

**Eton College King's Scholarship Examination 2009**

SCIENCE (SECTION 2 - DATA ANALYSIS)

(30 minutes)

*Candidate Number:* \_\_\_\_\_

*Write your candidate number, not your name, in the space provided above.*

*This paper describes some data collected from experiments and a survey.*

*Read the information and answer the questions only in the spaces provided.*

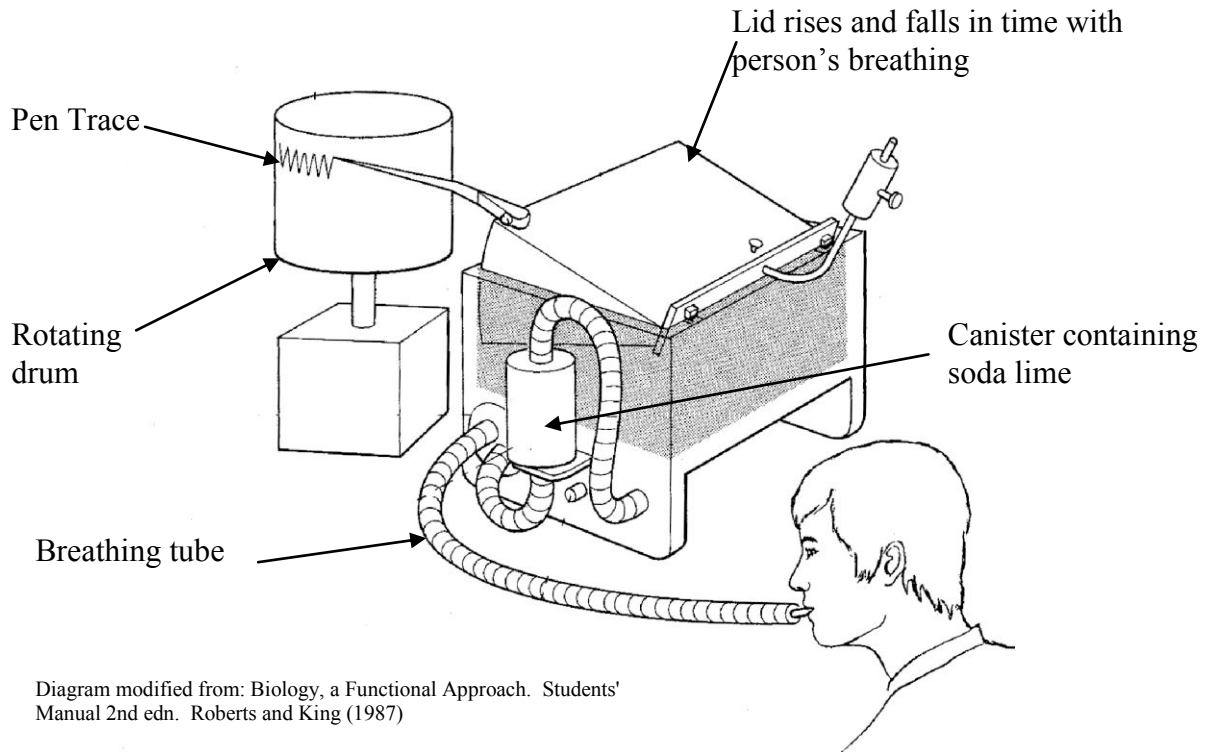
*In questions involving calculations, all your working must be shown.*

*The graphs should be plotted on the graph paper provided.*

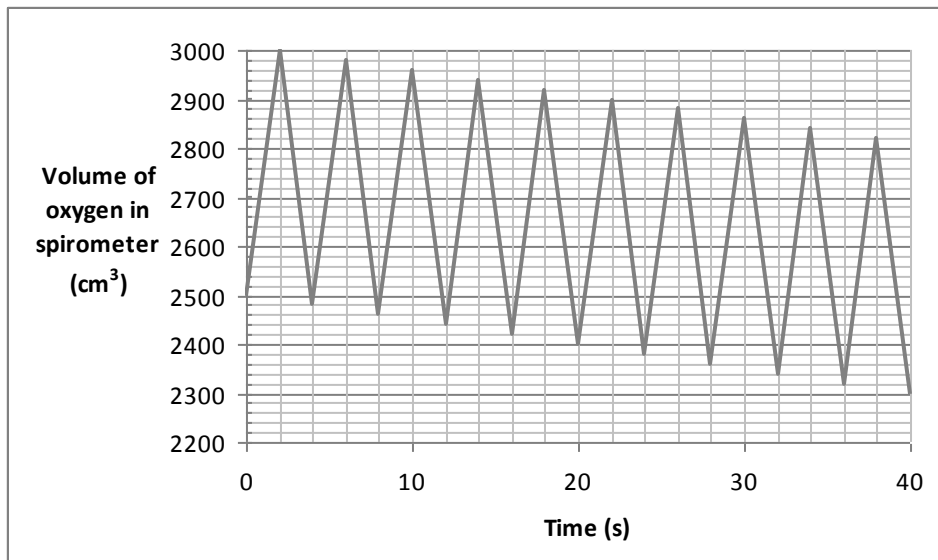
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Total [40]	
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- The diagram below shows a spirometer, which is a machine used to measure the volume of air breathed in and out. Wearing a nose-clip, a person is connected to the machine via a breathing tube and, as he breathes in and out through his mouth, the lid on the machine falls and rises in time with his breathing. All the gas that is breathed in and out passes through a canister of soda lime. Soda lime absorbs carbon dioxide. Changes in the volume of gas under the chamber are recorded on a rotating drum which is set to rotate at a constant speed.



The graph below shows the trace from the spirometer over a period of 40 seconds.



a) When the subject breathes out, what happens to the pen trace?

\_\_\_\_\_ [1]

b) What volume of air is inhaled by the subject in one breath?

\_\_\_\_\_ [1]

c) Calculate the breathing rate in breaths per minute. Show your working.

\_\_\_\_\_  
\_\_\_\_\_ [2]

d) Calculate the oxygen consumption per second. Show your working.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [2]

e) Explain why the trace moves steadily downwards over time.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [3]

f) Describe three ways in which the pen trace would differ if the subject were exercising vigorously.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [3]

A scientist wanted to investigate the effect of smoking on breathing rates during exercise. To do this he recorded the breathing rates of individuals while they were jogging at a set speed on a treadmill (a running machine). He decided to use three groups of people in his study:

- People who have never smoked
- Ex-smokers
- Smokers

The results of his investigation are shown in the table below:

Table 1

Group	Mean breathing rate (breaths/minute)
Never smoked	35
Ex-smokers	38
Smokers	51

(g) Use the graph paper provided to display these data in an appropriate graphical format. [4]

(h) Each of the three groups used in this study consisted of 10 individuals. State three variables which the scientist would need to have kept the same between the three groups in order to make this investigation fair. In each case, explain your reasoning.

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[6]

(i) Using your knowledge of the effect of smoking on the body, suggest and explain possible reasons for the results of this investigation.

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[3]

In the UK, tobacco companies must by law print a number of health warnings on cigarette packets. One such message is “**Smoking when pregnant harms your baby**”. In the USA a similar warning which appears on some tobacco products states: “**Smoking by pregnant women may result in fetal damage, premature birth, or low birth weight**”.

Low birth weight is defined by the World Health Organization as a birth weight less than 2.5 kg. Of course, many factors affect the birth weight of babies.

- (j) Complete Table 2 by listing three different factors **apart from smoking** which you think would affect the birth weight of babies and for each one explain why it has such an effect. [3]

Table 2

Factor affecting birth weight	Reason why factor affects birth weight

- (k) The table below shows the percentage of low birth weight babies born in Canada in relation to the total household income and whether the mother smoked or not.

Table 3

Babies born to families in which	% of babies born with low birth weight
Household earned less than \$60,000	6.4
Household earned more than \$60,000	4.2
Mother smoked	7.8
Mother did not smoke	5.2

- (l) What conclusions, if any, can you draw from the data in table 3?

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[2]

(m) Table 4 shows data gathered from ten mothers who gave birth to low birth weight babies, in relation to the amount smoked by the mother during pregnancy. All the babies were born in an industrial town in England.

- (i) Plot the data below on the graph paper provided. Make sure you label the axes fully. Draw a single line of best fit through the points to show the apparent trend. [5]

Table 4

Amount smoked by mother (cigarettes per day)	Baby's birth weight (kg)
1	2.48
3	2.38
4	2.46
5	2.38
7	2.27
7	2.40
9	2.30
10	2.24
13	2.19
15	2.14

- (ii) Use your graph to predict the birth weight of a baby born to a woman who does not smoke. Mark this on the graph and write in the weight on the y axis. [1]

- (iii) How valid is it to use these data to predict the birth weight of a baby whose mother does not smoke? Explain your answer.

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[2]

- (iv) Does the data allow you to conclude that low birth weight is caused by smoking cigarettes? Explain your answer.

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[2]