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OCR
RECOGNISING ACHIEVEMENT

Wednesday 18 January 2012 – Morning

**GCSE TWENTY FIRST CENTURY SCIENCE
SCIENCE A**

A142/02   Modules B2 C2 P2 (Higher Tier)

| Candidates answer on the Question Paper
A calculator may be used for this paper	**Duration:** 1 hour
OCR supplied materials:
None	
Other materials required:
• Pencil
• Ruler (cm/mm) | |

Candidate forename		Candidate surname	

Centre number					Candidate number				

INSTRUCTIONS TO CANDIDATES

• Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
• Use black ink. HB pencil may be used for graphs and diagrams only.
• Answer **all** the questions.
• Read each question carefully. Make sure you know what you have to do before starting your answer.
• Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
• Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

• Your quality of written communication is assessed in questions marked with a pencil (✎).
• The number of marks is given in brackets **[ ]** at the end of each question or part question.
• A list of useful relationships is printed on page **2**.
• The total number of marks for this paper is **60**.
• This document consists of **20** pages. Any blank pages are indicated.

OCR is an exempt Charity

Turn over

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Useful relationships

The Earth in the Universe

distance = wave speed × time

wave speed = frequency × wavelength

Sustainable energy

energy transferred = power × time

power = voltage × current

efficiency = $\dfrac{\text{energy usefully transferred}}{\text{total energy supplied}}$ × 100%

Explaining motion

speed = $\dfrac{\text{distance travelled}}{\text{time taken}}$

acceleration = $\dfrac{\text{change in velocity}}{\text{time taken}}$

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

work done by a force = force × distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight × vertical height difference

kinetic energy = $\dfrac{1}{2}$ × mass × [velocity]^2

Electric circuits

power = voltage × current

resistance = $\dfrac{\text{voltage}}{\text{current}}$

$\dfrac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \dfrac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$

Radioactive materials

energy = mass × [speed of light in a vacuum]^2

3

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Answer **all** the questions.
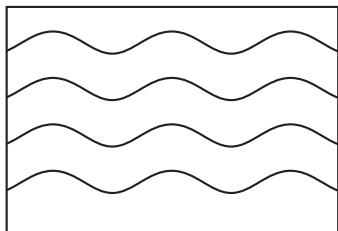
1 Modifying polymers changes their properties.

(a) Draw a straight line from each **change in property** to the **modification** and another straight line from each **modification** to the **reason why it works**.
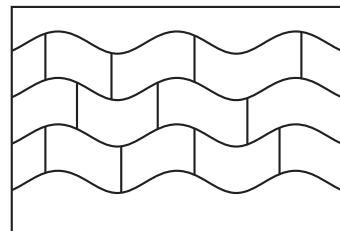
change in property	modification	reason why it works
polyethene is made more flexible	by adding a plasticiser	polymer molecules are joined together
polypropene is made more dense	by crosslinking polymer molecules	decreases forces between polymer molecules
rubber for tyres is made more hardwearing	by increasing the crystallinity	increases forces between polymer molecules

[3]

(b) The diagrams show a polymer before and after modification.

before

after

What has been modified in this polymer?

Put a (ring) around the correct answer.

chain length   cross linking   crystallinity   plasticizer

[1]

[Total: 4]

2 Many British people sunbathe in the summer months, even though they know that it can be harmful.

(a) These statements are about the risk from sunbathing, but they are not all true.

Put a tick (✓) in the correct box after each statement.

	true	false
If you don't feel hot while sunbathing you will not have any damage to your skin.	☐	☐
Ozone high in the atmosphere absorbs most of the ultraviolet from the Sun.	☐	☐
Ultraviolet radiation can damage the cells of the skin.	☐	☐
Using a cream which absorbs ultraviolet will protect the skin.	☐	☐
The British summer is not hot enough for sunbathing to be a risk.	☐	☐

[2]

(b) Many people still choose to sunbathe, even though they know about the risks.

Which of the following reasons can explain this?

Put ticks (✓) in the boxes next to the **two** correct reasons.

They prefer to have pale skin.	☐
They think that a sun-tan is attractive.	☐
The weather is often cloudy in the summer.	☐
They are afraid that they might get skin cancer.	☐
They don't think skin cancer will happen to them.	☐

[2]

[Total: 4]

3 Some students are investigating how much different types of rubber will stretch.

This is how three students plan to do their investigation.

Kylie

I will hang a mass from each piece of rubber and measure the stretch. I will take turns with my partner to make the test fair.

Jake

I will make sure the rubber pieces are the same length and width. I will hang a 1 kg mass on each piece. I will wait until it has stretched and measure the length. I will repeat the test five times and work out the mean for each piece of rubber.

Lewis

I will cut out pieces of each type of rubber so that they are all the same size. I will hang masses on each piece until it stretches and then measure its length.

(a) Whose plan is the best? Explain why you make this choice.

The quality of written communication will be assessed in your answer.

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.... **[6]**

(b) Here are some results for one type of rubber.

sample	1	2	3	4	5
stretch in cm	2.1	1.2	2.4	2.2	2.1

(i) These results include an outlier.

Jake says the outlier should be included.

Kylie says that the outlier should be excluded.

How would you decide if the outlier should be included or excluded?

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....

....

.... **[2]**

(ii) The rubber for a wet suit needs to have a stretch between 2.2 and 2.8 cm.

Jake and Kylie decide to include the outlier.

Work out their best estimate of the true value for the stretch of this type of rubber.

Use this best estimate to decide if this rubber is suitable for wet suits.

best estimate = ... cm
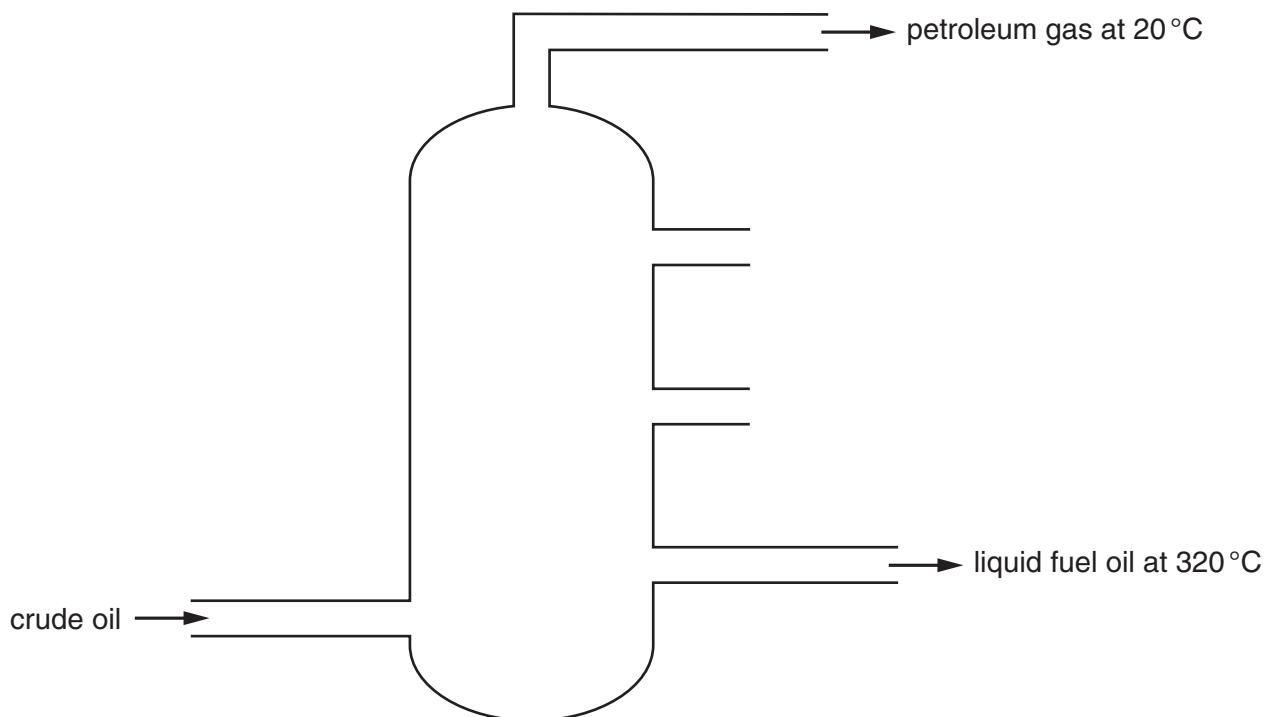
decision .... **[2]**

[Total: 10]

Turn over

4 Crude oil is separated into fractions in a fractionating tower.

The diagram shows crude oil entering the tower and two of the fractions coming out.

These fractions are petroleum gas and liquid fuel oil.

(a) Petroleum gas and liquid fuel oil have very different boiling points.

Describe the sizes of the molecules in petroleum gas and fuel oil and explain why they boil at different temperatures.

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.... **[4]**

(b) Another process makes the molecules that are used in polymerisation.

Heptane is changed into propane and ethene by this process.

The diagram shows how the atoms are rearranged in this reaction.

Complete the boxes to show how many molecules of propane and ethene are made when **one** molecule of heptane is changed by this process.

molecules of heptane	molecules of propane	molecules of ethene
1		
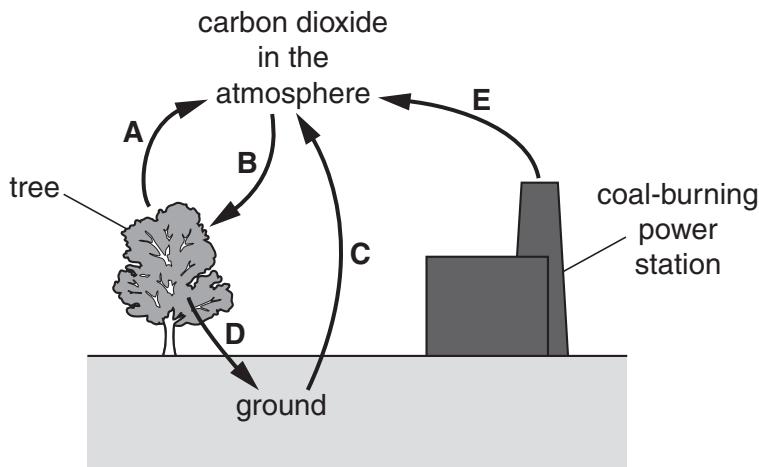
[2]

[Total: 6]

Turn over

5 The diagram shows part of the carbon cycle.

(a) Use two of the letters, **A**, **B**, **C**, **D**, **E**, from the diagram to complete the following sentence.

The rise in the concentration of atmospheric carbon dioxide in the last 200 years has been

largely due to an increase in process .... and a decrease in process .... **[1]**

(b) The concentration of carbon dioxide in the atmosphere was constant for a long time.

Which one of the following equations would keep the carbon dioxide concentration in the air constant?

Each letter in the equation stands for the amount of carbon being transferred in the direction shown.

Put a tick (✓) in the box next to the correct equation.

A + B = C + E ☐

A + C + E = B ☐

A + E = D ☐

A + E = B + D ☐

[1]
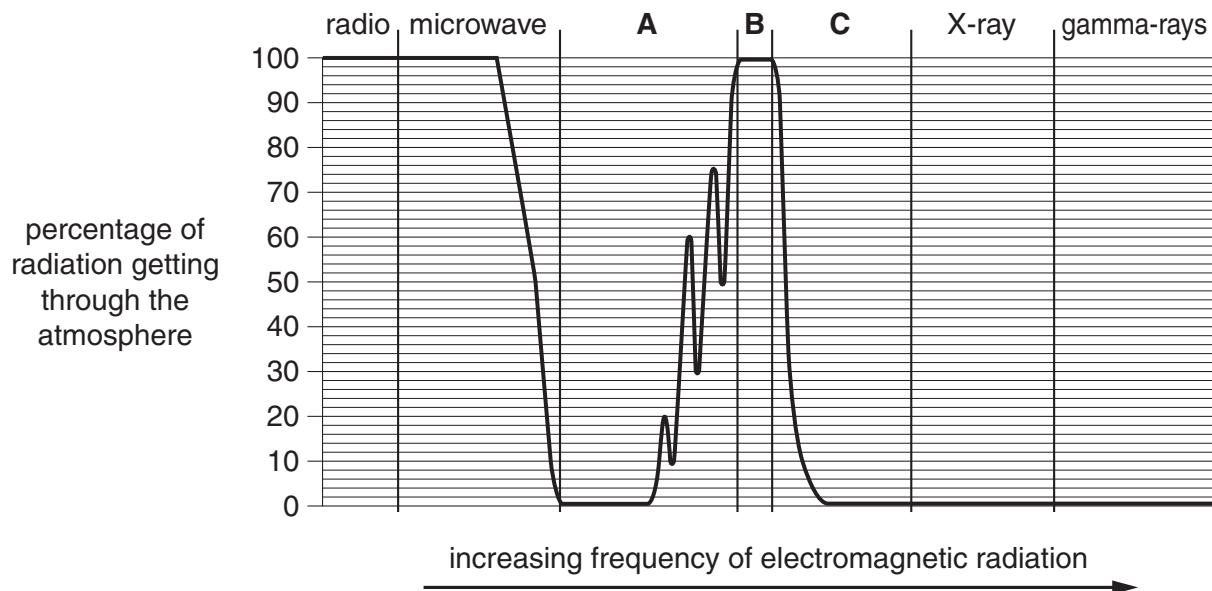
[Total: 2]

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6 The graph shows the percentage of different regions of the electromagnetic spectrum which can get through the Earth's atmosphere.

Three regions of the electromagnetic spectrum are not named.

(a) What are the names of regions **A**, **B** and **C** of the electromagnetic spectrum?

region **A** ....

region **B** ....

region **C** .... **[1]**

(b) (i) Radio waves are used to communicate with spacecraft.

Which of the following statements is the correct explanation for this, according to the data shown on the graph?

Put a tick (✓) in the box next to the correct statement.

The atmosphere absorbs radio waves. ☐

The atmosphere emits radio waves. ☐

The atmosphere reflects radio waves. ☐

The atmosphere transmits radio waves. ☐

[1]

   (ii) Microwaves are used to carry satellite television signals. These are in the part of the microwave region with lower photon energies. Use information from the graph to justify why lower photon energies are used.

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.... **[2]**

(c) Look at the region **A** on the graph.

Describe how different frequencies in this region are affected by the atmosphere.

....

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.... **[2]**

(d) The graph shows that X-rays and gamma rays do not reach the Earth's surface.

Explain why, using ideas about photon energy and ionisation.

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.... **[2]**

[Total: 8]

Turn over

7 Over the last few years, digital radios have become popular.

One of the advantages of digital radios is that they are not affected by noise as much as analogue radios.

Explain how the differences between digital and analogue signals make this possible.

You may draw diagrams to help your answer.

The quality of written communication will be assessed in your answer.

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.... **[6]**

[Total: 6]

8 Microorganisms can enter the body and cause illness.

Vaccinations can provide protection against some microorganisms.

(a) Put a tick (✓) in the box next to the correct word to complete each sentence.

Vaccines usually contain a

harmful	
resistant	
safe	

form of a disease-causing microorganism.

Vaccination establishes

dead	
memory	
stem	

cells in the body.

On reinfection
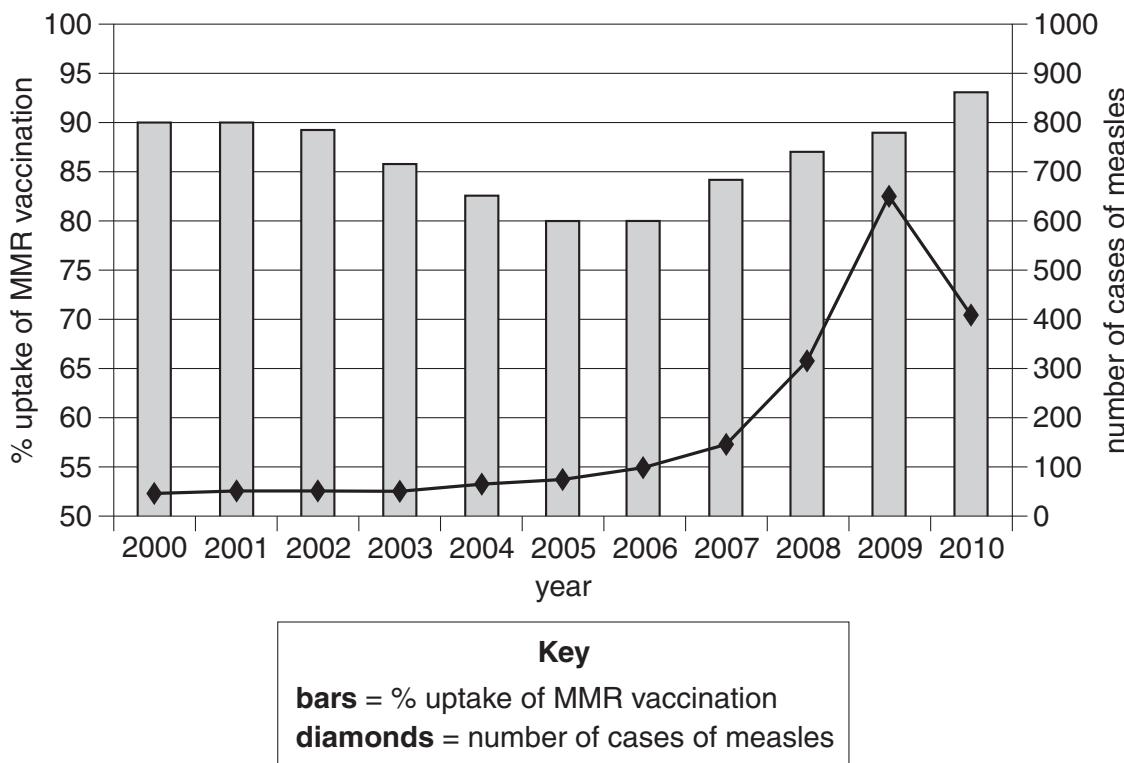
| antibiotics	
antibodies	
antigens	

are produced more quickly.

[2]

Turn over

(b) The MMR vaccination provides protection against measles. Measles is a disease caused by a microorganism.

The graph shows the percentage of children receiving the MMR vaccination and the number of cases of measles in a country over a period of 11 years.

Key

bars = % uptake of MMR vaccination
diamonds = number of cases of measles

- **(i)** Calculate the percentage increase in the number of cases of measles between 2006 and 2009.
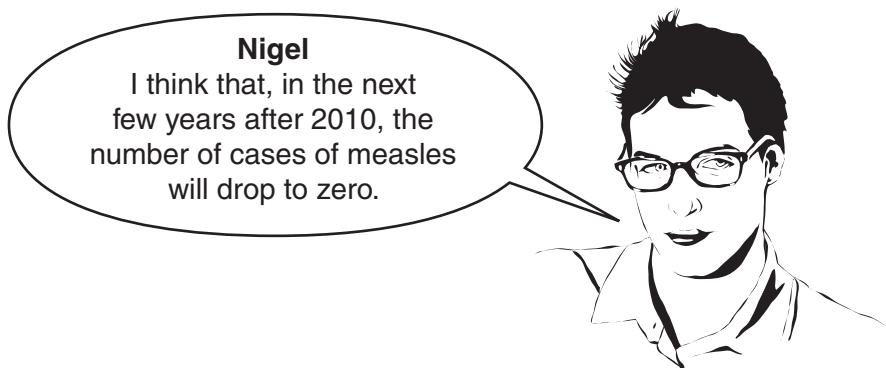
  [2]

- **(ii)** How does the graph suggest an explanation for the increase in the number of cases of measles between 2006 and 2009?

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  .... **[2]**

(c) Nigel is looking at the graph.

Nigel
I think that, in the next few years after 2010, the number of cases of measles will drop to zero.

Discuss arguments for and against Nigel's idea.

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.... **[2]**

[Total: 8]

Turn over

9 Read the article about heart disease.

> **Working overtime can lead to heart disease**
>
> Scientists have found that people who work more than 8 hours per day have a much greater risk of developing heart disease than those working less than 8 hours per day.
>
> People who work 12 hours per day have a 60% higher risk of developing heart disease than people who work 8 hours.
>
> This could be because they suffer from more stress or because they have less time to exercise.

(a) The article suggests that stress could be a factor in the development of heart disease.

Look at the statements about the effects of stress on the heart muscle.

Not all of the statements are correct, and they are in the wrong order.

When the correct statements are put in the correct order, they explain how stress may cause a heart attack.

    A   The lining of the arteries can be damaged by high blood pressure.

    B   Less oxygen reaches the heart muscle.

    C   Blood supply through the artery is dramatically reduced.

    D   More oxygen reaches the heart muscle.

    E   Blood clots can form where the artery has been damaged.

    F   Fatty deposits occur in the damaged veins leading to the heart.

    G   Stress is commonly associated with high blood pressure.

Choose the correct statements and then write the letters in the boxes to show the correct order.

One has been done for you.

G				

[2]

(b) (i) People who work 8 hours per day have a 4% risk of suffering from heart disease.

Show that the percentage risk of suffering from heart disease if a person works 12 hours per day is 6.4%.

[1]

(ii) A company has 1000 employees. They all work for 12 hours per day.

The company predicts that 64 employees will develop heart disease.

Suggest why this does not mean that exactly 64 employees will develop heart disease.

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.... [1]

(c) (i) The results of this study are published in a scientific journal.

Before publication, the results are sent to other scientists for them to read.

Name this process.

.... [1]

(ii) Explain why this process is carried out.

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.... [1]

[Total: 6]

Turn over

10 Maintaining a balanced water level in the body is very important.

The amount of water entering Jessica's body is approximately the same every day.

The table shows the water loss from Jessica's body on a day when she is not very active.

	volume of water lost in cm^3 per day
urine	1 500
sweat	500
breathing	400
faeces	100

On the following day, Jessica is much more active. This changes some of the figures in the table.

Explain how the figures would change by describing how Jessica's body would balance her water levels.

✎ *The quality of written communication will be assessed in your answer.*

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.... **[6]**

[Total: 6]

END OF QUESTION PAPER