

Candidate forename						Candidate surname					
Centre number						Candidate number					

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE

A142/02

TWENTY FIRST CENTURY SCIENCE
SCIENCE A

Modules B2 C2 P2 (Higher Tier)

FRIDAY 22 JUNE 2012: Afternoon

DURATION: 1 hour
plus your additional time allowance

MODIFIED ENLARGED

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 4–5.
- The total number of marks for this paper is 60.

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TWENTY FIRST CENTURY SCIENCE DATA SHEET

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

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

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

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

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

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

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

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

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

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

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

Answer ALL the questions.

1 Climbing ropes are made from fibres.

One hundred years ago fibres used in climbing ropes were made from plants.

The properties of these climbing ropes are shown in the table opposite.

(a) (i) The most commonly used rope for climbing was manila.

Which of the following statements explains why manila ropes were used?

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

Manila ropes are lighter and stronger in tension than the other types of rope.

☐

Manila ropes stretch well and absorb more water than jute ropes.

☐

Manila ropes are heavier than the other ropes.

☐

Manila ropes are strong in tension and absorb less water than jute and sisal.

☐

[1]

PROPERTY	ROPE MADE FROM ...			
	... COTTON	... JUTE	... MANILA	... SISAL
density in g/cm ³	1.54	1.50	1.62	1.43
tensile strength in N/mm ²	29 – 43	44 – 56	49 – 75	60 – 70
stretch at break point in %	3	2	7	3
moisture absorberency in %	25	45	33	51

(ii) The tensile strength of each rope is shown as a range.

It could be shown as the mean value.

Give TWO reasons why it is more useful to show the tensile strength as a range and not as the best estimate of the true value.

[2]

(b) Modern climbing ropes are made from nylon.

A scientist tests samples of a nylon rope.

Here are the results for its tensile strength.

SAMPLE	1	2	3	4	5
TENSILE STRENGTH IN N/mm²	62	66	75	79	73

(i) What is the best estimate of the tensile strength of the nylon rope?

tensile strength = _____ N/mm² [2]

Opposite is the property table repeated with the values for nylon added.

- (ii) The best estimate of the tensile strength of jute rope is 48 N/mm^2 .**

Use data from the table and the best estimates to decide whether there is enough evidence to conclude that nylon rope is stronger than jute rope.

Explain your answer.

[2]

- (iii) Why have nylon ropes replaced ropes made from plant fibres?
Use data from the table to explain your answer.**

[2]

[Total: 9]

ROPE MADE FROM ...					
PROPERTY	... COTTON	... JUTE	... MANILA	... SISAL	... NYLON
density in g/cm ³	1.54	1.50	1.62	1.43	1.14
tensile strength in N/mm ²	29 – 43	44 – 56	49 – 75	60 – 70	62 – 79
stretch at break point in %	3	2	7	3	22
moisture absorbcency in %	25	45	33	51	4

2 Some students are talking about the importance of crude oil as a source of new materials.

(a) Here is what they say.

DAVE says “Hydrocarbons are separated into their different sizes.”

GEORGIA says “The chain molecules are different lengths and are made up of only carbon and hydrogen atoms.”

TANYA says “Small molecules join together to make long chain molecules.”

CLAUDIA says “Large molecules are broken down to small molecules.”

SCOTT says “The larger the molecules, the larger the forces between them.”

(i) Who is talking about refining crude oil into fuels and lubricants?

answer _____ [1]

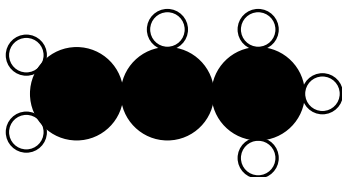
(ii) Who is describing polymerisation?

answer _____ [1]

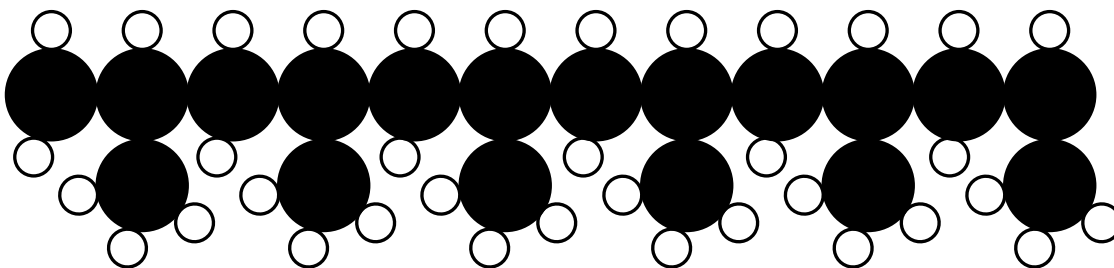
(iii) Who is explaining why small molecules boil at a lower temperature than large molecules?

answer _____ [1]

(b) A molecule of propene is shown in this diagram.



This diagram shows part of a molecule of polypropene.

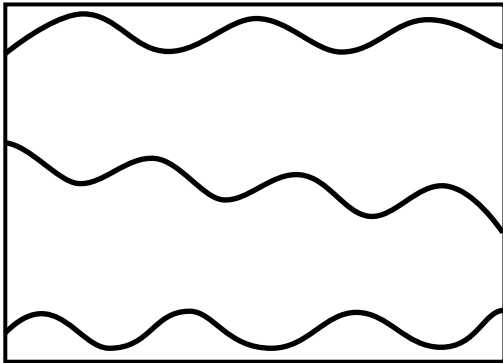


How many molecules of propene have joined to make this part of a polypropene molecule?

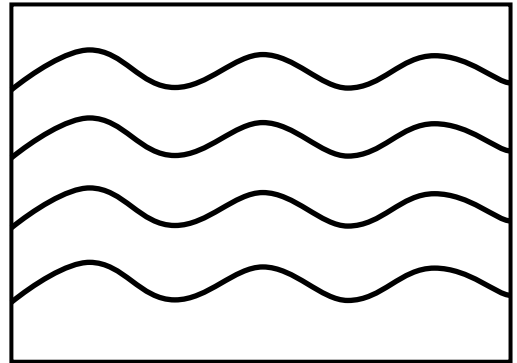
answer = _____ [1]

(c) 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]

(d) The students test TWO different samples of polypropene.

Here are their measurements.

PROPERTY	SAMPLE A	SAMPLE B
melting point in °C	170	130
flexibility	brittle	flexible

The properties of polymers can be changed by modifying their structures.

Suggest and explain why the two samples of polypropene have different properties.



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

[6]

[Total: 11]

3 Read this article.

EVERYBODY LIKES SUNNY WEATHER!

Sunlight is a source of natural light and energy. It is good for our general health and makes us feel good.

Although sunbathing may be enjoyable it is important to remember that too much exposure to sunlight is a health hazard. The ultraviolet (UV) radiation in sunlight can harm the skin, so many people take steps to protect themselves from its effects.

Sunburn often affects skiers, climbers and trekkers in the mountains. As you go higher, the Sun's UV rays become stronger.

The Sun's rays can also penetrate through water. When swimming, people can underestimate their exposure to sunlight because of the cooling effect of the water.

The article shows that ultraviolet radiation is hazardous but people still take part in activities that expose them to it.

Explain what the risk from exposure to ultraviolet radiation is, and suggest why people are willing to take this risk.

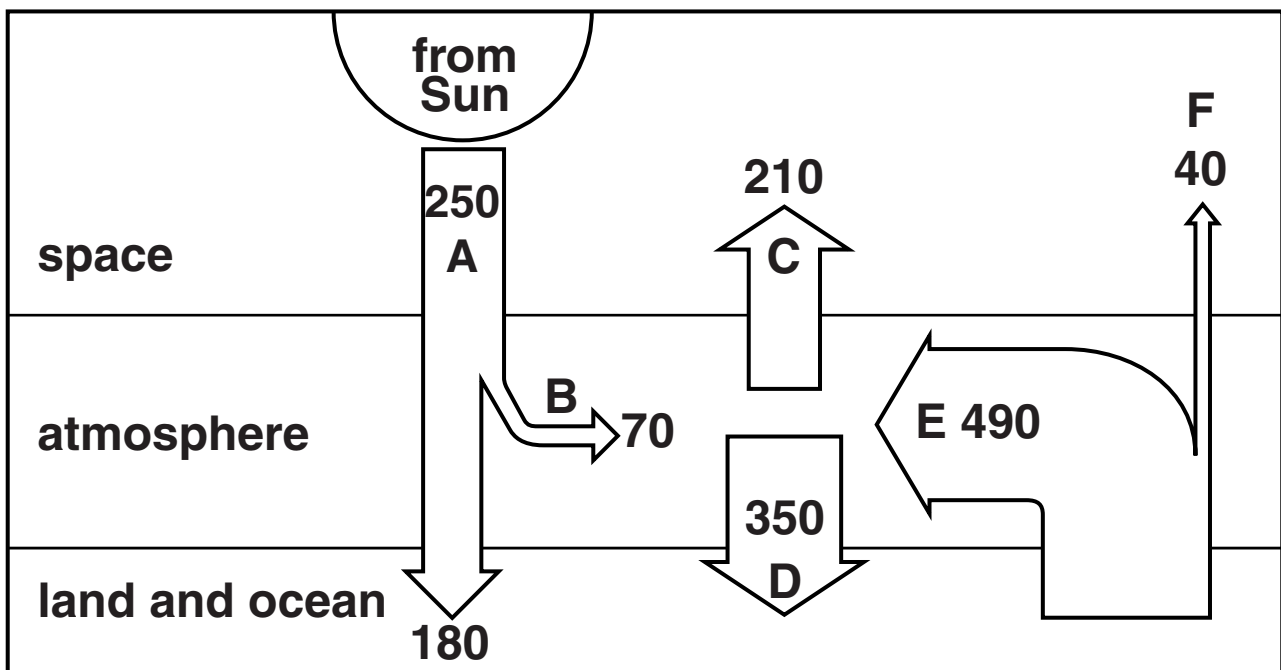


The quality of written communication will be assessed in your answer.

[6]

[Total: 6]

- 4 The diagram shows energy transfers to do with global warming.



The numbers on the diagram represent the amount of energy transferred in joules per m² per second, averaged over 24 hours. For example, the average energy from the Sun (A) reaching the top of the Earth's atmosphere is 250 joules per m² per second.

- (a) Use data from the diagram to confirm that there is no overall gain or loss of energy by the land and ocean.

Show your working.

[2]

- (b) Some of the energy values will change if the concentration of greenhouse gases in the atmosphere increases.**

Which ONE of A, B, C, D, E and F is unaffected by the concentration of greenhouse gases?

answer _____ [1]

- (c) The atmosphere warms up but the energy from the Sun stays the same.**

This is because TWO of A, B, C, D, E and F have increased.

Which two?

answer _____ and _____ [1]

[Total: 4]

5 Fig. 1 opposite shows part of a signal being sent to a receiver.

(a) Write down the digital code for this series of pulses.

_____ **[2]**

(b) The signal at the receiver, which is some distance from the transmitter, is shown in Fig. 2 opposite.

Fig. 2 has the same scale as the one on Fig. 1.

Identify and explain TWO differences between this received signal and the one emitted.

_____ **[4]**

[Total: 6]

signal
strength

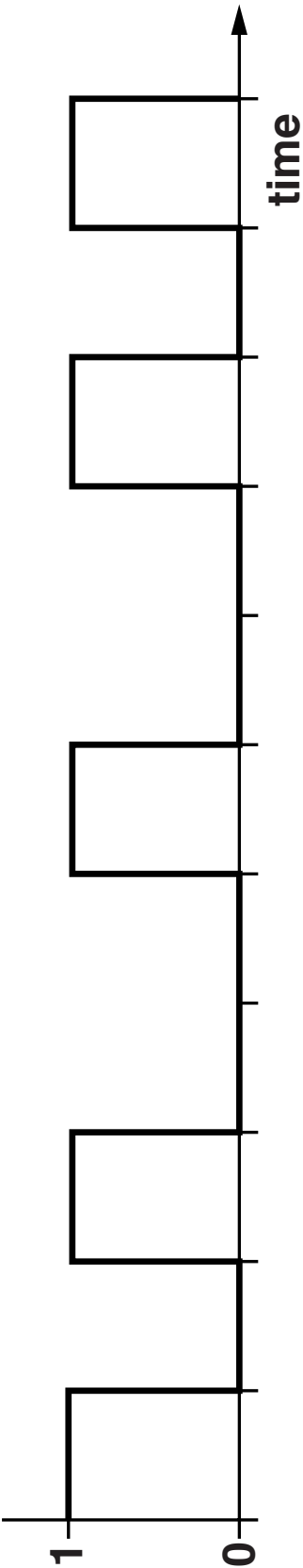


Fig. 1

signal
strength

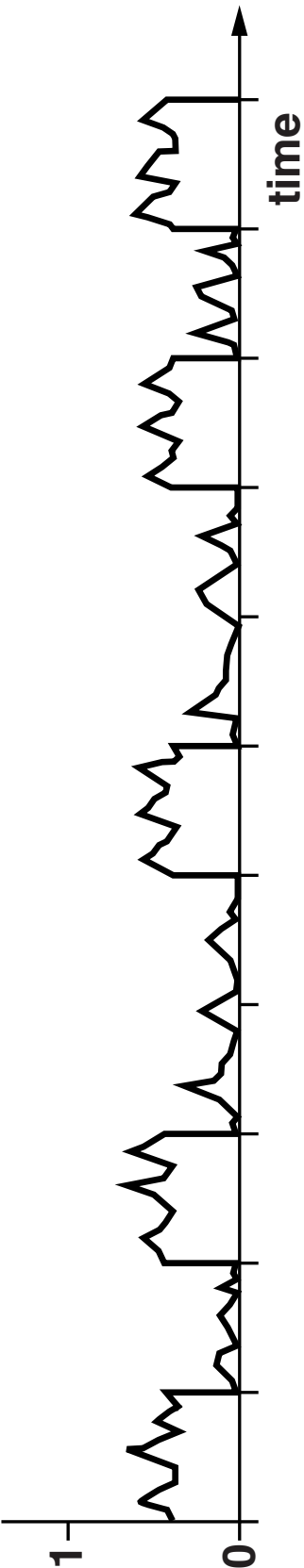


Fig. 2

6 This question is about photons.

- (a) Some of the following statements about electromagnetic radiation are true, and some are false.**

Which are true?

Put ticks (✓) in the boxes next to each TRUE statement.

Infrared is an ionising radiation.

☐

The frequency of the radiation is the number of photons emitted per second.

☐

Microwaves are reflected from metal surfaces.

☐

X-ray photons have enough energy to remove electrons from atoms.

☐

If a red light and a blue light emit the same energy, the red light emits more photons.

☐

The energy of two ultraviolet photons is the same as the energy of one photon of visible light.

☐

Radio waves and microwaves of the same intensity will transfer the same amount of energy to an absorber per second.

☐

[3]

(b) Here are some possible equations for calculating the energy of a light beam.

- A energy = photon energy × number of photons**
- B energy = photon power × photon speed**
- C energy = photon speed × number of photons**
- D energy = photon amplitude × photon wavelength**

Which equation, A, B, C or D, is correct?

equation _____ [1]

[Total: 4]

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7 Liam and Ryan are going to run a 100 m race.

They measure their pulse rate before they start. This is called their resting pulse rate.

(a) There is variation in resting pulse rate between all individuals.

Liam and Ryan are both 16 years old.

The normal range for the resting pulse rate for 16-year-old boys is between 50 and 90 beats per minute.

Suggest why there is a range of values for resting pulse rate.

[1]

- (b) Liam's resting pulse rate is 57 beats per minute.
Ryan's resting pulse rate is 72 beats per minute.

Immediately after the race, Liam and Ryan record their pulse rate again.

They continue to record their pulse rate every minute for a further five minutes.

The table shows their results.

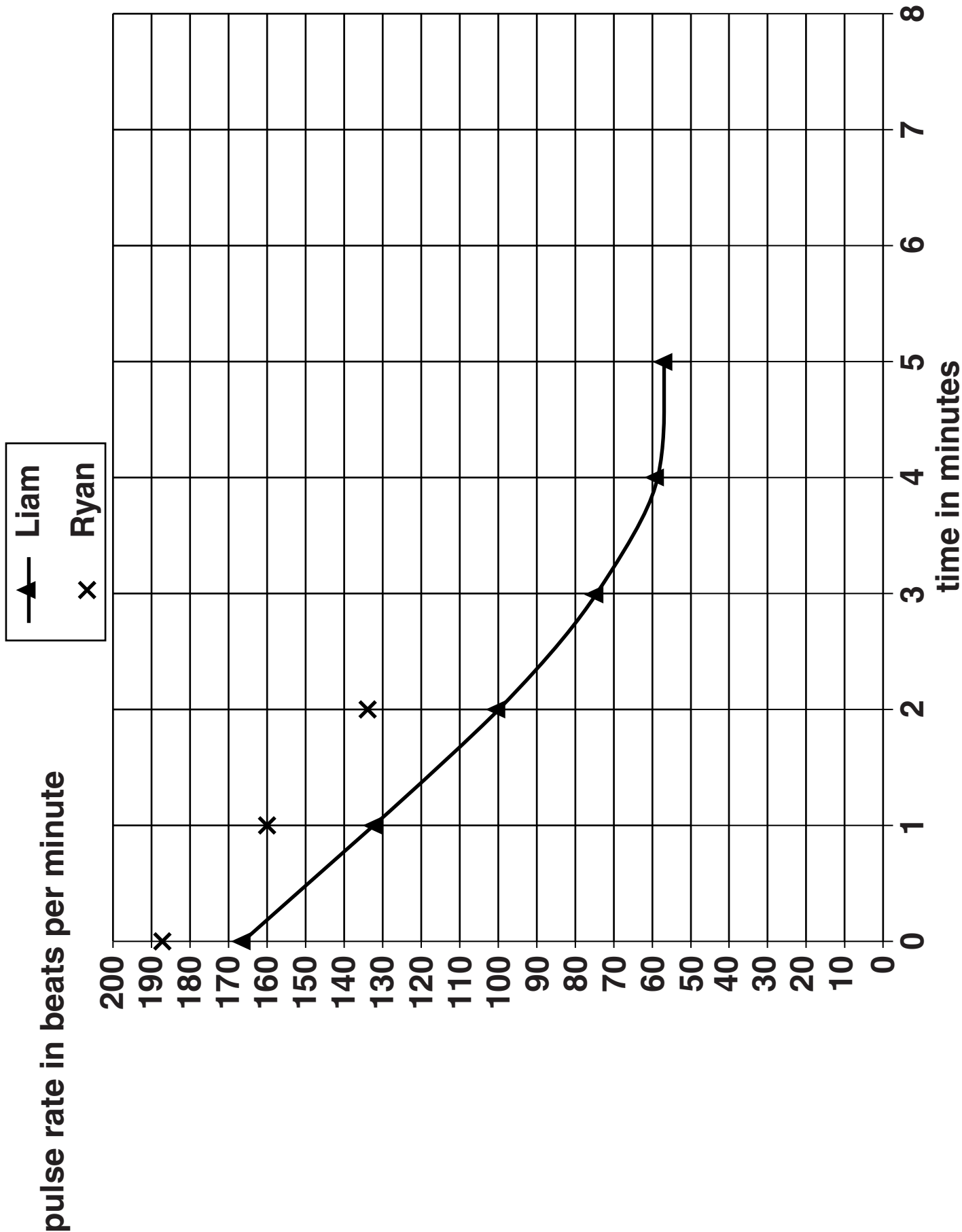
TIME AFTER RACE ENDS IN MINUTES	PULSE RATE IN BEATS PER MINUTE	
	LIAM	RYAN
0	168	187
1	132	160
2	100	134
3	74	114
4	59	95
5	57	83

Liam's pulse rate over the five-minute period after the race is plotted on the graph opposite.

- (i) Plot the data for Ryan's pulse rate over the same five-minute period, and draw a line of best fit.

The first three points have been done for you.

[2]



- (ii) After how many minutes do Liam and Ryan's pulse rate return to their resting values?

Use your graph to help you.

Liam _____ minutes

Ryan _____ minutes
[2]

- (iii) One indication of a person's fitness is their recovery rate after exercise.

Suggest what the graph shows about the relative fitness of Liam and Ryan.
Explain your answer.

_____ [1]

[Total: 6]

8 (a) The concentration of urine in the body is controlled by a chemical called ADH.

(i) Where in the body is ADH secreted from?

_____ [1]

(ii) What type of chemical is ADH?

_____ [1]

(b) Taking the drug Ecstasy can affect ADH secretion.

Put a tick (✓) in the box next to the correct option to complete each sentence on the next page. [1]

When someone takes Ecstasy

MORE	
THE SAME AMOUNT OF	
LESS	

ADH is secreted.

This

INCREASES	
DECREASES	
DOES NOT CHANGE	

the concentration of urine produced.

It also results in

MORE	
THE SAME AMOUNT OF	
LESS	

urine being produced.

- (c) An investigation was carried out to look at whether drinking alcohol increases the volume of urine produced.**

10 male students aged between 20 and 30 were asked to drink no alcohol at all. They were also asked to record how often they produced urine.

Another 10 male students aged between 20 and 30 were allowed to drink alcohol. They were asked to record how much alcohol they drank and also how often they produced urine.

Evaluate the design of this study to decide if it is likely to successfully test whether drinking alcohol increases the volume of urine produced.

[3]

[Total: 6]

9 Vaccinations provide protection from microorganisms that enter our body.

(a) Explain how vaccinations provide protection from microorganisms.

[2]

(b) Influenza is a common viral disease which causes fever, headaches and severe tiredness. In some cases, it can cause death.

New vaccines against influenza are developed each year.

The vaccine against influenza is only offered to people over 65 years of age, pregnant women, young children and people with serious medical conditions.

The Government of a country wants to introduce a compulsory influenza vaccination for everyone every year.

Discuss the arguments for and against introducing compulsory vaccination.



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

[6]

[Total: 8]

END OF QUESTION PAPER

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