AQA

General Certificate of Secondary Education
Higher Tier
January 2013

Additional Applied Science   AAS1HP

H

Unit 1   Science at Work

Written Paper

Tuesday 22 January 2013   9.00 am to 10.00 am

For this paper you must have:
- a ruler
- a calculator
- the Equations Sheet (enclosed).

Time allowed
- 1 hour

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 3(c) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- In all calculations, show clearly how you work out your answer.

AAS1HP

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

1 Scientists need to think about the properties of the materials they work with.

The properties of a material depend on its structure.

Complete the sentences about the structure of materials.

Sodium chloride has a very high melting point because its structure has strong forces of

attraction between positive and negative ....

Iron conducts heat because its structure has free moving ....

Carbon dioxide has a low melting point because its structure has small molecules with

.... bonds holding the molecules together.

(3 marks)

3

2 The photograph shows an archer using a bow.

2 (a) The diagram shows an enlargement of part of the bow. Part of the bow is under tension. On the diagram, label a part of the bow under tension with the letter T.
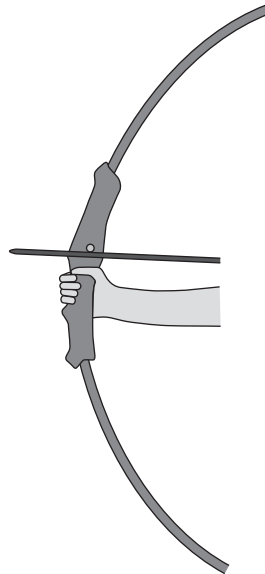
(1 mark)

Question 2 continues on the next page

Turn over ▶

2 (b) A technician tested two different materials used to make bowstrings. The materials were nylon and nustring. The technician measured the extension of each material when forces were applied to the materials.

2 (b) (i) The results for nylon have been plotted on the graph.
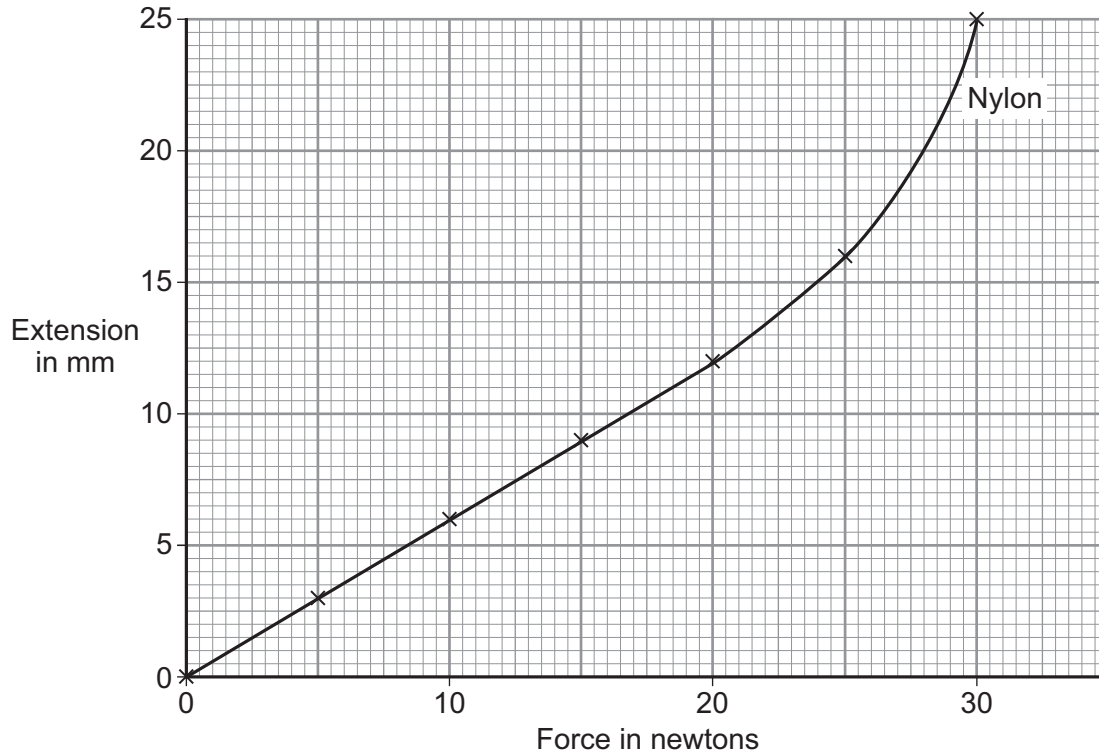
Over what range of force is it certain that the nylon string obeys Hooke's law?

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(1 mark)

2 (b) (ii) The results for nustring are shown in the table.

Force in newtons	Extension in mm
0	0
5	1.5
10	3.0
15	4.5
20	6.0
25	7.5
30	9.0

On the graph, plot the results for nustring. Draw a line of best fit.

(3 marks)

2 (b) (iii) Archers do not want the bowstrings to stretch when the bowstrings are being used.

Would it be better to use nustring or nylon to make the bowstrings?

Explain your answer, using evidence from the graph.

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(2 marks)

2 (c) The nylon string had a cross-sectional area of 3 mm^2.

Calculate the stress on the string when the extension is 7.5 mm.

Use the Equations Sheet and the graph to help you answer the question.

Give the unit in your answer.

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Answer ....

(3 marks)

10

Turn over for the next question

Turn over ▶

3   A farmer uses intensive farming methods. He adds fertiliser to the soil to increase the yield of his crops.

3 (a)   Name **one** other type of chemical the farmer could add to his crops. Explain why adding this chemical increases the yield.

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(2 marks)

3 (b)   Fertilisers can be made when an acid is added to an alkali.

What is the name for the reaction between an acid and an alkali?

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(1 mark)

3 (c)   *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

A farmer wants to use a new source of water to water his crops. The farmer sends a sample of the water to an analyst to find out the acid content of the water.

The analyst does an acid–alkali titration to analyse the water. First she puts $25.0 \, cm^3$ of alkali solution into a conical flask and does an approximate titration.

Conical flask

$25 \, cm^3$ alkali solution

The analyst then does an accurate titration.

What are the main stages in doing an accurate titration?

Include any readings the analyst should take.

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(6 marks)

9

Turn over ▶
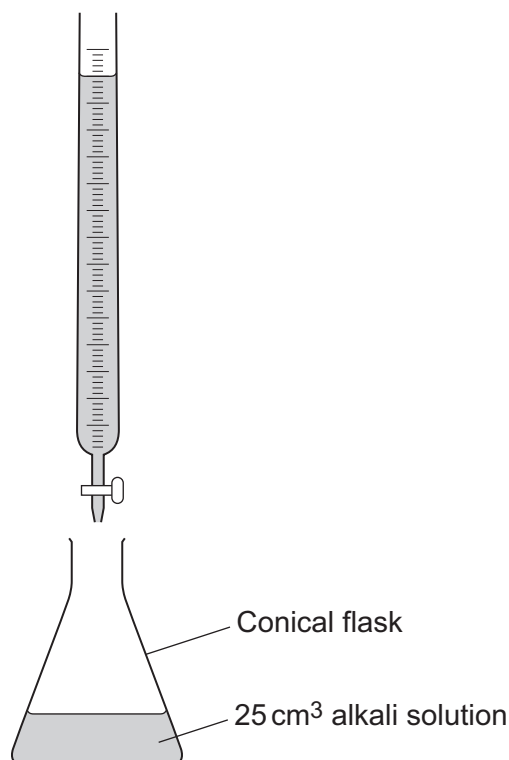
4 A Trading Standards scientist tests some children's toys to make sure that the toys are not coloured with harmful dyes.

He tests the colours from five different toys, **A**, **B**, **C**, **D** and **E**, using paper chromatography.

The scientist also tests a harmful dye.

Diagram 1 shows the chromatogram the scientist obtained.

Diagram 1
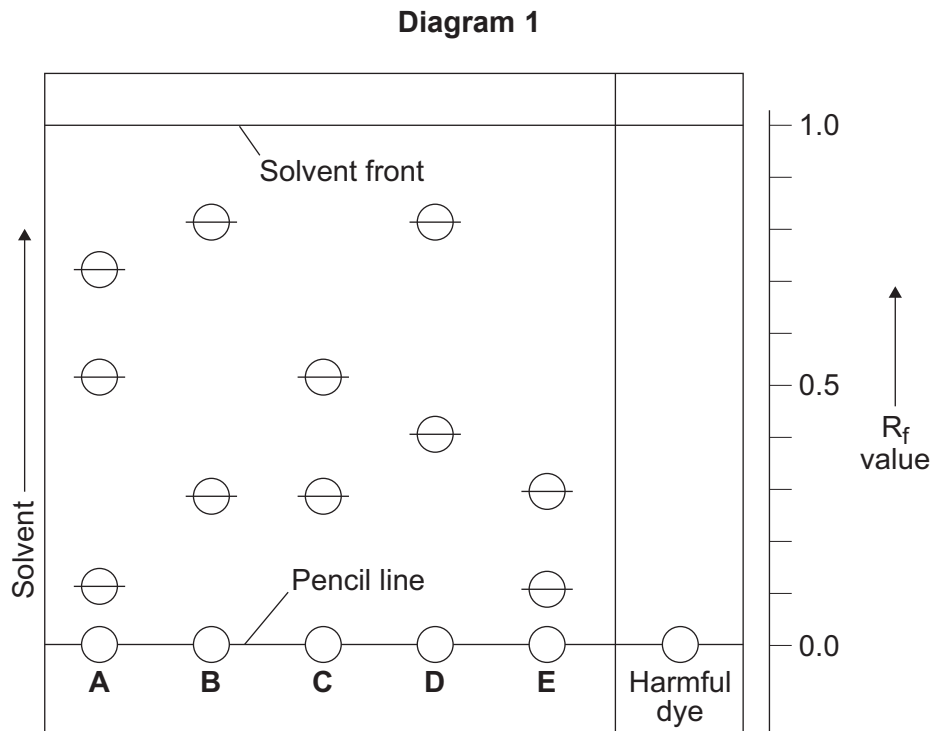
4 (a) The solvent front moves 9 cm.

The single spot from the harmful dye moves 3.6 cm.

4 (a) (i) Calculate the R_f value of the harmful dye.

Use the Equations Sheet to help you work out your answer.

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R_f value ....

(2 marks)

4 (a) (ii) Draw the spot from the harmful dye in the correct position on the chromatogram.

(1 mark)

4 (b) Use the chromatogram to decide which one of the toys, **A**, **B**, **C**, **D** or **E**, should **not** be sold to the public. Explain your answer.

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(2 marks)

4 (c) The scientist tests the samples again using a different solvent.

Which **two** statements best explain why he used a different solvent?

Tick (✓) **two** boxes.

All dyes dissolve in lots of different solvents. ☐

Different solvents separate different dyes. ☐

More data can be collected about which dyes are on the toys. ☐

There is only one colour in the harmful dye. ☐

The scientist wanted to make the test a fair test. ☐

(2 marks)

Question 4 continues on the next page

Turn over ▶

4 (d) Chromatography separates samples using a mobile phase and a stationary phase.

Use the correct answers from the box to complete the sentences.

| beaker | dye | paper | pencil line | solvent |

The mobile phase is the ....

The stationary phase is the ....

(2 marks)

4 (e) Gas–liquid chromatography (GLC) is often used to separate complex mixtures.

Diagram 2 shows the GLC trace obtained when different components in a mixture are separated by their retention times.

Diagram 2
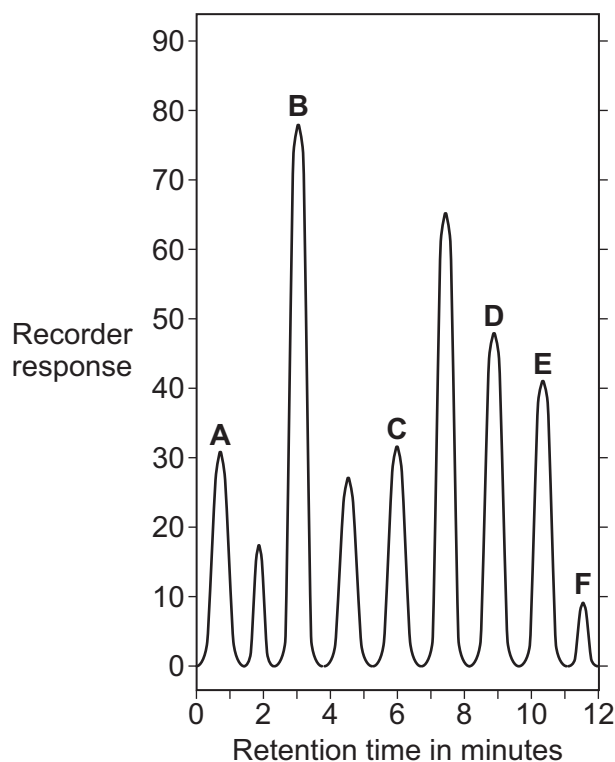
4 (e) (i) Which component, **A**, **B**, **C**, **D**, **E** or **F**, has a retention time of 3 minutes?

Write your answer in the box.

(1 mark)

4 (e) (ii) How could you tell which **two** components are present in the same concentration?

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(1 mark)

4 (e) (iii) How could you tell which component is present in the greatest concentration?

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(1 mark)

12

Turn over for the next question

Turn over ▶

5 An athlete goes for a training run.

5 (a) While the athlete is exercising, an 'oxygen debt' can occur in her muscles. The 'oxygen debt' is caused by a build up of a substance in her muscles.

Name the substance that causes the 'oxygen debt'.

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(1 mark)

5 (b) While the athlete is exercising, her blood glucose level falls because glucose is being used to release the energy she needs.

Describe how the athlete's body responds to a fall in blood glucose to bring the level back to normal.

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(5 marks)

6

6　　Polymer scientists need to know how differences in the structures of polymers affect their properties.

6 (a) (i)　What happens to the melting point of a polymer if the length of molecules in the polymer is increased?

Explain your answer.

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(3 marks)

6 (a) (ii)　What happens to the strength of a polymer if side chains are added to the molecules to make a branched polymer?

Explain your answer.

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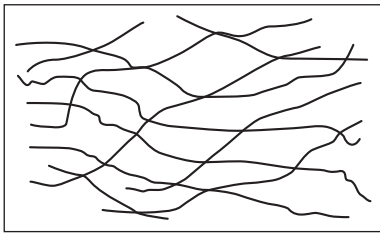
(3 marks)

Question 6 continues on the next page

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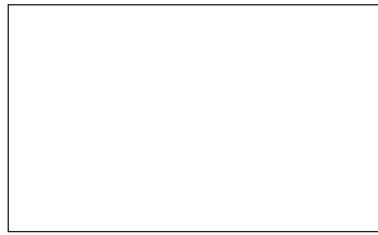
6 (b) (i) The diagram in the left-hand box shows the structure of a thermoplastic polymer.

Thermoplastic polymer   **Thermosetting polymer**

In the right-hand box draw a diagram to show the structure of a thermosetting polymer.

(1 mark)

6 (b) (ii) Thermoplastic polymers can be easily moulded and shaped but thermosetting polymers cannot.

Explain why.

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(4 marks)

11

7 (a) A man had surgery to replace a damaged hip joint.

After surgery, the man worked with a specialist to make sure that the joint works well.

What is this type of specialist called?

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(1 mark)

7 (b) People with a high body mass index (BMI) are more likely to need hip joint replacements.

Suggest why.

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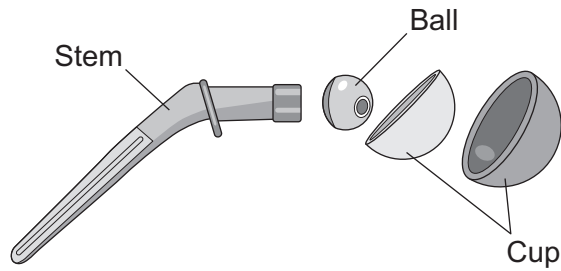*(3 marks)*

Question 7 continues on the next page

Turn over ▶

7 (c) Read the information below about artificial hip joints.

Artificial hip joints have three main parts:

- the stem fits inside the femur
- the ball replaces the round head of the femur
- the cup replaces the socket in the hip.

Ceramic on ceramic joints have the ball and cup made of a ceramic material. Flaws in ceramic joints can cause the joint to shatter during use. Ceramic on ceramic joints have the least wear with time.

Metal on metal joints have the stem, ball and cup made of the same metal. In this type of joint friction can release harmful metals into the surrounding tissues.

Metal on polythene joints have a plastic layer between the metal surfaces of the ball and cup to reduce friction between them. Metal on polythene joints wear the fastest as the polythene lining gets worn away.

90% of replacement joints last at least 10 years.

A doctor needs to replace a hip joint of an active 50-year-old man.

Which type of hip replacement joint would you suggest for this patient?

Use the information and your own knowledge and understanding of materials to justify your conclusion.

You should compare all three types of replacement joint in your answer.

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(5 marks)

9

END OF QUESTIONS

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