Eton College King's Scholarship Examination 2016

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> *DOUBLE-SIDED A4 SHEET INSERT*

Do not turn over until told to do so.

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Question 1 : *START A NEW SHEET OF PAPER NOW*

THIS QUESTION REFERS TO SOURCES ON THE INSERT

Source 1: M. C. Escher, ***Reptiles*** (1943)
Source 2: M. C. Escher, ***Relativity*** (1953)

(a)   Look carefully at Source 1 on the insert. Suggest an alternative title for this picture, explaining the reasons for your choice.

[3]

(b)   The image in Source 1 appears to be telling a kind of story. Choose the part of the picture where you think the story could end, and explain the reasons for your choice.

[4]

(c)   Compare Source 2 on the insert with Source 1. Which of these two images do you find the more thought-provoking, and why? Explain your ideas as fully as you can.

[6]

(d)   During the course of the last century a number of artists displayed everyday objects in art galleries: examples of such exhibits include a urinal (1917), a rectangular pile of 120 bricks (1976), and an untidy bed (1999). The public often greeted these exhibitions with outraged disbelief.

Discuss why the artists might have decided to exhibit such objects publicly as works of art and possible reasons for the public's reaction. Explain your reasoning in detail.

[12]

[Total Marks for Question 1 : 25]

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

In an underground vault of Eton College, a chest is found belonging to a former Head Master. In the chest are extracts from a unique language that he created, called 'Babbubabbu'. It is understood that this language's word order is much freer than English. Why the Head Master was writing about such things is still unknown…

1.	mildim ker bold	*a boy eats a jelly bean*
2.	gondezdem sep mild	*a duck pecks the boy*
3.	bozdom josh-o o-mildvumild	*the monster confuses the boys*
4.	mildvumildim bozd o-torok	*the boys will kick the monster*
5.	doktom bozd e-sep	*the chicken will peck the monster*
6.	gondezdvugondezdem joshok-o o-dokt	*the ducks confuse the chicken*
7.	pip bold kerek gondezdem vu ashkoldom	*the duck and a policeman eat a big jelly bean*
8.	ashkoldom ker-e e-mild bold	*the policeman makes the boy eat a jelly bean*
9.	bozdvubozd mildim sep-e e-dokt	*the boy makes the chicken peck the monsters*
10.	gondezdvugondezdem pipik fitbold	*the ducks are bigger than the jelly bean*
11.	doktom e-sep pip fitgondezd	*the chicken will peck more than the duck*
12.	ashkoldvuashkoldom e-kerek shnoz-po-shnoz	*the policemen will each eat a berry*
13.	shnozvushnozom pippipik	*the berries are the biggest*
14.	sakvusakam pop e-kerek bold-po-bold	*the small hamsters will each eat a jelly bean*

[Question 2 continued]

(a)   What do the following mean in English?

      (i)   ker

      (ii)   bozd

      (iii)   vu

      (iv)   pip

      (v)   -po-

                                          [5]

(b)   How is the future tense formed in Babbubabbu?

                                          [2]

(c)   Describe what happens if the subject of the sentence is plural.

                                          [3]

(d)   How do you say the following in Babbubabbu?

      (i)   The duck pecks the policeman.

      (ii)   The jelly bean is the biggest.

      (iii)   The hamster will eat a jellybean.

      (iv)   The berry is the smallest.

      (v)   The jellybeans will make the boy smaller.

      (vi)   The monster and the policeman confuse the boy more than the big duck.

                                          [15]

[Total Marks for Question 2 : 25]

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

Before particle accelerators were developed it was thought that all matter was made up of protons, neutrons and electrons. Subsequent experiments confirmed that electrons were fundamental particles (particles that cannot be split into smaller particles); however, this was not the case for the proton and neutron.

It is now thought that protons and neutrons are composed of two types of quark, the up, u, and down, d, quark. The u quark has a charge of $+\frac{2}{3}q$ and the d quark has a charge of $-\frac{1}{3}q$. Protons and neutrons are both made from three quarks.

(a)   If a proton has a charge of $+1q$, what three quarks is a proton made from? Explain your reasoning.

[2]

(b)   If a neutron has a charge of $0q$, what three quarks is a neutron made from? Explain your reasoning.

[2]

Each quark has a related particle called an anti-quark. These have an equal mass, but opposite charge. For example, an anti-up, $\bar{u}$, has a charge of $-\frac{2}{3}q$, and anti-down, $\bar{d}$, has a charge of $+\frac{1}{3}q$.

(c)   A particle like the proton and neutron exists, but it has a charge of $-1q$. What three anti-quarks will make this particle? Explain your reasoning and suggest a name for the particle.

[3]

(d)   Quarks also come in pairs, but the combination must always have an integer charge (whole number of charge, for example $-2q$, $-1q$, $0q$, $+1q$ and $+2q$). Write down the combinations of quarks and anti-quarks that give an integer charge.

[2]

[Question 3 continued]

With the ever-increasing energies in particle accelerators, it is quite likely that new particles will be created. Imagine a new category of particle is discovered called an eton. Etons come in two forms called a beak, b, and an oppidan, o. Like quarks, they are never found alone, but the properties of combinations of them can be measured. Each particle also has its own anti-particle with the same mass, but opposite charge.

The following is observed:

- Two beaks and three oppidans have no overall charge
- Five beaks and five oppidans have a charge of $+1q$
- The mass of five beaks is equal to the mass of fifteen oppidans
- The mass of five oppidans is $5m$

Use this information to answer the following questions:

(e)   Find the mass of an oppidan and find the mass of a beak.

[3]

(f)   Find the charge of an oppidan and find the charge of a beak.

[6]

(g)   Show that a particle containing three beaks and two oppidans can have a charge of $+1q$ and a mass of $11m$.

[2]

(h)   What combination of five etons and anti-etons makes a particle with a charge of $-1q$ and a mass of $11m$?

[2]

(i)   What combination of four etons and anti-etons makes a particle with a charge of $-2q$ and a mass of $8m$?

[3]

[Total Marks for Question 3 : 25]

[End of Paper]

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