

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**  
**GCSE**

**A142/02**

**TWENTY FIRST CENTURY SCIENCE**  
**SCIENCE A**

**Modules B2 C2 P2 (Higher Tier)**

**MONDAY 20 MAY 2013: Afternoon**

**DURATION: 1 hour**  
**plus your additional time allowance**

**MODIFIED ENLARGED**

<b>Candidate forename</b>		<b>Candidate surname</b>	
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<b>Centre number</b>						<b>Candidate number</b>				
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**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)**

**READ INSTRUCTIONS OVERLEAF**

## **INSTRUCTIONS TO CANDIDATES**

- Write your name, centre number and candidate number in the boxes on the first page. 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).

## **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 pages 3 and 4.
- The total number of marks for this paper is 60.
- 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**

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

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

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

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

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

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

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

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

## **ELECTRIC CIRCUITS**

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

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

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

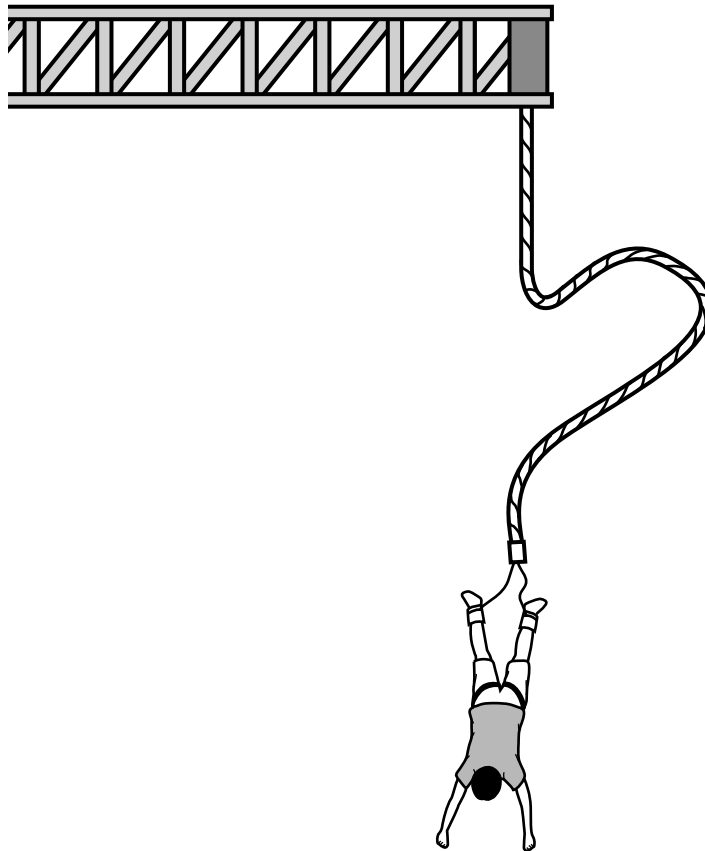
## **RADIOACTIVE MATERIALS**

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

**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.**



**(a) Here are safety rules for a bungee cord:**

**It must not break when a mass of 130 kg is hung on it.**

**The mass of 5 m of cord is 1 kg.**

**The mass of the person jumping will extend the cord between 110% and 140%.**

**The table gives properties of four cords A, B, C and D.**

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>MINIMUM MASS TO BREAK CORD IN kg</b>	<b>125</b>	<b>235</b>	<b>250</b>	<b>300</b>
<b>MASS OF 10 m CORD IN kg</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>
<b>MASS TO EXTEND CORD BY 50% IN kg</b>	<b>65</b>	<b>30</b>	<b>40</b>	<b>100</b>
<b>MASS TO EXTEND CORD BY 100% IN kg</b>	<b>120</b>	<b>60</b>	<b>70</b>	<b>190</b>
<b>MASS TO EXTEND CORD BY 150% IN kg</b>	<b>cord broke</b>	<b>80</b>	<b>90</b>	<b>280</b>

**Lee has a mass of 80 kg.**

**Which bungee cord would you choose for his jump?**

**Use the properties in the table to explain why you would use this cord and not the others.**



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

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**[6]**

- (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, in table on page 6, 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	271

- (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.

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[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 says, “There is 22 kg difference in the mean values so the sets are very different.”

BARRY says, “They are different because the means of each set lie outside the range of the other set.”

DAN says, “They are different because the range in the second set is bigger than in the first.”

CARLY says, “Repeating measurements leads to a better estimate of the difference.”

ED says, “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 (ii) and the data from stem repeated below.

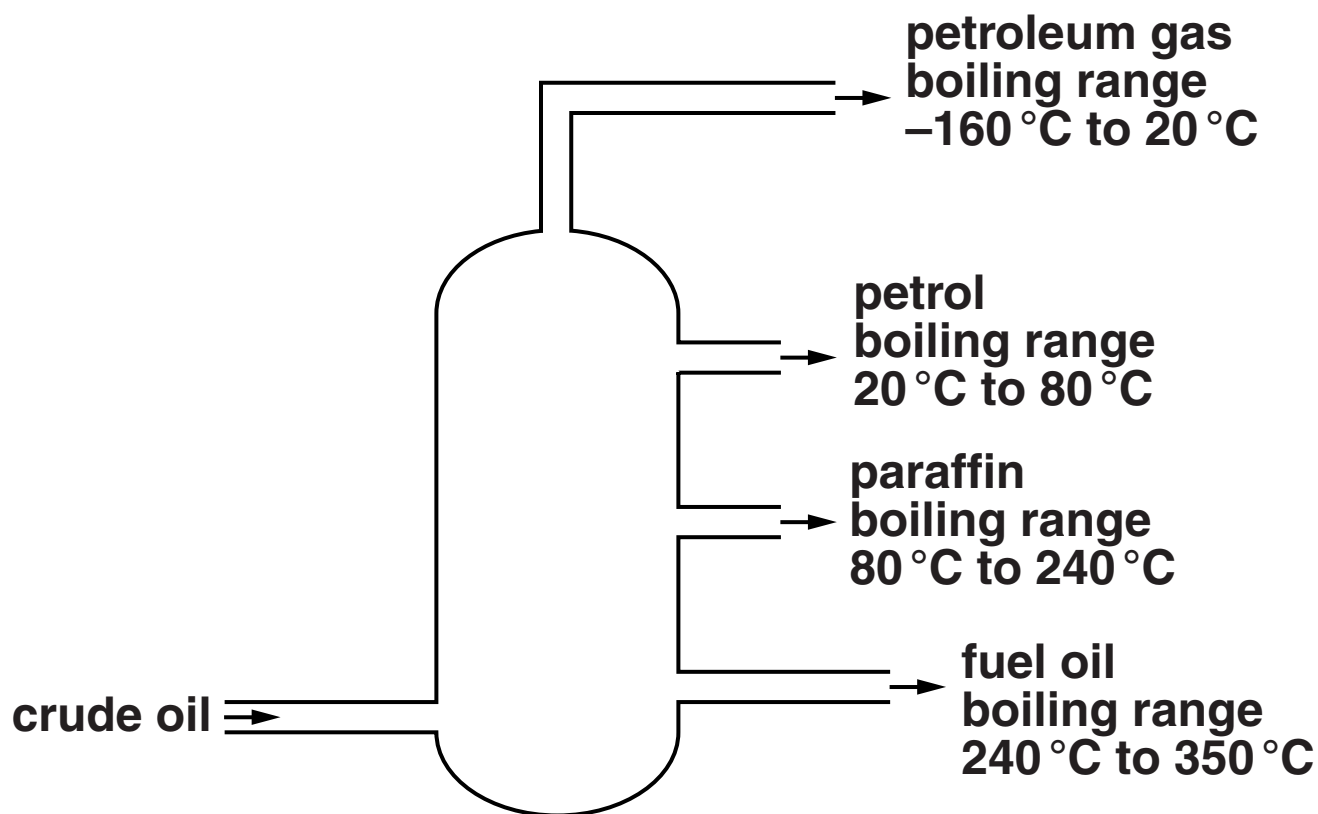
PIECE	1	2	3	4	5	MEAN
MASS TO BREAK CORD IN kg	275	278	256	271	275	271

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]

- 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.**

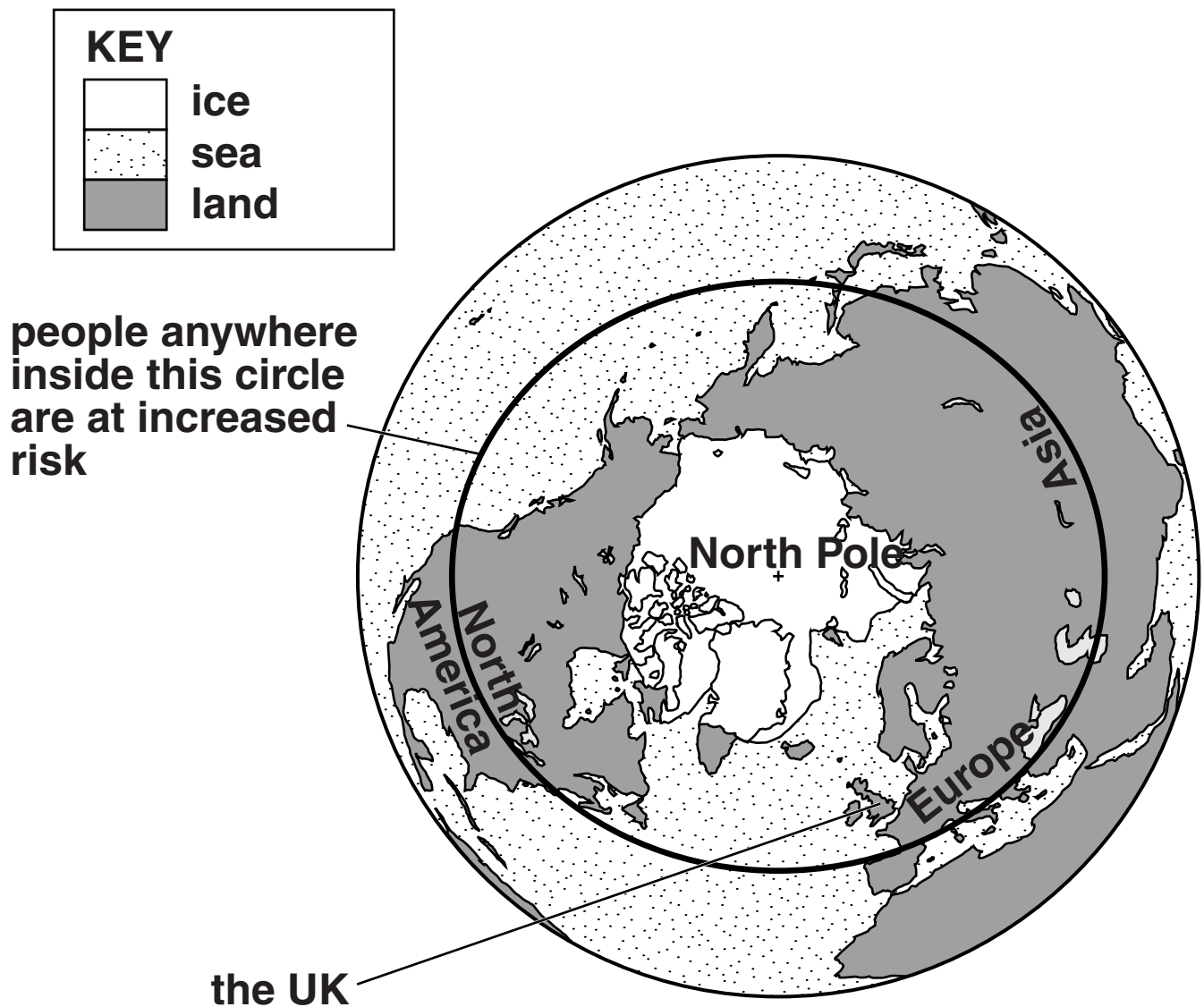
☐ **radio waves do not consist of photons.**

☐ **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 inside the circle on the diagram.



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

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**[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]**

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**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>	<b>50</b>	<b>75</b>	<b>100</b>	<b>125</b>	<b>150</b>
<b>SOLAR CONSTANT IN J/s/m<sup>2</sup></b>	<b>12 000</b>	<b>5400</b>	<b>3000</b>	<b>2000</b>	<b>1400</b>

**(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]

- (b) Venus is closer to the Sun than the Earth, but it is very much hotter than you would expect for a planet in its position.

Venus has a mean surface temperature of 460 °C, which is hot enough to melt zinc. The mean surface temperature of the Earth is 15 °C.

The atmospheres of the two planets are very different, as shown in the table below.

GAS	PERCENTAGE OF GAS IN THE ATMOSPHERE	
	EARTH	VENUS
ARGON	0.92	0.007
CARBON DIOXIDE	0.04	96.5
NITROGEN	77.3	3.5
OXYGEN	20.7	negligible
WATER VAPOUR	about 1	0.002
SULFUR DIOXIDE	negligible	0.015

**Using the data provided, explain the processes which have produced the difference in temperatures between Venus and the Earth, and why there are concerns about the future of the Earth.**



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

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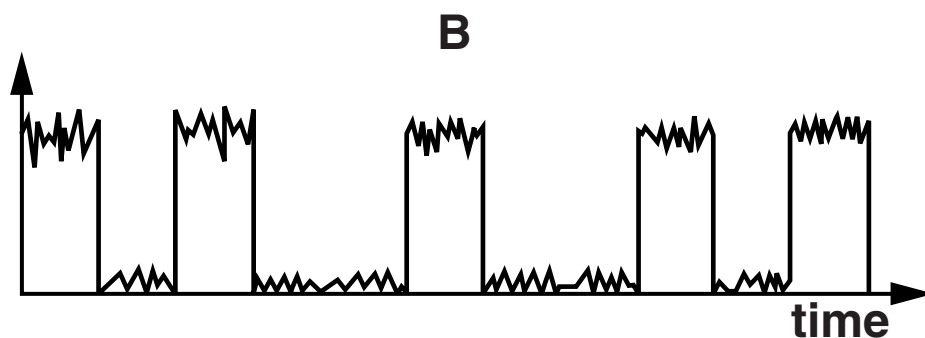
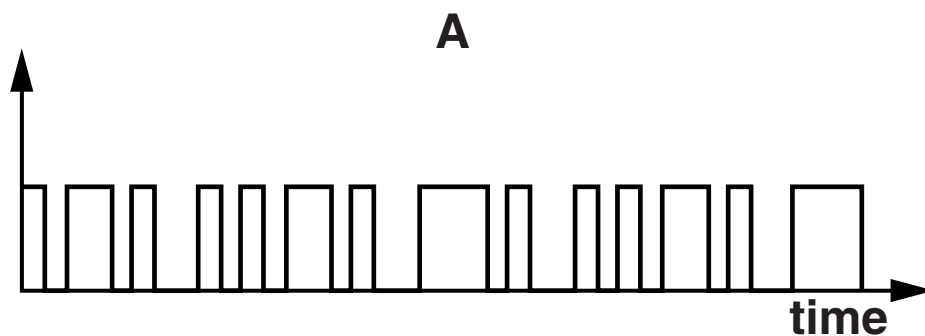
**[6]**

**[TOTAL: 9]**

**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?**

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**[1]**



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

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**[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.**

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**[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.**

<b>HIGHER VALUE OF BLOOD PRESSURE IN mm Hg</b>	<b>LOWER VALUE OF BLOOD PRESSURE IN mm Hg</b>	<b>BLOOD PRESSURE CATEGORY</b>
<b>&gt; 160</b>	<b>&gt; 100</b>	<b>severe hypertension</b>
<b>140 – 160</b>	<b>90 – 99</b>	<b>moderate hypertension</b>
<b>120 – 139</b>	<b>80 – 89</b>	<b>mild hypertension</b>
<b>90 – 119</b>	<b>60 – 79</b>	<b>normal</b>
<b>&lt; 90</b>	<b>&lt; 60</b>	<b>low</b>

**(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.**

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**[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 mmHg.

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

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[2]

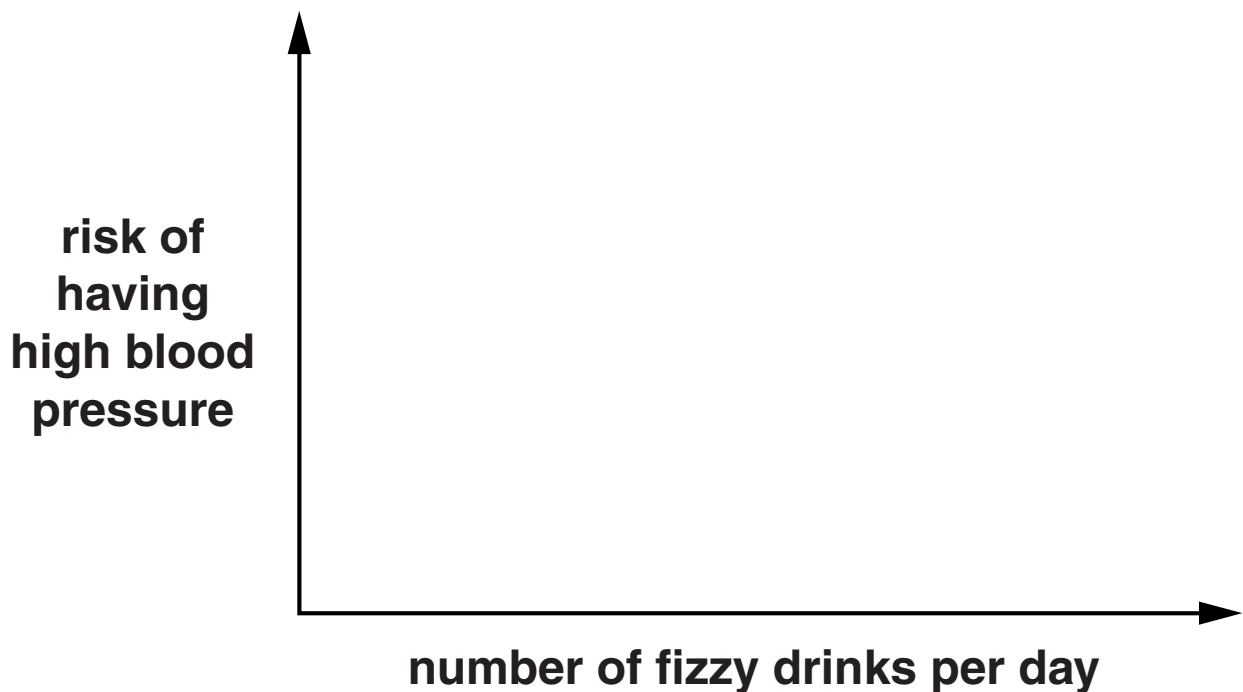
**(b) Andrew is worried about his high blood pressure.**

**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.

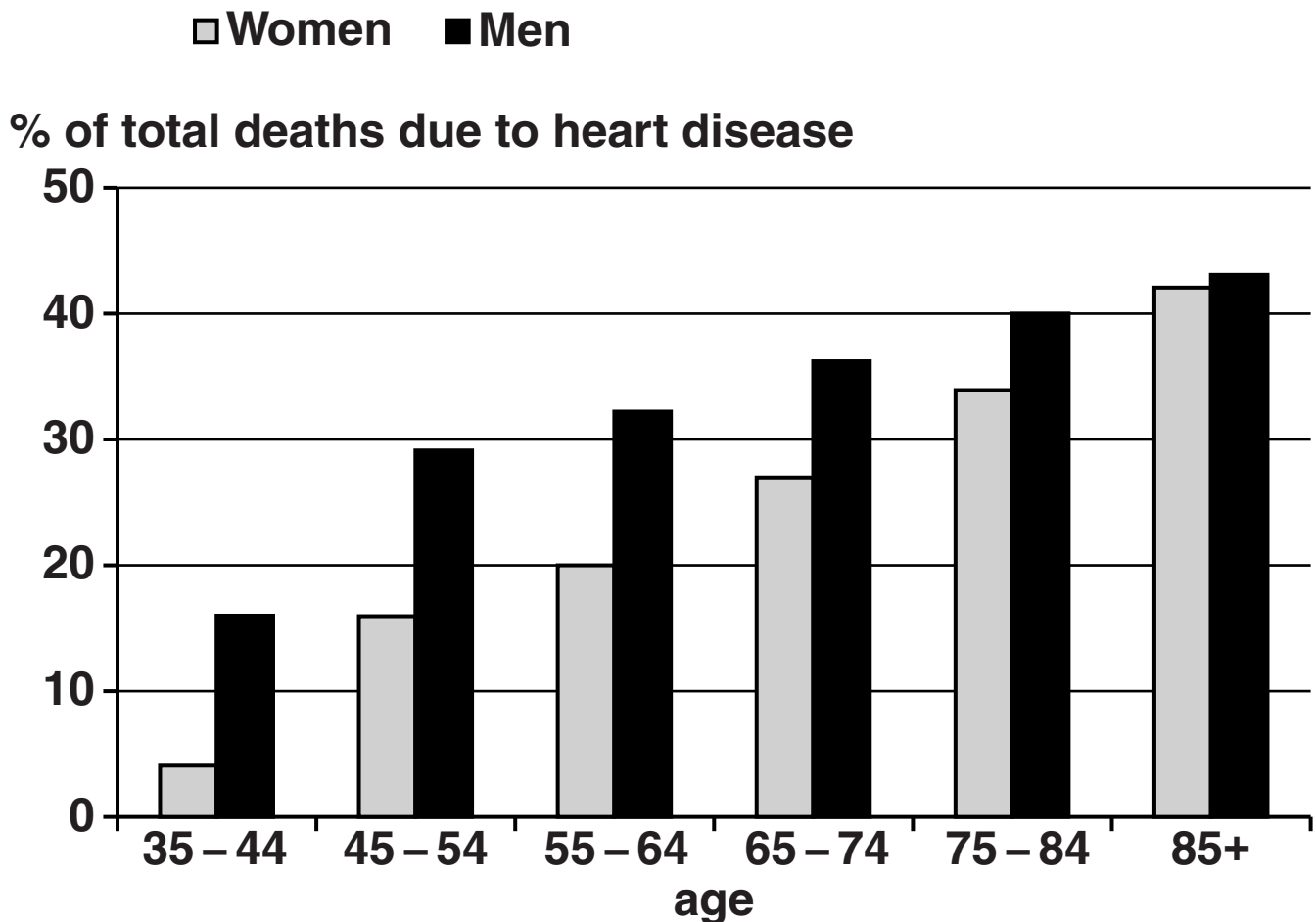
	<b>MORE CONFIDENT</b>	<b>LESS CONFIDENT</b>	<b>MAKES NO DIFFERENCE</b>
<b>the study was carried out in the USA</b>			
<b>100 000 people took part</b>			
<b>the study was peer reviewed</b>			
<b>it was carried out in 2011</b>			
<b>the study was funded by a company that sells fresh fruit juices</b>			

[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 opposite 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.

<b>E</b>				
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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]

- 9 A vaccine has been developed against cancer of the cervix and approved for use in the UK.**

**The vaccine protects against the human papilloma virus (HPV), the most common cause of this cancer. In the UK, approximately 1120 women die from this cancer each year.**

**The vaccine was given to teenage girls for the first time in September 2008.**

**In September 2009, a teenage girl died shortly after being given the cervical cancer vaccination.**

**This death sparked worry regarding the safety of having the vaccination.**

**Explain why girls should not be worried about having the vaccination and why the vaccination programme should continue.**



**[6]**

**END OF QUESTION PAPER**

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