OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE **A141/01**

SCIENCE A

Unit A141: 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 clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- A list of useful relationships is included on page 2.
- The number of marks for each question is given in brackets **[ ]** at the end of the question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.

For Examiner's Use		
	Max	**Mark**
1	**5**	
2	**8**	
3	**6**	
4	**6**	
5	**9**	
6	**6**	
7	**6**	
8	**4**	
9	**6**	
10	**4**	
TOTAL	**60**	

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Useful Relationships

The Earth in the Universe

distance = wave speed x time

wave speed = frequency x wavelength

Sustainable Energy

energy transferred = power x time

power = voltage x 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 x velocity

change of momentum = resultant force x time for which it acts

work done by a force = force x distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight x vertical height difference

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

Electric Circuits

power = voltage x 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 x [speed of light in a vacuum]^2

Answer **all** the questions.

1 In the future it may be possible to repair damaged body parts using stem cells.

(a) Use the words provided to complete the sentences.

active	**altered**	**clones**	**genes**	**illnesses**
inactive	**infections**	**living**	**specialised**	**unspecialised**

Embryonic stem cells can develop into any kind of cell because they are ..... .

During the development of multicellular organisms, cells usually become ..... .

Scientists hope that research into stem cells will lead to treatment for some ..... .

[2]

(b) Stem cells can also be used to produce clones.

Put a tick (✓) in the box next to the **correct** description of what clones are.

Clones…

…contain only specialised cells, for example skin cells. ☐

…can only be produced by sexual reproduction. ☐

…are genetically identical cells or organisms. ☐

…are cells that are the same size and perform the same function. ☐

[1]

(c) Using human embryos to produce stem cells has caused a lot of argument and discussion.

Suggest **two** arguments **against** the use of human embryonic stem cells.

.....

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

[Total: 5]

2 Read the information about phenylketonuria (PKU).

PKU is an inherited disorder.

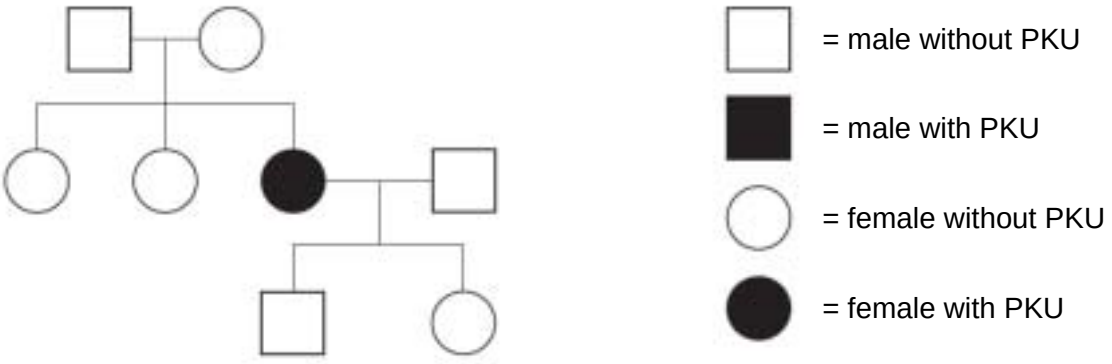
PKU is caused by a faulty gene.

A chemical called phenylalanine builds up in the bodies of people with PKU.

Too much phenylalanine causes serious health problems.

Serious health problems can be avoided with a controlled diet. The sooner this diet is started after birth, the less harm is caused.

(a) Look at the family tree.



Draw straight lines to link the correct **description** of the inheritance of PKU with the **two** correct **explanations.**

You should join **one** description with **two** explanations.

description	**explanation**
	Parents can be carriers of PKU.
PKU is inherited in a similar way to cystic fibrosis.	
	PKU is caused by a dominant allele.
PKU is inherited in a similar way to Huntington's disease.	
	Parents cannot be carriers of PKU.
PKU is inherited in a different way from cystic fibrosis and Huntington's disease.	
	PKU is caused by a recessive allele.

[2]

(b) **About** 1 in 10 000 babies born in the UK has PKU.

(i) Testing a baby for PKU costs the NHS £6.

Calculate the cost to the NHS in 2008 of giving PKU tests to the 710 000 babies born that year.

answer = £..... **[2]**

(ii) The Office for National Statistics reported that 710 000 babies were born in the UK in 2008.

How many babies born in the UK in 2008 would you expect to have been born with PKU?

Show your working.

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

(iii) Doctors have said that it is right to test all babies for PKU even though it costs the NHS money.

Use the information about PKU and your answers to parts **(i)** and **(ii)** to suggest reasons why the doctors have come to this conclusion.

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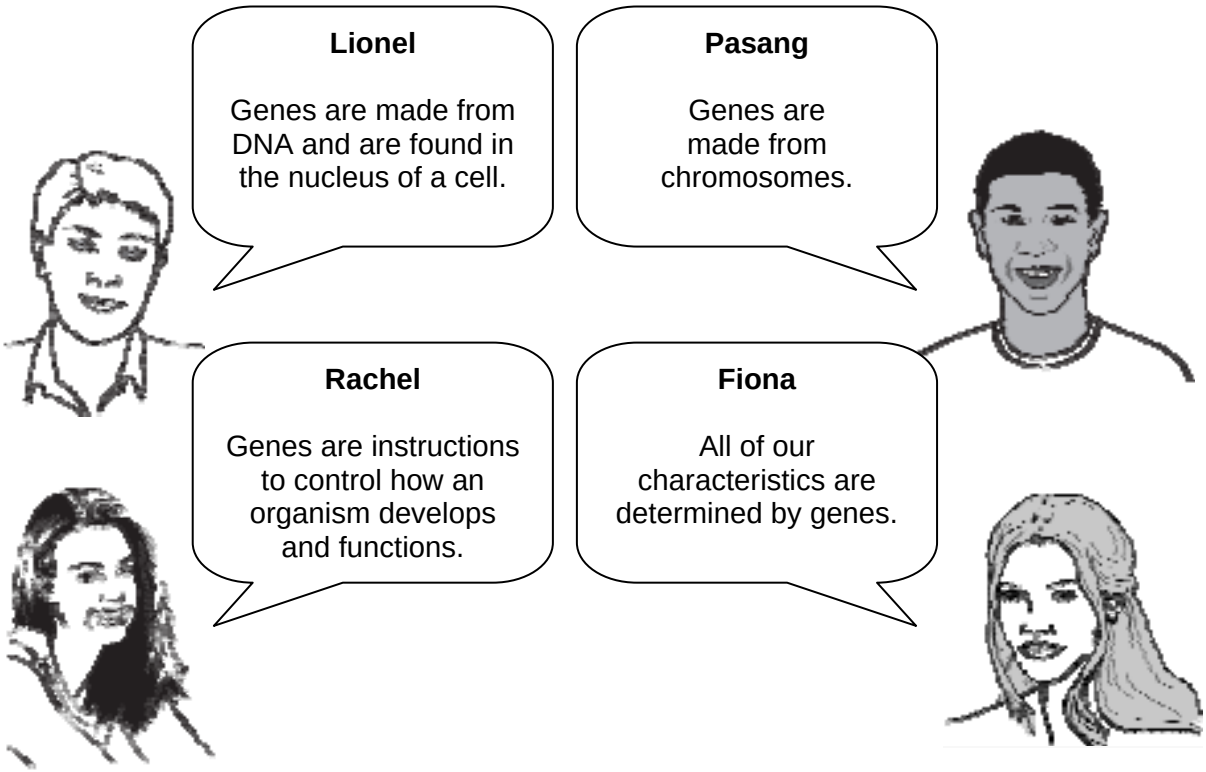
..... **[2]**

(c) PKU is a genetic disorder.

After a science lesson about genetics, some friends discuss what they think genes are.



Write down the names of the **two** people who make correct statements.

answers ..... and ..... **[1]**

[Total: 8]

3 Jadzia has similarities to her mother and similarities to her father, but is **not** identical to either of them.

Use your knowledge of genes, sexual reproduction and the environment to explain why.

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

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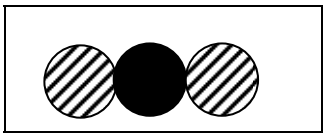
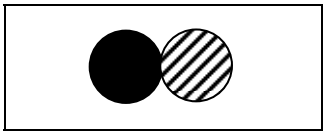
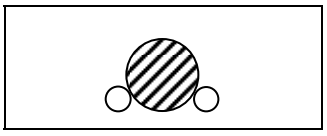
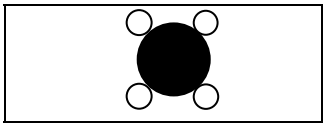
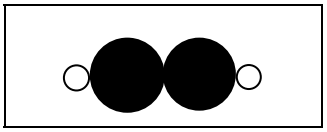
..... **[6]**

[Total: 6]

4 Ethene is used as a fuel. It is obtained from crude oil.

(a) Carbon dioxide and water are produced when ethene burns completely.

Draw a straight line from each **product** to the **diagram** representing its molecule.

product	**diagram**
carbon dioxide	
water	
	
	
	

[2]

(b) A scientist analyses the products of combustion of ethene.

He collects all the products of the reaction.

His results are shown in the table.

	mass in g
carbon dioxide	82.0
water vapour	70.2
carbon monoxide	52.0
carbon	2.0
total	**206.2**

(i) The scientist calculates that carbon dioxide made up 39.8% of the mass of the total products.

What is the percentage by mass of carbon monoxide?

percentage by mass = ... % **[1]**

(ii) What can be concluded from these results about the conditions in which combustion occurred?

Explain your answer.

.....

.....

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

(iii) Carbon monoxide is a dangerous gas.

How could the scientist change the conditions to prevent carbon monoxide from being formed when ethene burns?

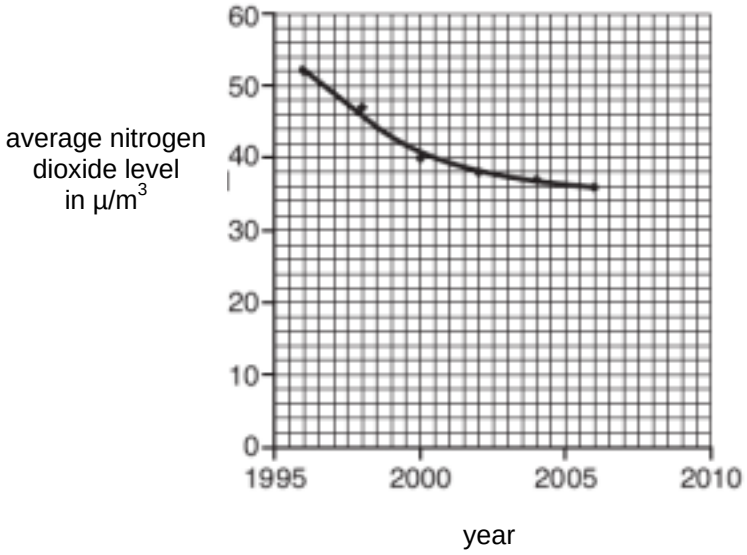
..... **[1]**

[Total: 6]

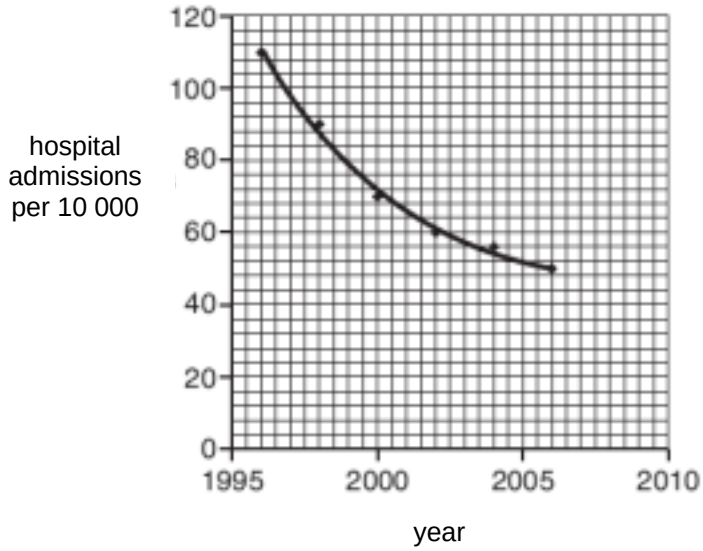
5 This question is about air pollution.

The graphs show nitrogen dioxide pollution in the air and the number of hospital admissions for asthma between 1996 and 2006.

average nitrogen dioxide levels in UK towns



hospital admissions for asthma



(a) (i) What was the average nitrogen dioxide level in UK towns in 2000?

answer = ... µg / m^3 **[1]**

(ii) In what year did hospital admissions reach 60 per 10 000 people?

year = ... **[1]**

(b) (i) The graphs, **when taken together**, show a correlation between two factors.

Write a sentence to describe this correlation.

.....

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

(ii) Scientists looking at the graphs suggest that nitrogen dioxide in the air may cause asthma.

What extra information would support this suggestion?

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

how nitrogen dioxide is made in a car engine	☐
nitrogen dioxide levels in the countryside	☐
how nitrogen dioxide affects breathing	☐
similar data from other countries	☐
how many asthma inhalers are prescribed by doctors	☐

[2]

(c) The number of cars and lorries on the roads increased between 1996 and 2006.

During this time, the amount of pollution by nitrogen dioxide decreased.

Describe and explain how nitrogen dioxide pollution from cars and lorries has been reduced.

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

[Total: 9]

6 The atmosphere of Venus was originally formed from gases released from inside the planet.

It is nearly completely made of carbon dioxide (96.5%).

The surface temperature is about 464°C.

How does the atmosphere of the Earth compare with the atmosphere of Venus?

Suggest similarities and differences in

- how the atmosphere formed
- the way this affected what the atmosphere is now made of.

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

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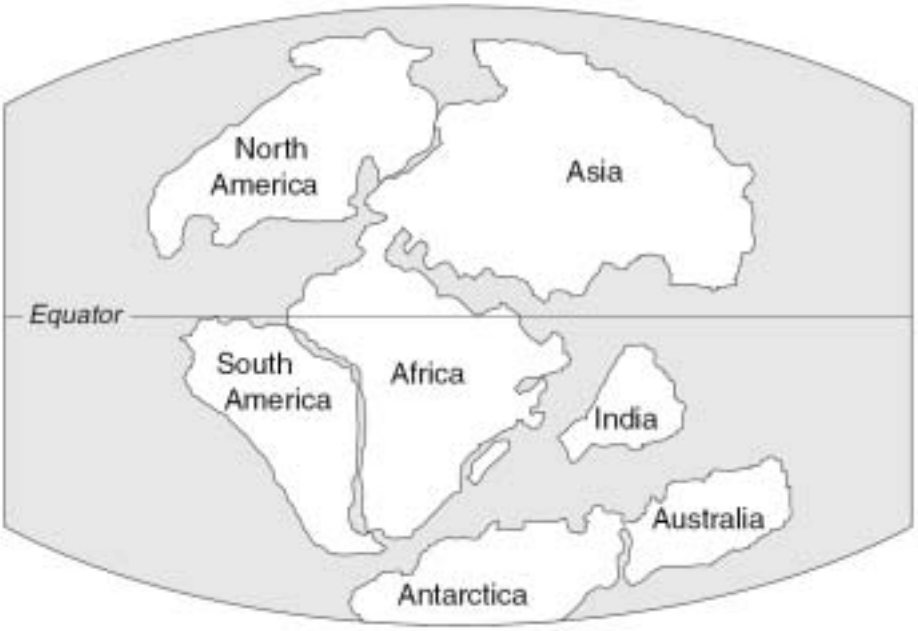
..... **[6]**

[Total: 6]

7 Wegener proposed his theory of continental drift in 1915.



Wegener's theory was not accepted by geologists when he first suggested it.

Wegener's theory became accepted in the 1960s.

Explain why Wegener thought the continents had moved, why geologists rejected his ideas, and how the theory became accepted.

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

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

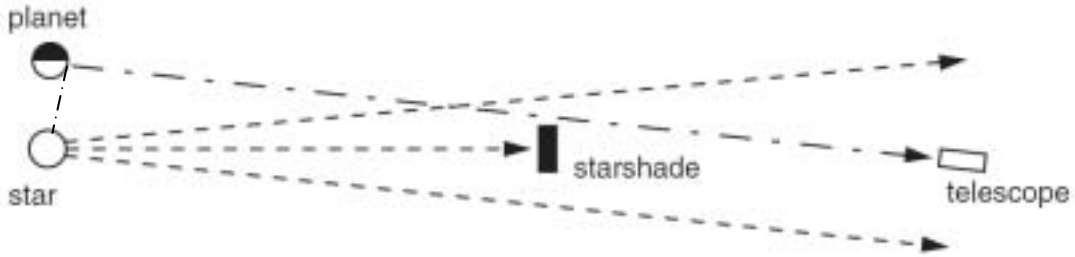
[Total: 6]

8 Read the article.

'Starshade' could help us see planets around other stars

The giant 'starshade' would be launched into space together with a space telescope, and would orbit the Earth at a distance of around 1 million kilometres. The 'starshade' and the telescope would be around 15 000 kilometres apart from each other.

Small thruster rockets, fired by remote control from Earth, would allow scientists to move the 'starshade' in front of a star they wanted the telescope to look at. The 'starshade' will allow light reflected from planets orbiting the star to be seen.



(a) Read the following statements.

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

The ‘starshade’ will block out the light from the star.	☐
The ‘starshade’ will reflect light to the telescope.	☐
The ‘starshade’ will be fixed to a space telescope.	☐
The ‘starshade’ and space telescope will be launched separately.	☐
The space telescope will be able to detect light from distant planets.	☐

[2]

(b) Most telescopes are on the Earth's surface.

This telescope and 'starshade' will be put into orbit a long way from the Earth.

Which of these statements are correct reasons for doing this?

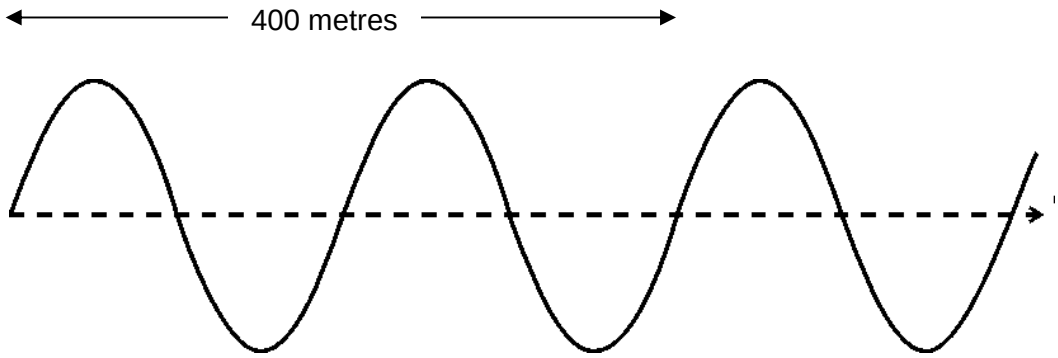
Put ticks (✓) in the boxes next to the **two** correct statements.

Light pollution from Earth will not affect the telescope if it is in space.	☐
It is too expensive to put the telescope and the 'starshade' on Earth.	☐
The telescope and 'starshade' would take up too much room on the Earth's surface.	☐
The Earth's atmosphere will not reduce the quality of the image if the telescope is in space.	☐

[2]

[Total: 4]

9 The diagram shows a seismic wave.



(a) Calculate the wavelength of this wave.

wavelength = ... m **[1]**

(b) Another wave has a wavelength of 500 metres.

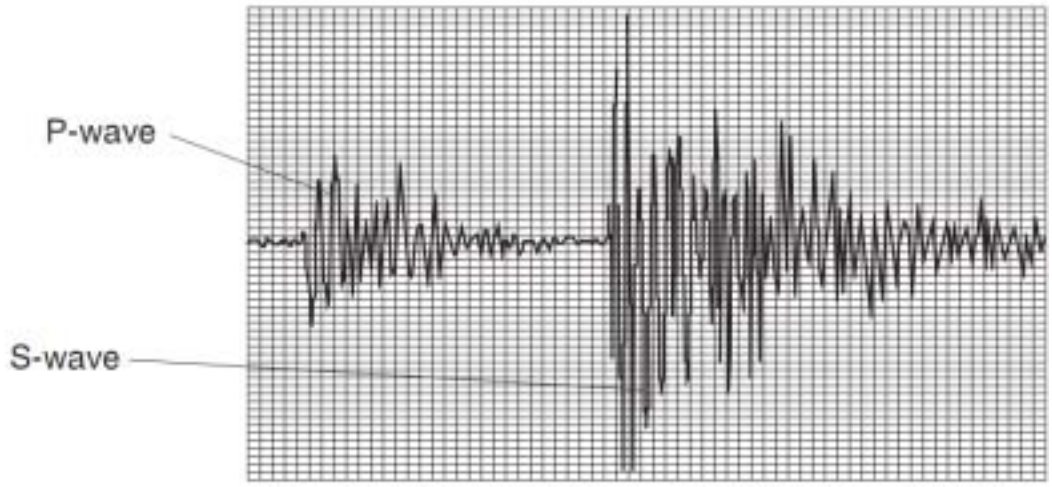
This wave has a frequency of 4 hertz.

Calculate the speed of this wave.

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

(c) The diagram shows a recording from an earthquake detector.

It has detected a P-wave and an S-wave from an earthquake.



What conclusion can you draw from the diagram about the damage caused by S-waves compared to the damage caused by P-waves?

Explain how you reach your conclusion.

Use the correct scientific terms to compare the waves.

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

[Total: 6]

10 The Solar System consists of many different objects.

The Earth, the Moon, the Sun and asteroids are some of these objects.

The table shows the diameters of four objects in the Solar System.

object	diameter in km	type of object
A	756	
B	12 742	
C	1 392 000	
D	3474	

(a) Complete the table to identify what each object is **most likely** to be from the data provided.

Choose from this list.

an asteroid **the Earth** **the Moon** **the Sun**

[2]

(b) Suggest why it is **not** possible to be certain of the identity of all of these objects from the data provided.

.....

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

[Total: 4]

[Paper Total: 60]

END OF QUESTION PAPER

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OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

SCIENCE A **A141/01**

Unit A141: Modules B1, C1, P1 (Foundation Tier)

MARK SCHEME

Duration: 1 hour

MAXIMUM MARK 60

This document consists of 16 pages

Guidance for Examiners

Additional guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.
2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.
3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).
4. Abbreviations, annotations and conventions used in the detailed mark scheme:

/	=	alternative and acceptable answers for the same marking point
(1)	=	separates marking points
not/reject	=	answers which are not worthy of credit
ignore	=	statements which are irrelevant - applies to neutral answers
allow/accept	=	answers that can be accepted
(words)	=	words which are not essential to gain credit
<u>words</u>.	=	underlined words must be present in answer to score a mark
ecf	=	error carried forward
AW/owtte	=	alternative wording
ORA	=	or reverse argument

Eg mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)
work done = 0 marks
work done lifting = 1 mark
change in potential energy = 0 marks
gravitational potential energy = 1 mark

5. Annotations:
The following annotations are available on SCORIS.

✓	= correct response
✖	= incorrect response
bod=	benefit of the doubt
nbod	= benefit of the doubt **<u>not</u>** given
ECF	= error carried forward
^	= information omitted
I	= ignore
R	= reject

6. If a candidate alters his/her response, examiners should accept the alteration.

7. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

   Eg
   For a one mark question, where ticks in boxes 3 and 4 are required for the mark:

Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.
☐	☐	✓
☐	☐	✓
✓	✓	☐
✓	✓	☐
☐	☐	☐
This would be worth 0 marks.	This would be worth one mark.	This would be worth one mark.

8. The list principle:
   If a list of responses greater than the number requested is given, work through the list from the beginning. Award one mark for each correct response, ignore any neutral response, and deduct one mark for any incorrect response, eg one which has an error of science. If the number of incorrect responses is equal to or greater than the number of correct responses, no marks are awarded. A neutral response is correct but irrelevant to the question.

9. Marking method for tick boxes:

   Always check the additional guidance.

   If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.
   If there is at least one tick, ignore crosses. If there are no ticks, accept clear, unambiguous indications, eg shading or crosses.
   Credit should be given for each box correctly ticked. If more boxes are ticked than there are correct answers, then deduct one mark for each additional tick. Candidates cannot score less than zero marks.

   Eg If a question requires candidates to identify a city in England, then in the boxes

Edinburgh	
Manchester	
Paris	
Southampton	

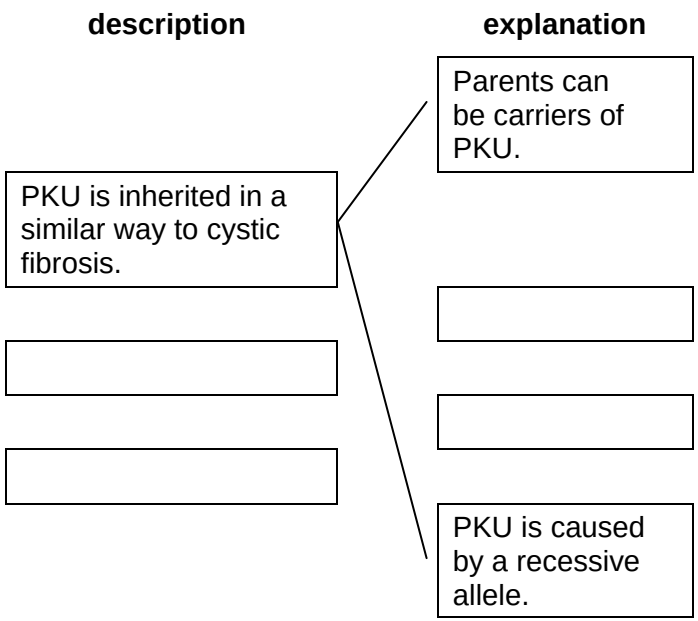
   the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third should be blank (or have indication of choice crossed out).

Edinburgh			✓			✓	✓	✓	✓	
Manchester	✓	×	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	×		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	0	0	NR

10. Three questions in this paper are marked using a Level of Response (LoR) mark scheme with embedded assessment of the Quality of Written Communication (QWC). When marking with a Level of Response mark scheme:

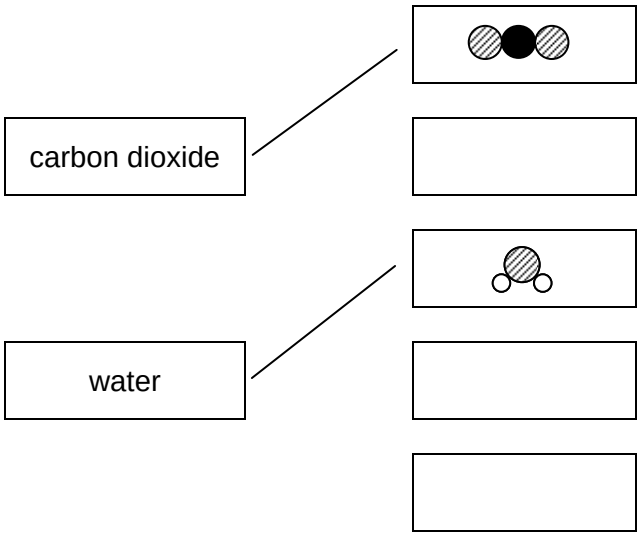
- Read the question in the question paper, and then the list of relevant points in the 'Additional guidance' column of the mark scheme, to familiarise yourself with the expected science. The relevant points are not to be taken as marking points, but as a summary of the relevant science from the specification.
- Read the level descriptors in the 'Expected answers' column of the mark scheme, starting with Level 3 and working down, to familiarise yourself with the expected levels of response.
- *For a general correlation between quality of science and QWC*: determine the level based upon which level descriptor best describes the answer; you may award either the higher or lower mark within the level depending on the quality of the science and/or the QWC.
- *For high-level science but very poor QWC*: the candidate will be limited to Level 2 by the bad QWC no matter how good the science is; if the QWC is so bad that it prevents communication of the science the candidate cannot score above Level 1.
- *For very poor or totally irrelevant science but perfect QWC*: credit cannot be awarded for QWC alone, no matter how perfect it is; if the science is very poor the candidate will be limited to Level 1; if there is insufficient or no relevant science the answer will be Level 0.

Question			Expected answers	Marks	Additional guidance
1	(a)		unspecialised specialised illnesses	[2]	all three correct = 2 marks one or two correct = 1 mark
	(b)		genetically identical cells or organisms ✓	[1]	tick in any other box = 0 marks
	(c)		**any two from:** it is 'playing God' / religious objection embryos killed / lives wasted some actions are wrong whatever the consequences may lead to reproductive cloning benefit does not outweigh , cost / named arguments against	[2]	
			Total	[5]	

Question	Expected answers	Marks	Additional guidance
2 (a)		[2]	choice of only top left box = 1 mark any line from the top left box indicates the candidates choice then look at the right hand boxes to award second mark **both** top and bottom "explanation" boxes selected = 1 mark no extra boxes allowed

Question			Expected answers	Marks	Additional guidance
2	(b)	(i)	£60 000	[2]	
		(ii)	71	[1]	
		(iii)	idea that benefits outweigh costs one life worth more than £60 000 / 71 lives improved/owtte each year can start treatment very early to limit damage / this saves (NHS) money in the long run (because it is expensive to treat people who get ill due to PKU) / idea that parents have the right to know or can start preparing for child with PKU	[2]	**accept** some actions are right whatever the cost **allow** ecf from parts **(i)** and **(ii)**
	(c)		Lionel <u>and</u> Rachel	[1]	**both** needed either order
			Total	[8]	

Question			Expected answers	Marks	Additional guidance
3			**[Level 3]** Answer clearly explains why children have similarities to both parents **and** why they are not identical to either of them. Answer considers genetic **and** environmental factors. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** Answer gives limited genetic explanations for the similarities and differences **OR** explains just one side (similarities or differences), but in detail. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** Answer discusses only similarities or differences, not both, and lacks detail **OR** answer considers only environmental factors without explaining genetic basis of inheritance. Not much detail is provided in the explanation and little consideration is given to the role of genes in sexual reproduction. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	[6]	**relevant points include:** she has similarities to her parents because: • children , inherit / get , their genes from their mother and father • half of her , genes / alleles , are from her mother and half are from her father • genes , control / code for / are instructions for , characteristics • **accept** examples of characteristics, eg hair colour, eye colour • behavioural , traits / characteristics , are learned from parents • **accept** references to 'inheritance' of behavioural characteristics (nurture) she is not identical to them because: • idea that , egg / sperm / gametes , only contain half of the genetic material of each parent • combination / mixture , of , genes / alleles / chromosomes , from both parents gives different , characteristics / phenotype • child may inherit (recessive) alleles that were not expressed in the parents • she inherited X from father (and X from mother) so is female, unlike father • different environmental factors • **accept** examples of environmental factors that would certainly differ between parents and child, eg diet, amount of exercise, etc • **ignore** references that make assumptions about superficial differences, eg she wears different clothes, wears spectacles, has a different hair cut, dyes her hair, had plastic surgery, etc
			Total	[6]	

Question			Expected answers	Marks	Additional guidance
4	(a)			[2]	1 mark for each correct answer
	(b)	(i)	25.2	[1]	
		(ii)	there was a lack of oxygen since carbon monoxide and carbon were produced due to incomplete combustion	[2]	for full marks the explanation must be linked to the conclusion
		(iii)	provide more oxygen	[1]	
			Total	[6]	

Question			Expected answers	Marks	Additional guidance
5	(a)	(i)	41	[1]	**allow** 40 - 42
		(ii)	2002	[1]	**allow** 2003
	(b)	(i)	as nitrogen levels decrease, the number of hospital admissions decreases / ORA	[1]	**ignore** correlations with time
		(ii)	☐ ☐ how nitrogen dioxide affects breathing ✓ similar data from other countries ✓ ☐	[2]	
	(c)		**any two of the following for two marks each** • more efficient engines; which burn less fuel so make less nitrogen dioxide • catalytic converters; that reduce nitrogen monoxide to nitrogen and oxidise carbon monoxide to carbon dioxide • enforced legal limits to emissions; which make people maintain efficient engines	[4]	**ignore** references to sulfur **ignore** references to public transport
			Total	[9]	

Question			Expected answers	Marks	Additional guidance
6			**[Level 3]** Similarities and differences between the present atmospheres (for the factors mentioned in the question) fully described and related to similarities and differences in the formation of the atmospheres. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **[Level 2]** Similarities and differences in atmosphere composition and formation partially described with an attempt to relate these to one another. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **[Level 1]** Limited description of similarities and differences with little or no attempt to relate differences in formation to differences in composition. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	[6]	**relevant points include:** *composition* • both contain carbon dioxide and nitrogen • much less CO_2 in Earth's atmosphere and much more N_2 *formation* • both originally formed from gases released from inside planet/volcanic activity • original atmosphere of both was mainly carbon dioxide • as the Earth cooled water vapour condensed to form the oceans, but Venus may have been too hot for water to condense (this is a 'suggest' question so reasonable suggestion should be credited) • on Earth carbon dioxide dissolved in oceans, but no oceans on Venus (reasonable suggestion) • plants evolved on Earth but not on Venus • (on Earth) as the trees and plants grew they photosynthesised to make their own food • (on Earth) absorbed carbon dioxide • (on Earth) produced oxygen • (on Earth) carbon dioxide decreased in the atmosphere • (on Earth) oxygen increased in the atmosphere • (on Earth) water vapour decreased in the atmosphere • but on Venus carbon dioxide not reduced and oxygen not increased since no plants/photosynthesis
			Total	[6]	

Question			Expected answers	Marks	Additional guidance
7			**[Level 3]** Includes most relevant points in each category in the answer. Explains Wegener's idea, objections to his theory, and acceptance following further evidence in terms of a causal mechanism. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** Outlines Wegener's idea with some evidence, and makes reasonable suggestions why his contemporaries did not accept it. The idea of a mechanism for continental drift likely to be absent. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** Outlines Wegener's idea with little supporting evidence. Objections by contemporaries likely to be personal rather than scientific. 1960s evidence likely to be missing. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	**relevant points include:** *Wegener's evidence* • continents 'fit together' • similar rock layers in different continents • similar fossils in different continents *his contemporaries' objections* • Wegener was an outsider/not a geologist • no continental movement detectable • existing theories (land bridges) explained fossils • no mechanism proposed for movement *for subsequent acceptance* • idea that a plausible mechanism is reasonable grounds for accepting the theory • sea-floor spreading provided a mechanism • movements in mantle as underlying cause **accept** description of magnetic stripes on seabed as evidence for seafloor spreading **ignore** references to mountain chains, unless specifically to chains on the West coast of North and South America **reject** objections to Wegener based on personality
			Total	**[6]**	

Question			Expected answers	Marks	Additional guidance
8	(a)		starshade will block out light ✓ ☐ ☐ ☐ space telescope will be able to detect… ✓	[2]	2 marks for correct pattern 1 mark for just one mistake 0 marks for more than one mistake (mistake = tick in incorrect box, missing tick or extra tick)
	(b)		Light pollution will not affect … ✓ ☐ ☐ Earth's atmosphere will not … ✓	[2]	2 marks for correct pattern 1 mark for just one mistake 0 marks for more than one mistake (mistake = tick in incorrect box, missing tick or extra tick)
			Total	[4]	

Question			Expected answers	Marks	Additional guidance
9	(a)		200 m	[1]	
	(b)		speed = 4 Hz × 500 m = 2000 metres/second	[2]	correct answer with no working gets 2 marks **accept** 2km/s
	(c)		S-waves cause more damage (than P-waves) because the graph shows that S-waves are 'larger' / have greater amplitude (than P-waves) therefore they have more energy (than P-waves)	[3]	throughout, **credit** reverse argument for P-waves
			Total	[6]	

Question			Expected answers	Marks	Additional guidance
10	(a)		A - asteroid B - Earth C - Sun D - Moon	[2]	all correct = 2 marks 2 or 3 correct = 1 mark 1 or 0 correct = 0 marks
	(b)		**any two from:** asteroids vary in size asteroids overlap in size with other objects there are other objects in the Solar System in this range of sizes	[2]	
			Total	[4]	

Assessment Objectives (AO) Grid

(includes quality of written communication✎)

Question	AO1	AO2	AO3	Total
1(a)	2			**2**
1(b)	1			**1**
1(c)		2		**2**
2(a)	1	1		**2**
2(b)(i)		2		**2**
2(b)(ii)		1		**1**
2(b)(iii)		1	1	**2**
2(c)	1			**1**
3 ✎	5	1		**6**
4(a)	2			**2**
4(b)(i)		1		**1**
4(b)(ii)		1	1	**2**
4(b)(iii)		1		**1**
5(a)(i)		1		**1**
5(a)(ii)		1		**1**
5(b)(i)		1		**1**
5(b)(ii)		2		**2**
5(c)		4		**4**
6 ✎	6			**6**
7 ✎	4	2		**6**
8(a)	1	1		**2**
8(b)		2		**2**
9(a)		1		**1**
9(b)		2		**2**
9(c)			3	**3**
10(a)			2	**2**
10(b)			2	**2**
Totals	**23**	**28**	**9**	**60**