THIS IS A NEW SPECIFICATION

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Friday 22 June 2012 – Afternoon

GCSE TWENTY FIRST CENTURY SCIENCE SCIENCE A

A142/02 Modules B2 C2 P2 (Higher Tier)

A135780612

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

A142020

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.

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful relationships

The Earth in the Universe

distance = wave speed × time

wave speed = frequency × wavelength

Sustainable energy

energy transferred = power × time

power = voltage × current

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

Explaining motion

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

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

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

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

Electric circuits

power = voltage × 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

energy = mass × [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 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.

	rope made from …			
property	**… 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 absorbency in %	25	45	33	51

(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]

(ii) The tensile strength of each rope is shown as a range.
It could be shown as the mean value.
Give **two** reasons why is it more useful to show the tensile strength as a range and not as the best estimate of the true value.

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..... **[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/mm^2	62	66	75	79	73

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

tensile strength = ... N/mm^2 **[2]**

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

	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 absorbency in %	25	45	33	51	4

(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.

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

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

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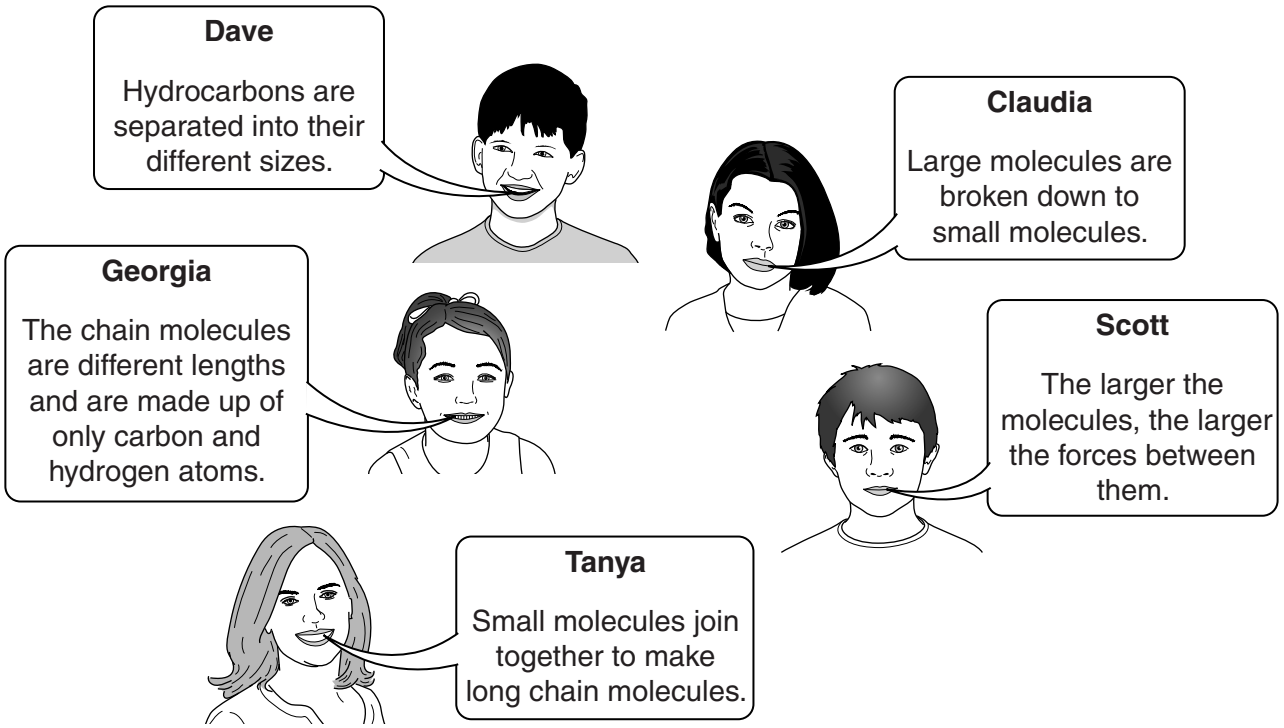
..... **[2]**

[Total: 9]

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

(a) Here is what they say.



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

answer ..... **[1]**

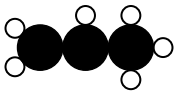
(ii) Who is describing polymerisation?

answer ..... **[1]**

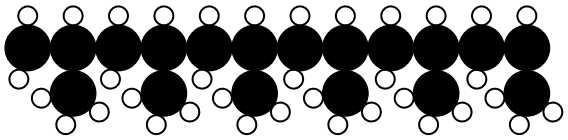
(iii) Who is explaining why small molecules boil at a lower temperature than large molecules?

answer ..... **[1]**

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



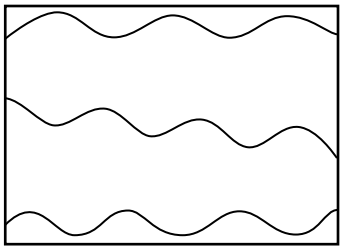
This diagram shows part of a molecule of polypropene.



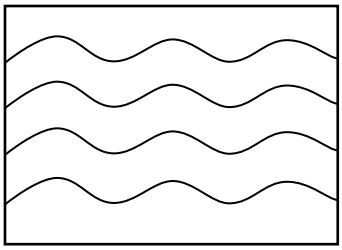
How many molecules of propene have joined to make this part of a polypropene molecule?

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.

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..... **[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.

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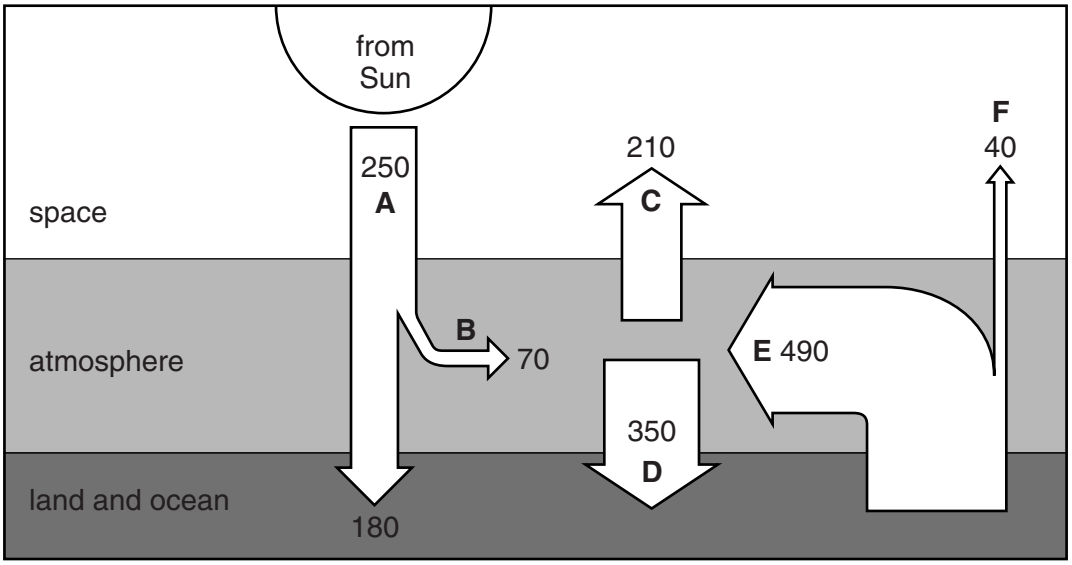
[Total: 6]

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 m^2 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 m^2 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.

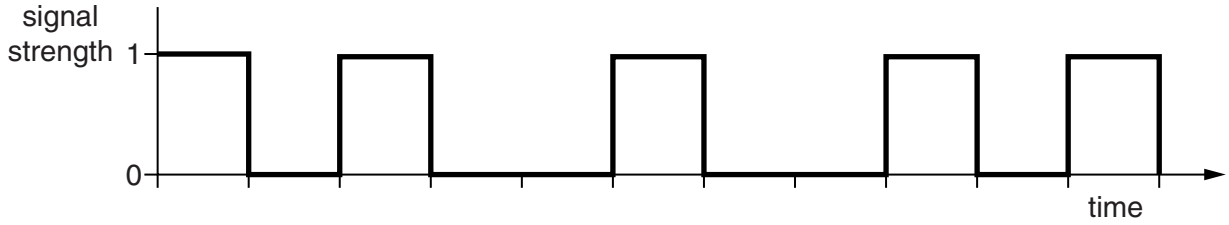
This is because **two** of **A**, **B**, **C**, **D**, **E** and **F** have increased.

Which two?

answer ..... and ..... **[1]**

[Total: 4]

5 The diagram shows part of a signal being sent to a receiver.

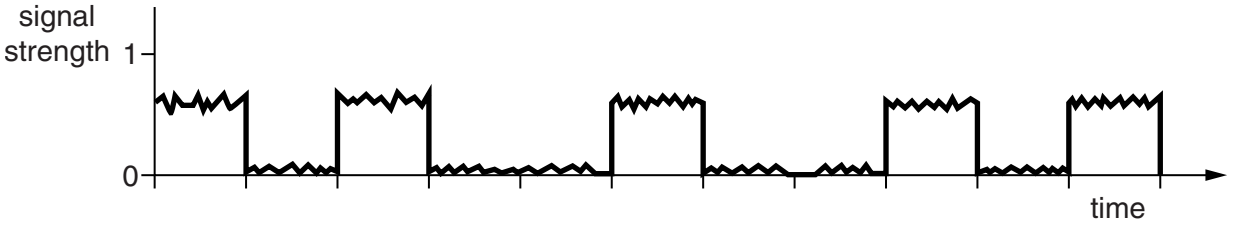


(a) Write down the digital code for this series of pulses.

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

(b) The signal at the receiver, which is some distance from the transmitter, is shown in the next diagram.

This diagram has the same scale as the one above.



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

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..... **[4]**

[Total: 6]

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]

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.

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

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

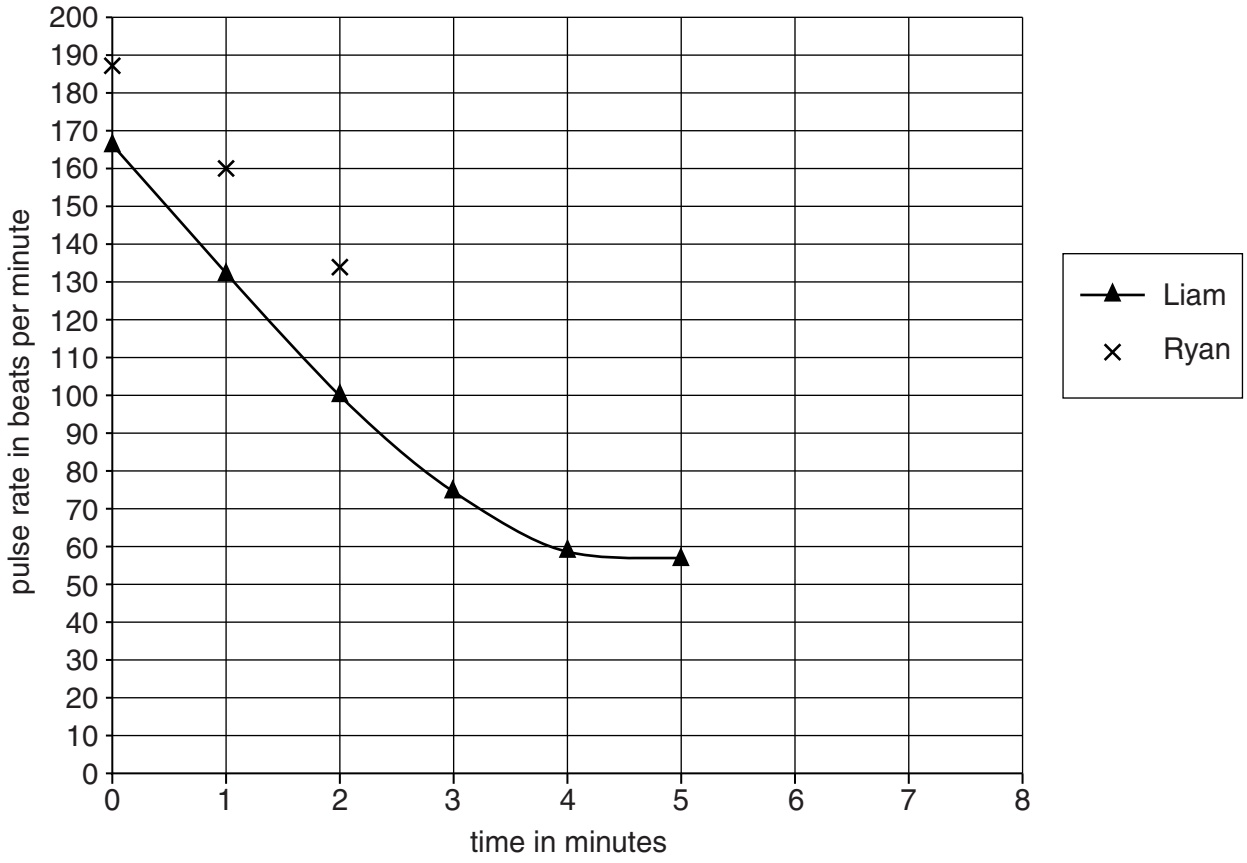
Immediately after the race, Liam and Ryan record their pulse rate again.

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.



(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.

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..... **[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 (ring) around the correct option to join the start of each sentence to its end.

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.

[1]

(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.

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..... **[3]**

[Total: 6]

9 Vaccinations provide protection from microorganisms that enter our body.

(a) Explain how vaccinations provide protection from microorganisms.

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..... **[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.

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..... **[6]**

[Total: 8]

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