

**GENERAL CERTIFICATE OF SECONDARY EDUCATION
 TWENTY FIRST CENTURY SCIENCE
 ADDITIONAL APPLIED SCIENCE A
 Materials and Performance
 HIGHER TIER
 FRIDAY 15 JUNE 2007**

H A336/02

Morning
 Time: 45 minutes

Calculators may be used.
 Additional materials: Pencil
 Ruler (cm/mm)



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Candidate
 Name

Centre
 Number

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Candidate
 Number

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INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- **WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED. ANSWERS WRITTEN ELSEWHERE WILL NOT BE MARKED.**

INFORMATION FOR CANDIDATES

- The number of marks available is given in brackets [] at the end of each question or part question.
- The marks allocated and the spaces provided for your answers are a good indication of the length of answers required.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	13	
2	9	
3	8	
4	6	
TOTAL	36	

This document consists of **13** printed pages and **3** blank pages.

Answer **all** the questions.

- 1 John is making a gate out of wood.



- (a) John fastens the piece of wood shown below onto the gate to make it more rigid.

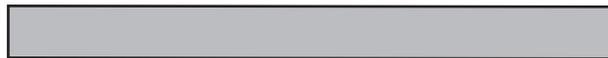


Show the **best** position for the wood by drawing it on the diagram.

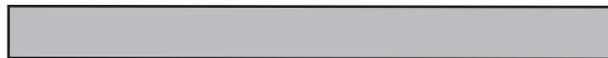
[1]

- (b) Wood is stronger in **tension** than in **compression**.

- (i) Draw arrows on the diagram of the block of wood below to show forces of **tension**.

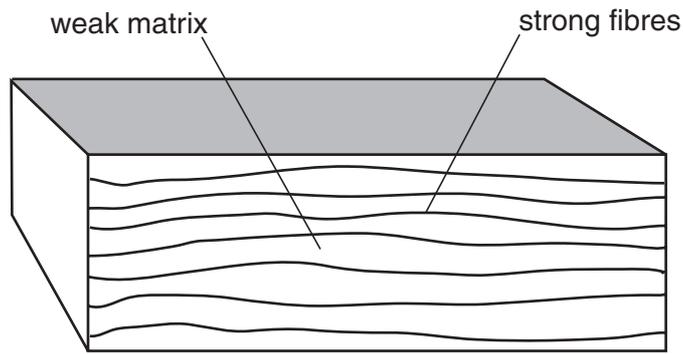


- (ii) Draw arrows on the diagram of the block of wood below to show forces of **compression**.



[2]

(c) John finds this diagram which shows the structure of wood.



(i) Describe the arrangement of the fibres by completing the sentence.

Choose the **best** phrase from this list.

to make a pattern

randomly

in line with each other

The fibres are arranged [1]

(ii) Wood splits more easily in one direction only.

Use the diagram above and your answer to part (i) to suggest a reason for this.

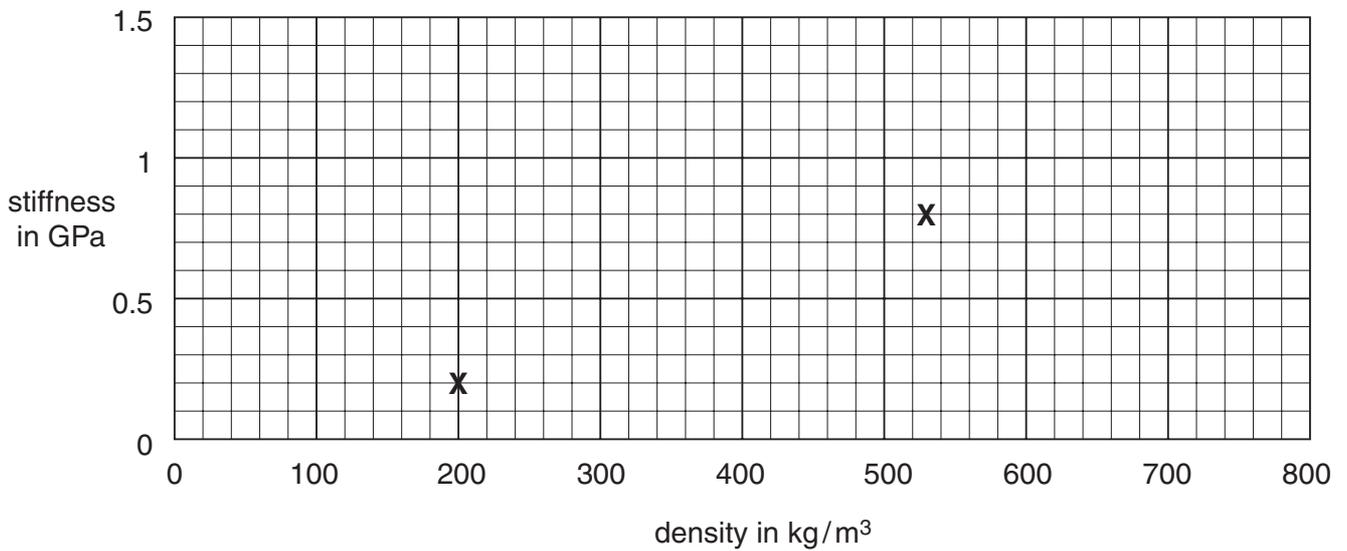
.....
..... [1]

(iii) Wood is a tough material. What is meant by the term **tough**?

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

(d) The table shows some data for the density and stiffness of wood.

type of wood	density in kg/m ³	stiffness across fibres in GPa
balsa	200	0.2
mahogany	530	0.8
pine	550	0.8
birch	620	0.9
ash	670	1.1
oak	690	1.0



(i) Plot the points on the grid. Two have been done for you. [2]

(ii) Finish the graph by drawing the line of **best fit** through the points. [1]

(iii) What does the graph tell you about the relationship between the density of wood and the stiffness of the wood?

.....
[1]

(e) Describe how you could find out the stiffness of a sample of wood in a school laboratory.

Use a labelled diagram to help your explanation.

.....

.....

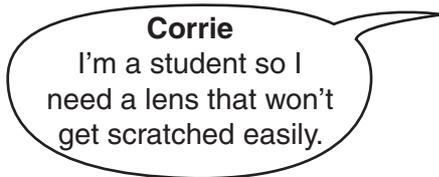
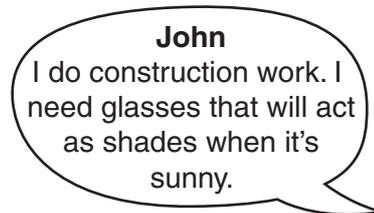
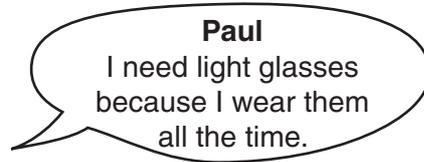
.....

.....[3]

[Total: 13]

2 Rachel is on work experience in an optician's.

(a) People can choose different material for the lenses in their glasses.



They can choose material from this list.

glass

plastic

tinted glass

mirror glass

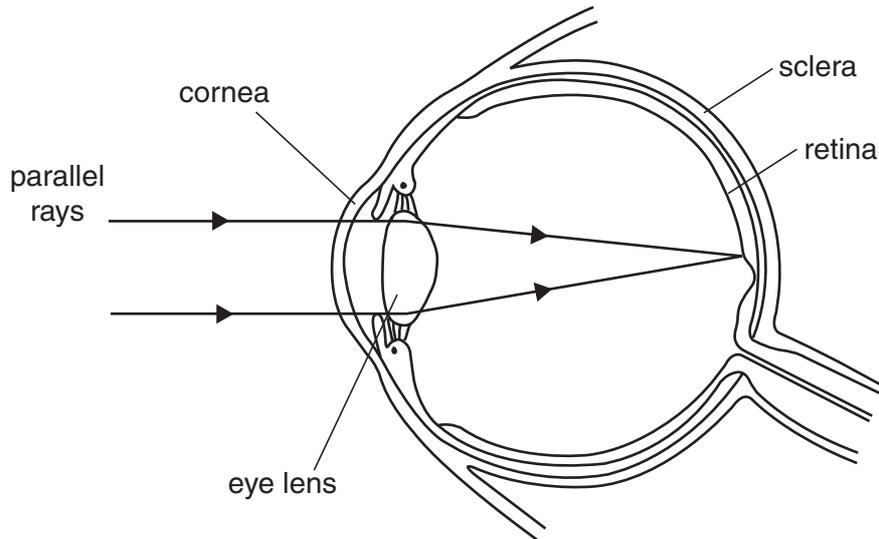
glass that darkens in bright light

Complete the table to show the **best** choice for each person.

person	best choice of material
Corrie	
John	
Pat	
Paul	

[2]

(b) The diagram shows how an eye with normal vision focuses light from a distant object.



(i) Which word in the list **best** describes what the lens in the eye does to the light?

Put a **ring** around the correct answer.

conducts converges diverges disperses reflects

[1]

(ii) State where the image is focused in the eye.

Choose from the labels on the diagram.[1]

(iii) Complete the sentence. Choose the **best** phrase from the list.

diameter of the eye eyeball length focal length focal plane

The distance from the eye lens to the retina is the.....

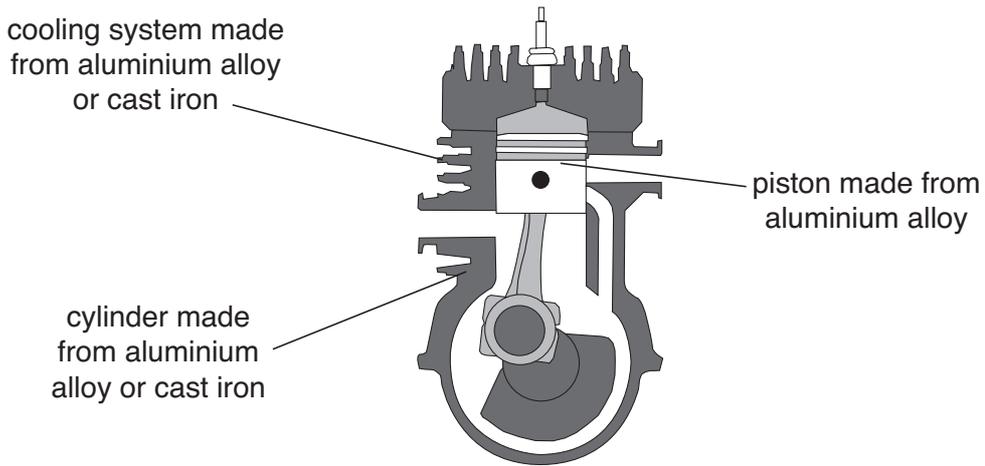
[1]

9
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Question 3 begins on page 10.

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3 Motorbike engines can be made of different materials.



If the cylinder and piston are made of the same material they expand at the same rate.

The piston transfers heat to the cylinder.

The cylinder transfers heat to the **cooling system**.

metal	thermal conductivity in W/m K	thermal expansivity /MK	stiffness in GPa	density in kg/m ³	cost in £/tonne
aluminium alloy	140	20	71	2700	910
cast iron	25	12	152	7400	120

(a) (i) Suggest **two** properties of aluminium alloy that make it better than cast iron for motorbike cylinders.

For **each** property, describe how it helps to improve performance.

.....

.....

.....

.....

.....[4]

(ii) Use data in the table to suggest **two** disadvantages of using aluminium alloy for the cylinder.

.....

.....[1]

(b) Sarah is a metallurgist. She tests the expansivity of samples of aluminium alloy.

These are Sarah's results.

metal sample	% increase in length caused by 200 °C temperature rise				
	1st	2nd	3rd	4th	mean
A	0.39	0.42	0.42	0.45	
B	0.49	0.48	0.49	0.50	
C	0.44	0.43	0.44	0.50	
D	0.40	0.41	0.43	0.44	

(i) Which sample gave the most reliable results?

Use data in the table to explain your choice.

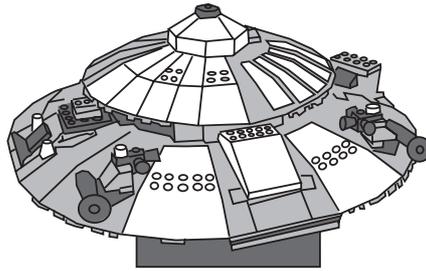
.....
[1]

(ii) Calculate the mean value for each sample. Use the calculation to decide which **two** samples are **most likely** to be of the same type of metal. Use the final column of the table.

samples and [2]

[Total: 8]

4 Jacob has built a LEGO® spaceship. It is lit by two filament bulbs.



(a) The bulbs are not equally bright. Jacob investigates the **conductance** of each bulb.

Describe how Jacob could compare the electrical conductances of the light bulbs.

A circuit diagram may help your answer.

.....

.....

.....

.....[3]

(b) The spaceship has some bricks made of transparent plastic.

Their refractive index affects how light travels through them.

(i) Explain what is meant by refractive index.

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

The table shows the refractive index of different transparent materials.

material	refractive index
acrylic	1.49
flint glass	1.74
perspex	1.50
plastic	1.58
resin	1.63

(ii) Name a material for the bricks that would have **less** effect on light than plastic.

Give a reason for your answer.

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

(c) Jacob's spaceship has optical fibres to direct light from the bulbs.

Glass used for optical fibres must have high purity to let the light through.

Suggest a reason why high purity is needed.

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

[Total: 6]

END OF QUESTION PAPER

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