OCR
RECOGNISING ACHIEVEMENT

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Thursday 12 January 2012 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE
SCIENCE A

A141/01   Modules B1 C1 P1 (Foundation Tier)

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

Duration: 1 hour

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 physics equations is printed on page 2.
* The total number of marks for this paper is **60**.
* This document consists of **24** 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 Huntington's disease is a genetic disorder.

(a) Write down one **symptom** of Huntington's disease.

.... **[1]**

(b) Alesha's father has Huntington's disease but Alesha's mother does not.

Huntington's disease is caused by a dominant allele.

(i) The Punnett square shows all the possible alleles that Alesha could have inherited from her parents.

Complete the Punnett square to show the alleles of Alesha's parents.

key	**Alesha's mother**	
H = Huntington's disease allele h = normal allele	....	....

		Alesha's mother	
Alesha's father	....	Hh	Hh
	....	hh	hh

[2]

(ii) Use the Punnett square to work out the probability that Alesha has Huntington's disease.

Put a (ring) around the correct answer.

0   0.25   0.5   0.75   1

[1]

(c) The symptoms of Huntington's disease do not usually develop until middle age.

Alesha is 19 years old and she does not know if she has inherited Huntington's disease.

Alesha can have a genetic screening test. The test will tell her if she has inherited Huntington's disease.

She is unsure whether to have the test.

Suggest one reason **for** and one reason **against** Alesha deciding to have the test.

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.... **[2]**

[Total: 6]

Turn over

2 Simone found out about Mendel, a scientist who investigated inheritance.

Mendel could not use humans in his experiments so he used pea plants.

Pea plants are either tall or short. This is controlled by one gene with two alleles.

Mendel allowed **two tall** parent plants to reproduce sexually.

He counted the number of tall plants and the number of short plants produced.

Simone did Mendel's experiment and then repeated it.

Look at her results.

	number of plants counted	
	tall	**short**
experiment 1	6	4
experiment 2	152	48

(a) (i) Calculate the ratio of tall to short plants produced in experiment 1.

Write your answer in its simplest form.

ratio of tall to short plants = ... **[1]**

(ii) Simone calculates that 60% of the 10 plants in experiment 1 were tall.

She uses the following formula.

$$\frac{\text{number of tall plants counted}}{\text{total number of plants counted}} \times 100$$

Use this formula to calculate the percentage of plants in experiment 2 that were tall.

Put a ring around the correct answer.

15%   24%   48%   60%   76%

[1]

(b) Simone thinks that the allele for short plants must be recessive.

Use evidence from her experiments to explain why she is correct.

....

....

.... **[2]**

(c) Simone compares the results of her two experiments. She knows the results that are expected.

Complete the sentences.

Put a (ring) around the correct option to join the start of the sentence to its end.

The results of experiment 2 are likely to be …

closer to

the same as

further away from

… the expected results.

This is because there are …

more plants

the same number of plants

fewer plants

… counted in experiment 2.
[2]

[Total: 6]

3 Thomas and James are identical twin boys.

Thomas   **James**

(a) Explain why identical twins look very similar, but have some differences in their appearance.

You may use examples from the diagrams to support your answer.

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

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.... **[6]**

(b) Thomas and James are both boys.

Their sex depends on the sex chromosomes they inherited from their parents.

The sentences below are about the inheritance of sex chromosomes.

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

Each body cell in a human male contains

XY	
YY	
XX	

chromosomes.

Each body cell in a human female contains

XY	
YY	
XX	

chromosomes.

Human egg cells contain one

Y	
X	
Z	

chromosome.

[2]

[Total: 8]

4 Read this information about hybrid cars.

> The Government is encouraging people to buy hybrid cars.
>
> Some of the power in hybrid cars comes from an engine that burns petrol.
> The rest of the power comes from an electric motor that runs off a battery.
>
> The battery is recharged when the brakes are used.
> The battery does not have to be recharged from mains electricity.
>
> Hybrid cars make less air pollution than cars that only have a petrol engine.

(a) Why do hybrid cars make less air pollution?

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

The car is heavier because it contains an engine and an electric motor. ☐

The battery stops polluting gases reaching the air. ☐

The electric motor means less petrol is burned. ☐

The battery stores energy that would otherwise be wasted. ☐

[1]

(b) Dave drives his car 16 000 km each year.

(i) At first Dave has an old car that only burns petrol.

He uses 1200 kg of petrol each year.

Each kilogram of petrol burns to make 2.1 kg of carbon dioxide.

Show that Dave's car puts 2520 kg of carbon dioxide into the air each year.

[1]

(ii) Dave changes his car for a hybrid model.

His new car makes 90 g of carbon dioxide per kilometre.

He still drives 16 000 km in one year.

How much **less** carbon dioxide is made in one year in Dave's new car compared with his old one?

.... kg **[2]**

(c) Most of the carbon dioxide from car engines does not stay in the air.

What happens to the carbon dioxide?

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

It reacts with oxygen in the air.   ☐

It is used by plants in photosynthesis.   ☐

It is deposited on surfaces.   ☐

It is used by animals in respiration.   ☐

It dissolves in sea water.   ☐

[2]

Turn over

(d) Driving hybrid cars lowers pollution from cars.

Describe other ways of lowering pollution from cars.

For each one, explain in **detail** why it lowers air pollution.

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

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.... **[6]**

[Total: 12]

5 **(a)** Carbon can react with oxygen to make **carbon monoxide**.

Two carbon atoms react with one molecule of oxygen.

This is the word equation for the reaction.

carbon + oxygen ⟶ carbon monoxide
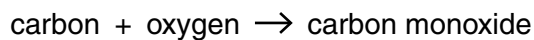
Below is a diagram of the reaction.

One molecule is missing.
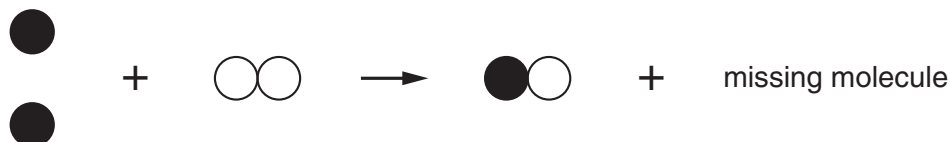
Which of the molecules below is the missing molecule?

Put a ⬭ring around the correct answer.

[1]

(b) Burning fossil fuels makes carbon dioxide as well as carbon monoxide.

Explain why this happens.

You must write about

- where the carbon atoms and oxygen molecules come from
- why carbon monoxide is made instead of carbon dioxide.
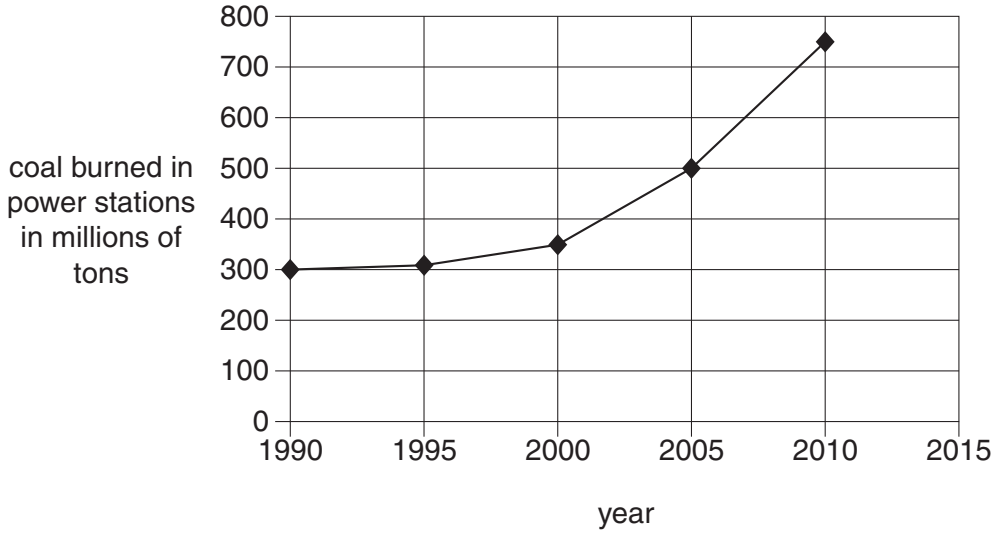
....

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.... [3]

[Total: 4]

Turn over

6 China makes electricity from coal-burning power stations.

Look at the two graphs.

This graph shows the amount of coal burned in power stations in China each year.

coal burned in power stations in millions of tons (y-axis: 0 to 800)
year (x-axis: 1990 to 2015)

This graph shows the amount of sulfur dioxide put into the air by China each year.

sulfur dioxide put into air in millions of tons (y-axis: 0 to 30)
year (x-axis: 1990 to 2015)
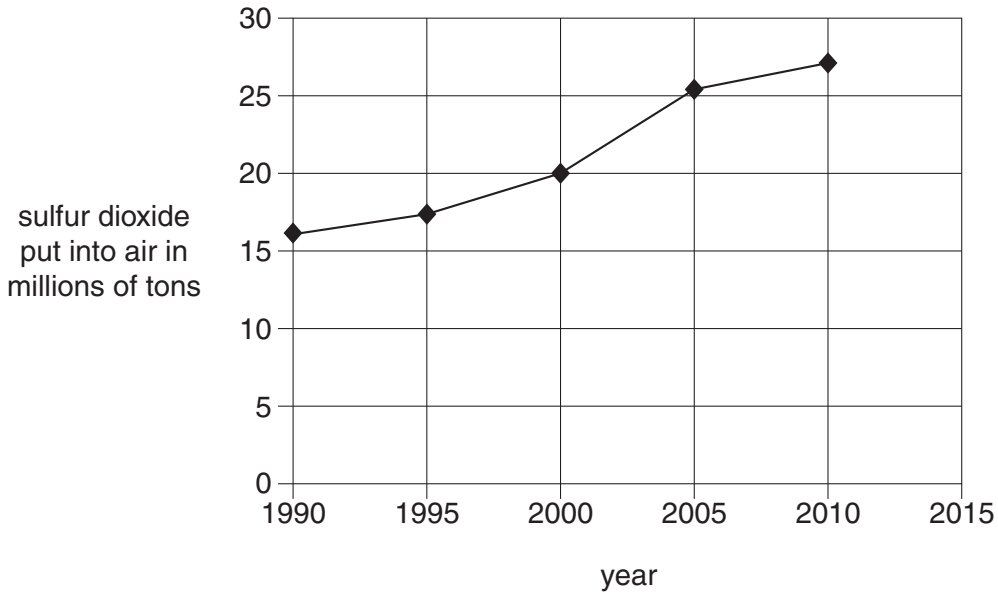
(a) What is the correlation shown by the data between 1990 and 2005?

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

As the amount of coal burned increases, the sulfur dioxide put into the air increases. ☐

Between 1990 and 2005, the amount of coal burned in China increases. ☐

More power stations are built in China every year. ☐

Burning coal has no effect on sulfur dioxide pollution. ☐

Modern power stations put less sulfur dioxide into the air than older ones. ☐

[1]

(b) Look at the shapes of the graphs from 2005 to 2010.

Compare the shapes of the two graphs.

What does this tell you about the amount of sulfur dioxide put into the air for each ton of coal burned?

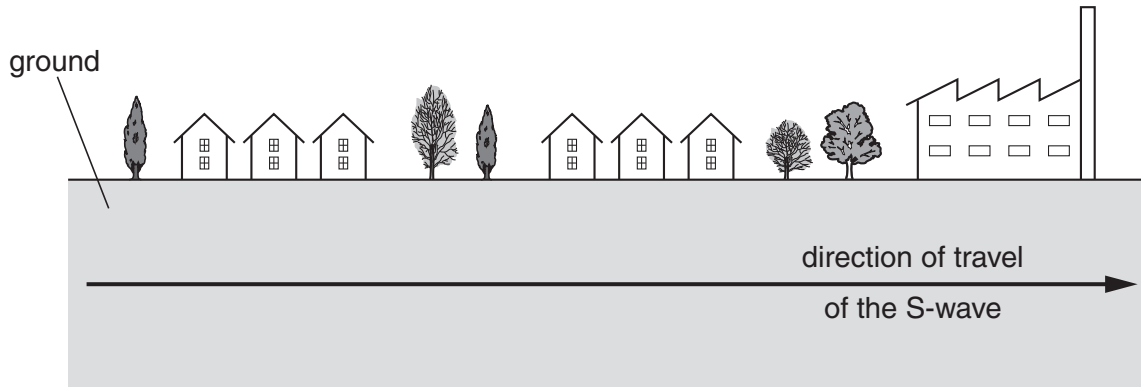Suggest reasons why this has happened.

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.... [3]

[Total: 4]

Turn over

7 When earthquakes occur, S-waves and P-waves are produced which travel through the Earth. S-waves are transverse.

(a) The diagram below shows the direction travelled by an S-wave moving through the ground.

ground

direction of travel
of the S-wave

Which arrow, **A**, **B** or **C**, shows the way the ground vibrates as the **transverse** S-wave moves through it in the direction shown above?

A   **B**   **C**
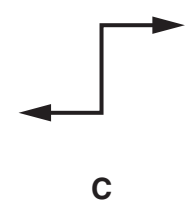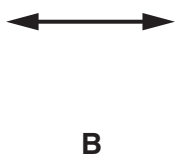
answer .... **[1]**

(b) The S-wave travels at 4 km/s. It takes 100 seconds to travel from an earthquake to a detector.

(i) What is the distance from the earthquake to the detector, measured in km?

Put a ⟨ring⟩ around the correct answer.

0.04   25   104   400

[1]

(ii) The P-wave travels at a speed of 6 km/s.

What does this tell us about the arrival time of the two waves at the detector?

Explain your answer.

....

....

.... **[2]**

(c) The speeds of the S-waves and P-waves can be calculated from their wavelengths and frequencies.

    (i) Calculate the speed of an earthquake wave with wavelength 400 metres and frequency 10 hertz.

speed = ... m/s **[2]**

    (ii) Is this an S-wave or a P-wave?

    Explain your answer.

....

.... **[1]**

[Total: 7]

8 In 1912, Alfred Wegener presented his theory of continental drift. It was not believed at the time.

Explain Wegener's theory and give reasons why geologists in 1912 did not believe his theory.

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

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.... **[6]**

[Total: 6]

9 Many people like to look at the stars at night.

   Read what these four people have to say.

Ann

I live in the city. I can see the Moon, but I can't see many stars because the street lights are too bright.

Ben

I live in the country. On a clear night I can see thousands of stars.

Colin

It's so cloudy where I live that I can't see the stars at all on most nights!

Diana

I use my binoculars to see Jupiter's moons and also some galaxies.

(a) Who is talking about light pollution?

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

Ann ☐

Ben ☐

Colin ☐

Diana ☐

[1]

(b) Who is talking about objects in our solar system?

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

Ann ☐

Ben ☐

Colin ☐

Diana ☐

[2]

[Total: 3]

10 Look at the speed-distance graph for five galaxies, **A**, **B**, **C**, **D** and **E**.
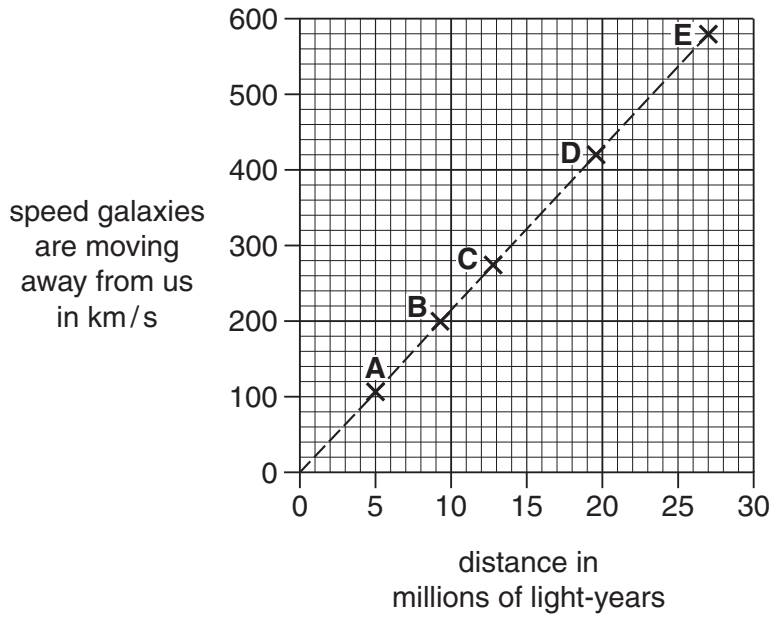
(a) Write down the distance to galaxy **A**.

distance = ... million light-years **[1]**

(b) Describe what the graph shows about these galaxies.

....

....

.... **[1]**

(c) The distance to galaxy **B** was actually a best estimate obtained from six galaxies in the same part of the sky all moving at 200 km/s.

The table shows the distances to these six galaxies.

distance in millions of light-years	9.3	9.0	9.2	9.4	9.1	6.6

The value for galaxy **B** shown on the graph was found from

$$\frac{9.3 + 9.0 + 9.2 + 9.4 + 9.1}{5} = 9.2$$

Is this a suitable method for calculating the best estimate of the distance to galaxy **B**?

Explain your answer.

....

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.... **[2]**

[Total: 4]

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