Science: Single Award (Modular)

Materials and their Management Module 4

Higher Tier

[GSC42]

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THURSDAY 25 FEBRUARY 2010, MORNING

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

1 The diagram below shows two alcoholic drinks, each containing one unit of alcohol.
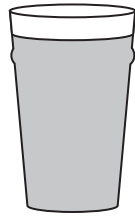
Half pint of beer
= 1 unit

Glass of wine
= 1 unit

(a) A person drinks **two** half pints of beer and **three** glasses of wine. Calculate the number of units of alcohol consumed and the increase in blood alcohol this produces if 1 unit of alcohol = 20 mg alcohol per 100 cm^3 of blood.

_____ units

_____ mg alcohol per 100 cm^3 of blood   [2]

(b) A man has a blood alcohol level of 160 mg per 100 cm^3 of blood. Calculate his blood alcohol level after two hours if his body removes one unit of alcohol per hour.

(i) _____ mg alcohol per 100 cm^3 of blood. [1]

(ii) The legal limit to drive is 80 mg alcohol per 100 cm^3 of blood. Explain fully why it would still be dangerous for him to drive even after waiting two hours.

_____

_____

_____[2]

2 **(a)** In an investigation to find how much energy is released, the same amount of four hydrocarbon fuels were burnt and the following results were obtained.

Hydrocarbon fuel	Formula	Energy released/kJ
Methane	CH_4	890
Ethane	C_2H_6	1560
Propane	C_3H_8	2220
Butane	C_4H_{10}	2880

(i) What was done in the investigation to make it a fair test?

_____[1]

(ii) Use the information to give one trend, shown by the results, when the fuels are burnt.

_____

_____[1]

(iii) Use the information in the table to suggest the value for the energy produced when pentane, C_5H_{12}, is burnt.
Circle your answer.

2900 kJ : 5100 kJ : 2400 kJ : 3510 kJ [1]

(b) Ethanol, C_2H_5OH, is an organic molecule which can also be used as a fuel.

(i) How many different elements are contained in ethanol?

_____ [1]

(ii) Explain fully why ethanol is not a hydrocarbon.

_____

_____

_____[2]

3 **[Turn over**

(iii) Complete the word equation to show what happens when ethane burns in excess oxygen.

ethane + oxygen → _____ + _____ [2]

(c) (i) Name the hydrocarbon molecule that is used to make polythene.

_____ [1]

(ii) Give **one** environmental problem caused by polythene.

_____

_____[1]

3 In Northern Ireland, there are many areas where the water is hard. While many physical features associated with hard water areas attract tourists, hard water also has several disadvantages. One major disadvantage is the limescale which builds up in kettles.

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(a) (i) Explain the meaning of the term **hard water**.

_____[1]

(ii) $Ca(HCO_3)_2$ is the formula of the compound which causes temporary hardness. Name the two ions present in this compound. (You may find your Data Leaflet useful.)

_____ ion and _____ ion [1]

(iii) Name the rock that is responsible for the formation of temporary hard water.

_____ [1]

5

[Turn over

(b) (i) Describe fully an experiment you could carry out in the laboratory to show that a sample of water only has temporary hardness.

_____

_____

_____

_____

_____ [3]

(ii) Calcium sulphate and magnesium chloride are two compounds that cause permanent hardness. Give the formula for each of these two compounds.
(You may find your Data Leaflet useful.)

Calcium sulphate _____

Magnesium chloride _____   [2]

**(c)** Give **one** physical feature found in a hard water area.

_____ [1]

4 **(a)** Each equation below has one mistake; either a formula or a balancing number is incorrect, but not both. Put a circle round the incorrect part. The first has been done for you.

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

B $CaCl + Na_2CO_3 \rightarrow 2NaCl + CaCO_3$

C $CH_4 + O_2 \rightarrow CO_2 + 2H_2O$

D $Mg(HCO_3)_2 \rightarrow Mg_2CO_3 + H_2O + CO_2$ [3]

(b) From the above reactions (**B**, **C** and **D**) select the reaction which is:

(i) combustion _____

(ii) thermal decomposition _____ [2]

5 **(a)** Spectacles made from shape memory metal can be easily crushed, as shown below, but they will quickly return to their original shape form with the warmth of the hand. Shape memory metal is described as a smart material.
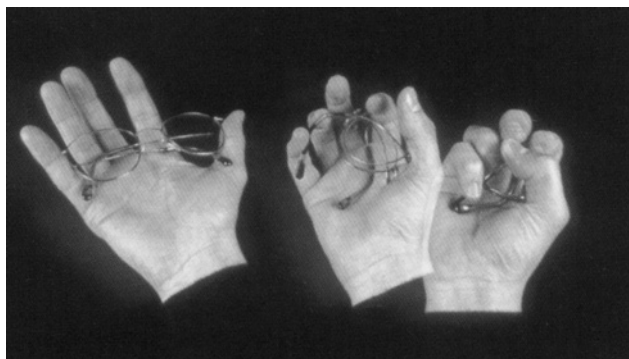
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    (i) Explain fully the meaning of the term **smart material**.

        _____

        _____

        _____[2]

    (ii) Explain what happens when the following two paints behave as smart materials.

        1. Photochromic paint _____

        _____

        2. Thermochromic paint _____

        _____[3]

(b) Complete the table below about flame colours.

Metal chloride	Flame colour
Potassium	Lilac
	Yellow
Calcium	
	Green

[3]

6 Ethane is a hydrocarbon with a molecular formula C_2H_6 and is obtained from crude oil.

(a) (i) Name the process that is used to obtain liquids and gases from crude oil.

_____ [2]

(ii) Complete the table below to show the structural formula of propane.

Name	Molecular formula	Structural formula
Ethane	C_2H_6	H—C—C—H with H H above and H H below
Propane	C_3H_8	

[2]

(b) Alkenes are hydrocarbons that are used to make important commercial polymers.

(i) Name the type of reaction that is used to make polymers.

_____ [1]

(ii) In terms of bonds, describe how polythene is made from ethene.

_____

_____

_____

_____ [3]

THIS IS THE END OF THE QUESTION PAPER

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