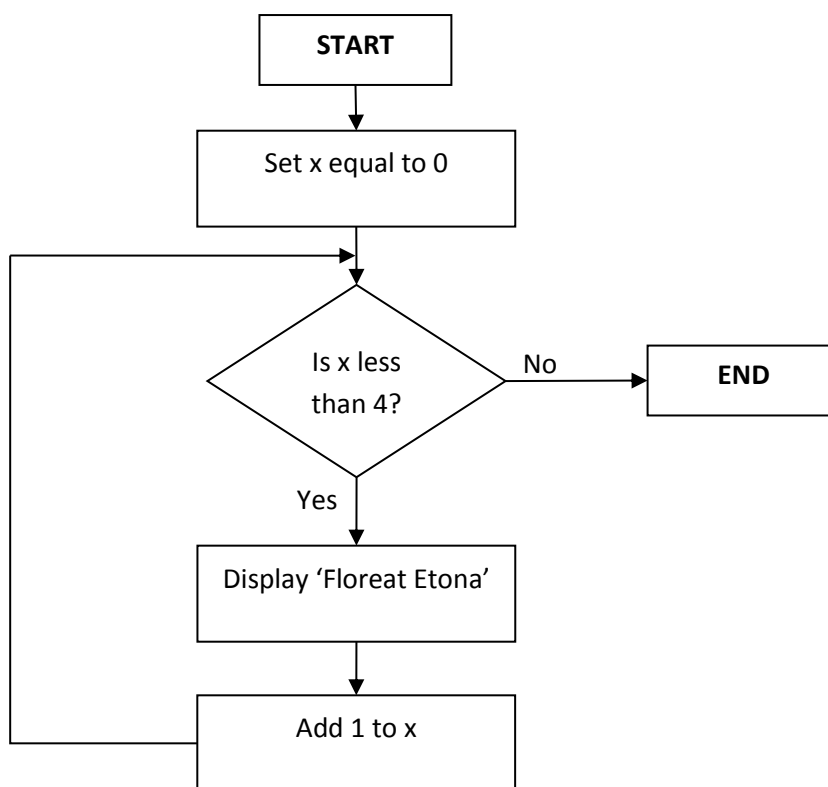
[12]

Question 2 : *START A NEW SHEET OF PAPER NOW*

Computer programs work by executing a set of instructions called an algorithm. Although computers read their instructions in specific programming languages, the algorithms that they use may be represented using flow diagrams.
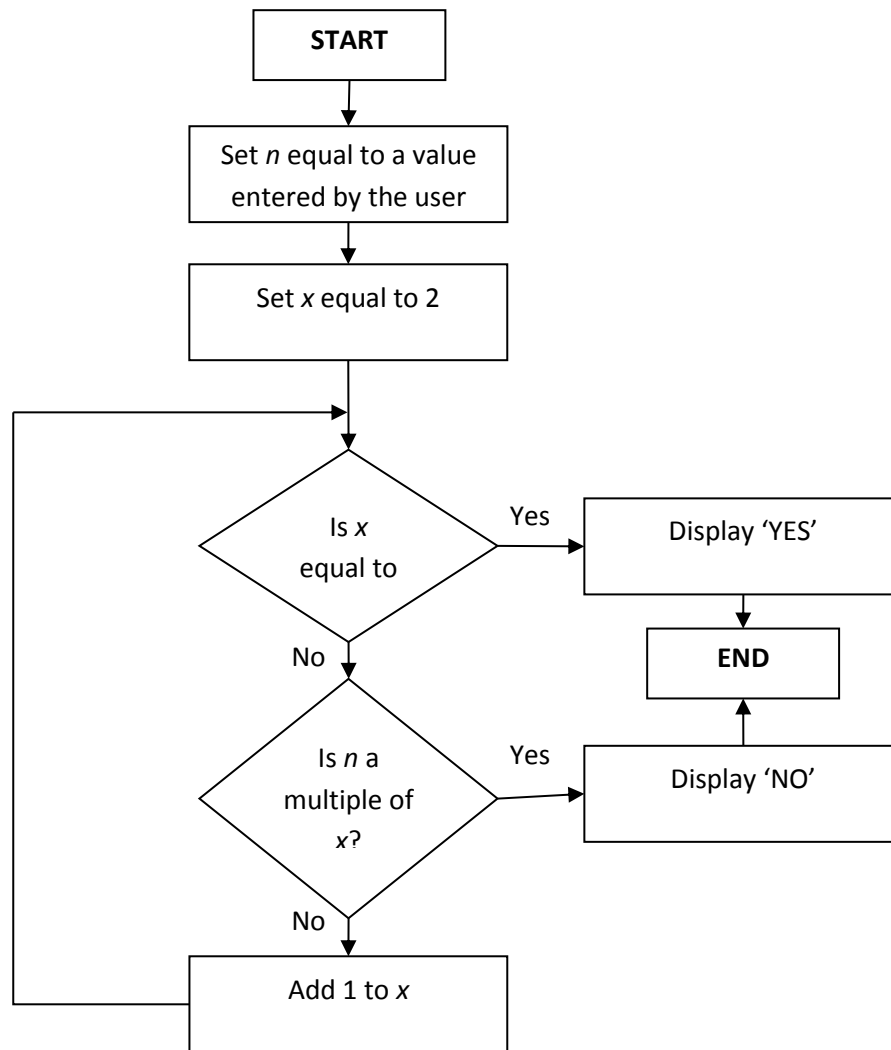
An example of such an algorithm is shown below. It is designed to tell a computer to display a particular phrase ('Floreat Etona') four times. The computer executes the instructions in the rectangular boxes and then moves on to the next stage according to the direction of the arrows. Sometimes the computer is required to make a decision; this is represented by a diamond-shaped box. After making the decision, the computer proceeds according to the outcome of the decision.

Note that every box must have at least one arrow entering it and one arrow leaving it. The only exceptions are the **START** and **END** boxes.

```
                    ┌──────────────┐
                    │    START     │
                    └──────┬───────┘
                           │
                    ┌──────▼───────┐
                    │ Set x equal  │
                    │    to 0      │
                    └──────┬───────┘
                           │
         ┌─────────────────▼─────────────┐
         │              ╱╲                │
         │             ╱  ╲    Is x less   ──No──►  ┌──────────┐
         │             ╲  ╱    than 4?            │   END    │
         │              ╲╱                         └──────────┘
         │              │                │
         │             Yes               │
         │              │                │
         │      ┌───────▼────────┐       │
         │      │ Display        │       │
         │      │ 'Floreat Etona'│       │
         │      └───────┬────────┘       │
         │              │                │
         │      ┌───────▼────────┐       │
         └──────┤   Add 1 to x   │       │
                └────────────────┘       │
```

(a) Study the algorithm below. It is designed to display either YES or NO depending on the value of a number *n* entered by a user. You may assume that the user enters a positive whole number.

(i) Write down the outcomes displayed by the computer when it executes the algorithm for *n* = 2, *n* = 3 and *n* = 4.

[3]

(ii) This algorithm displays YES if *n* possesses a particular mathematical property. What is this property?

[2]

(iii) This algorithm is not very good. It is inefficient and also contains a flaw: if a particular positive whole number is entered as *n* the program will not work properly. What is the flaw, and which value of *n* will trigger it?

[3]

(b) Design a flow diagram that represents an algorithm to display the first *n* even numbers, where *n* is a value entered by the user.

[4]

Algorithms are not restricted to the context of computing.

(c) Animal decision-making can be crudely described with simple algorithms.

Using the three instructions and one decision given in bold below, design a flow diagram for the decision-making algorithm of a gazelle in the African bush. It should be designed such that if no lion is present then the gazelle keeps grazing. However, if a lion is detected, the gazelle will flee until the lion is no longer a threat.

[4]

START   **Flee for 2 minutes**   **Graze for 5 minutes**   **Is there a lion present?**

(d) Many modern cars have 'cruise control', designed for making driving easier at high speeds. When cruise control is switched on at a speed selected by the driver, the driver can take his feet off the pedals and the car's computer keeps the car travelling at the selected speed. The computer continually checks to make sure that the car is going at the correct speed and if not, the computer adjusts the speed accordingly. If the driver presses the brake pedal, then the cruise control is immediately switched off.

(i) Design a flow-diagram for the cruise control algorithm. It should satisfy the following requirements:

- When the cruise control is switched on, the algorithm must immediately check the current speed and end immediately if it is less than 25 mph.
- It should check the current speed at every 2 seconds and adjust the speed either up or down as appropriate.
- It should switch itself off (i.e. END) if the driver presses the brake pedal.

You may use the following instructions in your rectangular boxes in the flow diagrams. You will need to decide for yourself what should be contained in any decision boxes that you use.
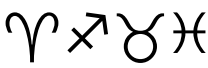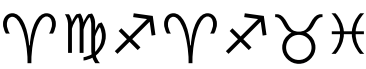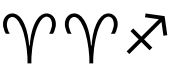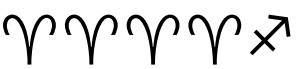
[7]

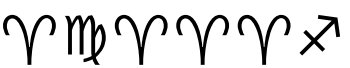**START**   **END**   **Increase speed by 5mph**   **Decrease speed by 5mph**

Set s equal to current speed   **Wait 2 seconds**

(ii) Even a well-written algorithm for a cruise control would lead to an uncomfortable ride for the occupants of the car if it was limited to the instructions in the previous part of the question. Why is this?

[2]

Question 3 : *START A NEW SHEET OF PAPER NOW*

On a trip to the German colony of Wingdingland, Prof. Dr. Dr. Heinrich von Schliemann discovers the six inscriptions below which are in the local language, Linear W. Their translations are also listed below, but you do not know which inscription corresponds to which translation.

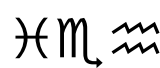|		
1. ♈ ⚴ ♉ ♓		A. to take a bath
2. ♈ ♍ ⚴ ♈ ⚴ ♉ ♓		B. is getting dressed
3. ♈ ♈ ⚴		C. several hats
4. ♈ ♈ ♈ ♈ ⚴		D. garment
5. ♈ ♍ ♈ ♈ ♈ ⚴		E. is putting on a hat
6. ⚇ ♍ ♌ ♊		F. hat

(a) Schliemann was first able to work out which inscription corresponded to meaning A. How did he do so? Give a very brief explanation of your reasoning.

[2]

(b) Match the rest of the inscriptions with their translations. Explain briefly, for Schliemann's benefit, how you have done so, being sure to include details of how you know which inscriptions are verbs and which nouns.

[5]

Sir Michael Ventris unearths seven more Linear W inscriptions in British Equatorial Wingdingia, which are listed below with their translations.

7. ♓ ♒		K. to wear spectacles
8. ♓ ♒ ♓ ♒		L. thief
9. ♓ ♏ ♒		M. several thieves
10. ♓ ♏ ♒ ♓ ♒		N. spectacles
11. ♉ ♑ ♒		O. is stealing
12. ♉ ♍ ♑ ♒		P. to steal
13. ♌ ♏ ♊		Q. to kill by drowning

(c) Match these inscriptions to their translations. Write a brief explanation for Sir Michael, including any refinements to your earlier conclusions about verbs and nouns.

[6]

(d) How are nouns made plural in Linear W? You may wish to refine translation D or N.

[3]

Lord Youlbury stumbles across five more inscriptions on tablets acquired by his grandfather and now languishing in the basement of the British Museum. This time they form simple sentences with sensible meanings.

14. ♓♒ · ♋♍♌♋♌♊

15. ♓♒ · ♌♍♊♌♊

16. ♓♒♋ · ♓♏♒♓♒ · ♈♈♐

17. ♓♒♓♒♋ · ♓♏♒♓♒ · ♉♑♒

18. ♓♒♓♒♋ · ♈♏♈♈♈♐ · ♌♊

(e)   Suggest translations for the inscriptions above using the understanding you have gained of Linear W.

Lord Youlbury is particularly interested in grammatical peculiarities.
Briefly explain to him any aspects of the grammar of Linear W which seem peculiar.

[9]