

Surname	Centre Number	Candidate Number
Other Names		0



**New GCSE**

4791/02

**ADDITIONAL APPLIED SCIENCE**  
**UNIT 1: Science at Work in Applied Contexts**  
**HIGHER TIER**

A.M. TUESDAY, 22 January 2013

1 hour

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	6	
2.	12	
3.	10	
4.	10	
5.	6	
6.	6	
7.	10	
<b>Total</b>	<b>60</b>	

**ADDITIONAL MATERIALS**

In addition to this paper you may require a calculator and a ruler.

**INSTRUCTIONS TO CANDIDATES**

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

**INFORMATION FOR CANDIDATES**

The number of marks is given in brackets at the end of each question or part-question.

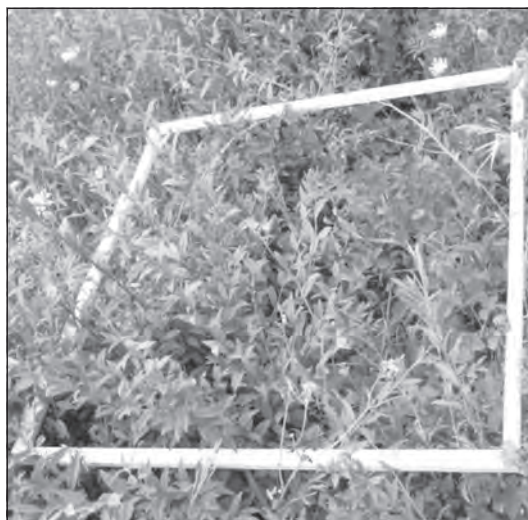
You are reminded that assessment will take into account the quality of written communication used in your answer to question 3(c) and 5.

You are reminded to show all your working. Credit is given for correct working even when the final answer given is incorrect.

Answer **all** the questions in the spaces provided.

1. The Wildlife Trust manages a number of reserves where they maintain natural habitats. A farm shares a boundary with a Wildlife Trust reserve. The plants are monitored to avoid the spread of species across the boundary (invasive species). Rapeseed is grown by the farmer as a crop. Teasel is a plant that grows in the Wildlife Trust reserve.

A quadrat can be used to sample the number of plants.



*Quadrat used in a field study*

Sample **A** is from the boundary on land of the Wildlife Trust reserve.

Sample **B** is taken 10 metres from the boundary on the farmland.

The quadrat is thrown once near the boundary and once 10 metres from the boundary to obtain the results below.

	Number of teasel plants	Number of rapeseed plants
Sample <b>A</b>	5	6
Sample <b>B</b>	1	14

(i) Suggest **one** reason for the difference in results for the two samples. [1]

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(ii) State **how** the sampling could be improved to give more reliable data on the number of plants. [2]

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(iii) Explain why the farmer needs to monitor the teasel plants. [3]

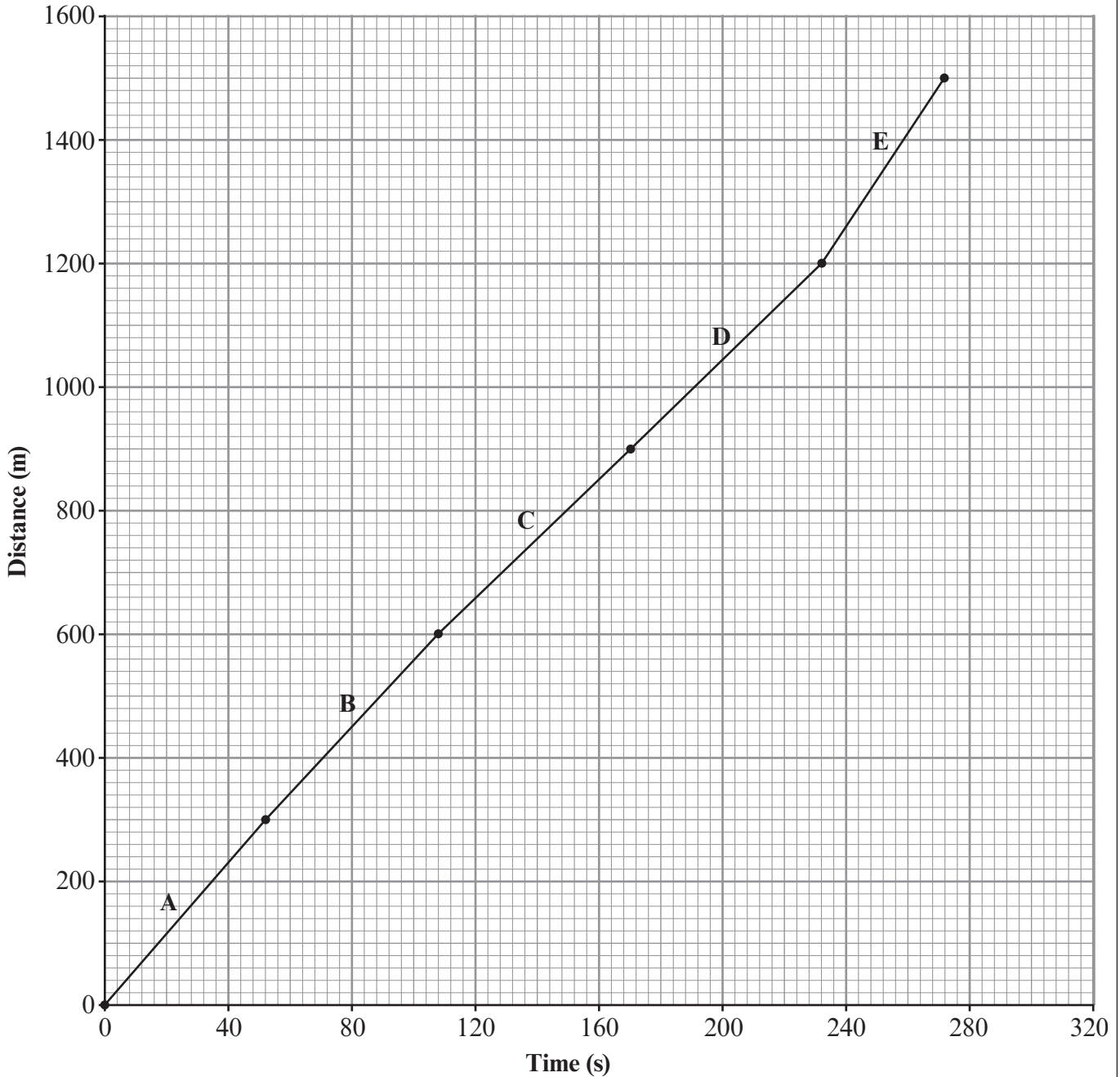
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2. Gareth and Kevin entered a 1500 m race. Their performance during the race was measured. The time they take to complete each 300 m stage of the race was measured.

A distance–time graph is plotted below for Kevin.



- (a) (i) In which section of the race (A, B, C, D or E) did Kevin run the fastest? [1]

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- (ii) Give **one** reason for your answer. [1]

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(b) Gareth's performance in the same race is recorded in the table below.

Time (seconds)	Distance (metres)
0	0
60	300
120	600
180	900
240	1200
320	1500

(i) On the same graph, **plot** the performance of Gareth using the values shown in the table above. [3]

(ii) Calculate the mean speed for **Gareth** during the first **900 m** using the equation: [2]

$$\text{Mean speed} = \frac{\text{distance}}{\text{time}}$$

Answer ..... m/s

(c) Use the data to explain how the fitness of Gareth compares with Kevin. [2]

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(d) (i) At the start of the race the runners were respiring aerobically. The equation below represents aerobic respiration. Balance the equation:



(ii) At the end of the race a runner has aching muscles due to oxygen debt. State what is meant by the term *oxygen debt*. [1]

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3. Clothing worn by cyclists is made from a number of modern materials that include Lycra<sup>®</sup>, Gor-Tex<sup>®</sup> and Thinsulate<sup>®</sup>.

(a) Gor-Tex<sup>®</sup> is a material often used for the jackets worn by cyclists in the rain. Gor-Tex<sup>®</sup> is described as a 'breathable' material. What is meant by the term '*breathable*'? [2]

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(b) The shell of a cycle helmet is made from a polymer. Describe the structure of a polymer. *You may include a labelled diagram to aid your description.* [2]

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(c) Lycra<sup>®</sup> is used to make cyclist’s shorts. Thinsulate<sup>®</sup> is used as the filling in their jackets. Explain why the structure and properties of Lycra<sup>®</sup> and Thinsulate<sup>®</sup> make them suitable for these uses. [6] *QWC*

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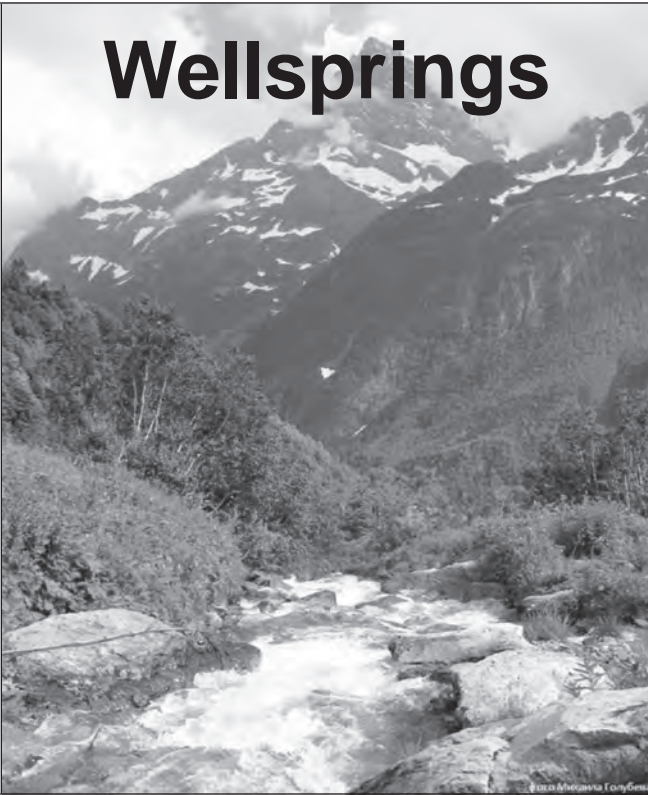
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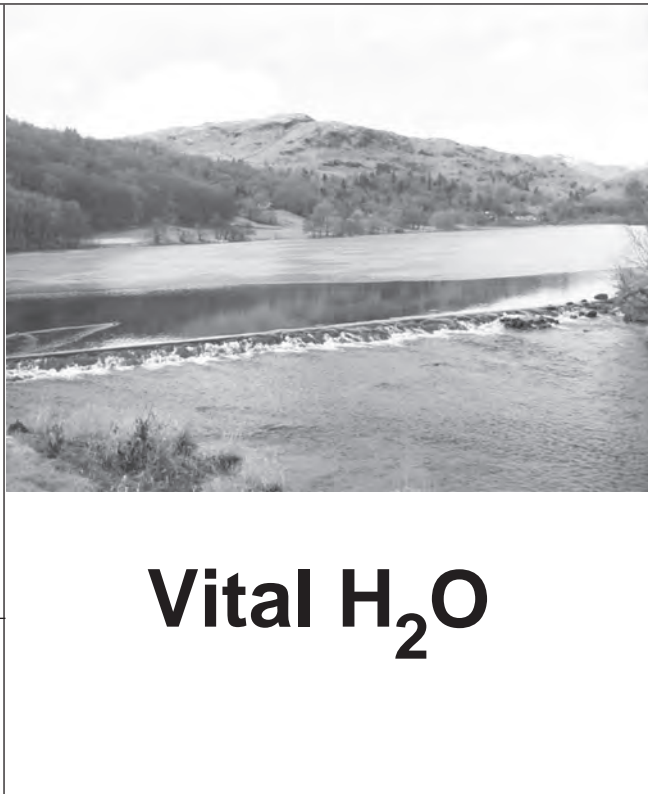
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4. “Wellsprings” and “Vital H<sub>2</sub>O” are companies producing bottled water. The data from the labels on their bottles is shown below.

	mg/cm <sup>3</sup>	
Calcium	1.0	
Magnesium	0.2	
Sodium	0.8	
Potassium	0.1	
Bicarbonate	2.4	
Chloride	1.2	
Sulfate	1.0	
Nitrate	1.1	
Total dry residue at 180°C	7.9 mg	
pH at source	6.1	

	mg/cm <sup>3</sup>	
Calcium	0.9	
Magnesium	1.1	
Sodium	0.1	
Potassium	0.1	
Bicarbonate	1.9	
Chloride	0.9	
Sulfate	0.0	
Nitrate	0.1	
Total dry residue at 180°C	5.4 mg	
pH at source	7.3	



- (a) Suggest **one** reason why the **total dry residue** value does not equal the sum of the masses of the different minerals shown to be present in the water sample. [1]

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- (b) The table below shows analytical techniques that the companies could use to test their water.

Technique	Observation	Ions present
Flame test	yellow flame	sodium
	brick red flame	calcium
	lilac flame	.....
Test with sodium hydroxide	white precipitate forms	calcium
	brown precipitate forms	iron(III)
Test with barium chloride	white precipitate forms	sulfate

- (i) **Complete** the table above. [1]

- (ii) Give **one** reason why the results of the **flame test** for 'Wellsprings' water might be difficult to interpret. [1]

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- (iii) Predict the observations you would make if you tested each bottle of water with: [3]

1. sodium hydroxide

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2. barium chloride

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(c) Sodium chloride (NaCl) is one of the compounds present in the water sample.

- (i) Calculate the relative formula mass of sodium chloride, given the relative atomic mass of sodium is 23 and chlorine is 35.5. [1]

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- (ii) A water sample was found to contain 0.87 mg sodium chloride. Calculate the number of moles of sodium chloride present in the sample. Show your working. [3]

Number of moles = .....

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- 5. Read the following extract which is taken from “The Organic Way” Summer 2008.

It is estimated that one third of human nutrition relies on the activities of bees. They are an important part of the natural ecosystem and their role as pollinators of wild and cultivated plants is enormous. After World War 2 farming became much more intensive to meet the needs of the UK population. Bee numbers went into decline. It is estimated that bumblebee populations halved since World War 2. If bees continue to disappear the plants they pollinate will set less seed. Worryingly losses in agricultural yields are already being reported.

Use the information in the extract and your understanding of intensive farming techniques to explain the changes in bee populations. [6] *QWC*

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6. A school group visits a working farm to see how food is produced. The produce from the farm is sold in the onsite shop.

(a) Assistants need to be aware that bacteria can cause food poisoning. *E-coli* is one species that causes food poisoning. Name **another** species that can cause food poisoning. [1]

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(b) Yoghurt is one of the foods produced on the farm and sold in the shop. Describe the production sequence for yoghurt starting with raw milk. [3]

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(c) The milk used in the production of this yoghurt is produced on a farm with a herd of 1000 cows using intensive farming methods. Give **one** advantage and **one** disadvantage of producing milk in this way. [2]

Advantage .....

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Disadvantage .....

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7. A firm manufactures sporting safety equipment including rugby post protectors.



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The post protectors are made of a heavy duty PVC polymer outer case and an inner high density foam that is able to absorb the impact made by rugby players.

- (a) Give **two** reasons why the post protectors have a heavy duty PVC polymer outer case.

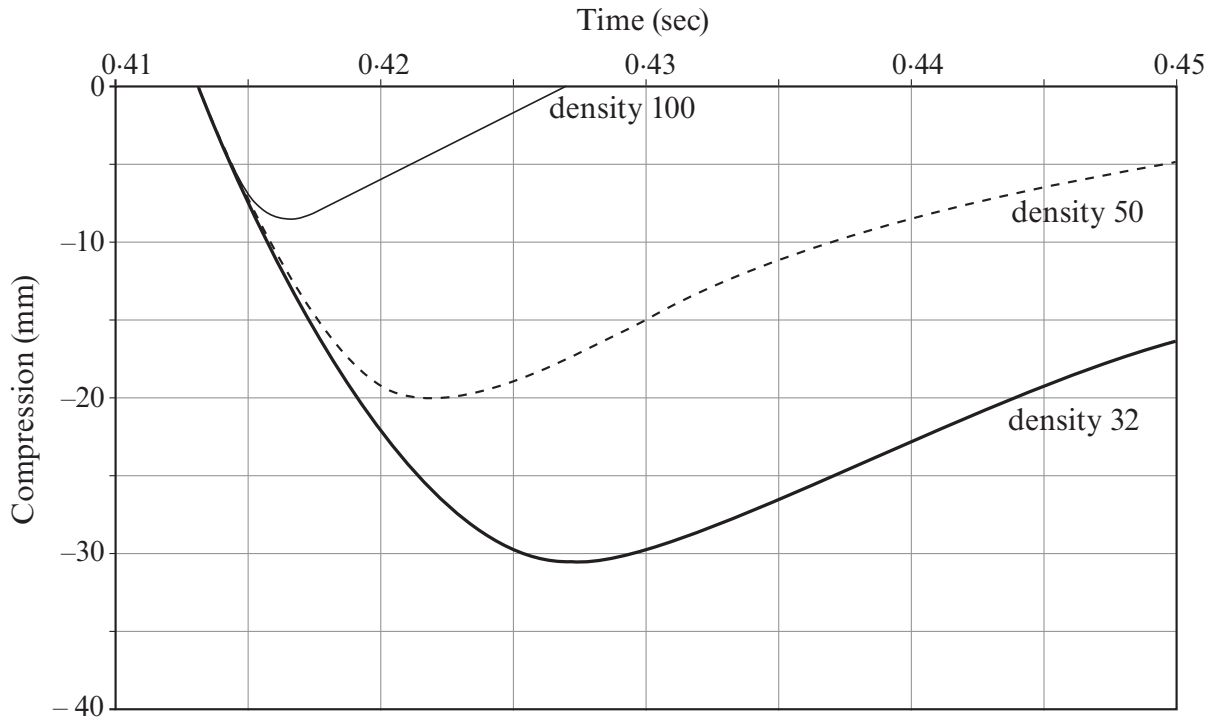
[2]

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(b) To find out the impact by players, one of the tests measures the compression of the foam. Foam specimens of different densities are put onto a solid base. The foam specimens are tested by dropping a 1 kg mass from 0.75 m onto each piece of foam. To enable accurate measurements to be taken each impact is videoed. A graph showing the compression for foam of different densities is shown below.



(i) Describe what is happening to the foam during the test. [2]

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(ii) State the maximum compression for density 50 foam. [2]

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(iii) Use the graph to list the three densities of foam in order of how easy it is to compress them. [1]

1st foam ..... **Most** easy to compress

2nd foam .....

3rd foam ..... **Least** easy to compress

**Question continued over page.**

(iv) Sketch **on the graph** the predicted result for a density 40 sample. [1]

(v) Using the information from the graph state which density of foam would be most suitable in the production of rugby post protectors and give **one** reason for your choice. [2]

Density of foam for rugby post .....

Reason .....

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only

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**END OF PAPER**