Eton College King's Scholarship Examination 2013

SCIENCE (SECTION 1) **(60 minutes)**

Candidate Number:_____

INSTRUCTIONS

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

You should attempt ALL the questions. Write your answers in the spaces provided: continue on a separate sheet of paper if you need more space to complete your answer to any question.

Allow yourself about 12 minutes for each question.

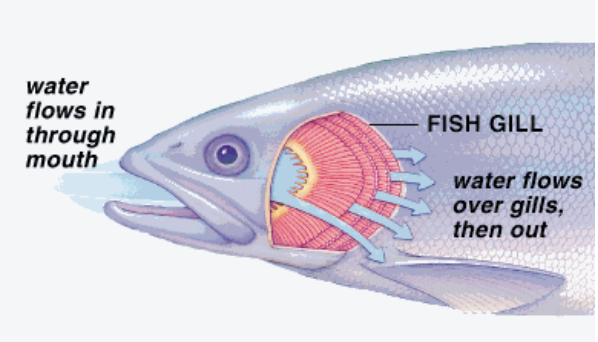
The maximum mark for each question or part of a question is shown in square brackets.

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

For examiners' use only.

1	2	3	4	5	TOTAL

1. Fish possess gills, feathery structures that they use to obtain oxygen from the water in which they swim. Water enters through the mouth and passes over the gills, before emerging through openings on the sides of the head.



a) As well as taking in oxygen through the gills, fish also get rid of carbon dioxide through them. What name is given to this pair of processes? [1]

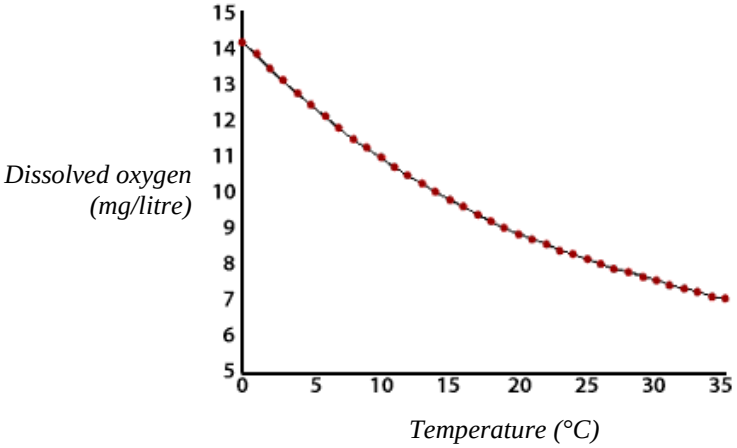
b) For what process do fish use oxygen? [1]

c) Suggest how oxygen that enters the gills is distributed to the rest of a fish's body. [1]

d) The gills of active, predatory fish (such as tuna) are larger and more developed than the gills of slow-moving, relatively inactive fish (such as plaice). Suggest and explain a reason for this difference. [3]

[Turn over]

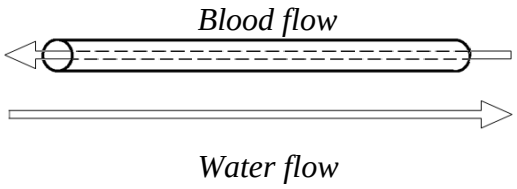
e) The graph below shows how oxygen solubility varies with temperature:



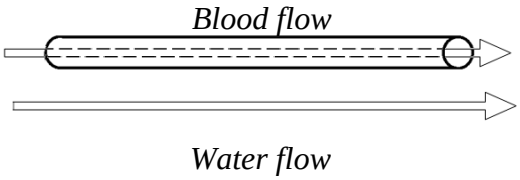
Some fish live in warm, shallow, muddy pools of water. Suggest the problems such fish might face compared to fish living in colder, open water, and how they might be adapted to cope with these problems. [3]

f) Microscopic analysis of fish gills has shown that in all species of fish studied, the blood that passes through the gills flows in the opposite direction to the water that flows over them (see A below). Explain why this arrangement might be advantageous compared to a system in which blood and water flow in the same direction (see B below). [3]

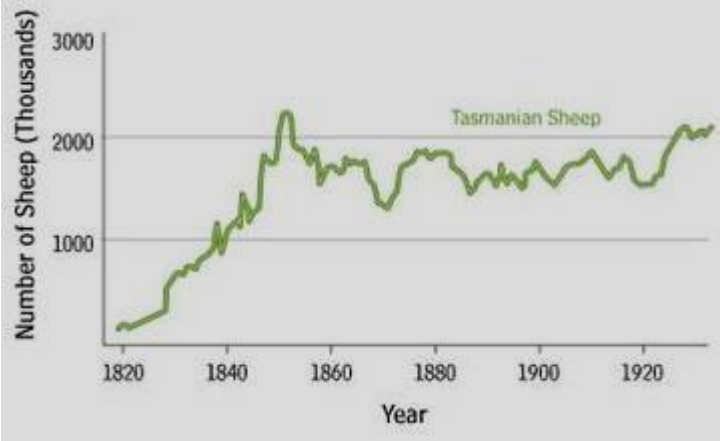
A: Found in fish gills



B: Never found in fish gills



2. Tasmania is a large island off the south east coast of Australia. Sheep were introduced to Tasmania in 1814 and the graph below shows what happened to the population of sheep between 1820 and 1938.



Sheep population on Tasmania. (Data from Davidson 1938.)

a) Discuss the biological factors that might affect the population size of sheep on an island, and use this information to explain possible reasons for the changes observed on Tasmania between 1820 and 1938. [8]

b) Average temperatures in Tasmania have risen by almost 1ºC since 1938. Giving reasons, describe what you think will have happened to the population size of Tasmanian sheep as a result. [4]

[Turn over]

3. A car travels from Eton to Harrow, which are 30 km apart. The driver maintains an average speed of 80 km/hr.

a) Convert 80 km/hr into m/s. [2]

_____

b) How long does the journey take? Give your answer in hours. [2]

_____

The same driver takes 50 minutes to make the return journey from Harrow to Eton.

c) What was the driver's average speed on the return journey? Give your answer in km/hr. [2]

_____

_____

d) What is his average speed for the whole journey (there and back)? Give your answer in km/hr. [2]

_____

_____

'Average speed areas' are now found on many motorways. One such stretch of motorway has a speed limit of 80 km/hr. The average speed is monitored between two cameras placed 10 km apart. The driver of a car notes that he has travelled 6.0 km from the first camera at a speed of 100 km/hr.

e) Calculate the speed with which he has to travel the remaining 4.0 km in order that his average speed for the whole 10 km is 80 km/hr. Give your answer in km/hr. [4]

_____

_____

_____

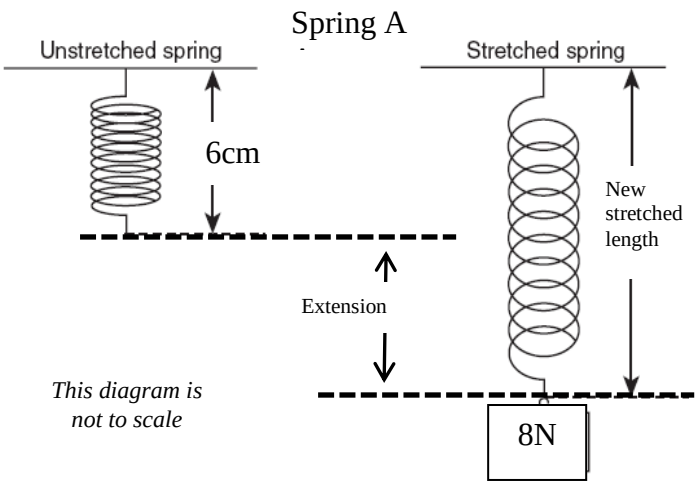
_____

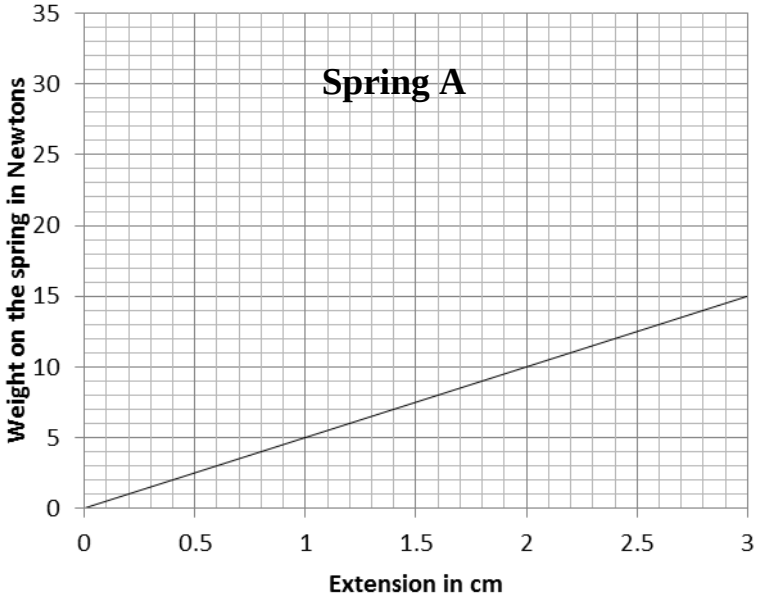
[Turn over]

4. A student needs a weight of 8N for his experiment.

a) If the strength of the earth's gravitational field is 10N/kg, what size mass should he choose? Show your working clearly and include a unit with your answer. [2]

An unstretched spring (A) has a length of 6cm. When the weight of 8N is hung onto the spring it stretches.



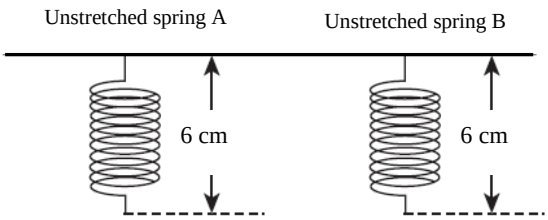


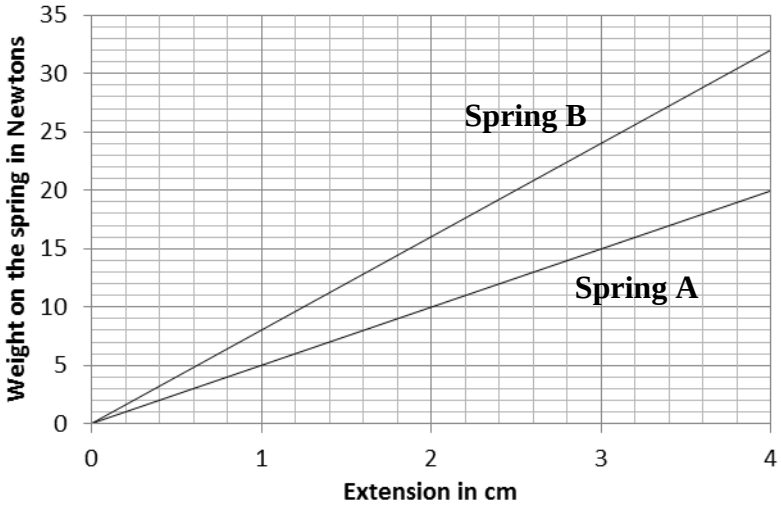
b) Use the graph to work out the spring's new stretched length. [1]

c) The student now wishes to obtain a stretched length of 7cm. What size weight should he hang on the unstretched spring? [1]

[Turn over]

d) The student is now given a second spring B.





The student has a set of weights that total 26N. He hangs some of the weights on spring A and the rest of the weights on spring B. How should he divide the 26N between the two springs so that both springs are stretched to the same length? [3]

Weight on spring A_____

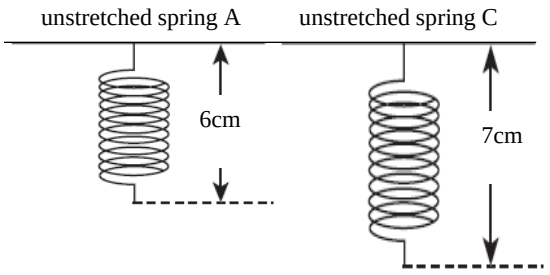
Weight on spring B_____

How long will each spring be?_____

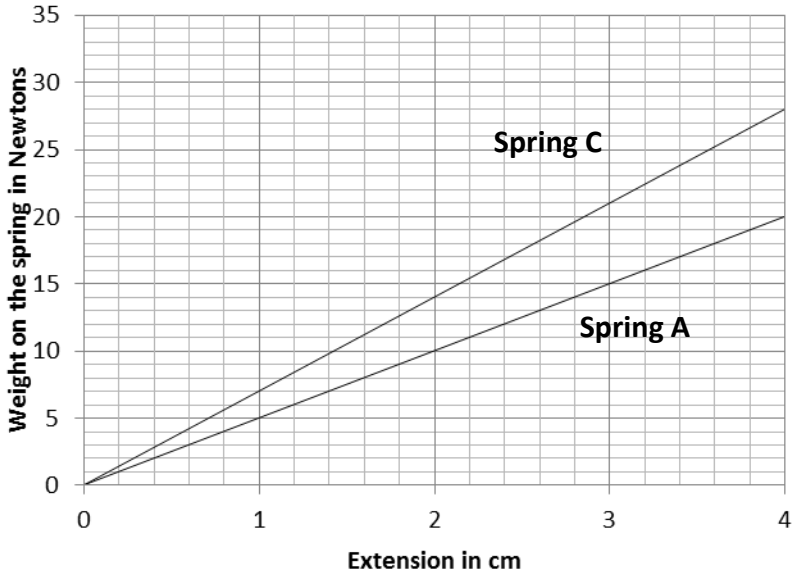
You may use the space below for working, but put your final answers in the spaces above.

[Turn over]

e) The student then replaces spring B with another spring C. Spring C is 7cm long when it is unstretched.



This diagram is not to scale



The student now uses a set of weights that total 29N. He hangs some of the weights on spring A and the rest of the weights on spring C. How should he divide the 29N between the two springs so that both springs are stretched to the same length? [5]

Weight on spring A_____

Weight on spring C_____

How long will each spring be?_____

You may use the space below for working, but put your final answers in the spaces above.

[Turn over]

5. The test for hydrogen gas is to use a lit splint and listen for a squeaky pop. In that test hydrogen is reacting with oxygen.

a) What is the product of this reaction? [1]

_____

b) Why do you not see this product? [2]

_____

_____

_____

A student half-filled a beaker of water from the tap and then heated it to 50 °C.
He noted that bubbles appeared on the inside of the beaker.

c) What did these bubbles contain and why do you think they appeared as the water got warmer? [2]

_____

_____

_____

d) He continued to heat the water from 50 °C to 100 ºC. How would you expect the rate of bubbles appearing to change over this temperature range? Explain your answer. [2]

_____

_____

_____

e) Water boils at 100 °C. What do the bubbles formed at 100ºC contain? [1]

_____

[Turn over]

The student then took some tap water and completely filled a bottle into which some iron wool had previously been pushed. He put a lid on and left it for a week.

f) What would you expect to see after this time? [1]

_____

g) If he then repeated the experiment in part (f) but used water that had first been heated to 50ºC, what changes, if any, would you expect to observe? Explain your answer. [2]

_____

_____

_____

h) Why would it be inadvisable to repeat the experiment described in part (f) using sodium instead of iron wool? [1]

_____

_____

[END OF PAPER]