

**Monday 20 May 2013 – Afternoon**

**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.

**OCR supplied materials:**  
None

**Other materials required:**

- Pencil
- Ruler (cm/mm)

**Duration:** 1 hour



Candidate forename		Candidate surname	
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Centre number						Candidate number				
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**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.

## TWENTY FIRST CENTURY SCIENCE EQUATIONS

### Useful relationships

#### The Earth in the Universe

$$\text{distance} = \text{wave speed} \times \text{time}$$

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

#### Sustainable energy

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{voltage} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

#### Explaining motion

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

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

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved in the direction of the force}$$

$$\text{amount of energy transferred} = \text{work done}$$

$$\text{change in gravitational potential energy} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

#### Electric circuits

$$\text{power} = \text{voltage} \times \text{current}$$

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

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

#### Radioactive materials

$$\text{energy} = \text{mass} \times [\text{speed of light in a vacuum}]^2$$

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**Question 1 begins on page 4**

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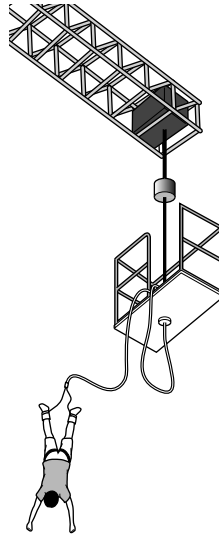
Answer **all** the questions.

- 1 This is a question about cords made for bungee jumping.

In bungee jumping you jump from a high structure.

You are connected to the structure by an elastic cord. You fall until the cord stretches and then rebound.

After that you bounce up and down.





- (b) Cars can be bounced on bungee cords.  
More than one cord is used.

You can work out the number of cords needed using this equation.

$$\text{number of cords} = \frac{\text{mass of car in kg} \times 2}{\text{mass to break one cord in kg}}$$

Cord **C** is used for this purpose.  
Work out how many cords will be needed for a car of mass 1200 kg.

answer ..... cords [2]

- (c) Students test the mass needed to break a **different** bungee cord.  
Here are their results for five pieces of this cord.

Piece	1	2	3	4	5	mean
Mass to break cord in kg	275	278	256	271	275	<b>271</b>

- (i) One of these results is an outlier.

The students agree that they should not discard this outlier.

Suggest reasons why they should not discard this outlier.

.....

.....

.....

..... [2]

- (ii) The students test pieces of the same cord after it has been flexed and stretched many times. Here are their results.

Piece	1	2	3	4	5	mean
Mass to break cord in kg	269	238	229	266	243	249

The students compare these results with those in part (i). They agree that they are different. This is what they say.

**Anna**  
There is 22 kg difference in the mean values so the sets are very different.

**Barry**  
They are different because the means of each set lie outside the range of the other set.

**Dan**  
They are different because the range in the second set is bigger than in the first.

**Carly**  
Repeating measurements leads to a better estimate of the difference.

**Ed**  
The ranges overlap. This shows there is a difference between sets of results.

Which student is giving the **best** reason for deciding that the results are different?

answer ..... [1]

- (iii) The students explain why the mass to break a bungee cord is different after it has been flexed and stretched many times. Here are some statements they make.

- A** Every cord is different from any other one.
- B** The flexing and stretching strengthens the ends of the cord.
- C** The flexing and stretching weakens some parts of the cord.
- D** The flexing and stretching changes the thickness of the ends of the cord.

Look at the data in (i) and (ii).

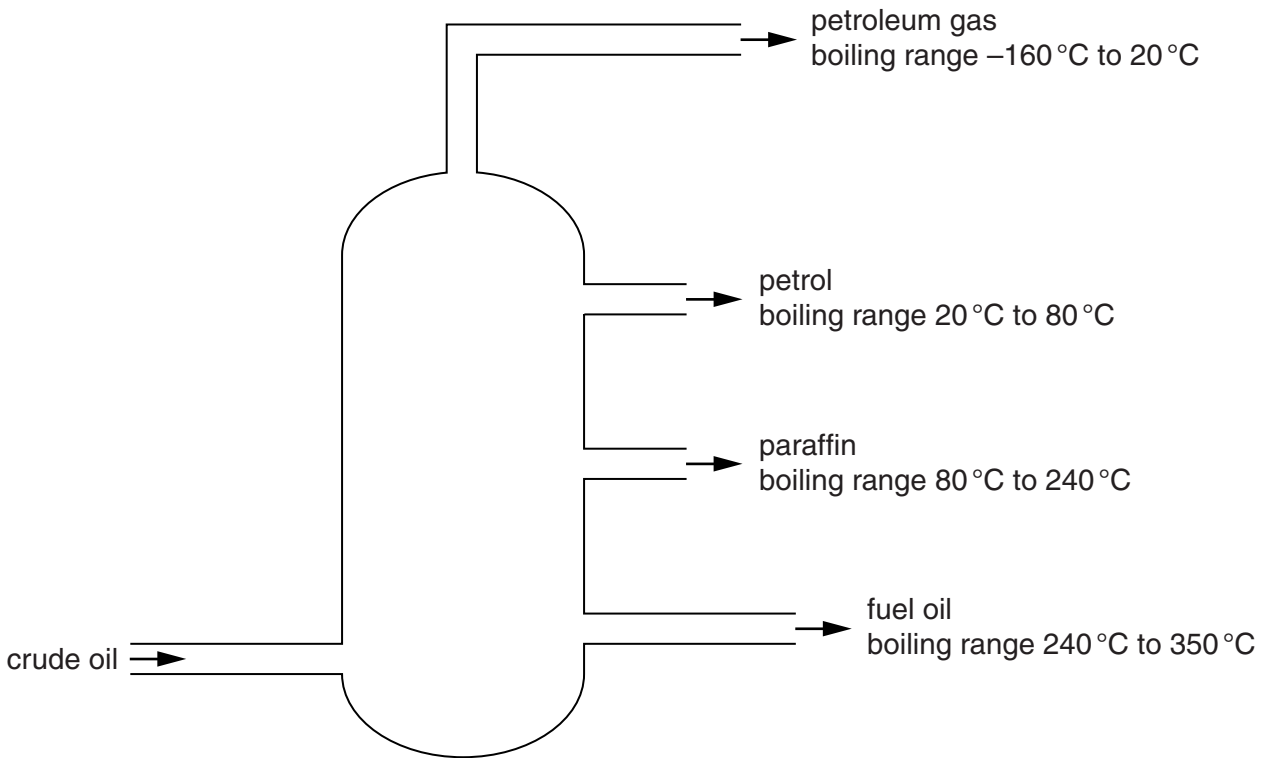
Which statement gives the best **explanation** about why the mass to break a bungee cord is different?

answer **A, B, C or D** ..... [1]

[Total: 12]

Turn over

- 2 In an oil refinery crude oil is distilled into fractions.  
Each fraction is a mixture of substances with similar boiling points.



Use ideas about forces and molecules to explain why different fractions boil at different temperatures.

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..... [4]

[Total: 4]



3 Polymers are stronger if they are more crystalline.

(a) Which **two** statements, when put together, explain why a more crystalline polymer is stronger?

The forces between the atoms in the polymer are larger.

The forces between polymer molecules are larger.

Extra atoms are linking the polymer molecules together.

The forces between molecules increase with increasing size.

More strength is needed to break bonds in the molecules.

More strength is needed to pull the molecules apart.

[2]

(b) Changing crystallinity can alter the flexibility of a polymer.

Write down **two** other changes to the structure of a polymer that can make it more flexible.

1 .....

2 .....

[2]

[Total: 4]

4 In the first months of 2011 the layer of ozone over the North Pole was the thinnest on record.

(a) Complete the sentences to describe how the ozone layer prevents damage to living organisms. Use the words in this list.

**electrons      ions      molecules      photons**

High energy ..... can remove ..... from ..... in living cells.

Exposure to ultraviolet radiation produces ..... which can damage living cells.

The ozone layer absorbs high frequency ultraviolet radiation.

[2]

(b) Ultraviolet radiation can damage living cells, but radio waves of the same intensity cannot.

Which of the following is the best explanation for this?

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

Radio waves do not damage living cells because ...

... radio photons do not have enough energy.

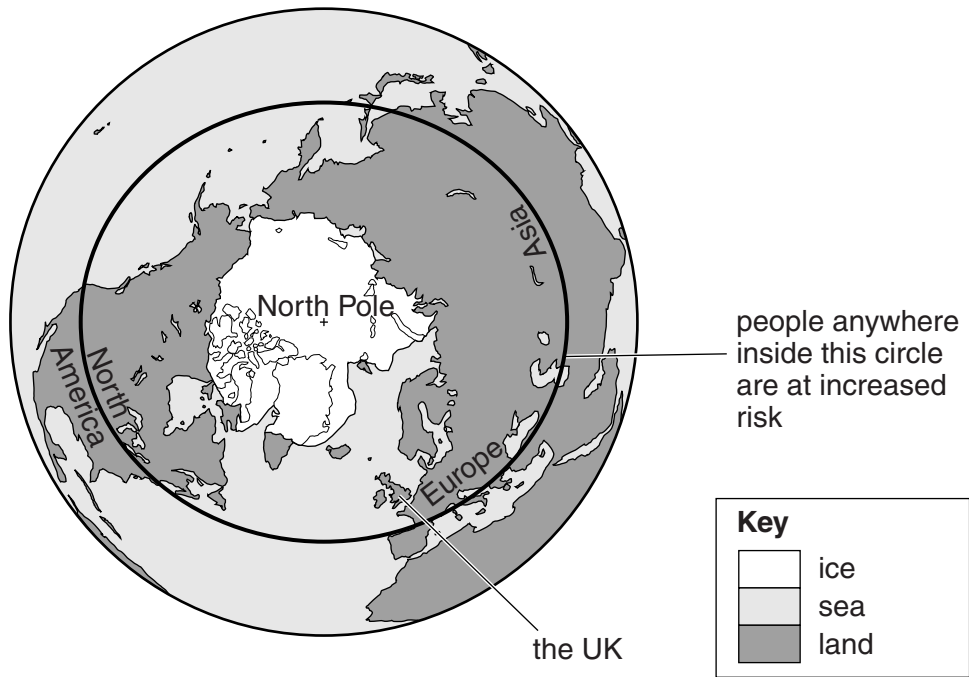
... radio waves are not part of the electromagnetic spectrum.

... radio waves do not consist of photons.

... radio waves have too high a frequency.

[1]

(c) As the ozone layer over the North Pole becomes thinner, there are increased health risks to people in the area shown on the diagram.



Describe and explain one way in which people living in this area can reduce these risks.

.....

.....

.....

..... [2]

(d) Which is the best explanation for the action of ultraviolet radiation on the ozone layer?

Use **one** straight line to join the two boxes which give the correct explanation.

Absorption of ultraviolet radiation ...

... is responsible for the hole in the ozone layer.

Transmission of ultraviolet radiation ...

... produces chemical changes to the ozone.

Reflection of ultraviolet radiation ...

... sends all of the ultraviolet radiation away from the Earth.

[1]

[Total: 6]

Turn over

5 This question is about the absorption of the Sun's energy by the planets.

(a) The solar constant is the energy received from the Sun each second by a square metre of surface. The table below shows how the solar constant depends on the distance from the Sun.

<b>Distance from Sun (millions of km)</b>	50	75	100	125	150
<b>Solar constant in J/s/m<sup>2</sup></b>	12 000	5400	3000	2000	1400

(i) Here are four properties of electromagnetic radiation. One of these is the same as the solar constant. Which one? Put a tick (✓) in the box next to the correct answer.

- frequency
- intensity
- photon energy
- speed

[1]

(ii) The planet Mars is about 250 million kilometres from the Sun. Use the data in the table to estimate the solar constant at Mars. Put a tick (✓) in the box next to the best estimate.

- 500 J/s/m<sup>2</sup>
- 1000 J/s/m<sup>2</sup>
- 4000 J/s/m<sup>2</sup>
- 8000 J/s/m<sup>2</sup>

[1]

(iii) The Earth and our Moon are both 150 million kilometres from the Sun. The following statements are all true. Which statement correctly explains why the Moon receives less energy than the Earth? Put a tick (✓) in the box next to the correct statement.

- The Earth has an atmosphere, but the Moon does not.
- The Earth rotates once a day while the Moon rotates once a month.
- The Moon has a much smaller surface area than the Earth.
- The Moon is all rocky, while the Earth has oceans.

[1]



**14**  
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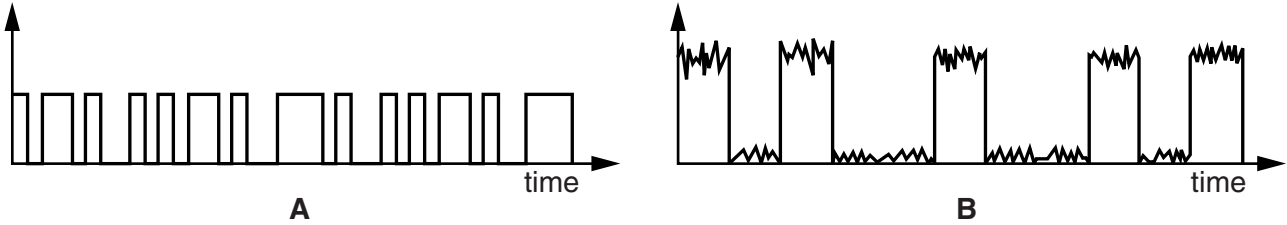
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6 This question is about signals used to transmit information.

(a) The graphs below show two digital signals. In each case, the first two codes of the signal are 1 and 0.

The x-axes (time) are drawn to the same scale.

The y-axes (signal intensity) are not to the same scale.



(i) Why is the scale on the **y-axes** not important when decoding these signals?

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

(ii) Describe the differences between signal **A** and signal **B**.

.....  
.....  
..... [2]

(b) Radio waves and infrared radiation are used to transmit signals in different circumstances. Describe and explain the different circumstances in which these two regions of the electromagnetic spectrum are used to transmit information.

.....  
.....  
.....  
..... [2]

[Total: 5]

7 Joanne goes to the doctors for a check-up.

The doctor takes Joanne's blood pressure.



(a) People's blood pressure can be placed in different categories.

High blood pressure is called hypertension.

Look at the table.

Higher value of blood pressure in mm Hg	Lower value of blood pressure in mm Hg	Blood pressure category
> 160	> 100	severe hypertension
140 – 160	90 – 99	moderate hypertension
120 – 139	80 – 89	mild hypertension
90 – 119	60 – 79	normal
< 90	< 60	low

(i) The doctor says that Joanne's blood pressure is 115 over 62.  
Use the table to make a conclusion about Joanne's blood pressure.

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

(ii) Joanne's brother, Andrew, is in the moderate hypertension category.

His blood pressure is 159 over 90.

Calculate by how much he will need to reduce the lower value of his blood pressure to move down to the normal category.

Show your working.

lower value needs to be reduced by ..... mmHg [1]



(iii) Andrew's doctor gives him a drug.

It lowers both of the values of his blood pressure by 10 mm Hg.

How effective has this drug been at reducing Andrew's hypertension?

.....

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..... [2]

(b) Andrew is worried about his high blood pressure.

He finds a scientific article on the internet.

... scientists suggest that the higher the number of fizzy drinks you drink per day, the higher the risk of having high blood pressure ...

(i) The article describes a correlation.

Draw a line on the axes to represent the correlation.



[1]

- (ii) Andrew is not very confident about the scientists' conclusion as he thinks there were some problems with the study.

Put ticks (✓) in the columns to show which aspects of the study might make Andrew more or less confident in the scientists' conclusions, or makes no difference.

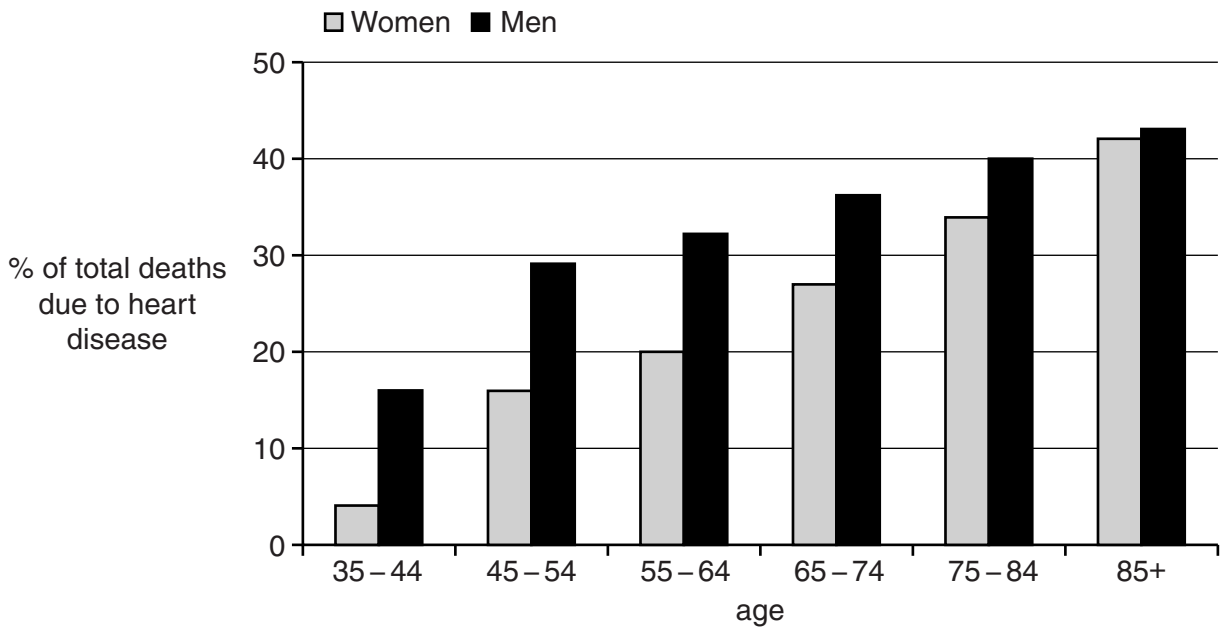
	More confident	Less confident	Makes no difference
the study was carried out in the USA			
100 000 people took part			
the study was peer reviewed			
it was carried out in 2011			
the study was funded by a company that sells fresh fruit juices			

[2]

- (c) High blood pressure is one factor that can increase the risk of heart disease.

Other factors include age and whether you are male or female.

Look at the bar chart.



Men are always at greater risk of heart disease than women.

Use the data to describe how age affects the risk of heart disease for men and women.

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.....

[2]  
[Total: 9]

8 The concentration of urine is controlled by a hormone called anti-diuretic hormone (ADH).

(a) Write down which part of the body releases ADH.

..... [1]

(b) Robert is exercising.

(i) Look at the statements about how Robert's body works to balance his water levels.

They are **not** in the correct order.

Put a (ring) around the correct word in each statement to describe what is happening when Robert exercises.

**A concentrated / dilute** urine released

**B** concentration of blood plasma **increases / decreases**

**C** kidneys reabsorb **less / more** water

**D less / more** ADH released

**E less / more** water is lost through breathing and sweating

[1]

(ii) Write the letters **A** to **E** in the boxes to show the correct order in which the statements in (b)(i) occur.

One has been done for you.

E				
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[1]

(c) Explain why the control of ADH secretion is an example of negative feedback.

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.....  
.....  
..... [2]

[Total: 5]

