Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2009–2010

Science: Single Award (Modular)

Materials and their Management
Module 4

Higher Tier

[GSC42]

GSC42

FRIDAY 21 MAY 2010, MORNING

TIME

45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all seven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 45.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Data Leaflet, which includes a Periodic Table of the elements, is provided for you.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
Total Marks	

Examiner Only	
Marks	Remark

1 **(a)** Photochromic and thermochromic paints are smart materials which alter with a change in the surrounding environmental conditions.

(i) What environmental condition causes photochromic paint to change?

_____ [1]

(ii) Shown below is a baby's feeding bottle.

The bottle is made from thermochromic plastic which changes colour as temperature changes.
Suggest how this may make the bottle safer to use.

_____

_____

_____ [2]

(b) Nanotechnology involves the use of nano-sized particles.

(i) Explain fully the meaning of **nanotechnology**.

_____

_____ [2]

(ii) Give one use of nanotechnology.

_____ [1]

(iii) How many nanometres are in one metre?
Circle the correct answer.

10^{-9} **10^{9}** **10^{3}** **10^{-3}** [1]

2 Many areas in Northern Ireland have hard water. Hardness is caused by certain salts of calcium and magnesium.

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(a) (i) Explain fully what is meant by the term **hard water**.

_____

_____ [2]

(ii) Name a compound that forms permanent hard water.

_____ [1]

(b) Four samples of water (A, B, C and D) were tested for hardness. The results are shown below.

Sample	A	B	C	D
Volume of soap solution required **before** boiling/cm^3	21	26	24	18
Volume of soap solution required **after** boiling/cm^3	11	12	24	13

From the results which sample (A, B, C or D) has:

(i) the hardest water ? _____

(ii) permanent hard water only? _____

(iii) the greatest problem with kettle 'fur'? _____ [3]

Examiner Only

Marks	Remark

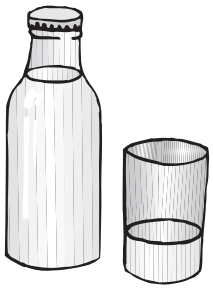
(c) Temporary hardness in water is caused by calcium hydrogencarbonate. Complete the word equation to show how temporary hardness is removed by boiling.

Calcium hydrogencarbonate → water + _____ + _____

[2]

Examiner Only	
Marks	Remark

3 Glass is a non-biodegradable material. Each year thousands of tonnes of glass are recycled.



(a) Describe fully the main stages in recycling glass.

_____

_____

_____

_____

_____ [4]

(b) Apart from being non-biodegradable, give **two** other environmental reasons why it is important to recycle glass.

_____

_____ [2]

Examiner Only	
Marks	Remark

4 **(a)** For each set of equations below, **(i)**, **(ii)**, **(iii)**, only one of the three equations is correct. Put a circle around the correct equation.
The first is done for you.

(i) $2C + O_2 \rightarrow 2CO_2$

$C + 2O_2 \rightarrow CO_2$

(circled) $C + O_2 \rightarrow CO_2$

(ii) $NaCO_3 + MgCl_2 \rightarrow MgCO_3 + 2NaCl$

$Na_2CO_3 + MgCl_2 \rightarrow MgCO_3 + 2NaCl$

$Na_2CO_3 + 2MgCl_2 \rightarrow 2MgCO_3 + 2NaCl$

(iii) $CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$

$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + 2H_2O$

$2CaCO_3 + HCl \rightarrow CaCl + CO_2 + H_2O$

[2]

(b) Each of the three sets of equations, **(i)**, **(ii)**, **(iii)**, shown above can be classified as one of neutralisation, displacement, combustion or precipitation.
Complete the reaction type for:

Equation set **(i)** _____

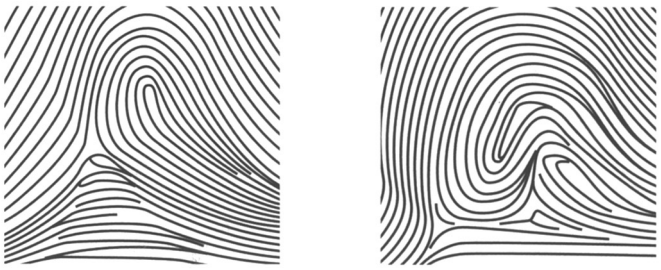
Equation set **(ii)** _____

Equation set **(iii)** _____

[3]

Examiner Only	
Marks	Remark

5 Two common types of fingerprints are shown below.



A B

(a) Name the two types of fingerprints A and B.

A _____

B _____ [2]

(b) Describe and explain why many people support the idea of having a national database of fingerprints.

_____

_____

_____ [2]

6 The table below gives information about four materials.

Material	Relative heaviness	Relative strength	Relative stiffness	Relative cost
Nylon	1100	8	3	medium
Kevlar	1500	300	190	very high
Polythene	960	2.0	0.6	low
Carbon-reinforced plastic	1600	180	200	high

(a) Using the values in the table and your knowledge of materials, describe and explain one reason for using polythene in packaging.

_____

_____

_____ [2]

(b) A company won a contract to make bulletproof vests. Using the information provided, suggest which material they should use. Explain your answer.

_____

_____

_____

_____ [3]

(c) Carbon-reinforced plastic is a composite material. What is meant by the term composite material?

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

7 **(a)** Ethene is an important chemical used to make polythene. It can be obtained by the thermal cracking of alkanes as shown in the equation below.

$$C_{10}H_{22} \rightarrow C_8H_{18} + C_2H_4$$

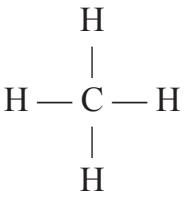
Explain fully the meaning of the term thermal cracking.

_____

_____

_____ [2]

(b) Complete the table below.

Name	Molecular Formula	Structural Formula
Methane		
Ethene	C_2H_4	
Butane	C_4H_{10}	

[3]

(c) Propane is a fuel used in gas barbecues. Complete the **balanced** equation below to show the combustion of propane.

$C_3H_8 + 5O_2 \rightarrow$ _____ + _____

[2]

(d) The combustion of hydrogen produces water as shown in the equation below.

$$2H_2 + O_2 \rightarrow 2H_2O$$

Suggest why hydrogen is termed a clean fuel.

_____

_____ [1]

Examiner Only	
Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

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