**GCSE**

**4791/02**

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

P.M. MONDAY, 20 May 2013

1 hour

**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 **4**(i) and **9**.

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

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

**1.** Plant biologists have examined some plants that had not grown very well.

*(a)* They looked at cells from the leaves of a plant under a microscope.

**Label** the parts **A, B, C** and **D** on the diagram below. [4]

cell membrane

A .................................................

D .................................................

B .................................................

C .................................................

cytoplasm
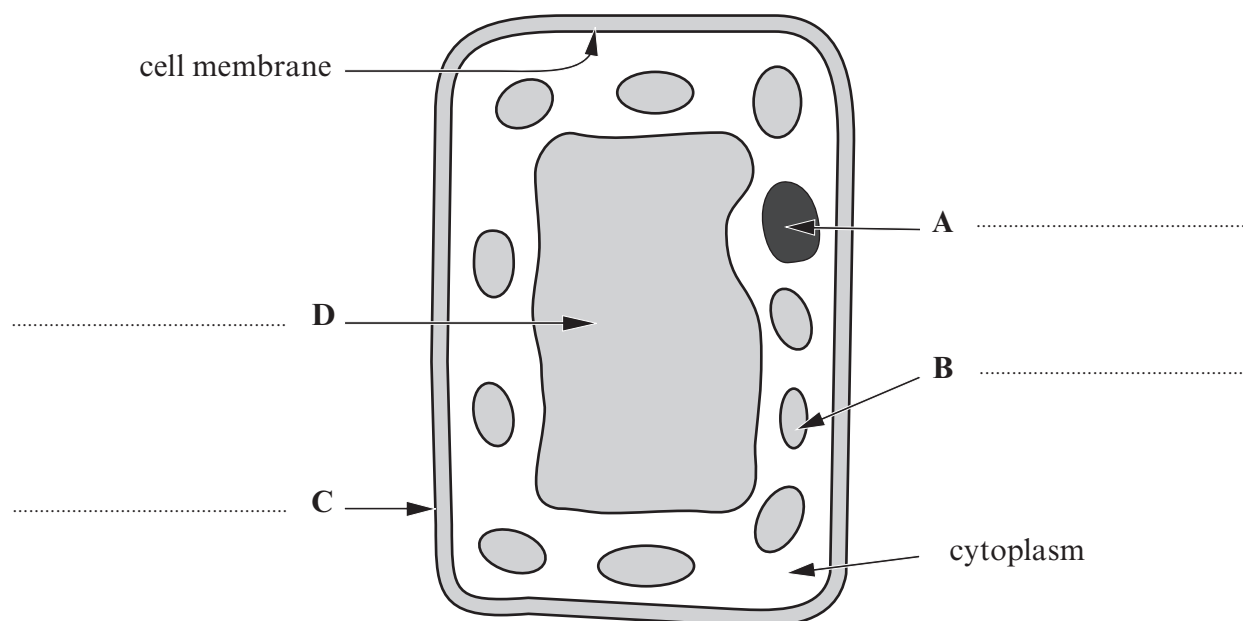
*(b)* The biologists found that the plants were deficient in phosphate and magnesium.

(i) Complete the table to show the symptoms of these deficiencies. [2]

| Mineral | Use | Deficiency symptoms |
|---------|-----|---------------------|
| nitrate ions | building proteins and growth | poor growth and yellow leaves |
| phosphate ions | respiration and growth | ............................................. |
| potassium ions | respiration and photosynthesis | poor flower and fruit growth |
| magnesium ions | photosynthesis | ............................................. |

(ii) Explain the function of chlorophyll. [2]

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**2.** An engineering firm makes springs for trampolines.



The springs are tested to see if they return to their normal length after being stretched.

The table shows how far a spring extends when different weights are added.

| Weight (N) | Extension (cm) |
|---|---|
| 0 | 0 |
| 10 | 0.5 |
| 20 | 1.0 |
| 30 | 1.5 |
| 40 | 2.0 |
| 50 | 2.5 |
| 60 | 3.4 |
| 70 | 5.0 |

(i) Plot a graph of the data on the grid opposite. [3]

(4791-02)

Extension (cm)
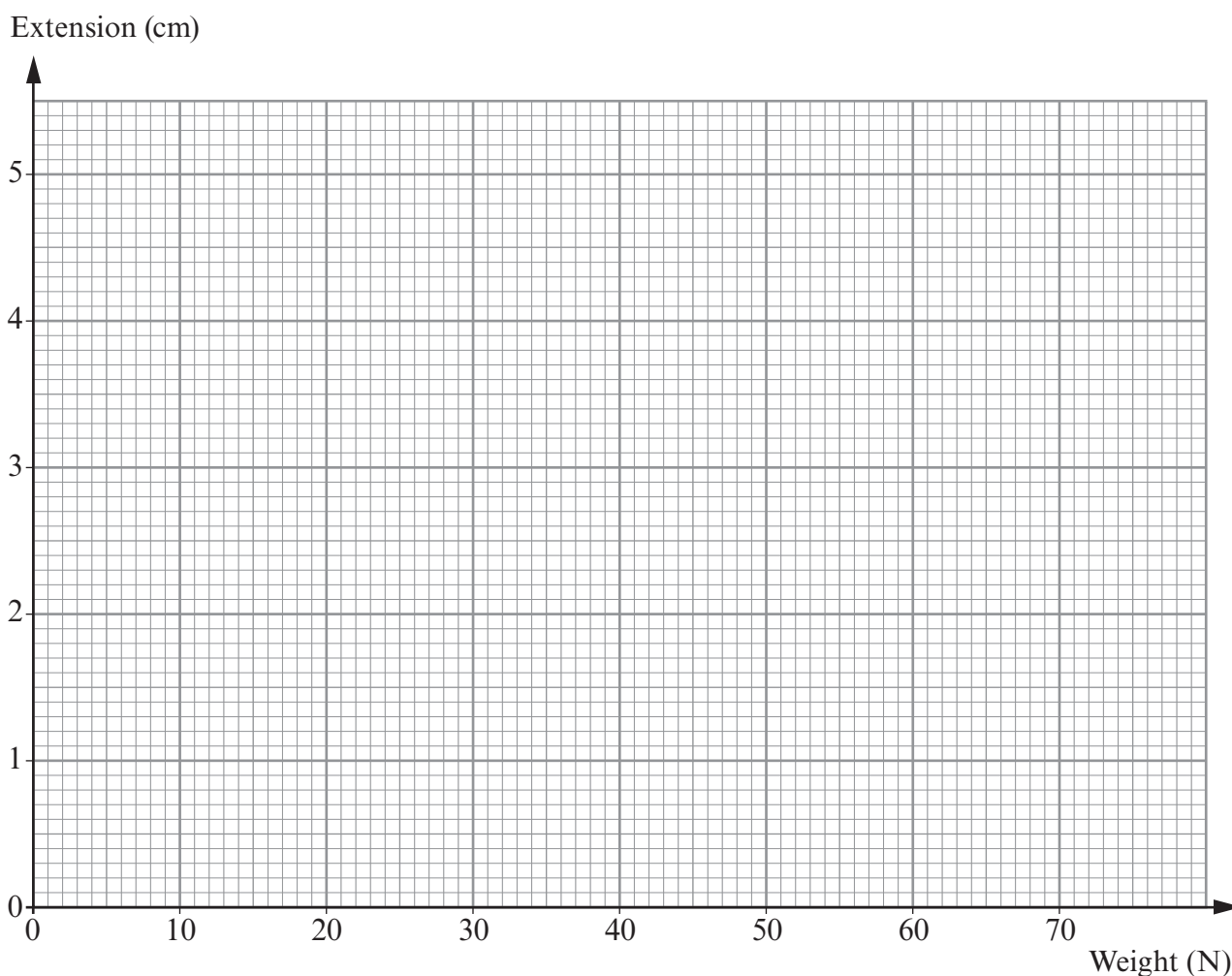


Weight (N)

(ii) Beyond the elastic limit the spring will not return to its original length. The elastic limit is where the extension is no longer proportional to the weight.

In a trampoline, this spring will experience a maximum force of 65 Newtons. Explain whether the spring is suitable for this use. [2]

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(iii) Calculate the constant for this spring using the equation: [2]

$$\text{spring constant (N/cm)} = \frac{\text{force (N)}}{\text{extension (cm)}}$$

Constant = ..................... N/cm

(iv) Suggest a constant for a spring that will not extend as much when weights are added.

......................................... [1]

8

**3.** A Scene of Crime Officer (SoCO) collects some powder from a crime scene. She carries out flame tests and precipitation reactions on solutions of the powder. When performing the tests, the SoCO refers to the following information sheet.

| Type of salt | Test | Results |
|---|---|---|
| carbonate | add hydrochloric acid | carbon dioxide gas is given off |
| chloride | add nitric acid then silver nitrate | thick white precipitate |
| nitrate | add iron(II) sulfate solution followed by sulfuric acid | brown ring forms |
| sulfate | add a solution of barium chloride | white precipitate |

| Metal | Flame test colour |
|---|---|
| calcium | brick red |
| copper | green |
| lead | blue |
| sodium | orange/yellow |

*(a)* To check her equipment, the SoCO tests some copper sulfate.

(i) What colour is produced in the flame test? [1]

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(ii) State what happens, if anything, when hydrochloric acid is added to copper sulfate solution. [1]

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(iii) Describe what happens when barium chloride solution is added to the solution of copper sulfate. [1]

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(iv) **Write down** the correct chemical formula for copper sulfate. [1]

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*(b)* The SoCO then carries out the following tests on solutions of the powder found at the crime scene.
Complete the table below to show the conclusions reached by the SoCO. [2]

| Test | Observation | Conclusions |
|---|---|---|
| flame test | orange/yellow | The metal is ......................................... |
| add nitric acid then silver nitrate | thick white precipitate | The type of salt is ......................................... |

*(c)* These tests are examples of qualitative analysis. How would the results of quantitative analysis tests be different? [1]

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**4.**    (i)    A nurse takes blood samples from patients. The samples are examined under a microscope by a technician who records the results in the table below. These are compared with the normal range for a healthy person.

| Patient | Red blood cells (units) | White blood cells (units) | Platelets (units) |
|---------|-------------------------|---------------------------|-------------------|
| Tom | 6.5 | 56 | 250 |
| John | 5.1 | 8.1 | 260 |
| Julie | 2.2 | 5.0 | 50 |

| | Red blood cells | White blood cells | Platelets |
|---|---|---|---|
| *Normal range* | *4.5-6.5* | *4-11* | *150-440* |

Explain what the results show about the health of each patient.                    [6] *QWC*

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(ii)    The blood plasma carries blood cells around the body. State **one** other function of blood plasma.                                                                                          [1]

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**5.** Researchers into arthritis study synovial joints.

(i) Label the diagram of a synovial joint shown below. [3]

Bone

Synovial membrane

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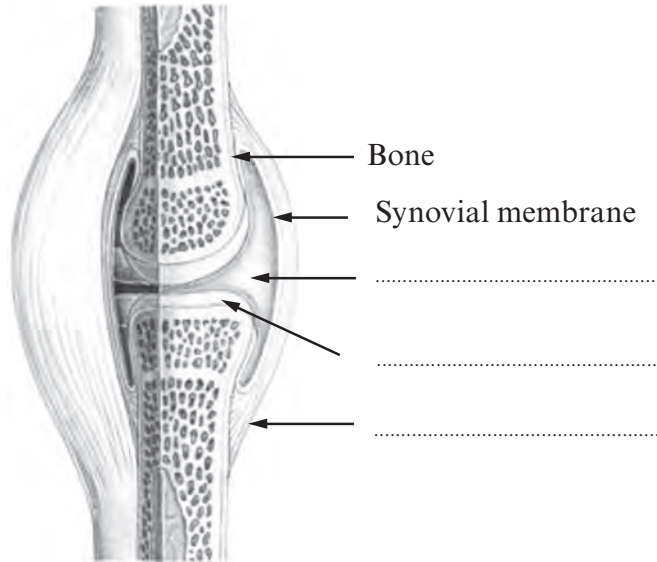
(ii) Doctors remove a sample of synovial fluid to diagnose the type of arthritis present. Describe the function of synovial fluid. [2]

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**6.** Aeroplane wings are made out of sheets of metal.

*(a)* Explain why metals can be rolled into sheets. [2]

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*(b)* The table shows properties of different metals.

| Metal | Density (g/cm$^3$) | Stiffness (GPa) | Melting Point (K) | Tensile strength ($\times 10^7$Pa) |
|---|---|---|---|---|
| Aluminium | 2.7 | 69 | 933 | 10 |
| Steel | 7.8 | 210 | 1630 | 40 |
| Titanium | 4.5 | 110 | 1943 | 55 |
| Vanadium | 5.7 | 138 | 1708 | 63 |

Wings for modern jet fighter aircraft are made from an alloy consisting of 90% titanium, 6% aluminium and 4% vanadium. The alloy has a density of 4.4 g/cm$^3$, stiffness of 110 GPa, melting point of 1890 K and tensile strength of 100 $\times 10^7$ Pa.

Use the information in the table to answer the following questions.

(i) Compare the properties of this alloy with steel. [3]

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(ii) State **one** advantage of adding aluminium to this alloy. [1]

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(iii) State **one** advantage of adding vanadium to this alloy. [1]

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*(c)* Alloys consist of more than one type of atom, as shown in the diagram below.



Explain why this makes the metal stronger. [2]

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**7.** Sourdough bread is made using two types of microorganism – yeast and bacteria. The bacteria make lactic acid which makes the bread taste sour.

The graph shows how the growth rates of the yeast and the bacteria change with temperature.
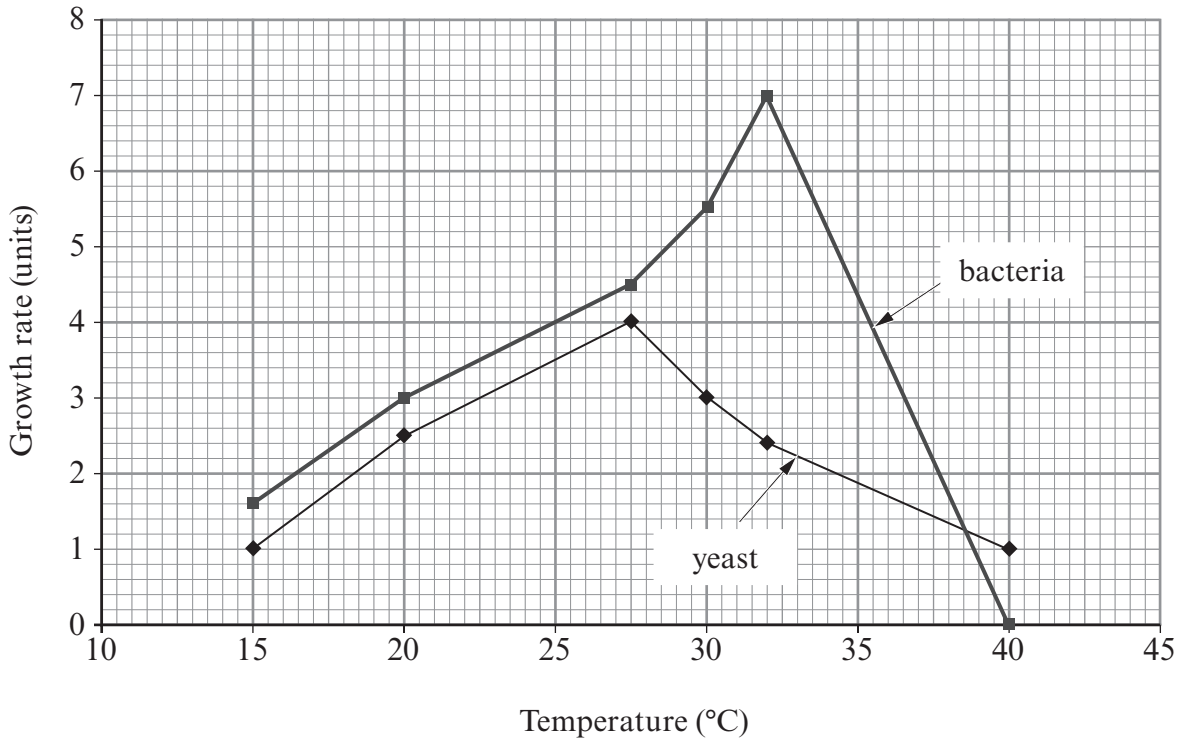


*(a)* (i) State the temperature at which sourdough bread rises fastest. ..................................... [1]

(ii) Explain your answer. [2]

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*(b)* The bread will taste most sour at 32°C. Explain why. [2]

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**8.** *(a)* Calculate the relative formula mass of the fertiliser ammonium nitrate ($NH_4NO_3$).

(Relative atomic masses: H = 1; N = 14; O = 16) [3]

Relative formula mass = .....................................

*(b)* Potassium nitrate ($KNO_3$) is another fertilizer. The relative formula mass of potassium nitrate is 101.
(relative atomic masses: N = 14; O = 16; K = 39)

Calculate the mass of fertiliser that contains 13 g of potassium. [2]

Mass = ..................................... g

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**TURN OVER FOR QUESTION 9**

**9.** Describe the short and long term impact of excessive alcohol consumption on the body.
[6] QWC

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**END OF PAPER**

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