

**GENERAL CERTIFICATE OF SECONDARY EDUCATION  
TWENTY FIRST CENTURY SCIENCE  
ADDITIONAL APPLIED SCIENCE A**

**A336/02**

Materials and Performance  
(Higher Tier)

**Wednesday 24 June 2009  
Morning**

**Duration: 45 minutes**

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)



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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**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.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **36**.
- This document consists of **12** pages. Any blank pages are indicated.

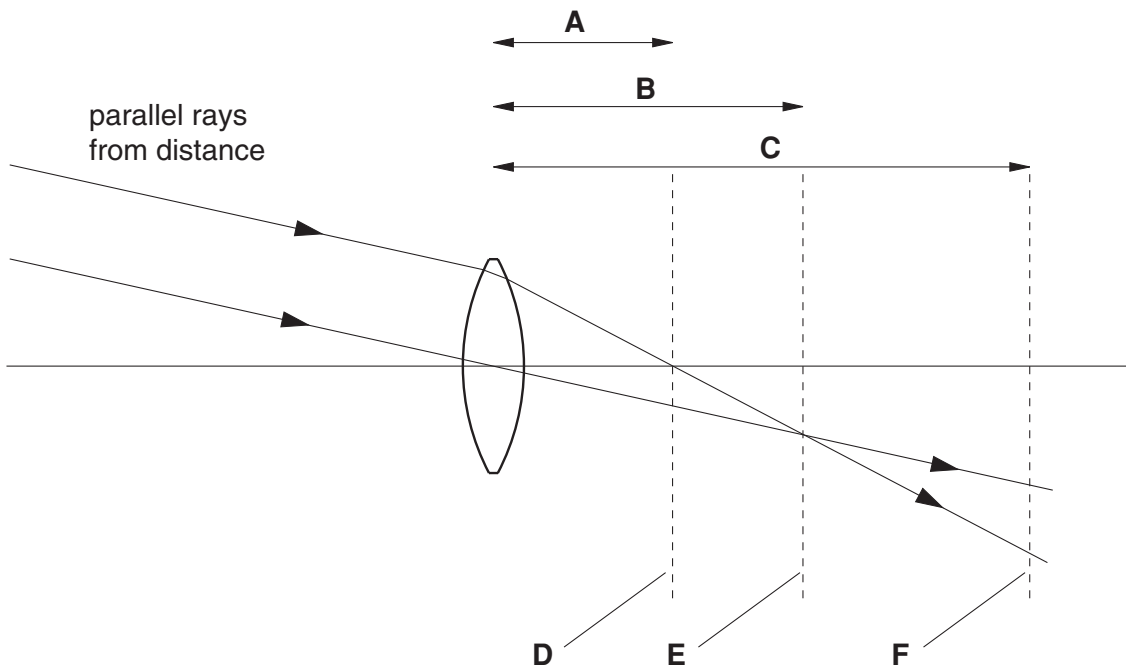
Answer **all** the questions.

1 Chris is a teacher. He uses a projector to give some questions to the class. The image formed by the projector is **larger than** the original writing.

(a) Give **two** other properties of the image.

- 1 .....
- 2 ..... [2]

(b) Chris shows the class how a convex lens brings rays of light to a focus.



This ray diagram shows how a lens produces an image of the top of a distant object.

(i) Which letter, **A**, **B**, **C**, **D**, **E** or **F** labels the **focal plane**? ..... [1]

(ii) Which letter, **A**, **B**, **C**, **D**, **E** or **F** labels the **focal length**? ..... [1]

(c) Chris uses a second, more powerful lens.

(i) How is its focal length different from the first lens?

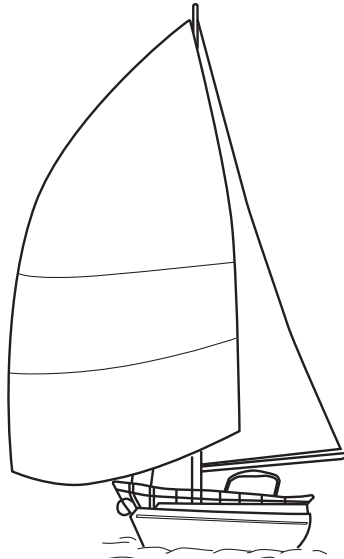
.....  
..... [1]

(ii) Write down the unit for measuring the power of a lens.

..... [1]

[Total: 6]

2 Eva works for a company which makes cloth for the sails of yachts.



The wind blows on the sails with a force that stretches the cloth.

Eva receives a complaint that the cloth becomes permanently stretched too easily.

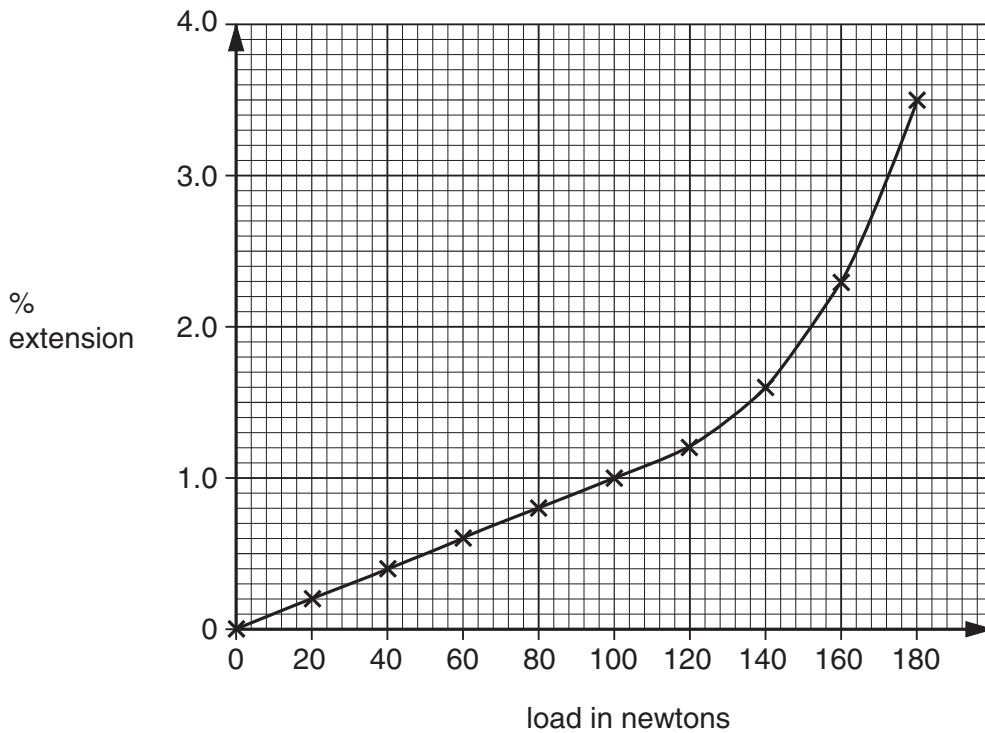
- (a) (i) If the force on the cloth is small, the cloth goes back to its original shape after being stretched.

Give the name for this type of behaviour. .... [1]

- (ii) If the force on the cloth is too great, the cloth does not go back to its original shape after being stretched.

Give the name for this type of behaviour. .... [1]

- (b) Eva tests how the cloth behaves when it is stretched.  
This is the graph of her results:



Use the graph to answer these questions.

- (i) Up to what load does the cloth probably return to its original shape?

answer .....N [1]

- (ii) What is the % extension for this load?

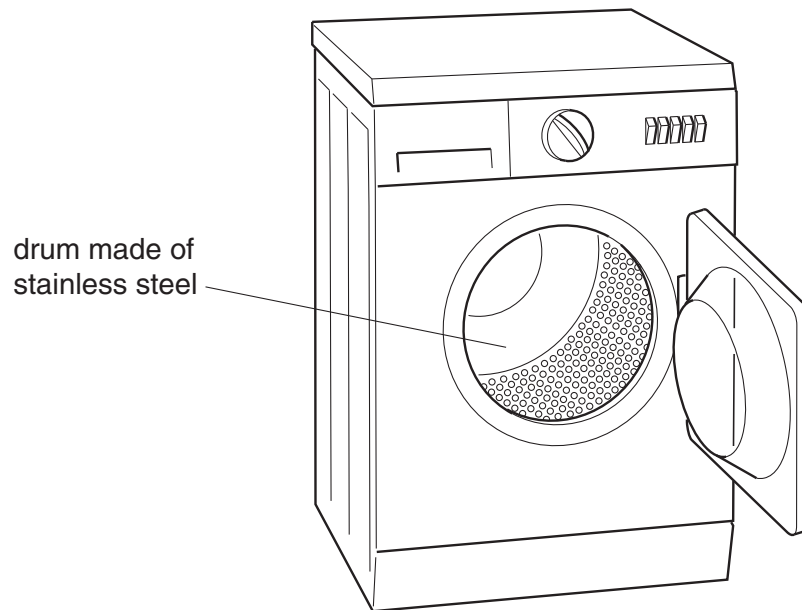
answer ..... [1]

- (iii) Cloth for sails should return to the original shape after being stretched by 1%.  
Does the cloth meet this requirement?  
Give a reason for your answer.

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

[Total: 5]

- 3 Steel is used to make drums for washing machines.



- (a) There are many steel alloys.  
An alloy is made by mixing small amounts of different elements with a pure metal when it is molten.

What **best** describes an alloy?

Put a ring around the best description.

**a composite material**

**a pure crystalline material**

**a solid solution**

**a metallic polymer**

[1]

(b) Steve reads this passage. It describes how steel is formed to make a washing machine drum:

A bar of steel is cold rolled to reduce its thickness. This also changes the mechanical properties of the steel.

The steel sheet is then annealed (heated in a controlled atmosphere) to make the steel easy to shape.

A machine forms the sheet into the right shape for the drum.

The drum is joined by welding. The edges of the metal are made to touch and join as the metal is strongly heated to a very high temperature.

(i) How is the steel formed into thin sheets?

..... [1]

(ii) How is the steel made more malleable?

..... [1]

(iii) Suggest how welding joins the edges of the sheet.

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

(c) (i) The International Organisation for Standards set the product standard ISO 15610 for welded goods.  
Give an example of **another** organisation which sets product standards.

..... [1]

(ii) The drum of a washing machine is tested by running it at the maximum spin speed for 42 days.  
This is to ensure a **safety margin** in its performance.

Other artefacts are designed with a safety margin.  
Choose **another** artefact and describe its safety margin.

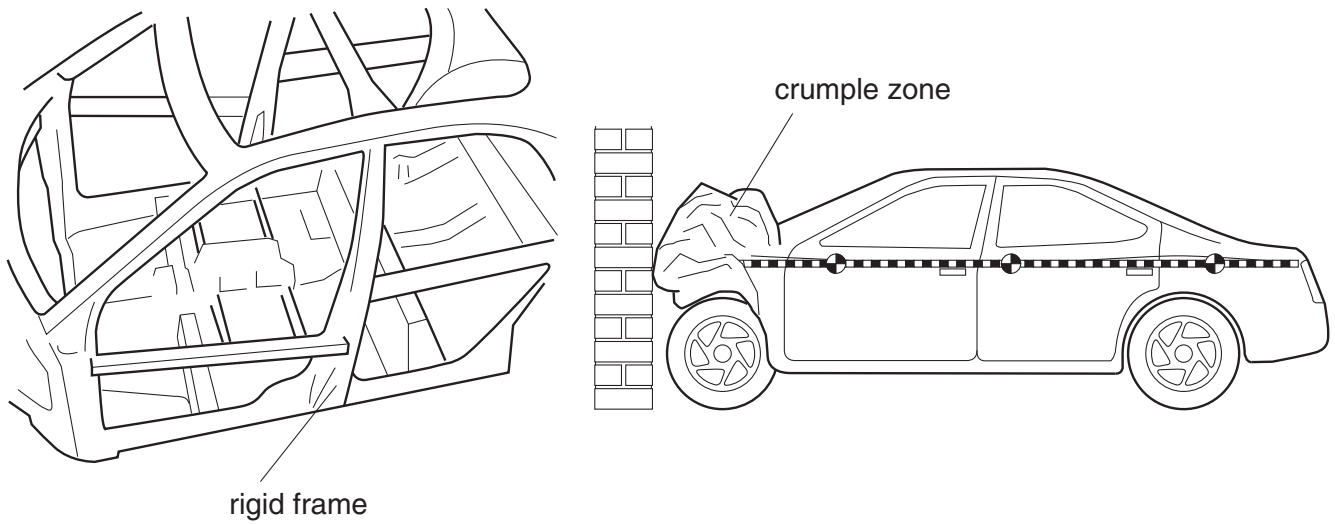
Artefact .....

Safety margin .....

..... [1]

[Total: 6]

4 A car manufacturer has improved the safety of its cars by using a crumple zone and a rigid frame.



(a) (i) Suggest how the manufacturer could make the frame more **rigid**.

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

(ii) The properties of the materials in the crumple zone and rigid frame are **complementary**.

Describe **another** example of using materials with complementary properties.

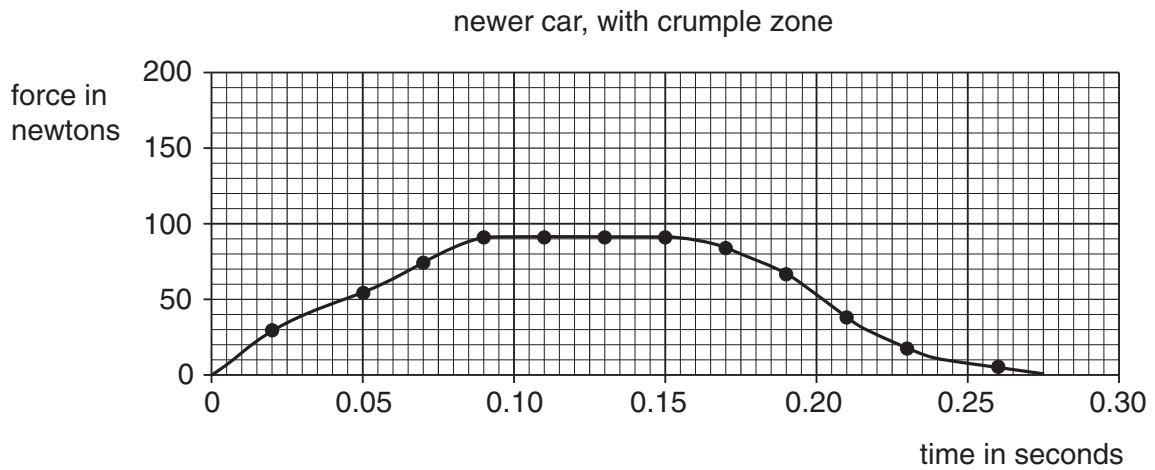
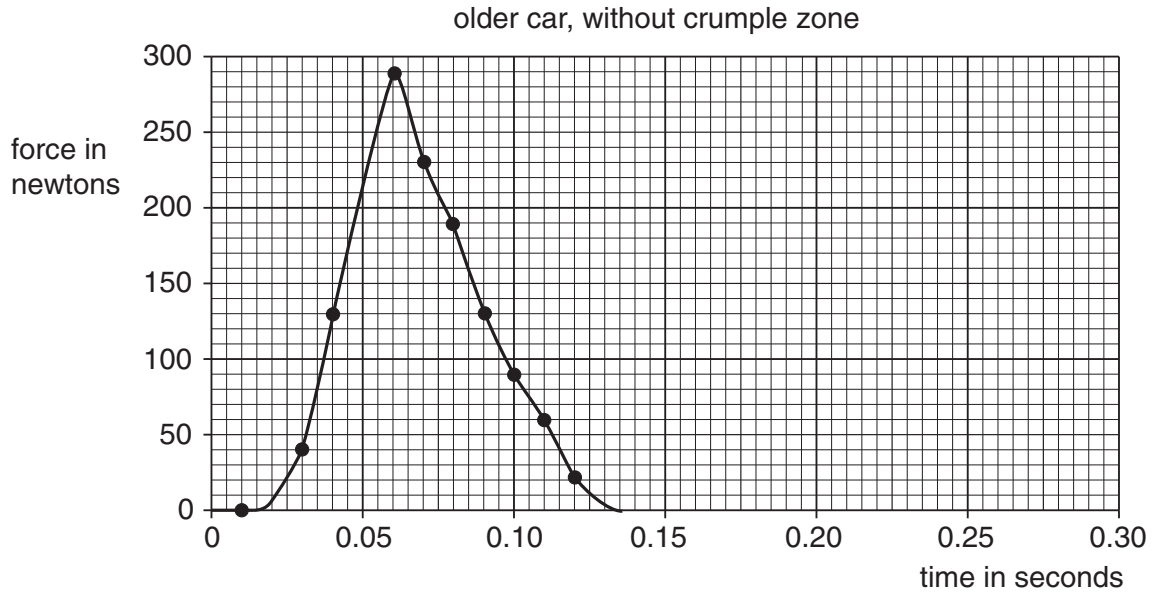
Your answer should include:

- the property of each material
- how this contributes to the required performance.

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



- (b) Older models of cars do not have crumple zones.  
 The graphs show the force acting during a collision. The cars are the same mass and travel at the same speed before the collision.



- (i) Use information from the graphs and your ideas about momentum to explain how a crumple zone improves safety in a collision.

.....

.....

.....

..... [3]

- (ii) In a new model the crumple zone gives a collision time of 0.3s when the car is travelling at 13.5 m/s, collides and stops.

The mass of the car is 1100 kg.  
 Calculate the force on the car during the collision.  
 Use this equation. Show your working.

$$Ft = m(v - u)$$

force = .....N [3]

[Total: 9]

- 5 Sadiq is an engineer. He works in the oil industry. He uses many classes of materials when designing structures. One such class is **composites**.

- (a) State two **other** material classes and give an example of a material in each class.

class 1 ..... material .....

class 2 ..... material ..... [2]

- (b) Some parts of an oil platform can be made of a composite material. These composites are lightweight, strong, do not bend under heat and require little maintenance.  
 Give an example of a composite material.  
 Explain how it combines the useful properties of the materials used to make it, and avoids their drawbacks.

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

(c) The material used for a handrail on an oil platform must be:

- stiff so it does not give way
- corrosion-resistant because it may be used in salty air.

Give **another** example to explain why a combination of properties can make a material suitable for a particular job.

.....

.....

.....

..... [2]

(d) (i) Sadiq chooses materials for an oil platform in a region where the temperature varies considerably. He needs to know the temperature range.

Suggest why this information is important for the choice of material.

.....

..... [1]

(ii) On land, large-scale structures are often made of steel-reinforced concrete. Explain why large temperature changes could reduce the lifetime of these structures.

.....

.....

..... [2]

[Total: 10]

**END OF QUESTION PAPER**

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